THE

REPERTORY

OF

ARTS AND MANUFACTURES:

CONSISTING OF

ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS,

AND

SELECTIONS OF USEFUL PRACTICAL PAPERS

FROM THE

TRANSACTIONS

OF THE

PHILOSOPHICAL SOCIETIES

OF ALL NATIONS, &c. &c.

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REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER XXXVII.

I. *Specification of the Patent granted to* Mr. MAJOR PRATT, *of Running Waters, in the Parish of Pittington Halgarth, in the County Palatine of Durham, Lime-burner; for his Invention of an Art or Method of manufacturing or making a certain Composition-Stone, which will be equally applicable, in grinding all Species of Corn, and other Articles, as the Mill-Stone at present used.*

Dated March 11, 1796.

TO all to whom these presents shall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Major Pratt do hereby declare the following to be the nature of my ſaid invention, and the manner in which it is to be performed; that is to ſay, the principle of my ſaid invention is by a mixture of ſiliceous and argillaceous earths, under certain circumſtances; and, by due application of heat, converting it into a ſubſtance capable of being formed into mill-ſtones, or ſubſtitutes for mill-ſtones, anſwering the various purpoſes to which foreign and other mill-ſtones are now, or may be, applied. The proportion in which the earths may be mixed for the purpoſe admits of conſiderable variation; as moſt of the clays which are capable of being burnt into bricks are alſo convertible to the preſent uſe. As clay and ſand alone are highly refractory in the fire, and are more liable, when applied without farther mixture, to be baked into bricks, or ſubſtances reſembling them, than to be made to undergo that ſemi-vitrification which qualifies them to be wrought up into mill-ſtones, I have found it expedient to apply to them, and duly to mix with them, a proportion of calcareous earth, previous

previous to their being expofed to the fire. The quantity of calcareous earth, thus added, may be confiderably varied, without effentially altering the effect: I have found that about one-feventh will do. Now, although I have found it moft convenient to ufe lime, or other calcareous earth, for the purpofe of affifting in the above procefs, I have ftrong reafons to apprehend, that other fubftances, fuch as gypfum, the alkaline falts, and perhaps coal, and many others, and particularly iron, will produce a fimilar effect, or facilitate the operation; and, befides thefe, other bodies may be difcovered, having the fame property of affifting the fufion of the clay and filex; but I hold all fuch attempts to be clearly within the meaning and operation of my aforefaid patent; the real difcovery being, that clay and filex may, by the action of fire, and by the addition of a third body, be converted into a fubftance fuch as is above ftated, and convertible into the feveral ufes adverted to. The degree of heat beft adapted to the operation, I think, can only be determined by experience: I have found the heat employed in calcining lime adequate to the purpoſe, having prepared ſome in an ordinary lime-kiln, at the ſame time that the lime was burning. I muſt obſerve, however, that there is a conſiderable difference in the heat which different lime-ſtones require, to be burnt into good lime, and that the heat I employed, in the above inſtance, was rather too great for the lime-ſtone I am accuſtomed to burn. That lime-ſtone is found, by chemical analyſis, to contain $\frac{7}{100}$ of ſilex; and I know that a higher heat may be uſed, without materially affecting the reſult. I have alſo reaſon to believe, that beſides the latitude admiſſible in the intenſeneſs of the heat employed, the length of the time for which it is continued may be varied, and (under certain circumſtances, relating to the proportion of the different ingredients, and probably to other cauſes, only to be fully learnt by experience) ought probably to be conſiderably varied: I have found twenty-four hours anſwer. Beſides the purpoſes above ſtated, a ſimilar mixture of ſilex and argillaceous earths, with a proportion of calcareous earth,

earth, or other matter, may, as my obſervation leads me to believe, be formed, by the application of heat, into a hard and apparently-durable ſubſtance, capable of reſiſting the action of the weather for a long ſeries of years; and, as this might, when moiſt and ſoft, be made to aſſume any form deſired, by being put into proper moulds, or otherwiſe, it would be convertible, in my opinion, to the purpoſes of ornamenting buildings, or other uſes, to which ſtucco, &c. are now applied, and would probably prove more durable. In witneſs whereof, &c.

II. *Specification of the Patent granted to* DANIEL MAUNSEL, *of Clifton, near Briſtol, in the County of Somerſet, Eſq.; for his Invention of a horizontal Windmill, upon entire new Principles, for grinding Corn, and various other Purpoſes.*

WITH TWO PLATES.

Dated Dec 8, 1795.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Daniel Maunſel do hereby declare, that the nature of my ſaid invention, and in what manner the ſame is to be performed, is particularly deſcribed and aſcertained in the ſeveral plans or drawings hereto annexed, marked reſpectively Fig. 1, Fig. 2, Fig. 3 𝔄, Fig. 4, and Fig. 3 𝔅, and in the ſeveral explanations or deſcriptions thereof herein after mentioned, and referring thereto; that is to ſay,

Fig.

Fig. 1. repreſents a horizontal windmill, with two horizontal engines, fixed on a perpendicular axis, marked X X X. Theſe engines may act together, or either of them may act ſeparately, if neceſſary. A is the upper engine, which may have four, five, ſix, or any greater number of horizontal arms or levers: the length of theſe arms or levers may be proportioned to the force required. This engine has only four horizontal arms or levers, two of which are marked B and B; the other two do not appear, on account of the ſituation in which the figure is repreſented. C, D, E, F, G, H, I, and K, ſhew the wings or ſails in their different poſitions, which are all doubled, and may be made of thin boards, or frame-work; and ſuch frame-work may be covered with canvas, like the ſails of a common windmill. Theſe wings move on hinges, or gudgeons, reſpectively marked O; and, being opened by the wind, on the ſide which is intended to receive its direct impulſe, preſent perpendicular ſurfaces; but are prevented from folding back, by the boards marked Q, Q, Q, and Q, which ſtrike againſt four vertical bars, three of which are marked L, L, and L; the other

does

does not appear; and ſuch vertical bars are fixed at the extremities of the arms: the wings are alſo ſtopped by other bars near the axis. The upper wings, marked C, E, G, and I, are hindered from cloſing too far, by cords, marked P, P, and P, which are faſtened to the vertical bars. The lower wings are at liberty. M, M, M, and M, are weights, which, together with four other weights that do not appear, are ſuſpended by rods to the backs of all the wings, and are nearly balanced thereby; and ſuch wings open freely, to receive on one ſide the whole force of the wind, as they are turned round, and are eaſily cloſed on the other ſide, that they may give but little reſiſtance as they move in oppoſition to the wind. N and N repreſent two of the wings doubled; which may be opened by hinges, or be made to ſlide out, for the purpoſe of extending the levers, and expoſing greater ſurfaces to the action of the wind. C and D repreſent the wings expanded by the wind. E and F are wings moving in oppoſition, and preſent ſurfaces much diminiſhed, and greatly inclined. G and H are wings which have paſſed the current of the wind, and are ready to

4 open.

open. I and K are the remote wings, which give no oppofition. Another engine, of the like nature, may be fixed on the fame axis, to act below, inftead of the lower engine. B is the lower engine. R reprefents the wing opened by the wind. T, T, T, T, and T, are the wings clofed by the wind. S is the top of the cylinder. U and U is a frame for the lower engine to act in, if neceffary. V and V is the top of the houfe, or building.

Fig. 2. is a fection of the lower engine. X is the axis. A is a cylinder, or regular-fided figure. B reprefents the top or bottom of this engine, which projects about two feet beyond the cylinder: the height and diameter thereof are proportioned to the force required. The lines, refpectively marked C, reprefent twelve vertical boards; which are fixed at equal diftances round the cylinder, and extend within about twelve inches of the circumferences of the top and bottom thereof: the number of thefe boards may be either increafed or decreafed at pleafure. D reprefents a wing which is opened, and acted upon, by the wind. E, F, F, F, and F, are wings

 which

which are clofed by the wind. G, G, G, and G, are wings on the fide oppofite to the wind. All the aforefaid wings may be made of thin boards, or frame-work, and fuch frame-work may be covered with canvas. Thefe wings are equal in number to the vertical boards, and are exactly fitted between the top and bottom of the engine, and round the cylinder. They are fufpended upon hinges, or gudgeons, and, being opened by the wind, ftrike with force againft the vertical boards; by which they are allowed to open only fo far as that D, the open wing, may form nearly a right angle with E, the clofed wing immediately fucceeding; by thefe means a perpendicular furface is always prefented to the wind. The wings which are clofed are prevented from fhutting, farther than to form nearly right angles with lines drawn from the centre to the points of fufpenfion, which are refpectively marked ⊙. The motion of this engine may be ftopped, and the wings prevented from opening, by cords faftened to three adjoining wings, which are connected by one rope, as reprefented by the Figures 1, 2, 3, and 4. There are four ropes to the twelve wings;

which ropes paſs over pulleys, and are conducted along the axis, ſo that they may be managed in the inſide of the mill.

Fig. 3. A, repreſents another engine, conſtructed on the ſame principles as before mentioned, and has its wings marked 1, 2, 3, and 4; which are nearly balanced by the weights marked F, F, and F, and are ſuſpended, upon the hinges reſpectively marked G, to four vertical bars; three of which are reſpectively marked B; the other does not appear. The wings are cloſed in towards the arm, by the wind, and receive its direct force; but, in order that they may be eaſily opened, they are prevented from cloſing too far, by other bars fixed to each arm, one of which bars is marked C C. M and M are ropes, which are faſtened from thoſe bars to the wings; and ſuch wings are prevented from opening too wide, leſt the current of back air ſhould impede the velocity. The wings may be made of thin boards, or frame-work, covered with canvas, and may alſo be doubled to ſlide out. The motions of this engine may be ſtopped, by drawing the wings cloſe to the bars with ropes; which ropes, being

faſtened to the extremities of the wings, paſs over pulleys on the bars, and are conducted along the axis into the inſide of the mill, as expreſſed by the dotted line.

Fig. 4. is a ſection of the engine as deſcribed in Fig. 3 𝔄. Figures 5, 6, 7, and 8, are the horizontal arms. The characters or marks correſpond in each of the ſaid Figures 4 and 3 𝔄, as follows; that is to ſay, 1 ſhews the wing acted upon by the wind, and preſenting the entire ſurface. 2 ſhews the remote wing. 3 the near wing. And 4, the wing moving in oppoſition to the wind; which three laſt wings give very little reſiſtance. C, C, C, and C, are the bars to prevent the wings from cloſing. M is the rope to hinder them from opening too far.

Fig. 3. 𝔅, is a repetition of the upper engine, marked 𝔄, in Fig. 1, with the double wings marked N, N, N, and N, extended; which wings may be contracted or extended, by ropes faſtened to them, and conducted over pulleys into the mill. The length of all the aforeſaid arms or levers, and the dimenſions of the wings of all the aforeſaid engines, may be enlarged or diminiſhed,

in

in proportion to the force required. O and O is the top of the houſe, or building.

The aforeſaid plans or drawings are by a ſcale of an inch to three feet. Each of the aforeſaid engines may be uſed and conſidered as a ſeparate and diſtinct windmill, and a number of ſuch windmills or engines may be brought to act on one and the ſame object: they may therefore be made proportionably ſmall; by which means they will be eaſily managed, and the force may be increaſed or decreaſed at pleaſure. The motions of any of the aforeſaid engines may be ſtopped, or retarded, by a girth of pliable wood faſtened to a lever, and preſſed horizontally againſt a wheel, which may be fixed on the axis. The houſe or building on which the aforeſaid windmills or engines are to be erected, and the inſide machinery of ſuch houſe or building, are no part of my invention, as they may be made or conſtructed at pleaſure, and therefore the ſame are not repreſented or deſcribed. From the aforeſaid ſeveral plans or drawings, and explanations or deſcriptions, it is to be obſerved, that, upon the aforeſaid principles, wings or ſails may be balanced, and ſuſ-

pended

pended by various other ways and methods, upon hinges or other things, or in any other manner, ſo that horizontal motions may be occaſioned by expoſing the entire ſurfaces of the wings to the force of the wind on one ſide, and by diminiſhing the reſiſtance of the wings to the wind on the other ſide, and therefore I the ſaid Daniel Maunſel do, by virtue of the aforeſaid letters patent, claim and inſiſt upon the full, ſole, and excluſive right, power, privilege, and authority, of making, uſing, exerciſing, and vending, within that part of his Majeſty's kingdom of Great Britain called England, his dominion of Wales, and town of Berwick upon Tweed, all and every ſuch horizontal windmills or engines as can or may be conſtructed, by all or any of ſuch other ways and methods as aforeſaid. In witneſs whereof, &c.

III.

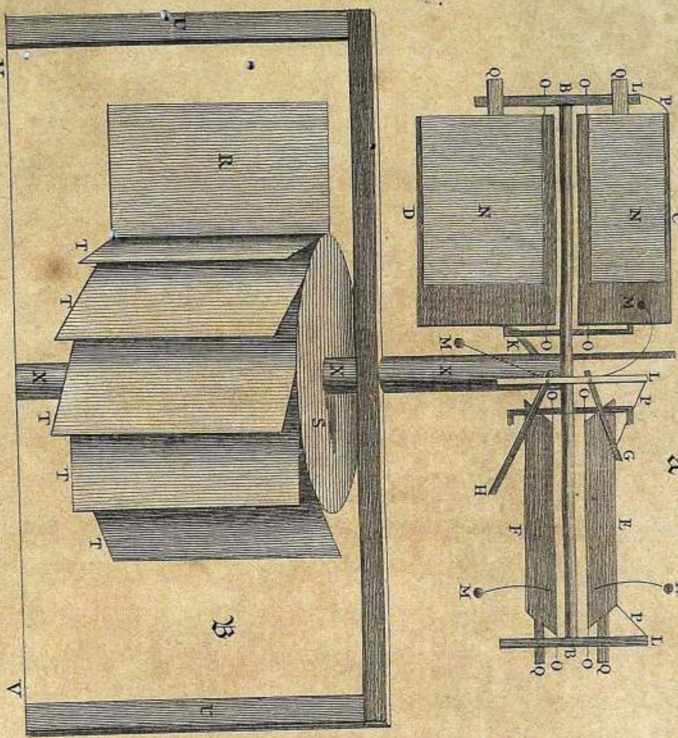


Fig. 1.

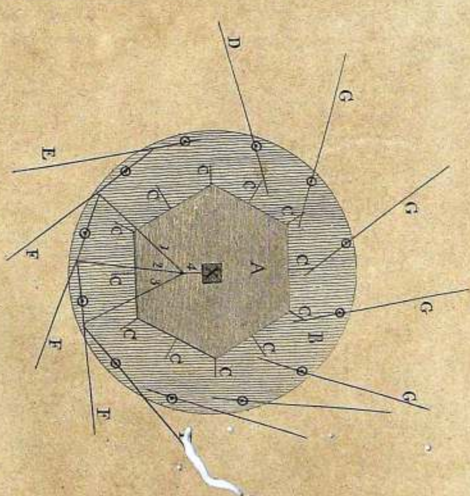


Fig. 2.

Fig. 3. A

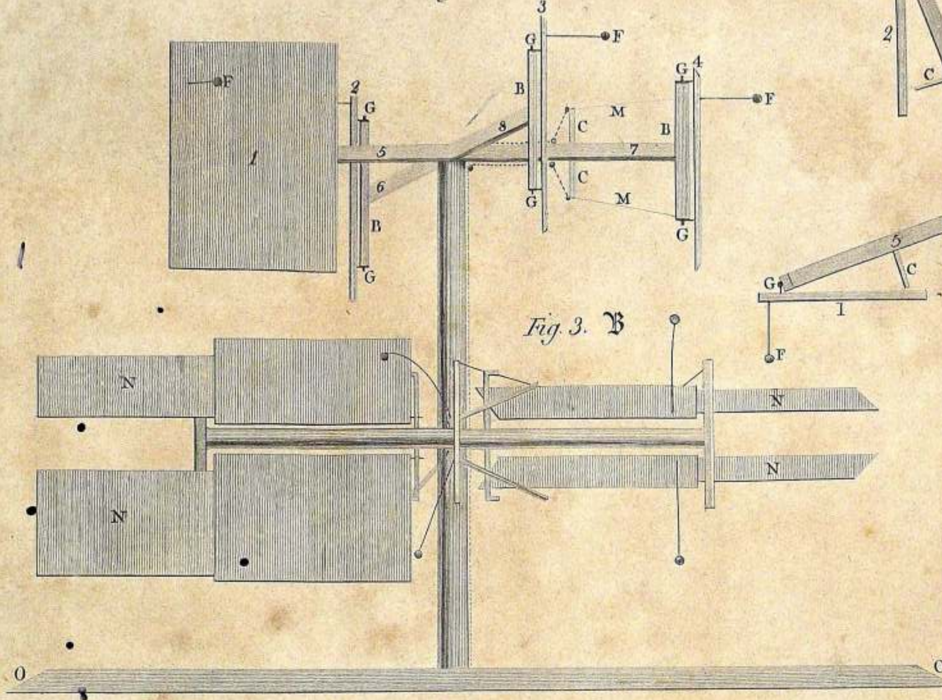
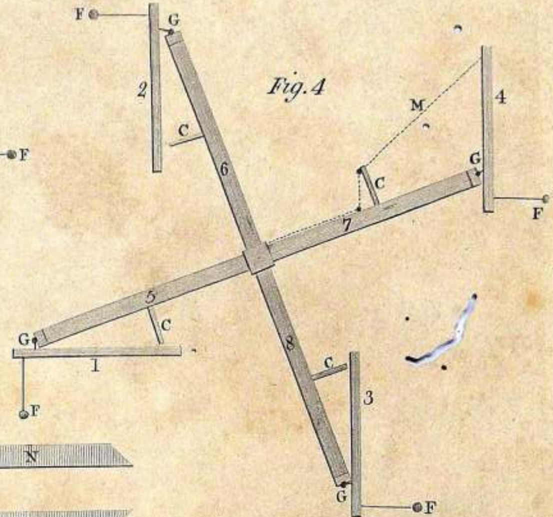


Fig. 3. B

Fig. 4



III. *Specification of the Patent granted to Mr.* Robert Blair, *Surgeon in the Royal Navy; for his Invention of a Method of improving the refracting Telescope, and other dioptrical Instruments.*

Dated April 4, 1791.

To all to whom these presents shall come, &c. Now know ye that, in compliance with the said proviso, I the said Robert Blair do hereby declare, that my said invention of a method of improving the refracting telescope, and other dioptrical instruments, is described in manner following; that is to say, in order to state clearly the nature of my new invention for improving the refracting telescope, and other dioptrical instruments, it will be necessary, first, to explain the principal cause of their present imperfection, which I discovered in the course of my experiments, as it is in removing this imperfection that this improvement consists. The indistinctness of refracting telescopes, with single object-glasses, arises principally from the unequal refrangibility of the rays of which light is composed, which prevents their being converged by refraction to one point. It has been supposed, that this imperfection is entirely removed by composing the object-glass of a convex and concave lens which differ in dispersive power, and that the cause why large apertures cannot be given to telescopes with such compound object-glasses, is the imperfection of flint-glass, of which the concave lens is generally made. But, on constructing object-glasses with large apertures, by using fluid dispersive mediums, free from the faults complained of in flint-glass, I found that the imperfection arose from a defect in the principle of these instruments, more than from any fault in the execution. The defect in the principle is this: flint-glass refracts the green light considerably less than crown-glass, in proportion to the whole refraction of red and violet light; so that, when the divergency of the red and violet light, caused by the refraction of the two mediums, is equal, the divergency of the red and green light is always greater in the crown-glass

than

than in the flint-glaſs; and the divergency of the violet and green light is always leſs in the crown-glaſs than in the flint-glaſs. Thoſe who are converſant in optical ſtudies will perceive from this, that it is impoſſible to unite all the rays by any combination of theſe two mediums; for, the correction of colour is moſt perfect when the red and violet light is united; and, when this is effected, the green light will always be refracted more than this united red and violet light, and conſequently cannot be converged to the ſame point with the united red and violet light. I found this property to obtain in moſt diſperſive mediums, ſuch as, eſſential oils, and metallic ſolutions of many different kinds, as well as in flint-glaſs. After a great variety of experiments, I diſcovered a claſs of diſperſive mediums with very different properties from the above. The marine and nitrous acids, which are diſperſive fluids of conſiderable ſtrength, inſtead of refracting the green light leſs than crown-glaſs, in proportion to the whole refraction of the red and violet light, were found to refract the green light more than crown-glaſs, in proportion to the whole refraction of red and violet light: I therefore mixed these two kinds of dispersive mediums, and thus obtained a medium which disperses the rays much more than crown-glass, and yet causes all of them to diverge accurately, in the same proportion in which they are made to diverge by the refraction of crown-glass; which is the desideratum required, to remove entirely the aberration from the unequal refrangibility of light. It is for this invention alone, of employing a dispersive medium which separates, by its refraction, the several kinds of rays, either exactly in the same proportion in which they are separated by the refraction of crown-glass, or more nearly in that proportion than flint-glass separates them, that the present patent is granted. And it is hereby set forth and declared, that those persons only will be deemed to encroach on the patent, whereof this is the specification, who, without my permission, shall employ mediums in the construction of refracting telescopes, refracting microscopes, or other dioptrical instruments, in order to remove that colour and indistinctness which arise from the dispersive and indispersive mediums

not

not separating the several orders of rays proportionably; the method of diminishing or removing which colour was unknown, until discovered by my experiments. Whether or not this has been done, will appear, on viewing any bright object with the half of the object-glass covered, or when the eye-glass is not adjusted to distinct vision; for, in both cases, all refracting telescopes, constructed previous to my invention, will discover more or less of colour, according to the largeness of the aperture of the object-glass, in proportion to its focal distance. In the most perfect construction of achromatic telescopes, this colour will be purple and green; and, if the spheres of the convex and concave lenses are not properly proportioned, it will incline more or less to red and blue: a diminution of this colour, in any object-glass, will appear, from comparing it with one of crown and flint glass, of the same diameter and focal length. I have thought it requisite thus fully to describe the principle of the invention, that no person acquainted with the theory and practice of optics may remain in any doubt concerning it. To dioptrical instruments constructed upon this principle, I apply the term *aplanatic*, which denotes the abſence of aberration, in order to diſtinguiſh them from thoſe which have, with impropriety, been ſtiled achromatic. The diſperſive medium which I have found to anſwer beſt is, a ſolution of antimony or mercury in the marine acid; but a variety of others may be uſed for the ſame purpoſe; and it is poſſible to remove the colour by a combination of two eſſential oils with glaſs; but in a more complex and leſs effectual way than by uſing one diſperſive medium, as above ſtated. It is well known, that beſides the aberration from unequal refrangibility, it is neceſſary to correct alſo the aberration from the ſpherical figures of lenſes; but this has no connection with the invention above ſpecified. The colour may be entirely removed by uſing only one concave lens, formed of a diſperſive medium, combined with one or with two convex lenſes, formed of an indiſperſive medium; and, if the diſperſive medium be more denſe than the indiſperſive medium, the ſpherical aberration may be alſo corrected, without any addition; but, if the diſperſive medium made uſe of be of leſs denſity than

than the indiſperſive medium, an additional lens becomes neceſſary, to remove the ſpherical aberration. The cavity which, in this caſe, is formed between this additional lens and the former, may either remain empty, or may be filled with ſpirit of wine, or any other tranſparent indiſperſive fluid, merely to prevent the loſs of light which would otherwiſe ariſe from reflection. The choice of the ſpheres to which the lenſes require to be ground admits of great variety; and no general rule can be given reſpecting this proportion, becauſe it depends entirely on the denſities and diſperſive qualities of the mediums employed, which ſeldom turn out exactly the ſame, even when made by the ſame proceſs at different times; but the intelligent optician, after examining the properties of the mediums, will not be at a loſs in proportioning the ſpherical ſurfaces of the lenſes to them; and, in any particular caſe, the ſpheres may be found more accurately from examining the inſtruments themſelves, than could be communicated by any deſcription or figures. In witneſs whereof, &c.

IV. *Specification of the Patent granted to Mr.* ALEXANDER BRODIE, *of Carey-ſtreet, Chancery-Lane, in the County of Middleſex, White-ſmith; for his Invention of a Ship's Stove, Kitchen, or Hearth, with a Smoke-Jack, and Iron Boilers.*

Dated Dec. 8, 1780.—Term expired.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, he the ſaid Alexander Brodie doth hereby deſcribe and aſcertain the nature of his ſaid invention, and in what manner the ſame is to be performed, as follows; that is to ſay, the ſtove, kitchen, or hearth, is made of wrought-iron, and ſuch part thereof as may be affected by the fire, covered with caſt-iron, except the ventilator and hood, which are made of copper. The hearth is nearly of a ſquare form or ſhape; the frame of which contains a range or grate, with

two

two cranes, one or two iron boilers, one or two iron ovens, and one ventilator: to the outſide of the ſaid frame are fixed two or three iron rails, for hanging ſtewing-ſtoves upon. The hood over the range and flue for boilers is made of iron, with an eaſy ſlope, of the ſize of the flue or funnel where the fly of the ſmoke-jack is. The range is made with a folding top-bar, two trivets to turn round, and one or two cranes, with a ſtay to each. The oven is made according to the ſpace of the room. Between the back of the range and the inmoſt ſide of the fire-place of the boilers, is fixed the ventilator for carrying off foul air, in a funnel about ſix inches in diameter, under the ſlope which conveys the fire round the boilers; the ſaid funnel goes through the deck of the ſhip below, and may be conveyed to any part of the ſhip, or where the ſick people are kept. The ſquare iron boilers have ſcrewed cocks fixed in the bottoms, and are made of plate and bar iron. The bottom frame is made of two, three, or four inches iron, kneed ſquare, with two rows of holes, one row for the bottom, and the other for the

the ſides, counter-ſunk for rivetting the bottom and ſides together, and put together with rivets. The corner-pieces are nearly the ſame for the ſides. There is an upper or top rail to the ſaid boilers, to which the ſides are fixed on the inſide of the frame, with counter ſunk-holes and rivets. The ſaid frame is made of flat iron, from two inches to ſix inches broad, under the edge of the ſaid frame, and regulates the height of the flue round the boilers; which flue is incloſed by three or four kneed plates of iron, ſcrewed or rivetted to the top of the frame of the hearth. The boilers have double covers, for the convenience of clean-ing the ſame, and are made with only one row of holes, for rivetting, and adding a triangular piece in the corner, or of a triangular form, by which triangular piece, the boilers may be put together, with nuts and ſcrews, ſo that there may be new ſides and bottoms put in them, in caſe of any ac-cident by being broken. The ſmoke-jack is fixed with an iron bar, by nuts and ſcrews, to the hood, or the funnel, of the ſhip's hearth. The ſpindle, where the chain-wheel is fixed, comes through the funnel, and is supported at the end by a ſtay, which is ſcrewed to the ſide of the hearth, and is made with one, two, or more flies, with worm-wheels or pinions, and may be uſed for pumping of water, or extracting foul air, as well as turning the ſpit. There are ſtewing-ſtoves with iron frames, and a drawer for aſhes, made to hang or ſtand. There are double-diſhed ſcrewed plates, to mend the boilers, in caſe of accidents by ſhot, or otherwiſe. The ſaid hearth is chiefly put together with nuts and ſcrews, for the purpoſe of being taken to pieces with more eaſe. In witneſs whereof, &c.

V. *Experiments on mixing Gold with Tin. By* STANESBY ALCHORNE, *Esq.*; *of His Majesty's Mint.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

IT is a generally received opinion, among metallurgifts, that tin has a property of deftroying the ductility of gold, on being melted with it, even in very fmall quantities. Our late ingenious countryman, Dr. Lewis, in his Philofophical Commerce of Arts, page 85, has well expreffed the fenfe of moft writers on this fubject, in the following words: "The moft minute proportion "of tin and lead," fays he, "and even the va-"pours which arife from them in the fire, though "not fufficient to add to the gold any weight "fenfible in the tendereft balance, make it fo "brittle, that it flies in pieces under the ham-"mer."

Divers

Divers circumſtances, nevertheleſs, have long ſince induced me to diſbelieve the fact; but theſe, having chiefly ariſen from ſmall experiments, did not ſeem to warrant any general concluſion. A late public occaſion, however, which led me to various trials of mixing theſe metals together, in different proportions, and in ſufficiently large quantities, has put the matter out of diſpute; and ſhewn me that tin, in ſmall quantity at leaſt, may be added to gold, either pure or alloyed, without producing any other effect than what might eaſily be conceived, *à priori*, from the different texture of the two metals. In confirmation of which, I beg leave to relate the following experiments.

Experiment I. Sixty grains of pure tin were ſtirred into twelve ounces of refined gold, in fuſion, and the mixture was then caſt into a mould of ſand, producing a flat bar, one inch wide, and one eighth of an inch thich. The bar appeared ſound and good, ſuffered flatting under the hammer, drawing ſeveral times between a large pair of ſteel rollers, and cutting into circular pieces, of near an inch diameter, which bore ſtamping in the money-preſs, by the uſual ſtroke, without ſhewing the leaſt ſign of brittleneſs, or rather with much the ſame ductility as pure gold.

Experiment II. Ninety grains of like tin were added to twelve ounces of fine gold, ſtirred, and caſt as above. The bar produced was ſcarcely diſtinguiſhable from the former, and bore all the operations, as before mentioned, quite as well.

Experiment III. One hundred and twenty grains of fine tin were mixed with twelve ounces of fine gold, and, being caſt like the foregoing, produced a bar rather paler and harder than the preceding, but which ſuffered the like operations very well, except that, on drawing between rollers, the outer edges were diſpoſed to crack a little.

Experiment IV. One hundred and forty grains, or half an ounce, of the like grained tin, were mixed, as before, with twelve ounces of fine gold. The bar reſulting from this mixture was completely ſound and good, evidently paler and harder, however, than any of the foregoing, and cracking rather more than the laſt on paſſing between the rollers; but bearing every other

operation,

operation, even ſtamping under the preſs, by the common force, without any apparent injury.

Experiment V. One ounce of tin was next ſtirred into twelve ounces of the like refined gold, and then caſt as before. The bar produced, though ſeemingly ſolid and good, was bad-coloured, brittle in texture, and, on the firſt paſſing between the rollers, ſplit into ſeveral pieces, ſo that no farther trials were made with it.

Experiment VI. To enquire how far the fumes of tin, brought into contact with the gold, would do more than mixing the metal in ſubſtance, a ſmall crucible, filled with twelve ounces of ſtandard gold, $\frac{11}{12}$ fine, was placed in a larger crucible, having one ounce of melted tin in it, and kept there in fuſion, the whole being covered by another large inverted crucible, for about half an hour. In this time a full quarter-part of the tin was calcined; but the gold remained unaltered, and equally capable of being manufactured as another portion of the ſame gold, melted in the common manner.

It may well be aſked, whether the tin, or part of it, in every trial, might not be deſtroyed, and thus

thus render the conclufions fallacious; but as, in any of thefe experiments, not more than fix or eight grains of the original weight were miffing after the cafting, and as even fine gold can fcarcely be melted without fome lofs in the operation, fo we may reafonably fuppofe, that our fmall loffes, in the foregoing trials, do not deferve confideration.

The above experiments then feem to fhew, that tin is not fo mifchievous to gold as has been generally reprefented. But it would be unfair to infer, that the original author of this doctrine (from whom fo many have implicitly tranfcribed) had no foundation for the affertion. Gold and tin indeed are fubftances pretty well known; but it is eafy to imagine, that coins or trinkets may have been ufed for the one, and impure tin, or pewter, perhaps, for the other; and it is difficult to guefs what might be the refult of fuch uncertain combinations. To enquire farther, therefore, the experiments were continued as follows.

Experiment VII. To determine whether the two metals might be more intimately combined, and the mafs rendered brittle, by additional heat; the mixture

mixture of gold and tin, produced in the firſt of theſe experiments, was re-melted, in a ſtronger fire than before, and thus kept in fuſion full half an hour. By this operation, ſix grains only were loſt in the weight; and the bar obtained was no leſs manufacturable than at firſt.

Experiments VIII and IX. The mixtures of gold and tin, from the ſecond and fourth experiments, were re-melted ſeparately, and one ounce of copper added to each. Being both well ſtirred, they were caſt as uſual; and the bars, though ſenſibly harder, bore all the operations of manufacturing as before. The laſt bar cracked a little at the edges, on drawing through the rollers, as it had done without the copper, but not materially, and bore cutting rather better than in its former ſtate.

Experiments X and XI. A quarter of an ounce of the laſt mixture, (being tin half an ounce, and copper one ounce, with gold twelve ounces,) and as much of the bar from experiment the third, (being tin one hundred and twenty grains, with gold twelve ounces,) were each melted by a jeweller, in the moſt ordinary manner, with a common

common ſea-coal fire, into ſmall buttons, without any loſs of weight. Theſe buttons were forged by him into ſmall bars, nealing them often by the flame of a lamp, and afterwards drawn each about twenty times through the apertures of a ſteel plate, into fine wire, with as much eaſe as coarſe gold commonly paſſes the like operation.

Experiment XII. To enquire whether the adding of tin to gold already alloyed would cauſe any difference, ſixty grains of tin were ſtirred into twelve ounces of ſtandard gold, $\frac{11}{12}$ fine; and the reſult paſſed every operation before deſcribed, without ſhewing the leaſt alteration from the tin.

For greater certainty, ſeveral other trials were made, of different mixtures of copper, tin, and ſilver, with gold, even ſo low as two ounces and a half of copper, with half an ounce of tin, to twelve ounces of gold. But theſe are not worth particularizing; for they all bore hammering, and flatting by rollers, to the thinneſs of ſtiff paper, and afterwards working into watch-caſes, cane-heads, &c. with great eaſe. They all, indeed, grew more hard and harſh in proportion to

the

the quantity of alloy; but not one of them had the appearance of what all workmen well know by the name of *brittle gold.* Whence it ſhould ſeem, that neither tin in ſubſtance, nor the fumes of it, tend much to render gold unmanufacturable.

Whenever, therefore, brittleneſs has followed the adding ſmall quantities of tin to fine gold, it muſt be ſuppoſed to have ariſen from ſome unfriendly mixture in the tin, probably from arſenic; for, other experiments have ſhewn me, that twelve grains of regulus of arſenic, injected into as many ounces of fine gold, will render it totally unmalleable.

From the foregoing experiments, I preſume, we may fairly conclude, that though tin, like other inferior metals, will contaminate gold, in proportion to the quantity mixed with it, yet there does not appear any thing in it ſpecifically inimical to that precious metal. This being contrary to the doctrine of moſt chemical writers, it may be uſeful to make known theſe experiments.

VI. *Strictures on the Husbandry of Turnips. By Mr.* Joseph Wimpey, *of North Bockhampton.*

From the Letters and Papers of the Bath and West-of-England Society for the Encourage-ment of Agriculture, &c.

TURNIPS have been generally confidered as an article of precarious culture. This, however, is not to be taken in an abfolute fenfe; for, every thing was made perfect in its kind, and there are few things that vegetate more freely, or more certainly, than the turnip, in its proper feafon; but, like all other vegetables, it is more or lefs precarious, as the circumftances attending its culture are more or lefs favourable.

Nature has fet and appointed feafons for her fe-veral operations. The fpring-months are the pro-per time for vegetation, and the growth of plants; the fummer-months, for confolidating and ma-turing

turing their growth; and the autumn, for reaping, gathering, and harvesting the same. The farmer, in the cultivation of turnips, is obliged to depart from those established laws of nature, to accommodate the crop to his own convenience. The great use of turnips, as food for sheep and cattle, is to supply the deficiency of grass and herbage, at a season of the year when little of these are to be got; and, that turnips may be in perfection at the time they become most useful, the farmer is obliged to postpone sowing them at least three months beyond the time that would be most seasonable, that is, most favourable to their vegetation. For instance, were turnips to be sown in March, or April, as the season might prove most favourable, there would be, I conceive, as great a certainty of a crop of these as of any other vegetables usually sown in those months; but the farmer, for the reason before given, being obliged to defer sowing them until the hottest season of the year comes on, his success becomes exceedingly precarious, unless he is so fortunate as to have a few rainy days, or cloudy weather and frequent showers, soon after the seed is in the ground. This, I conceive, is the true and only reason why the turnip is a more uncertain article than those which are sown in due season.

If these observations are just, the provident farmer will embrace every favourable opportunity that offers for sowing his seed. He fortunately is not confined to a few days, or even weeks. He has from the end of May to the beginning of August to perform this work; and he had better defer it, even to the last, than sow when the weather is hot and dry; for, in that case, he may sow again and again, and lose both seed and labour. But, should the weather be ever so favourable, that alone will not insure him success: there are several other things that are equally necessary.

First. It is absolutely necessary that the land be very well pulverized. The number of ploughings and harrowings for this purpose cannot be ascertained; that must ever depend upon the nature and condition of the soil. Twice, in some land, would be more effectual than four times in other land;

land; but, be the labour whatever it may, it muſt not be omitted.

Secondly. It is equally neceſſary, either that the ſoil be naturally rich and good, or be made ſo by a proper quantity of manure. Turnips never arrive to a good and profitable ſize, in poor land, without good manure to promote their growth, and puſh them forward.

Thirdly. It is of great conſequence to have ſeed that is both good in quality, and of a good ſpecies. I prefer the large green-topped turnip, as being the ſweeteſt and moſt juicy. Some prefer the red or purple-topped, as being hardier; but, which ever ſort you ſow, if the ſeed be from the largeſt and fineſt tranſplanted turnips, it is greatly to be preferred, even if it coſt double or treble the price of the common ſort. I have frequently bought of the ſeedſmen in London, but it is generally of a mixed kind, and often, in great part, not worth cultivating. I would, therefore, recommend it to the farmer to buy the beſt ſpecies he can get, let the price be what it may.

Fourthly.

Fourthly. As to the quantity of ſeed, I am pretty much of the ſame opinion as another of your correſpondents, who adviſes to be ſure to allow ſeed *enough*; and, to that end, thinks the ſafeſt way is to allow two pounds to an acre, though it is uſual, with many, to allow but one. Suppoſing the ſeed to be good, and the ſeaſon favourable, a few ounces will be ſufficient to ſtock the land: but, as this article is ſo very precarious, it is by far the ſafeſt way to allow ſeed in plenty, and reduce the plants afterwards, by well harrowing the ground.

Laſtly. The greater your ſucceſs in providing a good plant, the greater will be the neceſſity that the crop be well and carefully hoed; without this, the great advantage to be derived from a good crop of turnips would in a great meaſure be loſt. Twice hoeing is often ſufficient for this purpoſe, eſpecially if the land be pretty clean; but, if it be foul, three times is hardly ſufficient. Hoeing, in many places, is not well underſtood, although it be an operation of very little difficulty. Practice is neceſſary to give dexterity to every kind of work: but a labourer who has been

uſed

used to work in a garden, and knows the use of a hoe, would not only perform the business well himself, after a few hours instruction, but would be able to teach all the labourers in the parish, in a few days; this would greatly reduce the price of hoeing, which has hitherto been exorbitant in many places.

The business, however, might be made easy, and much expedited, by well hoeing the turnips as soon as they arrive at a proper stage of their growth, that is, when they have four leaves; and, where the plants are thick, they might be well harrowed a second time, at the distance of a fortnight, or three weeks. This would not only thin the crop, but also would greatly improve and encourage the growth of the remainder. In this situation, the hoers would readily distinguish those that are proper to be cut up, from those that are proper to remain; whereas, should it be deferred till they are over-run with charlock and other noxious weeds, the labour and difficulty would be more than doubled, and the work never could be performed so well. I have seen a field of turnips so entirely over-run with weeds, that the hoer worked as it were in the dark, and chopped away at random. Three weeks or a month ſooner, the work might have been done at half the expence, and to more than three times the advantage.

As to the mode of planting, I am of opinion that the broad-caſt is the moſt productive, if the hoeing be properly performed, and in good time. However, I am much inclined to think, that the mode of ſowing turnips between beans planted in rows, as recommended by ſeveral of your correſpondents, is a much more certain means of inſuring a crop: it exactly correſponds with all my obſervations on the ſubject. A conſiderable degree of moiſture is neceſſary to the rapid vegetation of this very juicy root, and nothing retains moiſture equal to ſhade; which can be obtained and ſecured by no means ſo effectually, on a large ſcale, as in the intervals of tall-growing plants, ſuch as beans, or wheat, planted in drills.

My experimental field, of about ſeven acres, is now drilled with wheat, on three-bout ridges, about four feet and a half wide. It was horſe-hoed

hoed in December; and I intend it ſhall be horſe-hoed again in the ſpring and ſummer, as the ſeaſons arrive: in that caſe, the mould in the intervals will be in very fine tilth for turnips, with which I intend to ſow them. Theſe may be hand-hoed whenever it becomes neceſſary, notwithſtanding the wheat; and, as ſoon as that is harveſted, the ridges it ſtood on may be ploughed, and the turnips horſe-hoed, which perhaps ſhould be repeated before winter. I propoſe that the crop ſhall be fed off, in January and February, time enough to plant the intervals, on which it grew, with beans, the beginning of March; horſe-hoeing the intervals, as the growing of the beans will permit, to prepare them for potatoes, to be planted between the beans, the latter end of April, or beginning of May.

If this method ſhould be attended with the ſucceſs I expect, the land may be continually planted with a double crop, that is to ſay, with wheat and turnips one year, and with beans and potatoes another, in alternate ſucceſſion. If this courſe of cropping ſhould be found to exhauſt the land more than the horſe-hoeing can re-

 pleniſh,

plenish, which I do not think very probable, a moderate dressing of dung might be given every fourth year, as soon as the turnips are off, to prepare the land for beans and potatoes; the extra-expence of which, should it be found necessary, would probably be amply repaid by the increase of quantity. Indeed, the benefit would not terminate here; for, as one of your correspondents has, I think, rightly observed, it is far better to manure for turnips the preceding year than immediately before sowing them; and I am sure it is so for wheat, especially if the manure be not thoroughly digested, and become inoffensive.

Whether plants from new or old seed are most secure from the depredations of the fly, is perhaps a question which cannot be easily determined, even by experiments; for, concomitant circumstances are frequently so much more operative and powerful as to render the difference between them, if there be any, imperceptible.

It is, however, in the knowledge of every practical man, that new seed sprouts or vegetates several days before old, and I think more vigorously;

rously; and it is equally well known, that the healthy and vigorous plants escape the fly, which the stinted and sickly seldom or never do. It should seem then, that new seed, *cæteris paribus*, is more secure from the fly than old, and, for my own use, I would always prefer it.

That old seed is preferred to new, in some articles, by experienced gardeners, is very true, and I believe with good reason; but this furnishes a reason against giving a preference to old turnip-seed, contrary to what it is brought for. Old melon and cucumber seed is preferred to new, because the plants from old seed are far less luxuriant, and more fruitful. In a former paper we observed, that luxuriance and fructification are very different things, and, in few genera of plants, perhaps in none, are they strictly compatible; but the roots of the turnip can never be too luxuriant, and, the more they are so, the more secure they are from the ravages of the fly.

Many are the nostrums for preventing or remedying the evils of this destructive insect; but, like charms for the cure of the ague, or the tooth-

tooth-ache, they are found to be equally fabulous and quackiſh. It is certainly very bad reaſoning to conclude, that becauſe certain things are diſagreeable to *our* ſmell and taſte, they muſt neceſſarily be ſo to creatures of a different kind; and yet, from this ſource their recommendation ſeems to originate. From the great encomiums beſtowed on elder, I was in great hopes a ſpecific remedy had been found; I therefore determined to give it a fair trial. Accordingly, I repeatedly drew elder-branches, not only over beds of young turnips, but over a variety of other plants. I whipt the ground with them, and ſtrewed the leaves, tops, and tender ſhoots, over the beds. At length, finding all this totally ineffectual, I made a very ſtrong infuſion of elder in boiling water, and, when it was cold, watered the plants with it ſeveral times. All this had juſt as much effect, and no more, as walking round the bed in the ſuperſtitious garb of a magician, and chaunting *Abracadabra* at every turn. Yet, this elder-noſtrum has diſgraced almoſt every repoſitory of papers, on theſe ſubjects, that has been publiſhed for many years.

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I am of opinion, that nothing has yet been discovered which is at all adequate to the purpose, farther than as it may invigorate and promote the growth of the plants. To this end, ashes, soot, or a rich compost of lime and dung, if used in sufficient quantities, may be deemed specific. The best way of using them is, either to sow them with the seed, or by themselves immediately before, and to harrow them in well, that they may be completely incorporated with the soil. This, for the most part, would so invigorate and encourage the growth of the plants, that they would be able to withstand the most vigorous attack of the fly.

VII. *Experiments and Obſervations on Ferments and Fermentation; by which a Mode of exciting Fermentation in Malt-Liquors, without the Aid of Yeaſt, is pointed out; with an Attempt to form a new Theory of that Proceſs.* By Mr. THOMAS HENRY, *F. R. S.*

WITH A PLATE.

From the MEMOIRS of the LITERARY and PHILOSOPHICAL SOCIETY of MANCHESTER.

OF all the proceſſes of chemiſtry, there is perhaps none, the phenomena of which have been leſs ſatisfactorily explained than thoſe of fermentation. The writers on chemiſtry have been content to deſcribe the ſeveral appearances, progreſs, and reſult, of fermentation, and have declined any inquiry into its primary cauſes, or into the mode by which the changes, induced by it, are effected in bodies which are the objects of its action.

Within

Within theſe few years, great changes have taken place in the theory of chemiſtry. The important diſcoveries of Black and Prieſtley, and of ſeveral other philoſophical chemiſts who have endeavoured to emulate their examples, have happily explained many of the operations of chemiſtry, which were before wholly unintelligible; and the preſent time forms one of the moſt diſtinguiſhed æras in the hiſtory of that ſcience. We now underſtand the nature of lime, and of alkalies; the difference between a metal and its calx; the cauſe of the increaſe of weight in the latter, and of its decreaſe when returned to a metallic form. The conſtitution of atmoſpheric air has been demonſtrated. Various gaſes, reſembling air in many points, but differing from it in others, have been diſcovered; and, among theſe, an ætherial fluid, ſuperior in its properties to common air, and capable of ſupporting life and combuſtion more vigorouſly and durably. Our acquaintance with this pure fluid, which forms the vital part of common air, ſeems to promiſe much enlargement to our chemical knowledge, in the inveſtigation of its various com-

combinations; and we have already derived much information relative to the conſtitution of the acids, and of water, from the reſearches of philoſophers into the nature of pure air.

Of the gaſes which have ſo much engaged the attention of the pneumatic chemiſts, fixed air, or, as it has more properly been denominated by Sir Torbern Bergman, aërial acid, was that which firſt attracted their notice. This gas, which had been remarked, even by Van Helmont, to be diſcharged in great quantities from liquors in the vinous fermentation, was found by Dr. Prieſtley to be again miſcible with them; and he proved, that on the preſence of this gas the briſkneſs and pleaſantneſs of theſe liquors depended, and that, when deprived of it, they became vapid and flat.

But thongh Mr. Cavendiſh had proved the ſeparation, and aſcertained the quantity, of this gas, diſcharged in fermentation, and though Dr. Prieſtley had early made the above-mentioned obſervations, it does not appear to have occurred to theſe philoſophers, that this gas was the

the exciting cauſe, as well as the product, of fermentation.

It is a fact well known to brewers of malt-liquors, that wort, contrary to what takes place in liquors more purely ſaccharine, as the juice of the grape, cannot be brought into the vinous fermentation without the addition of a ferment; for which purpoſe, yeaſt or barm, which is a viſcid frothy ſubſtance taken from the ſurface of other maſſes of fermenting liquor, has been commonly uſed.

But the nature of this ſubſtance, much leſs its mode of action, has not been conſidered with that degree of attention which one would have expected ſhould have been excited by ſo extraordinary an agent. We are told indeed, that a vinous ferment induces the vinous, that a ferment of an acetous kind brings on the acetous fermentation, and a putrid one, that fermentation which ends in putrefaction. But we receive no more information, relative to the manner in which they produce theſe effects, than we do with regard to fermentation itſelf.

 Before

Before I endeavour to deliver any theory of ferments, or of fermentation, I ſhall relate a number of facts which have led to a few thoughts on the ſubject; and, having mentioned the phenomena attendant on the proceſs, as deſcribed by other chemiſts, ſhall then, with the greateſt diffidence, proceed to offer an hypotheſis.

Soon after Dr. Prieſtley had publiſhed his method of impregnating water with fixed air, I began to prepare artificial Pyrmont water by that means; and early obſerved, that although water ſo impregnated ſhewed at firſt no ſparkling, when poured into a glaſs, yet, after it had been in a bottle cloſely corked for ſome days, it exhibited, when opened, the ſparkling appearance of the true Pyrmont water *. This I attributed, and perhaps not unjuſtly, to the gas, which had been more intimately combined with the water, and reduced to a kind of latent ſtate, recovering its elaſticity, and endeavouring to eſcape.

* Various methods have ſince been deviſed, of forcing ſuch a quantity of gas to combine, or at leaſt to mix, with water, as immediately to communicate to it this appearance.

Having

Having one day made ſome punch with this water, and having about a pint of it remaining, after my friends had retired, I put it into a bottle capable of containing a quart, and corked the bottle. On opening it, at the diſtance of three or four days, the liquor, when poured out, creamed and mantled like the briſkeſt bottled cider. An old gentleman, to whom I gave a half-pint glaſs full of it, called out in raptures to know what delicious liquor he had been drinking, and earneſtly deſired, that if I had any more of the ſame, I would give him another glaſs.

Dr. Prieſtley, as has been already mentioned, had informed us that fixed air, thrown into wine or malt-liquor grown vapid, reſtored to them their briſkneſs and pleaſant taſte. On impregnating ſome vapid ale with fixed air, I was diſappointed in not finding that effect immediately produced. But, after bottling the ale, and keeping it cloſely ſtopped for four or five days, it was become as briſk as ale which, in the common way, has been bottled ſeveral months.

In the year 1778, I impregnated with fixed air a quantity of milk-whey, which I had clarified for the purpoſe of preparing ſome ſugar of milk, and bottled it. In about a week, the whey in one of the bottles, which had been ſo looſely corked that the liquor had partly oozed out, was remarkably briſk and ſparkling. Another bottle, which was not opened till the ſummer of 1782, contained the liquor not in ſo briſk a ſtate, but become evidently vinous, and without the leaſt acidity perceptible to the taſte.

I now began to ſuſpect that fixed air is the efficient cauſe of fermentation; or, in other words, that the properties of yeaſt, as a ferment, depend on the fixed air it contains; and that yeaſt is little elſe than fixed air, enveloped in the mucilaginous parts of the fermenting liquor. I therefore determined to attempt the making of artificial yeaſt.

For this purpoſe I boiled wheat-flour and water to the conſiſtence of a thin jelly, and, putting the mixture into the middle part of Nooth's machine, impregnated it with fixed air, of which it imbibed a conſiderable quantity. The mixture was then put into a bottle looſely ſtopped, and placed in a moderate heat.

The

The next day, the mixture was in a ſtate of fermentation, and, by the third day, had acquired ſo much of the appearance of yeaſt, that I added to it a proper quantity of flour, kneaded the paſte, and, after ſuffering it to ſtand during five or ſix hours, baked it, and the product was bread, tolerably well fermented.

I now determined to make a more ſatisfactory experiment. The wort obtained from malt, it is known, cannot be brought into a ſtate of fermentation without the aid of a ferment; for which purpoſe, yeaſt is always uſed. If, therefore, by impregnating wort with fixed air, I could bring on the vinous fermentation, if I could carry on this fermentation ſo as to produce ale, and from the ale procure ardent ſpirit, I imagined that I ſhould be able to announce to the world a mode of procuring newly-fermented liquors, in moſt climates, and in moſt ſituations.

I accordingly procured, from a public-houſe, two gallons of ſtrong wort. It had a diſagreeable bitter taſte, owing either to bad hops, or to ſome ſubſtitute for hops. A large part of the liquor was impregnated, in Nooth's machine, with fixed air,

air, which it feemed to abforb very rapidly, and in large quantity. When it was thus impregnated, it was mixed with the other part, and poured into a large earthen jug, the mouth of which was ftopped with a cloth, and placed in a degree of heat varying from 70° to 80°. In twenty-four hours the liquor was in brifk fermentation, a ftrong head of yeaft began to collect on its furface; and, on the third day, it appeared to be in a fit ftate for tunning. It was therefore put into an earthen veffel, fuch as is ufed in this country by the common people, as a fubftitute for a barrel, for containing their fmall brewings of fermented liquors. During the fpace of near a week, previous to the ftopping up of the veffel, much yeaft was collected on its furface, and occafionally taken off; and, by means of this yeaft, I fermented wheat-flour, and procured as good bread as I could have obtained by ufing an equal quantity of any other yeaft.

The veffel was now ftopped up; and, in about a month, tapped. The liquor was well fermented, had a head or cream on its furface, and though, as might be expected from the defcription

tion of the wort, not very pleaſant, yet as much ſo as the generality of the ale brewed at public-houſes.

A part of the ale was ſubmitted to diſtillation, and from it a quantity of vinous ſpirit was produced; but, the veſſel being broken before the diſtillation was finiſhed, the quantity it would have yielded was not aſcertained. However, that which was obtained appeared not to differ much, in quantity, from what an equal portion of common ale would have afforded.

As I had loſt my notes, and was obliged to make out the preceding account from memory, I deſigned to repeat the experiments again; but various engagements prevented me, till the latter end of Auguſt 1784.. Of theſe experiments, the following notes are taken from my journal.

Auguſt 30, I procured two gallons of common ale-wort, two quarts of which were in the evening impregnated, but not ſaturated, with fixed air. The impregnated liquor was then added to the other part, and about midnight placed in a large jug within the air of the kitchen-fire,

where

where it remained during the night. In the morning no ſigns of fermentation. At five o'clock P. M. only a ſlight mantling on the ſurface. Apprehending the quantity of gas to have been too ſmall, a bottle with a perforated ſtopper and valve, containing an effervefcing mixture of chalk and vitriolic acid, was let down into the wort. At nine o'clock, the diſcharge of air from the bottle was going on briſkly, and the wort ſeemed to be fermenting. At eleven o'clock the bottle was withdrawn, the fermentation being commenced beyond a doubt, the ſurface of the liquor having a pretty ſtrong head. Temperature of the wort 80°: at the outſide of the veſſel 78°.

September 1ſt, ſeven o'clock, A. M. the fire having been low during the night, the fermentation was leſs briſk: temperature of the wort reduced to 72°, and probably had been lower during the night, as the fire was now increaſed. The liquor was ſtirred up, placed in a ſituation where the thermometer pointed to 82°, and the effervefcing mixture was again immerſed. It was withdrawn at noon, and, the thermometer ſtanding at 92°, the wort was removed farther from the cover the moſt ſimple means of keeping up, in their houſes, a comfortable degree of heat, it was alſo neceſſary that this ſhould be done with the leaſt poſſible expence of fuel.

The ſtoves we are now about to deſcribe, and of which we have given figures, with ſections, &c. of the different parts, perfectly fulfil the above-mentioned intentions; they are alſo ſuſceptible of every kind of ornament. The more ſurface we give to a ſtove conſtructed in this manner, the more the heat is increaſed; conſequently, we muſt not be ſurprized to find, that this kind of ſtove ſometimes occupies the whole height of an apartment; its width, and depth, being proportioned to its height.

Fig. 1 (Plate III.) repreſents a ſtove ſeen in front. A is the door by which the wood, &c. is introduced, and through which the fire is lighted.

Fig. 2 is a ſection of the ſame ſtove. B is the cavity in which the wood, &c. is placed, and which may properly be called the fire-place: it is ſeparated from the aſh-hole C, by an iron grating. D, D, are cavities, which ſerve to collect and retain the heat, and alſo to form paſſages for the ſmoke. E is another cavity for collecting heat, but which has no comunication with the inferior cavities, conſequently affords no paſſage for the ſmoke: this cavity is formed in the *higheſt* part of the ſtove.

Fig. 3 repreſents a plan of the bottom or baſe of the ſtove, or that part wherein the aſhes are collected: this part is ſhut by an iron door, at F, and there is alſo a ſmall door, at G, at the other end of the aſh-hole. The principal uſe of the laſt door is, to keep up the current of air neceſſary to make the fire burn; the door F being never opened, except to take out the aſhes, or occaſionally to put fire into that cavity, in order to encreaſe the draught of air.

Fig. 4 is a plan correſponding to the ſection Fig. 2.

The conſtruction of this ſtove, and the direction of the ſmoke, will be better underſtood by conſidering Plate IV. in which Fig. 5 repreſents a ſection of the ſtove; HH ſhewing the fire-place charged with wood, and I, I, I, the courſe of the ſmoke. Plates of iron, or earthern tiles,

form

form the roofs, K, K, K, of the three lowermoſt cavities; two of theſe roofs do not reach quite acroſs, but are continued only a little more than three quarters of the whole ſpace, and are ſupported at their extremities L, L, by pieces of iron fixed in the ſtove. By this means, the ſmoke finds a free paſſage, and follows the current of the air.

The courſe of the ſmoke will appear more clearly by examining Fig. 6, in which M, M, M, M, repreſent the flues for the ſmoke. On a level with the upper part of the cavity for the fuel, or fire-place, and in the laſt of the flues, is fixed a valve N, which is to be cloſed when the wood is ſo far burnt as to be brought into the ſtate of charcoal; by which means, all the heat is confined in the ſtove, from which it ſpreads itſelf into the apartment. But as, when the air of the atmoſphere is very cold, it would be apt to communicate a portion of its coldneſs to that which is near the valve N, a ſecond valve is placed in the exterior part of the chimney, where it is carried up beyond the roof of the building. By means of an iron wire, commmunicating with both valves, the operation of opening and shutting them is rendered very quick and easy.

Figures 7 and 8 are plans of the corresponding sections above them.

If this manner of constructing stoves be compared with that which is followed in France, it will soon be perceived how much superior it is to the French method; not only with respect to the quantity of heat it produces, but also with respect to the expence of fuel. A fire lighted in one of these stoves early in the morning, and with a small quantity of fuel, retains a strong heat during the whole day; besides which, these stoves never smoke, and are free from many other inconveniencies attending the common ones. In the common French stove, the door of the fire-place and the ash-hole is in one; that is to say, a small door is made in a large one which closes both cavities; in these stoves the door of the fire-place is only opened to put in the wood, and remains afterwards constantly shut. The wood lies upon a grate, consequently it is not buried in, and stifled by, the ashes. The ash-hole is spacious, and one or two feet in height, according to the capacity

city of the ſtove. Two doors are placed at the extremities of the aſh-hole, and the current of air is very conſiderable, by which the ſmoke is carried up with great force, and the wood burns very briſkly.

Stoves of this kind may be advantageouſly placed in halls, at the bottom of ſtair-caſes, and in the anti-chambers of great houſes: they may alſo, by proportioning their ſize to that of the rooms for which they are intended, be made uſe of in the houſes of private perſons. It may, perhaps, be objected, that the heat produced from theſe ſtoves is unwholeſome; that they deprive the air of its moiſture, and that the air, by being made too dry, loſes its elaſticity, in conſequence of which reſpiration becomes difficult and laborious. Theſe objections would appear of great weight, if we had not the example of the Ruſſians, the Swedes, the Danes, the Germans, and, in ſhort, of all the inhabitants of the north of Europe, to ſhew that thoſe who are habituated to ſuch ſtoves do not find them unwholeſome. If others ſhould be ſenſible of inconveniencies, like thoſe we have mentioned

above,

above, they may be easily removed by the following very simple method, which has been tried, and found to answer. Place upon your stove a vessel of glass, earthen ware, &c. which has a large surface, and is very shallow; fill it with water; this water will insensibly evaporate, and restore to the air that moisture which the heat of the stove has deprived it of: the air will then recover its elasticity, and the breathing will become free. If orange-trees are exposed to the heat of such a stove, and the fire is not properly regulated, the plants grow yellow and lose their leaves, especially if the air is not changed, which in winter is not very conveniently done; but, if a vessel of water be placed upon the stove, the evaporation of the water will preserve the trees.

Those who wish to scent their apartments, may do so, by putting rose-water, &c. in the vessel, instead of common water: but these kinds of odours affect many persons who have delicate nerves. Upon the whole, the advantage of these stoves is sufficiently proved, by the great warmth they produce, and the great saving of fuel they occasion.

Fig. 2.

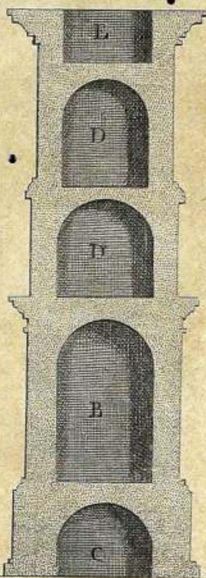


Fig. 1.

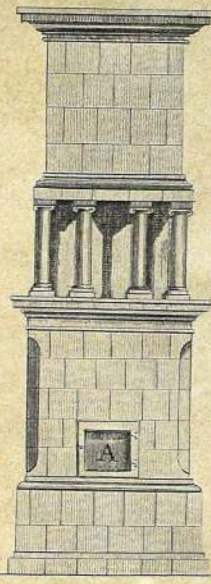


Fig. 4.

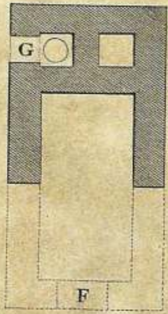
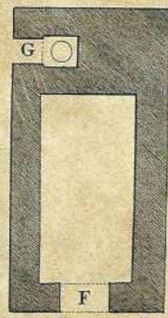


Fig. 3.



Scale of 6 Feet.

X. *Lift of Patents for Inventions, &c.*

(Continued from Vol. VI. Page 431.)

WILLIAM DESMOND, of Shepherd-ftreet, Hanover-fquare; for a method or procefs of tanning all forts of hides and fkins, and of rendering more folid and incorruptible, in water, feveral vegetable and animal fubftances, fuch as flax, hemp, fpartery, cotton, filk, hair, wool, &c. as well as the materials made thereof. Dated Jan. 15, 1796.

ISAAC WHEILDON, and JOHN BOWLER, of London; for a new method of making and working preffes for packing goods. Dated April 26, 1796.

WILLIAM GOLDFINCH, of Canterbury, Chemift; for the invention of an improved trufs for the cure and prevention of ruptures. Dated May 24, 1796.

JOSEPH STACEY SAMPSON, of Tabernacle-walk, Moorfields; for the invention of an art or method of cutting up tallow-fat, fpermaceti, and wax, for melting; and of making the fame into candles. Dated May 24, 1796.

John Strong, of Bingham, in the county of Nottingham; for the invention of certain new improvements in the construction of piston-cylinders, suction-chambers, and valves, whereby the same may be more expeditiously repaired. Dated May 31, 1796.

John Howell, of Oswestry, Salop; for an improved engine or machine for the purpose of boring or hollowing wooden water-pipes, or aqueducts, in a much more expeditious manner than hitherto practised, and whereby a considerable saving will be made in timber Dated May 31, 1796.

William Booth, of St. Anne's, Soho, Middlesex; for the invention of an improvement in making stays and corsets. Dated May 31, 1796.

William Law, of St. Anne's, Soho, Middlesex; for certain new improvements in and upon water-closets. Dated May 31, 1796.

Edward Haskew, of Gloucester, Timber-merchant; for an engine for raising earth from the bottom of canals, or any other place of depth, to the surface of the earth. Dated May 31, 1796.

John Pepper, of Newcastle under Line, Builder; for the invention of a certain kiln, for drying malt, or other grain. Dated June 9, 1796.

REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER XXXVIII.

XI. *Specification of the Patent granted to the Earl of* DUNDONALD; *for his Method or Methods of disengaging and obtaining a Mineral or Fossil Alkali or Soda, and Vegetable Alkali or Pearl or Pot Ash, from Neutral Salts composed of those Alkalies and an Acid, or from the Solutions of those Salts, that in Processes previous to the Disengagement of those Alkalies, or in Processes connected therewith, several Articles are disengaged, or formed, which may be collected, and applied to various valuable Purposes.*

Dated Feb. 28, 1795.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said Archibald, Earl of Dundonald, in compliance with the faid provifo, do hereby defcribe and afcertain the nature of my faid invention, and declare that the method or methods of difengaging and obtaining a mineral or foffil alkali or foda, and vegetable alkali or pearl or pot afh, from neutral falts compofed of thofe alkalies and an acid, or from the folutions of thofe falts, is and are fully defcribed in this fpecification; as likewife are the method or methods of performing other proceffes, to which thefe patents have reference, under the words, "that in proceffes previous to the difengagement of thefe alkalies, or in proceffes connected therewith, feveral articles are difengaged, or formed, which may be collected, and applied to various valuable purpofes."

In this fpecification it will be neceffary to begin with the defcription of the proceffes referred to in the affidavit and petition, as previous to, or preparatory to, the difengagement of thofe alkalies; that is, I firft prepare and collect the neutral falts confifting of an alkali and an acid, and I then decompofe thofe neutral falts, and difengage from them mineral alkali or ſoda, and vegetable alkali or pearl or pot aſh. My intentions likewiſe were, by the method of wording my affidavit and petition, to reſerve to myſelf a power of manufacturing and diſpoſing of the ſeveral articles made in my different proceſſes, in a more or leſs finiſhed ſtate, particularly Glauber's ſalt or the ſulphat of ſoda, and mineral alkaline hepar or ſulphuret of ſoda; articles which, by experiments I had made, I had found might be uſed to advantage in various proceſſes, particularly as manures or ſalſhe ſtimulants, to promote the growth of vegetables in certain ſoils.

My methods or proceſſes for diſengaging and obtaining alkaline ſalts, from neutral ſalts conſiſting of an alkali and an acid, are numerous. It will require a long and detailed account to deſcribe them fully, as well as to deſcribe the various articles formed, or diſengaged, in proceſſes previous to the diſengagement of the alkali, or in proceſſes connected therewith. Prudential conſiderations made it neceſſary that, in my affidavit and petition, I ſhould ſtudy brevity as much as

 poſſible;

poſſible; at the ſame time that what was ſtated in the affidavit and petition might read with, and be fully explained in, the ſubſequent ſpecification. And now that the letters patent have been obtained, I ſhall proceed with fidelity and accuracy to deſcribe my different proceſſes; knowing that not only my duty to the public requires it, but that it is my intereſt to do ſo, to prevent others from incroaching on my patents, or raiſing a ſuperſtructure on my foundation. I ſhall now proceed, firſt, to give an index to my different proceſſes, ſtating what I claim as my diſcoveries included in the affidavit and petition; and, laſtly, I ſhall give the fulleſt poſſible detailed account of each proceſs, and of the article or articles formed, and capable of being collected.

Index. The firſt and moſt important of the proceſſes, is the making of Glauber's ſalt or ſulphat of ſoda; being one of thoſe neutral ſalts conſiſting of an alkali and an acid, from which an alkaline ſalt is to be procured. In this proceſs ſeveral other articles are formed, or diſengaged, and may be collected. Theſe articles are, mu-

riatic

riatic acid, ſal ammoniac or muriat of ammoniac, and ochry matter or earth of iron, mixed with a greater or leſs proportion of clay, as a pigment. Secondly, the decompoſition of Glauber's ſalt or ſulphat of ſoda: obtaining from it hepar ſulphuris or ſulphuret of ſoda, and mineral alkali or ſoda, either in a mild or cauſtic ſtate. Thirdly, the decompoſition of muriat of pot-aſh or digeſtive ſalt of Silvius, and preparation from it of ſulphat of pot-aſh or vitriolated tartar. Fourthly, the procuring from the ſulphat of pot-aſh, either ſulphuret of pot-aſh or vegetable alkaline hepar, or mild or cauſtic vegetable alkali. The alkaline ſalts and ſulphurets, thus formed or prepared, may be applied to various purpoſes, particularly for the decompoſition and diſengagement of mineral alkali or ſoda, from Glauber's ſalt or ſulphat of ſoda. This proceſs or application of the vegetable alkali and ſulphuret, procured from muriat of pot-aſh or digeſtive ſalt, or from ſulphat of pot-aſh or vitriolated tartar, in my method or methods, is not to be underſtood to be limited or confined to the decompoſition of ſulphat of ſoda or Glauber's ſalt made according to my processes, but embraces and includes the decomposition of Glauber's salt or sulphat of soda, in whatever manner it has been made or procured. Fifthly, the sulphat of pot-ash or vitriolated tartar, re-produced in the decomposition of the Glauber's salt or sulphat of soda, is recovered by me, after each process, in the state of an alkaline salt or saline matter, fit to decompose more Glauber's salt or sulphat of soda, and to disengage from it mineral alkali. Sixthly, the decomposition of, or change produced on, sulphat of barytes or terra ponderosa. The result of this preparation to be applied to the decomposition of sulphat of pot-ash or vitriolated tartar, and sulphat of soda or Glauber's salt, or to the decomposition of preparations containing these salts, or their solutions. The sulphat of barytes, re-produced in this process, may be recovered, and made to undergo again the same process, so as to fit it for the decomposition of more sulphat of pot-ash or vitriolated tartar, or sulphat of soda or Glauber's salt, or preparations or solutions containing these salts. Lastly, the decomposition of muriat of soda or sea-salt, or salts or substances containing sea-salt, by alkaline

salts

falts prepared by me, or according to my proceffes.

I fhall now proceed to defcribe thefe proceffes, and the nature of the different articles or faline matters formed, or obtained.

General defcription of the Glauber's falt or fulphat of foda procefs.—I have difcovered that fea-falt or muriat of foda is decompofed by fulphat of alumine or alum, by fulphat of iron or green vitriol or vitriol of iron, and by fulphat of magnefia or Epfom falt, with the aid of heat, when a due proportion of clay or ferruginous argillaceous earth is mixed with the falts which are intended to be operated upon. I have likewife difcovered that muriat of foda or fea-falt is decompofed, in confiderable proportion, by fulphat of magnefia or Epfom falt, with the aid of heat, without the intervention of clay or argillaceous earth. I have alfo difcovered that muriat of foda or fea-falt may be decompofed by fulphat of lime or gypfum, with the aid of heat, when a due proportion of clay or argillaceous earth, containing much iron, is mixed with the fea-falt and gypfum or fulphat of lime.

The above account of my discoveries and processes is intended by me to embrace and include, not only all the saline matters above mentioned, when used singly, but likewise when these saline matters are found mixed, or when they are mixed together, in different proportions, as when they are contained in alum-rock or schist, calcined or uncalcined, in alum raw liquor, obtained by lixiviating alum-rock or schist, calcined or uncalcined, lixiviated either with fresh or salt water, in alum boiled liquor, mother-liquor, alum-washings or tun-liquor, or in alum-slam or the refuse saline matters of alum-works; in vitriolic, sulphureous, or pyritous schist, or substances, or in their solutions, such as are, or may be, used for making sulphuric or vitriolic salts, with metallic or earthy bases. In this description I include the saline matters arising from a mixture of substances capable of producing any of the above saline matters, such as sulphur and iron, or sulphur and the earth of iron, with or without water. And lastly, under the article of muriat of soda or sea-salt, I include rock or fossil salt, and all other

substances

ſubſtances containing it, ſuch as, kelp, ſandiver or the refuſe from glaſs-works, ſoapers leys, ſalts, aſhes, or refuſe materials, or the ſolutions of any of theſe ſubſtances.

Particular or detailed deſcription of the Glauber's ſalt or ſulphat of ſoda proceſs.—Take a given quantity of ſea-ſalt or rock-ſalt or muriat of ſoda, or any ſalt containing ſea-ſalt or muriat of ſoda, or ſea-water, or ſolutions of ſalts containing muriat of ſoda or ſea-ſalt. Add to any of the above ſalts, or their ſolutions, ſuch a quantity of ſulphat of alumine or alum, or ſulphuret of alumine, ſulphat of iron or green vitriol or vitriol of iron, ſulphat of magneſia or Epſom ſalt, or ſulphuret of magneſia, or ſalts, or ſaline mixtures, or ſolutions containing any one or more of theſe ſalts or ſubſtances, as that the ſulphuric acid or vitriolic acid, contained in the particular ſubſtances, ſalt or ſalts, or ſolutions uſed, ſhall be ſufficient to produce the effect hereafter deſcribed. Let the muriat of ſoda or other ſalts firſt mentioned, or their ſolutions, and the ſulphuric ſubſtances or ſalts above deſcribed, or their ſolutions, be mixed together:

gether: add to or mix with them a due proportion of argillaceous earth or clay, or rather ferruginous argillaceous matter. The materials are then to be dried, or deprived of moifture, ground to a powder, the finer the better, and then fubmitted to the action of heat, in a reverberatory or other furnace, pot, or crucible, until the muriatic acid is expelled. The refiduum after calcination confifts of fulphat of foda or Glauber's falt, of clay and the earth of iron, or clay and the earth of magnefia, according to the nature of the fulphuric falt or falts ufed in the procefs. The Glauber's falt or fulphat of foda is to be feparated by lixiviation or wafhing; it may be cryftalized, or boiled to drynefs, or kept in a ftate of folution, according to the particular purpofes to which it is to be applied. The earthy matter, when it contains much iron, when properly levigated, wafhed, and dried, may be ufed as a pigment. The muriatic acid, expelled in the before-defcribed procefs, may be collected, ufing the veffels or apparatus adopted for that purpofe by chemifts, or others that may be found proper

for

for the purpofe: or the muriatic acid may be applied for making the muriat of ammoniac or falammoniac, by conducting or conveying the muriatic acid, or muriatic acid gas, with volatile alkali, or volatile alkaline gas, obtained from coal, tar-water, bones, foot, urine, or other materials, into a proper receiver. This patent is intended to include all and every one of the products above mentioned.

I likewife decompofe muriat of foda or fea-falt, or folutions of falts containing muriat of foda, by the means of fulphat of magnefia or Epfom falt, without the ufe of clay or earth of iron, fimply by the application of a properly-regulated degree of heat; but the decompofition in this procefs is not fo complete as in the proceffes above mentioned. Muriat of foda or fea-falt is likewife in part to be decompofed by fulphat of lime or gypfum, with the aid of heat, when a due proportion of ferruginous clay is ufed, proceeding in all other refpects, in thefe two laft-mentioned proceffes, as when fulphat of iron, of clay, or of magnefia is ufed. The more free the clay or argillaceous earth, used in the above-described process, is from quartzose or siliceous earth, the better it answers for promoting the expulsion of the muriatic acid. What I have found to answer best is, alum schist or rock, particularly that part which abounds most in sulphat of iron or vitriol of iron: the more earth of iron it contains, the more readily and completely the process succeeds. I have operated with so large a proportion of the earth of iron, that, to guard my patent from encroachment, I must here, to the former directions for the addition of clay or argillaceous earth to muriat of soda or sea-salt, and any of the before-mentioned sulphuric or vitriolic salts, subjoin the words, earth of iron; in which case my specification will run, clay, ochre, or earth of iron, or clay and ochre, or earth of iron in any different proportions.

Decomposition of sulphat of soda or Glauber's salt, and disengagement of mineral alkali or soda. —Take sulphat of soda or Glauber's salt, made in any of the above-described processes: add to it such a proportion of pearl-ash or pot-ash or vegeta-

ble

ble alkaline ſalt, as will combine with the ſulphuric acid of the ſulphat of ſoda or Glauber's ſalt: let the liquor be properly concentrated by boiling or evaporation, and the ſeparation of the ſulphat of pot-aſh or vitriolated tartar be performed by cryſtalization and cooling. The proportion of the mineral alkali adhering to, or which humects the ſurface of, the cryſtals of ſulphat of pot-aſh or vitriolated tartar, may be ſeparated by waſhing the cryſtals of ſulphat of pot-aſh or vitriolated tartar with a ſmall proportion of cold water: the mineral alkali may then be cryſtalized, or boiled to dryneſs, or ſubmitted or not, as may be required, to the action of a reverberatory, or other furnace. I do not lay claim to the excluſive privilege of applying pearl or pot aſh or vegetable alkali, for the diſengagement of mineral alkali from ſulphat of ſoda or Glauber's ſalt, a proceſs well known to every chemiſt; but I lay claim to the excluſive application of pearl or pot aſh or vegetable alkali, for the ſeparation of the alkali contained in ſulphat of ſoda or Glauber's ſalt, when the ſulphat of ſoda or Glauber's falt is made according to any of my proceffes. It is the more neceffary to infert this claim here, as I may have occafion to difpofe of large quantities of fulphat of foda or Glauber's falt, or preparations from fulphat of foda or Glauber's falt, for other purpofes than for making mineral alkali; and it is intended that the claim here lodged fhall guard my intereft, againft thofe who fhould attempt to manufacture mineral alkali, in the manner above defcribed, or in any manner or method, from the fulphat of foda or Glauber's falt prepared by me, or by others under my patent, and fold or difpofed of.

Thirdly. The decompofition of muriat of pot-afh or digeftive falt of Silvius, and preparation from it of fulphat of pot-afh or vitriolated tartar, come next in order to be defcribed, and is to be performed, in all refpects, and with the fame materials, as have been ftated and enumerated for preparing Glauber's falt or fulphat of foda, from muriat of foda or fea-falt; fubftituting only muriat of pot-afh for muriat of foda or fea-falt. The refults or products of the

procefs

procefs are, fulphat of pot-afh or vitriolated tartar, muriatic acid, muriat of ammoniac or fal-ammoniac, when volatile alkali or ammoniac is ufed, and ochre or earth of iron, mixed with a greater or lefs proportion of clay.

Fourthly. The procefs which comes now to be defcribed, is the procuring, from fulphat of pot-afh or vitriolated tartar, fulphuret of pot-afh, and mild or cauftic vegetable alkali. Thefe are to be procured by feveral different proceffes; and this fulphuret, and thefe alkalies, may be applied for the decompofition of fulphat of foda or Glauber's falt. The fame proceffes may be extended to the procuring fulphuret of foda or mineral alkaline hepar, as well as mild and cauftic mineral alkali, from fulphat of foda or Glauber's falt. Take fulphat of pot-afh or vitriolated tartar, produced in the laft procefs, or produced in difengaging the mineral alkali from fulphat of foda or Glauber's falt, or take fulphat of pot-afh prepared in any other manner; add to it a due proportion of carbonaceous, ligneous, vegetable, or inflammable matter. Let the materials be brought to fufion

in

in a pot, crucible, reverberatory, or other furnace, and the fusion continued until a proper hepar or hepatic alkaline salt is formed; let the melted matter be run or taken out of the furnace, pot, or crucible; let it cool; break the hepar into pieces, or grind it to powder. To sulphat of soda, or to a solution of sulphat of soda, made in any of the before-described processes, or to sulphat of soda, or a solution of sulphat of soda, made in any other process, or any how procured, add as much of the hepar or alkaline liver of sulphur, or hepatic alkaline salt above described, as shall be requisite to decompose the sulphat of soda. The sulphat of pot-ash, formed in the process, may be separated by priority of crystalization. After the separation of the sulphat of pot-ash, there will remain a carbonat of soda or mild mineral alkali, and a sulphuret of soda or mineral alkaline liver of sulphur. These remaining salts may be applied in the manufacture of soap, although the alkali is not so pure as that which is procured in processes formerly and afterwards to be described.

Fifthly.

Fifthly. Under this head are included a variety of proceſſes for recovering and procuring a perfectly pure vegetable alkali, from ſulphat of pot-aſh or vitriolated tartar, however procured; and thoſe proceſſes may alſo be applied for making a ſulphuret of ſoda or mineral alkaline liver of ſulphur, from ſulphat of ſoda or Glauber's ſalt, made in any of my different proceſſes; as well as for making, from ſulphat of ſoda or Glauber's ſalt, prepared in my proceſſes, or made or procured in any other manner, a mild or cauſtic mineral alkali or ſoda; ſubſtituting only, where neceſſary, the words ſulphat of ſoda or Glauber's ſalt, and ſulphuret of ſoda or mineral alkaline hepar, for ſulphat of pot-aſh or vitriolated tartar, and ſulphuret of pot-aſh or vegetable alkaline hepar, reſpectively.

Ligneous proceſs, in the wet way, in cloſe veſſels.—Take hepar or liver of ſulphur, made from ſulphat of pot-aſh or vitriolated tartar; diſſolve it, when newly made, in water; add a due proportion of ſawings of wood, or any ligneous or vegetable matter, their juices, gums, reſins, or extracts, or vegetable matter, such as peat; or the hepar or sulphuret or liver of sulphur may be mixed with the before-described vegetable substances, and then dissolved in a due proportion of water. The materials, when thus mixed, must be kept from the action of air; and, in that situation, a due degree of heat may be applied to them. The liquor, after standing a due time, is to be drawn off, and the residuum repeatedly lixiviated with water, to separate the saline matter. The lixivia or leys must be boiled to a due consistence: the proportion of sulphat of pot-ash (if any) contained in them must be separated by crystalization; and the remaining liquor must be boiled to dryness, and then calcined in a reverberatory or other furnace. The saline matter, remaining after calcination, will consist of mild vegetable alkali or carbonat of pot-ash.

Ligneous process, in the wet way, in open vessels.—This process is performed with the same materials, and is in all respects similar to the process last described, excepting that the access of air is not excluded. A less proportion of vegetable alkali,

and

and a larger proportion of ſulphat of pot-aſh or vitriolated tartar is obtained in this, than in the laſt-deſcribed proceſs, which is therefore preferable.

Ligneous proceſs in the dry way.—Take hepar or liver of ſulphur or ſulphuret, recently made from ſulphat of pot-aſh or vitriolated tartar; diſſolve it in water; draw off the clear liquor, and mix it with a due proportion of ſawings of wood, or any ligneous or vegetable matter, their juices, gums, reſins, or extracts, or vegetable matter, ſuch as peat; boil the materials to dryneſs, or otherwiſe bring them to a dry ſtate; ſubmit them to calcination in a pot, crucible, or reverberatory or other furnace; lixiviate the aſhes; boil down the lixivium or leys to a dry ſalt, which will conſiſt of mild vegetable alkali, with a proportion of ſulphat of pot-aſh or vitriolated tartar. The ſalts may be ſeparated by ſolution, and priority of cryſtalization. The preparations of ſulphat of pot-aſh or vitriolated tartar, according to theſe three ligneous proceſſes, may be uſed with greater advantage than hepar or ſulphuret of pot-aſh, in decomposing sulphat of soda or Glauber's salt, or muriat of soda, and disengaging from them the mineral alkali.

Ligneous preparation of sulphat of soda or Glauber's salt.—Let sulphat of soda or Glauber's salt be made into a hepar or sulphuret, and treated either by the first, second, or third ligneous process, directed for the sulphat of pot-ash or vitriolated tartar; the result will be carbonat of soda or mild mineral alkali, and sulphat of soda or Glauber's salt. But I do not so much recommend this process, from the difficulty of separating the mineral alkali from sulphat of soda: but, as the same objection does not apply to the separation of mineral alkali from sulphat of pot-ash or vitriolated tartar, I recommend that the above processes, for treating the solution of hepar with vegetable matter, shall either be applied to hepar or sulphuret made from sulphat of pot-ash or vitriolated tartar, for the purpose of afterwards decomposing the sulphat of soda or Glauber's salt, or that both the hepar of the sulphat of pot-ash, and that of the sulphat of soda,

ſoda, ſhall be treated in the ſame manner with vegetable matters; their ſolutions afterwards mixed in the proportions requiſite to produce a complete double decompoſition, and the ultimate formation of only two ſalts, to wit, the carbonat of ſoda, and the ſulphat of pot-aſh, which are capable of being eaſily ſeparated.

The diſcovery of making uſe of vegetable matter, and of the combination of the alkali of the hepar with the previouſly-not-diſengaged acid or acids of vegetable matter, is perfectly new, and has been made by me. A patent, therefore, not only ſecures to me the uſe of ſuch vegetable matter with hepars of ſulphat of ſoda formed in my proceſſes, and ſulphat of pot-aſh recovered, and ſulphuret of pot-aſh formed in my proceſſes, but likewiſe for ſulphat and ſulphuret of ſoda, and ſulphat and ſulphuret of pot-aſh, however made or procured.

Beſides the uſe of the ligneous and vegetable ſubſtances above mentioned, containing an acid not diſengaged, I claim an equal right with others to the uſe of the vegetable acid, or acids produced by by fermentation, or of the carbonic acid, for the purpose of separating sulphur from hepars of pot-ash and soda; such hepars of pot-ash and soda being made of their respective sulphats, got or prepared in the processes now practised by others; but I claim the exclusive use of the vegetable, or fermented, or carbonic acids, for separating sulphur from the sulphurets or hepars of soda and pot-ash, made from the respective sulphat of soda and pot-ash, procured in the already-described processes. This patent is likewise intended to protect me in my invention or discovery of disengaging the carbonic acid or fixed air from calcareous earth, by the means of muriatic acid, or muriatic acid gas, expelled from muriat of soda, or muriat of pot-ash, in the processes for making the respective sulphats already described; of exclusively applying the carbonic acid, thus disengaged, to any purpose I may think proper; and of exclusively making, using, and disposing of the muriat of lime formed in the process, which is thus described. The muriatic acid, or muriatic acid gas, expelled from the muriats of

soda

ſoda and pot-aſh, is to be conveyed into a vaulted chamber, veſſel, or receiver, conſtructed for the purpoſe, containing a ſufficient quantity of chalk or mild calcareous earth, and of water; carbonic acid gas will be expelled, which may be collected, and applied to the purpoſes above deſcribed, or any other. Excluſive of the uſes already mentioned, and ſeveral others not here particularized, the muriatic acid, or muriatic acid gas, diſengaged in my proceſſes, may be converted into oxygenated muriatic acid, or oxygenated or dephlogiſticated muriatic acid gas, by means of mangeneſe. I claim the excluſive benefit of this, as well as other modes of applying or uſing the muriatic acid, or muriatic acid gas, diſengaged in my proceſſes.

Proceſs for decompoſing hepar or ſulphuret of ſoda, or of pot-aſh, by mould or ſoil.—Take a quantity of rich black vegetable mould; provide a vat or ciſtern, having a tap-hole at the bottom; fill it with the mould, to within a foot of the top, putting it in as looſely, and keeping it as open, as poſſible. The ciſtern is then to be filled

filled with a ſolution of hepar or ſulphuret of pot-aſh, or of ſoda; obſerving, as the liquor is run in, that it does not run too faſt, ſo as to ſadden, furrow, or compreſs the mould, which is beſt prevented by cauſing the ley to run firſt into a veſſel of a ſufficient ſize, ſunk to the level of the mould in the lixiviating ciſtern. The ciſtern ſhould have a cover to exclude the action of air. The liquid ſhould be kept on the mould without being run off, until, by trial, it is found to have combined with the vegetable acid, and that the ſulphur is precipitated, or left in the mould. The liquor is then to be boiled down to dryneſs, and ſubmitted to calcination; previous to which, it may be proper to ſeparate the phoſphoric acid formerly contained in the mould, and with which the alkali may be combined, by the means of lime or calcareous earth, and then to boil down and calcine the clear ley with vegetable matter, to give the carbonic acid. The proceſs anſwers beſt when a proportion of carbonat of ſoda, or of pot-aſh, or mild mineral or vegetable alkali, is mixed with the ſolution of the hepar or ſulphuret,

before

before pouring it on the mould; in which caſe, when the vegetable acid of the mould combines with the alkali, the carbonic acid is expelled, and acts in ſeparating the ſulphur from the ſolution of the hepar or ſulphuret.

Sixthly. Preparations of ſulphat of barytes or heavy ſpar.—Sulphat of barytes or heavy ſpar, when formed into a ſulphuret or hepar, more eſpecially when that hepar is made to undergo one of the ligneous proceſſes, may be uſed for the decompoſition of ſulphat of ſoda, or ſulphat of pot-aſh, or their ſulphurets. Carbonat of barytes is, in part, to be procured by making it undergo, firſt the hepar, then the ligneous proceſs. I therefore claim this diſcovery, and the excluſive application of the carbonat of barytes or aërated ponderous earth, thus obtained, to the decompoſition of all ſulphat of ſoda and ſulphat of pot-aſh, whether made in my proceſſes, or procured in any other manner. And I likewiſe claim the excluſive application of carbonat of barytes, however procured, whether native or artificial, for the purpoſe of decompoſing and disengaging the alkalies from sulphat of soda or Glauber's salt, and sulphat of pot-ash or vitriolated tartar, made in any of my processes. I farther claim the exclusive application of hepar or sulphuret of barytes, to the decomposition of sulphat of soda, or sulphat of pot-ash, made in my processes.

Besides the claims now and formerly stated, I claim the exclusive application of all the methods now known of decomposing sulphat of soda, or of pot-ash, or hepars of soda and pot-ash, when those sulphats and hepars or sulphurets are formed of the materials, and in the processes, described in this specification. I apply the sulphat of soda or Glauber's salt, sulphat of pot-ash or vitriolated tartar, and their respective hepars or sulphurets, formed in the processes described in this specification, for the decomposition or solution of peat, fossil coal, and undecomposed inert vegetable matter, frequently greatly superabundant in soils, or for acting on ground on any other principle. I claim the exclusive application of the above-mentioned saline

substances,

ſubſtances, prepared by me, for the purpoſes of improving ground. They are all manufactured by me, under the patents, and may be applied to purpoſes which I have diſcovered; as is more fully explained in letters patent, obtained by me, for the preparation of ſundry manures, and other articles.

Laſtly. The laſt proceſs requiſite to be deſcribed in this ſpecification, is the diſengagement or ſeparation of mineral alkali from muriat of ſoda or ſea-ſalt, by the means of pearl-aſh pot-aſh or vegetable alkali.—Take ſea-ſalt, or a ſaturated ſolution of ſea-ſalt, or of ſalts or ſubſtances containing ſea-ſalt or muriat of ſoda, ſuch as, kelp, ſandiver, ſoapers waſte-leys, or ſoapers ſalts; add to any of theſe, as much vegetable alkali or pearl-aſh or pot-aſh as will diſengage the mineral alkali, and combine with, and neutralize, the muriatic acid of the muriat of ſoda. Then boil down the ſolution, and ſeparate the ſalts by priority of cryſtalization. The diſengagement of mineral alkali from muriat of ſoda, by vegetable alkali, is a fact well known to every chemist; therefore a patent is not claimed for this process in general, but only for the application of such vegetable alkali, to this process, as is manufactured and prepared from muriat of pot-ash, and sulphat of pot-ash, under the patent.

Remarks on some of the above processes.—In describing the process for disengaging mineral alkali, from sulphat of soda or Glauber's salt, by vegetable alkali, I limited my claims, on that process, to the exclusive manufacture of alkali, from sulphat of soda or Glauber's salt made in my processes. But, in all repeating processes, in which the same sulphat of pot-ash or vitriolated tartar is recovered, and manufactured into a hepar or sulphuret, or into an alkaline salt, as has been described, I lay claim to the exclusive use of such hepar, or such vegetable alkaline salt, for the purpose of decomposing sulphat of soda or Glauber's salt, however prepared or procured, and for disengaging from it the alkali, or for any other use in the arts, to which the said sulphat of pot-ash or hepar, or vegetable alkaline salt, prepared by me, is capable of being applied. This

method

method of recovering the vegetable alkali, or vegetable alkaline ſulphuret or hepar, after each proceſs, muſt be conſidered as an important diſcovery; as the vegetable alkali firſt uſed is thereby rendered capable of producing the ſame effect, an indefinite number of times. As in the ligneous proceſſes, the alkalies, or great part of the alkalies, enter into a ſtate of combination with the vegetable acid, this acid may be in part recovered by diſtillation, and a proper application of heat; and, by a farther degree of heat, it may be converted into the carbonic acid; both of which acids may be applied for ſeparating ſulphur from ſulphat of pot-aſh, or of ſoda. In witneſs whereof, &c.

XII.

XII. *Specification of the Patent granted to Mr.* JOHN FALCONER ATLEE, *of Wandſworth, in the County of Surrey, Diſtiller; for his Invention of an improved Method of condenſing and cooling Spirits, in the Proceſs of Diſtillation, by Means of Machinery not before uſed for that Purpoſe.*

WITH A PLATE.

Dated Feb. 7, 1797.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid John Falconer Atlee do hereby declare, that my ſaid invention is deſcribed in the following deſcription, and plan hereunto annexed. In witneſs whereof, &c.

The Figure A A A A (Plate V.) repreſents a worm-tub.

B B B repreſents a worm, like one of thoſe worms that are uſed at preſent.

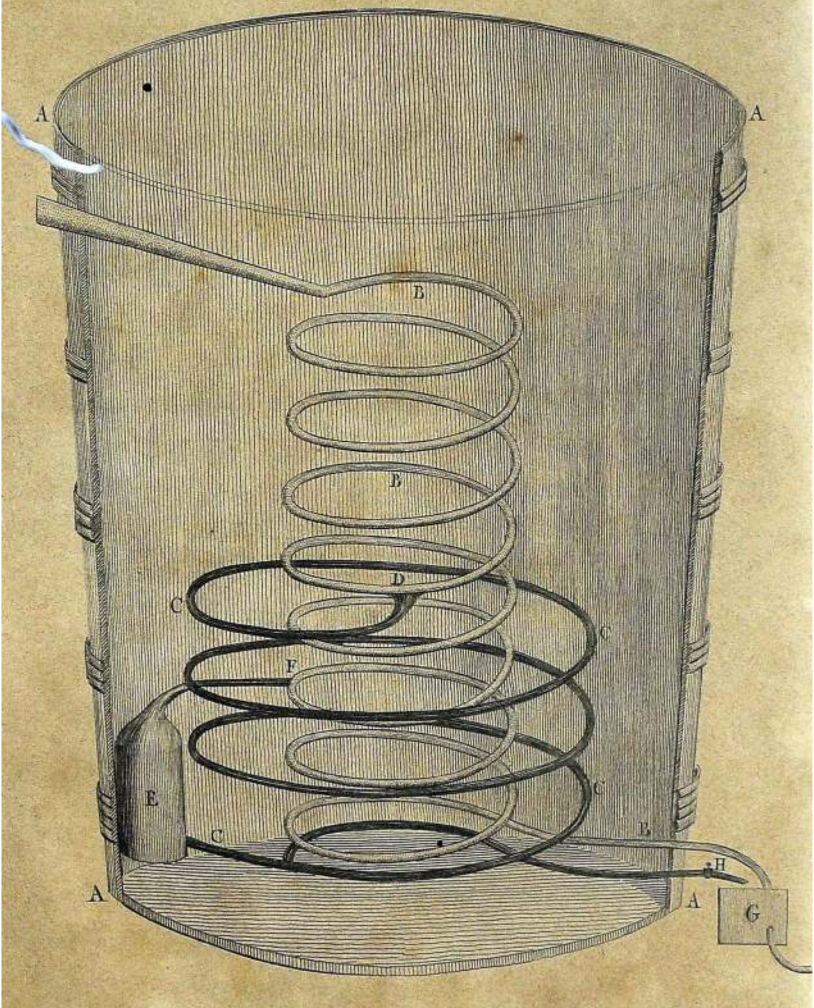
CCCC

CCCC represents my invention of a worm: the same is connected and attached to the worm BBB, at the under-part of a coil of the worm, with a tundish or funnel-like communication, as at D. The worm CCCC, commencing from the point D, goes in a circular or other form or course to the refrigerator E; (the application of this refrigerator being my invention;) which is fixed at the bottom, or nearly so, of the worm-tub, and may be made of pewter, or any other metal fit for the purpose. The size and figure of the refrigerator may be made to vary, as the nature of the business may require, or convenience of situation may admit. From the refrigerator, the worm CCCC is continued ascending, by a circular or other form or manner, till it is again connected and joined to the worm BBB, as at F: the same being introduced into the side or upper part of the coil. The coil to which this junction is formed, must be lower than that coil whence the worm CCCC first branched off, as at D. A branch of the worm CCCC is carried through the side of the worm-tub, to the faveall G. At the end of this branch is a stop-cock H, which, when opened,

discharges

diſcharges and clears the worm CCCC, and the refrigerator E, of their contents.

The purpoſe and intention of this my invention are, to condenſe, to cool, and refrigerate ſteam, vapour, or any evaporation, either from waſh, low wines, ſpirits, and every other kind of liquor undergoing the proceſs of diſtillation, in a more efficacious, complete, and cheap method than any now uſed and practiſed. The preſent conſtruction of worms not admitting the ſpirits or low wines to remain a ſufficient length of time, or in proportionate quantity, to the expoſure of the cooling medium; nor are the parts of the preſent worms ſo arranged that they can be acted upon ſo immediately, and to ſuch an effect, as my invention profeſſes to do.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G

XIII. *Specification of the Patent granted to Mr.* William Redman, *of Salisbury, in the County of Wilts, Tin-Plate Worker; for his Invention called the* Salisbury Portable Kitchen, *for roasting, boiling, or baking any Kind of Provision, in any Room, or in the open Air, without the Assistance of a common Fire-Place, and which may be moved from Place to Place at Pleasure.*

Dated June 9, 1780.—Term expired.

TO all to whom these presents shall come, &c. Now KNOW YE that, in pursuance of the said letters patent, and in conformity to the proviso therein contained, the said William Redman hath described and ascertained, and by these presents doth fully and particularly describe and ascertain, the nature of his said invention, and in what manner the same is to be made; that is to say, the body or furnace is made oval, or round, of wrought or cast iron, tin, or copper; within it is placed a grate for the fire, and in the upper part a pot for boiling, with water and steam, or a plate for baking. Underneath the fire is a vacuity, open in the front, serving as a receptacle for the ashes, as well as admitting a current of air to pass through the fire, thereby carrying off any smoke or dust through a tube or funnel affixed. A front is fixed to the furnace before the fire, which joins close to a reflector, purposely to confine the heat, so as to roast and boil, or do either separately, with a very small quantity of fire. The reflector is made of tin, brass, or copper; a spit goes through it, and at the bottom a dripping-pan is so fixed as to draw off the gravy, that the meat may be easily basted, at a door which is made on the top, or any other convenient part. A gridiron may be fixed occasionally in the place of the spit, for broiling, with an additional reflector placed obliquely underneath it, or occasionally an iron plate may be placed in the reflector, for the purpose of baking. They may also be made with two reflectors, to fix to the same body, for roasting two or more joints at once; which is a full and true description of the said invention. In witness whereof, &c.

XIV. *Specification of the Patent granted to Mr.* Mark Noble, *of Lambeth, in the County of Surrey; for his new Invention or Improvement of a Pump or Engine for raiſing Water.*

WITH A PLATE.

Dated Jan. 29, 1784.

TO all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the ſaid proviſo, he the ſaid Mark Noble doth hereby deſcribe and aſcertain the nature of his ſaid invention, and in what manner the ſame is to be performed, by a plan or drawing hereunto annexed, that is to ſay;

A, A, (Plate VI.) two cylinders or chambers.

B, B, two fixed or ſtop boxes.

C, C, C, C, four working-boxes, two in each chamber, wherein the whole of the improvement conſiſts; two boxes continually working alternately in the ſame chamber.

 D,D,D,D,

D, D, D, D, little ring-bolts, one to one valve of each box, to be opened by a ſmall hook, to enable the boxes to be drawn with more eaſe.

E, E, two round ſpears, to which the middle boxes are fixed, which traverſe through a hole in the foot of the ſpears F, F, which foot croſſes the middle of the upper boxes.

F, F, the two ſpears to the two upper boxes.

G, G, G, G, four centre-bars, with a hole in the middle, for the ſpears of the boxes to paſs through, to keep the boxes perpendicular.

H, H, H, H, four crank-irons, faſtened to each of the ſpears E, E, and F, F, by four little bolts and keys, as I, I, I, I.

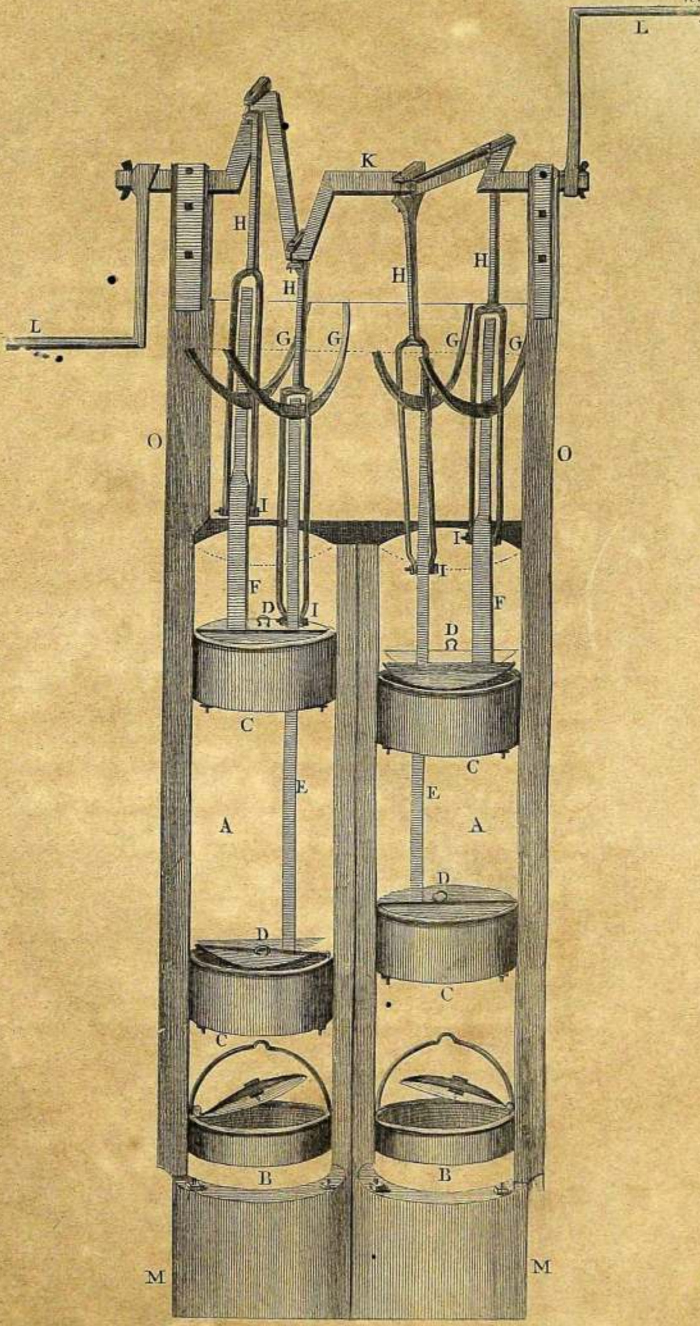
K, the crank, with four throws, two oppoſite the other two, alſo oppoſite each other, but croſſing the former two in direct angles.

L, L, the handles or winches.

M, M, the trees.

O, O, the bearings.

Motion may be effected with any other power. In witneſs whereof, &c.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XV. *Obſervations on a Pendulum deſcribed in the Third Volume (Page 15) of this Work. In a Letter to the Editors.*

WITH A PLATE.

OBSERVING, in the third volume of the Repertory of Arts, &c. an account of a pendulum on a new conſtruction, by the Rev. J. Pine, and which is ſaid to completely compenſate the expanſion or contraction of the rod; as the plauſibility of the contrivance may lead uninformed perſons into uſeleſs expence, and loſs of time, I beg you will allow me to demonſtrate its fallacy.

Let *a c* (Plate VII. Fig. 1.) repreſent the compenſation-rod, *a b* the connecting bar, and *b d* the pendulum-rod. Mr. Pine's principle is, that as the rod *a c* is fixed at *g*, its expanſion or contraction will affect the point *a* only, and conſequently

quently raise or lower the connecting bar *a b*, as well as the pendulum-rod *b d*; but, as the pendulum-rod itself expands or contracts equally with the rod *a c*, it is clear that the bob *d* will always remain at the same point, which is perfectly just. Now, to maintain the pendulum constantly at the same length, he interposes a fixed cock, in the direction of the dotted line *e f*, through which the spring of the pendulum passes, so that the expansion or contraction takes place above this cock. This would evidently have the desired effect, could there be any method of establishing two invariable points *e* and *g*; but, could this be done, it is clear that the compensation would be useless, for we should only need to apply the same substance which connects the points *e* and *g* to the construction of the pendulum-rod itself.

I do not wish to be thought to impeach Mr. Pine's veracity, when he asserts the perfect equality of the rate of going of his clock, but it is evident he must have been inaccurate in his observations. As the substance he uses to connect the points *e*

and

and g is mahogany, probably ſtraight-grained and well-ſeaſoned, the alteration in length is certainly not very conſiderable, and may in ſome meaſure account for his prevention; but it is evident that a pendulum-rod of the very ſame mahogany would have anſwered every effect produced by his machinery.

A compenſation equally fallacious with the above, as it is entirely founded on the ſame principle, is inſerted in the ſame volume of the Repertory, being an extract from the Tranſactions of the Royal Iriſh Academy, and may, with ſtrict propriety, be termed an Iriſh compenſation.

I am, &c.

A. B.

XVI. *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 Graffham Farm, near Guildford.*

WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Fifty Guineas was voted to Mr. EAGER for the Communication of his 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

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 ſtop 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, is dead 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.

EXPLANATION of the Figures of Mr. EAGER's INSTRUMENTS for relieving hoven CATTLE and SHEEP.

(See Plate VIII.)

A A. Fig. 2. 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.

BB. Fig. 3. 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 injure. 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 ſink, 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

Fig. 2

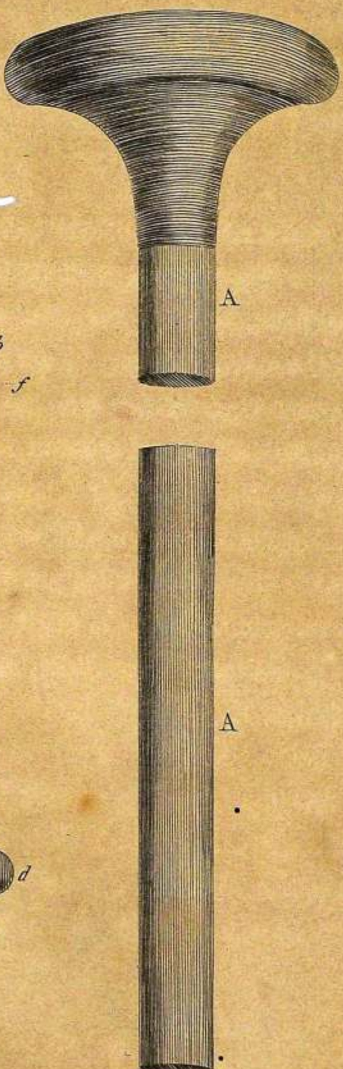

Fig. 3.

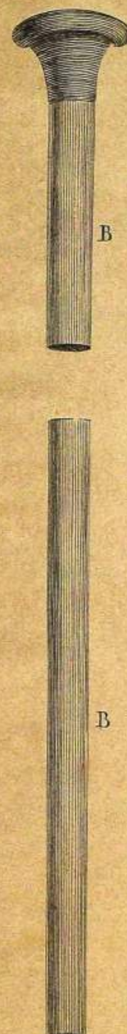

Fig. 1.

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 is alſo a certificate ſigned by Mr. Charles Ellis, of Noar Farm, in the pariſh of Bramley, and three other perſons, ſtating, that Mr. Ellis had an ox violently ſtrung or hoven, ſo that he muſt have died in a ſhort time; but that Mr. Eager applied his inſtrument, which effectually cured him in two minutes. The animal returned to his food, and, in leſs than half an hour, ate as heartily as he had done before.

In a ſubſequent letter, Mr. Eager mentions another inſtrument, which he ſays he has found very uſeful for removing turnips or potatoes, when a bullock, fed with either of thoſe roots, gets them into his throat. He adds, that he has thereby ſaved two of his own in the laſt winter, but does not deſcribe the inſtrument, nor is there any figure of it.

XVII. *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 as 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

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 above-mentioned, and therefore 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 be ever ſo well attended to in reſpect 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 or more volatile

parts

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 appearance to braſs and copper, as if you had breathed on them; for, if you rub your finger lightly over the veſſels, you will have both the taſte and ſmell of the metal.

It alſo happens ſometimes, that after the veſſels are waſhed, they are not carefully rinced, nor perfectly dried by the fire; ſo that ſome of the milk, &c. is left on the ſurface of them, 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 profits accrue to the dairy-man; therefore he keeps it in the veſſels as long as he can, and it is frequently kept till it is very ſour, and capable of acting

upon

upon them; if they are of lead, a calx or fugar of lead is produced; if of brafs or copper, verdegris.

It is true, the quantity cannot be very great; this however will depend upon the degree of fournefs, and length of time which the milk ftands; but, independent of the acid, the animal oil in the cream will diffolve brafs and copper.

That an acid floats in the atmofphere of a dairy, may be proved, by placing therein a bafon of fyrup 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 obfervations which I have made to fatisfy myfelf of the fact, and which it would be trifling to relate here, may not the reputation of the wholefomenefs or unwholefomenefs of butter depend upon, or be owing to, fome of the above caufes? And may not many a cafual, nay obftinate complaint, which phyficians have in vain laboured to account for, have originated from this fource? Butter is found very frequently to occafion much diforder to very weakly, delicate, and

 irritable

irritable ſtomachs, yet theſe ſtomachs will bear olive-oil: this cannot eaſily be accounted for, but from metallic 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 ſome have aſſerted; though, when it does 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 abler 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

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

George Baker on the effects of lead, and the melancholy cafe of a young lady, who died from eating pickled famphire very lightly impregnated with copper, and which others ate without being difeafed, as related by Dr. Percival, will receive my opinions with lefs objection. If I have erred, I have done it in honourable company.

I fhall be very glad if the foregoing obfervations have fufficient influence on the dairy-men to induce them to change their utenfils. Very commodious veffels may be made of caft-iron, equally well fitted for the purpofes of the dairy, which will not be expenfive, and will be more innocent and cleanly.

XVIII. *Concluſion of Mr.* HENRY'*s Experiments and Obſervations on Ferments and Fermentation, &c.*

(From Page 58.)

I FLATTER myſelf that theſe experiments may be of extenſive utility, and contribute to the accommodation, the pleaſure, and the health, of men in various ſituations, who have hitherto, in a great degree, been precluded from the uſe of fermented liquors; and be the means of furniſhing important articles of diet and of medicine. Not only at ſea, but in many ſituations in the country, and at particular ſeaſons, yeaſt is not to be procured. By the means I have ſuggeſted, in theſe experiments, freſh bread and newly-fermented malt, or ſaccharine liquors, may, at any time, be procured. Of how much importance this may be, and how great an improvement to the malt-decoctions recommended by the late Dr. Macbride,

Macbride, I ſhall not at preſent ſtay to expatiate on; but, in domeſtic œconomy, its uſes are very obvious, and perhaps none more ſo than the ready mode which the preceding experiments teach, of reviving fermentation when too languid. The ſinking of a bottle, ſuch as I have deſcribed in my Eſſay on the preſervation of water at ſea, &c. (printed at London, 1781,) with an efferveſcing mixture of chalk and vitriolic acid, appearing to be fully adequate to the purpoſe; and it would, I believe, be ſufficient for impregnating the wort, without any other contrivance. (See Plate VIII.) This diſcovery therefore may, perhaps, be of no ſmall utility in public breweries, and I would recommend it to the attention of perſons concerned in the brewing-trade.

Let us now proceed to ſtate the circumſtances neceſſary to, and the phænomena attending on, fermentation, as deſcribed by chemical writers; and then endeavour to form ſome theory which may account for them.

Sugar, the juices of ripe fruit, and malt, are all more or leſs diſpoſed to run into fermentation. But, before this can take place, it is neceſſary they ſhould be diluted with water, ſo as to bring them to a liquid ſtate. A due degree of heat is alſo requiſite, as the fermentation ſucceeds beſt when the temperature varies from 70 to 80 degrees.

When the fermentation takes place, a briſk inteſtine motion is obſervable in the liquor; it becomes turbid, ſome fæculæ ſubſide, while a frothy ſcum ariſes to the ſurface. A hiſſing noiſe is obſerved, and a quantity of gas is diſcharged, which has been proved to be fixed air. The liquor acquires a vinous ſmell and taſte; and, from being heavier, becomes ſpecifically lighter, than water. During the progreſs of the proceſs, the temperature of the liquor is higher than that of the ſurrounding atmoſphere, with which it is neceſſary that a communication be preſerved.

After ſome days, theſe appearances begin to decline. If the proceſs be rightly conducted, and ſtopped at a proper period, a liquor capable of yielding vinous or ardent ſpirit is the reſult. If the proceſs has been too ſlow, and the degree of heat inſufficient, the liquor will be flat and ſpiritleſs: if theſe have been too rapid and exceſ-

five,

five, it will paſs into the acetous fermentation, to which indeed it is continually tending; but, the more ardent ſpirit is generated, the leſs ſpeedy will be the change to the acetous ſtate.

During the progreſs of the acetous fermentation, which will even proceed in cloſely-ſtopped veſſels, no ſeparation of air is obſervable, nor any ſtriking phænomena. The liquor gradually loſes its vinous taſte, and becomes ſour, and a groſs ſediment falls to the bottom; while a quantity of viſcid matter ſtill remains, enveloping the acid, which may be ſeparated from much of the impurity, by diſtillation.

The progreſs of theſe proceſſes is accelerated by the addition of ferments, to the action of which it has been ſuppoſed neceſſary, that they ſhould have paſſed through the ſtate of fermentation into which they are intended to bring the liquor to which they are added; and, that it was not poſſible to bring the farinaceous infuſions into the vinous fermentation, without the aid of matter already in that ſtate. This, the preceding experiments have proved to be an ill-founded notion; as it appears that fixed air, obtained from calcareous

calcareous earth by means of acids, produces the effect as perfectly as when the ferment has been taken from a fermenting liquor.

In fermentation, it is ſaid, new arrangements take place in the particles of the liquor, and the properties of the ſubſtance become different from what it before poſſeſſed; but what theſe arrangements are, or how theſe properties are changed, we are not told. Dr. Black, I am informed, declares he is unacquainted with any ſatisfactory theory.

But perhaps facts, eſpecially ſome late chemical diſcoveries, may throw light on the matter, and enable us to advance ſome conjectures that may tend, at leaſt, to lay the foundation of a theory.

1. Sugar is an eſſential ſalt, containing much oily viſcid matter. During its combuſtion it repeatedly explodes: a proof that it contains not only much inflammable matter, but alſo a quantity of air. Malt is ſaccharine, united to much viſcid mucilaginous, matter.

2. If nitrous acid be added to ſugar, the inflammable principle of the latter is ſeized by the

acid; the whole, or at leaſt one of the conſtituent parts, of which, is thereby converted into nitrous gas, and flies off in that form. By repeated affuſions of this acid, more gas is formed, and the remainder of the ſugar is changed into cryſtals, having the properties of an acid *ſui generis*, and which has been denominated, by Bergman, ſaccharine acid *.

3. Saccharine acid is reſolvable by heat into ſome phlegm, a large quantity of inflammable and fixed air, both of which contain latent heat, and a browniſh reſiduum, amounting to $\frac{1}{10}$ of the weight of the acid. Fixed air is ſuppoſed to conſiſt of pure air united to phlogiſton; and inflammable air, to be almoſt pure phlogiſton.

4. Water is found to be formed by the union of pure air and inflammable gas, deprived of their latent heat; for, if theſe two elaſtic fluids be exploded together, in a cloſe veſſel, over mercury, the whole is converted into water, of the ſame weight as that of the air and gas jointly.

* Bergman. *Opuſcula Chemica. Vol. I. Art. de Acido Sacchari.*

In the proceſs, much heat is evolved. Again, if water, in the form of ſteam, be forced to paſs through a tube containing iron-ſhavings, ſtrongly heated, the water, according to Meſſrs. Watt and Lavoiſier, is decompoſed; the phlogiſton paſſes off, united with heat, in the form of inflammable gas, while the *humor*, or dephlogiſticated water, unites to the calx of the metal; from which it may be again obtained, in the form of pure air, or of aërial acid, according to the degree in which the calx has been dephlogiſticated. It has been already obſerved, that ſaccharine matter cannot be brought to ferment without water.

5. A vinous liquor, on diſtillation, yields an ardent ſpirit.

6. Spirit of wine has had the whole of its inflammable part diſſipated by combuſtion; after which, M. Lavoiſier found the watery part increaſed in weight, from ſixteen to eighteen ounces, by the abſorption of the air decompoſed by the combuſtion.

7. The reſiduum after the diſtillation of ardent ſpirit, from fermented liquors, is *acid*.

8. M.

8. M. Lavoifier has fuppofed pure air to be the acidifying principle of all the acids; and that their difference, from each other, confifts in the bafis united to this pure air.

As our experiments were made with an infufion of malt, and with fixed air, employed as a ferment, let us endeavour to account for the feveral phænomena and refults of fermentation, as appearing in thefe experiments.

The wort being impregnated with fixed air, and placed in fuch a fituation as to bring it to the degree of heat at which wort is commonly mixed with yeaft, the gas for fome time remains in a latent or quiefcent ftate; but, from its tendency to recover its elaftic form, aided by heat, it prefently begins to burft from the bonds in which it was confined. By this effort, the mucilaginous parts of the infufion are attenuated; the faccharine matter is developed; and, the fame caufe continuing to act, the conftituent parts of that matter are feparated, and the particles of the component principles, being by this means placed beyond the fphere of their mutual attraction, begin to repel each other. A large quantity of

 phlogifton

phlogiſton is diſcharged, together with ſome pure air. The greateſt part of the inflammable principle enters into a new combination, joining the phlogiſtic part of the water, and, in proportion, ſeparating from it the pure air; while another, but much ſmaller, portion, uniting in its naſcent ſtate with this pure air, forms fixed air; which, in its attempt to eſcape, carries up with it much of its viſcid confinement. In the converſion of the pure into fixed air, a conſiderable portion of heat is rendered ſenſible; and this heat contributes to the farther decompoſition of the ſaccharine ſubſtance. The viſcid matter, collecting on the ſurface, prevents the eſcape of too much of the gas, and promotes its reabſorption, that thereby the briſk and agreeable taſte of the liquor may be formed; while the inflammable principle, accumulating and becoming condenſed in it, forms the ardent ſpirit.

Thus, a decompoſition of the water takes place, ſomewhat ſimilar to what Mr. Watt has ſuppoſed in the production of pure air from nitre. The nitrous acid, ſeizing on the phlogiſton of the water, dephlogiſticates the *humor*, or other part

of

of the water, which, combining with the matter of heat, paſſes off in the form of pure air.

The veſſel being ſtopped, ſome of the ſaccharine matter being not decompoſed, the liquor will continue to have a ſweetiſh taſte; but, the fermentation ſtill going on in a more gradual manner, the liquor will become leſs ſweet, and proportionably more impregnated with ardent ſpirit; and the fæculæ ſubſiding in the form of lees, it will be now fully fermented, mellow, and pellucid *.

But, if the ſaccharine matter be too much diluted, or the veſſel be placed in a warm ſituation, the liquor will then paſs from the vinous to the acetous fermentation.

In the formation of the ſaccharine acid, by means of nitrous acid, the laſt is ſuppoſed, by carrying off the phlogiſton of the ſugar, to develope

* In the fermentation of wine, a ſubſtance is depoſited at the ſides and bottom of the caſk, called tartar; which is lately diſcovered to conſiſt of pure vegetable alkali, united to a ſuperabundant quantity of a peculiar acid. As this is not produced by malt-liquors, it has not been noticed.

the ſaccharine acid: or, according to M. Lavoiſier's hypotheſis, one of the conſtituent parts of the nitrous acid performs this office, while the other, or pure air, uniting to the peculiar baſis contained in the ſugar, forms ſaccharine acid.

So, in the acetous fermentation, if it happen that the phlogiſton is not in ſufficient quantity, or the force with which it is combined in the liquor be weakened by a long application of heat, or other cauſes, it will begin to ſeparate from the other conſtituent parts of the liquor. The ardent ſpirit, thus decompoſed, diſappears gradually; the *humor*, or dephlogiſticated water, or, in other words, the baſis of pure air, predominates; and this, combining with the ſaccharine baſis, but ſtill retaining ſome portion of phlogiſton, forms the acetous acid.

Thus, the acetous fermentation acts in a manner, in ſome reſpects, analogous to the action of nitrous acid on ſugar. In the latter caſe, the phlogiſton is ſeparated more rapidly; and the acid reſulting from the proceſs is that called ſaccharine acid. In the former, the changes are more ſlowly produced; the phlogiſton flies off more gradually; and, from a different modification, in conſequence of theſe varieties, the product is not ſaccharine acid, but vinegar. Perhaps it may ſerve to give ſome appearance of probability to the above theory, to recollect that the reſiduum of fermented liquors, after the ſeparation of the ardent ſpirit, which appears to be water ſuperſaturated with phlogiſton, is *acid.*

I have avoided carrying theſe reflections to the phænomena which appear in the putrid fermentation, as not ſo immediately connected with ſaccharine ſubſtances, and from a conviction that I have already engroſſed too much of the Society's time. If I have contributed any thing to their entertainment, or that may tend to enlarge the bounds of ſcience, I ſhall eſteem myſelf happy; and more ſo, if what has been advanced may prove uſeful and advantageous to my fellow-creatures. Senſible that one ſuch fact is of more real worth than the moſt ingenious and well-wrought hypotheſis.

APPA-

APPARATUS for impregnating WORT and other fermentable LIQUORS with fixed AIR.

(See Plate VIII.)

Fig. 1. A A. The caſk, or other veſſel, in which the wort is to be impregnated.

C C. The ſtrings by which the air-veſſel B is to be let down.

D D. The pegs to which the ſtrings are to be faſtened.

Fig. 2. E. The air-veſſel, ſimilar to the bottom part of Dr. Nooth's glaſs machine, to be made of glaſs or earthen ware.

F. A glaſs ſtopper, ground in to fit the mouth of the veſſel, having a number of capillary tubes running from bottom to top, in a diverging direction, ſo as to ſpread the air in its paſſage through the liquor.

Fig. 3. The ſtopper viewed ſeparately, to ſhew its capillary tubes.

XIX.

Fig. 2.

Fig. 1.

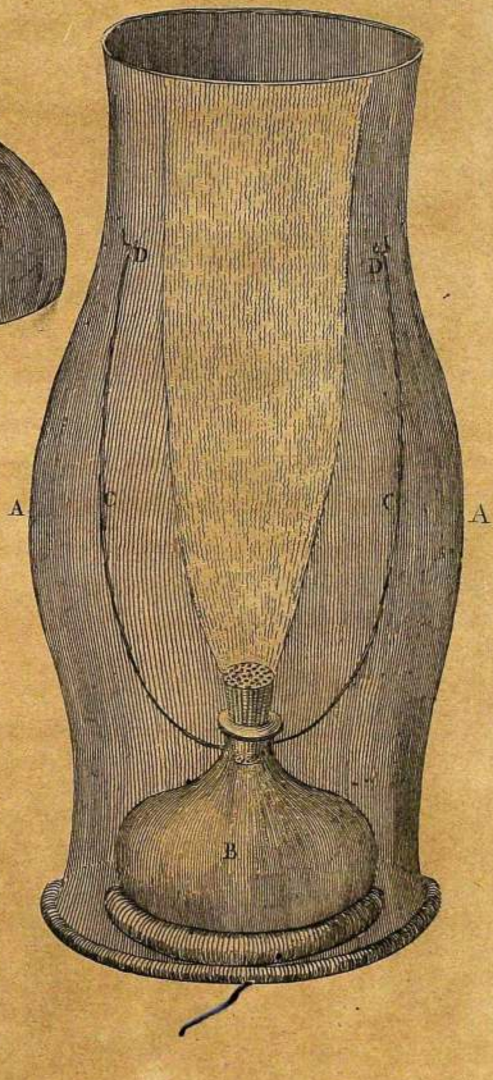

Fig. 3.

XIX. *Account of a Method of increaſing the Effects of Gunpowder; ſhewing alſo the Neceſſity of certain Precautions in loading Fire-Arms.*

From the *Journal des Sciences, des Lettres, 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 wadding is not rammed down cloſe to the powder *.

* 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 the ball.

Without

Without undertaking to ſhew how far theſe two circumſtances are analogous 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 gunpowder, it breaks into a great number of pieces; whereas, if it is quite filled, it merely ſeparates into two or three pieces, which are thrown to a very great diſtance.

Secondly, if the 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.

XX. *On the Influence of Vital Air in colouring Vegetable Substances, and on a new Preparation of solid Colours for painting; by M.* de Fourcroy.

FROM THE *ANNALES DE CHIMIE.*

THE discoveries of modern chemists have thrown so much light on the analysis of vegetables, as to have shewn that it was necessary to undertake a fresh examination of them, in every point of view, and to adopt new ideas, not only with respect to their composition, but also with respect to the nature of their constituent principles. These discoveries have demonstrated, that the primitive and formative bases of these organized beings are much more simple than they were supposed to be, and that the difference of their *immediate principles*, however remarkable it may be, or however varied, depends almost entirely on a diversity in the proportion of their conſtituent principles. They have alſo ſhewn us how, by means of a ſmall number of different elements, (that is to ſay, water, atmoſpheric air, caloric, the contact of the ſolar rays, and ſome gaſes diſengaged from the ſurface of the earth,) vegetable bodies grow, and form, by ſucceſſive combinations, all the ſubſtances of which they are compoſed. Thus, extracts, mucilages, ſaccharine ſubſtances, acids, oils, reſins, *gluten*, and all other ſubſtances which can be extracted from vegetables, by ſimple proceſſes, or ſuch as do not change their nature, and which ſubſtances have, on that account, been called the *immediate principles* of plants, are chemical compoſitions, formed, almoſt all of them, of the ſame primitive principles, and differ from each other only in the proportion of thoſe principles, and ſometimes by their having more or leſs numerous combinations of them. They are always compounds of hydrogen, carbon, and oxygen, to which azote, in ſome of them at leaſt, is united.

Many modern chemiſts have had doubts reſpecting the preſence of oxygen in theſe productions of nature; but the formation of acid, which ſo often takes place in vegetables, the number of different acids, and the conſiderable quantity of acid found in ſome vegetables, ſeem to announce the preſence and permanence of this acidifying principle. It is indeed true, that vital air, and particularly its baſe or oxygen, has ſo ſtriking an action upon many of the principles extracted from vegetables, and ſeems by its action to cauſe ſo great and ſo quick a change in them, that they appear not at all to have felt its influence during the work of vegetation. This remark particularly applies to the colouring matter of vegetables, reſpecting which the diſcoveries of Mr. Scheele and Mr. Bergman have furniſhed many new ideas.

The firſt mentioned of theſe chemiſts found, that moſt of theſe ſubſtances were deprived of their colour by the oxygenated muriatic acid. M. Berthollet has carried this diſcovery much farther; having proved, by many new and ingenious experiments,

Firſt, that every kind of colouring matter in vegetables, except yellow, had its colour deſtroyed by the oxygenated muriatic acid.

 Secondly,

Secondly, that the oxygenated muriatic acid, uſed to deprive theſe ſubſtances of their colour, was thereby brought into the ſtate of common muriatic acid.

Thirdly, that the ſubſtances which had loſt their colour had abſorbed the oxygen; and appeared to have ſuffered that loſs merely from a ſuperabundance of that principle.

Fourthly, that the oxygenated muriatic acid became, in conſequence of this property of taking away colour, a ſort of touch-ſtone, by which the ſtability of colours and dyes might be aſcertained.

Fifthly, that it might alſo be employed to bleach cloth made of linen, or cotton, or any other vegetable ſubſtance. This laſt way of uſing it has given riſe to a new art, which is practiſed in many of our provinces, and alſo in England, with a degree of ſucceſs which gives its inventor every poſſible claim to the gratitude of the public; as, in conſequence of his diſcovery, the old method of bleaching has given place to a new one, which may be practiſed with the advantages of a conſiderable diminution of time, ſpace, and labour.

It

It ſeemed, therefore, very probable, from the above-mentioned experiments, (in which oxygen appeared to have ſo much influence upon the principles of vegetables, and to produce ſo great a change in their properties,) that they did not contain any of that principle in their natural ſtate; and this opinion agreed perfectly well with that property which had been diſcovered in leaves, of exhaling vital air, and not retaining it in their compoſition. But it appeared to me to be going too far, to conſider vital air as the principle which always deprived vegetables of their colour. My attention had been long directed to ſeveral phænomena of nature and the arts, which had led me to ſuppoſe that vital air had great power upon the colouring matter of certain vegetable ſubſtances. I conſidered that cloths, &c. which are dyed with indigo, come from the vat of a green colour, and become blue only by the contact of the air; that the black dye of wool does not acquire its proper ſhade till it has been expoſed to the air; that various ſorts of *byſſus* and *mucor* are white when they grow *in vacuo*, and afterwards acquire colour in the air; that all vegetable infuſions

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and decoctions grow darker in colour by the contact of the air; that white-wine acquires colour by exposure to the air. In short, almost all the phænomena of dying, and even those of painting, kept me in suspence; and, although I could not doubt, after the experiments of M. Berthollet, that vital air, and the absorption of oxygen, were really the causes of that loss of colour which takes place, more or less rapidly, in all vegetable bodies, I still thought I observed, that before this loss of colour was completed, the shades of colour altered, some grew darker, others, after having absorbed a certain quantity of oxygen, appeared to be more fixed and stationary than at first.

TO BE CONCLUDED IN OUR NEXT.

XXI. *List of Patents for Inventions, &c.*

(Continued from Page 72.)

James Keeling, of Hanley, in the county of Stafford, Potter; for a ſubſtitute for white-lead, red-lead, or any other preparation of lead, in glazing and enamelling all manner of earthen and China wares, &c. Dated June 20, 1796.

William Whittington, of Sheffield, in the County of York, Wheelwright; for a portable baking-ſtove. Dated June 28, 1796.

William Bundy, of Pratt-place, Camden-town, in the county of Middleſex, Mathematical Inſtrument maker; for a machine for cutting and making combs. Dated June 28, 1796.

James Parker, of Northfleet, in the County of Kent, Gentleman; for a cement or terras, to be uſed in aquatic and other buildings, and ſtucco work. Dated June 28, 1796.

John Ching, of Launceſton, in the County of Cornwall, Chemiſt and Apothecary; for a medicine

dicine for deſtroying worms. Dated June 28, 1796.

Robert Miller, Callico-printer, at Milton Printfield, in the county of Dumbarton, Scotland; for a method of weaving all kinds of linen, cotton, woollen, and worſted cloths, by looms wrought by water, ſteam-engines, horſes, or any other power. Dated June 28, 1796.

William Batley, of Mancheſter, in the county palatine of Lancaſter, Engineer; for an improvement in the working of ſteam-engines. Dated June 28, 1796.

Daniel Davis, of the pariſh of St. Giles in the Fields, Middleſex, Surveyor; for an apparatus or machinery for cleanſing or ſweeping of chimneys, and extinguiſhing them when on fire, without ſending any perſon up the chimney. Dated July 4, 1796.

William Sabatier, of the Pariſh of St. Mary-le-bone, Middleſex, Gentleman; for a method of retaining cotton, hemp, flax, hops, hay, and other articles, in nearly the ſame compaſs in which they can be compreſſed. Dated July 4, 1796.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER XXXIX.

XXII. *Specification of the Patent granted to* SAMUEL BENTHAM, *Esquire, of Queen-square, Westminster; for his new Method of performing and facilitating the Business of divers Manufacturing and Œconomical Processes.*

Dated Jan. 24, 1795.

TO all to whom these presents shall come, &c. Now KNOW YE that, in compliance with the said proviso, I the said Samuel Bentham do hereby declare, that my said invention is described in manner following; that is to say, my invention consists in the idea of applying to the purposes

purpoſes of art and manufacture, in the large way, the practice that has been ſo long in uſe, of extracting and excluding the air in the way of philoſophical experiment. Air, neceſſary as it is to the ordinary functions of life, is either known to be, or ſuſpected of being, an obſtacle to art and manufacture, in a great variety of ways; whether with reference to bodies taken ſingly, or with reference to bodies conſidered in their application one to another; whether in virtue of its mechanical or chemical properties; and, in both caſes, whether in relation to proceſſes of a mechanical nature, or proceſſes of a chemical nature; whether in the capacity of a cauſe of deterioration, or in that of an obſtacle to amelioration and improvement; whether in relation to colour, or relation to ſubſtance; and, in the caſe of the application of body to body, whether the bodies in queſtion be in the ſtate of ſolidity, liquidity, or vapour, and, if in a ſolid ſtate, whether in maſſes, or in bodies. It may, in ſhort, be conſidered in the capacity of an obſtacle to preſervation, to ſeparation, (as in the way of diſtillation,) to the effectuation of contact, to intromiſſion, to impregnation,

nation, to tranſmiſſion and percolation, to mixture, or to the regulation of heat by the degree of preſſure. By way of exemplifying the uſes that may be made of this my invention, I ſhall proceed to give particular examples of the ſeveral proceſſes included in the above general denominations, ſhew in what way the preſence of the air may be an obſtacle to the accompliſhment of the end in view, and thence, in what ways advantage may be reaped from the extraction and excluſion of it.

I. *Preſervation, in point of ſubſtance.* There are few ſubſtances but what, when expoſed, as in the natural courſe of things almoſt every thing is, to the action of the atmoſpheric air, are ſubjected to certain alterations, which are underſtood to depend in great meaſure upon the preſence of that element, and which, ſo far as that is the caſe, may be prevented by its extraction and excluſion. Such, for example, are the putrefaction of animal and vegetable ſubſtances in general, the alteration which cauſes rancidity in oil, the ruſting of metals, &c. The practice of potting ſolid ſubſtances, in a ſubſtance which, like fat, is fluid in the degree of heat at which it is applied, ſeems to owe its preſerving quality, in good meaſure, to the excluſion of the air, by means of the fat inſinuating itſelf into all the vacuities. Where, by an air-pump, or otherwiſe, the air can be perfectly extracted from all ſuch vacuities, and the ſubject kept incloſed in an exhauſted chamber, 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 the air. An exhauſted chamber affords the means of preſerving them from all ſuch changes, for any length of time, care being taken to exclude the light, when the preſence of that element alſo is found to influence the reſult. Thus, tarniſhing, fading, and other ſuch injuries, may be prevented.

II. *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 heat neceſſary to enable any portion of that ſubſtance, whether it

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be in a ſolid or in a liquid ſtate, to aſſume an elaſtic ſtate, and ſo paſs into the receiver. Extract the air from the whole of the incloſed ſpace, (ſtill and receiver,) you ſubtract in proportion from the preſſure, and, by that means, from the quantity of heat neceſſary to the diſtillation. From the reduction that may, in this way, be made in the quantity of heat neceſſary to the diſtillation, a variety of advantages may be derived; 1ſt, the injuries which various ſubſtances are apt to ſuſtain from certain degrees of heat (the burnt flavor, for example, called empyreuma, in the diſtillation of oils and ſpirits) may be prevented from taking place; 2dly, leſs fuel may be conſumed, and a ſimilar ſaving may be made in applying to this purpoſe the ſuperabundant heat of fuel conſumed for other purpoſes, and, in ſome caſes, heat obtained from other ſources than that of combuſtion, as from the rays of the ſun, from fermentation, and from chemical mixtures.

III. *Effectuation of contact.* The preſence of air is an obſtruction to many proceſſes which conſiſt in the bringing about a uniformly cloſe, though ſimple, contact betwixt body and body; whether junction by cohesion or configuration be the result intended. Hence, the expulsion of the air may be made to give facility to the operation of coating the surfaces of metals, stones, glasses, pottery, wood, horn, ivory, bone, or other hard substances, melted or unmelted, of metal or other materials, as in plating, tinning, gilding, silvering, painting, varnishing, and the like. So likewise to the operations of casting, whether of metal, glasses, wax, plaster of Paris, *papier maché*, miscellaneous compositions, or any other materials, simple or compound, capable of being made fluid or ductile, by fusion, solution, or otherwise.

IV. *Intromission into tubular or other cavities*, may be regarded as a modification of the process of producing simple contact. Hence, the expulsion of the air may be made to give facility to such operations as those of filling thermometer and barometer tubes, filling beads for neckláces, hollow globes for mirrors, and to all other instances of intromission, whether either the smallness of the orifice, or the irregularity of the canal, oppose difficulties to the expulsion of the air, otherwise than by exhaustion.

V. *Im-*

V. *Impregnation.* By the expulſion of the air, this proceſs may be facilitated in every inſtance, whatever be the deſign of impregnation, the nature of the ſolid to be impregnated, or of the fluid with which it is to be impregnated. Thus, facility may be given to the proceſs of dying filamentous or other fibrous or porous ſubſtances, woven or unwoven, where, according to the preſent method, the preſence of the air operates as an impediment to the equal application of the mordant, or the dye, to all the ſurfaces, or all the pores; ſo likewiſe to the ſtaining of wood, ſtraw, bone, marble, &c. So, for example, to the impregnating of ſkins with an infuſion of tanners' bark, or other aſtringent or preſervative ingredients, for the purpoſe of preſerving them from putrefaction. So, for example, to the impregnating any ſubſtance with any other, whether in a liquid ſtate or vapour, with a view to preſerving the ſubſtance in queſtion, by the excluſion of atmoſpheric air. So, for example, to the impregnating of meat, fiſh, and other kinds of proviſion, with ſaline ſolutions, or other antiputreſcent applications; in which inſtance, the laborious, tedious,

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and imperfect uncleanly operation of rubbing may be ſaved. So, for example, to the impregnating of wood, or other fibrous and cellulated maſſes, with any ſubſtance, for any purpoſe; for inſtance, with ſaline ſolutions, to preſerve them from putrefaction and combuſtion; with oleaginous matters, to preſerve them from putrefaction; or with poiſonous matters, to preſerve them from corroſion by the ſea-worm or other inſects.

VI. *Tranſmiſſion and percolation.* By the ſame means, the proceſs of percolation or filtration may be rendered comparatively inſtantaneous; whether the object in view be the purification of the fluid tranſmitted, or the purification of the ſubſtance through which it is to be tranſmitted. Thus, water, for example, may be filtered through ſtone, natural or artificial, in maſſes or graduated powders, with a ſmall apparatus, in a ſhort time, in quantities ſufficient for large conſumption, as in a ſhip at ſea: thus alſo may water, or any other fluid, be driven through ſkins, for example, to prepare them to receive the tan, or through wood, to cleanſe it from its putrifiable juices. The expedition thus given is attended with farther ad-

vantages,

vantages, where the liquid, if not ſpeedily tranſmitted, may grow ſolid by abatement of heat, before the proceſs is completed, as in the caſe of portable ſoups, glues, and other gelatinous ſolutions that run into cryſtalization; or deſtroy or injure the filter, as in ſaline or other chemical ſolutions and mixtures.

VII. *Mixture*, viz. *of fluid maſſes, with powders, or heaps of ſmall-ſized bodies.* By the ſame means, may this proceſs be accelerated, and, in ſome inſtances, with the advantage of an increaſed degree of uniformity and compactneſs given to the mixed maſs. Thus, for example, the operation of mixing malt or grain with water, for the purpoſe of brewing, may be rendered comparatively inſtantaneous. So, for example, the mixture of water with lime or plaſter of Paris, and with ſand or tarras, or other powders, for making mortar, ſtucco, or other mortar-like cements; and the mixture of oils with different powders, for the making of glaziers putty, and paints.

VIII. *Regulation of heat.* By the proceſs of diſtillation, when carried on in vacuo, a means is afforded of producing a balneum in which any degree of heat may be maintained at pleafure, and for any length of time, from a degree fomewhat higher than the loweft at which the liquid can be made to diftil in vacuo, up to a degree any thing lefs than that which would caufe the vapour of the liquid (whatever it may be) to burft the ftill. For this purpofe, conceiving the contents of the ftill (whether the liquid, or the vapour, or both together,) to conftitute the balneum, nothing more is neceffary than to ftop the paffing of the vapour out of the ftill into the condenfer, by a valve, fo loaded by determinate weights, or other means, as to confine the vapour till it has acquired the intended degree of heat. By means of the extenfion thus given to the fcale of temperature, by the removal of air, a balneum of regulated heat will be produced; fuch as, befide the many chemical purpofes to which the exifting expedients for the regulation of heat have been applied, may be applicable with advantage to a variety of objects, as well of a mechanical as of a chemical kind, hitherto unattempted; for inftance, to the preferving motions in mechanifm, clock-work for example, from the irregularities

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to which, under the ordinary fluctuations of temperature, they ſtand expoſed.

IX. *Exſiccation.* Diſtillation may be applied likewiſe, and in ſome caſes with advantage, to the purpoſe of ſeparating fluids from ſolids, and thereby drying ſubſtances impregnated with water or other fluids; wood, for example, may perhaps be dried in this way in a ſmall degree of heat, and in a ſhort ſpace of time.

Several of theſe operations being ſuch for the performance of which the experimental apparatus that forms the common accompaniment to a philoſophical air-pump could not, by the mere enlargement of its dimenſions, be made to ſuffice, in the way of inſtruction, to ſhew how an apparatus of that ſort may be modified, for the purpoſe of adapting it to thoſe purpoſes, may be found of uſe.

As to the vacuum-chamber or receptacle, which is to be exhauſted of its air, and into which the ſubjects of the ſeveral proceſſes are reſpectively to be introduced; the bulk of it will of courſe be regulated by the ſcale on which it is propoſed to operate; like the veſſels of a large brewery, it may be of the ſize of a large room. In general, it ſhould be no larger than neceſſary, ſince the greater the ſpace left unoccupied by the ſubject in queſtion, the greater the quantity of air to be extracted. In the ſame view, there may be an advantage in adapting the form of the chamber, in ſome meaſure, to the form of the ſubject to be contained in it; of courſe, it would not be made in the ſame ſhape for a plank of timber, as for a barrel of proviſions; where flatneſs is not neceſſary, convexity will be preferable, on account of the advantage it gives in point of ſtrength. To enable the operator to ſee the proceſſes as they go on, the chamber may have glaſs-windows to it; but it is evident the glaſs muſt be thick, to enable it to reſiſt the preſſure of the atmoſphere, and muſt be fitted in the cloſeſt manner. Whatever apertures the particular proceſs in view may require to be made in it, the ſmaller they are made the better, the difficulty of cloſe fitting increaſing with the ſize: for the cloſing of theſe

apertures,

apertures, the expedients already in uſe may ſuffice.

For the accompliſhment of ſuch a variety of purpoſes, a variety of operations may reſpectively require to be performed; to ſome of which, a variety of machinery, and that more or leſs complicated, may be neceſſary; as, in all or moſt of theſe inſtances, the ſource of motion will be expoſed to the external atmoſphere, while the ſubject to be operated upon will be in the vacuum-chamber, the moſt commodious means of tranſmitting the motion from the one of theſe ſituations will, on this account, be an object of attention. The methods already in uſe in the way of experiment, ſuch as the collar of leathers, will in general be found ſufficient, however large the ſcale. A ſpindle, ſliding in ſuch a collar, gives rectilinear motion; a ſpindle, turning round on its axis, gives circular motion: from one or other of theſe two, or indeed from either of them, any other motions may be produced at pleaſure. Agitation, or preſſure, by ſtampers, rollers, or ſcrews, may ſerve for examples, amongſt a thou-

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ſand others. The friction that may appear eſſential to ſuch a communication, will naturally render it adviſable that the motion ſhould, at that ſtage of it, be ſlow; but, within the chamber, any degree of quickneſs may be obtained by the well-known contrivances of acceleration. Of the friction, ſo much as depends upon the preſſure of the external air may be got rid of, by ſubſtituting to the preſſure of a cloſe-fitting collar, like that of leathers, that of a column of mercury, of a height ſufficient to counterbalance the greateſt weight of a column of the atmoſphere, forming by this means an annular ſtopple, in which the axis of communication plays.

To facilitate the extrication of air from bodies in different ſtates, different operations may come to be requiſite. Where the ſubſtance of the body is of an adheſive nature, the particles of an inferior ſtratum of it may come to be forced together, by the preſſure of the ſuperior ſtrata, in ſuch manner as to form a kind of cells; within which ſmall maſſes of air may be pent up. In proportion as a maſs is thus diſ-

poſed

poſed to keep air entangled in it, to extricate the air, it becomes neceſſary to break up the whole maſs, in ſuch manner that the boundaries of the ſeveral cells may be broken down. 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 kind of colander, or ſieve, or filtering ſtone. If the maſs is too viſcous to be treated as above, ſo much ſo as to form, for example, a kind of paſte, butter for inſtance, it may be kneaded by a kind of ſtampers; or the whole maſs may be forced through ſlits or holes, like vermicelli or macaroni; or paſſed between rollers, ſpreading it out into ribbons of any degree of thinneſs. From the apparatus thus employed in the comminution, 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 purpoſe of preſſure. This preſſure may be performed, for example, by a kind of ſtamper or

 piſton,

piſton, ſo ordered as that the frequency of its deſcent ſhall correſpond with the rate at which the caſk is fed, as above. When the caſk has thus been filled, the cover, being conveyed by a movement from its ſtation 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 in 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 correſpondency 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, and thus

thus forced asunder 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 the 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 it, for example, a ſkin which 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; ſo far as this is the caſe, the 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 accurately 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. Suppoſe now, the body into or through which the fluid is intended to be forced be a log of wood, the varieties of which the conſtruction of the apparatus is ſuſceptible, may be comprized under two principal caſes; either the whole of the log, one end excepted, will be within the chamber, that end only remaining expoſed to the fluid without; or the whole of it, one end excepted, will be expoſed to the fluid without, that one end alone being introduced within the chamber. In the firſt caſe, the chamber muſt be large enough to contain the log. In the other caſe, there muſt indeed be, without the chamber, a veſſel large enough to contain the log, together with the fluid with which it is to be encompaſſed, but the chamber itſelf need only be of ſuch a ſize as to have one of its boundaries large enough for the log to fit into; what the log wants of filling up the aperture thus left in the chamber to receive it, muſt of courſe be filled up air-tight, at each operation, for inſtance, by wedges of wood with a cement.

It is ſcarce neceſſary to obſerve, that wherever air is intended to be, or happens to be, extricated, gradually or at ſucceſſive periods, there the operation of exhauſtion will, in proportion, require either to be continued or repeated. Where heat is to be tranſmitted from without the vacuum-chamber to a body within it, the intervention of an intermediate body or maſs, for the more ready conducting of the heat, ſuch as a metallic ſubſtance, or ſand, for inſtance, may ſometimes be of uſe. In witneſs whereof, &c.

XXIII.

XXIII. *Specification of the Patent granted to* Conradus Shiviers, *of Hoxton, in the County of Middlesex, Doctor in Divinity, and Mr.* Isaac Blydesteyn, *of Harp-lane, Tower-street, London, Merchant; for their Invention of a Machine on a self-moving Principle, or perpetual Motion.*

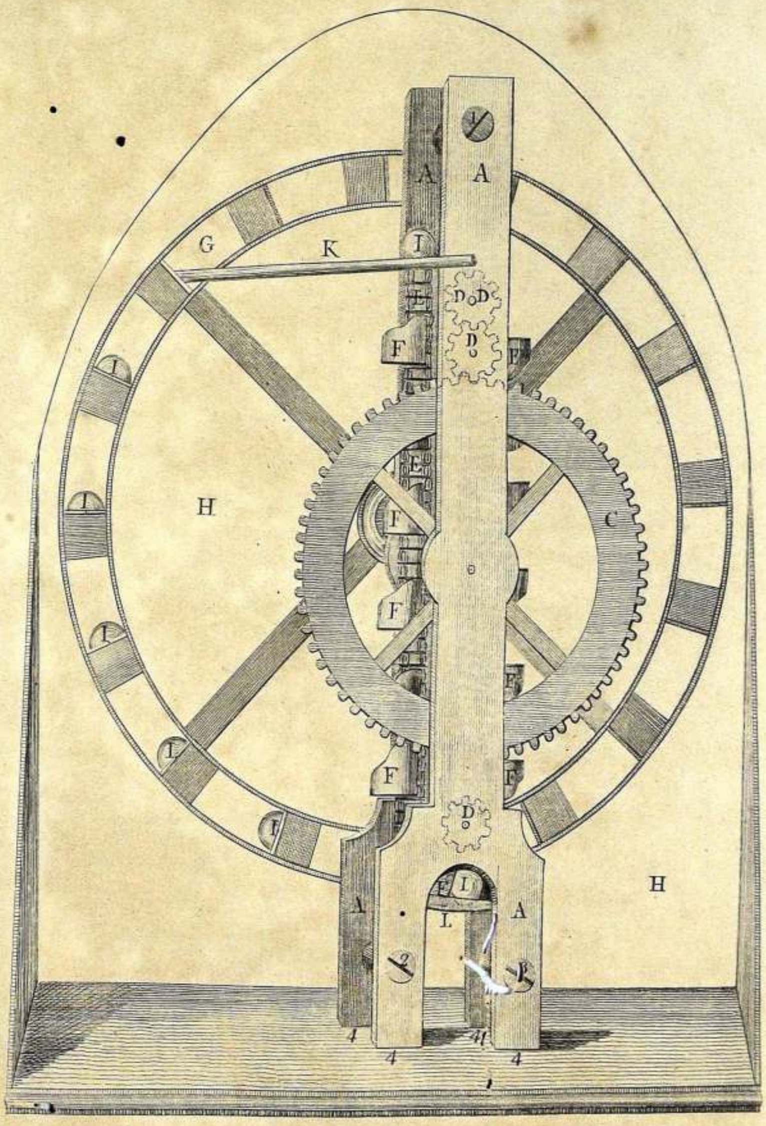
WITH A PLATE.

Dated April 21, 1790.

TO all to whom these presents shall come, &c. Now KNOW YE that, in obedience of the said letters patent, I the said Conradus Shiviers do hereby declare, that my said new-invented self-moving principle, or perpetual motion, is made and performed in manner following; that is to say, two stiles or uprights, marked in the plan hereunto annexed (see Plate IX.) A, A, &c. and fastened together by the screws 1, 2, 3, and to the base at 4, 4, 4, 4; between which stiles or uprights, run the wheel C, and the pinion D, and the two double pinions D D, &c. over which double pinions runs the double chain E E, &c. to which chain are fixed the buckets F, F, &c. The chain

chain is made with joints on each ſide, and bars running acroſs, equal in number to the cogs of the wheel C. Upon the ſame axle with the wheel C, on the farther ſide of the inner ſtile A, runs the wheel G, whoſe diameter is full double that of the wheel C; and the pivot of the wheel G runs in the back H H, as the other pivot of the ſame axle runs in the front ſtile A. The wheel G is divided, near the periphery, into receptacles, in number equal to the buckets on the chain; which receptacles are ſupplied with metal balls I, I, &c. from the buckets F, F, &c. by means of the gutter K; which balls, by their weight, forcing round the wheel G, and thereby lifting up the buckets F, F, &c. on one ſide, as they go down on the other ſide, diſcharge themſelves again at the gutter L, where they are taken up by the buckets F, F, &c. and diſcharged again at the gutter K; and are ſo repeated, in a conſtant ſucceſſion, as often as any receptacle is vacant in the wheel G, at the gutter K; for their reception. By that means the perpetual revolution is obtained; the upper ball being, at the ſame time, diſcharged from one bucket, when the lower ball is taken up by another. In witneſs whereof, &c.

XXIV.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XXIV. *Specification of the Patent granted to Mr.* FRANCIS UNDERWOOD, *of the Parish of St. Mary-le-bone, in the County of Middlesex, Plumber and Glasier; for his Invention of making and ornamenting all Sorts of Railing, Balusters or Balustrades, and Pannels, for Staircases, Balconies, Galleries, Altars, or any other Parts of Churches, Houses, and Buildings, and of making and ornamenting Chimney-Pieces.*

Dated April 20, 1782.—Term expired.

TO all to whom these presents shall come, &c. NOW KNOW YE that, in pursuance of the aforementioned proviso, I the said Francis Underwood do, by this present instrument in writing, under my hand and seal, intended to be inrolled in his Majesty's said Court of Chancery, declare and make known, that my said new invention consists of the several materials, and is made and performed in manner following; that is to say, by preparing

preparing a compoſition made of grain or block tin, regulus of antimony, and copper, or zink, mixed together, in ſuch proportions of the harder and ſofter metals as are requiſite, to bring the maſs or compoſition to the degree of hardneſs and ſtiffneſs which the nature or purpoſe of the work requires. Then, by making or providing moulds of iron, braſs, copper, or other hard metal, or ſtone, either plain or for ornaments, as ſcrolls, leaves, huſks, ſhells, flowers, or whatever ornaments the work or drawings after which I am to work may require; within which moulds I place plain rods, bars, or wires, of iron, braſs, copper, ſteel, or other ſtrong or hard metal, the length or ſize of the railing or baluſters, or of whatever form or ſize may be requiſite to ſtrengthen the work. I then caſt the compoſition firſt mentioned upon thoſe rods, bars, or wires, in the moulds; and I afterwards form the work, thus prepared, by bending, ſetting, and ſoldering it, to whatever form is wanted, either by way of frame, for the reception of baſſo-relievos of plaſter of Paris, paintings, drawings, or ornaments of any other kind; or to exhibit the ornaments of this compo-

ſition.

ſition. And, in the ſetting or fixing of baluſtrades upon wood or ſtone, with a pediment or baſe, I firſt ſet the baluſter plain, or without its plinth, into the wood or ſtone, and then, being provided with the proper mould for the plinth to go round the foot of the rail or baluſter, I caſt the compoſition round the baluſter when fixed. And, in order to the making and ornamenting of chimney-pieces, I make uſe of ſmall rods or wires, upon which to caſt the before-mentioned compoſition; which I bend or turn, and ſolder, ſo as to become a frame, of whatever figure or dimenſions I want, to receive plate or other glaſs, either plain or ſilvered; behind which, if plain, I place paintings, drawings, baſs-reliefs, or other ornaments; and which chimney-pieces I finiſh round with mouldings, ſtrengthened with bars or rods, as aforeſaid, if requiſite; and with pediments of the ſame metal, or compoſition, caſt in moulds, and caſed or covered behind with a plate of the ſame, or any other kind of metal, or other body. In witneſs whereof, &c.

XXV. *Specification of the Patent granted to Mr.* JAMES SADLER, *of the City of Oxford, Engineer; for his Invention of an Engine for lessening the Consumption of Steam and Fuel, in Steam or Fire Engines, and gaining a considerable Effect in Time and Force.*

WITH A PLATE.

Dated June 10, 1791.

TO all to whom these presents shall come, &c. NOW KNOW YE that, in compliance with the said proviso, I the said James Sadler do hereby declare, that my said invention of an engine for lessening the consumption of steam and fuel, in steam or fire engines, and gaining a considerable effect in time and force, is described in the plan and description thereof hereunto annexed. In witness whereof, &c.

Ex-

Explanation of the Figures.

(See Plate X.)

Fig. 1, the ſteam generated in the boiler A is conveyed, by the ſteam-pipe B, into the ſpindle of the rotative cylinder CCCC, which is left hollow for that purpoſe, and connected with the pipe B, by means of a ſtuffing-box at N, which admits of the rotative motion of the ſpindle, without loſs of ſteam; it there paſſes along the arms of the rotative cylinder, nearly to the ends thereof, where it meets with a jet of cold water, whereby it is condenſed. This jet is introduced by the ſmall pipes O, O, which communicate with the ſpindle M, which is hollow, and receives the water by a hole at L. The water falls through the bottom of the caſe D D, into the pipe E; and is, together with the air, admitted into the pipe G, through the cock F; and, deſcending when the valve H is open, into the pipe I I, which has a rotative motion round the end of the pipe G, it is thereby ejected through the valves K, K. The air which is left in the upper end of the pipe G is, by turning the cock F, ſuffered to eſcape; whilſt an equal portion of water takes its place, out of the reſervoir P. Otherwiſe the ſteam is admitted into the caſe D D, and, ruſhing into the arms of the rotative cylinder, is therein condenſed; whilſt the external ſteam, by its action on the arm, cauſes a rotative motion. Theſe arms may alſo be included in the boiler A, which will prevent the neceſſity of a caſe.

Fig. 2, is a ſection of the machine, acroſs the ſpindle of the rotative cylinder before deſcribed. A, A, are two ſmall pipes, which convey the cold water for injection into the ends of the cylinder arms at B, B; which, as deſcribed before, paſſes down the pipe E, through the cock F and valve H, into the rotative arms I, I; it is ejected from them through the valves K, K, as before deſcribed.

XXVI.

Vol. VII. Pl. X.

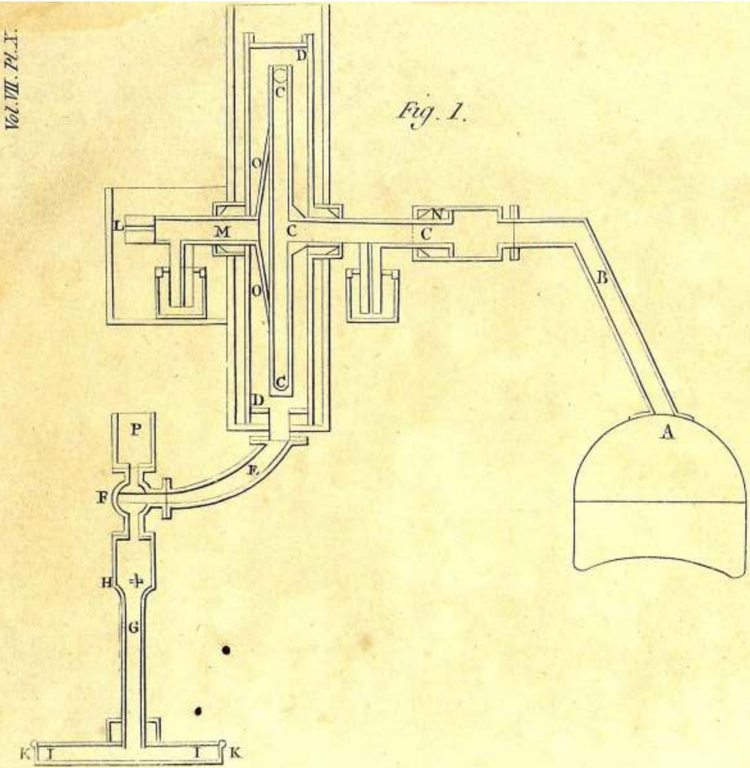


Fig. 1.

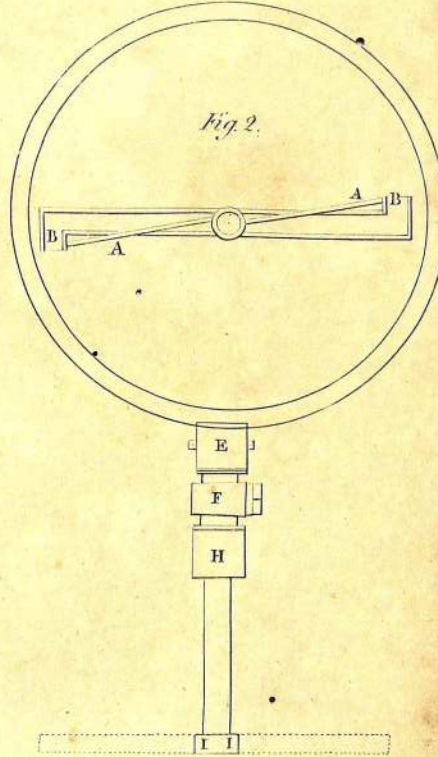


Fig. 2.

XXVI. *An Attempt to compare and connect the Thermometer for strong Fire* * *with the common mercurial ones. By Mr.* JOSIAH WEDGWOOD, *F. R. S. Potter to her Majesty.*

WITH A PLATE.

From the TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE thermometer for meaſuring the higher degrees of heat has been found, from extenſive experience, both in my manufactories and experimental enquiries, to anſwer the expectations I had conceived of it, as a meaſure of all degrees of common fire above ignition; but, at preſent it ſtands in a detached ſtate, not connected with any other thermometer, as it does not begin to take place, till the heat is too great to be meaſured or ſupported by mercurial ones.

* This thermometer is deſcribed in our ſixth volume, page 255.

What

What is now therefore wanting, to give us clear ideas of the value of its degrees, is, to connect it with one which long use has rendered familiar to us; so that, if the scale of the common thermometer be continued indefinitely upwards, as a standard, the divisions of mine may be reduced to that scale, and we may thus have the whole range of the degrees of heat brought into one uniform series, expressed in one language, and comparable in every part, from the lowest that have hitherto been produced by any artificial freezing mixtures, up to the highest that can be obtained in our furnaces, or that the materials of our furnaces and vessels can support.

This attempt is founded upon the construction and application of an intermediate measure, which takes in both the heats that are measurable by the mercurial thermometer, and a sufficient number of those that come within the province of mine to connect the two together. The manner of doing which will be apparent from Figs. 1, 2, and 3, of Plate XI; wherein F represents Fahrenheit's thermometer, with a continuation of the scale; W my thermometer; and M the intermediate

mediate meaſure, divided into any number of equal parts at pleaſure *.

For, if the heat of boiling water, or 212 degrees of Fahrenheit, be communicated to M, and its meaſure upon M marked, as at *a*; and if the heat of boiling mercury, or 600° of Fahrenheit, be alſo communicated to M, and marked, as at *b*; it is plain that the number of degrees upon M, beween *a* and *b*, will be equal to the interval between 212 and 600°, that is, to 388° upon Fahrenheit.

In like manner, upon expoſing M to two different heats above ignition, along with my thermometer-pieces, if a certain degree of my ſcale be found to correſpond with the point *d*, and another degree of mine with the point *c*, then the interval, between thoſe two degrees upon mine, muſt be equal to the interval *d*, *c*; and how many of Fahrenheit's that interval is equivalent to, will be known from the preceding compariſon. Thus we can find the number of Fahrenheit's degrees contained in any given extent of mine, and the de-

* The dimenſions of our figures are juſt two-thirds of the original ones.

gree of Fahrenheit's with which a given point of mine coincides; whence either ſcale is eaſily reducible to the other, through their whole range, whether we ſuppoſe Fahrenheit's continued upwards, or mine downwards.

For obtaining the intermediate thermometer different means were thought of; but the only principle which, upon attentive conſideration, afforded any proſpect of ſucceſs, was the *expanſion of metals*. This, therefore, was adopted, and among different methods of meaſuring that expanſion, which either occurred to myſelf, or which I can find to have been practiſed by others, there is no one which promiſes either ſo great accuracy, or convenience in uſe, as a gage, like that by which the thermometer-pieces are meaſured. The utility of this gage had now been confirmed to me by experience; and the machines and long rods, which have been employed for meaſuring expanſions on other occaſions, were abſolutely inadmiſſible here, on account of the inſuperable difficulties of performing nice operations of this kind in a red-heat, and of communicating a perfectly equal heat through any conſiderable extent.

To

To give a clearer idea of this species of gage, which, simple as it is, I am informed has been misunderstood by some of the readers of my former paper, a representation of one used on the present occasion is annexed, in Fig. 4; where A B C D is a smooth flat plate, and E F and G H are two rulers or flat pieces, a quarter of an inch thick, fixed flat upon the plate, with the sides that are towards one another made perfectly true, and a little farther asunder at one end E G than at the other end F H; thus they include between them a long converging canal, which is divided, on one side, into a number of small equal parts, and which may be considered as performing the offices both of the tube and scale of the common thermometer. It is obvious that if a body, so adjusted as to fit exactly at the wider end of this canal, be afterwards diminished in its bulk by fire, as the thermometer-pieces are, it will then pass farther in the canal, and more and more so, according as the diminution is greater; and conversely, that if a body, so adjusted as to pass on to the narrow end, be afterwards expanded by fire, as is the case with metals, and applied, in that expanded ſtate, to the ſcale, it will not paſs ſo far; alſo that the diviſions on the ſide will be the meaſures of the expanſion of the one, as of the contraction of the other, reckoning, in both caſes, from that point to which the body was adjuſted at firſt.

I, is the body whoſe alteration of bulk is thus to be meaſured, which, in the preſent inſtance, is a piece of fine ſilver: this is to be gently puſhed or ſlid along, towards the end F H, till it is ſtopped by the converging ſides of the canal.

K, is a little veſſel, formed in the gage, for this particular ſeries of experiments, the uſe of which will appear hereafter.

The *contraction* which the thermometer-pieces receive from fire is a permanent effect, not variable by an abatement of the heat, and which accordingly is meaſured commodiouſly, and at leiſure, when the pieces are grown cold. But the *expanſion* of bodies is only temporary, continuing no longer than the heat does that produced it; and therefore its quantity, at any particular degree of heat, muſt be meaſured in the moment while that heat ſubſiſts. And farther, if the

heated

heated piece was applied to the cold gage, the piece would be deprived of a part of its heat on the first contact; and, as the gage receives some degree of expansion from heat, as well as the piece, it is plain that in this case the piece would be diminished in its bulk, and the gage enlarged, before the measurement could be taken. It is, therefore, necessary that both of them be heated to an exact equality; and, in that state we can measure, not indeed the *true expansion of either*, but the *excess* of the expansion of one above that of the other; which is sufficient for the present purpose, as we want only an uniform and graduated effect of fire; and it is totally immaterial whether that effect be the absolute expansion of one or the other body, or the difference of the two, provided only that its *quantity* be sufficient to admit of nice measurement.

Some difficulties occurred with respect to the choice of a proper *matter* for the gage; the essential requisites of which are, to have but little expansibility, and to bear the necessary fires without injury. All the metals, except gold and silver, would calcine in the fire: those two are indeed free from that objection, and accordingly it is of the most expansible of them that the piece is made. But, if the gage also was made of the same, the measure itself would expand just as much as the body to be measured, and no expansion at all would be sensible; and, though the gage was made of one of those metals, and the piece of the other, the difference between their expansions would be too small to give any satisfactory results, as more than two-thirds of the real expansion of either would be lost or taken off by the other.

For these reasons, I had recourse to earthy compositions, which expand by heat much less than metallic bodies, and bear the necessary degrees of fire without the least injury. I made choice of tobacco-pipe clay, mixed with charcoal in fine powder, in the proportion of three parts of the charcoal to five of the clay, by weight. By a free access of air, in the burning by which the gage is prepared for use, the charcoal is consumed, and leaves the clay extremely light and porous; from which circumstance it bears sudden alternations of cold and heat, often requisite in these operations, much better than the clay alone. Another and more important motive for the uſe of charcoal, was, that in conſequence of the remarkable poroſity which it produces in the clay, it would probably diminiſh the expanſibility, by occaſioning the maſs to contain, under an equal ſurface, a much leſs quantity of ſolid or expanſible matter. It may be objected to this idea, that the expanſions of metals, in Mr. Ellicott's * and Mr. Smeaton's † experiments, do not appear to have any connection at all with their denſities; but the caſes are by no means parallel; for, there the compariſon lies between different ſpecies of matter; but here, between one and the ſame matter, in different ſtates of compactneſs. If a metal could be treated as clay is in this inſtance, that is, if a large bulk of any foreign matter could be blended with it, and this matter afterwards burnt out, ſo as to leave the metallic particles at the ſame diſtances to which they had been ſeparated by the mixture of it, we may preſume that the metal, thus enlarged, would not expand ſo much

* See Philoſophical Tranſactions, vol. XLVII. p. 485.

† Ibid. vol. XLVIII. p. 612.

as an equal volume of the ſolid metal. Such at leaſt were the ideas which determined my choice to a compoſition of clay and charcoal-powder; and, being afterwards deſirous of ſatisfying myſelf whether they had any foundation in fact, I have, ſince the experiments were made, prepared two pieces of clay, one with, and one without charcoal: having burnt them at the ſame fire, I ground them at the ſides, to make them both fit exactly to the ſame diviſion, near the narrow end of the gage; then, examining their expanſions by equal heats, I found the piece with charcoal to expand only one-third part ſo much as that without; and thus was fully ſatisfied with the compoſition of the gage.

To aſcertain a fixed point on the ſcale, for the diviſions to be counted from, the ſilver-piece and gage were laid together for ſome time in ſpring-water, of the temperature of 50° of Fahrenheit; the point which the piece went to, in this cold ſtate, is that marked o near the narrow end of the gage. The adjuſtment is re-examined at the beginning and end of every ſucceeding experiment, leſt the repeated attrition, in ſliding the

the piece backwards and forwards, should wear off so much from the surface of this soft metal, as to occasion an error in the minute quantities here measured.

The apparatus is then exposed successively to different degrees of heat, with the piece lying always in a part of the canal at least as wide as it is expected to fill when expanded, otherwise the sides of the gage would be burst asunder by its expansion, as I experienced in some of my first trials. When the whole has received any particular degree of heat desired, the piece is cautiously and equably pushed along, till it is stopped by the convergency of the sides, of which I always find notice given me, by the gage itself (which is small and light) beginning to move upon the continuance of the impulse. A flat slip of iron, a little narrower than the piece, bent down to a right-angle at one end, and fixed in a long handle at the other, makes a convenient instrument for pushing the piece forward, or drawing it back again, whilst red-hot: this instrument, at every time of using, is heated to the same degree as the piece itself.

The

The heat of boiling water is taken without difficulty, by keeping the apparatus in boiling water, during a ſufficient ſpace of time for the full heat to be communicated to it. The water I made uſe of was a very fine ſpring-water, which, on chemical trials, appeared very nearly equal in purity to that of rain or ſnow; and I had previouſly ſatisfied myſelf, by trials in the cold, that the gage and piece being wet, or under water, made no difference in the meaſurement. The expanſion of the ſilver by this heat, that is, by an increaſe of the heat from 50° to 212°, or a period containing 162° of Fahrenheit, was juſt 8° of the gage, or intermediate thermometer M; whence, one of theſe degrees, according to this experiment, contains juſt $20\frac{1}{4}$° of Fahrenheit's. The operation was many times repeated, and the reſult was always preciſely the ſame.

For the boiling heat of mercury, it was neceſſary to proceed in a different manner; not to convey the heat from the mercury to the inſtrument, but to convey it equally to them both, from another body. I made a ſmall veſſel for holding the mercury in the gage itſelf, ſeen at K, Fig. 4, and more diſtinctly in Fig. 5, which is a tranſverſe ſection of the gage through this veſſel. The plate C D, which forms the bottom of the canal, ſerves alſo for the bottom of the veſſel, which is ſituated cloſe to the ſide of the canal, and as near as could be to that part of it in which both the ſilver-piece, and the diviſions required for this particular experiment, are contained. By this arrangement it is preſumed, that all the parts concerned in the operation will receive very nearly an equal heat.

The gage, with ſome mercury in the veſſel, was laid upon a ſmooth and level bed of ſand, on the bottom of an iron muffle kept open at one end; the fire encreaſed very gradually till the mercury boiled, and then continued ſteady, ſo as juſt to keep it boiling, for a conſiderable time. The boiling heat of mercury was thus found to be $27\frac{1}{2}°$ of the intermediate thermometer, which, anſwering to an interval of 550° of Fahrenheit, makes one degree of this equal to juſt 20° of his; a reſult correſponding, even beyond my expectations, with that which boiling water had given.

These ſtandard-heats of Fahrenheit's thermometer are obtained, with little difficulty, on a common fire; but it is far otherwiſe with the higher ones, in which mine begins to apply; and all the precautions I could take, by uſing a cloſe muffle, ſurrounding it as equally as poſſible with the fuel, varying its poſition with reſpect to the draught of air, &c. proved inſufficient for ſecuring the neceſſary equality of heat, even through the ſmall ſpace concerned in theſe experiments. Nor had I any idea, before the diſcovery of this thermometer, of the extreme difficulty, not to ſay impracticability, of obtaining, in common fires, or in common furnaces, an uniform heat through the extent even of a few inches. Incredible as this may appear, at firſt ſight, whoever will follow me in the operations I have gone through, placing accurate meaſures of the heat in different parts of one and the ſame veſſel, will ſoon be convinced of its truth; and that he can no otherwiſe expect to communicate, with certainty, an equal heat to different pieces, than by uſing a fire of ſuch magnitude as to exceed, perhaps, ſome hundreds of times, the bulk of the matters required to be heated.

To

To ſuch large body of fire, therefore, after many fruitleſs attempts in ſmall furnaces, not a little diſcouraging by the irregularity of their reſults, I at length had recourſe; fitting up for this purpoſe an iron oven, uſed for the burning-on of enamel colours upon earthen-ware, about four feet long, by two and a half wide, and three feet high, which is heated by the flame of wood conducted all round it. An iron muffle, four inches wide, two inches and three-quarters high, and ten inches long, containing the gage and piece, was placed in the middle of this oven, and the vacancy between them filled up with earthen-ware, to increaſe the quantity of ignited matter, and thereby communicate the heat more equally from the oven to the muffle. In ſuch a ſituation of the muffle, in the centre of an oven more than five hundred times its own capacity, it could not well fail of being heated pretty uniformly, at leaſt through the ſmall ſpace which theſe experiments required, nor have I found any reaſon to ſuſpect that it was not ſo.

The gage being laid flat upon the bottom of the muffle, with the ſilver-piece in the canal, as

 before,

before, ſome of the clay thermometer-pieces were ſet on end upon the ſilver-piece, with that end of each downwards which is marked to go foremoſt in meaſuring it; that is, they were in contact with the ſilver, in that part of their ſurface by which their meaſure is afterwards aſcertained. I was led to this precaution by an experiment I had made upon another occaſion, in which a number of thermometer-pieces having been ſet upright upon an earthen-ware plate, over a ſmall fire, till the plate became red-hot, all the pieces were found diminiſhed, (ſome of them more than two degrees,) at the lower ends which reſted upon the plate; whilſt the upper ends were as much enlarged, not having yet paſſed the ſtage of extenſion, which, as obſerved in the former paper, always precedes the thermometric diminution; thus we ſee how punctually every part of the piece obeys the heat that acts upon it.

The fire about the oven was ſlowly increaſed for ſome hours, and kept as even and ſteady as poſſible, by an experienced fire-man, under my own inſpection. Upon opening a ſmall door, which had been made for introducing the apparatus,

ratus, and looking in from time to time, it was obſerved, that the muffle, with the adjacent parts of the oven and ware, acquired a viſible redneſs at the ſame time; and, in the progreſs of the operation, the eye could not diſtinguiſh the leaſt diſſimilarity in the aſpect of the different parts; whereas, in ſmall fires, the difference, not only between the two ends of the muffle, but in much leſs diſtances, is ſuch as to ſtrike the eye at once.

When the muffle appeared of a low red heat, ſuch as was judged to come fully within the province of my thermometer, it was drawn forwards, towards the door of the oven, and, its own door being then nimbly opened by an aſſiſtant, I immediately puſhed the ſilver-piece as far as it would go. But, as the diviſion which it went to could not be diſtinguiſhed in that ignited ſtate, the muffle was lifted out, by means of an iron rod paſſed through two rings made for that purpoſe, with care to keep it ſteady, and avoid any ſhake that might endanger the diſplacing of the ſilver-piece.

When

When grown ſufficiently cold to be examined, I noted the degree of expanſion which the ſilver-piece ſtood at, and the degree of heat ſhewn by the thermometer-pieces meaſured in their own gage; then returned the whole into the oven as before, and repeated the operation with a ſtronger heat, to obtain another point of correſpondence on the two ſcales.

The firſt was at $2\frac{1}{4}^{\circ}$ of my thermometer, which coincided with 66° of the intermediate one; and, as each of theſe laſt has been before found to contain 20 of Fahrenheit's, the 66 will contain 1320; to which add 50, the degree of his ſcale to which the 0 of the intermediate thermometer was adjuſted, and the ſum, 1370, will be the degree of Fahrenheit's correſponding to my $2\frac{1}{4}^{\circ}$.

The ſecond point of coincidence was at $6\frac{1}{4}^{\circ}$ of mine, and $92\frac{1}{4}^{\circ}$ of the intermediate; which 92 being, according to the above proportion, equivalent to 1840 of Fahrenheit, add 50°, as before, to this number, and my $6\frac{1}{4}^{\circ}$ is found to fall upon the 1890th degree of Fahrenheit.

It appears from this, that an interval of four degrees upon mine is equivalent to an interval of 520° upon his, conſequently 1 of mine to 130 degrees of his; and that the 0 of mine correſponds to his 1077½°. Several other trials were made, which gave reſults ſo nearly alike, that I have little apprehenſion of any material error.

From theſe data, it is eaſy to reduce either ſcale to the other, through their whole range; and, from ſuch reduction it will appear, that an interval of near 480° remains between them, which the intermediate thermometer ſerves as a meaſure for; that mine includes an extent of about 32000 of Fahrenheit's degrees, or about 54 times as much as that between the freezing and boiling points of mercury, by which mercurial ones are naturally limited; that if the ſcale of mine be produced downwards, in the ſame manner as we have ſuppoſed Fahrenheit's to be produced upwards, for an ideal ſtandard, the freezing-point of water would fall nearly on 8° below 0 of mine, and the freezing-point of mercury a little below 8½°; and that, therefore, of the extent of now mea-

ſurable

ſurable heat, there are about $\frac{5}{10}$ths of a degree of my ſcale from the freezing of mercury to the freezing of water; 8° from the freezing of water to full ignition; and 160° above this to the higheſt degree I have hitherto attained.

As we are now enabled to compare, not only the higher degrees among themſelves, and the lower degrees among themſelves, upon their reſpective ſcales, but likewiſe the higher and lower with each other, in every ſtage, it may be proper to take a general view of the whole range of meaſurable heat, as expreſſed both in Fahrenheit's denominations and in mine: for this purpoſe, I have drawn up a little table of a few of the principal points that have been aſcertained, to ſhew their mutual relations, or proportions, to each other. Any other points that have been, or hereafter may be, obſerved, by theſe or any other known thermometers, may be inſerted at pleaſure.

	Fahrenheit.	Wedgwood.
Extremity of the scale of my thermometer,	32277°	240°
Greatest heat of my small air-furnace,	21877	160
Cast iron melts, - -	17977	130
Greatest heat of a common smith's forge,	17327	125
Welding-heat of iron, greatest, - -	13427	95
———————— least, - -	12777	90
Fine gold melts, - -	5237	32
Fine silver melts, - -	4717	28
Swedish copper melts, - -	4587	27
Brass melts, - -	3807	21
Heat by which my enamel-colours are burnt on, - -	1857	6
Red-heat fully visible in day-light, -	1077	0
Red-heat fully visible in the dark, -	947	1
Mercury boils, - -	600	$3\frac{673}{1000}$
Water boils, - - -	212	$6\frac{658}{1000}$
Vital heat, - -	97	$7\frac{542}{1000}$
Water freezes, - -	32	$8\frac{42}{1000}$
Proof-spirit freezes, - -	0	$8\frac{289}{1000}$
The point of which mercury congeals, consequently the limit of mercurial thermometers, - -	about 40	$8\frac{506}{1000}$

To assist our conceptions of this subject, it may be proper to view it in another light, and endeavour to preſent it to the eye; for numbers, on a high ſcale, are with difficulty eſtimated and compared by the mind. I have therefore completed the ſcales of which a part is repreſented in Figs. 1 and 3, by continuing the ſame equal diviſions, both upwards and downwards, as far as the utmoſt limits of heat that have hitherto been attained and meaſured *.

In a ſcale of heat drawn up in this manner, the comparative extents of the different departments of this grand and univerſal agent are rendered conſpicuous at a ſingle glance of the eye. We ſee at once, for inſtance, how ſmall a portion of it is concerned in animal and vegetable life, and in the ordinary operations of nature. From freezing to vital heat is barely a five-hundredth part of the ſcale; a quantity ſo inconſiderable, relatively to the whole, that, in the higheſt ſtages of ignition, ten times as much might be added, or taken away, without the leaſt difference being diſcer-

* Mr. Wedgwood preſented this, in the form of a very long roll, to the Royal Society.

nible,

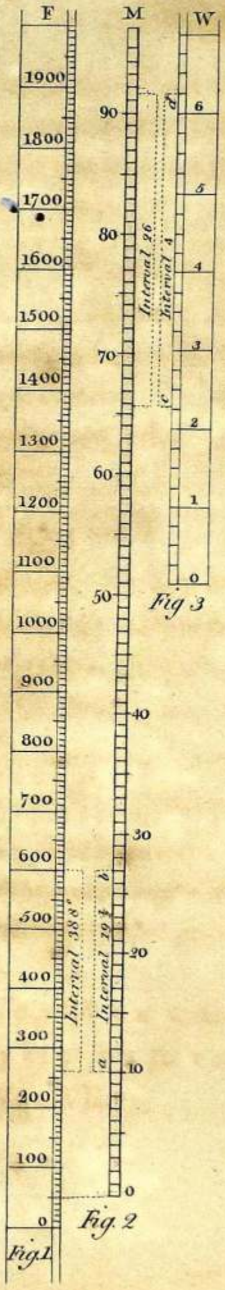
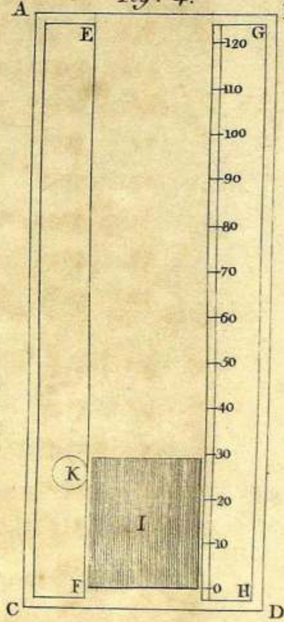


Fig. 1 Fig. 2 Fig 3

Fig. 4.



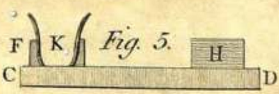


Fig. 5.

nible, in any of the appearances from which the intenſity of fire has hitherto been judged of. Hence, at the ſame time, we may be convinced of the utility and importance of a phyſical meaſure for theſe higher degrees of heat, and the utter inſufficiency of the common means of diſcriminating and eſtimating their force. I have too often found differences, aſtoniſhing when conſidered as a part of this ſcale, in the heat of my own kilns and ovens, without being perceivable by the workmen at the time, or till the ware was taken out of the kiln.

XXVII. *Deſcription of an Implement for tranſplanting Turnips; with ſome Obſervations on their Cultivation. By* JOSEPH KIRKPATRICK, *Eſq. of the Iſle of Wight.*

WITH A PLATE.

From the Letters and Papers of the Bath and Weſt-of-England Society for the Encouragement of Agriculture, &c.

FROM the ſimplicity and cheapneſs of the inſtrument herein deſcribed, and the very eaſy manner of uſing it, (two great recommendations in all implements in huſbandry,) I cannot but think it may become generally uſeful. As it frequently happens in turnip-fields, that large ſpots fail, it is uſed for filling up thoſe ſpots, from the adjoining parts of the ſame field. It may alſo be uſeful in gardens, for tranſplanting plants of different kinds.

The method of uſing it is as follows; hold the long handle A (Plate XII. Fig. 1.) with the left hand, and

and the fhort handle B with the right, drawn up; put the inftrument over the plant that is to be taken up, and with your foot force it into the ground; then give it a twift round, and, by drawing it gently up, the earth will adhere to the roots of the plant in a folid body. Afterwards, with another inftrument of the fame fize, take the earth out where the plant is to be put, and, bringing the inftrument with the plant in it, put it into the hole which has been made by the other; then keep your right hand fteady, and draw up your left, and the earth and plant will be left in the hole, with the roots undifturbed.

When turnips are to be tranfplanted in a field, there are two men employed, each with an inftrument; one man taking up a plant, while the other fills his inftrument with earth only, thereby making room for depofiting the plant; and the hole which is made by taking up the plant, is filled with the earth taken out where the plant is to be put. The other man, having depofited the earth, takes up a plant, and returns to the place he firft fet out from; the firft man, at the fame time, returning with earth only; fo that each

man

man is alternately the planter; and each being employed both ways, the work goes on brifkly.

This inftrument was invented by Mr. Cubitt Gray, of Southrepps, in Norfolk, a perfon who has given a great deal of attention to hufbandry, and particularly to the cultivation of turnips; for which he prepares his land in a different manner from moft of his neighbours. They harrow their land immediately after each ploughing, and then roll it, in order (as they fay) to keep in the moifture. He, on the contrary, never rolls his land, nor harrows it, till he is going to plough it again, but leaves it as open as poffible, in order to warm it, as he thinks land can never be too warm or dry for turnips; and he has always had the beft crops, even when the feafon has been dry when fown. This method he has followed fixteen years, and never once failed of a crop of turnips, though his neighbours frequently have. He has fold turnips at five guineas and a half *per* acre, to be fed off on his land; he always hand-hoes twice, as indeed do all the farmers in that country; his land is a fandy loam, a very free working foil.

XXVIII. *Description of a Comb-Pot, to be used with Pit-Coal. By Messrs.* DANIEL *and* THOMAS DYKE, *of Sarum.*

WITH A PLATE.

From the Letters and Papers of the Bath and Weſt-of-England Society for the Encouragement of Agriculture, &c.

THE comb-pot herein deſcribed was invented by John Aſhman, who has been in our ſervice about ſix months: he worked it two years and a half at Abbey Milton, and three years and a half at Blandford.

It is repreſented in Plate XII. Fig. 2. In which A is the furnace for water, which contains a ſmaller one, keeping the ſuds of the ſecond waſhing of the wool, to be uſed with the next quantity of wool, the firſt way.

B. A chimney for conveying the ſmoke, made of tin, and may be carried higher in any direction: the lower part of it is almoſt globular, for the better conveniency of taking the four ſmaller ones

ones C, C, C, C, from the top of the furnace, to clean the ſame tubes continued through the furnace, cloſe to the ſide, at equal diſtances, and directly over each fire-place.

D, D. The fire-place doors. There are two more on the other ſide.

E, E. Cocks for drawing off the water and ſuds.

F, F. Covers to the furnaces.

G, G. Spaces between each fire-place, (with two more on the other ſide,) for receiving the combs to heat on a caſt-iron plate.

H, H. Large wires on iron plates, (with two more,) projecting a diſtance ſufficient to prevent the wool from being ſinged in the combs, while heated; each plate heating one pair of combs.

I I. An iron plate for making the fire on, with holes to let the aſhes through.

K K. A ſtone to receive the aſhes; and, at four equal diſtances, bricks to ſupport the upper part.

L L. A place for the pit-coal, ſupporting in like manner the aſhes, plate, &c.

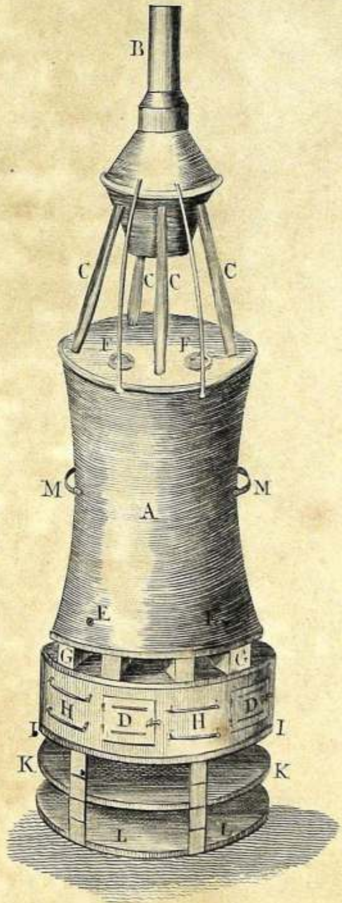
M, M. Handles for taking off the furnace.

The pot here deſcribed is of a circular form, leſſened in the middle, for receiving the handles of the combs while heating.

XXIX.

Fig. 1.

Fig. 2.



XXIX. *Conclusion of M.* DE FOURCROY'S *Observations on the Influence of Vital Air in colouring Vegetable Substances, and on a new Preparation of solid Colours for painting.*

(From Page 142.)

AFTER having reflected upon what I had observed in the above-mentioned phænomena, it appeared to me that oxygen had a real influence upon the colouring matter of many vegetable principles. This it is my intention, if possible, to demonstrate: if I should fail in doing so, what I have to say upon the subject may at least induce philosophers to make it the object of their attention and experiments. In order to render that influence more evident, I shall observe, that it is not at all probable that vital air, in which vegetables are more or less immersed, should not have some particular ac-

 tion

tion upon their principles, when we ſee that thoſe vegetables which grow where they are not expoſed to the air are weakly, and without colour; and that thoſe which grow in an expoſed ſituation, provided it be not too cold for them, are vigorous and full of colour. Leaves, when they firſt come out of the bud, are of a pale green colour, but they grow darker, when, by being fully expanded, they are expoſed to the action of the air. Flowers, while folded up within their *calices*, have frequently no other colour than white, with a ſhade of green, but their expanſion ſoon colours them; it is true, that it is to their diſadvantage, in ſome reſpects, as they are ſoon withered by the contact of the air, which often cauſes their colours to change three or four times, before they are entirely faded.

Indeed the abſorption of oxygen by vegetables, though conſidered for ſome time as a doubtful circumſtance, appeared to me no longer ſo when I reflected that acids, ſo frequent and ſo plentiful in vegetables, cannot exiſt in them without this principle; for, the artificial formation of

theſe

theſe acids, by means of nitrous acid, which evidently furniſhes oxygen to vegetables, puts this laſt-mentioned fact out of doubt. But, beſides this formation of acids, it appeared to me, that among the various effects of oxygen, one of the moſt remarkable was its influence upon the colour of vegetable ſubſtances.

If the circumſtances which I have already mentioned in ſupport of this opinion leave any doubts, I think it is in my power to remove them, by experiments which are more deciſive, and whoſe reſults are more evident, than what paſſes in the organization of vegetables, during the concealed proceſs of vegetation. Plants, and their various products, expoſed to the action of atmoſpheric oxygen, when vegetation is interrupted, and when the obſcurity of its mechaniſm no longer embarraſſes our reaſoning, are altered in ſuch a manner as not to leave any doubt reſpecting the influence of this agent. The colour of green leaves changes; they grow pale, and turn to a dull yellow colour, in which they remain during a long ſpace of time, without any farther alteration. The fæculæ of indigo, and of woad, after having undergone a certain degree of decompoſition, acquire a beautiful blue colour by the abſorption of oxygen; for, the formation of the blue-colour is only brought about by expoſure to the air, and beating. This truth is ſtill more confirmed by the action of oxygenated muriatic acid; which ſhews us, at the ſame time, that a difference in the quantity or proportion of the oxygen cauſes a difference in the colours of this product; for, if a certain portion of oxygen be added to the blue, it changes it to green; if the oxygen be taken away, it turns to blue again; if a greater quantity of oxygen be added, it becomes yellow; and then this new combination has ſo altered the internal texture of the ſubſtance, that it cannot be again turned blue. If a tincture or ſyrup of violets, and an aqueous tincture of turnſol, are ſhut up from the air, both of them almoſt entirely loſe their colour; but, if they are afterwards expoſed to atmoſpheric air, or, what is ſtill more powerful, to vital air, their blue colour appears again, as bright as at firſt: other elaſtic fluids produce

no

no ſuch effect. Here it is to be obſerved, that the production of this colour depends upon a particular proportion of oxygen; for, if that proportion be augmented, the blue colour diſappears, and there remains only a yellow tinge. This fact has been demonſtrated by Mr. Scheele and M. Berthollet.

The effects of the contact of air, upon decoctions of yellow or red woods and barks, preſent a very remarkable phænomenon, and one from which great advantages may be drawn, reſpecting the preparation of colours uſeful in painting. Moſt of the decoctions of theſe ſubſtances, when expoſed to the air, grow turbid, and are covered with a pellicle, the colour of which paſſes ſucceſſively through ſhades of dark brown, browniſh purple, reddiſh cheſnut, orange, and yellow: at this laſt, the colour ceaſes to change, and remains permanent. The ſhades above mentioned, in the order in which they take place, are owing to different proportions of oxygen; which proportions, as they encreaſe, change the colour from dark brown to yellow. At either of the fore-mentioned

tioned ſtages, the oxygen may be fixed in the coloured ſubſtance, and the colour retained, by ſeparating it from the water, (to which much of the change of colour is owing,) and drying it quickly.

In the manner here deſcribed, I prepared, from two kinds of Jeſuit's bark, one from Peru, the other from St. Domingo, (which laſt is the *Cinchona caribbæa* of Linnæus,) cheſnut-brown, red, and purple colours, all of which are very brilliant and permanent, and have been tried and approved of by a painter, who employed them for the purpoſes of his profeſſion.

What led me to believe that the above-mentioned changes of colour were produced by different proportions of oxygen, was, that by taking the firſt depoſition of the decoction of bark, which, as mentioned above, is of a dark brown colour, and treating it with oxygenated muriatic acid, it may be made to paſs through all the ſhades above enumerated, in proportion as it abſorbs more oxygen; and, at laſt, it may be brought into the form of a yellow ſubſtance,

of

of a pretty good colour, which is very permanent. This ſubſtance, when yellow, is fuſible in the fire, is of a reſinous nature, and is ſoluble in alcohol; whereas, while it is of a cheſnut colour, or red, it is not ſoluble either in boiling water or alcohol. To produce the alterations of colour here ſpoken of, in the precipitated or evaporated product of Jeſuit's bark, it is neceſſary to expoſe that product, in bottles of water ſaturated with it, to the contact of oxygenated muriatic acid gas; for, if this acid, in a liquid ſtate, be poured upon the ſubſtance after it is dried, the ſhade of colour is very little or not at all changed; yet the deepeſt coloured carmine, however well it is prepared, immediately loſes its colour, and becomes white, by the contact of oxygenated muriatic acid, in a liquid form.

What I have ſaid ſhews how to procure five or ſix ſhades of beautiful colours, which are permanent when dried, from one vegetable ſubſtance, impregnated with different proportions of oxygen. By the ſame experiment, applied to decoctions of ſuch woods, barks, and roots as are employed in dying, we may obtain (as I perceive by ſome trials I have made) decompoſitions of various kinds; which, by means of the oxygenated muriatic acid, may be formed into coloured fæculæ, more or leſs of a reſinous nature, and which would be very uſeful to thoſe who profeſs the art of painting. This, if I am not miſtaken, will furniſh a new branch of induſtry, for which we ſhall be indebted to chemiſtry. But, without examining any farther what advantage this new proceſs promiſes to the above-mentioned art, or without entering into details which will be more proper in another place, I ſhall here only mention thoſe inferences which may be deduced from theſe facts, with reſpect to the theory of chemiſtry, and which alſo apply immediately to the practice of thoſe arts in which colours are made uſe of.

It appears to me to be proved, by the facts which I have taken notice of, and by the experiments of which I have given only the more general reſults,

Firſt, that oxygen, when combined with vegetable ſubſtances, changes their colour.

Secondly,

Secondly, that different proportions of this principle produce different ſhades in coloured vegetable matter.

Thirdly, that theſe ſhades paſs, by a ſort of degradation, from the darkeſt colours to the lighteſt; and that the extreme point of the latter may be conſidered as a complete deprivation of colour.

Fourthly, that, in many vegetable ſubſtances, this degradation does not take place, as M. Berthollet has obſerved.

Fifthly, that many red, violet, purple, cheſnut, and blue vegetable colours are produced by different proportions of oxygen; but that none of theſe are completely ſaturated with this principle.

Sixthly, that the complete ſaturation here ſpoken of generally produces yellow colours, which are the leaſt changeable of all.

Seventhly, that vegetable ſubſtances coloured by oxygen, not only change their colour according to the proportion of oxygen they have imbibed, but that they alſo change their nature, in the ſame proportion, and approach more to a reſinous ſtate, as they become nearer to a yellow colour.

Laſtly, that the cauſe of the changeability of the red, brown, and violet colours, procured from vegetables, is ſuch as I have ſtated above; that there exiſts a method of fixing them, or rendering them permanent, by impregnating them with a certain quantity of oxygen, by means of the oxygenated muriatic acid; imitating, by this proceſs, the method purſued by nature, who never forms fixed and permanent colours, except in ſubſtances which have been long expoſed to the open air.

XXX. *Experiments upon the Composition of Flint-glass, with some Observations upon the Means of rendering it more perfect.* By M. Macquer.

From the Memoirs of the Academy of Sciences of Paris.

I HAVE made, during the course of some years, a great number of experiments upon flint-glass; chiefly with a view to find out the cause of those defects to which this kind of glass is so very liable. I thought it right to determine, in the first place, whether the matter of the pot or crucible, in which the glass is melted, might not (by being corroded in certain parts, and thereby mixing with the glass) be the cause that it is so apt to be glutinous and stringy. To ascertain this, I made some glass which consisted only of red-lead and sand, and to which I was certain that the crucible, in which it was melted, could

 not

not contribute the ſmalleſt portion of its ſubſtance, becauſe I had taken the precaution to coat the inſide of it with a pretty thick coating of very pure ground ſand. The glaſs I obtained, in many experiments of this kind, was very yellow; and, although it was very brilliant, and very tranſparent, I obſerved that it had the ſame defects as are found in flint-glaſs when made in the common way, without thoſe precautions I had uſed in my experiments. It ſeems to me, therefore, to be aſcertained, by the forementioned trials, that the imperfections of this kind of glaſs are not owing to any mixture of argillaceous earth, acquired from the pot in which the glaſs is melted; and, although my experiments did not furniſh me with a kind of flint-glaſs free from defects, as I had flattered myſelf they would have done, they have at leaſt ſerved to determine a point reſpecting which there would otherwiſe always have remained doubts, which appeared well founded, and which were of a nature to produce great uncertainty, with regard to the above-mentioned imperfections of flint-glaſs.

As my intention, when I undertook the investigation of this matter, was to examine, in succession, every circumstance relative to the making of this kind of glass, in order to discover those upon which its good or bad qualities depended, I had many other objects to bring under examination. The principal of these were, the degree of fluidity which it was necessary to give to the matter, at different periods of the melting; and the nature of the different calces or preparations of lead, which might be made use of as ingredients in its composition.

Although I had reason to believe, from the result of a great number of experiments, that the last-mentioned circumstance was of little consequence, with respect to the nature of flint-glass, yet, the small success I had obtained from a method in which I had more confidence (but which, as appears from the experiments above related, I found to be of no avail,) determined me to undertake an enquiry into the effects of the different preparations of lead; and, considering that there were several which had never yet been tried, I

 resolved

resolved to make trial of them all, one after the other.

As I had always attributed the want of a complete dissolution of the sand, by the calces of lead, to the inflammable principle still remaining, in too great quantity, in those calces, I endeavoured to prepare some which should be more perfectly calcined; and, as the mineral acids have a very powerful effect in depriving metals of their phlogiston, it was by their means I tried to deprive more completely of that principle those calces of lead which it was my intention to make use of in my future experiments.

TO BE CONCLUDED IN OUR NEXT.

XXXI. *Lift of Patents for Inventions, &c.*

(Continued from Page 144.)

JOHN LUKE, of Treviles, in the County of Cornwall, Efq.; for machinery for lifting, drawing, and conveying loaded and light veffels from one canal to another. Dated July 4, 1796.

VALENTINE CLOSE, of Hanley, in the county of Stafford, Merchant, and JAMES KEELING, of the fame place, Potter; for improvements in ovens, kilns, and firing-places, for firing, hardening, and baking, porcelain and earthen wares, &c. Dated July 5, 1796.

GABRIEL AUGHTIE, of Cheapfide, Hardware-man; for a coffin, fo fecure as to render it impracticable either to break, cut, or otherwife open the fame. Dated July 20, 1796.

ROBERT HOAKESLEY, of the city of Chefter, Merchant; for making Britifh pot-afh, for all kinds of manufactures in which foreign pot-afh, or any alkali, is ufeful. Dated July 20, 1796.

HENRY

Henry Walker, of Thurmaston, in the County of Leicester, Gentleman; for a method of erecting houses, &c. in one entire mass or body. Dated July 20, 1796.

Thomas Potts, of Sanctuary, in the county of Glamorgan, Farmer; for a machine attached to the stern of any vessel, boat, or barge, for moving the same. Dated July 20, 1796.

Charles Haley, of Wigmore-street, Cavendish-square, Watchmaker; for a marine time-keeper, for the better ascertaining the longitude at sea. Dated August 17, 1796.

Samuel Guppy, of the city of Bristol, Merchant; for a method of cutting and heading nails, whereby much labour is saved. Dated August 19, 1796.

Arnold Wilde, and Joseph Ridge, of Little Sheffield, in the county of York, Saw-makers; for a method of making saws, and divers other articles, of iron and steel united, also of iron or steel. Dated August 25, 1796.

Francis Lowndes, of St. Paul's Church-Yard, Medical Electrician; for a machine for exercising the human body. Dated September 9, 1796.

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER XL.

XXXII. *Specification of the Patent granted to Mr.* THOMAS CLIFFORD; *of the City of Briſtol, Merchant; for his Invention of an entire new Mode of manufacturing Nails of every Kind, by Machinery never before made uſe of for that Purpoſe.*

Dated July 17, 1790.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that my invention of an entire new mode of manufacturing nails of every kind, by machinery never before made uſe of for that purpoſe, is deſcribed in manner following; that is to ſay, the principle on which the invention is founded, and by which it appears to be altogether new, is that the nails are to be made by having a die, or the impreſſion of them, cut into one or more pieces of iron, ſteel, or other metal; and the iron, or other metal, of which the nails are to be made, drawn, or rolled, into a proper form or thickneſs; and, by force, preſſed into ſuch cavity or die, ſo as to form the nails, either complete, or ſo nearly completed as that they can be finiſhed with but little labour. The operation of manufacturing the nails on this principle may be done ſeveral different ways; the firſt that I ſhall deſcribe, and what I eſteem the beſt mode, is by the uſe of rollers, made of iron or ſteel, and worked either by water, ſteam, wind, cattle, or any other power. A pair of rollers ſhould be made of iron, caſed with ſteel, each of the ſame diameter, and the diameter proportioned to the length and ſize of the nail intended to be made: each roller ſhould have one or more cog wheels, and the cogs of one roller ſhould work in the cogs of the other; ſo that the rollers may both perform the ſame exact revolution. One-half the impreſſion of the nail ſhould be cut in

one

one roller, the other half in the other; ſo as that the two impreſſions form a cavity or die, of the exact form of the nail, extending the lengthways of the nail, round or on the circumference of the rollers; and as many impreſſions of the ſame kind cut in the rollers, one at the end of the other, as will complete their circumference, and continue the cavity all round the rollers; the point of one nail joining the head of the next, or the two points and two heads joining each other: the rollers muſt be made to work very true and exact, and cloſe to each other. A rod of iron, or other metal, rolled or drawn to the moſt convenient ſize, is to be heated, and, while hot, the end of it put between the rollers, into the cavity or die which forms the impreſſion of the nail. The rollers, being put in motion, will draw the iron or other metal through, preſſed into the cavity, ſo as to form what may be called a ſtring of nails, the one joined to the other; which muſt afterwards be ſeparated from each other, and may be ſeparated by inſtruments acting as nippers, ſhears, chiſels, &c. The rollers being made to work cloſe to each other, where the edge of the nail is formed, will prevent much of the metal from being preſſed out on each ſide of the nail; what is preſſed out may be cut off by inſtruments of various kinds, acting as nippers, ſhears, chiſels, &c. The ſame operation may be performed by means of three, four, or more rollers working together, and part of the impreſſion of the nail cut in each or ſeveral of the rollers. A pair of rollers may have ſeveral rows of dies, or the impreſſion of nails, cut on them, ſo as to form the impreſſion for ſeveral ſtrings of nails; and a rod of iron, or other metal, being put into each of them, will roll out as many ſtrings of nails, with one revolution of the rollers. A pair of rollers may alſo have the greater part of their ſurface cut with dies, or the impreſſion of nails, and a flat bar, or piece of iron, or other metal, be made to paſs between the rollers, ſo as to form what may be called a ſheet of nails; the whole of them connected to one another by thin plates of the iron, or other metal, of which they are compoſed, and would require each nail to be cut out, or ſeparated from the ſheet, and which may be done by various inſtruments for the purpoſe. Nails may alſo

alſo be made on this principle, by having the die, or impreſſion of them, cut in one or more pieces of iron, ſteel, or other metal, either of a flat, round, or circular ſurface, and the metal preſſed into ſuch cavity or die, by any mechanical powers, by means of levers, prizes, ſcrews, ſtamps, or otherwiſe. Altough I have minutely deſcribed one mode of operation for the making of nails, on the principle of my invention, and have in general terms pointed out other modes, there are ſuch a variety of alterations which may be made in the machines uſed for the purpoſe, and ſo many different ways of working them, that I do not confine this ſpecification to any particular machine or mode of operation deſcribed, but include all the various machines, and different modes of working them, by which nails of every kind and ſort may be made upon the principle of the invention, as in the foregoing is ſet forth, and claimed by me. In witneſs whereof, &c.

XXXIII. *Specification of the Patent granted to Mr.* ROBERT FULTON, *of the City of London; for his invention of a Machine or Engine for conveying Boats or Vessels, and their Cargoes, to and from the different Levels in and upon Canals, without the Assistance of Locks, or the other Means now known, and used for that Purpose.*

WITH A PLATE.

Dated May 8, 1794.

TO all to whom these presents shall come, &c. NOW KNOW YE, that, in obedience to the said letters patent, and the proviso therein contained, I the said Robert Fulton do hereby describe and ascertain the nature of my aforesaid invention, and the manner in which the same is to be performed, in manner following; that is to say,

First, the ends of the two levels in and upon canals, which are to be united by means of my said invention,

invention, ſo far as reſpects the uſe thereof where a double inclined plane is preferred, muſt be brought as near each other as the nature of the ground will admit, ſo as to obtain a plane of any angle from twenty to ninety degrees elevation. Stone foundations are then to be laid from one level to the other, on an angle with the plane, and covered with timber, braced at proper diſtances, ſo as to render it ſecure: the timbers to be faced with grooves or ſegments of caſt-iron, on which the wheels of the ciſterns after mentioned are to run.

II. Two ciſterns are to be conſtructed, water-tight, and of a capacity to contain water ſufficient to preponderate againſt any weight which it may be thought proper to raiſe from one to fifty tons. The ciſterns to be mounted on four, ſix, or eight wheels: the hind wheels being either large enough in diameter, or fixed to timbers, ſo as to keep the body of the ciſtern parallel with the horizon, as in figures 7 and 8, contained in the plan or drawing of my ſaid invention annexed hereto. (See Plate XIII.) Each ciſtern to have two valves; one to receive the water at the upper level,

level, and one to difcharge it at the level beneath.

III. At each end of the plane, and on the end or fide of the canal, whichever prefents itfelf to the plane, a bafon is to be formed, of ftone, or brick, to keep in the water. The bafon on the upper level to have a recefs, long and wide enough to receive the two cifterns, as in Fig. 4; from each end of which a plane is to defcend into the canal, as reprefented at B and C, for the purpofe of raifing the boats on the ciftern. The lower bafon may be conftructed exactly fimilar to the faid Figure 4, or as Figure 5; where a ftage may be erected to fupport the fide planes, and the cifterns defcend into the lower canal.

IV. A ftrong frame of timbers muft be erected over the upper bafon, to fupport the weight of the cifterns, boats, cargoes, preponderating power, leading ropes, and machinery.

V. The cylinders or pulleys being rendered fecure, the leading ropes are to run over the backs of the outfide pulleys; but they may or may not take a coil round the centre-fhaft, as in Fig. 11. A, being the fhaft, on which a wheel is placed, and

and over it a lever; which lever, by being preſſed on the wheel, will create friction, and ſtop the velocity of the deſcending body, as at B and C in the ſaid Fig. 11.

VI. The ciſterns being placed on the planes at A and B, in Fig. 1, the leading-ropes are to be ſtretched over the pulleys, (as deſcribed in the preceding or fifth article of the deſcription of my ſaid invention,) and ſecured to the ciſterns by brace-blocks, to draw up the ſlack rope, ſhould either of them ſtretch, as in the ſaid Fig. 8.

VII. Each ciſtern is to have a ſmall carriage, on which the boat is to float, and be drawn out of the canal, up the ſide-plane on the ciſtern, as in Fig. 12.

VIII. The power to draw the boat on the ciſtern, may be obtained either by a capſtan or a water-wheel. The firſt wheel being placed as at C, in Fig. 1, near the upper level, a portion of water is to be let on the wheel, out of the upper level, until a power is gained to draw the boat out of the canal on the ciſtern; the water which paſſes over this wheel is caught in a ciſtern at E, and, paſſing down the tube F, will put the wheel D in motion, to draw the boat out of the canal beneath the lower ciſtern; which water ultimately enters the lower canal.

IX. Fig. 13 ſhews the mode of the leading-rope paſſing over the body of the ciſtern, for the purpoſe of raiſing the boat on the ciſtern.

X. The component parts of my ſaid invention, ſo far as reſpects the uſe thereof where a double inclined plane is preferred, from the different levels in and upon canals, being deſcribed, Fig. 1 exhibits a front-view, and Fig. 2 a ſide-view, of a double inclined plane, with the moving ciſterns; and the following is the mode of paſſing the boats from one level to the other. The upper ciſtern being made faſt to the timbers, the loaded boat is to be drawn out of the lower canal on the ciſtern beneath, and an empty or loaded boat out of the next aſcending level on the upper ciſtern. Should the weight above not be ſufficient to preponderate againſt the weight beneath, water muſt be let into the upper ciſtern, from ſuch next aſcending level, or ſome neighbouring ſtream, to create a preponderating power; which, deſcending the plane, will draw its opponent to ſuch next aſcending

aſcending level. The ciſterns are then to be made faſt; the boats let off from them into the different levels, and others taken on the ciſterns; the water to be diſcharged from the deſcended ciſtern, either into the lower or next deſcending level, or to waſte; water to be taken into the upper ciſtern, as before, and ſo on alternately. This operation may be performed without a deſcending boat, as the body of the ciſtern is ſufficiently large to contain water enough to preponderate againſt any weight which it may be thought proper to raiſe by this means.

In the operation of this machine, all boats over fifteen feet in length, moving on an inclined plane of above twenty degrees elevation, muſt riſe and deſcend end to end, as exhibited by the ciſterns in Fig. 9; and all boats under fifteen feet in length, when the plane is under forty-five degrees elevation, may riſe and deſcend ſide by ſide, and the ciſtern be placed accordingly.

XI. In caſes where it may be thought proper to uſe my ſaid invention in a perpendicular lift, in preference to one on an inclined plane, ſuch perpendicular lift is to be obtained as follows. The ſide of the hill muſt be cut down, or a ſhaft ſunk, equal to the perpendicular difference between the two levels. The ſhaft may be either round, ſquare, or oblong, and of a width and length to let two ciſterns paſs each other; which ciſterns are to be of a ſize that each may receive a boat, either in or on its body, as at A and B, fig. 3. To meet the bottom of the ſhaft, a tunnel muſt be driven into the ſide of the hill, as exhibited in the ſaid Fig. 3, the tunnel and ſhaft to be walled with ſtone or brick.

XII. In this caſe, the two ciſterns are to be conſtructed without wheels; each having their valves as deſcribed in article the ſecond herein before contained.

XIII. Two inclined planes muſt deſcend from the edge of the ſhaft into the upper level, for the purpoſe of raiſing the boat on the ciſterns, as at A and B, Fig. 6; which repreſents the top of the ſhaft on the lower level: ſimilar planes muſt be conſtructed to raiſe the boat on the lower ciſtern.

XIV.

XIV. On the top of the ſhaft, a ſtrong frame-work muſt be conſtructed, to ſupport the weight of the work, as deſcribed in article the fourth.

XV. One ciſtern being placed at the lower level, and one at the next aſcending level, the leading-ropes are to be ſtretched, as deſcribed in article the fifth, and ſecured to the ciſterns by brace-blocks; the ciſterns will then play alternately from the lower to the upper level, as in the ſaid Fig. 3. Two ſmall carriages are to be uſed to raiſe the boats on the ciſtern, as in article the ſeventh.

XVI. The power to raiſe the boats on the ciſterns may be obtained by a capſtan, or water-wheel, as deſcribed in article the eighth: the water-wheels being placed in the ſhaft, as in the ſaid Fig. 3.

XVII. The component parts of my ſaid invention, ſo far as reſpects the uſe thereof in a perpendicular lift, being deſcribed, the ſaid Fig. 3 exhibits the lift with its ciſterns. In this caſe, the boats are to be drawn on the ciſterns, as deſcribed in article the tenth, and water ſufficient let into the

the upper ciſtern to preponderate againſt the weight beneath; which, deſcending the ſhaft or lift, will draw its opponent to the next aſcending level. The boats are then to be let off into the different levels, and others raiſed on the ciſterns; the water to be received and diſcharged in and from the ciſterns, as deſcribed in article the tenth, herein before contained, and ſo on alternately.

XVIII. Laſtly, in the operation of the perpendicular lift, the two ciſterns, with their boats, muſt paſs each other ſide by ſide, and be worked either with ropes or chains, of which Fig. 10 exhibits the ciſterns. In witneſs whereof, &c.

XXXIV.

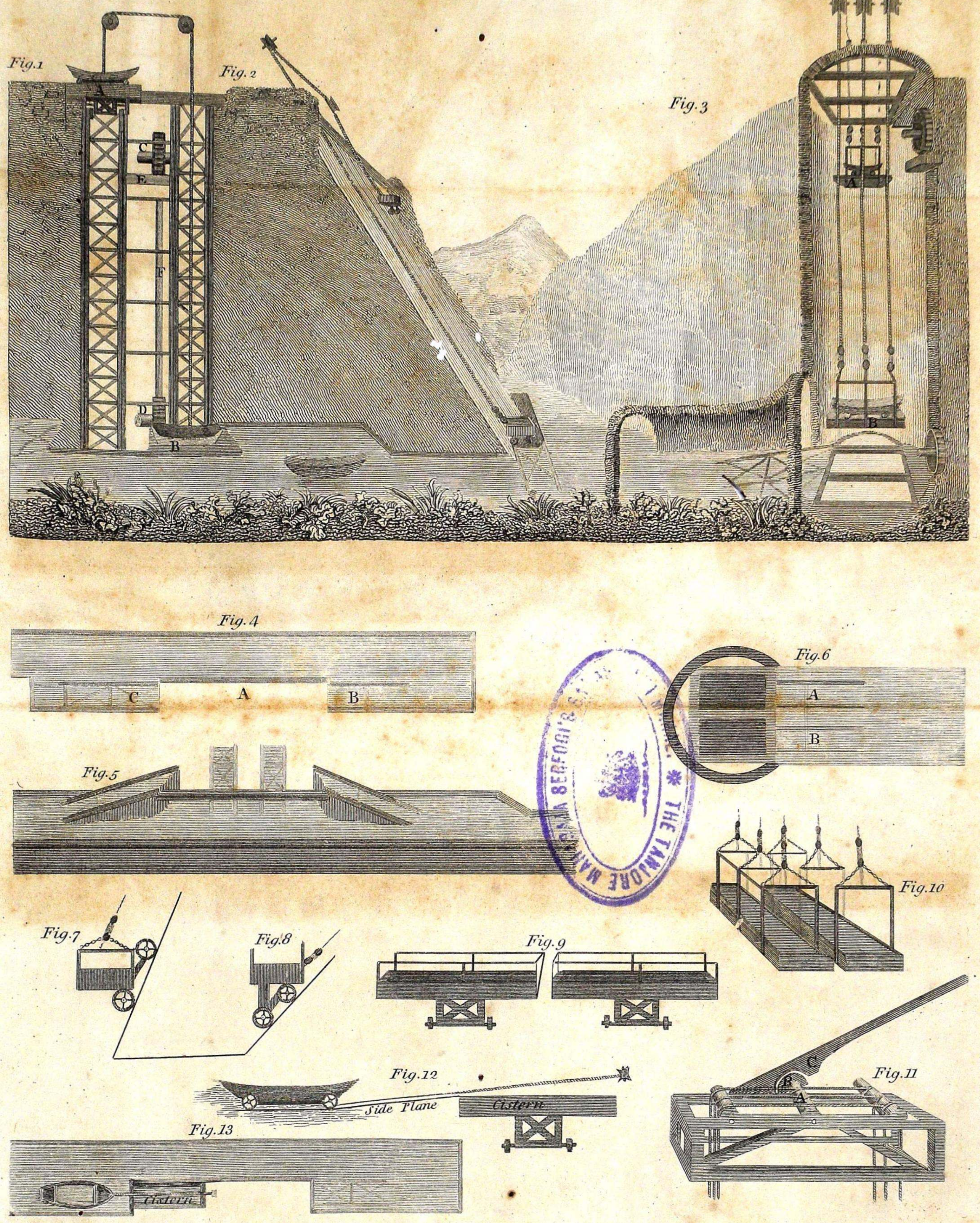


Fig. 1
A
C
E
F
D
B
Fig. 2
Fig. 3
A
B
Fig. 4
C
A
B
Fig. 5
Fig. 6
A
B
Fig. 7
Fig. 8
Fig. 9
Fig. 10
Fig. 11
A
B
C
Fig. 12
Side Plane
Cistern
Fig. 13
Cistern

XXXIV. *Specification of the Patent granted to Mr.* GEORGE CUMMINGS, *of Ludgate-ſtreet, London, Toyman; for his Invention of a Compoſition to put on all Sorts of Skins, Paper, or Linen, for drawing or writing on with Pen and Ink, or Pencil, and rubbing clean off again**.

Dated March 31, 1764.—Term expired.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that in compliance with the ſaid proviſo, I the ſaid George Cummings do hereby declare, that my ſaid invention of a compoſition to put on all ſorts of ſkins, paper, or linen, for the uſe of drawing or writing on with pen and ink, or pencil, and rubbing clean off again, and to form it into a memorandum-book, diſtinguiſhed by putting the name of each day of

* This is what was called German *aſſes-ſkin*.

the week on the top of each leaf of the book, and for other uſes and purpoſes, is to be performed in manner following; that is to ſay, take either vellum, parchment, very fine cloth, or paper, and ſtretch it in a frame as tight as poſſible. Then take twelve pounds of white-lead, and pound it very fine; add thereto one-third part of the beſt plaſter of Paris, and one-fourth part of the beſt ſtone-lime; pound them well, mix them well together, and grind them very fine with water. Then take a new glazed veſſel, and diſſolve ſix or ſeven pounds of the beſt double ſize, over a fire, and mix the above ingredients in this, till it is of ſuch a conſiſtence as to lay on with a bruſh. Then lay three or four layers on the ſkin or cloth, as ſmooth as poſſible; obſerving that the ſkin is dry each time, before a ſecond layer is put on. Then take the beſt nut or linſeed oil, and to every pound of this oil add four ounces of the beſt white varniſh, and mix them well together. Then put on three or four layers of this oil, thus prepared, each time expoſing it to the air till it is thoroughly dry: this is for the white ſort. For a brown or yellow, add to every pound of the above,

above, three or four ounces of the beſt ſtone-oker, or orpiment, or Dutch pink, and three or four ounces of litharge. Theſe muſt be well ground with very old linſeed-oil, and laid on, as ſmooth as poſſible, ten or twelve times; expoſing it each time to the air, to be thoroughly dry, before a ſecond layer is put on: obſerve you do not put it where any duſt or dirt can fall upon it. It may be, by the ſame proceſs, altered to any colour: as for inſtance; to a red, by tincturing it with vermilion, or the like; to a blue, Pruſſian blue; and for a black, by pounding ſlate, grinding it very fine, and mixing with it as much ivory-black as will turn it to a fine black colour. When it is thoroughly dry, you may write on it with a ſlate-pencil, or black or red lead. In witneſs whereof, &c.

XXXV. *Specification of the Patent granted to Mr.* THOMAS BINNS, *of Barlow-ſtreet, in the Pariſh of St. Mary-le-bone, Carpenter; for his Invention of a Machine or Apparatus for Water-Cloſets and Privies; which, upon a ſelf-acting Principle, will introduce Water into the Baſon, and empty and cleanſe the ſame, leaving a proper Portion of clean Water therein, without the Aſſiſtance or Attention of any Perſon thereto.*

WITH A PLATE.

Dated March 15, 1793.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in purſuance of the ſaid letters patent, and of the above-mentioned proviſo therein contained, I the ſaid Thomas Binns do hereby particularly diſcloſe, diſcover, deſcribe, and aſcertain, the nature of my ſaid invention, in manner following; that is to ſay, I do hereby refer

refer to the drawing hereunto annexed, which I conſider as a part of this my ſpecification, and the ſeveral letters thereon as references to the deſcription hereafter more particularly mentioned, and which is as follows. Firſt, A (Plate XIV.) is the vaſe or baſon under the ſeat. BB is the water-ciſtern, which may be in any part of the houſe where it will be moſt convenient. C is a box or veſſel of lead, copper, or any other proper material; which is to contain the quantity of water neceſſary for the proceſs, and no more, and may be called the *meaſurer:* at the top of it is a valve, at D, to let the water in from the ciſtern, and at the bottom, at E, another valve, to let the water out. Y is a cock, which, according as it may be more or leſs turned, will regulate the length of time within which the given portion of water ſhall run through, and perform the ſubſequent operations. The cock at Y is not to be turned by any perſon for the purpoſe of uſing the water-cloſet, but to be ſet in the ſame manner as though merely a ſpace left for the water to paſs through; only, by having a cock there, it may be at any time regulated as to the time within which, after the closet is used, the operation herein after described shall take place. F F is a section of the newly-invented part, a trunk or cylindrical vessel, which I call the *sliding-conveyer*; by which one of the principal effects of the machine is performed. G is a side-view of the same vessel, shewing how it is hung to a roller at H, and balanced by a weight at I; both of which are fixed at the roller by straps of leather or joint-chain. At X is a plan of the *conveyer*, with the roller, and frame in which they are fixed and act. At K is a valve, at the bottom of the *conveyer*, which is tapered, as in the annexed drawing, to let out of it into the vase, (by means of a leaden pipe J J,) the water which it receives from the *measurer*, through the valve at E. The *conveyer*, when it moves, descends to the bottom of the frame at L, about two inches, and forms a valve there, which prevents the water from rising into the frame while it is discharging it into the vase. At M is a valve, fitted to the bottom of the vase, through which the foul water is conveyed into the soil-pipe before the seat at N, and is conveyed into the com-

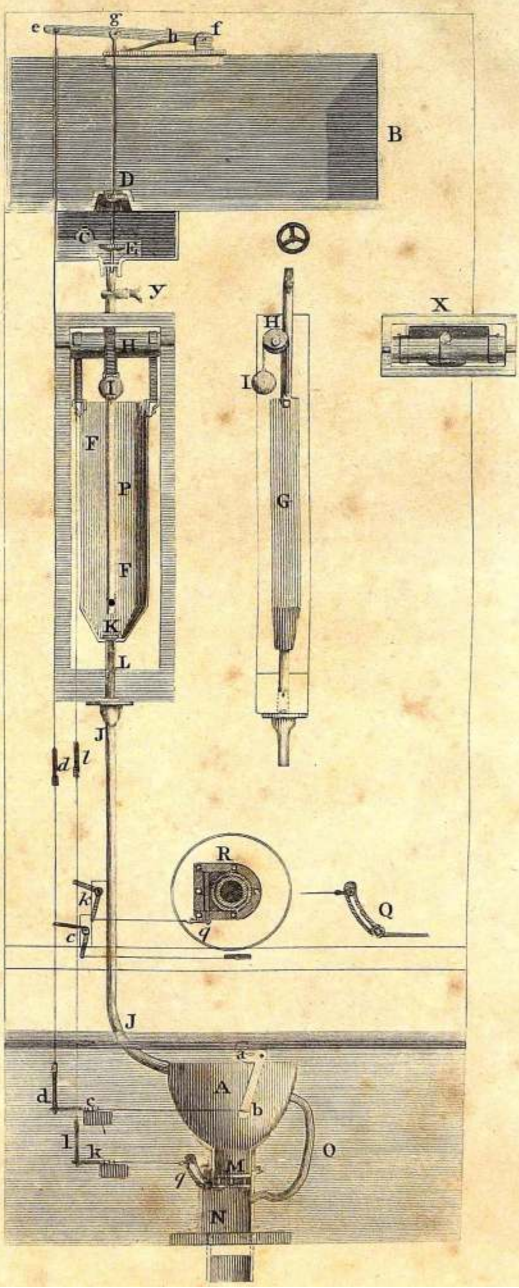
mon-

mon-ſewer or ceſs-pool. O is a leaden pipe to carry off the waſte water.

The performance of the proceſs is by ſitting down and riſing up from the ſeat. The former meaſures out the quantity of water from the ciſtern, by means of the ſeat deſcending about a quarter of an inch; and, by preſſing the lever-crank at *a*, the other end, at *b*, draws back three quarters, and pulls the crank at *c*, which is horizontal, and that communicates with a vertical one at *d*; which, by a wire, draws down the end of the lever at the top of the ciſtern by the end *e*, which opens the valve at D, at the bottom of the ciſtern, and cloſes that at E, in the *meaſurer*. The lever-crank below, with the valves, *&c.* are parts of the new invention. At R is a plan, which exhibits a ſection through the neck of the vaſe, and ſhews how the lever *q*, fixed to the valve, draws the cranks at *k* and *l*, anſwering to thoſe at *k* and *i* below. On riſing from the ſeat, the valve of the ciſtern is cloſed, and that of the *meaſurer* opened; which diſcharges its contents into the *conveyer*, cauſing it to deſcend with the

the weight of the water it has received, which is discharged into the vase by the leaden pipe J J; which being done, it rises again by the weight at I, (the roller being so contrived, by making it elliptical where the strap or chain by which it is hung embraces it,) and thereby loses its power or weight, in respect of the *conveyer*, when down; but recovers it again to the full diameter when it is up, and, by its superior weight, drawing back the lever at *q*, shuts the valve at M, and keeps it water-tight. Mean while, the water from the *conveyer* is injected by the pipe J J into the vase, which rinses it clean; part of which is retained by the closing of the valve at M; after which, the remaining water in the *conveyer* descends through a small notch in the valve at K, filling the vase with the due quantity of water for the next occasion. As witness my hand and seal, &c.

XXXVI.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XXXVI. *Appendix to Mr.* Wedgwood's *Attempt to compare and connect the Thermometer for strong Fire with common mercurial ones* *.

WITH A PLATE.

From the Transactions of the Royal Society of London.

Since my former experiments were made, I have seen a very curious memoir by Messrs. Lavoisier and De la Place, containing a Method of measuring heat by the quantity of ice which the heated body is capable of liquefying. The application of this important discovery, as an intermediate standard-measure between Fahrenheit's thermometer and mine, could not escape me; and I immediately set about preparing an apparatus, and making the experiments necessary for that purpose, in hopes either of attaining, by this

* See our last Number, p. 173.

method,

method, a greater degree of accuracy than I could expect from any other means, or of having what I had already done confirmed, by a ſeries of experiments upon a different principle.

But, in the proſecution of theſe experiments, I have, to my great mortification, hitherto failed of ſucceſs; and I ſhould have contented myſelf for the preſent with ſaying little more than this, if ſome phænomena had not occurred, which appear to me not unworthy of farther inveſtigation.

The authors obſerve, that if ice, cooled to whatever degree below the freezing point, be expoſed to a warmer atmoſphere, it will be brought up to the freezing-point, through its whole maſs, before any part of its ſurface begins to liquefy; and conſequently that ice, beginning to melt on the ſurface, will be always exactly of the ſame temperature, *viz.* at the freezing-point; and that, if a heated body be encloſed in a hollow ſphere of ſuch ice, the whole of its heat will be taken up in liquefying the ice; ſo that, if the ice be defended from external warmth, by ſurrounding it with other ice in a ſeparate veſſel, the weight of the water produced from it will be exactly proportional to the heat which the heated body has loſt, or, in other words, will be a true phyſical meaſure of the heat.

For applying theſe principles in practice, they employ a tin veſſel, divided, by upright concentric partitions, into three compartments, one within another. The innermoſt compartment is a wire cage, for receiving the heated body. The ſecond, ſurrounding this cage, is filled with pounded ice, to be melted by the heat; and the outermoſt is filled alſo with pounded ice, to defend the former from the warmth of the atmoſphere. The firſt of thoſe ice-compartments terminates at bottom in a ſtem like a funnel, through which the water is conveyed off; and the other ice-compartment terminates in a ſeparate canal, for diſcharging the water into which *that* ice is reduced. As ſoon as the heated body is dropped into the cage, a cover is put on, which goes over both that and the firſt ice-compartment; which cover is itſelf a kind of ſhallow veſſel, filled with pounded ice, with holes in the bottom, for permitting the water from this ice to paſs into the ſecond compartment; all the liquefaction that happens here, as well as there, being the effect of the heated body only. Over the whole is placed another cover, with pounded ice, as a defence from external warmth.

As ſoon as this diſcovery came to my knowledge, on the 23d of February, a thaw having begun three days before, after a froſt which had continued, with very little intermiſſion, from the 24th of December, I collected a quantity of ice, and ſtored it up in a large caſk in a cellar.

I thought it neceſſary to ſatisfy myſelf, in the firſt place, by actual experiment, that ice, how cold ſoever it may be, comes up to the freezing-point, through its whole maſs, before it begins to liquefy on the ſurface. For this purpoſe, I cooled a large fragment of ice, by a freezing mixture, to 17° of Fahrenheit's thermometer, and then hung it up in a room whoſe temperature was 50°. When it began to drop, it was broken, and ſome of the internal part nimbly pounded, and applied to the bulb of a thermometer that was cooled, by a freezing mixture, below 30°. The thermometer roſe to, and continued at, 32°. Being then taken out, and raiſed, by warmth, to

40°,

40°, some more of the same ice, applied as before to the bulb, sunk it again to 32°; so that no doubt could remain on this subject.

Apprehensive that pounded ice, directed by the authors, might imbibe or retain more or less of the water, by capillary attraction, according to circumstances, and thereby occasion some error in the results, I thought it necessary to satisfy myself in this respect also by experiment. I therefore pounded some ice, and laid it in a conical heap on a plate; and, having at hand some water coloured with cochineal, I poured it gently into the plate, at some distance from the heap. As soon as it came in contact with the ice, it rose hastily to the top; and, on lifting up the lump, I found that it held the water, so taken up, as a sponge does, and did not drop any part of it till the heat of my hand, as I suppose, began to liquefy the mass. On farther trials I found, that in pounded ice, pressed into a conical heap, the coloured water rose, in the space of three minutes, to the height of two inches and a half; and, by weighing the water employed, and what remained upon the plate unabsorbed, it appeared, that four ounces of ice had thus taken up, and retained, one ounce of water.

To afcertain farther this abforbing power, in different circumftances, more analogous to thofe of the procefs itfelf, I preffed fix ounces of pounded ice pretty hard into the funnel, having firft introduced a wooden core, in order to leave a proper cavity in the middle; then, taking out the core, and pouring an ounce of water upon the ice, I left the whole for half an hour; at the end of which time the quantity that ran off was only 12 pennyweights and 4 grains; fo that the ice had retained 7 pennyweights and 20 grains, which is nearly one-twelfth of its own weight, and two-fifths of the weight of the water.

Thefe previous trials determined me, inftead of ufing pounded ice, to fill a proper veffel with a folid mafs of ice, by means of a freezing mixture, as the froft was now gone, and then expofe it to the atmofphere till the furface began to liquefy. The apparatus I fitted up for this purpofe was made of earthen-ware well glazed, and is reprefented in Plate XV. AA is a large funnel, filled with a folid mafs of ice. B, a cavity

vity in the middle of this ice, formed, part of the way, by ſcraping with a knife, and, for the remaining part, by boring with a hot iron wire. C, one of the thermometer pieces, which ſerves for the heated body, and reſts upon a coil of braſs wire: it had previouſly been burnt with ſtrong fire, that there might be no danger of its ſuffering any farther diminution of its bulk, by being heated again for theſe experiments. D, a cork-ſtopper in the orifice of the funnel. EE, the exterior veſſel, having the ſpace between its ſides, and the included funnel A, filled with pounded ice, as a defence to the ice in the funnel. F, a cover for this exterior veſſel, filled with pounded ice, for the ſame purpoſe. G, a cover for the funnel, filled only with pounded ice, with perforations in the bottom, for allowing the water from this ice to paſs down into the funnel.

The thermometer-piece was heated in boiling water, taken up with a pair of ſmall tongs equally heated, dropped inſtantly into the cavity B, and the covers put on as expeditiouſly as poſſible; the bottom of the funnel being previouſly corked, that the water might be detained till it ſhould part with all its heat, and likewiſe to prevent the water

water from the other ice, which ran down on the outfide of the funnel, from mingling with it.

After ftanding about ten minutes, the funnel was taken out, wiped dry, and uncorked over a weighed cup; the water that ran out weighed 22 grains. Thinking this quantity too fmall, as the piece weighed 72 grains, I repeated the experiment, and kept the piece longer in the funnel; but the water this time weighed only 12 grains. Being much diffatisfied with this refult, I made a third trial, continuing the piece much longer in the cavity; but the quantity of water was now ftill lefs, not amounting to quite three drops; and, to my great furprife, I found the piece frozen to the ice, fo as not to be eafily got off, though all the ice employed was, at the beginning of the experiment, in a thawing ftate.

I had prepared the apparatus for taking the boiling heat of mercury; but, being entirely difcouraged by thefe very unequal refults, I gave that up, for the prefent at leaft, and, heating the piece to 60° of my thermometer, turned it nimbly out of the cafe in which it was heated into the cavity, throwing fome fragments of ice over it. In

about

about half an hour I drew off the water, which amounted to 11 pennyweights; then, stopping the funnel again, and replacing the covers, I left the whole about seven hours.

At the end of that time, I found a considerable quantity of water in the funnel; the melting of the ice had produced a cavity between it and the sides, great part of the way down, which, as well as that in the middle, was nearly full. The water neverthelefs ran out so slowly, that I apprehended something had stopped the narrow end of the funnel, but the true cause became afterwards apparent upon examining the state of the ice. The fragments which I had thrown over the thermometer-piece were frozen entirely together, and in such a form as they could not have assumed, without fresh water superadded and frozen upon them, for the cavities between them were partly filled with new ice. I endeavoured to take the ice out with my fingers, but in vain; and it was with some difficulty I could force it asunder, even with a pointed knife, to get at the thermometer-piece; when that was got out, great part of the coiled wire was found enveloped in new ice. The

passage

paſſage through the ice to the ſtem of the funnel, which I had made pretty wide with a thick iron wire red-hot, was ſo nearly cloſed up, that the ſlow draining off of the water was now ſufficiently accounted for, and indeed this draining was the only apparent mark of any paſſage at all. On taking the ice out of the funnel, and breaking it, to examine this canal, I found it almoſt entirely filled up with ice, projecting from the ſolid maſs in cryſtaline forms, ſimilar in appearance to the cryſtals we often meet with in the cavities of flints and quartzoſe ſtones.

If, after all theſe circumſtances, any doubt could have remained of the ice in queſtion being a new production, a fact which I now obſerved muſt have removed all ſuſpicion. I found a coating of ice, of conſiderable extent, and perfectly tranſparent, about a tenth of an inch in thickneſs, upon the outſide of the funnel, and on a part of it which was not in contact with the ſurrounding ice, for that was melted to the diſtance of an inch from it.

Some of the ice being ſcraped off from the inſide of the funnel, and applied to the bulb of the thermometer,

thermometer, the mercury ſunk from 50° to 32°, and continued at that point till the ice was melted; after which, the water being poured off, it roſe in a little time to 47°.

Aſtoniſhed at theſe appearances of the water freezing after it had been melted, though ſurrounded with ice in a melting ſtate, and in an atmoſphere of about 50°, where no part of the apparatus or materials could be ſuppoſed to be lower than the freezing point, I ſuſpected, at firſt, that ſome of the ſalt of the freezing mixture might have got into the water, and that this, in diſſolving, might perhaps abſorb, from the parts contiguous to it, a greater proportion of heat than the ice of pure water does. But the water betrayed nothing ſaline to the taſte; and I had applied the freezing mixture with my own hands, and with great care, to prevent any of it being mixed with the water.

To remove all doubts, however, upon this point, I purpoſed repeating the experiment, with ſome pieces of the ice I had ſtored up in the cellar, to ſee if this would congeal, after thawing, in the ſame manner. But, going to fetch the ice, and examining it in the caſk in which it was kept, I was perfectly ſatisfied with the appearances I found there; for, though much of it was melted, yet the fragments were frozen together, ſo that it was with difficulty I could break or get out any pieces of it with an iron ſpade; and, when ſo broken, it had the appearance of *breccia* marble, or plumb-pudding ſtone, for the fragments had been broken, and rammed into the caſk with an iron mall.

A porcelain cup being laid upon ſome of this ice about half an hour, in a room whoſe temperature was 50°, it was found pretty firmly adhering; and, when pulled off, the ice exhibited an exact impreſſion of the fluted part of the cup, with which it had been in contact; ſo that the ice muſt neceſſarily have liquefied firſt, and afterwards congealed again. This was repeated ſeveral times, with the ſame event. Fragments of the ice were likewiſe applied to one another; to ſponges; to pieces of flannel, and of linen cloth, both moiſt and dry: all theſe, in a few ſeconds, began to cohere, and, in about a minute, were frozen ſo as to require ſome force to ſeparate them. After ſtanding

ſtanding an hour, the coheſion was ſo firm, that, on pulling away the fragments of ice from the woollen and ſponge, they tore off with them that part of the ſurface with which they were in contact; though, at the ſame time, both the ſponge and flannel were filled with water which that very ice had produced.

To make ſome eſtimate of the force of the congelation, which was ſtronger on the two bodies laſt mentioned than on linen, I applied a piece of ice to a piece of dry flannel which weighed two pennyweights and a half, and ſurrounded them with other ice. After lying together three quarters of an hour, taking the piece of ice in my hand, and hooking the flannel to a ſcale, I found a weight of five ounces to be neceſſary for pulling it off; and yet ſo much of the ice had liquefied as to increaſe the weight of the flannel above 12 pennyweights. I then weighed the piece of ice, put them together again, and four hours after found them frozen ſo firmly as to require 78 ounces for their ſeparation; although, from 42 pennyweights of the ice, 15 more had melted off: the ſurface of contact was, at this time, nearly a ſquare inch. I continued them again together for ſeven hours, but they now bore only 62 ounces; the ice being diminiſhed to 14 penny-weights, and the ſurface of contact reduced to about ſix-tenths of a ſquare inch.

Having ſeen before, that pounded ice abſorbs water in very conſiderable quantity, I ſuſpected that ſomething of the ſame kind might take place even with entire maſſes; and experiment ſoon convinced me, that even apparently ſolid pieces of ice will imbibe water, ſlower or quicker, according to its ſtage of decay. I have repeatedly heated ſome of my thermometer-pieces, and laid them upon ice, in which they made cavities of conſiderable depth; but the water was always abſorbed, ſometimes as faſt as it was produced, leaving both the piece and the cavity dry.

Thus, though I cannot ſufficiently expreſs how much I admire the diſcovery that gave riſe to theſe experiments, I have nevertheleſs to lament my not being able to avail myſelf of it at preſent, for the purpoſe I wiſhed to apply it to.

That, in my experiments, the two ſeemingly oppoſite proceſſes of nature, congelation and liquefaction,

faction, went on together, at the same instant, in the same vessel, and even in the same fragment of ice, is a fact of which I have the fullest evidence that my senses can give me; and I shall take the liberty of suggesting a few hints, which may tend perhaps to elucidate their cause, and to shew that they are not so incompatible as at first sight they appear to be.

It occurred to me, at first, that water highly attenuated and divided, as when reduced into vapour, may freeze with a less degree of cold than water in its aggregate or grosser form; hence, hoar-frost is observed upon grass, trees, &c. at times when there is no appearance of ice upon water, and when the thermometer is above the freezing-point *. Boerhaave, I find, in his elaborate theory

* I am aware that experiments and observations of this kind are not fully decisive; that the atmosphere may, in certain circumstances, be much warmer or colder than the earth and waters, which, in virtue of their density, are far more retentive of the temperature they have once received, and less susceptible of transient impressions; that even insensible undulations of water, from the slightest motion of the air, by bringing

theory of fire, aſſigns 33° as the frezing-point of vapour, and even of water, when divided only by being imbibed in a linen cloth.

Now, as the atmoſphere abounds with watery vapour, or water diſſolved and chemically combined, and muſt be particularly loaded with it in the neighbourhood of melting ice; as the heated body, introduced into the funnel, muſt neceſſarily convert a portion of the ice or water there into

bringing up warmer ſurfaces from below, may prove a farther impediment to the freezing; and, therefore, that the degree of cold, which is ſufficient to produce hoar-froſt, may poſſibly, if continued long enough, be ſufficient alſo to produce ice. I am not acquainted with any ſatisfactory experiments or obſervations yet made upon the ſubject; nor do I advance the principle as a certain, but as a probable one, which occurred to me at the moment, which is countenanced by general obſervation, and conſentaneous to many known facts; for there are numerous inſtances of bodies, in an extreme ſtate of diviſion, yielding eaſily to chemical agents, which, before ſuch diviſion, they entirely reſiſt; thus, ſome precipitates, in the very ſubtle ſtate in which they are at firſt extricated from their diſſolvents, are re-diſſolved by other menſtrua, which, after their concretion into ſenſible moleculæ, have no action upon them at all.

vapour

vapour; and, as ice is known to melt as ſoon as the heat begins to exceed 32°, or nearly one degree lower than the freezing-point of vapour; I think we may hence deduce, pretty ſatisfactorily, all the phænomena I have obſerved. For, it naturally follows, from theſe principles, that vapour may freeze where ice is melting; that the vapour may congeal, even upon the ſurface of the melting ice itſelf; and that the heat which (agreeably to the ingenious theory of Dr. Black) it emits in freezing, may contribute to the farther liquefaction of that very ice upon which the new congelation is formed.

I would farther obſerve, that the freezing of water is attended with plentiful evaporation in a cloſe as well as an open veſſel; the vapour, in the former, condenſing into drops on the under ſide of the cover, which either continue in the form of water, or aſſume that of ice, or a kind of ſnow, according to circumſtances *; which evaporation may perhaps be attributed to the heat that was

* See Mr. Baron's paper on this ſubject, in the Memoirs of the Academy of Sciences at Paris for the year 1753.

combined

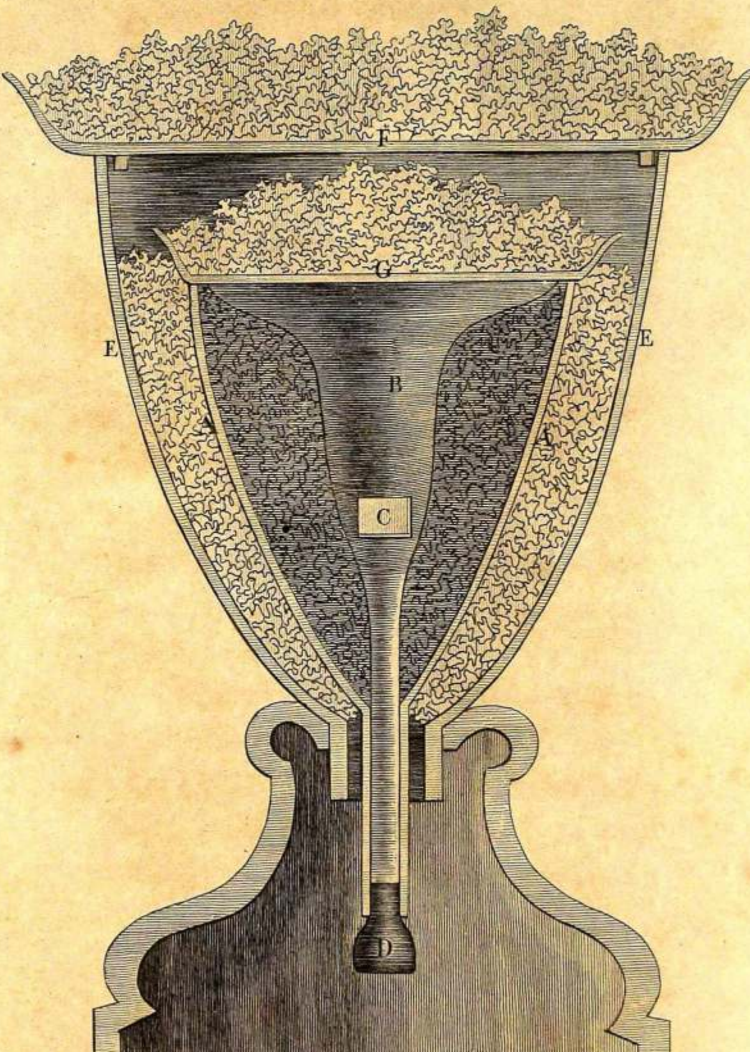
combined with the water, at this moment rapidly making its eſcape, and carrying part of the aqueous fluid off with it. We are hence furniſhed with a freſh and continual ſource of vapour, as well as of heat; ſo that the proceſſes of liquefaction and congelation may go on uninterruptedly together, and even neceſſarily accompany one another; although, as the freezing muſt be in an under proportion to the melting, the whole of the ice muſt ultimately be conſumed.

In the remarkable inſtance of the coating of ice on the outſide of the throat of the funnel, there are ſome other circumſtances which it may be proper to take notice of. Neither the cover of the outer veſſel, nor the aperture in its bottom, which the ſtem of the funnel paſſed through, were air-tight; and the melting of the ſurrounding ice had left a vacancy of about an inch, round that part of the funnel on which the cruſt had formed. As there was, therefore, a paſſage for air through the veſſel, a circulation of it would probably take place; the cold and denſe air in the veſſel would deſcend into the rarer air of the room, then about 50°, and be replaced by air from

from above. The effect of this circulation, and sudden refrigeration, of the air, will be a condensation of part of the moisture it contains, upon the bodies it is in contact with: the throat of the funnel, being one of those bodies, must receive its share; and, the degree of cold in which the ice thaws being supposed sufficient for the freezing of this moist vapour, the contact, condensation, and freezing, may happen at the same instant.

The same principles apply to every instance of congelation that took place in these experiments; and a recollection of particulars which passed under my own eye convinces me, that the congelation was strongest in those circumstances where vapour was most abundant, and on those bodies which, from their natural or mechanical structure, were capacious of the greatest quantity of it: stronger, for instance, on sponge than on woollen: stronger on this than on the closer texture of linen; and far stronger on all these than on the compact surface of porcelain.

If, nevertheless, the principle I have assumed (that water highly attenuated will congeal with a lefs degree of cold than water in the mafs) fhould not be admitted, another has above been hinted at, which experiments have decidedly eftablifhed, from which the phænomena may perhaps be equally accounted for, and which, even though the other alfo is received, muft be fuppofed to concur for fome part of the effect: I mean, that *evaporation produces cold*; both vapour and fteam carrying off fome proportion of heat from the body which produces them. If, therefore, evaporation be made to take place upon the furface of ice, the contiguous ice will thereby be rendered colder; and, as it is already at the freezing point, the fmalleft increafe of cold will be fufficient for frefh congelation. It feems to be on this principle that the formation of ice is effected in the Eaft Indies, by expofing water to a ferene air, at the coldeft feafon of the year, in fhallow porous earthen veffels: part of the water tranfudes through the veffel, and, evaporating from the outfide, the remainder in the veffel becomes cold enough to freeze; the warmth of the earth being at the fame time intercepted, by the veffels being placed upon bodies little difpofed to conduct heat.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heat *. If ice is thus producible in a climate where natural ice is never seen, we need not wonder that congelation should take place where the same principle operates amidst actual ice.

It has been observed above, that the heat emitted by the congealing vapour probably unites with, and liquefies, contiguous portions of ice; but, whether the whole, either of the heat so emitted, or of that originally introduced into the funnel, is thus taken up; how often it may unite with other portions of ice, and be driven out from other new congelations; whether there exists any difference in its chemical affinity or elective attraction to water in different states, and the contiguous bodies; whether part of it may not ultimately escape, without performing the office expected from it upon the ice; and, to what distance from the evaporating surface the refrigerating effect of the evaporation may extend; must be left for farther experiments to determine.

* See a description of this process in the Philosophical Transactions, Vol. LXV. p. 252.

XXXVII. *On making Butter and Cheese. By Mr.* JOSIAH HAZARD, *of Stoney Littleton, Somerfetfhire.*

From the Letters and Papers of the Bath and Weft-of-England Society for the Encouragement of Agriculture, &c.

AS no butter is efteemed equal to that which is made in the county of Effex, which is well known by the name of Epping butter, and which, in almoft every feafon of the year, will yield at London from one fhilling to fourteen pence *per* pound, I prefume it will not be deemed improper to recommend farmers to adopt the method of making fuch butter. I fhall alfo add what I have gathered from upwards of twenty years experience, part of which time I refided, and occupied a large farm, in the neighbourhood of Epping. I have fince been a refident in the county of Somerfet;

merfet; and, in both counties, we could obtain, in general, one halfpenny or penny *per* pound more for our butter than the general market-price.

Before I proceed to point out the method of making the butter, it may not be improper to fay fomething concerning the dairy-houfe, which fhould always be kept in the neateft order, and be fo fituated that the windows or lattices fhould never front the fouth, fouth-eaft, or fouth-weft: lattices are alfo to be preferred to windows, as they admit a more free circulation of the air than glazed lights poffibly can do. It has been objected, that they admit cold air in winter, and the fun in fummer; but this defect is eafily obviated, by making a frame, the fize of, or fomewhat larger than, the lattice, and conftructing it fo as to flide backward and forward at pleafure: packthread ftrained acrofs this frame, with oiled cap-paper pafted thereon, will admit the light, and keep out the fun and wind.

It is hardly poffible in the fummer to keep a dairy-houfe too cool; on which account, none fhould be fituated far from a good fpring or current of water. It fhould be neatly paved, either with red brick or ſmooth hard ſtone, 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 we ever ſuffer the churns to be ſcalded in the dairy, as the ſteam that ariſes from hot water will injure the milk. Neither do I approve of cheeſe being kept therein, or rennet for making cheeſe, nor of having a cheeſe-preſs fixed in a dairy, as the whey and curd will diffuſe their acidity throughout the room.

The proper receptacle for milk are earthen pans, or wooden vats or trundles; but none of theſe ſhould be lined with lead, as that metal certainly is of a poiſonous nature, and may, in ſome degree, affect the milk. If people are ſo obſtinate as to perſiſt in uſing ſuch, I adviſe that they never forget to ſcald them, to ſcrub them well with ſalt and water, and to dry them thoroughly before they depoſit the milk therein. Indeed all the utenſils ſhould be cleaned in like manner before they are uſed; and if, after this, they in the leaſt degree ſmell ſour, they muſt undergo a ſecond ſcrubbing before they are fit for uſe.

With reſpect to making of butter, it is right to obſerve, that the greater the quantity made from a few cows, the greater will be the farmer's profit; therefore he ſhould never keep any but ſuch as are eſteemed good milkers. A bad cow will be equally expenſive in her keep, and will not, perhaps, (by the butter and cheeſe that are made from her,) bring in more than from three to ſix pounds a year; whereas a good one will bring in from ſeven to ten pounds a year; therefore, it is obvious that bad cows ſhould be parted with, and good ones purchaſed in their room.

When ſuch are obtained, a good ſervant ſhould be employed to milk them; as, by the neglect and miſmanagement of ſervants, it frequently happens that the beſt cows are ſpoiled. I adviſe farmers not to truſt entirely to ſervants, but ſometimes to ſee themſelves that their cows are milked clean; for, if any milk be ſuffered to remain in the udder, the cow will daily give leſs, till at length ſhe will become dry before the proper time,

time, and the next feafon fhe will fcarcely give milk fufficient to pay for her keep.

It fometimes happens, that fome of a cow's teats may be fcratched or wounded, fo as to produce foul or corrupted milk. When this is the cafe, we fhould by no means mix it with the fweet milk, but give it to the pigs; and that which is conveyed to the dairy-houfe fhould remain in the pail till it is nearly cool before it is ftrained; I mean if the weather be warm; but in frofty weather it fhould be immediately ftrained, and a fmall quantity of boiling water may be mixed with it, which will caufe it to produce cream in abundance, and the more fo, if the pans or vats have a large furface.

During the hot fummer-months, it is right to rife with or before the fun, that the cream may be fkimmed from the milk ere the dairy becomes warm; nor fhould the milk at that feafon ftand longer in the vats, &c. than twenty-four hours, nor be fkimmed in the evening till after fun-fet. In winter, milk may remain unfkimmed for thirty-fix or forty-eight hours; the cream fhould be depofited in a deep pan, which fhould be kept

during

during the ſummer in the cooleſt part of the dairy, or in a cool cellar, where a free air is admitted, which is ſtill better. Where people have not an opportunity of churning every other day, they ſhould ſhift the cream daily into clean pans, which will keep it cool; but they ſhould never fail to churn at leaſt twice a week in hot weather; and this work ſhould be done in the morning before the ſun appears, taking care to fix the churn where there is a free draught of air. If a pump-churn is to be uſed, it may be plunged a foot deep into a tub of cold water, and ſhould remain there during the whole time of churning, which will very 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

* In the volume from which this paper 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 is carried off; or, if any remain, it is ſo little as not to be perceived by the taſte. A table-ſpoonful or two of the

vinegar,

After the butter is churned, it ſhould be immediately waſhed in many different waters, till it is perfectly cleanſed from the milk; but here I muſt remark, that a warm hand will ſoften it, and make it appear greaſy, ſo that it will be impoſſible to obtain the beſt price for it. The cheeſemongers uſe two pieces of wood for their butter, and if thoſe who have a very hot hand were to have ſuch, they might work the butter ſo as to make it more ſaleable.

The Epping butter is made up for market in long rolls, weighing a pound each. In the county of Somerſet they diſh it in half-pounds for ſale; but, if they forget to rub ſalt round the inſide of the diſh, it will be difficult to work it ſo as to make it appear handſome.

Butter will require, and endure, more working in winter than in ſummer; but I muſt remark, that I never knew any perſon whoſe hand was warm by nature make good butter.

vinegar, to a gallon of cream, is ſaid to be ſufficient; and it is recommended not to be applied till the cream has undergone ſome conſiderable agitation.

Thoſe

Thoſe who uſe a pump-churn muſt endeavour to keep a regular ſtroke; nor ſhould they admit 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.

Where people keep many cows, a barrel-churn is to be preferred; but, if this be not kept very clean, the bad effects will be diſcovered in the butter; nor muſt we forget to ſhift the ſituation of the churn when we uſe it, I mean as the ſeaſons alter, ſo as to fix it in a warm place in winter, and where there is a free air 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, nor do I wiſh any perſon to make it, except for preſent uſe, as it will not keep good more than two days, and the whey will turn to better account to fatten pigs with; nothing feeds them faſter, nor will any thing make them ſo delicately white: but I muſt obſerve that no good bacon can be made from pigs thus fatted. Where much butter is made, good cheeſe for ſervants may be obtained from ſkimmed milk, and the whey will afterwards do for ſtore-pigs.

The foregoing rules will ſuffice for making good butter in any county; but, as ſome people are partial to the *weſt-country* method, I ſhall deſcribe it as briefly as poſſible.

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

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. If it be put into a tub, it is beaten well with the hand, and thus they obtain butter; but a cleanlier way is to make use of a churn. Some scald it over the fire, but then the 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 Cambridgeshire salt butter is held in the highest esteem, and is made nearly after the same method as the Epping; and, by washing and working the salt from it, the cheesemongers in London often sell it, at a thigh price, for fresh butter. It is deposited, when made, into wooden tubs or firkins, which are exposed to the air for two or three weeks, washing them often; but, a readier way is to season them with unslaked lime; or a large quantity of salt and water well boiled will do; with this they must be scrubbed several

times,

times, and afterwards thrown into cold water, where they ſhould remain three or four days, or till they are wanted. They ſhould then be ſcrubbed as before, and well rinſed with cold water; but, before they receive the butter, care muſt be taken to rub every part of the inſide of the firkin with ſalt. Then, if the butter be properly made, and perfectly ſweet, it may be gently preſſed into the firkin; but it muſt be well ſalted when it is made up, and the ſalt ſhould be equally diſtributed through the whole maſs, a good handful of ſalt being ſpread on the top of the firkin; after which the head ſhould be immediately put on.

They purſue nearly the ſame method in Suffolk and Yorkſhire; nor is the butter that is made in thoſe counties much inferior to that made in Cambridgeſhire; indeed it is often ſold in London for Cambridge butter. No people make more butter from their cows than the Yorkſhire farmers do, which, I am perſuaded, is owing to the care they take of their cows in the winter: at that ſeaſon they houſe them all, feed them with good hay, and never ſuffer them to go out (except to water) but when the weather is very ſerene.

When

When their cows calve, they give them comfortable malt-maſhes for two or three days after; but theſe cows never anſwer if they are removed to other counties, except the ſame care and attendance be given them, and then none anſwer better.

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; but thoſe cows that give milk muſt not partake of the hay made therefrom, as that will alſo diffuſe 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.

TO BE CONCLUDED IN OUR NEXT.

XXXVIII. *Conclufion of* M. Macquer's *Experiments upon the Compofition of Flint-glafs, &c.*

(From Page 214.)

I TOOK fome red-lead or minium, which is a calx of lead as much calcined as it can poffibly be by the action of fire, affifted by the concurrence of air. I put it into a matrafs, and poured upon it as much good nitrous acid as was fufficient to cover it, and to reach about an inch above it. The acid, without heat, had no fenfible effect upon the lead, except that of changing its bright red colour into a dark tawny brown.

Having afterwards placed this mixture upon a fand-bath, the acid, by the help of heat, diffolved a part of the red-lead, with effervefcence: the other part remained at the bottom of the matrafs, without changing its colour. I encreafed the

the heat, till I made the nitrous acid boil: a great quantity of fumes then eſcaped from it, which were of a white colour, as when this acid is watery, and does not act upon a metallic or inflammable ſubſtance. Theſe fumes continued to ariſe, till the mixture was reduced almoſt to dryneſs; then, by encreaſing the fire, the acid began to give out red fumes, which had their uſual ſmell. This kind of vapour continued, encreaſing in quantity and in ſmell, until the whole was brought to perfect dryneſs.

After breaking the matraſs, I found the red-lead in the form of a cake, which had ſeparated a little from the bottom. This cake was of a beautiful white colour at its upper ſurface; greyiſh in the middle; and of a dull brick colour at the bottom. The white part had a very ſtrong ſtyptic taſte; the red part had no ſenſible taſte.

I powdered, ground, and mixed the whole together: it was then of a greyiſh colour, and had rather a ſtyptic taſte, with a degree of ſweetneſs. I calcined this matter, with a naked fire, in a veſſel made of crucible-earth: it became quite red by calcination, and had very much the ap-

 pearance

pearance of red-lead. Having encreafed the fire, to fuch a degree as to bring the veffel to a dull red heat, a part of the matter began to melt into a yellow fubftance, which looked like mafficot, and adhered very ftrongly to the veffel.

Every circumftance of this experiment fhewed, that the calx of lead had not acquired any farther degree of calcination from the action of the nitrous acid. It even appeared to me, that this acid, inftead of taking the inflammable principle from the red-lead, was more likely to reftore it; and, as I had no hopes of improving flint-glafs by ufing a calx of lead thus prepared, I omitted trying it as an ingredient in its compofition, that I might the fooner enter into an examination of the effects of the marine and vitriolic acids upon the calces of lead.

I made a *plumbum corneum*, by precipitating a folution of lead in nitrous acid, by means of common falt. I filtered the liquor, to feparate the precipitate; and, after having dried it, I put fome of it, by itfelf, in a fmall crucible, into an open fire. When the crucible became red-hot, a part of the *plumbum corneum* exhaled in vapours like arfenic;

arſenic; another part paſſed through the crucible, but without melting any of it; in ſhort, the whole of the matter was loſt.

I put another portion of this *plumbum corneum* into a glaſs veſſel, and heated it gradually and carefully: when it approached to a dull red heat, and before it began to emit any fumes, it melted calmly, like ſo much wax. When it was cold, I found it united into one ſingle piece, of a white colour, and about as tranſparent as porcelain: it could neither be bent nor cut.

I then mixed two parts of this *plumbum corneum* with one part of fine ſand, ground, and put the mixture into a ſmall cup of hard porcelain. I heated it gradually; it bore a bright red heat without melting, but fumed very much. I covered the cup with an earthen cover, and encreaſed the fire, during three quarters of an hour, up to a white heat. At the end of that time, I found the earthen cover ſtrongly attached to the cup. Having ſeparated it, the matter ſtill continued to fume: it lay at the bottom of the cup, not melted, in the form of a white maſs, which, though rather hard, and adhering to the cup, might eaſily be broken. The inſide of a tube, which I had placed over the furnace to encreaſe the draught, was entirely covered with white flowers.

Theſe experiments prove very clearly, that lead, when combined with the marine acid, is too volatile to be made to vitrify with pure ſand; conſequently I could not expect any advantage from ſuch a preparation of lead.

It ſtill remained for me to try what would be the effects of a combination of this metal with vitriolic acid. With that intention I put ſome red-lead into a matraſs, and poured upon it ſome concentrated vitriolic acid. A conſiderable motion, ſuch as accompanies diſſolution, immediately took place; the whole of the red-lead was penetrated by the acid, and, aſſiſted by the heat of a ſand-bath, became white, like a ſalt. I encreaſed the fire, in order to drive off the acid: a great quantity of white fumes were emitted, which had not any ſulphureous ſmell. Finding it difficult to bring the matter to perfect dryneſs in the matraſs, I broke it, and put its contents into an earthen veſſel capable of bearing the fire. A very

ſtrong

ſtrong degree of fire was requiſite to dry the matter completely; from which there again exhaled a great quantity of thick white fumes, but which, like the others, had not a ſulphureous ſmell, nor could they indeed, properly ſpeaking, be ſaid to have any ſmell at all. When theſe vapours ceaſed to ariſe, the bottom of the veſſel being ſtill red-hot, I examined the matter: it was in the form of a cake, the top and bottom of which were very white, while the middle of it was of a light ſcarlet colour. I ground this matter, and mixed with it a ſufficient quantity of freſh vitriolic acid to make it into a paſte, which I again expoſed to the heat of a ſand-bath, in the ſame veſſel. Every thing went on as in the former operation: the acid exhaled in white vapours, without ſmell, till the matter was dry; which was now of a white colour, but had throughout a very ſlight ſhade of ſcarlet.

I calcined a part of this calx, or rather vitriol of lead, for the ſpace of two hours, by a pretty ſtrong fire, in a crucible: it appeared to me neither to be fuſible, like the calx made by the nitrous acid, nor volatile, like the *plumbum corneum*.

The

The only effect of this ſtrong calcination was, that the maſs acquired a yellow colour, which was darker at its ſurface than within.

Judging, from theſe circumſtances, that this ſalt deſerved to be tried as an ingredient in flint-glaſs, I mixed two ounces and a half with one ounce of fine ſand, ground. I put three ounces and ſix grains of this mixture into a veſſel, which I lined with fine ſand, properly prepared, and placed it under the muffle of my wind-furnace. After it had been expoſed to a moderate fire about an hour, ſeeing that the mixture gave no ſign of fuſion, I encreaſed the fire to a white heat, in which I kept it for an hour and a half; and I obſerved, with great ſurpriſe, that notwithſtanding the continuance of this violent degree of heat, and the quantity of lead which entered into the compoſition of the mixture, it not only was not vitrified, but the matter, which was of a white colour, was very little contracted, and had acquired very little conſiſtence. Having collected and weighed it very carefully, I found that it had ſuffered a loſs of weight, amounting, in the whole, to half an ounce and fourteen grains. I afterwards

afterwards tried the fire of a forge upon the ſame mixture: it did not bring it into fuſion, nor indeed did it occaſion any perceptible change.

It is clearly aſcertained by theſe experiments, that vitriol of lead, eſpecially when thoroughly ſaturated with acid, is not fuſible, like the other preparations of lead; conſequently, it is by no means capable of ſerving as a flux for ſand, or other refractory matters which may enter into the compoſition of flint-glaſs. This fact has been ſtill more evidently proved, by ſome experiments lately made upon white lead-ore, in which that ore was with difficulty melted in the focus of the lens belonging to the Academy of Sciences. Vitriol of lead, fully ſaturated with acid, which was expoſed to the action of the ſame lens, only melted into an opaque matter, very unlike a complete vitrification.

The diſcovery of this refractory quality of vitriol of lead, did not prevent me from trying its effect in ſome freſh experiments reſpecting the compoſition of flint-glaſs; but, I was very well convinced, that it would be neceſſary to join ſome other flux to the mixtures which I intended to

try.

try. Accordingly, I mixed together, very carefully, one ounce of my vitriol of lead with as much fine ſand, ground, to which I added half an ounce of nitre, and a quarter of an ounce of calcined borax. This mixture, being put into a German crucible, was placed in a wind-furnace, and heated gradually. The firſt effect of the heat was to diſengage a great quantity of vapours of nitrous acid; and the mixture ſwelled up, with very evident ſigns of effervefcence, which I ſuffered to diſappear, before I encreaſed the fire. When all was ſtill, I encreaſed the fire to a degree proper for a ſoft and eaſily fuſible glaſs: the matter now became very fluid, in which ſtate I kept it during two hours, encreaſing the fire a little towards the end. When I had aſcertained, by taking a little out with an iron rod, that the matter was perfectly vitrified, I poured it upon a copper-plate. This glaſs was covered with a conſiderable quantity of what is called *ſalt of glaſs*, ariſing from the decompoſition of the vitriol of lead; the acid of which, having partly combined with the alkali of the nitre, and partly with that of the borax, had conſequently formed vitriolated

tartar

tartar and Glauber's ſalt, which, as is always the caſe, had ſeparated from the vitrified matter.

In other reſpects, the glaſs obtained in this trial, though it was in every part of its ſubſtance very full of ſmall bubbles, and alſo contained a globule of lead in a metallic form, was perfectly tranſparent; it was likewiſe conſiderably whiter than any I had yet made, (a circumſtance which I thought very promiſing,) although it contained nearly half its weight of lead.

This determined me to make a great many other trials reſpecting the compoſition of flint-glaſs, (varying the proportion of the ingredients, and the circumſtances of the vitrification,) in all of which a large proportion of vitriol of lead was employed. I ſhall not, at preſent, enter into a particular detail of theſe experiments, which I mean to repeat and continue, but ſhall finiſh this memoir, by giving an account of thoſe ideas reſpecting the improvement of flint-glaſs, which the great number of experiments and obſervations I have made on that ſubject have ſuggeſted to me.

I have always thought, and am now confirmed in that opinion, that the glutinous and ſtringy quality of all glafs which has a great quantity of lead in its compofition, arifes merely from the want of an intimate and perfect combination betwen the calx of lead and the fand, &c. It is a certain fact, that all metals, and particularly lead, refufe to enter into any union with fand, or flint, or any fpecies of earth, fo long as they are furnifhed with the quantity of inflammable principle neceffary to their metallic ftate; from which it follows, that, the lefs of that principle metallic earths retain, the more eafily they muft unite in vitrification with other earths.

On the other hand, it is not lefs certain, that lead, though capable of being very eafily deprived, by common calcination, of a fufficient portion of its inflammable principle to lofe its opacity and ductility, is neverthelefs a metal which, after this firft lofs, retains a greater quantity than fome others, and retains that quantity with greater force: this is confirmed by many of the experiments related in this memoir, and particularly by thofe I made with nitrous acid. This being the cafe, two principal methods fuggeft themfelves, of procuring a perfect union between the calx of lead and the fand or filiceous earth.

The

The first is, to deprive the calx of lead of the greatest possible quantity of that portion of the inflammable principle which it retains with so much force.

The second, which applies to all other combinations, is to give to the substances which we wish to unite, that is to say, in the present instance, to those which are to enter into the composition of flint-glass, the greatest possible fluidity and mobility.

The fixity and refractory quality which the vitriolic acid communicates to the calx of lead, seem to point out this mode of preparation as the most proper to fulfil the first-mentioned intention. I even thought, after many trials, that the vitriol of lead, when I used it as an ingredient in flint-glass, gave it always more clearness than any other preparation of lead; but I have since discovered, that this good effect was in part owing to the nitre and borax which I was obliged to use at the same time; at least it appeared, that the vitriol of lead could not contribute to the clearness of flint-glass, without the assistance of those two salts.

 With

With reſpect to the ſecond method, which conſiſts in giving great fluidity to the matter, I believe it is one which deſerves the greateſt attention, and nothing is ſo eaſy as to put it in practice; all that is required is, to proportion the fluxes properly to the ſand. I made ſome of theſe mixtures, which, at the beginning of their melting, and with a very moderate fire, were almoſt as fluid as water; conſequently, the various ingredients of which they were compoſed were capable of mixing well together, and of acting upon each other, with a freedom and facility which never can take place when the melted matter is of a glutinous conſiſtence, as is generally the caſe with all ſorts of glaſs. It is indeed true, that if the matter is ſo fluid as not to be ropy, when a ſample of it is taken out of the melting-pot, the glaſs is neither perfectly tranſparent, nor is it ſufficiently firm; but, as the fluxes evaporate continually while the glaſs is in fuſion, it is very eaſy, (as I have many times experienced,) by keeping the matter a ſufficient time in fuſion, and regulating properly the degree of heat, to bring the glaſs, which at firſt was as fluid

fluid as water, to that clammy and ropy ſtate which characteriſes a well-made glaſs.

The production of the *ſalt of glaſs*, that is to ſay, of the vitriolated tartar and Glauber's ſalt, which were formed during the fuſion of the matter, in that experiment wherein I made uſe of vitriol of lead with nitre and borax, may help to contribute to the perfection of the glaſs: in the firſt place, by the action of the vapours of very concentrated nitrous acid, which, as they are diſengaged, are capable of deſtroying or carrying off ſome portion of phlogiſtic matter: ſecondly, by the inteſtine motion of the efferveſcence, which may very much contribute to mix intimately the ingredients of the compoſition.

It has never been remarked that the *ſalt of glaſs* is at all prejudicial to the glaſs upon which it collects during its fuſion. As it does not mix with the glaſs itſelf, it may be taken from it when it is completely melted; or it may be ſuffered entirely to evaporate by continuing the glaſs in fuſion for a ſufficient time; or, laſtly, if the glaſs is left to cool in a maſs, in the pot in which it was melted, (the ſalt being neither taken away, nor evaporated,)

rated,) there forms upon the glaſs, after the whole is grown ſolid, a white opaque cruſt, which, by the help of boiling water, may be eaſily ſeparated from the vitreous matter, ſo as not to leave the ſmalleſt portion behind. I will not, however, deny that there is a defect which I believe is to be attributed to the *ſalt of glaſs*; I mean the bubbles with which flint-glaſs is often very much disfigured. I ſtrongly ſuſpect that theſe bubbles are produced by particles of the *ſalt of glaſs*, which, not being able to ſeparate themſelves completely, while the matter is in a clammy or paſty ſtate, are reduced into vapour in the places in which they are retained, and, by their expanſion, form thoſe little vacuities here ſpoken of. Indeed I have conſtantly obſerved theſe bubbles, in great number, in all my experiments upon flint-glaſs wherein *ſalt of glaſs* was formed; but, beſides that this defect is of leſs conſequence than that of being gelatinous and ſtringy, there is great reaſon to hope, that if the cauſe of the defect is known, ſome remedy may be found for it.

XXXIX.

XXXIX. *List of Patents for Inventions, &c.*

(Continued from Page 216.)

THOMAS COOPER, of Old-street, in the parish of St. Luke, Engineer; for a machine for mashing or mixing of malt, for the purpose of brewing or distilling, by means of which both a vertical and horizontal motion is produced. Dated September 9, 1796.

RALPH WEDGWOOD, of Burslem, in the county of Stafford, Potter; for a method of making earthen-ware, whereby that article may be made at a less cost than hitherto. Dated October 3, 1796.

Ditto, of Ditto, for a composition for making glass upon new principles. Dated October 3, 1796.

Ditto, of Ditto, for a stove upon a new principle. Dated October 3, 1796.

JOHN PEPPER, of Newcastle-under-Line, in the county of Stafford, Builder and Architect; for a mode of building ovens and kilns, for firing and burning of china, earthen ware, bricks, tiles, and other earths and compositions. Dated October 3, 1796.

JOHN

JOHN STEEDMAN, of Trentham, in the county of Stafford; for a machine for thraſhing corn. Dated October 31, 1796.

EDWARD THOMASON, of Birmingham, in the county of Warwick, Button-maker; for ſteps for coaches, chariots, &c. Dated October 25, 1796.

EDMUND LLOYD, of the Strand; for a tea-kettle or tea-boiler on a new conſtruction, for boiling water more expeditiouſly, and at much leſs expence. Dated October 31, 1796.

JOHN RUSSELL, of Newman-ſtreet, in the pariſh of St. Mary-le-Bone, Eſquire; for an apparatus, named the *Selenographia*, to exhibit the phænomena of the moon. Dated Nov. 5, 1796.

JOHN DAVIDSON, of Peterhead, in the county of Aberdeen, Scotland, Mill-wright; for a machine for doubling, twiſting or making, reeling, and ſkaining, worſted, thread, ſilk, cotton, &c. which requires only one perſon to work, manage, and direct. Dated November 7, 1796.

WILLIAM RALEY, of Newbald, in the Eaſt-riding of Yorkſhire, Chemiſt; for a horizontal turning churn, which is eaſily worked, collects the butter ſooner, and is eaſier kept clean, than thoſe in common uſe. Dated Nov. 10, 1796.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER XLI.

XL. *Specification of the Patent granted to Mr.* WILLIAM RALEY, *of Newbald, in the East Riding of Yorkshire, Chemist; for his Invention of a horizontal turning Churn, for churning of Butter.*

WITH A PLATE.

Dated November, 10, 1796.

TO all to whom these presents shall come, &c. Now KNOW YE that, in compliance with the said proviso, I the said William Raley do hereby declare, that my said invention of a horizontal turning churn, for churning of butter, is described in the plan and deſcription thereof hereunto annexed. In witneſs whereof, &c.

Fig. 1, (Plate XVI.) a view of the churn cut longitudinally through its centre.

Fig. 2, a view of the external parts of the whole machine, ready for action by adding the crooks.

Fig. 1. AAAA, the outer frame of the whole machine.

B, B, the outer ſides of the barrel or churn.

D, the movable lid or cover of the churn, reſting on the inner frame at 20, 20.

O, O, O, O, O, O, the moving daſhes or breakers, (twelve in number,) fixed on the inner frame; conſiſting of four upright pieces at F, F, the top and bottom ends of which are fixed in two circular pieces, of the ſame diameter as the inſide of the churn, at G, G, G, G; forming a ring (one inch and a half thick, and two inches and a half broad) round the inſide of the churn, ſo as to keep the upright pieces in oppoſite direction.

rection. If the churn is large, there muſt be another of theſe circular pieces at B, B. On the edge or outſide of theſe pieces there are grooves, (in oppoſite direction,) which ſlide on ſmall pieces on the inſide of the churn at 33, 33, 33, 33, which prevent the inner frame F F, and the daſhes or breakers O, O, O, O, O, O, from moving ſide-ways, and cauſe them to be carried round by the motion of the barrel. This inner frame, and its daſhes or breakers, are fixed together, which admits of their being put in and taken out of the barrel, at one and the ſame time.

N, N, N, N, N, N, N, N, the immovable daſhes or breakers, (eight in number,) connected or joined together by the two upright pieces at 30, 30, between which paſſes the upright ſhaft or ſpindle H. Theſe daſhes or breakers are kept from ſettling too low, by a pin paſſing through one of the croſs-bars at 13, 13, 13, which confines the two upright pieces in their proper places. Note; as this draught repreſents only half of the churn, (the body of which is cut longitudinally through its centre,) only half the number of the moving daſhes or breakers O, O, O, O, O, O, and two of the upright pieces F, F, are expofed to view; but the fixed dafhes N, N, N, N, N, N, N, N, are reprefented in their proper number.

H, an upright fhaft or fpindle, (made of iron,) fquare from H to S, and fixed in a fquare groove or notch in the fore part of the frame at 21, where it is confined by a hafp, wedge, or other contrivance, fo as to keep it immovable, but admit of its being loofed at pleafure. From S to 14, this upright fhaft or fpindle is round, and paffes through a round hole in the wheel E, and lid D or cover of the churn, at 22, 22, which fuffers the wheel and lid to move freely round the fpindle; this fpindle is of a fmaller fquare from 14 to a little from its bottom, where it terminates in a point or gudgeon, which is received by the pot at 18. This fmaller fquare part of the fpindle paffes through fquare holes in the crofs-bars at 13, 13, 13, which keeps the two upright pieces (on which the dafhes or breakers N, N, N, N, N, N, N, N, are fixed) at a proper diftance, fo as to admit the fpindle H to pafs freely between them and their dafhes, immovable; while thofe at

O, O,

O, O, O, O, O, O, connected with the inner frame, revolve or circulate round them. The upright ſhaft or ſpindle H is kept from riſing, by having a protuberance or ridge going juſt under the outer frame at 5.

18, is a pot of hardened ſteel, let into the centre of the inſide of the churn's bottom. This pot has a margin or rim at 40, whereby it is faſtened with ſcrews, and receives the pivot or point of the upright ſhaft or ſpindle H.

Q, is a gudgeon of iron, with a margin or rim at 37, by which it is faſtened with ſcrews to the centre of the outſide of the churn's bottom. The lower end or point of this gudgeon, which moves in the pot R, is of hardened ſteel.

R, is a pot of hardened ſteel, or bell-metal, let into the bottom part of the frame, and faſtened to the ſame by ſcrews paſſing through its margin at 38.

P, an opening to diſcharge the churn-milk, &c. which may be a wooden tube, to be cloſed with a wooden plug, or a ſtraight turn-cock. The tube muſt be ſtraight, as it may be neceſſary to thruſt ſomething therein, to remove the butter

which

which may happen to obſtruct it; hence, the opening at 16 is for the diſcharge.

2, is a large wooden plug, which, being removed, leaves an opening (through the wheel E, and lid or cover D) into the churn, through which its contents are to be inſpected. The wheel E is fixed to the lid or cover of the churn by nails or ſcrews; or the wheel and lid may both be made of one ſolid piece. The extremity of this wheel reſts on the top edge of the churn at 36, 36, where it is kept down ſteady by the haſps at 23, 23.

17, 17, are two handles to lift the churn by.

I I, an iron axis, paſſing through the outer frame of the machine A A A A, at T, W, in buſhes of iron, or bell-metal, and through the upright ſhaft or ſpindle at 6, S. This axis is ſquare at the extremities 12, 27. At 10 is a fixed collar or ſtop, to act againſt the outer part of the frame: from this ſtop to 25, the axis is round; from 25 to 34, it is ſquare; and from 34 to 26, it is round.

L, is a crook, with a fixed collar at 11, which goes on the ſquare part of the axis at 12, forming a ſtop a ſtop to act againſt the outſide of the frame at 26.

U, is another crook, fixed on the ſquare top of the axis at 27. Note; as the crooks L, U, are both turned one way, their action may be made more uniform, and perhaps more agreeable to the perſons who turn them, by having two ſmall metal wheels or pinions, one placed on the axis I I, at 11, the other on a ſeparate axis, and placed either above or below the other wheel or pinion, ſo as to act with it; one end of its axis moving in a metal buſh in the frame at W, with its other end paſſing through the wheel or pinion, and terminating in a ſquare, on which is to be placed the crook, without its fixed collar, as the other wheel or pinion would (in that caſe) ſupply its place.

In caſe it is required to work the churn with more eaſe and regularity, a large iron wheel or fly (loaded with lead) may be placed on the ſpindle I I, at 35: this wheel or fly may be from three to ſix feet in diameter, or more, according to the ſize of the churn.

M, M, the two handles by which the two above-mentioned crooks are turned.

The

The above-mentioned upright ſhaft or ſpindle H is thicker or broader from 6 to S, to admit of a hole, through which the axis I I paſſes.

19, is a looſe collar, to ſlide on the axis I I, ſo as to act as a ſtop againſt the upright ſhaft or ſpindle H, which keeps it ſteady: this looſe collar is kept in its place by a ſcrew at 28.

K, is a ſmall wheel or pinion. 7, 7, are its teeth or cogs, acting with thoſe of the wheel E, at 8, 8. This wheel ſlides on its axis I I, and is kept in its place by a ſcrew at 9, paſſing through the fixed collar 39. This ſmall wheel is only half as large as the wheel E; hence, the firſt moves twice round to once of the latter. The ſize of the wheel may be altered as may be thought proper. N. B. The teeth of the large wheel may be made ſhort and broad, and likewiſe thoſe of the leſs wheel, and fixed in its edge at 31, 31. The above wheels may either be made of wood or metal.

The above-mentioned churn may be made of any ſize, either of wood, plate-tin, pewter, or other ſubſtance, as may be thought proper. Its outer frame may be fixed (by ſupporters) to ſome

6 part

part of the room in which it is kept; or it may ſtand upon feet fixed in the bottom part of its frame, as may be found moſt convenient. The number of its daſhes or breakers may either be increaſed or diminiſhed, according to the ſize of the churn, and they may either be ſolid, (as above repreſented,) holed, or indented on their edges, &c.

To make uſe of the above-mentioned Churn. Firſt, put the empty churn or barrel into its frame A A A A, with its pivot or gudgeon Q into the ſteel-pot at R. Then put in the inner frame F F, G, G, G, G, with its daſhes or breakers O, O, O, O, O, O. Or the frame and its daſhes may be put into the barrel before its pivot or gudgeon is put into the pot. After which, put in the cream, and take the upright ſhaft or ſpindle H, (without the daſhes,) and put it through the hole in the centre of the wheel E, and lid or cover of the churn, at 22, 22; then put thereon the daſhes or breakers N, N, N, N, N, N, N, N, connected with the two upright pieces 30, 30, and the croſs bars 13, 13, 13, which are prevented from ſettling too low, by a pin paſſing through one of the croſs bars into the ſpindle H. Then paſs the ſpindle (thus furniſhed) through the cream, with its pivot 18 into the ſteel-pot, in the centre of the churn's bottom; putting on the lid or cover D, with the wheel E, which faſten down by the haſps at 23, 23, and place the top end of the upright ſhaft or ſpindle H in the ſquare groove or notch at 21; making it faſt there with a haſp, or wedge, or other contrivance, as is found moſt convenient. Then take the axis I I, and paſs it through the outer frame at T; putting on the wheel H. Then put on the collar 34; after which paſs it through the upright ſhaft or ſpindle at 6, S, putting on the other looſe collar at 19, and paſs the axis through the frame at W; on the end of which put the fixed collar of the crook L, making it faſt with a pin or nut ſcrewed thereon. In caſe this crook is not wanted, a looſe collar muſt ſupply its place. Then bring the ſliding-collars or ſtops 19 and 34 to the upright ſhaft or ſpindle, where make them faſt by the ſcrews at 28, 28; after which, ſlide the ſmall wheel K, ſo as its teeth or cogs take hold of thoſe of the wheel E, (as at 7, 8,) where make it faſt by the ſcrew 9.

To

To cauſe the movement of the above Churn. Firſt, turn the axis I I by the crooks L, U, or either of them, which will move the wheel K, the teeth or cogs of which, at 7, 7, catch hold of thoſe of the wheel E, at 8, 8, cauſing it to move in a circular direction; in conſequence of which, the body of the churn, (*viz.* the upright barrel B B,) with the inner frame F F, G, G, G, G, the moving daſhes or breakers O, O, O, O, O, O, and cream, are turned round, in a horizontal direction, upon the pivot Q, while the upright ſhaft or ſpindle H, the two upright pieces at 30, 30, with the croſs bars at 13, 13, 13, and their daſhes or breakers at N, N, N, N, N, N, N, N, remain immovable; hence the friction and agitation of the cream, which produces butter. The above-mentioned peculiar movement of the above churn is an eſſential criterion, which diſtinguiſhes it from every other. Its poſition is perpendicular or upwright: the term horizontal denotes the peculiar direction in which it moves.

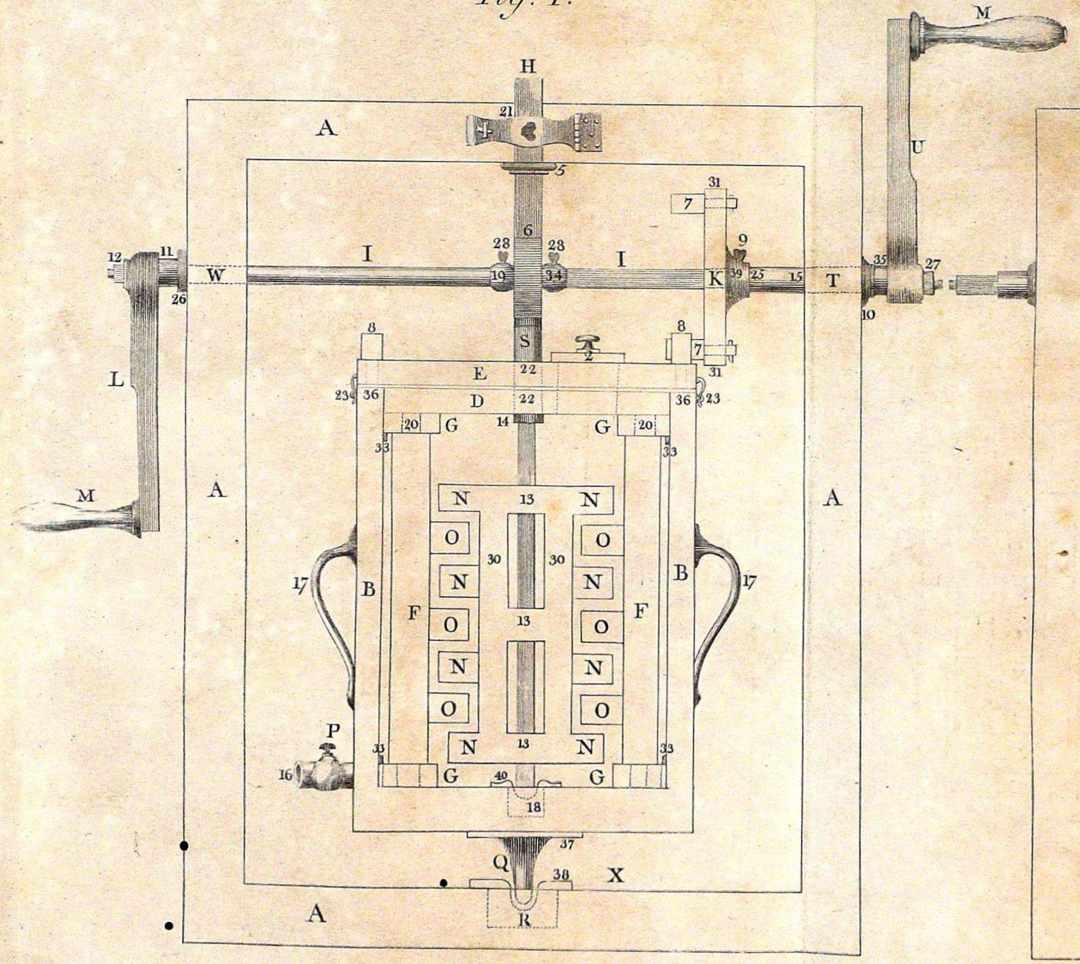
To take out the butter. Take off the nut 12, and crook L; looſen the collars 19, 34, and 30, by turning the ſcrews 28, 28, and 9; then draw

 out

out the axis I I, till it is free from the upright ſhaft or ſpindle H, putting the wheel K cloſe to the frame at 15: or, take the wheel off and draw away the axis. Then looſe the haſps at 23, 23, and lift up the wheel E, and cover or lid of the churn, to S, where they are to be ſtayed, by a pin put under them into a hole in the ſpindle H. Then ſhake the butter from the ſpindle, its daſhes, &c. and looſen the ſpindle at 21, and take it out with its daſhes or breakers, &c. After which, clear the butter from the inner frame, and its daſhes or breakers, and take them out, and collect or gather the butter. After which, let off the churn-milk, by the cock P, when nothing will remain but the outer part of the churn, (*viz.* the barrel,) and the butter it contains. Then the churn may be removed from its place, care being taken not to injure its gudgeon Q: to prevent which, a hole to receive it may be made in the bottom part of the outer frame at X; or in a ſeparate frame, or piece of wood, for that purpoſe. In witneſs whereof, &c.

XLI.

Fig. 1.


H
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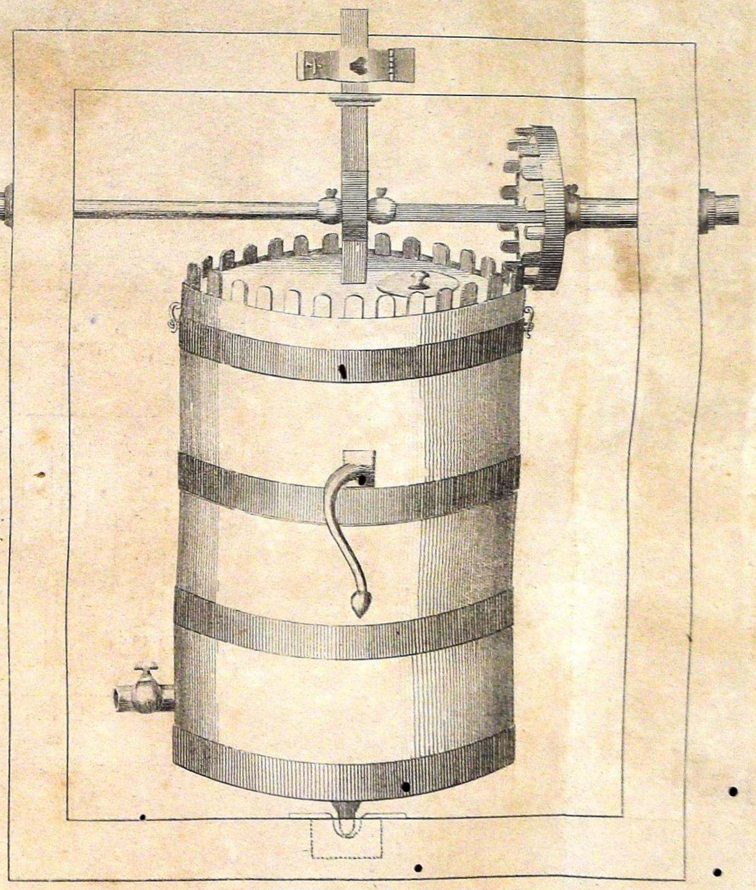
Q
38
X
A
R

Fig. 2.



XLI. *Specification of the Patent granted to Mr.* CHARLES SIMPKIN, *of Oxford-ſtreet, in the Pariſh of St. Mary-le-bone, in the County of Middleſex, Engine-maker and Plumber; for his Invention of certain conſiderable Improvements in all Kinds of Engines for extinguiſhing Fire.*

Dated Dec. 19, 1792.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Charles Simpkin do hereby declare, that my ſaid invention of certain conſiderable improvements in all kinds of engines for the purpoſe of extinguiſhing fire, is deſcribed in the explanation following; that is to ſay, my invention conſiſts in exploding or removing the valves, both from or out of the part or parts of the cylinder or cylinders where the vacuum is made by the piſton, fan, fly, or by what other name ſoever it may be called or denominated, ſpecified purpoſe in ſuch caſe provided; or by any other more eaſy or ready method. And that, agreeable to this my invention or improvement, it appears clearly, and ſhall be conſidered, to obviate the neceſſity of drawing the forces, fan, or fly, or opening of the air-veſſel or cylinders, as neceſſity has occaſioned in all former engines, not having theſe improvements. My chambers are, or may be, eaſily applied to the cylinders or air-veſſel, by means of copper or other pipes, ſoldered or ſcrewed at pleaſure. Engines, I ſay, may be improved without the uſe of the chambers or receptacles herein expreſſed, by the ſimple method of ſcrewing on a *flanch* or ſcrew, over any aperture by which acceſs may be had to the valves. And farther, my invention conſiſts in the introduction of a certain filtering-chamber or receptacle, chambers or receptacles, with certain partitions or diviſions, to preſerve the effect of the valves, during the uſe of any improper fluid; which filtering-chamber or chambers, with its partitions or diviſions, is to be fixed or placed between the ſuction-valves and the minated, and from under or out of the air-veſſel; and in placing, inſerting, or making uſe of the valves in the following manner, by the application of certain receptacles or chambers, for the expreſs intent or purpoſe of containing the valves only; thereby rendering the valves more free of acceſs, and preventing the neceſſity of opening any other parts of the engine, except thoſe chambers where the valves are contained. Of this improvement I ſay, that all chambers or receptacles for containing the valves are hereby conſidered and eſtabliſhed as my invention, be they placed howſoever or whereſoever in the engine. And that they may be fixed or uſed at any required diſtance from, or annexed to, the air-veſſel, or either or all of the barrels, or tubes, or cylinders, in any engine conſtructed for the purpoſe of extinguiſhing fire. And that my chambers or receptacles are conſidered to contain any number of valves, which may or can be introduced. And that, by this my invention, or theſe improvements, acceſs may be had ſeparately or ſeverally, when required for any purpoſe, by means of a ſcrew or flanch, ſcrewed on, to, or againſt, the chambers, for the

ſpecified

XLII. *Specification of the Patent granted to Mr.* JOHN STEEDMAN, *of Trentham, in the County of Stafford, Farmer; for his Invention of a Machine for thrafhing Corn, whereby much manual Labour may be fpared, and the Procefs greatly facilitated.*

WITH A PLATE.

Dated Oct. 31, 1796.

TO all to whom thefe prefents fhall come, &c. NOW KNOW YE, that I the faid John Steedman, in compliance with the faid provifo, do hereby declare, that the drawing delineated upon the margin hereof, with the feveral references and defcriptions herein after mentioned, defcribing the fame, contains a full and particular defcription of the faid machine or inftrument, and of the method of ufing or working the fame; as follows

A A A, (Plate XVII.) the horfe wheel, confifting of one hundred and twenty cogs.

B B, the levers, to which the horfes are hooked that work the machine, and move round in a tract of eighteen feet diameter.

the ſtrainer or roſe now in uſe, on the ſuction-pipe; and, although it is allowed that the preſent roſes or ſtrainers do, in ſome caſes, preſerve the effect of the engine during operation, yet this is intended to preſerve it more effectually, by a finer filtration, and thereby ſecure the powers and effects of the engine, for a longer time than without this improvement. Eaſy acceſs may be had to theſe partitions in the filtering-chamber, by means deſcribed in the foregoing ſpecified improvement, reſpecting the valves. The partitions may be fine wire-work, or any other ſubſtitute which will act as a firſt and ſecond filtration in the chamber. In witneſs whereof, &c.

XLII.

the circular floor of the machine, (which said floor will be described under the letters K K,) in their turning round the flail-barrel: the other part of the regulator prevents the flails from lighting upon their points upon the circular floor of the machine, by keeping them so long back, that when disengaged from the regulator they fall even on the circular floor.

K K, a circular floor, on which the corn in the straw is laid to be thrashed. It stands at about two feet and a half from the ground-floor: its planks are left open enough in the joints to admit the grain, as it is thrashed, to fall through to the ground-floor below; and it is moved round by means of the rope and pulleys which are herein after described, and by which it performs a revolution in about thirty seconds of a minute, which gives sufficient time, to the two people who attend it, to take off the straw that is thrashed, and to put fresh corn in the straw on, without stopping the machine.

L L L, the rope, which, by going round the floor K K, and over the tumbling-shaft D, puts the said floor in motion.

C, the nut of the tumbling-ſhaft, which has twenty cogs, into which the one hundred and twenty cogs of the horſe-wheel A A A work.

D, the tumbling-ſhaft.

E, the ſpur-wheel, (of the tumbling-ſhaft D,) which has ſeventy-two cogs.

F, the nut of the flail-barrel, which has twenty cogs, into which the ſeventy-two cogs of the ſpur-wheel E work.

G G, the flail-barrel.

H H H, the flails, to be made of wood, with iron joints; or the ſhaft of wood, and the ſtriking part iron; and to be mortiſed through the flail-barrel G G. In the above drawing, only three flails are repreſented as attached to the flail-barrel, in order to avoid confuſion in the drawing: ten or twelve are the number made uſe of in the machine intended hereby to be deſcribed; which number muſt be varied, according to the ſize and powers by which the machine may be worked.

I I I I, the guard or regulator, the lower part of which, by catching up the flails as ſoon as they have made their blow, prevents the ſtraw from being diſturbed or thrown back, off and from the

M, M, the pulleys, which conduct the rope L L L over the tumbling-ſhaft.

N N, a frame of wood, faſtened in the wall O O, in which the pulleys M, M, are fixed.

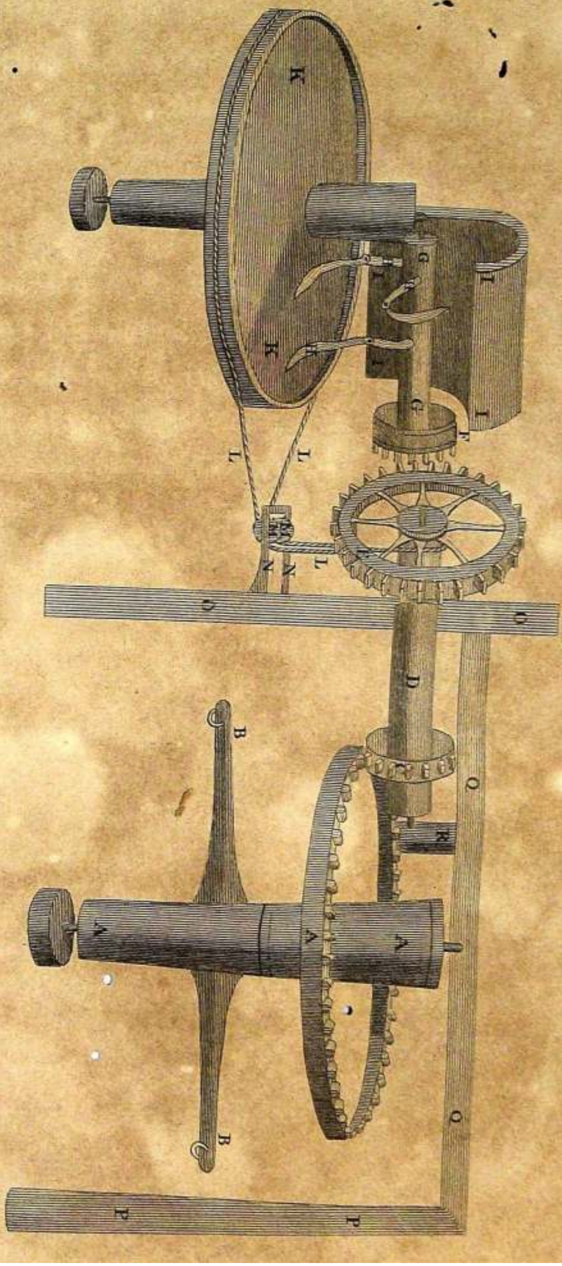
O O, the wall of the building.

P P, a ſtrong upright poſt, ſet faſt in the earth, to the top of which the croſs-piece of timber Q Q is mortiſed: the other end of the croſs-piece Q Q is made faſt in the wall O O. The pivot of the horſe-wheel A A A works in the ſaid croſs-piece of timber.

R, a piece of wood faſtened to the croſs-piece of timber Q Q, in which the pivot of the tumbling-ſhaft D works. The regulator, and machinery in the inſide of the building, are ſupported by beams going acroſs the building.

The machine, as above drawn and deſcribed, is worked by one or more horſes, according to the ſize of the machine; which ſaid machine may be alſo worked or put in motion, by the uſe of any other adequate power, ſuch as water, ſteam, or wind, where the ſituation may be convenient for that purpoſe. In teſtimony whereof, &c.

XLIII.



Scale of 10 Feet.

XLIII. *Specification of the Patent granted to Mr.* JOSIAH WEDGWOOD, *of Burslem, in the County of Stafford, Potter to her Majesty; for his Invention of ornamenting Earthen and Porcelain Ware with an encaustic Gold Bronze, together with encaustic Painting in various Colours.*

Dated Nov. 16, 1769—Term expired.

TO all to whom these presents shall come, &c. NOW KNOW YE that, in compliance with the said proviso, I the said Josiah Wedgwood do hereby declare, that my said invention, for the purpose of ornamenting earthen and porcelain ware with an encaustic gold bronze, together with a peculiar species of encaustic painting in various colours, in imitation of the ancient Etruscan and Roman earthen ware, is described in the manner following; that it is to say:

First

First Process, or Preparation of the Ingredients.

No. 1. A white earth from Ayoree in North America: calcine this in a red heat about half an hour.

No. 2. *Bronze Powder.* Diſſolve one ounce of pure gold in aqua regia; precipitate it with copper; then waſh the precipitate with hot water, till it is ſweet, or clean from the acid: dry it, and lay it up for uſe.

No. 3. Take two ounces of crude antimony, levigated, two ounces of tin-aſhes, and ſix ounces of white-lead; mix them well together, and calcine them in a potter's furnace, along with glaſs cream-coloured ware.

No. 4. Take eight ounces of good ſmalt, one ounce of roaſted borax, four ounces of red-lead, and one ounce of nitre: mix the ingredients well together, and fire them in a crucible, in a potter's biſcuit-oven.

No. 5. Take Engliſh copperas or vitriol of iron; calcine it in a moderate red heat about two hours; then waſh it in hot water, till it is ſweet: dry it, and lay it up for uſe.

No.

No. 6. White-lead.

No. 7. Flint, calcined and ground.

No. 8. Manganefe.

No. 9. Zaffer.

No. 10. Copper, calcined to blacknefs.

Second Procefs, or compounding and mixing the Colours.

Shining Black, A. Three ounces of No. 8, three ounces of No. 9, three ounces of No. 10, eleven ounces of No. 6, fix ounces of the green, F.

Red, B. Two ounces No. 1, two ounces No. 3, one ounce No. 5, three ounces No. 6.

Orange, C. Two ounces No. 1, fourteen ounces No. 3, half an ounce No. 5, four ounces No. 6.

Dry black, D. One ounce No. 4, two ounces No. 8.

White, E. Two ounces No. 1, two ounces No. 6.

Green, F. One ounce No. 1, two ounces No. 3, five ounces No. 4.

Blue, G, One ounce No. 1, five ounces No. 4.

Yellow, H. No. 3 alone.

Third

Third Process, or Application of the Encaustic Bronze and Colours.

Application of the bronze:

I. When the vessels are finished ready for burning, and before they are quite dry, grind some of the powder No. 2, in oil of turpentine, and apply it to the vessels or figures with a sponge or pencil, to imitate bronze, in such manner as your fancy directs: polish this powder upon the vessel or figure, and burn it, in such a furnace, and such a degree of heat, as is necessary for the ware; after it is burnt, burnish the bronze upon the vessel to what degree you please, and the process is finished.

Another Method of applying the Bronze after the Ware is fired biscuit, as some Figures or Vessels may be too delicate to bear the Process I.

K. Take four ounces No. 6, and one ounce No. 7; grind them well together; spread this very thin, with a sponge or pencil, over the ware

to

to be bronzed, and fire it till this layer of ſize is fluxed, which may be done in a potter's furnace; then take the powder No. 2, and apply it to the veſſel, as before directed; then burn the ware over again, till the powder adheres to the ſize: burniſh, &c. as before.

Application of the Shining Black upon red Veſſels, in the Manner of the antique Etruſcan Vaſes.

L. Take the colour A, grind it very fine with oil of turpentine, and with it trace the outlines of the deſign you intend to have upon the veſſel; then fill up the vacant ſpaces very even, and ſhade the drapery, &c. Fire the veſſels in a heat ſufficient to flux the black, and they are finiſhed.

Another Method to produce a different Effect with the ſame Colour, in the Manner of the Etruſcans.

M. Paint the deſign, with the black laid on as dead colouring, upon the red biſcuit-ware; and cut up or finiſh the deſign with red and other colours; for which purpoſe the above-mentioned ones are prepared; they muſt alſo be ground in oil of turpentine, and burnt upon the veſſels in a muffle, or enamel-kiln.

Another Method to produce, in a more expeditious Way, nearly the Effect of the Proceſs L.

N. Take the red, B, or the orange, C, and lay in your deſign with it, as a dead colour, upon black biſcuit-veſſels; and ſhade it with the black, D, with or without the addition of any of the other colours; firing them upon the veſſels, as before directed.

In witneſs whereof, &c.

XLIV.

XLIV. *Obſervations on raiſing Grapes; with a Deſcription of a Grapery. In a Letter to the Editors, from* Mr. RICHARD MARCH, of *Barnſtaple, Devon.*

WITH A PLATE.

GARDENING and agriculture having employed ſome part of my time, I was induced to try ſeveral experiments therein; one of them, which I now wiſh to communicate to the public, has been attended with a degree of ſucceſs which promiſes much benefit to this country: it is a ſimple, cheap, and eaſy way of raiſing grapes, of a quality ſuperior in flavour and perfection to any I have met with. I therefore ſend you a drawing of the grapery in which they were raiſed, with inſtructions reſpecting the management of them. Fig. 1. (Plate XVIII.) is a full view of the grapery. Fig. 2. an end or perſpective view of the inſide. The front and end walls are built with brick, two

 feet

feet high from the ground, and glazed in front, (two feet eight inches high,) at each end, and on the top, like a common green-houſe. It fronts due ſouth, and is not obſtructed, by buildings or trees, from receiving the advantage of the ſun. A, in Fig. 1, is the door; B, Fig. 2, the back, or garden-wall; CC are two beds of earth, two feet high, encloſed in a narrow brick-wall; D, the paſſage between them. The back wall B is plaſtered with mortar, made of lime, ſmith's cinders, and ſcales from the anvil, each equal parts. Thoſe vines which are ſet at the end of the grapery are trained along the wall, and meet in the centre: the grapery is twenty-two feet long; in which ſpace, and at the ends, no leſs than ten vines, of different ſorts, are introduced through the wood-work on the wall, which projects for that purpoſe. It is only four feet eight inches high in front, ſix feet ſix inches wide, and eight feet high at the back. I built it in 1790, having previouſly obtained all the information I could, from gentlemen of my acquaintance who underſtood the management of vines in France, Spain, Italy, Portugal, &c. from whom I learned, that

the

the roots of the vines ſhould not be more than two feet ſix inches aſunder, nor let to run high, and but little wood ſuffered to grow from each root. Obſerving theſe rules, I tried ſeveral experiments; and found the following method to be attended with flattering ſucceſs. Fill the two beds with rotten dung and garden-earth: water the ſame, when the ſun appears the whole day, morning and evening, and ſo in proportion. The exhalation will ſupply every part of the vine with nouriſhing warm water, as may be ſeen by examining the vine, which appears to be one of the cauſes of producing the effect. In the beds or earth-pits, pines, or any thing elſe, may be raiſed, to remain, or to be tranſplanted. In winter, remove the earth in the pits, place bricks on their edge, half-way up from the bottom, each row three feet aſunder. On the bricks, place common plaſtering-laths, on their edge; over which put ſome long litter, taken from horſe-dung, and put upon it the earth which was removed. Doors being made in the walls of the earth-pits, at the front of each partition, or ſix doors in each pit, as at G in Fig. 2, put into each, as much fermented horſe-dung as it will hold; ſtop it up cloſe with a wooden ſtopper, and let it remain ſix or eight days; then take it out, and repeat the ſame during the winter, or any time you pleaſe. The flavour of any thing, raiſed in beds ſo managed, is ſuperior to what is raiſed in a hot-houſe, and fire is ſaved. To prevent the heat from being too great in the ſummer, put five ſquares of glaſs, ſeparately framed, with an axis to each to turn on, as repreſented at Fig. 3; put one in each light, at E, E, E, E, E, in Fig. 1. The air, by being rarified, will lift up the ſquares, and eſcape; after which, each ſquare will ſhut again of itſelf, and maintain a regular heat without farther attention; but, when the ſun is very intenſe, cold air may be admitted by ſliding ſaſhes, one at each end of the grapery, as at F in Fig. 1; but this will require attention, leſt the grapery cool too faſt. In froſty weather, it is neceſſary that the glaſs part of the grapery ſhould be covered with mats; and, as the buds of the vines break early in the ſpring, it is alſo neceſſary to train the vines ſo as not to touch the glaſs, leſt the buds periſh. When the grapes are ſet, break off all ſuperfluous ſhoots, every ſecond

or

Fig. 1.

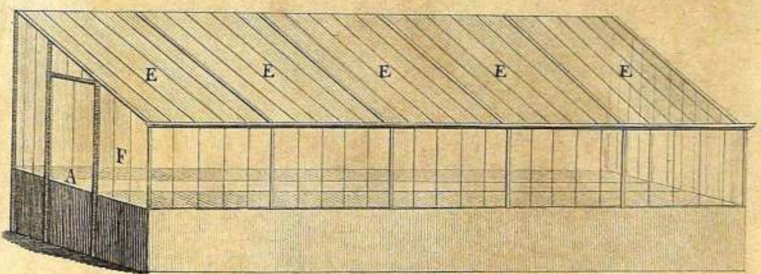


Fig. 2.

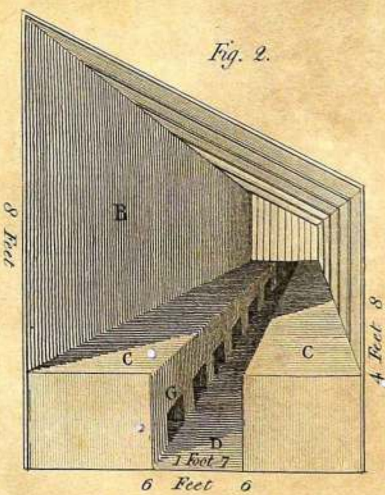


Fig. 3.

or third day; by which means, you will have ripe grapes in July, and the following eight months. Laſt year I left ſome on the vine to dry, and in March following I found them equal to any jar-raiſins imported. If theſe inſtructions are attentively obſerved, wine may be made in this country, as rich, and of as good quality, as any imported. It will anſwer the purpoſe of every man, who has a ſpot of ground, to build a grapery, ſince no profit in agriculture will be ſuperior to it. The whole of the expence of building my grapery did not exceed 14 *l.*: and, when the vines came into bearing, one year's produce, if ſold, would have more than cleared all expences; from which the profits may be eaſily calculated.

I am, &c.

RICHARD MARCH.

XLV.

XLV. *Obſervations on the Growth of Trees, with Tables ſhewing their Increaſe in Circumference, and in ſolid Meaſure.* By ROBERT MARSHAM, *of Stratton, in Norfolk, Eſq F. R. S.* *

From the TRANSACTIONS of the ROYAL SOCIETY of LONDON.

TABLE I.

Meaſures of Trees taken in April 1743, *before they began to ſhoot; and again in Autumn* 1758, *after the Years's growth was completed. The Meaſure taken at five Feet from the Earth.*

* It may be right to remark, that the firſt of this paper was printed near forty years ago: the ſupplement was printed this year.

1. Aſh

	Circumference in Spring 1743.			Circumference in Autumn 1758.			Increase in 16 years.			Content in 1743.			Content in 1758.			Solid Increase in 16 years.		
	Feet.	Inches.	8ths of In.	Feet.	Inches.	8ths of In.	Feet.	Inches.	8ths of In.	Cubic feet.	Quarters.	Inches.	Cubic feet.	Quarters.	Inches.	Cubic feet.	Quarters.	Inches.
1. Ash, planted since 1647, - -	9	10	4	11	1	0	1	2	4	60	1	318	76	3	43	16	1	157
2. Oak, past thriving, but sound, -	9	4	4	10	1	0	0	8	4	54	1	336	63	2	80	9	0	176
3. Oak, about 80 years old, - -	6	3	3	7	8	3	1	5	0	24	1	284	36	2	408	12	1	124
4. Scotch Fir, seed in 1698, - -	5	4	6	6	6	0	1	1	2	17	3	48	26	1	270	8	2	222
5. Oak, planted above 60 years, - -	5	11	1	7	2	3	1	3	2	21	3	224	32	0	174	10	0	382
6. Spanish Chesnut, near 60 years old,	4	4	0	5	6	3	1	2	3	11	2	408	18	3	270	7	0	294
7. Another, 45 or 46 years old, -	2	9	6	4	4	4	1	6	6	4	2	391	11	2	408	7	0	17
8. Oak, planted by me in 1720, - -	2	11	2	5	1	2	2	2	0	5	1	116	16	0	260	10	3	144
9. Scotch Fir, planted in 1734, 2 feet high,	1	11	6	4	0	0	2	0	2	2	2	0	10	0	0	7	2	0
10. Pinaster, planted in 1734 or 1735,	2	5	1	4	3	1	1	10	0	3	2	260	11	1	68	7	2	240
11. Oak, set an acorn in spring 1719,	1	7	0	2	8	2	1	1	2	1	2	116	4	1	336	2	3	220
12. Oak, planted in 1720 or 1721, -	2	9	5	4	9	4	1	11	7	4	2	391	14	0	176	9	1	217
										213	0	300	322	0	333	109	0	33

Now,

Now, as the twelve trees above contained 213 cubic feet, 300 inches, of timber, in ſpring 1743, and have increaſed to 322 cubic feet, 333 inches, in autumn 1758; that is, 109 cubic feet, 33 inches, in 16 years growth; if all the trees were of the ſame kind, 109 feet pays 3 *per cent.* for ſtanding. The 6 oaks pay near the ſame intereſt, although one of them, No. 2, appeared paſt thriving in 1743; for, the increaſe of the 6 oaks is from 112 feet, 1 quarter, 171 inches, of timber, to 167 feet, 138 inches; *i. e.* 54 feet, 2 quarters, 399 inches; which is above 3 *per cent.* But, if you take only the five thriving Oaks, then their content is from 57 feet, 3 quarters, 267 inches, to 103 feet, 2 quarters, 58 inches; *i. e.* 45 feet, 2 quarters, 223 inches, of timber; or near 5 *per cent.* The increaſe of the moſt thriving Oak, No. 8, appears, by the above table, to pay above 12½ *per cent.*; and the Scotch Fir, No. 9, being under 2 feet and a half of timber in ſpring 1743, and 10 feet in autumn 1758, pays above 18¾ *per cent.* Beſides, it ſhould be conſidered, that although I meaſured the largeſt and moſt thriving Oak and Scotch Fir in 1743, yet ſeveral others, of the ſame

age,

age, both Oaks and Scoth Firs, have greatly exceeded the meaſured trees for many years paſt; for inſtance, the Oak No. 11 appears, by the table, 2 feet, 8 inches, $\frac{2}{8}$ths in circumference; another, juſt by it, is 2 feet, 11 inches, $\frac{6}{8}$ths; and an Oak, tranſplanted from this grove, is 3 feet 9 inches, $\frac{5}{8}$ths round: this laſt tree was conſiderably leſs than the firſt, when removed, and not planted in a better ſoil, and yet is 1 foot, 1 inch, $\frac{3}{8}$ths larger than the original tree. The firſt contains 4 feet, 1 quarter, 336 inches, and has gained 2 feet, 3 quarters, 220 inches, in 16 years: the laſt contains 8 feet, 3 quarters, 68 inches; and, ſuppoſing them equal in 1743, gains 7 feet, 384 inches; *i. e.* above $2\frac{1}{2}$ the increaſe of the firſt tree. But, notwithſtanding the tranſplanted Oak is thus much larger than the original Oaks in the grove, yet, as the tranſplanted tree does not run half the height of the trees in the grove before it heads, they differ but little in their quantity of timber.

The following table ſhews the monthly increaſe of trees in the years 1757 and 1758. As I endeavoured to take the meaſures with as much exactneſs as was in my power, I cut three, four, or more notches in the bark of each tree, that my line might always be confined exactly to the ſame place. I obſerved, that if I meaſured ſoon after rain, whilſt the bark was ſaturated with water, the tree would be $\frac{1}{8}$ of an inch larger than after a day or two of dry weather. I may here add, that all the meaſures of circumferences of trees are taken at 5 feet from the earth: and, conſequently, the ſolid meaſures muſt include 10 feet in length. I generally made uſe of Keay's tables, in the ſolid meaſures, which go no lower than quarters of inches in girts.

TABLE II.

Meaſures of the monthly Increaſe of the moſt thriving Trees I had, of the following ſeveral Kinds, taken at five Feet from the Ground, in the Years 1757 and 1758.

1. An

	Feet. Inches. 8th of In.	June 1, 1757.	July 3, 1757.	August 3, 1757.	Sept. 4, 1757.	Nov. 1757.	June 1, 1758.	June 30, 1758.	July 31, 1758.	Aug. 29, 1758.	Sept. 29, 1758.
1. An Oak planted in 1720, No. 8 of the other table, .	4 9 7	4 10 1	4 10 3	4 10 7	4 11 2	4 11 2	4 11 3	4 11 6	5 0 4	5 1 2	5 1 2
2. A Beech, a feed in 1741, .	0 11 0	0 11 1	0 11 5	1 0 1	1 0 4	1 0 4	1 0 7	1 1 3	1 1 7	1 2 2	1 2 3
3. A Scotch Fir, planted in 1734, about 2 feet high, . . .	4 2 4	4 3 0	4 3 1	4 3 2	4 3 4	4 3 6	4 4 1	4 4 3	4 4 4	4 4 6	4 4 6
4. An Oak, an acorn in fpring 1719, never removed, . . .	2 9 4	2 9 5	2 9 6	2 10 1	2 10 2	2 10 2	2 10 4	2 10 6	2 11 1	2 11 5	2 11 6
5. A Spanifh Chefnut, 45 or 46 years old, No. 7 in the other table, .	4 2 5	4 2 7	4 3 0	4 3 1	4 3 4	4 3 4	4 3 4	4 3 5	4 4 1	4 4 4	4 4 4
6. An Elm, about 25 years old, .	1 7 0	1 7 4	1 8 0	1 8 2	1 8 4	1 8 4	1 9 0	1 9 4	1 9 7	1 10 2	1 10 3
7. A Spruce Fir, planted in 1735, about 2 feet high, . .	— — —	— — —	— — —	— — —	3 6 1	3 6 2	3 7 0	3 7 1	3 7 4	3 8 0	3 8 0
8. A Larch, planted in 1749, .	1 0 7	1 1 5	1 2 2	1 2 5	1 2 7	1 3 1	1 3 6	1 4 3	1 4 6	1 5 1	1 5 1
9. A Willow, fet in fpring 1736, .	— — —	— — —	5 1 7	5 2 2	5 2 3	5 2 3	5 2 3	5 3 0	5 3 7	5 4 2	5 4 3
10. A Beech, a feed in 1733, .	— — —	— — —	— — —	— — —	— — —	1 10 4	1 10 7	1 11 3	2 0 0	2 0 5	2 0 5
	Meafured Oct. 6, 1756, and on the 6th of Nov. they were rather lefs.	Moft of thefe were 1-8th lefs in the beginning of April 1757 than at their laft meafure, and had not encreafed on the 1ft of May.	The laft month was very dry.	The firft half of the laft month dry and hot; afterwards frequent fhowers.	From Auguft 3 to 10, very hot; then much cooler; and latterly frequent fhowers.		Very dry fpring.	Laft month rather dry.	Laft month very rainy, but hot.	Laft month hot, and rather moift.	Laft month very wet and cool.

TABLE III. *Shewing the Increase in Circumference, and in solid Measure, of each Tree in* 1758.

	Circumference in 1757.			Circumference in 1758.			Content in 1757.			Content in 1758.			The year's solid incr. of 1758			Interest the trees pay for standing	
	Feet.	Inches.	8ths of In.	Feet.	Inches.	8ths of In.	Cubic feet.	Quarters.	Inches.	Cubic feet.	Quarters.	Inches.	Cubic feet.	Quarters.	Inches.		per Cent.
1. The Oak, – – –	4	11	2	5	1	2	15	0	188	16	0	260	1	0	72	or near	7
2. The Beech, – – –	1	0	4	1	2	3	0	2	216	0	3	174	0	0	390	above	36
3. The Scotch Fir, – –	4	3	6	4	4	6	11	1	68	11	2	408	0	1	340	about	4
A Scotch Fir, (not in the 2d Table,) planted in 1735, – –	4	1	4	4	4	0	10	1	296	11	2	408	1	1	112	above	$12\frac{1}{2}$
4. The Oak, – – –	2	10	2	2	11	6	5	0	30	5	2	216	0	2	186	above	$12\frac{1}{8}$
5. The Spanish Chesnut, – –	4	3	4	4	4	4	11	1	68	11	2	408	0	1	340	near	4
6. The Elm, – – –	1	8	4	1	10	3	1	2	408	2	0	174	0	1	198	near	21
7. The Spruce Fir, – – –	3	6	2	3	8	0	7	2	270	8	1	264	0	2	426	above	$9\frac{2}{3}$
8. The Larch, – – –	1	3	1	1	5	1	0	3	392	1	1	8	0	1	48	above	$28\frac{1}{4}$
9. The Willow, – –	5	2	3	5	4	3	16	2	318	17	3	48	1	0	162	above	$6\frac{1}{2}$
10. The Beech, – – –	1	10	4	2	0	5	2	0	174	2	2	0	0	1	258	above	19
A Weymouth Pine, – – –	1	6	2	1	9	0	1	1	270	1	3	284	0	2	14	about	36

As the Scotch Fir, No. 3, has been sickly for two years past, I add another (one year younger) to shew the growth of that kind of tree. The extraordinary increase of the Weymouth pine induced me to put that in also, though I had not measured it monthly.

What

What great fortunes might be raiſed, by thoſe that have property, in the vaſt heaths and downs, or fields of poor land, in this kingdom, by planting parts of them! Some parts of theſe great waſtes would produce good oaks; and, where the ſoil is moiſt, Poplar, Alder, and other aquatics, would be very profitable to the planter. The chalky ſoil ſeems the leaſt promiſing, yet Beeches ſometimes thrive well upon it. The fir-kind, eſpecially the Scotch Fir, will grow ſurpriſingly upon poor ſandy land; but, woods of Fir ſhould be guarded with an out-line of Birch and Beech, to break the force of ſtrong winds. Birch, being the quickeſt grower, will beſt protect the young Fir; but, as Birch, after a few years, is eaſily blown down, Beech will be wanted, to defend the Firs as they become large. I have ſeen broad glades made by the wind, through great woods of Fir in Switzerland; which, perhaps, might have been prevented, at leaſt in part, by an outline of Beech.

I know ſome think, that poor land cannot produce large trees; yet the Oak at Northall, in Hertfordſhire, whoſe beautiful head ſpreads a

circle

circle of above 40 yards diameter, ſtands on a deep and dry ſand; and the fine Cheſnuts and Beeches by Mr. Naylor's grand Caſtle of Herſt Monceux, in Suſſex, grow in a light ſandy ſoil. I have alſo found, by experience, that the Weymouth, Scotch, Spruce and Silver Firs, which I planted in a poor ſandy ſoil, are larger and finer trees than others, ſet at the ſame time, in much better land. Perhaps it may require a rich clay to produce ſuch trees as the noble grove of Oaks in the Earl of Powis's park by Ludlow, or Lord Ducie's vaſt Cheſnut at Tortworth, in Glouceſterſhire, which I meaſured 46½ feet in circumference, at near 6 feet from the ground.

SUPPLEMENT.

The following meaſures were all taken by myſelf, except the ſecond of the Aſh in Scotland, and that, I believe, is fair. As that is the largeſt Aſh, and as thriving as any I had ſeen, I was deſirous to procure a ſecond meaſure of it. The meaſures (where there was no impediment) were taken

taken at five feet from the earth, as the eafieft height to run the line even, and a fair height for the bulk of the body. For, moft trees (at leaft Oaks and Chefnuts) are frequently found to be one-third more in circumference at one foot than at five. Where I have meafures of more than one tree of the fame kind, I give the largeft and a fmaller, to fhew the different proportion of the increafe of their different fizes; and, as trees ftanding fingle generally increafe more than thofe in groves, I mark them accordingly, with an S or a G; as the difference is more than would be expected by thofe who think little about trees.

In 1719, I had about two acres fowed with acorns; and, from 1729 to 1770, I planted oaks from this grove, always leaving the beft plants ftanding for the future grove. Moft of the tranfplanted trees are already larger than thofe that were not removed; the largeft of which is now (1795) but 5 feet, 6 inches, 8 tenths, in circumference; whereas the largeft tranfplanted tree (which was planted in 1735) is 8 feet, 8 inches, 7 tenths, *viz.* near 38 inches gained by tranfplanting, in 60 years. And, of Beeches from feed, in 1733, the largeſt is now (1795) but 6 feet, 9 inches; and the largeſt tranſplanted Beech is 7 feet, 5 inches, 1 tenth, *viz.* 8 inches larger; although the tranſplanted Beech is eight years younger than that from the ſeed. This proves that it is better to plant a grove than to raiſe one from the ſeed. The expence of planting is inconſiderable: the planted trees are full as good and handſome; and many years are ſaved, beſides the extra-growth of planted trees. But this extra-growth will not prove near ſo great in groves as in ſingle trees. The firſt grove I planted from theſe acorns of 1719, was in 1731. In 1732 I made another grove from them; in 1735 I planted a third grove from them: and, in 1753, the laſt conſiderable number of plants were taken from the grove, and theſe are very good trees; conſequently 34 years may be ſaved. But I would by no means adviſe planting trees ſo large; as the trouble and expence will be too much, unleſs where a ſhelter or ſcreen is wanted. Whether a grove is to be raiſed from ſeeds, or planted, it is adviſable to ſhelter it round; if from the ſeed, with ſuch ſorts as will grow quicker; and if by planting,

planting, with larger and taller trees. The ſoil in Norfolk is unfavourable to Elms; therefore, in planting, I will venture to recommend Horn-beams, as they may be planted large trees. I planted ſome Horn-beams (rather large) in 1757: diſliking their ſituation, in 1792, I removed them, when they were about three feet in circumference, and did not loſe one tree. They made ſhoots of near half a yard that year; but I ought to ſay that I cut off their heads.

Before I quit this ſubject, I will preſume to ſay, that if young Oaks are unthriving, there is reaſon to hope they may be helped, by cutting them down to a foot, or ſix inches: for, in 1750, I planted ſome oaks from my grove of 1719 into a poorer ſoil, and, although they lived, they were ſickly. In 1761, I cut moſt of them down to one foot, and then, by cutting off the ſide-ſhoots, in three or four years led them into a ſingle ſtem: moſt of them are now thriving and handſome trees, and you can hardly ſee where they were cut off; ſome are four feet round. I have uſed the ſame method with unhealthly Cheſnuts, Beeches, Horn-beams, and Wych-Elms, and with the ſame ſucceſs.

TABLE IV.

The aggregate Increase, in Circumference, of different Trees divided into Tenths of Inches of their annual Growth.

	Dates.	Measure.			Measure.			Number of years.	Average annual Increase.
		Feet.	Inches.	10ths of In.	Feet.	Inches.	10ths of In.		10ths of Inches.
S. Oak, in the Holt forest, by the lodge,	1759	34	0	2					
	1778	34	0	7	0	0	5	19	+ 1/4
S. Oak, in Stratton, planted in 1580, at 4 feet, - -	1760	15	2	9					
	1781	16	5	8	1	2	9	21	+ 7
S. Oak, planted by me, in 1720, -	1742	2	11	2					
	1781	8	2	6	5	3	4	39	16 1/4
S. Oak, acorn in 1719, and transplanted in 1735, - -	1756	3	6	0					
	1781	7	2	2	3	8	2	25	about 17 2/3
S. Wych-Elm, in Stratton Hollow, at 4 feet, -	1760	29	5	6					
	1781	29	10	0	0	4	4	20	2 1/3
S. Wych-Elm, by Bradley Church, Suffolk, -	1754	25	5	4					
	1765	26	0	6	0	7	2	11	6 1/2

G. Wych-

	Dates	Measure. Feet.	Measure. Inches.	Measure. 10ths of In.	Measure. Feet.	Measure. Inches.	Measure. 10ths of In.	Number of years	Average annual Increase. 10ths of Inches.
G. Wych-Elm, in Stratton, -	1787	3	9	0					
	1795	4	6	0	0	9	0	8	+11
S. Ash, in Benel ch. yard, N. of Dunbarton, Scotland,	1768	16	9	0					
	1783	18	0	0	1	3	0	15	10
S. Ash, in Stratton, planted after 1647,	1742	9	10	5					
	1782	12	11	2	3	0	7	40	+9
S. Ash, planted in 1725, in very poor land, -	1769	5	5	0					
	1781	6	6	1	1	1	1	12	near 11
S. Chesnut, in Christ Church Park, by Ipswich, -	1747	15	8	5					
	1763	16	11	2	1	2	7	16	+9
S. Chesnut, in Hevingham, Norfolk, planted in 1610,	1742	12	7	0					
	1781	14	11	2	2	4	2	39	near $7\frac{1}{4}$
S. Beech, in Christ Church Park, by Ipswich, -	1755	15	7	5					
	1763	15	10	6	0	3	1	8	near 4
S. Beech, in Stratton, seed in 1741, washed and dried, -	1778	3	7	4					
	1781	4	4	4	0	9	0	3	30
G. Beech, same age,	1785	3	10	5					
	179[illegible]	5	1	5	1	3	0	10	15

S. Plane,

	Dates.	Meaſure. Feet.	Inches.	10ths of In.	Meaſure. Feet.	Inches.	10ths of In.	Number of years.	Average annual Increaſe. 10ths of Inches.
S. Plane, in Shot-tiſham, Norfolk,	1755	3	10	3					
	1774	7	9	2	3	10	9	19	+ $24\frac{2}{3}$
S. Poplar, black, ſet in my father's time,	1756	11	5	0					
	1768	12	2	4	0	9	4	12	near 8
S. Poplar, black, in Horſtead, Norfolk,	1750	6	1	0					
	1754	7	4	0	1	3	0	4	$37\frac{1}{2}$
S. Poplar, white Abele, -	1760	0	7	0					
	1781	4	3	5	3	8	5	21	+ 21
S. Willow, -	1756	5	0	0					
	1765	6	4	2	1	4	2	9	18
G. Alder, in ſandy ſoil, -	1759	2	0	4					
	1776	3	4	7	1	4	3	17	+ $9\frac{1}{2}$
S. Aſp, -	1772	2	8	7					
	1781	4	2	0	1	5	3	9	+ 19
G. Mountain-Aſh,	1759	2	2	7					
	1781	4	2	4	1	11	7	22	+ $10\frac{3}{4}$
G. Birch, -	1759	2	10	4					
	1768	3	6	2	0	7	8	9	$8\frac{2}{3}$
G. Horſe-cheſnut,	1758	1	4	4					
	1779	3	0	2	1	7	8	21	near $9\frac{1}{2}$
G. Lime, in ſandy ſoil, -	1777	3	2	5					
	1783	3	9	0	0	6	5	6	near 11

G. Cedar,

	Dates.	Meafure. Feet.	Inches.	10ths of In.	Meafure. Feet.	Inches.	10ths of In.	Number of years.	Average annual Increafe. 10ths of Inches.
G. Cedar, one foot high in 1748,	1777	3	1	6					
	1795	6	1	5	2	11	9	18	almoft 20
G. Silver Fir, planted in 1746, -	1758	1	6	5					
	1781	4	10	6	3	4	1	23	near 17½
G. Scotch Fir, planted in 1735, -	1756	4	1	5					
	1781	6	8	0	2	6	5	25	12⅓
G. Spruce Fir, planted in 1735, -	1756	3	4	9					
	1781	5	2	0	1	9	1	25	near 8½
S. Weymouth Pine, planted in 1747,	1756	1	4	1					
	1781	4	8	5	3	4	4	25	+16
G. Pinafter, planted in 1738, -	1756	4	0	7					
	1762	4	11	5	0	10	8	6	18
G. Larch, planted in 1749, -	1758	1	5	2					
	1781	4	2	5	2	9	3	23	near 14½
S. Holly, from feed, by me, and tranfplanted, -	1749	1	10	4					
	1781	3	9	1	1	10	7	32	+ 7
S. Hawthorn, by Hethel Church, Norfolk, at four feet,	1755	9	1	0					
	1781	9	8	5	0	7	5	26	near 3

XLVI.

XLVI. *Concluſion of Mr.* Hazard's *Obſervations on making Butter and Cheeſe.*

(From Page 271.)

THE mountains of Wales, the highlands of Scotland, and the moors, commons, and heaths of England, produce excellent butter, where it is properly managed; and, though not equal in quantity, far ſuperior in quality, to that which is produced from the richeſt meadows; but the land is often blamed, when the butter is bad through miſmanagement, ſluttiſhneſs, or inattention.

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 in general would find their account in it.

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

I write all these particulars from my own knowledge, and am well persuaded they may prove useful to those who are not too much bigotted to their own opinion.

On making Cheese.

The methods of making cheese are so various, that it is not in the power of any person to be acquainted with them all; however, I have selected a few of the best, or those that are in the highest esteem.

The *double Gloucester* is a cheese that pleases almost every palate; the best of this kind is made from new, or (as it is called in that and the adjoining counties) *covered milk*. An inferior sort is made from what is called *half-covered milk*; though, when any of these cheeses turn out to be good, people are deceived, and often purchase them for the best *covered milk cheese*; but farmers who are honest have them stamped with a piece of wood, made in the shape of a heart, so that any person may know them.

It will be every farmer's interest (if he has a sufficient number of cows) to make a large cheese from one meal's milk; this, when brought in warm, will be easily changed or turned by the rennet; but, if the morning or night's milk be mixed with that which is fresh from the cow, it will be a longer time before it turns, and sometimes will not change without being heated over the fire, by which it often gets dust, or soot; nor should I forget smoke, which is sure to give the cheese a very disagreeable flavour.

When the milk is turned, the whey should be carefully strained from the curd, which should be broken small with the hands; and, when it is equally broken, it must be 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 shrink below the brim; if it does, the cheese will be worth very little. But

first,

first, before the curd is put in, a cheese-cloth, or strainer, should be laid at the bottom of the vat; and this should be so large, that when the vat 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 there remain for the space of two hours; it should then be turned, have a clean cloth put under it, and be turned over as before. It must then be pressed again, and remain in the press six or eight hours, when it should again be turned, and rubbed on each side with salt; after which, it must be pressed again, for the space of twelve or fourteen hours more, when, if any of the edges project, they should be pared off: it may then be put on a dry board, where it should be regularly turned every day.

It is a good way to have three or four holes bored round the lower part of the vat, that the whey may drain so perfectly from the cheese, as that not the least particle of it may remain.

The prevailing opinion of the people of Gloucestershire, and the neighbouring counties, is, that the cheeses will spoil, if they are not scraped and washed when they are found to be mouldy; but I know this to be erroneous, and that ſuffering the mould to remain mellows them, provided they are turned every day; or, if they will have the mould off, it ſhould be removed with a clean dry flannel, as waſhing them is only a means of making the mould (which is a ſpecies of fungus rooted in the coat) grow again immediately.

Some people ſcald the curd, but this is a bad and mercenary practice; 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 really are.

As moſt people like to purchaſe high-coloured cheeſe, it may be right to mix a little arnatto with the milk, before it is turned: no cheeſe will look yellow without it, and, though it does not in the leaſt add to the goodneſs, it is perfectly innocent in its nature and effects.

It is not in the power of any perſon to make good cheeſe with bad rennet; therefore the following receipt ſhould be attended to.

Firſt, that the *vell*, *maw*, *rennet-bag* (or by whatever other name it is called) be perfectly ſweet; for, if it be the leaſt tainted, the cheeſe

will

will never be good. When this is fit for uſe, three pints or two quarts of ſoft water (clean and ſweet) ſhould be mixed with ſalt; wherein ſhould be put ſweet-brier, roſe-leaves and flowers, cinnamon, mace, cloves, and, in ſhort, almoſt every ſort of ſpice and aromatic that can be procured: if theſe are put into two quarts of water, they muſt be boiled gently, till the liquor is reduced to three pints; and care ſhould be taken that the liquor is 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 upon 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 keep good for twelve months or more. It will ſmell like a perfume; and a ſmall quantity of it will turn the milk, and give the cheeſe a pleaſing flavour. After this, if the *vell* be ſalted, and dried for a week or two near the fire, it will do for the purpoſe again, almoſt as well as before.

Chedder Cheeſe is held in high eſteem; but I am well informed that its goodneſs is chiefly owing to the land whereon the cows feed; as the method of of making it is the ſame as is purſued throughout Somerſetſhire, and the adjoining counties: I mean not to exclude the north part of Wiltſhire, where the land has a ſurprizing effect on both butter and cheeſe.

Cheſhire cheeſe is much admired; and here I muſt obſerve, that no people take leſs pains with the rennet than the Cheſhire farmers; but their cheeſes are ſo large as often to exceed one hundred pounds weight each; to this (alſo to the time they are kept, the richneſs of the land, and the farmers keeping ſuch a number of cows as to make ſuch a cheeſe without adding a ſecond meal's milk) their excellence may be attributed. Indeed they ſalt the curd, (which may make a difference,) and keep the cheeſes in a damp place after they are made; they are alſo very careful to turn them daily.

But, of all the cheeſe this kingdom produces, none is more highly eſteemed than the *Stilton*; which is called the Parmeſan of England, and (except faulty) is never ſold for leſs than one ſhilling or fourteen pence *per* pound.

The Stilton cheeſes are uſually made in ſquare vats, and weigh from ſix to twelve pounds each cheeſe.

cheeſe. Immediately after they are made, it is right to put them into ſquare boxes, made exactly to fit them; they being ſo extremely rich, that, except this precaution be taken, they are apt to bulge out and break aſunder: they ſhould be continually and daily turned in theſe boxes, and muſt be kept two years, before they are properly mellowed for ſale. Some make them in a net, ſomewhat like a cabbage-net, ſo that they appear, when made, not unlike an acorn; but theſe are never ſo good as the other, having a thicker coat, and wanting all that rich flavour and mellowneſs which make them ſo pleaſing.

I muſt not omit to mention, that no people are more cleanly in their dairies than thoſe of Stilton and its neighbourhood; and muſt alſo obſerve, that the making of theſe cheeſes is not confined to them alone, as many perſons in Huntingdonſhire, (and alſo in Rutland and Northamptonſhire,) make a ſimilar ſort, ſell them for the ſame price, and give all of them the name of Stilton cheeſes.

Though theſe farmers are remarked for cleanlineſs, they take very little pains with the rennet, as they in general only cut pieces from the *vell*

or

or *maw*, which they put into the milk, and move gently about with the hand; by which the milk is broken or turned, ſo that they eaſily obtain the curd. But, I am well aſſured, that if the method above deſcribed for making rennet were put in practice, they would make their cheeſe ſtill better; at leaſt they would not have ſo many faulty and unſound cheeſes; for, notwithſtanding their cheeſes bear ſuch a name and price, they often find them ſo bad as not to be ſaleable, which I attribute to their being ſo careleſs about the rennet.

I am perſuaded, as good cheeſe might be made in other counties, if people would adhere to the Stilton plan, which is this. They make a cheeſe every morning; and, to this meal of new milk, they add the cream taken from that which was milked the night before; this, and the age of their cheeſes, I am almoſt confident, are the only reaſons why they are preferred to others; for, from the niceſt obſervation, I could never perceive that their land was in any reſpect ſuperior to that of other counties.

Excellent cream cheeſes are made in Lincolnſhire, by adding the cream of one meal's milk, to milk which comes immediately from the cow; theſe cheeſes are preſſed gently two or three times; turned for a few days, and then diſpoſed of, at the rate of one ſhilling *per* pound, to be eaten, while new, with radiſhes, ſallad, &c.

Many people give ſkimmed milk to pigs; but the whey will do equally as well, after cheeſes are 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 hath proved them to be much eaſier of digeſtion than any new-milk cheeſes. A good market may always be found for the ſale of them, at Briſtol.

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.

XLVII. *Account of a Method of making Soap of Wool, with Obſervations reſpecting its Uſe in various Arts.* By M. Chaptal.

FROM THE *ANNALES DE CHIMIE.*

I HAVE already ſhewn the manner of making, at all times, in every place, and at a ſmall expence, a ſaponaceous liquor which may be conveniently uſed, inſtead of ſoap, for domeſtic purpoſes. See the Report of Meſſrs. Pelletier, d'Arcet, and Le Lievre, on the art of making ſoap *.) I ſhall now

* As that part of the report referred to by M. Chaptal appears to be of general utility, we ſhall here give a tranſlation of it.

A very good way of uſing ſoap is, to employ it in a liquid ſtate; that is, diſſolved in water. In conſequence of which M. Chaptal propoſes that ſaponaceous liquors ſhould be prepared, which may be uſed inſtead of ſolutions of ſoap; and, in order to be able to procure ſuch liquors, at all times, in all places, and at a ſmall expence, he adviſes one or the other of now preſent to the public a ſupplement to my former

of the following methods to be practiſed. We ſhall deſcribe them exactly as M. Chaptal communicated them to us, with obſervations thereon, made by himſelf.

Firſt Method.

Take the aſhes produced from the combuſtion of wood which has not been floated, and make a ley of them, according to the uſual manner; mixing with the aſhes a handful or two of quick-lime, well pounded, or recently ſlaked. Let the ley ſtand till it is grown clear, by the ſettling or ſwimming of the foreign ſubſtances contained therein; then pour it into another veſſel, and keep it for uſe. When it is propoſed to make uſe of this ley, take any quantity of oil, and pour upon it thirty or forty times as much of the ley. Immediately a liquor as white as milk will be formed, which, by being well ſhaken, or ſtirred, lathers and froths like a good ſolution of ſoap. This liquor is to be poured into a waſhing-tub, or other veſſel, and to be diluted with a greater or leſs quantity of water; after which, the linen, meant to be waſhed, is to be ſteeped therein, to be rubbed, and wrung, in the uſual way.

Obſervations.

1. It is better that the ley ſhould not be made until the time when it is to be uſed: if it is left to ſtand in open veſſels, its power is weakened, and its nature is changed.

 2. Freſh

former work, inſtructing them how to prepare,

as

2. Freſh wood-aſhes are preferable to old ones, particularly if the latter have been expoſed to the air; in that caſe, they have no longer their uſual power, and we muſt, in order to make them ſerve our purpoſe, mix with them a greater proportion of quick-lime.

3. Thoſe aſhes alſo are preferable which are produced from hard wood: thoſe which are left after the burning of floated wood cannot be made uſe of with equal ſucceſs.

4. Fat oils, of a thick conſiſtence, are moſt proper for the purpoſe here ſpoken of: fine thin oils are by no means fit for it.

5. If ſtinking oil be made uſe of, it is apt to give a bad ſmell to the linen; this may be removed by paſſing the linen carefully through a ſtrong pure ley; but, in general, this ſmell goes off as the linen becomes dry.

6. When the mixture of oil with the ley is of a yellow colour, it muſt be diluted with water.

7. When the oil riſes in the ley, and ſwims upon the ſurface of it, in the form of ſmall drops, it ſhews that the oil is not fit for the purpoſe, not being thick enough; or elſe, that the ley is too ſtrong, or not ſufficiently cauſtic.

8. To prevent the quick-lime from loſing its power, and that we may always have ſome to uſe when we want it, it may be broken into ſmall pieces, and kept in bottles well dried, and well corked.

as a ſubſtitute for ſoſt-ſoap, (which is at pre-

ſent

Second Method.

Floated wood, which is made uſe of in many parts of France, produces aſhes which contain very litte alkaline ſalt, and which are conſequently very improper for making leys; in that caſe, barilla, or potaſh, may be uſed inſtead of them.

Take barilla, and break it into pieces about the ſize of a walnut; put theſe into a veſſel of any kind, and pour upon them twenty times their weight of water: the water is to be left upon the barilla till it appears, by putting a little upon the tongue, to be ſlightly ſalt.

Some oil is then to be put into an earthen veſſel, and forty times as much of the barilla-ley is to be poured upon it: the mixture, which ſoon becomes milky, is to be well ſhaken, or ſtirred; and, after being diluted with more or leſs clean water, according to its ſtrength, and the purpoſe for which it is intended, is to be made uſe of like a ſolution of ſoap in water.

Inſtead of barilla, pot-aſh may be employed, but it requires a ſmall quantity of pounded quick-lime to be mixed with it.

Obſervations.

1. Alicant or Carthagena barilla may be uſed without any mixture of lime; but the bad barilla of our country requires to haved mixed with it a greater or leſs proportion of lime, according to its degree of ſtrength and purity.

2. When

ſent made uſe of in fulling almoſt every kind of woollen ſtuff,) a kind of ſoap which coſts little, and which may be eaſily made in every woollen manufactory.

2. When barilla, of whatever kind it be, is in a ſtate of efloreſcence, it cannot be employed without a mixture of lime.

3. If the barilla-ley is too ſtrong, the oil is apt to ſwim on its ſurface; it muſt then be diluted with a proper quantity of water.

4. Fat oil is moſt fit for this purpoſe: fine light oils ſhould not be uſed.

5. When the ſaponaceous liquor is greaſy, and the linens waſhed in it are ſo likewiſe, they muſt be paſſed through a pure barilla-ley, to have their greaſineſs removed; which ley ſhould firſt be warmed a little, to increaſe its effect.

6. When the water which was poured upon the barilla is all uſed, freſh water may be poured upon the remaining barilla. This water will acquire a ſaline taſte, like the firſt: thus, the ſame barilla may ſerve for ſeveral ſucceſſive opetions.

TO BE CONCLUDED IN OUR NEXT.

XLVIII. *Observations on the best Method of dying with red Sanders. by Mr.* Vogler.

From Crell's Chemical Annals.

THE manner in which red sanders is used by the dyers is very disadvantageous; watery menstrua, which are generally employed by them, being incapable of extracting its colour effectually, or of imparting it afterwards, in sufficient quantity, to the articles which are to be boiled therein. Of the numerous experiments I have made with this wood, (which by botanists is called *Pterocarpus santolinus*, and grows on the mountains of the East-Indies,) the following were attended with the best success: they were repeated at least ten times, and always with similar results.

I. Into a solution of tin, made with aquafortis, and mixed with three times as much salt water, I put clean-washed wool, silk, linen, and cotton.

After

After six hours, I took them out, and washed them carefully in three different quantities of clean cold water, wringing them well each time. I let them dry, and then put half the quantity of each article into the spirituous tincture of red sanders, hereafter described in section VI, letting them soak therein, without heat, from half an hour to an hour. The other half of each article was boiled in the tincture of sanders mixed with water, described in section VII, a bare quarter of an hour. After being taken out, wrung, and dried in the shade, all of them appeared to be dyed throughout of a fine rich poppy-colour.

II. I took three drams of powdered alum, and dissolved it in twelve ounces of clean hot water. Into this solution, while yet warm, I put some well-washed wool, silk, linen, and cotton. After I had suffered them to remain therein for the space of twelve hours, I took them out, washed them well in three quantities of clean cold water, (wringing them each time,) and dried them. I then steeped the half of each article in the cold spirituous tincture of sanders, (section VI,) from half an hour to an hour; and boiled the other half of each in the diluted tincture of ſanders, (ſection VII,) for the ſpace of ſix or ſeven minutes. After they were taken out, wrung, and dried in the ſhade, they were found to have acquired a very beautiful and rich ſcarlet colour.

III. Three drams of blue vitriol or vitriol of copper, powdered, were diſſolved in twelve ounces of hot water; wool, ſilk, linen, and cotton, which had been well waſhed, were then ſteeped therein for twelve hours. When taken out, they were dried, having been firſt ſufficiently waſhed in clean cold water. One half of each article was then immerſed in the ſpirituous tincture of ſanders, (ſection VI,) from half an hour to an hour; and the other half of each was boiled, for ſix or ſeven minutes, in the diluted tincture. (Section VII.) Being then taken out, wrung, and dried in the ſhade, as before, they appeared to have acquired a beautiful, rich, bright, crimſon colour.

IV. Wool, ſilk, linen, and cotton, which had been well waſhed, were ſteeped, during twelve

 hours,

hours, in a ſolution of three drams of white vitriol or vitriol of zinc, in twelve ounces of hot water. After being taken out, well waſhed in clean cold water, and dried, one half of each was immerſed in the cold ſpirituous tincture of ſanders; (ſection VI;) the other half was boiled in the diluted tincture, (ſection VII,) as before. When taken out, wrung, and dried, they were of a fine, rich, deep, crimſon colour.

V. Three drams of common green vitriol or vitriol of iron were diſſolved in twelve ounces of hot water: well-waſhed wool, ſilk, linen, and cotton, were ſteeped in the ſolution, for the ſpace of twelve hours. They were then taken out, waſhed ſeveral times in clean cold water, and dried; after which, as in the preceding experiments, half of each was put into the ſpirituous tincture; (ſection VI;) half into the diluted tincture. (Section VII.) After being taken out, wrung, and dried, all of them were found to be of a fine, rich, deep, violet colour: in ſome repetitions of this experiment, their colour was a dark browniſh red.

The

The tinctures, in which the forementioned articles were dyed, were prepared in the following manner.

VI. I took half an ounce of red ſanders-wood, beat or ground to powder, as it is ſold at the colour-ſhops or druggiſt's. Having put it into a large glaſs bottle, I poured upon it twelve ounces of malt ſpirit or common brandy; I then corked the bottle, and ſet it in a moderately-warm place. In the ſpace of forty-eight hours, the ſpirit had extracted all the colouring-matter from the red ſanders, and had thereby acquired a bright red colour. The bottle ſhould be often ſhaken during the digeſtion; and the tincture, thus prepared, may be uſed for dying, without heat, and without ſeparating the powdered ſanders from the liquor. The articles to be dyed (after the application of the proper mordants, ſections I, II, III, IV, V,) are to be ſteeped in the tincture for half an hour, or a whole hour: they are then to be taken out, wrung, and dried in the ſhade. This tincture does not loſe its dying quality by age; but dyes ſubſtances, after being kept a long time, almoſt as well as when it is juſt made. Its colouring-power is indeed weakened by the frequent immersion and dying of different articles in it; and, when that is the case, it must be again digested with some fresh sanders-wood.

VII. I mixed the spirituous tincture of sanders, just described, with from six to ten times as much clean cold water. The mixture was made without any separation of the colouring-particles worth noticing; and, in this diluted tincture, the various articles (having their proper mordants first applied, sections I, II, III, IV, V,) were boiled, as before mentioned. Linen and cotton, by being dipped in glue-water, after the application of the mordants, acquired, in this diluted tincture, a much deeper and richer colour.

If a very fine and bright colour be desired, the above spirituous tincture of sanders should not be too old, nor should the digestion be protracted beyond forty-eight hours: for, after that period, the spirit appears to extract brown and yellow colouring-particles from the wood. The powder of sanders need not be separated from the diluted tincture which is made use of by boiling; nor is it absolutely necessary to wash the articles in cold

water,

water, after they are dyed; as ~~the~~ powder which adheres to them may eaſily be taken off by rubbing and ſhaking. I have, however, found it advantageous, after the articles were taken out of the dye, and wrung, to ſteep them, for a few minutes, in a cold ſolution of half an ounce of common ſalt, and quarter of an ounce of alum, in twelve ounces of pure water. In this caſe, they ſhould afterwards be waſhed ſeveral times in clean cold water, then wrung and dried in the ſhade. By this method the colours are not only more beaútiful, but are alſo more permanent. All the articles of wool, ſilk, linen, and cotton, which were dyed as is above mentioned, bore perfectly well the teſt of alkaline ley, ſoap, and acids; but, by expoſure to the open air and the ſun, the colours were more eaſily diſcharged, eſpecially from linen and cotton.

Water and alkaline ſalt, by boiling with red ſanders, extract but little of its colouring-matter; and articles which are boiled therein appear, from my obſervations, to be very faintly and badly dyed. Spirit is the beſt, and indeed the only menſtruum

by

by which the colouring-matter can be completely extracted from this wood, and properly communicated to the articles intended to be dyed with it. It is true that this method is rather expenfive; but it makes ample recompenfe, by the beauty and richnefs of the colours which are thereby given to all kinds of articles. Red fanders, by being ground to a fine powder, anfwers much better, for this purpofe, than when it is merely cut into fmall pieces; but, it muft be remarked, that the powder of red fanders which is fold at the fhops, is fometimes adulterated, by being mixed with other fubftances, and moiftened with acids. The beft kind is not light, but rather heavy; and is not of a dark red colour, but clear and bright.

XLIX. *Liſt of Patents for Inventions, &c.*

(Continued from Page 288.)

THOMAS COBB, of Banbury, in the county of Oxford, Banker; for a method of making coloured paper, which may be uſed as well for hanging rooms as for writing, printing, drawing, &c. Dated November 19, 1796.

CHARLES TRUSTED, of Overſley, in the county of Warwick, Gentleman; for a machine called a time-repeater, to be applied to common watches, for the purpoſe of ſtriking the hours and quarters. Dated November 24, 1796.

WILLIAM JACKSON, of Shire-lane, Temple-bar, Smith; for an improvement upon doors, whereby the door ſhuts of itſelf, without noiſe. Dated December 5, 1796.

JAMES TATE, of Tottenhamcourt-road, Ironmonger; for a machine for cooking, on improved principles. Dated December 5, 1796.

JOHN GOVER, of Hollen-ſtreet, Soho; for a carriage for all ſorts of cannon, whereby the working and management of them may be done

with

with lefs difficulty and labour. Dated December 8, 1796.

Francis Lloyd, of Woolftanton, in the county of Stafford, Iron-founder; for a furnace or fire-place calculated to fave expence in fuel. Dated December 13, 1796.

Moses la Fount, of Pentonville, Luftre-mounter; for a plate and hoop or band, to be ufed in mounting glafs chandeliers, &c. Dated December 23, 1796.

John Lee, of Lewifham, in the county of Kent, Brickmaker; for a mixture of chalk, whiting, or lime, together with clay, loam, or earth, for colouring and making of bricks. Dated January 23, 1797.

Dudley Adams, of Fleet-ftreet, Optician; for fpectacles upon a new principle, by which all preffure is removed from the temples and nofe. Dated January 23, 1797.

Anthony George Eckhardt, of Charing-Crofs, and Richard Morton, of Sheffield, in the county of York, Manufacturers; for making candlefticks, &c. fo that the lights may be raifed or lowered, having likewife the advantage of an extinguifher. Dated January 23, 1797.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER XLII.

L. *Specification of the Patent granted to Mr.* Joseph Brooks, *of New Woodſtock, in the County of Oxford; for his Invention of a buoyant Engine or Machine, for the Purpoſe of raiſing Water, Boats, and Weights, from a lower to a higher Level, without the Aid of Fire or Wind, and without taking any Water from the uppermoſt Level.*

WITH A PLATE.

Dated Jan. 14, 1791.

TO all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the ſaid proviſo, I the ſaid Joſeph Brooks do hereby describe and ascertain my said invention, and the nature thereof, and the manner in which the purposes to be effected thereby are to be performed, in the manner following; that is to say, a pit is to be prepared, of such size, form, dimensions, and depth, as may best suit the quantity of water or weight to be raised, proportioning the depth in the manner hereafter mentioned, and in such situation as the peculiar nature of the place may require; taking care that the mouth or top of the said pit may be at least on a level, or higher if possible, than the place to which the water or other weight is to be raised or conveyed. The said pit is to be of equal dimensions (or otherwise, as most suitable) from top to bottom; and the sides to be of such materials, and prepared in such manner, that the horizontal door, herein after named, may move up and down therein in a horizontal position, and exactly fill the cavity thereof. This door or gate is to be made so as exactly to fill the orifice of the pit; to descend and ascend from the top to the bottom, and from the bottom to the top, of the said pit; fitting the opening of the pit in each position, so as to give as little

little room as possible for any water to pass between the edges of the door or gate and sides of the pit, during its ascent or descent. To the upper surface of this door or gate are to be fixed ropes, passing through or over blocks or pulleys, fixed over the said pit for that purpose, by which it may be suspended in equilibrium, in a horizontal position, and by which the same may be raised or lowered; the other end of the said ropes being fixed to a capstan, or any other mechanical engine fit and suited for the purpose of raising and lowering weights, by means of pulling, hauling, or drawing ropes. In the said horizontal door or gate, one or two other doors or gates are made, to be opened or shut, as valves, by force of the water above or below alternately, as it becomes most powerful; and the weight of the said gate is so to be proportioned, that when the pit is full of water, and the said small doors are set open, it may sink, by its own gravity, therein. From the side or bottom of the canal or reservoir wherein the water to be raised, or to be used in raising the weight, is contained, and from below the surface thereof, a subterraneous canal, pasſage, conduit, pipe, or other conveyance for the water, is to be carried to the bottom of the ſaid pit, which is to open into the ſaid pit, in ſuch manner that when the ſaid horizontal door or gate is let down to the bottom of the pit, the water running down the ſaid ſubterraneous paſſage, conduit, or pipe, may empty itſelf into the ſaid pit, or riſe up in the ſaid pit, below the under-ſurface of the ſaid horizontal door or gate, when ſo lowered or let down. In ſome convenient part of the ſaid ſubterraneous canal, a groove is to be made, to admit a vertical door or gate aſcending and deſcending therein, that the water may at pleaſure be prevented from running, or permitted to run, down the ſaid canal, paſſage, conduit, or pipe, by lowering or raiſing the ſaid door or gate, by means of levers, blocks, ropes, chains, wheels, or other tackle, as may ſuit the circumſtances of the place. The depth of the ſaid pit is ſo proportioned, that the depth of the bottom of the pit below the level of the ſurface of the water in the ſaid canal or reſervoir, whence it is carried into the ſaid pit, may exceed the depth from the top or mouth of the ſaid pit to the ſaid level;

level; that is to ſay, if the top or mouth of the ſaid pit be ten feet above the ſaid level, the bottom of the ſaid pit ſhould be more than ten feet below the ſaid level, but how much more is immaterial; and the depth of the ſaid pit ſhould, in the whole, exceed twenty feet in an engine of this dimenſion, and ſo on in proportion.

And, for the farther and better underſtanding of the ſaid deſcription, I have, as part of this my ſpecification, annexed a plan and drawing of the ſaid works, wherein the ſame are properly delineated and deſcribed, and proper references for the explanation thereof are hereunto added. (See Plate XIX.) In order to apply theſe contrivances to the uſe intended, the vertical gate opening and ſhutting the ſubterraneous canal (which gate, in the plan annexed, is marked with the letter H) is to be drawn up; when the water in the lower level, (in the plan marked A,) deſcending through the opening marked E, down the ſubterraneous canal marked F, into the pit marked D, below the under-ſurface of the horizontal door or gate, which aſcends and deſcends in the ſaid pit in a horizontal poſition, (a delineation of which gate is marked with the letter G in the ſaid plan,) will, by its buoyant power, cauſe and force the gate to aſcend to the level of the water in the lower canal or reſervoir. The vertical gate H is then to be let down, to prevent the water being forced back up the ſubterraneous canal, paſſage, conduit, or pipe, by the deſcent of the horizontal gate or door; and the ſmall gates or doors, in the ſaid horizontal gate or door, (which in the plan are marked N, N,) will of courſe be opened, when the horizontal gate or door G will, by its own weight, deſcend; and, when it is ſunk to the bottom, the ſmall gates or doors in the horizontal gate (the machinery cauſing motion) will again ſhut; and the vertical gate H, which ſhuts the ſubterraneous canal, paſſage, conduit, or pipe, is to be opened, that the water from the lower level may again have an opportunity to flow into the pit, below the under-ſurface of the horizontal gate, and, by its buoyant power, to force the horizontal gate again to the level of the lower water, or canal, or reſervoir, whence the ſubterraneous canal, paſſage, conduit, or pipe, conveys the water. Which aſcent of the horizontal

gate

gate or door is to be aſſiſted and furthered, by pulling, hauling, and drawing the ropes fixed to the horizontal gate or door, (and paſſing through or over blocks or pulleys, fixed over or near the pit, for that purpoſe,) by means of the wheel and lever marked in the plan K and L reſpectively, or by any other mechanical contrivance commonly uſed for pulling, hauling, or drawing ropes, or raiſing weights, as may beſt ſuit the peculiar circumſtances of the place where ſuch contrivance is to be uſed. And, by the ſpecification of the ſaid wheel and lever, I do not mean to confine it to the uſe of that contrivance alone, but only to ſpecify one of the many mechanical means which may be uſed for the purpoſe; it being impoſſible to ſpecify all the various mechanical contrivances which have, at different times, been uſed to pull, haul, or draw ropes, or to raiſe weights; any one or more of which may be uſed to aſſiſt in raiſing the ſaid horizontal door or gate, according as the nature of the place, and the quantity of water to be raiſed, may admit or require. The ſaid horizontal gate or door, in ſuch its ſecond aſcent, will

force

force up the water, which, during its defcent, had rifen through the doors or valves in the faid horizontal gate or door, which are marked N, N; and which remained above it when the faid doors were fhut, and raife it to the mouth of the pit; whence it may, by a trough or channel, be conducted to any place that may be moft convenient, or may be fuffered to run over the edges of the pit. When the horizontal gate has again attained the level of the water in the lower canal or refervoir, the vertical gate of the faid fubterraneous canal, paffage, conduit, or pipe, may be again fhut; when the doors or gates in the faid horizontal door or gate will of courfe again be opened, and the horizontal gate or door fuffered to defcend; and, when it has arrived at the bottom, by opening the faid vertical gate, and pulling or drawing the ropes fixed to the faid horizontal gate, the fmaller valves, gates, or doors, N, N, fhutting in the manner before directed, the horizontal gate may again be forced to afcend, driving the water before or above it, which had rifen through the faid fmaller valves, gates, or doors, in the faid horizontal gate, during its de-

7 fcent,

ſcent, and forcing it over the edges of the pit, as before; which operation may be repeated, till ſufficient water is raiſed for any purpoſe required. If any circumſtances ſhould require it, a ſubterraneous canal may alſo be carried from the upper level, canal, or reſervoir, to the ſaid pit, in the ſame manner as from the lower; which may alſo be opened or ſhut at pleaſure, by means of a vertical gate, ſimilar to that before mentioned, to be opened or ſhut at pleaſure; by which means, water from either the upper or lower canal or reſervoir may be uſed, as may beſt ſuit, for the various purpoſes to which this engine may be employed. As the water from the mouth of the ſaid pit may be conducted in any direction, the ſaid contrivance may be applied to various purpoſes, either to fill the pen between the ſluice-gates of locks on canals or navigable rivers, from the water in the lower level, whereby the loſs of water from the higher level of the canal or river, by filling the ſaid pen when boats paſs through the ſame, will be avoided: or the upper level of the canal or river may, in dry ſeaſons, be ſupplied with

 water

water from the lower. Gentlemen's lakes, fiſh-ponds, or other waters, may alſo be ſupplied with water from the lower grounds; or mill-ponds, in dry ſeaſons, may be repleniſhed from the water which has already paſſed the mill, and which would otherwiſe run to waſte. It may be in like manner applied to floating of meadow-grounds, drainage of all ſorts, and imbankments of every kind, in any ſituation. It may alſo be rendered uſeful in fortified towns, by filling the foſs before the intrenchments. It is alſo conceived to be applicable to the navigation of veſſels on great rivers, or ſhips at ſea in a calm, by raiſing water from a well in the veſſel over a middle wheel or ſhaft, at the ſame time that a wheel, with floats at each end thereof, operates as a lever in the water, and cauſes—— *. In witneſs whereof, &c.

* Compared with the record in the office.

REFE-

References to the Figures.

(See Plate XIX.)

A. The lower level on a water or canal.

B. A lock on a canal in the present usual form.

C. A higher level.

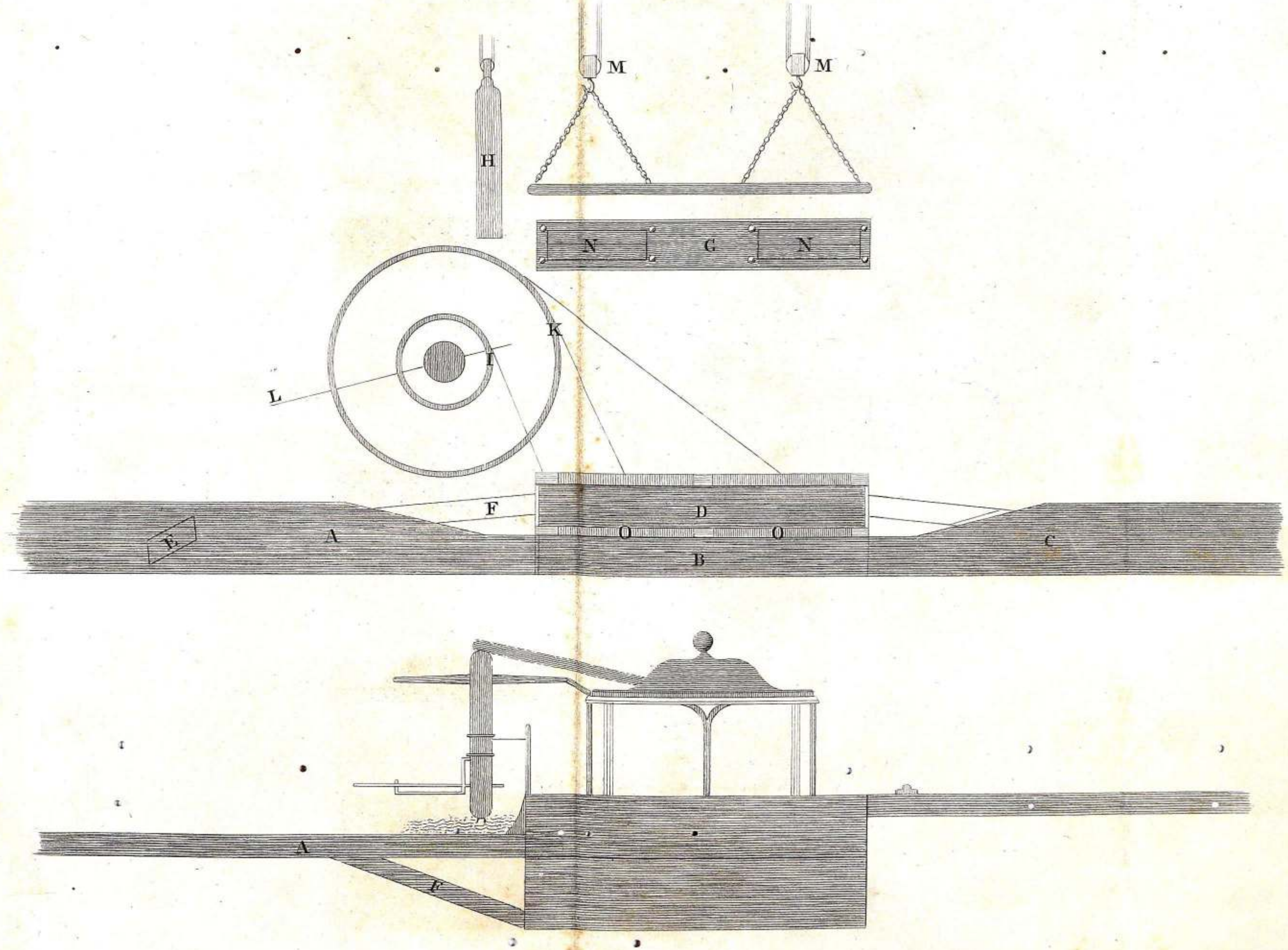
D. A pit, sunk more than double the depth of the lock B.

E. An aperture from the bottom or side of the canal A or lower level, which lets fall the water down the declivity F, into the bottom of the pit D, under the horizontal gate G, at the time the vertical gate H is drawn up for admission thereof, by means of the collar or chain I; which, when let off by a trigger, for that purpose, falls and retains the lock full.

K. A large wheel, round which a rope or chain is worked by a lever L, and also round the pulleys M, M, which are fixed to the horizontal gate working in the lower part of the pit D, as occasion requires.

N, N. Valves which open when the gate is ſinking through the water in D: the machinery puts the gates in motion, and the ſpace below the partition-gate admitting of more water than above, in obtaining its level, it buoys and forces the upper water over the ſide at OO; which, filling the ſaid lock B, raiſes a boat, or floating-weight, up to the higher level C.

A pit of any form, with the gates and valves therein, as above deſcribed, and a back level, will, in like manner, anſwer the purpoſe of raiſing water in any ſituation.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LI. *Specification of the Patent granted to Mr.* JOHN STRONG, *the Younger, of Bingham, in the County of Nottingham, Plumber; for his Invention of certain new Improvements in the Conſtruction of Piſton-Cylinders, Suction-Chambers, and Valves, whereby the ſame may be more expeditiouſly repaired, &c.*

WITH A PLATE.

Dated May 31, 1796.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid John Strong do hereby declare, that my ſaid invention of certain new improvements in the conſtruction of piſton-cylinders, ſuction-chambers, and valves, is deſcribed in the plan and deſcription thereof hereunto annexed. In witneſs whereof, &c.

De-

Deſcription of John Strong's Piſton-Cylinders, Suction-Chambers, and Valves.

(See Plate XX.)

A. Cylinder where the piſton acts.

B. A large male-ſcrew, introduced into the top of the piſton-cylinder at C, on the top of which is fixed a ſtuffing-box, repreſented as at D, if the piſton-rod is required to work on the outſide of the cylinder; but if not, the part above the dotted line acroſs the cylinder, marked *b b*, will not be required; the cylinder being carried upward the ſame diameter as at *b b*, and the piſton-rod will then act in the inſide of the cylinder all its length.

E, E. Communication-tubes, from the cylinder to the receptacles for the valves.

F G, F G. Receptacles for the valves.

H, H. Proper places for the valves to be ſcrewed down upon the ſhoulders I J, I J.

K L, K L. Places where the ſuction and conducting pipes are to be joined.

M, M.

M, M. Two large male-ſcrews, introduced into the top of the receptacles for the valves, at F, F, lined with a collar of leather to make them air-tight, for the convenience of repairing the valves when out of condition. Alſo a ſcrew is to be introduced, in the ſame manner, into the bottom of the piſton-cylinder, at *c d*, in order that the piſton may be lowered, and taken out there to be repaired, when the rod is required to be ſo long that a deal of inconvenience attends the drawing it up.

N. Top part of the rod that is attached to the piſton, repreſented as put through the cylinder in order to be repaired; the piſton being taken off for that purpoſe.

O, O. Key-joint, to ſeparate this piſton from the rod, that it may be repaired with the greater facility.

P. A ſquare collar, put over the key-joint to make it ſecure.

Q. The piſton.

R. A leathern collar, to go round the piſton at W.

S.

S. A collar of metal, ſcrewed on the bottom of the piſton; the edge of the leather collar being introduced between it and the piſton-bottom.

T. Place where the piſton-valve acts.

U. Piſton-valve, ground to be air-tight at V in the piſton.

V. Piſton-valve reſts here when at reſt.

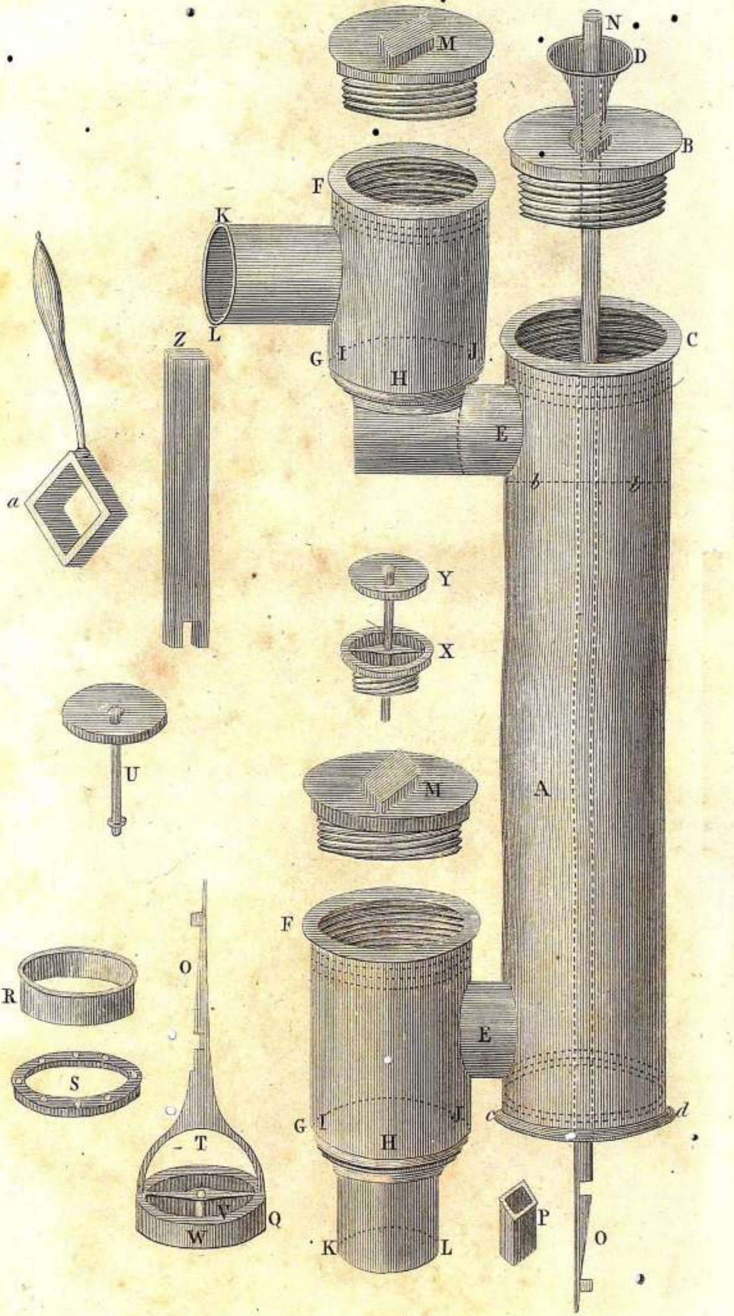
W. Where the leather is put round the piſton.

X Y. A repreſentation of the valve to be introduced into the receptacles F G, F G.

Z. The wrench to ſcrew the valves down ſafe.

a. The wrench to ſcrew the male-ſcrews marked M, M.

N. B. By attaching another cylinder, exactly ſimilar to the cylinder marked A, the ſteam may be made a continual one, one piſton being up when the other is down.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LII. *Specification of the Patent granted to Mr.* THOMAS CLIFFORD, *of the City of Briſtol, Merchant; for his Invention of an improved Mode of manufacturing Nails.*

Dated Dec. 4, 1790.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that my ſaid invention of an improved mode of manufacturing nails conſiſts, firſt, in drawing the iron, or other metal, of which they are to be made, tapering or in a wedge-like form, according to the length and thickneſs of the different ſizes of nails to be made. Secondly, the nails are to be cut out of thoſe wedge-like or tapering plates, by means of a punch, the face of which is made according to the ſize, taper, and form, of the nail to be cut out; as alſo having a hollow bolſter, (commonly called a bed,) the hollow or aperture of which muſt alſo be made to the ſize and form of the nail, and conſequently to to fit and receive the punch above mentioned. The punch thus fitted to the bed, and ſliding in a frame, to keep it exact and ſteady, doth, by a blow or other preſſure, cut and force a part of the taper plate above mentioned into and through the aperture of the bed fitting thereto, and by which the nail is formed: this operation is, by the manufacturers of buckles, buttons, and others, generally called cutting out. Thirdly, in order to form the heads of thoſe nails commonly called roſe-heads, as alſo ſome other ſorts which have a pretty large head, after the operation of drawing and cutting out as above, the nail is to be put into a heading-tool, which I alſo call a bed; which bed receives the nail, excepting a ſmall portion, at the thick end of which the head is formed, by a kind of punch, commonly called a die, the end or noſe of which die muſt be made according to the ſize and form of the head intended to be made. This die, by a blow or other preſſure, forms the head as required; and, when the nails are made of hard iron, or other metal, after they are cut out as above, I make the thick end hot, before they are

put

put into the bed or heading-tool, as above mentioned. Fourthly, my method of manufacturing ſome ſorts of nails is, by cutting them out of or from plates of equal thickneſs, and afterwards to point them, either by a hammer or other preſſure. Fifthly, for the making of ſuch nails as are not intended to be ſquare or right-angled, but more of a triangular form, I preſs or ſtamp the plate or ſtrip of iron, or other metal, into a die, having impreſſions cut to the form of ſuch nails; after which operation, I cut them out by a punch, in manner before deſcribed. I alſo make divers ſorts of nails, by paſſing the iron, or other metal, between two rollers, having impreſſions according to the different forms cut into the ſurface of one or both of the rolls; whereby a ſheet is procured, having, in ſome meaſure, the appearance of nails, and which ſaid nails are to be cut out in the manner above deſcribed. In witneſs whereof, &c.

LIII. *Specification of the Patent granted to Mr.* Edward Nairne, *of the Pariſh of St. Michael, Cornhill, in the City of London, Optician; for an Improvement in the common Electrical Machine, (which he calls the* Inſulated Medical Electrical Machine,) *by inſulating the whole in a particular Manner, and conſtructing the Conductors ſo that either Shocks or Sparks may be received from them.*

Dated Feb. 5, 1782.—Term expired.

To all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the ſaid proviſo, I the ſaid Edward Nairne do hereby declare, that the nature of my ſaid invention, and the manner in which it is performed, is as follows; *viz.* this electrical machine may be compoſed

posed of any substance that can be made electrical, and the excited parts of any form, as cylinder, globe, plates, or any other figure. The form to be executed is mounted with non-conducting substances, or else the part with which it is put in motion is of a non-conducting substance; it is likewise supported immediately on non conducting substances. It is excited by rubbing against silk, on which the amalgama is put; part of which silk nearly reaches the points which receive the electricity from the excited part. The conductor, or conductors, which either give to, or receive the electrical fire from, the excited part, is composed of a coated electrical jar, or jars, or any other substance that can receive a charge of electricity, and a conducting substance connected with them; by which means, any person may receive electricity from, or give electricity to, the conductor; and likewise may receive electrical shocks from the conductor, or conductors. There is likewise, to this electrical machine, a tube, or tubes, rod, or rods, with one or more joints, or a ball and socket, or balls and sockets,

ſockets, of any ſubſtance that will conduct electricity; thoſe, when electrical ſparks are to be drawn from, or given to, any particular part, are to be connected with either of the conductors, and, by means of the joints, or balls and ſockets, fixed to them, may be directed to that part. Alſo, electrical ſparks can be drawn from, and received into, different parts of the body at the ſame inſtant of time; ſo that double the number of electrical ſparks can be received and given, in any determinate time, than can be by any other electrical machine of the ſame ſize, as they are now made; and that, whether the perſon is or is not inſulated. This is done by bringing the parts within the ſtriking diſtance of two balls, one of which is connected with one conductor, and the other with the other conductor, by means of the tubes with the balls and ſockets; or, if the perſon chuſe to inſulate himſelf, then he may receive or give very ſtrong and pungent ſparks, to or from any particular part of himſelf, by approaching the part to any conducting ſubſtance connected with the earth, he being, at the ſame time, connected

nected with one of the conductors. Or he may keep himſelf in a condenſed or exhauſted ſtate of electricity, as long as he pleaſes, by inſulating himſelf, and being at the ſame time connected with one of the conductors. Or he may be changing his natural electricity as long as he pleaſes, by being inſulated, and at the ſame time connected with each conductor. Alſo, electrical ſparks may be received or given, or ſhocks may be received alternately, or ſeveral together, from each, and the change from ſhocks to ſparks made almoſt inſtantly; this is done by taking hold of the conducting ſubſtance that is connected with one ſide of the charged electric, (which, in this caſe, has a ſmall quantity of coated ſurface,) and bringing the part ſo near as to receive or give ſparks to or from the other ſide, or what is connected with it; but, if ſhocks are required, then nothing more is to be done than to increaſe that diſtance a little. Alſo, a much greater number of electric ſhocks may be made to paſs through any part of the body, at the ſame time, than has hitherto, I believe, been done by any other machine. This

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is effected by uſing ſmall glaſs tubes, or an electric with a very ſmall quantity of coated ſurface, and by making the part through which the ſhock is to be ſent a portion of that electric circuit. In all theſe caſes, the perſon himſelf may excite the electric, and perform theſe various operations, without any aſſiſtance from another, if he chuſes it. In witneſs whereof, &c.

LIV. *Obſervations on the Fuſion of Platina. By Mr.* Thomas Willis, *Chemiſt, London.*

From the Memoirs of the Literary and Philosophical Society of Manchester.

I OFFER the following experiments to the public, with a view to promote farther reſearches into the properties of this extraordinary metal, and in hopes that, by rendering the method of fuſing it better known, I may induce others to purſue the ſubject ſo far as to be the means of diſcovering methods of making it malleable. I ſhould have been happy, could I have ſucceeded in making it ſo, as it would be of the greateſt uſe in conſtructing optical inſtruments, on account of its not being affected by the air. It was the appearance of ſucceſs in Mr. Nowell's two firſt experiments that engaged me to try the following proceſſes; and I hope they are deſcribed ſo

 plainly,

plainly, that any gentleman may readily and eaſily perform the ſame, who has been accuſtomed to the common operation of fuſions. I am almoſt a ſtranger to what has been done on the Continent, having heard ſo many contradictory accounts; and I have not availed myſelf of any thing that has hitherto been performed. The experiments were conducted exactly as they are deſcribed; and ſeveral gentlemen of veracity and experience in chemiſtry were generally preſent. The great price platina bears in London has prevented me from making many more experiments; but it is hoped that theſe will be received with candour.

Experiment I. Mr. Nowell having mixed one ounce of platina with a flux of nitre, ſand, and borax, after three hours expoſure to a conſiderable degree of fire, in a wind furnace, ſigns of fuſion were perceived in the maſs in general, and ſeveral globules, larger than I had ever ſeen before, appeared in different parts of the vitreous flux; of theſe, the largeſt were nearer the middle and top of the maſs, and there was much leſs appearance of fuſion at bottom.

Experiment

Experiment II. On seeing the above product, it occurred to me, that if a bed of charcoal-powder was put into the crucible, to the height of one-fourth part, and the charge of platina, &c. put on it, it would be exposed to a greater heat. I therefore desired Mr. Nowell to mix one ounce of platina with half an ounce of nitre, and half an ounce of glass of phosphorus, to put the mixture on a bed of charcoal in the crucible, and to keep it three hours in the fire; which he did, and produced one mass, completely fused, that weighed about one drachm, besides several smaller masses.

Experiment III. As I had made several unsuccessful attempts to melt platina by itself, I was resolved to try if it could be done by mixing one ounce of borax, without any charcoal at bottom; but, after three hours, I found only a cohesion, not a perfect fusion: there were only small globules near the upper surface of the mass.

Experiment IV. I bruised the cohering mass of the last experiment, and mixed one drachm of alkali of tartar, two drachms of borax-powder, and one drachm of charcoal-powder, with it, put it on a bed of charcoal-powder, continued it three hours in the fire, and thus produced a perfect fuſion of the whole platina; half a drachm only of the original ounce being wanting. The ſpecific gravity of this was taken, and proved to be 15.353. It was ſent to different poliſhers and lapidaries, but was ſo hard that it ſpoiled their tools: it is not highly poliſhed, and is much paler than ſteel, but not ſo white as ſilver.

Experiment V. I mixed one ounce of platina, in grains, with one drachm of alkali of tartar, two drachms of borax-powder, and one drachm of charcoal-powder, and put the mixture on a bed of charcoal-duſt in the crucible; and, as I had obſerved ſomething of an incipient fuſion, when the crucible had been in the fire rather more than half an hour, I expoſed it one hour and a half, and obtained a perfect fuſion. The fuſed maſs was in two parts. The deficiency of weight of platina thus fuſed was half a drachm. I did not preſerve the whole of the charcoal, but obtained from what was ſaved near twenty grains of unfuſed platina, which I ſuppoſed were diſperſed too far from the power of the fire to be melted.

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The specific gravity of this parcel of fused platina was 16.8.

Experiment VI. I wrapped up one ounce of platina in a piece of white paper, to prevent any dispersion of its particles, and placed it on a bed of charcoal, covering also the paper with charcoal-powder: in two hours I obtained a perfect fusion, with the loss of only a few grains of the metal. The specific gravity of this melted platina was 15.704. The difference of specific gravity, between the platina in this and the former experiment, might probably arise from cavities in the latter, as I have since frequently found several cavities in parcels I have melted. The mass in experiment the fourth was not broken. The surfaces of those fusions made with fluxes are brighter than those melted *per se*; and for an obvious reason, *viz.* because the metal, in the latter case, has a more uneven pressure on its surface.

Experiment VII. Two ounces of platina were melted, according to the last process, in two hours, with very little loss of weight. Dr. Pearson was present at this operation; and indeed in most

moſt of theſe experiments ſome perſon was preſent with me.

Dr. Pearſon obſerves, "I ſaw Mr. Willis fuſe
"two ounces of platina, which he ſaid he pro-
"cured from Mr. Woulfe, who had purified it
"by boiling it in the marine acid. The mode of
"fuſion was by placing the platina, wrapped in
"paper, in the middle of a crucible of about
"three inches wide, on a bed of charcoal-pow-
"der. The charcoal was ground in a coffee-
"mill; the heat was as intenſe as could be given
"in his furnace.

"I put," ſays Dr. Pearſon, "five hundred
"grains of platina, which had not been purified,
"into the middle of finely-powdered and ſifted
"charcoal, in a crucible of about four inches
"wide; (therefore at leaſt one inch wider than
"in Mr. Willis's experiment;) and gave it as
"great a heat as I could well produce, for near
"two hours, in my melting-furnace: at the end
"of that time I found the platina only aggluti-
"nated. The fire in this experiment appeared
"to have been, according to Mr. Wedgwood's
"clay-pieces, in ſeveral parts of the crucible,
"from

"from 165° to 175° of his pyrometer. The "specific gravity, taken by Mr. More, in the "presence of Mr. Willis, Mr. Henry, junior, "and myself, was 15.42."

Experiment VIII. Mr. Henry, junior, brought me a piece of the coalesced mass, mentioned above in Dr. Pearson's remarks; and I melted it, *per se*, upon a bed of charcoal, in two hours, in a degree of heat of 140° to 150° of Mr. Wedgwood's pyrometer, but in a smaller crucible than the doctor used. Dr. Pearson took this fused piece, and exposed it to the heat of a forge, upon a thick plate of hammered iron; and, in a white heat, it became evidently in a beginning state of fusion; in which state, upon the hot anvil, it was flattened by the hammer, but cracked like cast-iron.

The doctor sent the other moiety of the five hundred grains that were agglutinated, mentioned under experiment seventh, and desired me to try to fuse it in the same-sized crucible he had used, but the operation failed. It was tried a second time, on account of the last operation being shortened

shortened a quarter of an hour, but with no better success.

On the third trial, it was put into a smaller crucible, but still the operation failed; there was a strong agglutination, but not a perfect fusion. The conjecture of the cause of this failure will be mentioned hereafter.

Mr. Henry, junior, was present at all the operations mentioned under experiment eighth; and Wedgwood's pyrometer-pieces were put into each crucible, to ascertain the degree of heat.

In this, and all the experiments before mentioned, the fire was not remarkably strong; but, in feeding it with coak, care was taken that it never burnt so low as to fall much below the upper part of the inverted crucible; and no fuel was added, which had not been previously heated on the iron plate which covered the furnace.

The pyrometer-piece indicated 160° in the last operation that miscarried; and, in the other two, the fire was at least 140° to 150°.

Experiment IX. One ounce of platina was placed on a bed of pulverised Welch coal, in the same manner

manner as in the former experiments with charcoal, and an uniform fusion was, in one hour and a half, effected. It must be observed, that in all these operations, the time of the continuance of the crucible in the fire was computed from the time it began to be red-hot, until the last charge of coak.

By several experiments made since the above, I have found that platina is capable of beginning to melt, so as to form a smooth surface, at 136°, and to be in perfect fusion at 150°.

I tried the malleability of the mass fused in experiment the fifth, and, with a moderate blow with the hammer, very little impression was made; but, with a few heavier strokes, it broke into two pieces. The grain was close, and resembled that of fractured steel, but was somewhat duller. I treated in the same manner, the mass melted *per se* in experiment sixth, and with the same effect; the grain also was perfectly similar. On filing this latter piece, it was found very hard, and exhibited a splendour nearly as bright as silver.

Experiment X. Mr. Nowell, who was preſent at many of the operations, deſired me to try whether platina would not melt on a bed of powdered clay, or bone-aſhes. I filled a crucible about one fourth part with calcined bone-aſhes in powder, and put one ounce of platina, wrapped up in paper, on them. I expoſed the crucible, for two hours, to the greateſt heat I could produce; but the platina was not melted, only a coheſion had taken place. Part of the bone-aſhes, near the platina at the top, was converted into a white enamel; but, in the lower part of the crucible, the bone-aſhes were only a ſpongy maſs.

Experiment XI. I put half an ounce of platina into twenty-four ounces of aqua regia, and obtained a ſolution by digeſtion in heat. A precipitate was made by a ſaturated ſolution of ſal-ammoniac; which precipitate, when dried, weighed half an ounce. This was put on a bed of charcoal in a crucible; in half an hour's time, the crucible was cracked, and all the precipitate was loſt in the fire.

Experiment XII. One ounce of platina was bruiſed, and diſſolved, more readily than in the former

former experiment, in twenty-eight ounces of aqua regia. This solution was precipatated with a solution of sal-ammoniac; after drying the precipitate, I took one fourth part of it, and added half a pint of water; stirred them well with a stick, and then saturated the liquor with dry volatile alkali. The liquor was then filtrated from the powder; which, being dried, was put on a bed of charcoal-powder, and exposed for two hours to the fire, as in the former experiments. I obtained only thirty-one grains of fused platina; fifteen of which were in five larger globules; the remainder in very small ones.

Experiment XIII. The other three parts of the precipitate, prepared in the last experiment, were treated in the same manner with dry volatile alkali; and I endeavoured to melt them upon a bed of charcoal, but could only obtain small globules, after the application of an intense heat for two hours. These globules were powdered, and mixed with one drachm of borax, one drachm of alkali of tartar, and one drachm of charcoal; a very small quantity of charcoal-powder was at the bottom of the crucible; and in two hours I obtained a complete fusion. There was one large button, which weighed one hundred and sixty grains, and several small globules; some of which were so intermixed with the vitreous flux, that they could not be weighed. The specific gravity of this was 23.4; it was very close-grained, and had no cavity, but was not malleable.

Experiment XIV. As I had melted the platina in the last experiment with a flux, and only a *little charcoal* at the bottom of the crucible, I now tried to melt it without any flux, and with only a small quantity of charcoal. The platina was wrapped in paper, and just covered with charcoal; and (as in all the former experiments) an inverted crucible served instead of a cover: in two hours time I obtained a complete fusion. I repeated this experiment two or three times, and always fused the platina; so that I think it extremely probable, that in the three operations I made to fuse Dr. Pearson's platina, and failed, there was too much charcoal added at the bottom of the crucible.

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I obſerved, in one of my experiments for fuſing platina by itſelf, that it continued in a fluid ſtate for more than five minutes after the crucible was taken from the fire; for, on breaking the crucible, it was perfectly fluid, and ran, like melted lead, on the floor of the laboratory. I tried to melt another parcel of platina, in grains, ſent to me by Dr. Pearſon; but, the crucible falling from the ſtand, after it had been in the fire half an hour, there was only an adheſion. This adheſive maſs was bruiſed, and treated as in the laſt experiment, and it melted in two hours. Its ſpecific gravity was 14.65; but there were ſeveral cavities found in it when broken, and it was the whiteſt of any of my ſpecimens.

Experiment XV. As all the experiments made by me were done in one furnace, and the degrees of fire employed very little above 160° of Wedgwood's pyrometer, I tried to melt ſome platina, *per ſe*, in another furnace, which produced a conſiderably greater degree of heat. In my firſt experiment, in one hour and a half the crucible was melted flat, and the platina loſt in the clinkers and aſhes which were thrown away.

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I made another experiment; and though I did not keep the fire fo ftrong, yet the upper crucible was partly melted, and by its preffure cracked the bottom one, and the contents were again difcharged among the afhes and clinkers: thefe, the next day, were carefully examined; and, where any fmall globules of platina could be traced among the clinkers, they were faved, as well as the afhes, and were very eafily melted into a flag. A button of platina was found at the bottom of the crucible, which weighed near three parts of the whole weight that was put in, but it was of a dull colour. Finding that inverted crucibles, in an intenfe fire, were improper, I have ever fince ufed flat covers, inftead of them.

Experiment XVI. Hearing very lately, that in France platina had been melted eafily firft with glafs of phofphorus, and afterwards by itfelf, and that it was rendered malleable by this procefs, I put half an ounce of glafs of phofphorus, in powder, to one ounce of platina; but, after two hours expofure to a ftrong heat, there was only a ftrong adhefion, not a complete fufion. The maſs was bruiſed, and put into a crucible, with very little charcoal at bottom, and in two hours there was a perfect fuſion. It was not malleable; and, when broken, was coarſe-grained, and had no apparent cavity. The ſpecific gravity was only 12.3.

Experiment XVII. One ounce of platina was mixed with only two drachms of glaſs of phoſphorus; but, after two hours of very ſtrong heat, there was only an agglutination. The maſs was afterwards bruiſed, and put into a crucible, with a little charcoal at bottom, and a complete fuſion was effected in two hours. This was not more malleable than the laſt; and, on breaking it, it was finer-grained than that in the laſt experiment; but the ſpecific gravity was only 13.89, although there were no cavities diſcovered. There were five different ſorts of platina, in grains, uſed in theſe experiments, one of Mr. Nowell's, two ſorts of Dr. Pearſon's, and two of my own.

Experiment XVIII. As the platina uſed after the fourteenth experiment was different from that

of

of my own uſed before, and as the fifteenth was not ſucceſsful, I repeated the latter, with the ſame platina as uſed in thoſe experiments, and in two hours I fuſed it. It had a ſmooth ſurface, and, when broken, had no cavities; the ſpecific gravity was 16.13. This was melted in the furnace which drew the ſtrongeſt, as were all the experiments from the fourteenth. The fuel was placed only a little above the cover of the crucible; and a vacancy between the draught-hole being left, the fire was prevented from being too intenſe.

LV. *Description of an improved Machine for cutting Chaff. By Mr.* Robert Salmon, *of Woburn, Bedfordshire.*

WITH A PLATE.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

A reward of Thirty Guineas was voted to Mr. Salmon for this Improvement.

WITH this machine, the chaff is cut by two knives, A, A, Fig 1, (Plate XXI.) fixed on the inside of the fellies of two wheels, B, B, which are strongly connected together; the edge of the knives being at an angle of about forty-five degrees from the plane of the wheel's motion. These knives are so fixed as to be forced forward by springs, C, C, on the wheel; which ſprings are formed to adjuſt, and act more or leſs, as occaſion may require, ſo as to give the knives as much preſſure againſt the box as may be requiſite to cut the ſtraw. The knives are prevented from coming too forward, and occaſioning unneceſſary friction, by the wedges under the ſtaples *a*, *a*; which wedges, as the knives wear, muſt be drawn out, ſo as to admit the knives to come more forward. With the before-mentioned proviſions, it will be found very eaſy, at any time, to put on new knives, as the ſprings, &c. will always adjuſt them to their work.

On one ſide of the wheel is fixed a round block of wood, D, in which there are four holes, and a movable ſcrew: to this block is ſcrewed one end of the feeding-arm E, running nearly horizontally to the croſs-bar F, at the end of the box G; to which croſs-bar it is fixed by the pin *b*, which is movable to five different holes in F; by means of which, and the four holes in the block before deſcribed, twenty changes in the length of the chaff may be obtained.

The ſtraw is brought forward by the rollers in the box G, (the form of them is ſhewn at Fig. 2,) which

which rollers are turned from the outſide, by the riggers or ratchet-wheels, H, one on each ſide of the box; which move more or leſs, according to the ſtroke given to the croſs-bar by the feeding-arm and wheel. By this mode of feeding, the ſtraw is perfectly at reſt, and does not preſs forward at the time the knife cuts; and, by the pin being taken out of the croſs-bar, the feeding is inſtantly thrown off, although the wheel and knives may continue their motion. Under the box is ſuſpended the preſſing-weight I, which may be made more or leſs powerful, by ſhifting the weight on the bearer K, to which it hangs: it may alſo be thrown on either ſide, more or leſs, as occaſion may require; which will be found uſeful, in order to force the ſtraw towards the knife, and counterbalance the ratchet-wheel of the upper roller. Near the fulcrum of this bearer is fixed a chain, ſhewn by the dotted line *c*: its upper end is ſuſpended from a roller, at each extremity of which is a ſmall bar of iron, joined to the end of the upper ſpiked roller; by which means, the ſtraw is always equally preſſed, in paſſing the two ſpiked rollers.

L. The winch, by which the machine is turned.

M M M M. The frame of the machine.

In order to apply this machine to the beſt advantage, the inventor propoſes a ſecond box, to be placed at the end of the firſt; which box may be of any length, and ſuſpended by a line and counter-weight, whereby the end of it is brought down level whilſt filling with ſtraw, and then drawn up, ſo as to give the ſaid box a declivity, to make the ſtraw more eaſily come forward.

It is alſo preſumed, that much advantage may be expected in this ſort of machine, from its cutting various lengths, and reſting during the cut; alſo from the knives being adjuſted to their work by regulating-ſprings; from the feeding being readily thrown off; and from the preſſure being movable to either ſide.

It is alſo well calculated to be applied to any power, which may be occaſionally fixed to the oppoſite ſide to that on which it is turned by hand. By the additional box, when uſed by hand, the workman will be able to cut for ſome continuance, without ſtopping to feed.

LVI.

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Fig. 1.

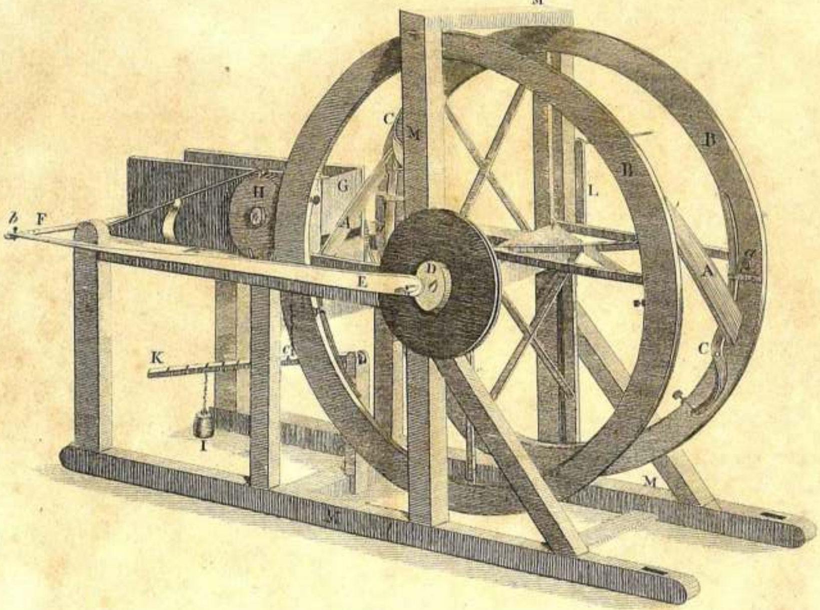

Fig. 2.

LVI. *Enquiry concerning the Smut in Wheat.*

From the Letters and Papers of the Bath and West-of-England Society for the Encouragement of Agriculture, &c.

THE firſt ſtep towards remedying any evil, either in the animal or vegetable kingdom, is the true knowledge of its cauſe; without it, all is quackery, and too often the artifice of deſigning adventurers, ſeeking to make a ſiniſter advantage of the weak and credulous, who are too apt to ſwallow the hook which is covered with a gilded bait. Every one embraces with pleaſure what he is perſuaded will promote his intereſt.

The previous queſtion is, what is the cauſe which generally produces the ſmut in wheat?

To this, no poſitive or probable anſwer has been given. It has been generally ſuppoſed, if one may judge by the means commonly uſed to prevent

vent it, that it proceeds from the feed, whofe *ftamina*, by fome means or other, have been vitiated; for, all the means of prevention I ever heard of confift in fome preparation of the feed, previous to its being fowed.

The moft common method is, brining and liming the day before fowing; which is done either with fea-water, the brine of meat, or of fea-falt diffolved in water, made ftrong enough to bear an egg. To this fome whimfical people have capricioufly added feveral ingredients, which are much more likely to deftroy the vegetative principle of the feed, than to remedy any evil the rudiments of which might latently fubfift in it. For this purpofe, flowers of brimftone, aloes, copperas, and verdegris, in fine powder, affafœtida, and even arfenic, have been recommended to be infufed in the pickle; but this is fo very abfurd, and even dangerous, that men of fober common fenfe are both afraid and afhamed of the practice.

The practice of brining and fteeping was fuggefted by accident, eftablifhed by cuftom, and continued againft all reafonable conviction of its

utility.

utility. In unfavourable ſeaſons, every one knows that ſmut generally prevails in ſpite of every pre-caution that has been hitherto taken. Brine, pickling, liming, change of ſeed, and ſeed of one year old and upwards, avail nothing. In cold wet ſummers the ſmut prevails, notwithſtanding the uſe of every means which invention hath urged, or ingenuity practiſed.

The circumſtances that firſt attracted my notice, and engaged my attention to this ſubject, were as follow. Some years ſince, I ſet a ridge with wheat, by way of experiment, in rows at various diſtances; in the courſe of the ſpring it was hoed two or three times, and was as healthy, vigorous, and fine, as ever was ſeen. In general it was from four to five feet and a half high; the ſtraw uncommonly large and ſtrong; and the ears from four inches to five and a half in length: no corn ever appeared more promiſing. Thus it continued till the bloom appeared, about the middle of June. The weather then became wet and cold, and frequently deprived the corn of what are uſually called its bloſſoms. Before the end of the month, the ears put on a ſickly look,

and,

and, upon examination, it was found amazingly ſmutty; more ſo, indeed, than I had ever obſerved any before. In vain I examined the roots, the ſtraw, the joints, &c. all appeared ſound and perfect, till I came to the ear; there the evil began, but from what cauſe, or by what means, not the leaſt veſtige could be found.

As the plants were vigorous, perfectly healthy, and ſound, till the bloom appeared, and then turned ſickly and diſtempered, and at length became immoderately ſmutty, it ſeemed very clearly to follow, that it could not be owing to any imperfection in the ſeed, but entirely to the inclemency of the air, which, by ſome means or other, infected the grain in its embryo-ſtate, and converted the milky ſubſtance, which conſtitutes the meal or flour of the corn, into a black, fœtid, unwholeſome powder, known by the name of *ſmut.*

Strongly impreſſed with this opinion, I determined to embrace every opportunity of gaining all poſſible information on the ſubject. For two or three years the ſeaſons were favourable, and afforded no opportunity for obſervation; but

1787 was an unprofperous year, and gave us fmutty wheat in abundance. Yet, though I was very attentive to its progrefs, after it was difcovered, I gained no additional intelligence refpecting the caufe; but a full confirmation of my former opinion, that the fmut was generally, if not totally, caufed by the inclement and vitiating principles of the atmofphere; which happened at the time of its bloffoming, for till then it was free from every appearance of defect whatever. This, however, did not relax my refolution of endeavouring, by every means in my power, to inveftigate the true caufe; whether it originated from any defect or imperfection in the feed, or was principally owing to a deftroying diftemperature, or blighting principle of the air.

The next year, 1788, was very favourable to the growth and ripening of wheat. The fummer was dry and healthy, and the corn found and good, though the ftraw was very fhort and fcanty. The feed I fowed was of my own faving, of the fame year's growth, and fowed on the fame land, without any change whatever; yet I had no fmutty wheat that year, and therefore no opportunity of making remarks. The next ſeed-time I had a mind to try the white cone-wheat, and therefore procured my ſeed from a different county, and took all the uſual precautions to guard againſt the ſmut: the ſeed was quite ſound and good, yet I had no ground that was perfectly free from ſmut this year.

Moſt of my wheat this year was ſown in drills, at various diſtances, for the ſake of experiments; and was all horſe and hand hoed. In the months of April and May it was amazingly fine, ſo as to be the admiration of all who ſaw it. The farmers in the neighbourhood declared they had never ſeen any thing equal to it before, for height, ſize, vigour, ſtrength of ſtalk, and length of ear. In this flouriſhing ſtate it continued till above the middle of June. About this time, the weather grew cold and ſtormy, and continued ſo till towards the end of July, a few fine days intervening. The wheat was now in full bloom, but frequently ſtripped of it by the haſty ſhowers that fell. Such, however, is the wonderful œconomy of nature, that if wheat be ſtripped of its bloom by the intemperance of the weather, a fine

fine warm day reinſtates it, and the bloom becomes as fair and promiſing as ever. This I have obſerved it to do ſeveral times, in alternate ſucceſſion; but there is a limit which the return of the bloſſoms cannot ſurvive; and, if it happens before the embryo is duly impregnated, then the kerning or granulating ſucceeds badly, and at harveſt the corn proves defective and ſmutty.

During the growth of the corn this year, (1789,) I was very attentive to it, from the firſt appearance of the ear in the ſide of the ſtalk, to the time of its maturity. Soon after the ſhowery time above mentioned, I obſerved a great number of the ears turned quite brown, as if they were ripe; but, upon examination, they proved to be abortive ears, without any corn in them: they handled as looſe and ſoft as corn that had been threſhed. This circumſtance ſurpriſed me very much. To ſee corn, which, ſo ſhort a time before, was ſo very fine and flouriſhing, prove to be nothing more than chaff, was exceedingly mortifying indeed. I imagined the roots had been deſtroyed by ſome inſect or reptile; but, upon examination, I found them as ſound and perfect (as indeed was the whole plant, the ear only excepted) as they could poſſibly be.

Soon after this, I obſerved the ſouth ſide of one of the fineſt fields was grown very ſmutty. It was very diſcouraging to ſee corn five feet high, with ears five or ſix inches long, and as healthy and vigorous as ever was ſeen, in a few days converted into ſmut. This unwelcome circumſtance furniſhed opportunities more than enough to exerciſe the moſt inquiſitive mind, in ſearch of the cauſe of thoſe evils which blaſt at once the hopes and expectations of the moſt ſagacious and induſtrious huſbandman. To inveſtigate the cauſe, I began by examining the roots of the ſmutty ears; then the ſtems or ſtraw, the joints, and every part up to the ear; in none of which any defect whatever was to be found. I had not proceeded far, however, before I obſerved, that both ſmutty and ſound ears were frequently produced and nouriſhed by the ſame root, and conſequently were both produced from one and the ſame individual ſeed. This circumſtance alone goes very far towards proving, that the cauſe of the ſmut does not exiſt originally in the

the feed; for, if its *ſtamina* were vitiated or corrupted, it is not poſſible to conceive that it ſhould produce plants ſound, healthy, and vigorous, for eight or nine months, and then ſome ears full of corn perfectly ſound and good, and others nothing but ſmut-balls.

Not fully ſatisfied with this, I purſued my intention, and ſpent much time in examining the ſmutty ears; I ſoon diſcovered, that it was no very uncommon thing for the ſame ear to contain both ſound and ſmutty corn.

In ſome ears, the tops were moſtly ſmutty, and the bottoms ſound; in others the tops were ſound, and the bottoms ſmutty; but, more generally, one ſide of the ear was all ſmut, and the other moſtly ſound. One of the laſt ears I examined contained forty ſmut-balls, twenty-one grains that were perfectly ſound and good, and five grains that had one end ſmutty and the other ſound.

From this ſtate of facts, it is hardly poſſible to reſiſt the conviction that the ſmut is cauſed by the inclemency of the atmoſphere, and that conſtantly and invariably in the ſeaſon of its blowing.

To

To ſum up the whole of this matter then, it ſeems as certain as demonſtration can render it, that the ſmut is not owing to any defect or imperfection in the ſeed, but entirely to ſome corrupt vitiating principle of the atmoſphere, in the blowing-ſeaſon, which blights and deſtroys the grain in one way or another, according to the time it has been blowing when ſtruck with the blight. Thoſe ears which are totally deprived of their bloſſoms at the beginning of the ſeaſon, before the corn, in its embryo ſtate, is duly impregnated with the *farina fecundans* or male duſt, become abortive, and are abſolutely without any corn at all. If thoſe which are farther advanced, and have the embryo formed ready for impregnation, are in that ſtate deprived of the fecundating principle, either wholly or in part, the milky matter, which conſtitutes the ſubſtance of the grain, for want of the vivifying principle, is wholly, or in part, converted into a ball of black ſtinking powder, or ſmut. Sometimes the corn, after it is well formed, and filled with the milky juice, ſufficiently impregnated with the male principle, is ſtruck with the blight; which, though

though it comes too late to prevent the perfection of the vivifying principle, and thereby render the corn unfit for feed, yet it is little more than two rinds, the mealy fubftance, of which the flour confifts, being almoft entirely wanting.

From all this, it very clearly appears, that the power of all the boafted fteeps prepared for preventing the fmut is chimerical, and void of all reafonable foundation whatever. In warm, dry, healthy fummers, the fmut is feldom if ever found, though the land be fown with feed that is fmutty, and without any preparation at all. I would, however, recommend wafhing the feed in fair water a day or two before fowing. By this means, the light imperfect grains, chaff, and feed of weeds, if any, are feparated from the feed-corn, and fwim at top; they are then eafily fkimmed off, and the remainder rendered much more clean and perfect.

However great the evil be which attends a crop of very fmutty wheat, the found grain may be made clean, fweet, and wholefome, with little trouble, and at a moderate expence, as appears by the following account.

In

In the year 1787 I had a great deal of very ſmutty wheat, which would ſell for little more than one-half, or at moſt two-thirds, of the price of good wheat, which put me upon making the following experiment. I took about a gallon of the wheat, put it into a pail of fair water, and ſtirred it about well, for a minute or two, with a ſtubbed broom: it made the water almoſt as black as ink. This water was then poured off, and a ſecond added, in which it was again very well ſtirred, and then poured off as before.

This cleared it entirely from the ſmut, and all diſcolouring matter. Then, after being well drained, it was put into a broad ſhallow pan, and ſet before the fire; when, in a ſhort time it became dry enough to grind; for, ſtaying ſo ſhort a time in the water, it imbibes very little of it, and what adheres merely to the ſuperficies is ſoon exhaled by a moderate heat. When dry, it was no way diſtinguiſhable from the cleaneſt and ſoundeſt wheat, except by the ſuperior brightneſs of the colour. It had a fairer and more delicate complexion than unwaſhed wheat, by which only it was to be diſtinguiſhed, even by thofe who had long dealt in the article, and were in the fecret. Encouraged by the fuccefs of this experiment, I had a load of it wafhed; fent it to a malt-houfe in the neighbourhood, and had it kiln-dried by a very moderate fire. I fent a fample of it to market by a neighbouring farmer, of long experience, without taking any notice to him of what had been done. He faid it was a very bright pretty fample; but did not difcover it had been fmutty, or wafhed, till he had fhewn it to a miller of great bufinefs, who prefently knew what had caufed its brightnefs; at the fame time, he owned it was not a penny the worfe, as it was now clean and fweet, and perfectly dry. The wafte in wafhing and drying was about two bufhels: ten fhillings I paid the maltfter for drying, &c. which made the expence about a guinea, whereby at leaft three or four were faved. From this account it appears, that a fmutty crop is not an evil of fuch intolerable magnitude as has been generally thought.

LVII. *Conclusion of* M. CHAPTAL's *Account of a Method of making Soap of Wool, &c.*

(From Page 350.)

IN all manufactories of cloth, blankets, and other woollen goods, it is the custom to full the stuff, as soon as it comes from the loom. The intention of this operation is, not only to scour the cloth, &c. but also to render it more compact; and, in performing it, about thirty pounds of soft-soap are used to eighty pounds of woollen stuff. In the south of France, before the Revolution, soft-soap cost twenty livres the hundred weight. A great part of our oil, and also of that of Italy, is consumed in making it; so also are the wood-ashes of the fires used for domestic purposes, in those countries where it is made.

From what has been said, it is obvious how advantageous it would be to the manufacturer, and

and to commerce in general, to be able to ſupply conveniently the place of ſoft-ſoap, by an article, the preparation of which is neither difficult nor expenſive. Beſides the ſaving which would take place in the manufacturing of woollen goods, great advantage would ariſe from the aſhes of our wood-fires being left, either for domeſtic uſes, or for ſalt-works, or for manufactories of green glaſs; and, at the ſame time, the oil now uſed in making ſoap would remain, to be wholly employed for purpoſes wherein it is impoſſible to find a ſubſtitute for it.

In all times, both the manufacturer and the government have ſought how to get rid of the above mentioned inconveniences. Fullers earth, pure alkalies, and other things, have by turns been made uſe of. The firſt performs the operations of bleaching and fulling very imperfectly: the ſecond diſſolve the cloth; and the manufacturers of Lodeve ſtill recollect, with terror, a quack ſent there by the government, ſome years ago, who propoſed to make uſe of mineral alkali or barilla, inſtead of ſoap.

To the inconveniences already mentioned we may add, that instead of rendering the cloth sufficiently soft and pliable, the substitutes just spoken of leave it in a degree of harshness, which nothing but soap completely removes. It is necessary, therefore, that any substance proposed to be used, instead of soft-soap, should possess the power of scouring, of fulling, and of softening, the cloth. The composition I am now about to describe unites all these advantages: experiments have, by my desire, been made with it, at Lodeve, by M. Michel Fabriguette; a person as well versed in philosophical pursuits as in manufacturing of cloth.

The whole process consists in making a caustic alkaline ley or lixivium, with wood-ashes or pot-ash; in causing the ley to boil; and then dissolving therein as great a quantity of old woollen rags, or shreds of cloth, as the ley will dissolve. By this means a kind of soft-soap is produced, of a greyish-green colour, the ingredients of which are well combined with each other, and which is very soluble in water. It has an animal smell; which,

which, however, the cloths get rid of, by being washed, and exposed to the air.

The various experiments I have made on this subject have been attended with the following results.

1. As soon as the wool is thrown into the boiling ley, its fibres adhere to each other, and a very slight degree of agitation is sufficient to render its dissolution complete.

2. In proportion as fresh wool is added, the ley gradually acquires colour and consistence.

3. The soap has more or less colour, in proportion to the cleanness and whiteness of the wool made use of.

4. Hair of a coarser kind, which happens to be mixed with the old wool, is dissolved with more difficulty.

5. The quantity of wool which the ley is capable of dissolving depends upon its strength, its causticity, and its degrees of heat. Two pounds, three ounces, and three quarters, of caustic alkaline ley, at twelve degrees of concentration, and at the boiling-heat, dissolved ten ounces and a half of

of wool. The ſoap, when cold, weighed one pound and four ounces.

A ſimilar quantity of alkaline ley, of the ſame degree of cauſticity and heat, in which I diſſolved four ounces of wool, did not thereby acquire ſufficient conſiſtence to be capable of being uſed for the various purpoſes for which this ſoap is intended.

Another ſimilar quantity of ley, of four degrees of concentration, could not diſſolve more than two ounces and ſeven drams of wool. The ſoap was of a good conſiſtence, and, when cold, weighed fourteen ounces.

6. In proportion as the wool is diſſolved in the ley, the ſolvent power of the alkali grows weak, and at laſt it will diſſolve no more. When we obſerve that the wool, upon being ſtirred in the liquor, is no longer diſſolved, it is then time to ſtop the proceſs.

I ſhall now point out what means are to be employed, in every woollen manufactory, to prepare the ſoap which will be wanted in it.

On

On the Choice and Preparations of the Materials.

The materials requiſite to form this ſoap are only two; alkaline ſubſtances, and wool.

The alkaline ſubſtances may be procured from the aſhes of any fires where wood is burnt; and the ley is to be made according to the common well-known proceſs. Quick-lime is to be ſlaked with a ſmall quantity of water, and the paſte formed thereby is to be mixed with the aſhes, (they being firſt paſſed through a ſieve,) in the proportion of one-tenth part of quick-lime, by weight, to the quantity of aſhes made uſe of. The mixture ſhould be put into a ſtone veſſel; (as wooden veſſels not only colour the ley, but are themſelves much injured by it;) and water is then to be poured upon it, in ſuch quantity as to cover it, and riſe ſome inches above it. Theſe are to be left together for a certain time, and then the ley is to be drawn off, by an aperture, made for that purpoſe, at the bottom of the veſſel. It is beſt not to draw off the ley, till the moment when it is to be uſed: its ſtrength ſhould be be from four to fifteen degrees; but the degree of concentration is a matter of very little confequence, fince all the difference that refults from making ufe of a weak ley or a ftrong one, is, that a greater or a lefs quantity of wool will be diffolved.

The pot-afh of commerce may alfo be made ufe of; it is to be employed in the fame manner as the wood-afhes, but with one third of its weight of quick-lime.

With refpect to the choice of the wool, every one knows, that in the making of woollen cloths, blankets, and all other kinds of woollen goods, a feries of operations are performed, from the firft wafhing of the wool to the finifhing of the cloth, &c. in each of which there occurs a lofs, more or lefs confiderable, of a portion of the original material. The water in which the wool is wafhed, the floor on which it is fpread, and the warehoufe in which it is depofited, exhibit fufficient proofs of this; fo alfo do the operations of beating, carding, fpinning, and weaving the wool, and thofe of fhearing, combing, and fulling the cloth. It is indeed true that the fcattered wool, produced from

from theſe various proceſſes, is collected with ſome care; but many of them are of ſuch a nature, that the waſte wool reſulting from them, either is dirty, and mixed with other ſubſtances, or it is cut ſo ſhort, that it is rendered incapable of being again uſed: in either caſe, the manufacturer throws it on the dunghill. The making of the ſoap here deſcribed furniſhes him with the means of bringing all theſe into uſe; nothing more being requiſite than to collect them in the baſkets in which the wool is waſhed, and to waſh them carefully; as well for the ſake of cleaning them, as to ſeparate from them all foreign ſubſtances. When waſhed, they may be laid by till wanted.

We may alſo, with equal advantage, make uſe of the cuttings and ſhreds of woollen cloth, which are found in the ſhops of woollen-drapers, tailors, &c. and likewiſe of all ſorts of garments, or other woollen articles, after they have been worn till they will ſerve no longer.

On the Preparation of the Soap.

When the ley is made, and the wool procured, nothing remains to be done, but to bring the ley to a boiling-heat in a common caldron. When it is brought to that degree of heat, the wool is to be thrown in, a little at a time, and the mixture is to be ſtirred, that the ſolution may go on the faſter. A freſh quantity of wool ſhould not be added, until the preceding quantity is diſſolved; and the proceſs ſhould be ſtopped, as ſoon as we find that the liquor will not diſſolve any more wool.

It has been aſcertained, by trials in the large way, made by Michel Fabriguette, with ſoap of this kind, which he prepared according to my inſtructions, that ſuch ſoap ſcours the cloths, felts them, and ſoftens them, perfectly well; but there are ſome obſervations to be made, reſpecting its uſe, which are too important to be omitted.

Firſt, when this ſoap is not prepared with ſufficient care, or when it is made with dirty or coloured wool, it is apt to give the cloths, &c. a

greyiſh

greyiſh tinge, which it is very difficult to remove. If the cloth is intended to be dyed, this tinge is of no conſequence; but it would injure that fine white colour, which, in certain caſes, is intended to be given, or to be preſerved. This tinge, however, may be prevented, by a very careful ſelection of the materials for making the ſoap which is meant to be employed for ſuch delicate purpoſes.

Cloths, &c. fulled with this ſoap, acquire, as was ſaid before, an animal ſmell, which, without being very ſtrong, is nevertheleſs unpleaſant; but, water and air never fail to remove it.

Having ſucceeded in fulling woollen cloths by the uſe of this ſoap, I attempted to uſe ſoda, in the place of pot-aſh, and thus to form (according to the proceſs above deſcribed) a hard ſoap, fit for the operations of dying cottons; and my experiments ſucceeded beyond my expectations.

Forty-ſix pounds of ſoda-ley (of eight degrees) diſſolved, in a boiling-heat, five pounds of wool; and afforded, when cold, ſixteen pounds fourteen ounces of ſoap, ſufficiently hard to keep its form.

The firſt quantities of wool thrown into the ſoda-ley are eaſily diſſolved; but it may be obſerved, that the liquor gradually grows thicker, and that the diſſolution becomes more difficult, and ſlower.

The ley, by the wool firſt diſſolved in it, acquires a green colour; it afterwards grows black; and the ſoap, when cold, ſtill retains a blackiſh green colour.

This ſoap has been made uſe of, in every different manner, and under every form, in my manufactory for dying cottons; and I am now ſatisfied that it may be employed, inſtead of the ſaponaceous liquor we are accuſtomed to make from ley of ſoda and oil, for the purpoſe of preparing the cottons. I have conſtantly obſerved, that if ſuch a quantity of this ſoap be diſſolved in cold water as will render the water milky, and the cotton be worked therein, in the uſual well-known manner, it will, by being paſſed three times through the liquor, and dried each time, be as ſtrongly diſpoſed to receive the dye, as cotton which has been ſeven times paſſed through the ſaponaceous liquors commonly uſed. This

will

will not be thought very aſtoniſhing, when it is conſidered, that animal ſubſtances are very fit for diſpoſing thread and cotton to receive the colours with which they are to be dyed; and that the intention of ſeveral of the operations performed upon them, previous to their being dyed, is merely to impregnate them with ſuch ſubſtances.

It is neceſſary to remark, that cotton, by being paſſed through a ſolution of this ſoap, acquires a grey tinge, very much like that which is given to it by aluming; although the common ſaponaceous liquors give it a beautiful white colour. This grey colour, however, is no diſadvantage to cotton which is intended to be dyed, as we have already remarked with reſpect to woollen cloths.

In confirmation of what I have ſaid above, reſpecting the advantage to be derived from making uſe of this ſoap, I may add, that after having impregnated ſome cotton with it, according to the uſual method, I made it paſs through all the proceſſes which wool undergoes, in order to be dyed of a ſcarlet colour. The conſe-

quence

quence was, that the cotton was thereby dyed of a deep and very agreeable flesh-colour; whereas, cotton which had not been prepared in that manner, came out of the bath almost of its natural colour. This first trial promises advantages which I mean to pursue.

It may be right to observe, that this soap of wool may advantageously be made use of, instead of common soap, for domestic purposes. I have employed it, with the greatest success, in washing linen; and it is particularly efficacious in scouring woollen garments, &c. I have no doubt that the facility and œconomy with which its preparation is attended, will cause its use to be extended to many other purposes; in the mean time, I thought it right to give an account of the various ways in which I have applied it.

I shall only add, that as the soap here described gives to woollens and cottons a grey tinge, which is very difficult to remove, it follows that it cannot be used for washing linen, unless it be made of white wool, carefully selected, and well washed.

LVIII. *Liſt of Patents for Inventions, &c.*

(Continued from Page 360.)

Timothy Sheldrake, of the Strand; for a method of curing the deformities of children, or others. Dated January 24, 1797.

Robert Ferryman, of Hammerſmith, in the county of Middleſex, Clerk; for a machine for blanching, grinding, and dreſſing of corn. Dated January 24, 1797.

James Murphy, of Hertford-ſtreet, Pancras; for improvements in tanning hides and ſkins, &c. Dated January 27, 1797.

William Rolfe and Samuel Davis, of Cheapſide, Muſical-Inſtrument-makers; for improvements in harpſichords and piano-fortes. Dated January 31, 1797.

George Cotes, of Edward-ſtreet, Chriſt-Church, in the county of Surrey, Carpenter and Builder; for a machine for expediting the making of horſe-ſhoe nails, brads, &c. Dated January 31, 1797.

John

JOHN GROVER, of Chesham, in the county of Bucks, Brewer; for improvements in the construction and fixing of coppers, boilers, and furnaces. Dated February 7, 1797.

JOHN FALCONER ATLEE, of Wandsworth, in the county of Surrey, Distiller; for a method of condensing and cooling Spirits, in the process of distillation. Dated February 7, 1797.

JAMES GLAZEBROOK, of Hadley, in the county of Salop, Engineer; for a method of working and giving power to machinery, by means of air. Dated February 7, 1797.

JOHN NASH, of Dover-street, St. James's, Architect; for a method of constructing bridges of plate-iron, &c. Dated February 7, 1797.

AARON GARLICK, of Duckenfield, in the county of Chester, Manufacturer; for a machine for spinning and roving of cotton. Dated February 7, 1797.

NICHOLAS DUBOIS DE CHEMANT, of Frith-street, Soho; for a table with a stove placed in the center thereof. Dated February 15, 1797.

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