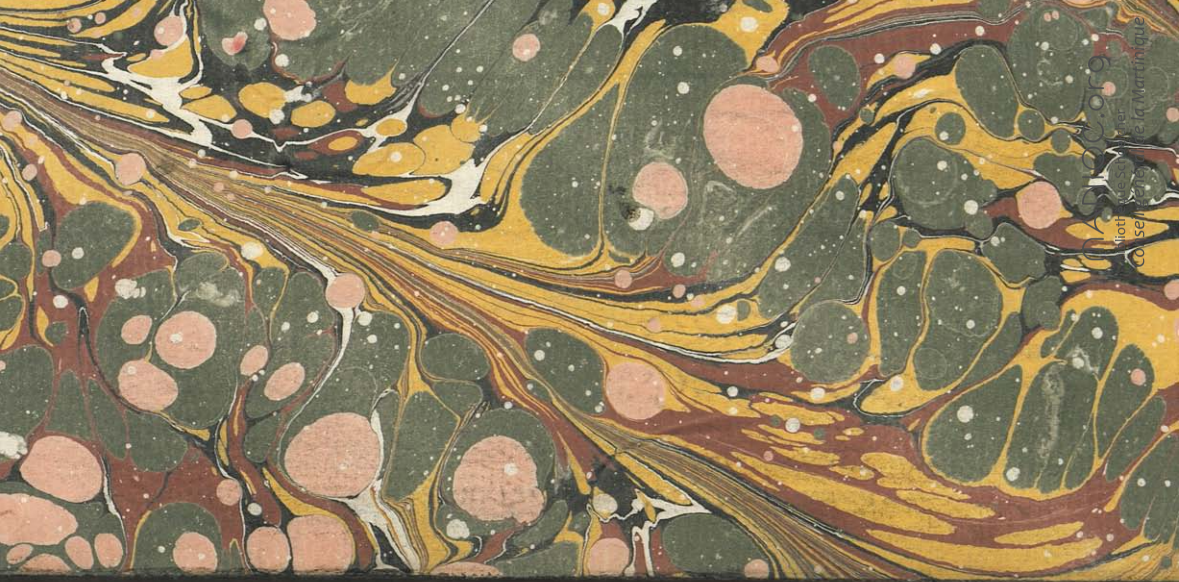

OBSERVATIONS

AND

ADVICES

FOR THE

Improvement of the Manufacture

OF

Muſcovado SUGAR and RUM.

By BRYAN HIGGINS, M. D.

ST. JAGO DE LA VEGA:
PRINTED BY ALEXANDER AIKMAN,
PRINTER TO THE HONOURABLE THE ASSEMBLY.
M.DCCC.

To the Honourable the Committees appointed for this subject, in 1796, this second part of Observations and Advices, for the improvement of Muscovado Sugar and Rum, is most respectfully presented, by their obliged and most obedient humble Servant,

BRYAN HIGGINS, M. D.

Spanish-Town, Nov. 25, 1799.

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OF THE
SECOND PART.

OBSERVATIONS and ADVICES.

SECOND PART.

AT the ſeſſion of the honourable houſe of aſſembly in 1798, the following pages on the ſubject of filtration, and ſome others, were ready for the preſs: But they could not, with any proſpect of public utility, be publiſhed without engraved diagrams, much more legible and correct than thoſe of the firſt part of this work; and theſe could not be procured before the preſent ſeaſon, notwithſtanding the early and repeated advertiſements of the printer, in the Gazette.

In the courſe of the laſt year, conſiderable improvements have been made, which ſerve greatly to accelerate the reduction of cane-juice to ſugar, to render ſmall doſes of temper uncommonly efficacious, and to

approximate perfection in the art of cleanſing, by rapid boiling and the proper uſe of the ſkimmer. And theſe improvements tend, in a great degree, to ſuperſede the proceſs of nice filtration, or to limit it to purpoſes leſs general than thoſe originally propoſed. They tend, for inſtance, to confine it to the melioration of rum; and to the working of the ſkimmings, for ſugar, when the comparative prices of theſe commodities require it.

But ſince it is as eaſy to deſcribe and engrave, for the machine which filtrates perfectly and applies in various ways, as for any other of more limited uſe; it is deemed beſt now to preſent the pages and plates originally compoſed for this ſubject, and regarding a machine which by one ſide only can filtrate cane-juice highly enriched by evaporation, with greater velocity than is neceſſary for the ſupply of a ſecond or third teach, in the quickeſt work of any ſyſtem of teaches and boilers; and which preſents another ſide equally competent, either to be worked alternately with the former, in ſubſervience to the teaches, or to the quick filtration of ſcums to obtain the clean ſweets, either for the teaches, or for the ſtill-houſe.

Deſcription of the FILTRATING MACHINE.

The figures 1, 2, 3, 4, PLATE I, repreſent the principal timbers of the fixed great frame.

Figure 1, ſhews the ſquare upright pieces A B, C D, joined by their mortices to the tranſverſe ſquare pieces E F, G H, I K.

Figure 2 repreſents a foot or ground piece, into the

the mortice of which the tenon B of figure 1 is to be inserted.

A like ground piece belongs to the tenon D, figure 1; and these ground pieces crossing the plane of the whole frame, figure 1, sustain it, by a broad base, in the upright posture required.

Pitch-pine serves for these pieces of the machine, and for all others that may not be specified as requiring stronger wood.

L M, figure 1, shews a spur let into the upright piece A B, to the depth of half an inch, and pinned to it. This, and a corresponding spur on the opposite side of the post, serve to support one end of the sieve trough hereafter to be described.

Figure 3 represents a piece of plank four inches in thickness, and the holes by which it is to be pinned, when it is received to the depth of three quarters of an inch, at N O, figure 1.

This transverse piece, and a corresponding piece which is to be pinned at the same height in the notch, which there appears in the upright post C D, figure 1, serve to support, on each side of the great frame, figure 1, a long leaded trough, called a fine liquor trough, hereafter to be described: For each of these troughs will extend from the edge at G, to the edge of the post at H, and somewhat further on each side.

Figure 4 represents a piece of plank, which ought to be of hard stiff wood, and three inches and an half in thickness. Figure 4 also shews the holes, by which this piece is to be iron-bolted to the upright piece A B, figure 1; when the piece, figure 4, is let an inch deep into this upright piece, at the cut appearing between E and I.

This tranſverſe piece, figure 4, when bolted in the deſcribed place, and the like tranſverſe piece to be bolted to the upright piece, C D, figure 1, in the notch F K, ſerve to ſupport or ſling the moveable ſide frames with fluted faces, which will preſently be exhibited.

P Q, figure 1, exhibits a piece of plank of hard wood, about three inches in thickneſs, let in by an inch or leſs in depth, to the upright poſt, A B. This, and the like piece on the oppoſite ſide of this poſt, are to be bolted together and to the intervening poſt, at the holes marked in P Q.

Theſe pieces P Q, ſo bolted, are to ſupport a leaded trough, into which the evaporated and boiling cane-juice is to be raiſed by a pump, and from which it is to preſs into the filtrating bags beneath. In order that the ſupport of this trough may be firm, the ſlender diagonal piece P R is to be applied as it is repreſented, and is to be let in at the ends P and R, to the depth of about half an inch. Another piece, like P R, is to be applied in the ſame way, on the oppoſite ſide of the upright poſt, A B.

Of the piece P Q, and of the correſponding piece on the oppoſite ſide of the upright poſt to which theſe are bolted, the part which projects from the upright poſt to Q, is intended for the ſupport of a board on which a negro may conveniently ſtand, in order to waſh the trough, or look to the piſton of the pump, when either may be neceſſary. To this board he will aſcend by a light ladder mounting him to the upper part of the middle frame at or near C; and then laying the ſame ladder from near C to Q, he will aſcend to the board on Q. For, a little above the middle ſquare frame E F H G, the upper parts of the pendulous fluted

luted frames hereafter to be described, together with the corresponding part of the middle square frame, will, when the machine is completed, present a plane of about five feet in length, by about three feet in breadth; and on this plane, near C, a board will be laid across; and on this cross-board the foot of the ladder will rest, and will be secured from slipping by the post at C.

Each of the circular spots appearing near E, G, F, H, shews the place of a large hole, which is to be truly bored there perpendicularly to the plane of this great frame, in order to receive and hold firmly the middle square part of the iron screw-bolt, next to be described.

PLATE I, figure 5, represents a screw-bolt forty-two inches in length, one inch and an half in diameter, square at the central part of its length, for the extent of five inches, but rounded and screwed from thence to each end.

In each of the four described holes in the great frame, figure 1, a screw-bolt of this kind is to be inserted, in the manner above mentioned, and so that the square part of the bolt shall secure it from being twisted round by the force to be employed in screwing; and that the screwed ends of the bolts, projecting equally out from the face of the great frame, figure 1, on either side, shall be perfectly parallel amongst themselves, and perpendicular to the plane of the great frame.

In proportion to the accuracy with which these bolts are inserted, the use of them will be easy, and their power great, in drawing home to the great middle frame, those moveable pendulous frames which are to be described. Each of these bolts is to be perfectly secured

in

in the required position, first by a washer such as is represented by figure 6, which is to be a quarter of an inch thick, especially at the central parts; and is to be let into the wood, until the square hole of the washer catches on the square of the bolt: On the opposite side of the frame, the like washer is to be fixed to each bolt; and then a nut, of an inch or more in thickness, and such as figure 7 shews, is to be applied to screw home each of the washers, and to make each bolt immovable in the frame.

On each broad face of the rectangular frame E F H G, a fluted boarding hereafter to be described is to be pinned: And as it might happen in the course of time, that filtrated liquor would pass through warped joints or cracks of this boarding, and drip on the upper surfaces of the pieces E F, I K, G H; and as such liquor ought not to be permitted to rest and sour there, it is expedient to cut a small groove, a quarter of an inch in depth and in breadth, across each of these upper faces, at the distance of a quarter of an inch or more from each tenon of these pieces; and to continue each groove downwards on each side, to give free passage, along the fluted boarding, to any leaked liquor.

Although no such leakage has yet occurred in any of the filtrating machines already made, it is advisable that the described grooves should be made; and the workman is to remember that similar grooves are to be made, in a slender pendulous moveable frame, that is to carry fluted boarding on both sides, as will presently be shewn: But such grooves are not required for either of the other pendulous frames, because they are to carry fluted boarding on one side only of each.

PLATE II exhibits other parts of the filtrating machine,

machine, by ſhaded figures, ſhewing the poſition of theſe parts in regard to the great fixed frame already deſcribed; the upright poſts of which fixed frame, ſhew themſelves here by the dotted lines, above and below the frame A B D C, which is diſtinguiſhed by ſhading, and which is a pendulous moveable frame, correſponding with the middle rectangular part of the great fixed frame above deſcribed.

The ſhaded figure A B D C, PLATE II, ſhews the pieces and junctures, and the form of a pendulous and moveable frame, belonging to each ſide of the great fixed frame, PLATE I.

The round ſpots near the angles of the pendulous moveable frame A B D C, PLATE II, ſhew the places of the holes in this frame, which are to give free paſſage to the ſcrew-bolts above deſcribed. At each of theſe holes, an iron waſher is to be nailed on the wood, to prevent the nuts of the ſcrew-bolts from grating on the wood, when theſe nuts are made to ſcrew home this pendulous frame towards the great fixed frame.

The upper piece A B, of the pendulous moveable frame A B D C, reſts, or occaſionally ſlides, by the part 1, 2, at one end; and by the part 3, 4, at the other end; on the upper face of one of the tranſverſe pieces of hard plank, repreſented by figure 4, PLATE I, when this tranſverſe piece is bolted in its proper place, in the upright poſt at 2, PLATE II, and the like tranſverſe piece is bolted in its proper place, at 3, in the ſhorter upright poſt of the great fixed frame, which poſts are here ſhewn by dotted lines.

Thus it appears that this pendulous frame, repreſented in PLATE II, is to be ſuſpended by the tranſ-

verſe

verſe pieces, figure 4 of PLATE I, and is to give free paſſage to the ſcrew-bolts, without grating on them.

The ſhaded rectangular figure, A B D C, PLATE II, ſhews the breadth as well as the length of the pieces of ſcantling, of which this moveable pendulous frame is to be formed. The thickneſs of each of theſe pieces is to be about 6 inches; and the wood of the longer pieces ought to be ſound, becauſe they are to ſuſtain a very great preſſure, without bending.

In PLATE II, the dotted lines E F, F G, G H, H E, ſhew the extent of a cloſe boarding, which is to have the thickneſs of an inch, and is to be faſtened to the frame, A B D C, by hard wooden pins; and is to be fluted, as will be taught hereafter, on the face of the boarding which looks to the great middle fixed frame.

A fluted boarding, of the ſame figure and extent, is to be faſtened in the ſame manner to each flat ſide of the great rectangular fixed frame, firſt mentioned. But this boarding is to have a thickneſs of $1\frac{1}{2}$ inch; in order that the filtrated liquor, which will ſtream from the fluting, may fall ſo much diſtant from the upright poſts of the great fixed frame, and that any excavation to be made, for the admiſſion of the ſcrew nuts at the upright poſts, may not cut through the fluting.

In making theſe frames, and in applying the boarding, care is to be taken that the faces be ſo flat, that they may meet and touch in all parts; otherwiſe they will not well ſerve to preſs the bags and filth, which will hang between them, to the degree of dryneſs which may be required.

The fluting is to run with the length and grain of the boards, and with parallel ridges and furrows.

Each

Each furrow is to have a depth of $\frac{1}{8}$ of an inch between the ſummits of the ridges, and is to be rather rounded than angular at the bottom; and is moreover to be ſmooth, to prevent the lodgement of dirt in it.

Each ridge of the fluting is to be rather angular than flat, but is not to be ſharp; for a ſharp ridge is apt to ſplinter, and might hurt the filtrating cloth when it is exceſſively compreſſed: On the other hand, a ridge which preſents much flat ſurface to the cloth, is apt to check the filtration there. When the fluted boards are pinned to their reſpective frames, the courſe of the fluting is vertical.

Every flaw that might give paſſage to a filtrated liquor through a fluted board, is to be plugged with hard wood; and the plugging is to be cut and dreſſed to continue the fluting uninterrupted: And in order that the liquor may not find paſſage between the fluted boards, they ought to touch each other, by about 3-4 of their thickneſs; and by the remainder of the thickneſs, and near the fluted face, they ought each to be bevelled ſo much, that the bevels of two contiguous boards may make one perfect furrow, equal in depth and width to any other furrow of the fluting. The liquor finding a free paſſage by ſuch a furrow, will never paſs from it between the boards.

An intermediate ſlender pendulous frame is now to be made, of pieces equal in length and breadth, and in the junctures, to the frame A B D C, but not ſo thick. For as the pieces of this ſlender pendulous frame will be preſſed almoſt equally on both ſides, they will not need a greater thickneſs than three inches.

This ſlender pendulous frame is to be ſlung moveable and intermediate, between the great fixed frame and

the moveable frame A B D C, and will hang in the manner of this laſt by the upper projecting ends.

Each broad face of the ſlender intermediate pendulous frame, is to carry fluting of the kind and extent already deſcribed, and made of boards not exceeding an inch in thickneſs.

The great fixed frame firſt deſcribed, being thus provided with a ſlender moveable frame, and a ſtronger moveable frame, on each ſide, two bags may be worked on either of them; the ſlender pendulous frame ſerving to ſuſtain one of the bags on each of its fluted faces; ſo that both bags may be compreſſed at once between parallel flutings, by the means of ſcrewing the nuts home upon the ſcrew-bolts of that ſide of the machine.

For the greater facility and expedition in fixing or removing a pair of bags, each of them is to be provided with tape loops at the upper border, by which the flatted bag is to be ſuſpended with the borders coinciding with thoſe of the fluting.

For this purpoſe, the upper border of the fluting, on each ſide of the ſlender intermediate pendulous frame, is to be notched with a ſaw to the depth of half an inch, to ſhew an interval of a quarter of an inch in breadth, on each ſide of a tooth-like piece, for thirteen ſuch teeth, and an extreme tooth-like piece at each corner. The thickneſs of each of theſe pieces is to be half an inch from right to left, and that of the board or leſs, in the tranſverſe cut. By theſe teeth fifteen corresponding tape loops of each bag will hang.

In order to ſhew how the filtrating bags, ſlung in the deſcribed manner, are to be charged with the liquor to be filtrated, it is expedient now to advert to the following parts of the mechaniſm.

The

The shaded figure, I K L M N, represents a common suction pump, under the spout of which appears a clipped bolt, K X, by which it is fastened to the contiguous long upright post of the great frame. The bolt-part passes through the centre of the post there, and is screwed by the end X to the post. The clip-part embraces the pump from the post to K, and there each end of the clip is rounded to enter a hole in a bent plate of iron, which is forced home against the pump by a key driven through a key-hole, made near each end of the clip. The pump is further secured in its position by the like clipped bolt at L Y.

The mounting of the handle and piston of the pump are omitted, because they are generally known; and it is sufficient to observe, that a short handle works on a pin, which is the fulcrum or centre of motion, near the edge of the funnelled mouth of the pump above; which edge is provided with the means of supporting and directing the handle in the usual manner. To this handle, at the distance of 18 inches from its centre of motion, a slender pole is slung, to reach to the longer lower handle placed at a commodious height for the workman, and by due mounting to communicate the motion of one handle to the other.

The pole is made of light wood 2 inches square, and has the angles planed off, except at the ends, which are made wedge-like to receive the necessary fixtures of iron.

When the handles are horizontal and parallel, the pole ought to be perfectly vertical, for otherwise the working of the pump will be unnecessarily laborious. The pin, or centre of motion, on which the long lower handle is to work, ought to have the same distance

with the pin, or centre of motion, of the upper ſhort handle, from the perpendicular axis of the pump. And the pin, on which the lower handle is to work, is to be ſuſtained by a ſtrong jaw-bolt, paſſing through the long upright poſt of the great frame, at the height of three feet ſeven inches from the ground, on which the pumper is to ſtand.

The valve of the piſton is to be made of folded canvas cloſely quilted, and nailed to a piece of ſheet-lead, which ought to extend $\frac{1}{8}$ of an inch or more, over the aperture of the piſton, on all ſides.

The mounting of the ſides of the piſton ought to be alſo of folded canvas, cloſely quilted and ſtiff, and having a breadth of $4\frac{1}{2}$ inches.

At the lower edge of this mounting, where it is nailed to the piſton, the circumference ought to be leſs than that of the chamber of the pump, in order that the friction may be leſſened there; but the upper edge or mouth of the canvas-mounting ought to have a greater circumference, to ſtop the chamber tight, and preſs againſt it, all around. Thus the piſton will work with leaſt friction, and the mounting will be durable.

The ſhaded figure M O P N, repreſents a trough that is lined with lead.

At P this trough meets, and reſts on the edge of the knee-wall of the furnace. Between P and O this end of the trough lies over the bench, towards the ſaddle between two contiguous veſſels, but leaves an interval between the bench and the bottom of the trough, for the convenience of waſhing, and to prevent the lodgment of ſcum there.

At the end O, this trough is ſemicircular, to receive and fit a ſieve, through which the liquor to be cleanſed,

is

is to be ladled, and which ought to ſtop ſuch ſcales, ſtraws, and other dirt, as might clog the pump or the tubes which deliver into the filtrating bags.

By this poſition of the trough, the liquor may as eaſily be ladled into it, as into the next teach; and when the liquor is ſo fine as not to require filtration, the ſieve trough may remain in its place, without giving any impediment to the ordinary buſineſs of the houſe. In this poſition alſo the ſieve trough ſtands very conveniently, for the reception of any ſcum taken from either the third or ſecond teach; for one of the uſes of the machine is, to ſeparate and ſend forward the rich ſweets of ſuch ſcums; and there is leſs danger of re-diſſolving the dirt of ſuch ſcums in the cooler liquor of the machine, than there is in throwing them back to a more watery boiling liquor in the uſual manner; and certainly there is leſs waſte of heat and fuel and of ſweets, than there is in throwing the hot ſcums backwards, to go at laſt to the ſtill-houſe.

The deſcribed poſition moreover renders it perfectly convenient to ladle from either of the near veſſels, and filtrate from the richeſt; but this is not to be done unleſs a ſkilful perſon attends, to prevent the charging of the bags with liquor of exceſſive ſpiſſitude, which is apt to clog them ſuddenly; and to prevent the advancing of any liquor, that is not very rich in ſugar and boiling hot, towards the firſt teach, about the time when its charge is almoſt completed, and near the period of graining.

By the repreſented diſtance of the machine from the knee-wall, the workmen can approach the boilers and work in the ordinary manner, without any impediment from the machine; and the man who pumps when the machine

machine is employed, ſtands cool, and does not at all interfere with any other workman.

As the negro boilers are apt to ſtrike the ſieve out of its place, and to throw ſome of the liquor with the ſcales and fibrous dirt contained in it, between the ſieve and the circular end of the trough, the ſieve is to be made faſt by any means that the workman chuſes. A bar of coarſe lead or ſolder placed acroſs the trough, and preſſing the ſieve to the round end of the trough, anſwers this purpoſe; ſo alſo does a ſtiff wire, placed in the ſame way and tightened to the ſide of the ſieve by a pin, riſing a quarter of an inch or more from the leaden lip of the trough on each ſide.

To give the liquor free paſſage from under the ſieve towards the pump tube, the hoop of the ſieve is to be ſuſtained above the bottom of the trough, by three pieces of lead an inch or more in height, and having a notch in each for the reception of the lower edge of the ſieve-hoop, and for the ſupport of it at the diſtance of half an inch from the bottom of the trough.

When the ſieve does not fit and fill the round end of the trough, it is neceſſary to tack a ſlip of thin ſheet copper round the ſieve, and that this ſlip ſhall have ſuch poſition, breadth, and ſlope, as will enable it to deliver over the edge of the trough, and back into the boiler, any liquor and dirt that might otherwiſe have fallen between the ſieve and the trough.

A braſs-wired hoop ſieve, meaſuring 16 or 17 inches in the greater diameter, and having the apertures between the wires 1-16 of an inch in diameter, is the fitteſt for this purpoſe; but a coarſer ſieve will anſwer, provided the apertures be not more than twice this ſize.

For the purpoſe of placing or removing the ſieve-

trough

trough, without straining the pump tube, which enters it and almost locks it to the long upright post of the machine, the end of this trough, next to N, is made to rest on a block of wood which is moveable, and is supported by the small transverse piece LM, figure 1, PLATE I, the place of which pieces appears in PLATE II, by the dotted lines crossing the the upright post, below the end of the trough at N.

The thickness of the bottom board of this trough is to be an inch and a quarter, or a little more at the end N, and there, at the orifice of the pump tube, the bottom is to be hollowed, to form a bason of about nine inches in width, by an inch or more in depth, in order that it may gather to the mouth of the pump tube, the last portions of liquor, that are to be raised by pumping.

As this trough will be placed so as to slope a little downwards, and to deliver towards the bason at N, the last portions of liquor, which might otherwise lodge on the whole expanse of the bottom, it is made, as the shaded figure represents, deeper at the part between P and N, than at the part OP; and this measure also serves to prevent the liquor from slopping over, at the end of the trough next to the long upright post, when the liquor is undulated by hasty ladling.

The inside of this trough, instead of having angles at the bottom, where this meets the sides, is round there, so as to deliver freely towards the middle line of the bottom, and into the small bason at the lower mouth of the pump tube.

The distance between this mouth and the bason must not be less than 3-4ths of an inch; for at a much shorter distance of these, the pump is apt to suck up air, when the charge in the trough is shallow.

According

According to the announced scale, the shaded figure M O P N truly represents the outside measure or depth of the trough, including the thickness of the bottom board, and that of the leaden lining, which ought to turn over the lip of the trough; the cavity of the trough will therefore measure less than this figure, by the thickness of the wood and lead at the bottom, and in some places will measure still less, by reason of the rounding of the angles at the bottom. Any perforation made in cutting out the cavity for the bason, at the mouth of the pump tube, may be covered by nailing a thin board over it, on the outside of the bottom board.

The described pump, drawing liquor from N, delivers it by the spout issuing between S and K, into the square cistern Q R S T, the depth of which, including the bottom, is here truly represented, according to the given scale; the thickness of the bottom board and leaden lining being $1\frac{1}{4}$ inch.

The spout of the pump is to be soldered to the leaden lining of the cistern, in order that the liquor may be occasionally raised to fill the cistern to the slender tube at R, when the highest column of liquor and its greatest pressure are required. Near the lip of this cistern at R, and on the side next the boilers, is inserted a small leaden tube W R, by which any superfluous liquor may fall back into the next boiler, instead of slopping over to waste, when more liquor is pumped up than is necessary for the supply of the machine at full work.

The bottom of this elevated cistern is hollowed on the inside, so that the liquor may all freely drain into a small cavity or bason, where the upper mouth of the vertical leaden tube, U Z, is to be soldered to the leaden lining

lining of the bottom of this ciſtern, in order to convey the liquor downwards, to the filtrating bags.

The width of this deſcending tube is to be conſiderably increaſed near Z, in order to make room for the inſertion and ſoldering of the tube Z C; which, receiving the liquor from the deſcending tube, is to deliver it horizontally, by the mouth C, into a filtrating bag ſlung on this ſide of the great fixed frame; and alſo, in order that there may be room for the inſertion and ſoldering of another tube, like Z C, which being alſo ſet to a right angle with the deſcending tube, is to deliver horizontally, in the manner of the tube Z C, into a filtrating bag ſlung on the other ſide of the great fixed frame.

In the horizontal tube Z C, at the place 5, a braſs ſtop-cock, of the ſame bore with the leaden tube, is fixed; in order that the flux of liquor may be regulated to the demand of the teaches, and that the liquor may be ſtopped at 5, when ſuch ſtoppage is required: The other horizontal leaden tube, correſponding with Z C, and delivering horizontally into a bag on the other ſide of the great fixed frame, is, in like manner, provided with a braſs ſtop-cock, for the like purpoſes.

Thus the liquor may be delivered through the open cock, to the bag on one ſide only; the other cock being cloſed, it may be delivered alternately to either ſide, or it may be delivered into both of the bags at once.

Each bag receives the liquor from the deſcribed horizontal tube, by a tube ſomewhat wider and made of double cloth: This cloth tube, iſſuing from the neareſt and loweſt corner of the bag, is tied on the

mouth of the horizontal leaden tube, by a double turn of tape.

The reason for the delivery of the liquor into a bag at the bottom, rather than at a greater height, will be given in due time.

With this provision of two bags, the machine has sufficient power for general use: But in order that the filtration, by only one side of the machine, may be carried on without interruption, for a double length of time, to the amount of 24 or 36 hours; or that there may be ample provision for the filtration of the foulest and most greasy liquors, and of the scums also, the following means are employed:

A filtrating bag, when flatted and doubled down at the mouth, and flung to the machine, as will be fully shewn hereafter, measures five feet six or seven inches in length from right to left, and about three feet six inches in breadth or depth, from above downwards. This measure is preferred, because the bag can be made to this size with the fewest seams, and the smallest waste of the broad cloth and blanketing. This rectangular area of each bag, corresponds with the area of each fluted-boarding.

When the whole power of the filtrating machine is to be employed, the intermediate slender pendulous frame is made to sling a bag by each of its fluted faces; and the machine, being provided with a slender pendulous intermediate frame, on each side of the great fixed frame, is capable of working by two bags at the same time, or by four, on both sides.

In order that it may be thus worked, the tube Z C is to point to the cloth tube of the outer bag, and from a part about midway, between the cock 5, and the ori-

fice

face C, the leaden tube is to send forth a short tube, branching horizontally to the cloth tube of the inner bag, on one side of the machine: To shew the angle with which the short branch ought to diverge from the tube 5, C, and the necessary interval between the orifices of these, the bags and the flutings ought to be placed as they ought to be for work, in the manner which will presently be shewn. The interval between these orifices ought not to be greater, than the thickness of the slender pendulous frame with the fluted boarding of both its sides: But it may conveniently be somewhat less. In this way the liquor will be delivered at equal heights, and by equal orifices, into the bags, and the delivering tubes will be easily accessible to a piece of wire, or a slender stick, whenever they may be suspected of harbouring dirt.

With the like precaution, the descending tube U Z, is made perfectly straight, that it may easily be cleansed by dropping into it, and moving up and down, a slender bar suspended by a cord.

The like branching of the delivering tube to furnish two orifices, and the like means of suspending bags to receive from these orifices, on the other side of the great fixed frame, gives to this last side, the like power of rapid and long continued filtration.

The pressure of the liquor, on each fluted facing of a pendulous frame, is, as the area covered by the filtrating bag, multiplied by the mean height of the pressing column of liquor. This mean height is that of the lip of the elevated cistern, above the centre of the bag; that is 99 inches: But, as the area above-mentioned is equal to 2672 square inches, the pressure on each fluted face of a moveable frame, is equal to

the weight of 2672 cubic inches of enriched cane-juice, multiplied by 99, the inches in the height of column.

If the preſſing fluid were water, the ſum of the preſſure would equal 9160 pounds; but, inaſmuch as evaporated cane-juice is ſpecifically heavier than water, this preſſure conſiderably exceeds the weight of 9160 pounds; and, as the great pendulous frames bend viſibly under this preſſure, they certainly require all the ſtrength of the deſcribed timbers.

But as the preſſure of the bags, on the ſlender pendulous intermediate moveable frame above deſcribed, is equal on both ſides of it, and in contrary directions, the force of the column of liquor tends only to preſs the ſides together, but not to bend the timbers of this frame; and therefore, this frame is made of ſlenderer ſcantling, and to ſerve only when two bags are worked on each ſide of the machine: When only one bag is worked on a ſide, it is neceſſary either to take away the ſlender pendulous frame, and uſe only the ſtronger moveable frame; or to ſupport the ſlender pendulous frame, by ſcrewing the ſtronger frame up to it.

Even when two bags are to be worked, one at each fluted face of the ſlender pendulous frame, care muſt be taken that the liquor ſhall flow at once into both bags, and riſe in both to the ſame extent and height: For, if one of the bags by being wrinkled, or by having the interior ſurfaces too cloſe to each other, ſhould refuſe admittance to the liquor, whilſt it riſes high in the next bag, this laſt will bend the ſlender moveable frame to preſs on the obſtructed bag, and cloſe it completely; eſpecially if the preſſing column of liquor be high.

The liquor is made to enter at the bottom of each bag,

bag, rather than higher up, for the following purpoſes: The firſt is to make the liquor riſe to equal heights in the contiguous bags, and to prevent the inconvenience lately mentioned, from attending the uſe of a ſlender intermediate frame, which is preferable to a thicker frame; becauſe it gives a ſmaller interval between the charges of hot liquor in theſe bags, and cools them leſs, and allows that the delivering tubes may branch with a ſmaller and more convenient angle.

Secondly, this manner of admitting the liquor to a bag, from the bottom upwards, mixes the ſucceſſive portions of reſiduary liquor of the bag, with the freſh portions admitted; and prevents any liquor from remaining long quieſcent or unmixed near the bottom of a bag, there to ſour by delay.

Thirdly, in this method of admitting the liquor, no more of a bag is brought into uſe, than is neceſſary for the required filtration, and an unneceſſary expanſion of the liquor, to cool or ſour, is prevented.

Fourthly, it is to be obſerved, that a woollen cloth bag, that is ſlung when dry, is capable of filtrating much quicker and longer, than a like bag ſlung wet to the machine; and therefore, no more of a bag ought to be wetted, with the liquor to be filtrated, than is neceſſary; and to avoid unneceſſary wetting, the liquor muſt enter near the bottom of the bag, rather than higher.

Fifthly, by the preſcribed entry of the liquor, and the horizontal poſition of the cocked tube which delivers it, all the liquor of a ſet of bags on one ſide of the machine, may be let into the bags on the other ſide, by turning the cock on each ſide; and it is highly convenient thus to empty any one ſet, when clogged with dirt; for otherwiſe, ſome time and attention would be neceſſary,

neceſſary, in order to drain off, or to preſs the reſiduary liquor of a dirty ſet of bags, through the clogged cloth.

Sixthly, this entry of the liquor, by a narrow aperture of the cock, through a wide cloth tube, ſidewiſe, and at the very bottom of the bag, is neceſſary towards perfect filtration, and to compenſate for any imperfection of the cloth; for when the liquor enters by a cloth tube, placed higher above the bottom of the bag, it cauſes a commotion by the fall, eſpecially at the commencement of the work; by which the plate of dirt, already gathered on the cloth, is diſturbed, and a freer paſſage is given to liquor imperfectly filtrated.

It might be apprehended, that when the reſiduary liquor in a dirty ſet of bags is thus turned into the freſh bags, the lighter dirt will accompany it: But this does not happen, when the liquor is let off with moderate velocity; for the dirt clings in the villous faces of the blanketing, and the ſweets drain from it, through the cloth ſpeedily.

PLATE III ſhews, by the dotted lines, the upright poſts of the great middle frame of the machine, and the relative poſition of the ſieve-trough, extending from this frame towards the knee-wall of the teaches.

The rectangular ſhaded figure, A B C D, exhibits the extent and poſition of a flatted filtrating bag, in regard to the great middle frame, when this filtrating bag is ſlung by tape-loops, between parallel fluted faces, which limit the diſtance between the inner ſides of the bag to about half an inch: The ſmaller this diſtance is, during the filtration, the leſs the bag will hold at any time, and the quicker will be the renovation of the liquor in it, to prevent cooling and fouring.

E D

D shews the tube of the bag; which tube is made of doubled cloth, to bear the great pressure of the column of liquor which it is to sustain; and this cloth tube, when tied on the orifice of one of the horizontal cocked leaden tubes, described in PLATE II, conveys the liquor from the top cistern into the flatted and suspended bag.

In the experience of many years, I have met no filtrable liquor which equals cane-juice, in the difficulties of quick and accurate filtration, or of that perfect depuration of which alone we treat at this moment: It soon clogs any linen or cotton cloth, that is close enough to filtrate truly. Blanketing, and other open spongy woollen cloths, serve only to stop the coarser dirt; and the closer spongy thick woollen cloth, called double swanskin, the evenest the author could find in England, has not, in trials hitherto made of it, served to filtrate unexceptionably: For, in the commencement of the process, it passes the liquor turbid, until the larger pores have been lessened by the deposition of herbaceous matter in them; and thus it becomes necessary, for perfect depuration, that the first portions which issue turbid, should be returned into the bags: The subsequent filtration also is the less perfect, as the liquor is worse in quality, or less disposed to the breaking and flocculence described in the first part of this work: But still this cloth, when the liquor is judiciously presented to it, approximates the thing required so nearly, as to shew, that woollen stuff made thick like this, with a villous surface, but closer and evener in the texture, and of finer wool, could filtrate completely in the form of a single bag.

The present want of such stuff, imposes on us the necessity

neceſſity of adverting to the following ſubſtitutes, and of adopting them now, at a quadruple expence.

By placing any woollen cloth between a ſtrong light and the eye, we can immediately ſee whether it can filtrate truly or not: For that which can, will appear uniform in its ſemi-tranſparency, without being diaphanous in any point; but that which cannot, will ſhew numerous minute lucid holes or pores; and, to the former of theſe deſcriptions, good broad cloth anſwers.

No broad cloth could be procured here, that had not been deprived of its moſt uſeful villous coat, and ſh rn and dreſſed to a cloſe even ſurface; and bags made of ſuch dreſſed cloth, although they paſs the liquor perfectly tranſparent, from the beginning to the end of the proceſs, cannot continue the filtration for the length of time, which is moſt convenient in the boiling-houſe; becauſe it has not the pile which would arreſt and ſuſtain the dirt to a conſiderable depth, and thus prevent it from clotting on the cloſer ſurface of the cloth itſelf.

To remedy this inconvenience it is, for the preſent time and circumſtances, expedient to line the broad-cloth bags with blanketing; the long villous pile of which is found to harbour and detain the dirt, in a divided and permeable ſtate, and to ſecure the cloth for a long time from being clogged.

Under theſe difficulties of the preſent moment, we muſt proceed to a deſcription of lined bags; taking care that it ſhall embrace every neceſſary advice, for the formation and uſe of ſimpler and cheaper ſingle bags.

Every kind of fine broad cloth ſhrinks in waſhing; and to allow for this, and for lapping over at the ſeams, which

which will presently be required, the cloth, which is to serve for a bag of five feet seven inches in length, ought to be cut into pieces of six feet; some of which pieces are to be torn along the middle, in order that a whole-breadth piece sewed to one of half-breadth, along their greatest length, may serve for a bag, with the least seaming and waste of cloth.

This large seamed piece is to be doubled up, to make the salvage borders coincide; and the best face or pile of the cloth is to be turned inwards, in making this duplicature: The doubled cloth is to be cut in the lines A F, F L, and in the lines B G, G K, to shew the flap L F, G K, belonging to each side of the intended bag.

By the like seams along the borders A D, and B C, lapped over, the closures of the bag will be completed, except near D, where the double cloth tube, E D, is to be inserted in the manner represented in the figure. Thus a flap-mouth will be left at the upper border of the bag, so that it may be opened there, by the whole extent of the cloth on both sides, from L to K.

This width of the flap-mouth is allowed, in order that there may be no occasion for pulling the cloth with force, when the inside of the bag is to be turned outwards, for the purpose of washing away the dirt. In seaming the bag at A F, and G B, care is to be taken, that it measure three feet seven inches, from this top border to the bottom border; which will allow an inch or more for shrinking in this direction, in the first washing; and will make the bag, when shrunk, to fit the fluting.

In cutting out for the flap-mouth, to the measure of three and an half feet in length, by three and an half

inches or more in breadth, as represented in the diagram, a little may be borrowed from the sound parts of the salvages, if that should be necessary to the requisite depth of the bag, and the described extent of the flap-mouth.

The seams which are the firmest, and by which the needle-holes are least apt to leak, when the cloth is most forced by the liquor, are made by lapping over the edges of the cloth, three quarters of an inch or less, where the juncture by sewing is to be; then, by tacking down here, to make the cloth smooth and even, and to prevent puckering; and then by back-stitching along each edge, and within $\frac{1}{8}$ of an inch of it: This double row of back-stitching is to be observed, in the juncture of the whole-breadth piece with the half-breadth piece, and at the seam at the ends A D, B C, and at the upper borders A F, G B: The bottom, D C, will have no seam, because it is made by the doubling up of the cloth.

As these seamed borders are to sustain a great pressure of the liquor, without meeting any support from the fluting which supports the flat sides only of the bag, it is necessary to strengthen these borders, and to meet their strained needle-holes, by a strap of the cloth sewed to these borders, and broad enough to be back-stitched on each side of the bag, to the extent of an inch and a quarter within the border. This binding of the bag will strengthen the border D A, and the border C B; but the upper borders A F, and G B, are to be secured in the same way, rather to prevent the mouth, F G, from being torn in washing, than to provide against the pressure of the liquor; because it presses here with the shortest column.

In

In order to line with blanketing, the inside of the bag is to be turned out, and it is to be laid flat on a table: When the blanket is to be made to cover the side A B C D, and to fold round the bottom D C, and to cover the other side, which corresponds with A B C D, in figure and extent. The finest pile, or most fleecy side of the blanket, is now to face outwards; in order that when the bag is returned to the state in which it will serve for work, the most fleecy side of the blanket may face inwards, as it ought.

The blanket lining is to be sewed to the cloth bag, along the bottom border D C, the borders C B, B A, A D. A lining is not required for the tube E D, because it is already made of double cloth, and an additional lining would narrow it too much.

It is unnecessary, and would be inconvenient, to line the flap-mouth of the bag; for the additional bulk of the lining would render it more difficult, to turn down this flap-mouth smooth and flat, in the manner hereafter to be described; and would render the part of the bag, on which such a thick flap-mouth should press, inaccessible to the liquor: Therefore, the edges of the blanket lining are to extend no higher than the line F G, at which they are to be sewed to the cloth.

It has been mentioned, that each bag is to be suspended by tape-loops, which are to hang on coincident teeth of the upper border of the fluting of the slender moveable middle frame; and now the particulars of this provision for hanging a bag for use, are to be described.

In order that the tapes, and the sewing to the cloth, may not be strained by any force greater than the mere weight of the bag, they ought to be fastened to it in a

manner to admit, that the upper border, or duplicature of the bag, may freely ſwell upwards, and become rounded equally, by the preſſure of the liquor, inſtead of bearing againſt the loops, and forcing their ſewing to the cloth; and therefore the loops muſt be faſtened to the cloth, not at the upper border, but below it, by an inch or more on either ſide of the bag.

In the beſt method of applying the loops, each piece of tape, which forms a loop, ought to be continued downwards, and around the lower duplicature or bottom of the bag, ſo that it may have, on each ſide, as many parallel ſtays of tape as there are loops: And, as the negroes are apt to pull or raiſe a bag by one or two of the loops, even when its weight is greatly increaſed by wet and dirt, theſe loops and ſtays are to be ſtrong; and the ſewing of them is to be ſmooth and firm, and is to paſs through the bag and lining, to keep theſe from wrinkling, and to facilitate the waſhing.

But, in order to make the deſcription ſimple and clear, we may confine ourſelves to the following method:

Suppoſing a piece of tape for each loop, of no greater length than is neceſſary for the duplicature forming the loop, and for the attachment of the ends to one of the parallel ſtay-tapes of the bag, then a piece of $6\frac{1}{2}$ inches in length will ſerve for each of the loops, 1, 2, and for that next to 2: And alſo for 4, 3, and that next to 3, on one ſide of the bag, near the upper border; and the like pieces will ſerve oppoſite to theſe, on the other ſide.

Each piece is to be formed into a loop, by doubling end to end, and by ſewing the contiguous ſides together, at the middle of the folded piece, and in a ſtraight line

line acroſs it: This ſewing ſerves to make the pulling of the loop equal on both ends of the tape, and on the ſewing which faſtens them to the bag; not one over the other, but cloſe by each other, on a greater extent of the cloth.

This ſewing is to be made an inch or more below the upper border of the bag, and quite through the ſtay-tape, the cloth, and the lining, for each of the enumerated loops.

On the ſide from which the flap-mouth turns, nine other loops like theſe are to be ſewed on, in the ſame line, near the border, and at equal diſtances from each other.

But, on the ſide to which the flap-mouth turns, and which PLATE III ſhews, and which is the neareſt to the fluting by which this bag hangs, the nine longer loops, appearing between F I, and G H, are to be fixed, as the figure repreſents.

This fixture of the loops, on this ſide of the bag, $3\frac{1}{2}$ inches below the upper border, ſerves to make room for the doubling down of the flap-mouth to the poſition F I H G, when the bag is cloſed for work: And the repreſented length of theſe laſt-mentioned nine loops, is to permit them to reach upwards, to the height of the correſponding oppoſite loops, in order that the duplicature of the flap-mouth may be ſuſtained between the oppoſite rows of loops, and that the oppoſite ſides of the bag may be held ſmooth, at equal heights near the upper border.

In order to maintain the figure of a bag, and to give it ſtrength and duration, the tapes which form the deſcribed loops at the upper border, are either to be continued downwards towards the bottom of the bag,

or

or are to be firmly joined to corresponding and parallel tape-loops, sewed to the cloth and lining, from the upper border downwards, and around the duplicature of the lower border or bottom, from one side to the other, and up to the top: And this sewing ought to be firm and even, without puckering, to prevent the stitches from being strained more in any one place than elsewhere; for, wherever they are excessively strained, the needle-holes are apt to be forced open, and to let through some liquor imperfectly filtrated.

A bag thus looped, will hang as much below the intervals of the teeth already described, as will be sufficient to prevent its upper border from spewing any filtrated liquor upon them.

By the mere inspection of the shaded figure A B C D, one may readily perceive, that when the loops of a bag are made to direct the duplicature of the flap-mouth to one side, the loops of the other bag, which is to work at the same time, on the other side of the same slender middle moveable frame, must be made to direct the duplicature to a contrary side of this last-mentioned bag: For otherwise both the flap-mouths would not turn to the corresponding fluted face, on which each duplicature ought to be held smoothed and steadied by the weight of the bag, whilst the frames are moving home to the proper intervals for filtration.

In every other respect, the bags are to be made alike, for both sides of the machine.

Formerly side-loops were provided, to fix on corresponding pegs at the outer edge of the fluting, and to keep the bags to their greatest extent from one side border to the other, on the fluting. But now it appears that these are not necessary, provided the borders

ders of the bag be pulled and dreſſed to the proper extent, after the fluted faces are fixed; for the ſubſequent heat and preſſure give a ſet, or a permanent diſpoſition to to the ſame extenſion and figure.

The ſhaded figure, M N O P, repreſents a long trough, lined with lead, in the proper poſition, relatively to the bag and to the great middle frame of the machine, for the reception of the filtrated liquor which falls from the fluting.

This trough is bevelled outwards to an edge, at the lip, in order that the lip, touching the upright poſt of the machine, may ſtand behind the lower edge of the fluted boarding of the great middle fixed frame, and that none of the filtrated liquor ſhall fall outſide of the trough, and between it and the contiguous face of the great middle frame.

The reaſon for making the trough ſo long as it is here repreſented is, that it may receive, by the bevelled lip at the end M, any liquor that may ouze at the tying E, of the cloth tube E D, to the horizontal leaden cocked-tube deſcribed in PLATE II; and that the trough may, in like manner, ſerve at the end N, PLATE III, in caſe it ſhould be thought neceſſary to lead down hither, the ſcums and the filth of the boilers, from a ciſtern placed at or near the ſhorter upright poſt of the machine, in order that they may be filtrated apart, on any ſide of the machine that is not occupied by the filtration of liquor from the teaches.

In order that the ſtreams of filtrated liquor, falling from the fluted boarding of the great middle frame, may not ſpread and chill on the ſides of the trough, it is expedient to make this fluted boarding a little thicker than the others, to the amount of $1\frac{1}{2}$ or of 2 inches; and

to

to notch the upright posts of the great middle frame, to let in the trough to the depth of half an inch or more. It is necessary also, that this fluted boarding should be bevelled from behind forwards, to shew an edge at the furrows of the fluting: for otherwise, the filtrated liquor will be apt to trickle backwards and behind the trough.

This trough is to be made of boards, an inch or a little more in thickness; it is to be dove-tailed at the corner joints, and is to be lined with lead: Its cavity ought then to measure 18 inches in breadth, at the bottom board, 22 inches at the mouth, by about seven at the greatest depth, and by the length shewn in the figure, according to the scale.

As this trough is to serve for different modes of filtration, its bottom must not be flat at the inside: When the bottom boards have been nailed on, an inch board is to be fastened to cover half the breadth, and the whole length of the bottom, so that the leaden lining of the bottom shall be deeper by an inch, at the side or half into which the streams of filtrated liquor will fall, than at the other side or half, which serves only to enlarge the capacity of the trough: The higher part of this bottom ought to slope a little to the lower; and to this lower channel, the step cock or tube, Q P, is to open.

The tube or cock, Q P, is to have a diameter of two inches in the aperture, because a smaller will not serve to deliver 30 or 35 gallons of filtrated liquor forwards, so quickly as a certain mode of filtration, hereafter to be described, may require: and because, no inconvenience attends this great aperture, when it serves to deliver the filtrated liquor directly from the bags and the channel in the trough, into the second teach, by the interven-

tion

tion of a small light moveable trough, three and a half or four inches deep, by four inches wide, at the end which receives the liquor.

Were it not more expensive, a stop-cock of this bore is preferable to a mere tube: But, when the tube is used, it is to be provided with a wooden plug, applicable at the inner orifice: And, in order that the workmen may insert or withdraw the stopper, without touching the filtrated liquor, the stopper is to have a slender wooden handle, 12 or 14 inches in length, inserted at right angles with it, near its thicker end, so that the handle shall stand forth above the liquor, by the whole or the greater part of its length, according to any occasional depth of the liquor in the trough.

If the tube be not perfectly round, and stopped by the plug, a slip of broad cloath is to be wound twice round the plug, where it is to fit the tube, and is to be secured there with pump tacks, driven lower than the surface of the cloth: On each side of the great fixed frame, and at the height represented in the figure, a trough of this kind is to be placed, and supported upon the transverse piece, figure 3, PLATE I, when they are pinned in the described notches of the upright post of the great fixed frame.

The parts which serve merely to facilitate the working of the machine, are now to be described.

At that face of the piece, figure 4, PLATE I, which will be the outward, when this piece is bolted in its proper place, to an upright post of the great middle frame, a line is to be drawn, parallel with the long upper edge of this piece, and distant from this edge by two inches: At the distance of six inches from the middle of the length of this line, and from thence towards each end in the same line, holes are to be bored, in which rounded pins of ha

wood are to be firmly inserted. Each of these pins is to project two inches or less, and is to have a diameter of one inch or a little more.

In the rank of pins, from the middle vacant space to each end of the piece, they are to be distant from each other by an interval of two inches, or a little more, for the admission of a small handspike.

By the handspike rested on one of these pins as its fulcrum, and catching a projecting end of any of the upper pieces of a moveable frame, this end of it may be slidden inwards or outwards with great ease: In the same manner, the other end may be moved on that piece, figure 4, PLATE I, which supports it, and is equally provided with the described wooden pins.

The stronger end of the handspike ought to have a thickness of about $1\frac{1}{2}$ inch by $1\frac{1}{4}$ inch, so that it may bear on one of the pins by the broader, or by the narrower side, as the occasion may require.

For the purpose of staying the fluted faces, at the distances required for the due support of the filtrating bags, pieces of wood, called regulators, are to be placed between the projecting ends, at the angles of the frames. Each of these regulators is to measure about seven inches in length, and as much in breadth as will serve to keep neighbouring fluted faces distant from each other by an inch, when the regulator stands between the scantling projections of the frames, and not between the fluted faces. Each regulator is also to have a thickness, by which it may serve to keep the fluted faces only $\frac{3}{4}$ of an inch asunder, when this smaller interval is required.

Each regulator is to have a shoulder at the upper end, to prevent it from slipping downwards from its proper position, between the ends of the frames; and, in order that each regulator may be kept to the angle which

it

it ſuits beſt, it ought to be provided with a gimlet-hole, by which it may be occaſionally hung to the poſt, on a nail, near its proper place.

When the regulators are duly placed, to make the fluted faces parallel to each other, in ſpite of any imperfections in the workmanſhip of the frames and fluting, they are made faſt, by ſcrewing home the moveable frames, as far as the regulators will permit.

If a regulator be ill placed, to touch the border of a bag that is at work, the liquor will be apt to run along the wood outwards, and to drip beyond the trough.

At theſe intervals of the fluted faces, and eſpecially at the ſmaller, laſt deſcribed, and determined by the regulators, the fleecy faces of the blanket lining of a bag, ſlung for filtration, either meet, or leave ſo ſmall an interval between them, that the ſlender opening from the cloth tube into the bag, at the border, is apt to be choked, by any fibrous or ſcaly dirt which the deſcribed ſieve cannot ſtop, in the ſieve-trough.

This ſlender opening is narrowed ſtill more, by the thickneſs of the ſeams which join the double cloth tube to the bag; and, on theſe conſiderations, it is neceſſary, that the interval between the fluted faces ſhould be duly widened, at the part of the fluting which meets theſe ſeams and duplicatures of the cloth tube.

For this purpoſe, the ridges of the fluting there are to be cut away, or hollowed out; and the original furrows, which are thus obliterated, are to be continued by new cuts: But this excavation is not to be made deeper, or wider, than is neceſſary for the expreſſed purpoſe.

To provide a convenient ſtanding place, for the negro who is to ſling or remove the bags, and to prevent him from dropping any dirt from his feet upon the

frames, or into the filtrated liquor below them, a moveable board is to be placed, outside of the frames, across the ends of the transverse pieces by which the moveable frames hang, on either side of the fixed middle frame. To guide and keep this board in the proper parallelism with the frames, and to permit that it may be made to advance or recede with them, a small ledge is to be nailed to the lower face of the board, close by each transverse piece on which it rests.

Of the art of working the FILTRATING MACHINE.

To set a pair of bags for filtration, the workman is to slide the frames asunder, to make an interval of six or eight inches, between corresponding parallel faces of fluting, for the reception of the bags: Mounted on the board lately described, he is to catch the bag, which suits the interval next the middle fixed frame, by the upper border, on each side of the flap-mouth; when he has lowered the bag into its place, he is to fix to the corresponding teeth of the slender moveable frame, two or three loops, near one upper corner, and then the two or three loops next the other upper corner of the bag.

He is then to fix, in the same way, the nine intermediate long loops belonging to the side of the bag, that touches the fluting. Having thus ridded himself of the weight of the bag, he is to bring the edges of the flap-mouth even together; and, press his finger-ends into the intended course of the duplicature, whilst the thumbs turn down the flap-mouth, to make it lie between the bag and the fluting.

When the flap-mouth is well doubled down, it lies smooth,

ſmooth, with parallel edges touching each other, and the upper border of the bag is ſtraight, from corner to corner.

If the flap-mouth be turned down, to lie ſmooth and flat againſt the fluting, and between oppoſite tape-loops of oppoſite ſides, there will be no leakage by this mouth, under any preſſure of the liquor; for the interval between the inner ſides of a bag, at work, is no where greater than half an inch, meaſured between the villous faces; and the duplicature of the flap-mouth reduces the interval there, to about a quarter of an inch: Thus, the area of the cloth, that is preſſed upwards at the bend of this duplicature, between F and G, is ten or twelve times leſs than the area of the flap, F I H G, by the whole of which area the flap is preſſed, and its ſides are cloſed againſt the fluting: And, as there is but little difference in the height of the columns preſſing on theſe areas, the preſſure tending to cloſe the flap-mouth, by forcing its ſides together between the bag and the fluting, is ten times greater than the preſſure, which tends to force the duplicature upwards at the bend, to diſturb the folding, or to cauſe a leakage by the mouth.

The flap-mouth being duly turned down, he is to ſlide the ſlender frame, which carries this bag, cloſe to the poſition at which it is to be faſtened for working, and is to tie the cloth tube, by two or three rounds of tape, on the orifice of the leaden tube, belonging to this bag; this leaden tube being previouſly notched round, within the eighth of an inch of the orifice, to prevent the tape from ſlipping: And, to guard againſt dripping, the ends of the tape are to lie upon the upper part of the cloth tube.

Another

Another bag being ſlung in the ſame manner, at the outer face or fluting of the ſlender moveable frame, and its cloth tube being thus tied to the leaden tube belonging to it, the regulators are to be ſet in their reſpective places, and the outer pendulous frame is to be ſcrewed home, as far as the regulators will permit.

When the flutings are not truly parallel and flat, or when a proviſion is to be made for much dirt, the regulators are to hold the flutings aſunder by their whole breadth: But, when the fluting is well made, and when the quantity of dirt to be ſtopped, is not likely to add much to the thickneſs of the blanket lining, becauſe it ſinks into it, the regulators are to be applied by their thickneſs only, ſo as to maintain an interval of $\frac{3}{4}$ of an inch between the fluted faces.

The ſmaller intervals are to be preferred, for liquor which carries but little dirt, becauſe they hold leſs liquor cooling, *in tranſitu*.

Each bag being pulled forth, and dreſſed to its proper extent and poſition, as heretofore deſcribed, the upper border will be parallel with that of the fluting, and ſo much below the intervals of the teeth, that no liquor can ſpew into them: And the parallel ſtaying-tapes will prevent the cloth from lengthening from above downwards, as it would without ſuch ſtays, in conſequence of the weight of the liquor forcing in this direction, and of the ductility of the woollen fibres, when wetted and heated.

If the bottom of a bag be permitted to hang below the fluting, either by its exceſſive depth, or by an exceſſive length of the tape-loops, it will belly upon the lower orifices of the fluting, and ſtop them, and greatly impede the filtration.

The

The liquor intended for filtration, is now to be ladled into the ſieve, and pumped up into the high ciſtern, and paſſed on to the bags on one ſide of the machine; not by ſpouting into them with a quick and ſtrong ſtream, but by a ſmall opening of the cock; and ſuch only as will ſerve to make both bags filtrate alike, in the courſe of a minute or leſs, by the whole length of the bottom borders: For clean bags, and thoſe eſpecially that are dry, can filtrate ten times quicker than is neceſſary for the ſupply of the teaches, before the column of liquor in them attains any great height; and exceſſive quickneſs in filtration is attended with inconvenience. It gives a ſurplus of liquor in the bags, and in the receivers beneath, to reſt and cool longer than is neceſſary: And, as it muſt be interrupted, when the receiver and the teaches are full, the ſupply of liquor muſt be ſtopped; that in the bags muſt ſhrink from the parts it has wetted, and leave them to evaporate, to cool, and to be clogged with viſcid dirty ſyrup. Another inconvenience attends the exceſſive velocity: In order to filtrate perfectly, the cloth muſt be quieſcent; for every motion of it operates, like that of waſhing, to carry the dirt through it: And, although the machine be well contrived to keep the filtrating medium at reſt, alternate overfilling and emptying cannot fail to cauſe ſome motion of it, and eſpecially at the unſupported borders, which belly when the liquor within ſtands high, and retract as the column lowers and abates of its preſſure.

It is adviſable to make the croſs-piece of the cock handle ſo long, that a ſmall turn may be eaſily ſeen and felt, and that the aperture which has been found to anſwer well, may be known by the pointing of this croſs-

croſs-piece, and may be taken at once, to commence and to continue the filtration.

With the proper aperture of the cock, the buſineſs goes on ſteadily; the liquor gradually riſes and wets the bags upwards, as the larger pores become narrowed by dirt. When the liquor diſtends the upper borders of the bags, the cock may be opened a little more. No other care is required for many hours, or for the day.

When the filtration abates, before the bags have worked long, or become clotted with dirt, it is to be underſtood, that the partial aperture of the cock is clogged with dirt which has eſcaped the ſieve, or has fallen accidentally into the ſieve trough, or the upper ciſtern: And we are aſſured that this is the cauſe, if we feel the borders of the bags, near the upper corners, rather flaccid than ſtrongly ſwollen outwards. In this caſe, the cock is to be ſuddenly opened widely, and as quickly cloſed again to the former aperture; for, in this ſhort interval, the dirt will ſlip through, and the filtration will then proceed as formerly. Such a ſtoppage rarely happens, when the upper ciſtern is waſhed out with a cloth, inſtead of corn leaves, or things that break and run into the leaden tube leading to the bags.

It is not adviſable to keep a ſet of bags at work, for the whole time they might ſerve for the ſupply of the teaches: For, when they are ſo much clogged, as to require the whole height of the preſſing column for a competent filtration, they keep more liquor than is neceſſary *in tranſitu*, and afterwards take more time in drainings.

To carry on the filtration in freſh bags, in due time, the ſtop-cock belonging to them is to be opened partially,

finally, to deliver into them the residuary liquor of the foul bags, and of the leaden tube, slowly. About a minute will serve for a moderate efflux of the liquor, in which little or no dirt will pass with it; for, with this slow motion or subsidence of the liquor in the foul bag, and the filtration which still subsists, the dirt clings in the pile of the blanket faces, instead of passing away into the clean bags.

To expedite the transition from the foul to the fresh bags, the regulators are to be removed; first, at the ends of the bags furthest from their tubes; and the frames are there to be shoved or screwed home, not forcibly, but only to make the fouled filtrating faces meet: The other ends are next to be closed in the same manner. In this condition, the bags will drain sufficiently in a few minutes, provided they have not been excessively clogged by working too long.

If such extreme economy were advisable, the small quantity of liquor which remains with the dirt, might be expressed, until this acquires the consistency of dough, and the bags become almost dry; or the last portion of the sweets might be washed out of the dirt and the cloth, by filtrating through them successive charges of water: For experience has shewn that the water thus introduced, between the plates of dirt which adhere to the sides of the bag, presses through them, and in its passage carries with it all the sweets, without washing forth any dirt, to disturb the transparency in the smallest degree.

This is mentioned with a mere view to other uses, and particularly that of extracting good sugar from the black, soft, and unsaleable. For, in respect to the work for the teaches, in ordinary, the foul bags drain

themſelves and their contents ſo well, in a few minutes, that little or nothing can be afterwards expreſſed from them, even by wringing: Such is the property of wet woollen cloth, hung perpendicularly.

After draining a few minutes, the foul bags ought to be removed, and the flutings are to be immediately waſhed, to prevent ſouring. For this purpoſe, the frames are to be ſlidden aſunder; and any ſweets that have lately dropped, are to be ſent along with the water, uſed in waſhing the fluting and its trough, to the ſtill-houſe.

For the removal of the foul bags, the workman is to preſs any dirt in the cloth tube forward into the bags, and is to looſen the tying at the lead: Then, mounting on the moveable board above deſcribed, he is to catch the neareſt bag by the border, at each ſide of the flap-mouth, and, by pulling ſtraight upwards, he is to diſengage all the loops.

Having raiſed the bag above the fluting, he is to lower it gently to the ground: For when it is thrown from on high, with the whole weight of the cloth, wet, and dirt, the ſewing is apt to be ſtrained, and ſmall pointed cane ſplinters, which have entered with the juice, wound the cloth.

In the ſame way, the ſecond bag is to be taken off: And now an hair-broom is the fitteſt inſtrument for waſhing the fluting; becauſe it can reach to every part of it, by the length of the handle; and by the length of the briſtles, it ſerves to waſh out the furrows, without ſcraping or wounding the ridges by the wood of the broom.

For waſhing the inſide of a lined bag is to be turned out, and is afterwards to be returned, to complete the waſhing

washing of the cloth: And then, to drain or dry, it is to be suspended, with the blanket lining outwards, by all the tape-loops, to maintain the proper figure, whilst it drains and dries: It will drain in an hour or two, to serve for filtration, when a longer time cannot be allowed for drying. Then the expression of the water by wringing, is never to be attempted; because it forces the seams, and opens the needle-holes, without ridding the cloth of water, further than may be done by an hour's draining.

The negro who washes the bags, ought to be cautioned against pulling the whole weight by a single tape-loop, and against dragging the cloth along the ground, or against stumps or sharp stones; and he who administers temper ought to be informed, that any considerable excess of it, not only impedes the cleansing, and discolours the sugar, but weakens the texture, and shortens the duration of the filters.

It was by inattention to these cautions, that the first filters employed, were frequently found to leak by cuts and rents, and the cloth became rotten in the course of the year.

As one side of the machine can filtrate abundantly for the teaches, for 18 or 24 hours or more, when it receives nothing but skimmed and enriched liquor; the other side of the machine may be employed, for the greater part, or almost the whole of this time, for other purposes: Because the business of setting fresh bags, to relieve those that have been clogged by the filtration of skimmed and enriched liquor, may be done in a few minutes, if there be a spare set of bags in readiness: For, in this case, it is to be understood, that the side intended to receive fresh bags, has, within

a few minutes, been employed in the filtration of the scums, and of the bulky filth of clarifiers and grand boilers; which work requires much less time and power, than this side can afford; because the bulk of the scums and filthy refuse is about ten or fifteen times less than that of the skimmed and enriched liquor of the teaches.

By changing the bags, at shorter intervals of ten or twelve hours, the extent and power of this machine are sufficient for filtration, for any two systems of teaches and grand boilers; and the machine may be thus used, wherever there is one boiler common to two systems, or where the systems range parallel with each other: For, in either of these cases, the slender moveable trough, which leads the filtrated liquor forward from the machine, needs not any inconvenient length.

It is to be acknowledged, in regard to the size of the described machine, and of every one hitherto made, that the objections urged against the trouble of changing and washing the bags, at shorter intervals of ten or fifteen hours, have had too much influence: And, for any one system of teaches and grand boilers, I should not hesitate, henceforward, to prefer a machine made with less extent of the frames and fluting, a shorter pump and pressing column, and smaller vessels: Because that which has the smaller filtrating surface and capacity, works with the smaller charges *in transitu*, and smaller loss of temperature; and may be made with slenderer timbers.

The described dimensions were adopted in the four machines first made; and, in these diagrams, not solely under the influence lately mentioned, but partly on the following considerations. A machine that has

greater

greater power and capacity, than is requiſite for the work to which it is chiefly applied, may be made to act with the deſcribed advantages of a ſmaller, by merely plugging up one of the leaden orifices, and working only one bag on either ſide, inſtead of two: For thus, the quantity of liquor in the filter, and the loſs of temperature, may be leſſened by nearly one half.

The large machine, with all the bags, may be the fitteſt for juices that are uncommonly watery and foul; and the deſcriptions comprehend all neceſſary advices, in regard to the conſtruction of any ſmaller or ſimpler inſtrument, for purpoſes more limited.

The augmentation of the value of Muſcovado ſugar by filtration, is the ſmalleſt, when the juice is naturally good, and when the ſyſtems and meaſures hereafter to be deſcribed, accelerating the tranſition of the juice to ſugar, and greatly promoting the depuration by rapid boiling and judicious ſkimming, are adopted: For ſugar, made under ſuch circumſtances, retains no coloured dirt to ſtrike the eye, and it appears white enough; becauſe the paler and thinner molaſſes of this Muſcovado, drain off ſo well, as to leave little or no yellow ſtain on the grains: And ſuch ſugar cannot be made much whiter by filtration, becauſe the filter cannot ſtop the melaſſes: In this caſe, the moſt valuable uſe of the filter, is to work all the ſweets of the ſcums into ſugar.

The augmentation of the value by filtration is the greater, as the juices are worſe in quality, and more apt to yield, in ordinary work, dirty ſugar, and melaſſes deeply coloured, always leaving a foul ſtain on the grains.

It is only for ſuch juices, that I would inſiſt on the filtration

filtration of all that passes to the teaches; in order to make the sugar clean and more easily curable, and much fairer than it would be, by ordinary work. Here the increase in the real worth is great and unquestionable, whether the scums be filtrated for sugar or not; and the expectation of a gradual increase of the price by the quality, independently of the quantity, in spite of any interested pretences to the contrary in Europe, is well founded. But not so is the expectation, that such juice shall, by filtration, be made to yield sugar, not only as clean as the fairest Muscovado, but also as white as the best; for every sugar that cures from its melasses by drainage only, will participate of the colour of its melasses, in some degree proportionate to the intensity; which is naturally the greatest in the worst juices, independently of the augmentation it receives, when the filth passes forward in the ordinary process, to be charred in the heat of the first teach.

In the most extensive use of a filtrating machine, it seems that the first and foulest, and most bulky scums, ought to be filtrated apart, whether for the teaches or for the still-house, on the side unemployed for the time, in the filtration of enriched juice: And, as such scums are apt to clog the valves of a pump, it is better that they should be conveyed in pails, as fast as they arise, into their proper elevated cistern, to which the negro is to mount by a few broad easy steps.

A cistern appropriated to this use, is to stand by the shorter upright post of the middle fixed frame, or somewhere near it, and is to deliver by a large leaden tube downwards, to the cloth tubes turned hither: It may be placed much lower than the former, because the bulk of what is to be filtrated here is comparatively small:

And

And it ought to be provided with a false bottom, bilged upwards, and pierced with holes of about $\frac{1}{6}$ of an inch in diameter, to prevent the larger fragments of cane-trash from clogging the tube.

Where clarifiers are used, and the heads of filth are long detained, and then mixed with the water used in washing; and where these, or any liquor extracted from them, are to be sent to the still-house, as being totally unfit for any other use; the scums of the teaches may be filtrated for sugar, without the trouble of setting fresh bags for them; and for this purpose, they may be thrown into the same sieve into which any liquor to be filtrated is ladled, in the ordinary course of work. For in the trials of this method, I have not discovered any inconvenience, except that bags which served otherwise for an unnecessary length of time, were now clogged in a shorter time, but not so soon as to create any considerable inconvenience. Further experience may, nevertheless, shew that this practice is inadvisable.

For the mean, or the smaller systems of vessels, the filtrating machine is to be placed at the third teach.

In the smaller systems, which admits but two fires; one large, to work three teaches and a cocked grand boiler; and one smaller, to work one grand boiler: the liquor of a third teach is sufficiently concentrated for filtration; but is seldom or never so much inspissated, as to clog the bags by the mere tenacity of a mixture of syrup and dirt. It is, however, in such a state that, when filtrated, it will never shew any scum, in the boiling down to give grain, that will not rise to the surface white, with a glutinous or greasy tenacity, which enables the skimmer to take it off completely.

In

In any such system, if the machine were placed to filtrate from the grand boiler into a third teach, or into a fourth, when there are four, the disadvantages would be, that the quantity of liquor to be filtrated must be almost equal to that of the raw cane-juice; and that the more watery liquor, although it should pass the filter with perfect transparency, will throw out abundance of herbaceous matter and scum, not white, but coloured; and not so fat and tenacious, or so easily separable by skimming, as that belonging to a richer filtrated liquor.

But, in placing the machine to any of the more extensive and powerful systems, hereafter to be described, the liquor of the grand boiler, next to the teaches, is sufficiently rich for filtration, and the machine is to deliver from that grand boiler, into the nearest teach, whether there be three or four of them.

Other particulars regarding the use of this filtrating machine, and of smaller and cheaper instruments for the filtration of scums only, are referred to the following head, in order to avoid repetitions.

Of the advantages and inconveniencies of FILTRATION; *and of simpler instruments for the filtration of* SCUMS *only.*

To make the fairest estimate that the present circumstances admit, of the advantages of filtration, we must advert to the different qualities of the juices: For, in regard to the fine, which need no filtration except that of the scums, the advantages depend on the quantity of sugar to be gained from the scums, or on the improvement of the rum in quality and quantity; and,

and, in regard to inferior juices, the advantages consist in these last, and in a much greater; namely, the improvement of the quality of the whole of the sugar, and of the rum also.

In the course of my long attendance in boiling-houses, I have taken great pains to ascertain the quantity of sweets, sent to the still-house in the scums and filth, relatively to the quantity boiled to sugar; and, to avoid a detail which could only serve to prove, what every experienced planter is ready to admit, I shall briefly state, that the quantity sent to the still-house is generally one-twentieth of the whole, under the most economical workmanship that I have seen; and is much greater in other cases.

About one-twentieth is the quantity, when no clarifiers are used, when the broken splinters and pith of the expressed juice are stopped at the mill by a sieve, and prevented from increasing the bulk of the first scum in yawing; and when the skimming is economical, in the manner described in the first part of this work.

But when clarifiers are used; when their yawed heads become thickened by cane splinters and pith, and slips of the green bands, through the want of a proper sieve at the mill-house; when this thickness of the head of filth, and the splinters and slips projecting downwards, render it impossible to draw off the last portions of clean liquor, without their sweeping with them some of the disturbed head; when the skimming at grand boilers and teaches is wasteful, by a quick projection of the sweets along with the scums, from the skimmer into the scum-trough; in the concurrence of some or all of these circumstances, the quantity of sweets sent to the still-house, is greatly above one-twentieth, and ap-

proaches to one-fifteenth of the whole of the ſweets in the juice.

This is but little different from the proportion by which the quantity of ſugar may be augmented, by the filtration of the ſcums, and the return of the ſweets to the boilers; becauſe, in the filtration of ſcums, it appears that the ſolid meaſure of them is trivial, in compariſon with the whole bulk of the liquid ſcums.

But, ſuppoſing the average augmentation to conſiſt generally, in an acceſſion of only one part to every nineteen of beſt ſugar obtained in ordinary work, without filtration, it would, in an eſtate of 300 hogſheads, amount nearly to ſixteen hogſheads; which, at 35*l.* ſterling each, would ſell for more than 600*l.* ſterling.

Little or no deduction is to be made, in conſideration of the rum which theſe ſcums would produce; becauſe, the profit from the manufacture of rum is generally very ſmall; and becauſe recent experience, the particulars of which will appear under the head of Rum, ſhews that, in the cuſtomary uſe of ſcums, they debaſe the attainable quality, character, and worth, of this ſpirit, as much as they increaſe the quantity.

Although there has been no diſcrimination of the various circumſtances and cauſes, which concur, in the uſe of the foul ſcums, in the manufacture of rum, many planters ſhew their ſenſe of the advantage of cleanſing for this proceſs, by the proviſions they make for approximating this end, by ſkimming and ſubſidence: But, were the perfection of the manufacture to depend entirely on the abſtraction of the filth, the means hitherto employed for this purpoſe, are incompetent.

It is the nature of the liquor, which runs to the ſtill-houſe fraught with filth, whether it be withdrawn from the

the operation of the ſtream or not, ſoon to acquire inteſtine motion, and to have it accelerated, not only by remnants of ſtaler liquor, but even by the previous impregnation of the veſſels.

Under theſe circumſtances, ſome of the filth is thrown upwards and forms ſcum, and ſome falls, whilſt a conſiderable part remains permanently diffuſed: And, as all that can be done by ſkimming, or ſubſidence, follows the inteſtine motion or fermentation, inſtead of preceding it; and is moreover incompetent to the end of purifying the liquor for the ſubſequent rapid fermentation, it ſerves only to diminiſh the evils producible by the putreſcent filth, but cannot avert them effectually.

But, by filtration, the putreſcent matter is eaſily and totally ſeparable from the ſweets, before inteſtine motion, fermentation, and taint, commence; and, for divers reaſons hereafter to be aſſigned, filtration of the ſcums muſt precede all other meaſures for the improvement of rum.

When the planter filtrates only for the ſtill-houſe, and ſends the clean ſweets freſh and warm, to mix immediately with ſome melaſſes, and to meet an abſorbent of the acetous acid, which the ſcum-ſweets are peculiarly apt to generate quickly and waſtefully, as will be better ſhown below, then, indeed, the gain by filtration will conſiſt chiefly in the additional price, which the beſt rum cannot fail to command in the market, ſo ſoon as the difference between it and ordinary rum, ſhall be found great and ſtriking to every palate. The increaſe of quantity is not regarded here, becauſe, in a commodity that has been generally productive of very little profit, an increaſe in the price is much more important, than an augmentation of the quantity.

For a limited use of this kind, a much smaller, simpler, and cheaper filter than that above described, will serve: The elevation for the delivery of filtrated liquor to the boilers or teaches, will be unnecessary; smaller and slenderer frames and fluting, smaller and single bags of double swan-skin will depurate sufficiently; no pump will be wanted for the machine; nor any sieve trough, nor any leaded receivers of fined liquor: For the scums will be thrown as fast as they arise, and in the manner already described, into a cistern but little elevated above the bags, and the filtrated liquor will fall into a slender wooden gutter, from thence to be directed to a mixing vat in the still-house.

The expence of the filter may still further be lessened, by omitting the screw-bolts; because extreme accuracy in setting the bags, in regulating the distances of the filtrating surfaces, and in the expression of the last portions of sweets from the loaded and clogged bags, is here unnecessary; and the frames may be pressed home sufficiently by an handspike, and may be stayed in the requisite position, by wedges advanced as room is gained between the angles of the frames, and certain notches or spurs in the cross-pieces on which the frames slide above, and in two similar cross-pieces serving at the lower angles.

Any carpenter who will take the trouble to look at any of the machines built according to these diagrams, and who will observe that the moveable frames do not touch the screw-bolts, will readily perceive how he may regulate and stay the frames by wood only, in the manner last mentioned.

The expence of a filter thus reduced and simplified, scarcely deserves notice; and, not to descend to things too

too minute and trifling, we may say, that none of the inconveniencies which will be mentioned hereafter, as belonging to the filtration for the teaches, have any place here.

In appreciating the advantages and disadvantages of the filtration of liquors, of inferior or bad quality, we are, on the grounds already mentioned, to state that, according to the nature of the juices, and the mode of charging, yawing, and skimming, what is thrown with the scums to the still-house, amounts, at a mean of the smallest and largest quantities, to about one-tenth of the whole of the saccharine matter.

This is but little different, as we have shewn above, from the proportion by which the quantity of sugar can be augmented, by working into it all the filtrated sweets of the scums: And we may fairly state the gain in sugar, by filtration, in the case last expressed, to be, at a mean, one hogshead for every nine attainable in the customary process.

But this is not the only gain by filtration; for it can undoubtedly augment the market price, and lessen the loss by leakage, in transportation: But to what extent, we cannot as yet ascertain.

We know that, when the filter is applied at vessels, which boil slowly, by reason of the bad construction of the furnace; and which cannot quickly restore the lost temperature to the filtrated juice; the time of the transition of the cane-juice to sugar, is lengthened: When the filtration is desultory, there is an unnecessary loss of temperature, and consequently of time, in the recovery of it: When, instead of running the filtrated liquor at its greatest heat, directly into the boiler or teach, it is detained to spread to the whole of the broad bottom

bottom and sides of the leaded trough, and to be delivered, after cooling considerably, into the boiler, by charges of 20 or 30 gallons each; when an unnecessary quantity of liquor is left in the sieve-trough, and in the upper cistern, and is contained in bags set with wide intervals of the fluting; there is an additional delay by cooling, and an improper augmentation of the quantity of liquor, *in transitu*, from the mill to liquid sugar: When bags are kept at work for 24 hours or longer, until the influx and efflux ceases, in some parts that are clogged, and the liquor there takes damage by delay: When, finally, there is a concurrence of many or all of these circumstances, the sugar may be very clean, and yet it may be doubtful whether it has not suffered in the grain; because, the utmost perfection of the grain is not attainable, under any considerable increase of the quantity of liquor in hand, or of the time between the expression and the reduction to sugar.

Rejecting the doubts which have nothing for their foundation, but the mere abuse of the machine, we are to advert to the circumstances in which the abstraction of the filth by filtration, must necessarily improve the sugar of juices of mean or bad quality.

When the extent of filtrating surface is no greater, than is necessary for maintaining a constant and sufficient efflux into a third teach, or thereabouts; when no more liquor is kept in the sieve-trough, than is necessary to prevent the pump from sucking air, nor any more in the upper cistern, than serves to keep the vertical leaden tube full; and when the capacity of every filtrating bag is made as small as it may be, consistently with the free influx of the liquor, between faces almost touching by the pile, the quantity of liquor kept at any instant, out of the ordinary

ordinary courſe of working, by a ſyſtem that has two fires or three, is generally about twenty gallons, for the firſt half of the time of filtration by the ſame bags; and, for the remaining half, gradually increaſes to about thirty gallons.

The whole quantity of liquor *in tranſitu* in ſuch ſyſtem, in the cuſtomary method of working, is about 1200 gallons; and the application of the machine makes it 1220 or 1230: Such trivial difference occurs hourly in the inequalities of the charges, and the advancement from one veſſel to another; and cannot be reaſonably ſuppoſed to affect the grain of the ſugar ſenſibly.

There is indeed nothing in filtration, except the prolongation of the time between the expreſſion of the juice and the tranſition to ſugar, that can operate towards weakening the grain: And it is only the delay, under the abuſive practice above deſcribed, and the attempt to filtrate liquor of exceſſive ſpiſſitude, that has ever ſenſibly injured the grain: For, when the filtration is properly conducted, and the veſſel which receives the filtrated liquor is competent to quick work, the delay is made only at this veſſel of the whole ſyſtem; and, in regard to the work of all the veſſels, is as the difference in evaporation, between boiling about 150 gallons of the 1200, with mean velocity, and boiling the like part of 1200 gallons, rapidly: For it is to be obſerved, that although the capacity of the veſſel ſhould be 200, not more than 150 can be retained in quick boiling. To reduce this relative meaſure to poſitive, we may aſſume, that this veſſel holding $\frac{1}{8}$ of all the liquor on the fires, and *in tranſitu*, does perform one-eighth of the evaporative work of the whole ſyſtem, in the ordinary proceſs for making ſugar: And, for the juices now under conſideration,

conſideration, we may aſſume the kind which may furniſh ſkips at intervals of ſixty minutes.

Suppoſing then, that the evaporation of the charge of 150 gallons, were to ceaſe entirely for the time of the ſkip, this time would be longer, by one-eighth of ſixty minutes, and would extend to 67½ minutes: Or let this evaporation, inſtead of ceaſing, be leſſened to one half; and then the time of the ſkip will be 63¾ minutes. The delay belonging to each ſkip, by reaſon of filtration, will be 3¾ minutes; and the delay belonging to an hogſhead of ſugar, will be about 22½ minutes.

In working inferior or bad juices, there is no experienced planter that would not gladly give theſe 22½ minutes, to be ſecured, for twice the uſual time, from the black incruſtation of the teaches, which requires that the whole of the proceſs ſhould be ſtopped, and the furnaces chilled, whilſt the negroes are employed in ſcraping and ſcouring the blackened veſſels: And no man of obſervation will find any reaſon to doubt, that the veſſels work twice the longer without being blackened and incruſted; when the filter prevents the herbaceous dirt from paſſing on to be charred in the great heat of the ſecond and firſt teaches.

However forcibly we may endeavour to inculcate the advantages of rapid boiling, with the ſmalleſt quantity of liquor *in tranſitu*; the moſt ſtrenuous advocates for the practice, will never be able to prove that in working juices, which cannot afford a ſkip at ſhorter intervals than ſixty minutes, in the beſt ſyſtems of veſſels, the difference of 3½ minutes for each ſkip, can make any notable difference in the grain, to countervail the unqueſtionable

queſtionable improvement which filtration makes, in the clearneſs, colour, and curing of the ſugar.

The refiner will look to his own ſkill and intereſt, in his valuation of filtrated and unfiltrated ſugar, from the ſame juice; but the conſumer of Muſcovado ſugar will undoubtedly chooſe the cleaneſt; and no man, who contemplates the proceſs of curing or of drying the ſugar, by the mere drainage of the melaſſes, can doubt whether the cleaneſt ſugar cures the beſt, or whether the beſt cured will loſe the leaſt, by drainage and leakage, in the tranſportation.

The moſt eaſy and ſatisfactory compariſon of filtrated ſugar, with the unfiltrated, of equal juices, in regard to the cleanneſs, is made by diſſolving a quarter of an ounce or an half ounce of each, in half a pint of water, in a drinking glaſs, to repreſent the quantity generally uſed to make liquors palatable: The difference in the cleanneſs of the ſolutions will appear greateſt, in ſugars made from the worſt juices.

Of the leſſer advantages of the filtration of ſuch juices, we need mention only two. By preventing the filth from paſſing forward to the ſecond and firſt teach, where it is apt to be charred by the greater heats of boiling ſyrup and fuſed ſugar, and to form black incruſtations, highly pernicious, we enable theſe veſſels to work for a double or triple time, before they require the ſcraping and ſcouring, which is always attended with a long interruption of the proper work of the boiling-houſe, and a great waſte of fire in the chilling of the furnaces.

Filtration operates alſo with great effect, to make the produce of night work equal in quality to that of the day; becauſe, the conſequences which uſually

follow the negligence of the negroes, in regard to yawing, ſtopping fire, drawing off, and ſkimming, by night, are prevented from affecting the ſugar, when the dirt is ſtopped in the manner deſcribed.

But, for theſe purpoſes, a bar muſt be placed, to prevent the negroes from forwarding any liquor towards the ſecond teach, without filtration: For, although the labour of pumping be little or nothing more than that of the ladling forward, and the ſkimming, which it prevents; they will not pump when they can ſafely avoid it.

The bar conſiſts of a piece of wood, locked by one end to the upright poſt of the machine, or to the frame which hangs the ladles and other tools; but not immoveably fixed; to which piece, ſlender laths, placed vertically, are nailed ſo cloſe to each other, as to make the labour of throwing forward through this grating much greater than that of pumping: Such a bar gives no impediment to the circulation of vapour, or the view of the teaches, or the ſkimming; and may be removed, when filtration for the teaches is not wanted.

In regard to any part of the ſcums of inferior or bad juices, which the planter may chuſe to depurate for the ſtill-houſe, the above-mentioned obſervations apply with double force; for, in ordinary work, the rum is the more debaſed and tainted, as the ſweets from the boiling-houſe are worſe in quality, and fraught with the greater quantity of filth.

If it ſhould be found expedient, at any future period, to work foul and waſteful Muſcovado ſugar into good ſugar, in this iſland, the planter may find another uſe of the filter, which has been ſuggeſted by Mr. Samuel

muel Vaughan, of St. James's; who, in reſpect to filtration, and other efforts of the author for improvement, has done all that might be expected from his well known zeal for the planting intereſt, and his diſtinguiſhed philoſophical knowledge.

Mr. Vaughan diſſolved and filtrated eight hundred weight of bad ſugar, and, from a black ſmall-grained, dirty, clammy ſubſtance, it was changed to a clean large-grained ſugar: Some of the ſame (he adds) or of a better quality, was diſſolved, and re-made, without the filtrating machine, but with every attention of lime, ſkimming, &c. and was not improved ſenſibly by the operation.

We are now to compare with the recited advantages, every expence and inconvenience of the proceſs of filtration for the teaches.

A machine made to this greateſt ſcale, in this iſland, under the cuſtomary charges for materials and workmanſhip, may coſt one hundred pounds, or ſomething more; but it might be made in Europe for one-fourth of this ſum: And this ſum, with what little might be allowed for wear and tear of the machine itſelf, is to be deducted from the deſcribed profits of the firſt year; but the trivial wear and tear only, is to be deducted, for the ſubſequent years.

For a bag made ſingle, of the deſcribed ſtrong villous undreſſed cloth, of the kind of double ſwanſkin, but fitter for this uſe, ſix yards, at about eight ſhillings each, would ſerve; and the cloth of the four might coſt about forty-eight ſhillings; and a ſufficient allowance is made for tape and making, in valuing the coſt of the bags at three pounds: But, ſhould they coſt twice this ſum, and require renovation at every crop, the ſum to

be deducted on this account, from the ſtated profits, would make only a trivial reduction of them.

Another ſimilar reduction may be admitted, on the ground of extra labour of a negro appropriated to the buſineſs of filtration; admitting that this is not balanced by the ſaving in labour at the ſtill-houſe.

But the moſt weighty objection and inconvenience, are founded on the loſs of temperature, in the paſſage of the liquor through the machine, and the conſequent extra expenditure of fuel: For the adminiſtration of heat is, generally, as the expenditure of the fuel in burning.

This expenditure may be calculated, by the rules for meaſuring quantities of heat or fuel, by the degrees of temperature, and the maſſes of the liquors; and, in this method of computation, the extra expenditure is found to be leſs, than we ſhall find by the following more popular eſtimation.

Seeing that the retardation above computed, is as the loſs of temperature, we can eaſily perceive, that the extra fuel uſed to reſtore the temperature, cannot be greater than the retardation; and, without entering into particulars which might ſerve to ſhew that it may be leſs; we may ſtate, that as the retardation is 1-17th of the whole time, the extra fuel will alſo be equal to 1-17th of the whole quantity, neceſſary for working without filtration, in the ſame ſyſtem of veſſels; provided, that in both caſes the ſcums are thrown to the ſtill-houſe.

When this is done, and the ſcums amount to one-tenth of the juice on the fire, the fuel neceſſary for heating ſuch quantity, from about 75 degrees to the boiling point, which ought to be taken at a mean of that of raw juice and that of the rich ſyrup, and which may not be ſtated lower than 213 degrees, is totally loſt; becauſe its heat paſſes uſeleſsly to the ſtill-houſe.

As

As the number of degrees, from 75 to 213 inclusive, is 138, this number is a relative expreſſion of the portions of fuel thus loſt: But, when the ſcums are filtrated into the teaches, at a temperatnre of 180 degrees, in judicious filtration, the difference between this and the boiling temperature, at the mean, is 33 degrees; and this number ſerves as a relative expreſſion of the loſs of fuel, as well as of temperature: And the portions of fuel loſt, in the filtration of 120 gallons of ſcums, or the tenth of the liquor in hand, is to that loſt in ſending them to the ſtill-houſe, as 33 to 138. So three-fourths of the fuel, neceſſary for heating 120 gallons of juice to the boiling point, are ſaved by filtrating the ſcums from the teaches, inſtead of ſending them to the ſtill-houſe. On this and other conſiderations, it may confidently be affirmed, that when the ſcums are worked for ſugar, the above-mentioned extra expenditure of mill-traſh, is leſs than 1-17th of the ordinary conſumption.

Where the traſh has been found, in the ordinary courſe of buſineſs, ſcarcely ſufficient for the boiling, it may be aſked, how are we to get this additional ſeventeenth or eighteenth of this fuel: But any one, except the author, might anſwer, the propoſed gains in produce ought to induce the planter to try, whether the improvements deſcribed in the ſubſequent pages, and regarding economical ſyſtems and workmanſhip, and the curing and management of mill-traſh, will not afford a competency of fuel: And, to guard againſt every poſſible diſappointment, theſe laſt mentioned meaſures may precede the uſe of the filter.

Nothing farther is now to be offered on this ſubject, except the following references.

Mr.

Mr. Vaughan's machine is uſed at Flamſtead, St. James's: The honourable Mr. Jones's machine is employed at Twickenham, near Spaniſh-Town: Another has been placed at Green-Caſtle, in St. Mary's, by Henry Hough, eſquire; who has firſt adopted, at Nutfield, the improvement in the traſh-houſe: At Holland, near the eaſtern end of the iſland, the honourable Simon Taylor has erected a machine, undoubtedly with views becoming his public ſpirit and opulence, rather than for any immediate or profitable uſe of it: For, in his ſpacious and lofty boiling-houſe, the preſent ſyſtems of veſſels were unfit for advantageous filtration for the teaches.

Engaged in the other ſubjects which follow, and at times diſabled by perilous ſickneſs, the author could not do more, in regard to filtration, than to ſpeak the acknowledgments which he now repeats; that, if a buſineſs of this kind could have been more advanced, without the aid of this publication, or of his perſonal attendance; or if he could have attended all that were willing to patronize theſe endeavours, he ſhould have the pleaſure of expreſſing obligations to many more gentlemen, than he has had the honour of ſerving, or mentioning on this occaſion.

Of IMPROVEMENTS *in* FURNACES, SYSTEMS *of* VESSELS, *and the* WORK *of the* BOILING-HOUSE.

IN the pages published in 1797, on these subjects, the author confined himself within the bounds of one system there described, for the introduction of many improvements, that are applicable in all: And the reader may perceive, that he gave priority to that system; not only on the ground of its fitness for most boiling-houses, but because it admitted that the same vessels might, with equal convenience, be worked either as clarifiers or as grand boilers; and because it gave the better chance of being speedily adopted by the advocates for clarifiers, as well as by those who should listen to the arguments in preference of the process by vigorous grand boilers.

Under this aptitude for either mode of working, by the same fires and vessels, and the facility of comparing them frequently, the process by grand boilers has obtained a decided preference; and now we may proceed to other systems, suitable to local circumstances, and different scales of work, but which admit no clarifier; and we shall not only amplify the former instructions, but add divers new improvements.

To avoid prolixity, it is expedient, in the first place, to describe certain particulars, by diagrams exhibiting merely the forms of the furnaces, and the arrangements of vessels: And, to supply what was deficient in the first part, for want of legible engravings, these diagrams must shew various ground plans, and central vertical sections.

For the advantage of the numerous references which may be made to it, the system in which an expanded

and

and heated mill gutter was first used, although with less confidence, and to smaller extent than it deserved, is to have priority.

Of the system of the honourable JAMES JONES, *near Spanish-Town, and the improvements.*

The dotted line A B, PLATE IV, and that which runs parallel to it, and near it, shew the course of the windward side-wall; the dotted line B C, and that which runs parallel to it, and near it, shew the course of the gable-wall; and the dotted line C D, and that which runs parallel to it, towards E, shew the course of the leeward side-wall.

The space bounded by the dotted lines, F G, G H, H I, I K, K L M, is that in which the stoker works, and in which the trash is deposited for his use, under an arched roof which covers the whole of this space: And, as these lines represent the inner faces of the walls, which support the arch, the dotted lines parallel to these respectively, and near them, shew the thickness of these walls.

The wall M L, is continued to K, but not before it has risen to leave an arched door-way, from L to K, to make a communication between the described space of the stoker, and another equal space on the right, belonging to another system equal to the present.

When hot clinkers are drawn out of the furnace, this door-way, L K, serves well to keep them apart from the trash, until they cool, and can easily be carried away.

The three large circular black spots, at N, O, P, respectively represent three teaches, and the larger circular black spot, between Q and X, represents an elevated cocked grand boiler, set to the flame which passes from the

the third teach, by the flue, of which the course and width are shewn, by the long white stripe R S: A slenderer white stripe, winding a little from R to T, shews the course and width of the waste-flue.

The white circular stripe, X U Q W, which encompasses the elevated cocked grand boiler, shews the interval for the passage of the flame around the grand boiler, to the cross-flue, which is represented by the white stripe, from X to Y: The square white spot Y, shews the place of the chimney-flue, and the like spot Z, shews the place of an unfinished chimney-flue, intended for another system equal to this, and adjoining.

The shaded circular stripe, which encompasses, and is concentric with the described white circular stripe, represents the circular side-wall, which surrounds the elevated grand boiler, every where but at X; where this circular wall meets the side-walls of the cross-flue, leading to the chimney.

In this circular wall, where the cock *f* passes through it, a niche is shewn, which serves to make room for the lever, which must frequently be used to turn the cock.

On the left of R, the large black circular spot *a*, *b*, *c*, *d*, represents a round bottomed grand boiler, set to a separate fire: The white circular stripe, which surrounds the grand boiler, shews the space for the passage of flame between this vessel and the circular wall, which space is much greater at the side *d*, than at the side *b*, *a*, for reasons which will appear hereafter.

At the side *c*, and in the direction *c*, *e*, *f*, a narrow white winding stripe appears, to shew the gutter by which the grand boiler *a*, *b*, *c*, *d*, receives a charge of cleansed juice, from the cock *f*, of the elevated grand boiler U, W, X.

This cock *f*, is made to point this way, towards the lower grand boiler *a*, *b*, *c*, *d*, in order that the deſcribed gutter may be ſhort and deep, to lead off the cleanſed juice in the ſhorteſt time, and with the ſmalleſt loſs of heat.

But, as the cock *f*, requires that a ſmall pier ſhould ſtand under it, to ſupport the cruſt of maſonry with which it ought to be covered, to the thickneſs of one or two inches; and as this pier, together with the incruſtation, ſtops up one-fourth or more of the depth of the circular ſpace, in which the flame ought to paſs, round the ſides of this cocked veſſel into the chimney, the great flue, R S, leading from the third teach, is continued with its arched roof under the cock-pier, to ſupport it, and to deliver the flame upon the bottom of the cocked veſſel, a little beyond its edge at Q.

As the flue, R S Q, opens by a circular mouth, to deliver the flame on the bottom of this veſſel, and impreſs it in a manner preſently to be deſcribed; and, as the circuit of the bottom reſts on the lips of this circular mouth, there is no avenue by which the flame can paſs, directly along the bottom of the veſſel, to the chimney.

But, for its paſſage around the ſides of the veſſel, in order that they may exhauſt it farther, by the longer courſe, lateral openings are made on either ſide of the cock-pier at Q; one extending between Q and U, to the right of the cock, and the other between Q and W, to the left; and, by theſe equal lateral apertures, the flame regurgitating from the bottom of the veſſel, paſſes by one half of its reſidue from Q U to X, and by the other half from Q W to X, and thence to the chimney Y.

The

The ſhaded irregular ſtripe running from K to Z, ſhews the courſe of the maſonry, which on this ſide bounds the teaches, and the ſpace around them, and the waſte-flue, R T, which runs directly to Y, under the great flue X Y, and ſeparated from it by an arched roof of nine inches in thickneſs; for a thinner arched roof would ſoon fail, by reaſon of the alternate action of the flame at its under and upper face: The like ſhading, on the left of the teaches, and their flues, ſhews the like maſonry.

The dotted lines which croſs the flue R T, to make a rectangular ſpot, midway between R and E, ſhew the place of the regiſter of the waſte-flue; and ſimilar dotted lines, to the right of theſe laſt, and croſſing the great flue, ſhew the place of the regiſter of this laſt.

The place of the mouth-piece of this teach furnace, is ſhewn by two lines; one of which ſlopes acroſs the end fire-wall, from N towards a point on the left of K, and the other from N, towards a point on the right of I, in the line I K.

The round-bottomed grand boiler, *a*, *b*, *c*, *d*, ſtands at the ſame level with the third teach, or a little lower, and at ſo ſmall a diſtance from this teach, as renders the ladling forward quite eaſy.

The white circular ſtripe, which encompaſſes the black ſpot repreſenting the grand boiler, ſhews the diſtance of this veſſel from its ſide-walls, and that its centre hangs greatly to the left of the centre of the fire-place.

Thus the chief part of the flame is determined to riſe on the ſide *d*, and to paſs through the narrowing ſpaces *d*, *c*, *b*, and *d*, *a*, to the croſs-flue, *a*, *b*, *g*.

Beyond *g*, the croſs-flue widens, to ſpread the flame

to the bottom of a ſhallow flat pan, repreſented by the large black quadrilateral ſpot, *g*, *h*, *s*: The courſe of the flue, from under the pan to the chimney, *i*, is ſhewn by the bent white ſtripe, *h*, *i*.

Similar ſpots and ſtripes being uſed to repreſent ſimilar things, lately expreſſed, the great circular black ſpot, between *m* and *l*, repreſents an elevated cocked grand boiler, ſet to its proper fire; the encompaſſing white ſtripe ſhews the circular flue, leading to the chimney by the croſs-flue, *l*. The narrow and bent white ſtripe, *k*, *e*, *c*, ſhews the courſe of the deep gutter, by which the cock, *k*, can deliver a charge of ſkimmed juice quickly into the round-bottomed grand boiler, *a*, *b*, *c*, *d*.

Although theſe elevated veſſels, which are uſed as grand boilers, but ſeldom require to be waſhed out, it is found convenient to provide gutters, whereby the dirt and waſhing water may paſs, by their cocks reſpectively, to the ſcum gutter: Therefore, there is a gutter leading from the cock *f*, by *e*, *n*, to *o*; and a gutter leading from the cock *k*, by *e*, *n*, to *o*, the ſcum gutter; but when the filth is to take theſe courſes, the gutter leading from *e*, to *c*, is to be ſtopped. Between *p*, and W, appears a ſmall ſemi-circular ſpot, ſtrongly ſhaded, which ſerves to ſhew the place of the ſcum baſon, whether fixed or moveable, which delivers from the bench downwards, by a wide tube, into the gutter *p*, *q*, *o*.

A ſimilar ſemi-circular ſpot, to the left of the cock *k*, of the elevated grand boiler on the left, ſhews the place of a ſcum baſon, which delivers over the cock by a bent tube, into the gutter *m*, *n*, *o*, provided it be a fixed ſcum baſon. But I prefer a moveable ſcum baſon, which allows the workman to change his poſt,

as

as the course of the vapour, or of the scum, may suggest.

The stripe bounded by dotted lines, and lettered *r*, *l*, *h*, *s*, *t*, shews the course of the gutters which lead in the cane-juice: The mill-gutter may deliver along *r*, *l*, *h*, into the quadrilateral pan, and thence may deliver by the gutter *s*, *t*, into this grand boiler: And the mill-gutter may deliver along *r*, *l*, *h*, to the quadrilateral pan only: And the charge of this, may turn by the gutter *h*, *l*, *u*, into the grand boiler next on the left; which may also receive directly from the mill, by the gutter *r*, *l*, *u*.

If the supply of cane-juice should cease, whilst flame acts on the quadrilateral pan, it is to be preserved from injury, by throwing in a pail or two of water, to cover the bottom, until the work of the lower round-bottomed grand boiler has ceased.

The place of a scum bason, whether fixed or moveable, to serve for the third teach, and also for the round-bottomed grand boiler, near this teach to the left, appears by the small circular spot at *w*, where there is a niche in the knee-wall beneath, for the scum tub, into which the bason delivers by a tube.

The quadrilateral white spot *x*, to the right of *w*, and in the course of the knee-wall, shews the place of an arched opening, by which the mason negro may easily enter, to clear out the flues, or to raise or lower the bar which ought to be across the flue, near *a*, *b*, at all times, except when the mason passes this way to cleanse or repair.

In the extent of the masonry, represented by this diagram, the intelligent reader may easily perceive, that a considerable part of it is superfluous: For instance,

it

it is not neceſſary that the houſing ſhould thus extend beyond the chimnies, nor any further on that ſide, than to cover the elevated grand boilers: It is alſo unneceſſary, that the houſing ſhould extend to the left, farther than to cover the elevated grand boiler on this ſide: It is moreover unneceſſary, and ineligible, that the elevated grand boilers ſhould be ſo far diſtant from the teaches: They ought rather to be nearer to each other by more than three feet; ſo as to reduce the length of the gutters to one half of that which now appears, and to bring the elevated grand boiler on the right, three feet nearer to the third teach, from which it receives the flame; and to bring the quadrangular veſſel alſo, three feet nearer to the ſource of its flame.

All this was attended to, in the original plan for the honourable Mr. Jones: But, as circumſtances preſently to be related, determined us to build according to this diagram; I have thought it better for the public ſervice, that the artiſts who may look to the building as a model, ſhould find it to correſpond with, and illuſtrate this deſcription: than that they ſhould be perplexed by any difference between the real and the deſcribed maſonry.

It is deemed unneceſſary to incur the expence of engraving the original diagram, becauſe a few remarks on this, will ſerve to ſhew the particulars in which it differs from the beſt plan.

Outſide of the leeward wall of the boiling-houſe, by the whole extent repreſented in the diagram, above C D, there was a building in very maſſive maſonry, on a bottom of looſe ſand, and it was deemed neceſſary for ſafety, as well as for economy, to uſe the old ſafe foundation, together with the whole building, which formerly

formerly houſed clarifiers; inſtead of erecting anew, on ſuch infirm ground, for the chimnies and piers of arches eſpecially.

The ſtate of the foundation of the leeward houſe-wall, and of the wall-plates, and of the principal timbers of the roof, rendered it inadviſable to break through this houſe-wall to any conſiderable width, or to ſubſtitute piers under the wall-plate; and therefore, the intervention of the houſe-wall, neceſſarily threw the upper veſſels three feet further from the lower grand boiler and the teaches, than they ought to be, and made the croſs-flues and gutters ſo much longer than they ought to be.

In deep gutters, diſcharging two or three hundred gallons of boiling juice in the courſe of a minute or two, I do not think the loſs of temperature, in the ſtream of ſix feet, is ſo much greater than the loſs by a like ſtream of three feet, as to deſerve any great notice: And I hold the ſame opinion of the loſs of heat by theſe long flues, in compariſon with the ſhorter; but ſtill a preference is to be given to the ſhorter gutters and flues, were it only to ſave extent of maſonry, of plumbers work, of principal walls, and roof.

When the reader has conceived, that the elevated grand boilers ought to ſtand nearer to the teaches, by three feet; and that the leeward wall, next the chimnies, ought to run cloſe by the elevated grand boilers, he will readily find, by meaſuring on the diagram, that a breadth of 39 feet, between the windward and the leeward ſide-walls, is ſufficient for the houſing of two moſt eligible ſyſtems, ranged by each other, and admitting the uſe of pillars, to aſſiſt in the ſupport of the roof.

In

In like manner, he may find, that for housing two such systems, a length of fifty-two feet is sufficient; and this, by the specified breadth, gives a clear area of 2028 square feet.

In any other position of two systems of such capacity and power, the building necessary for housing them, conveniently for work, must be much larger, and the quantity of masonry within, must also be greater.

As the annoyance from vapours, rising at the centre of the house, is undoubtedly greater than when it rises by the leeward wall, it cannot be for the workman's convenience, that the arrangement across the floor should be preferred, and I see no weighty reason for the preference, except that of saving expence.

When the housing is as small as this arrangement across it will permit, there is a consistency between the reason and the execution: But there is no such consistency, in extending the elevated housing to cover not only the area above described, but as much more as the coolers occupy.

The height of roof which is convenient for the boiling-house, and the massive walls necessary for such height, are by no means necessary for the place of the coolers; which, if they be properly set, perform their office perfectly, under a slender and low shed.

When the second system is added to that already built, some of the four coolers, which each system will fully employ, must be placed in a shed, and not as they now lie in the described house.

Plate V, figure 3, exhibits a central vertical section, by which the elevation of the vessels and masonry may be seen; the shaded parts serving generally to represent masonry.

The

The shaded stripe, C D, figure 3, represents the crown and the thickness of the arch, serving to cover the stoker's trash, outside of the house-wall A; and E C represents the crown of the arch, where it covers the stoker within the house-wall, and at a smaller elevation than that of the crown outside of the house-wall; in order that the floor, between the teaches and the wall A, may not be too high.

The ground under the point D, being high, the floor of this arched way, sloped downwards, from F to G; and at G, was left a passage for water to run, under the stoker's floor I G, along the dotted foundation line, running from below G, to H.

The semicircle concentric to K, shews the elevation of the first teach, above the grating-bars; and the course of these is shewn, by the horizontal rank of 12 small quadrilateral figures, between L and N.

In the shaded vertical stripe E N I, a white break appears at N, to shew the place of the fire-door, opening to the stoker's arch-way. As the whole of this furnace may be cleansed by a long raker, introduced through the large fire-door, it requires no apertures at the sides, such as are necessary to some other furnaces.

The curved line, L M, shews the course of the central line of the bed of the furnace: At L, and under the second teach, this bed is represented ten or 12 inches higher than the fire-bars; for otherwise, the trash forced in from N, towards L, would pass over the bed injuriously, as has been shewn in the FIRST PART.

At M, the bed L M slopes upwards and around the bottom of the third teach, into the cross-flue, M P, measuring 23 or 24 inches in height, by 21 or less in breadth: And it is here, on the left of M, that this

flue ſhould be barred with two or three courſes of bricks, laid endwiſe acroſs it, and without mortar, in order that the barring may be varied at pleaſure; or may be removed, whenever it is required that a workman ſhould paſs this way, to cleanſe or repair.

The white ſtripe, M O Q P, ſhews the courſe of the croſs-flue, from the bed of the furnace, near M P, to the bottom O Q, of the elevated grand boiler, repreſented by the concentric lines within the ſpace Q O S T: And it is meant to ſhew, that the flue widens to a circular mouth at O Q, to impreſs the flame upon the whole expanſe of the bottom of this veſſel, before it can paſs to the ſides: For the ſhading, which repreſents maſonry, ſhews, that the border only of the bottom, to the left of Q, reſts on the circular lip of the flue on that ſide; and only a little more than the border of the bottom, to the right of Q, reſts on the circular lip, on this ſide, which is neareſt to the cock.

The white ſpot U, ſhews the circular flue on this ſide, and the like ſpot W, ſhews the circular flue, continued to where it opens on the ſide fartheſt from the cock, into the croſs-flue, W X, to the chimney-flue, X Y.

Between Q and U, appears a pier of maſonry, ſupporting there the border of the bottom, near the cock; and it is only by the lateral apertures on each ſide of this pier, that the flame, regurgitating from O Q, can paſs up to the circular flue U, and around the veſſel, to W X Y, the croſs-flue and chimney.

It is to be underſtood, that the cylindrical part of this grand boiler, is the mere cocked copper veſſel; and that the bevelled part above, near S T, repreſents the leaden curving.

In the flue W X, the cavity under X, is made to bury

bury the duſt which drops from the chimney-flue, and is apt to obſtruct the croſs-flue in a ſhort time, if no receptacle of this kind be provided for it: The aperture to the left of X, through the back wall of the chimney, is left for the purpoſe of cleanſing and barring; and is, of courſe, to be bricked up in ordinary work.

The diſtance between L, the bridge which prevents the traſh from ſpreading on the bed of the furnace beyond the fire-bars, and N at the fire-face, near the mouth-piece, ſhews the greateſt length of the fire-place, and of the aſh-pit below it, in the direction L N; and it is to be obſerved, that this length is greater than the breadth of the fire-place and aſh-pit, meaſured at right angles with the length, for the reaſons formerly ſpecified; And it is moreover to be obſerved, that the centre of the firſt teach, K, is not in the plumb-line of the centre of the fire-place, L N, but is ſix inches to the left of it, ſo as to make an interval of 14 inches between the wall, N K E, and the neareſt ſide of the teach K: The reaſon of which will be given preſently.

The circular line, *a*, *b*, *c*, ſhews the lower face of an arch, ſupporting the veſſel and flue above it, and ſerving to houſe traſh, for the grand boilers on this ſide of the houſe, and this arch groins, upon piers, at the height *a* and *c*, with a long arched way, extending from *d* to *e*: The line *d*, *c*, ſhews the ſlope of the under face of the crown of this long arch; and the thickneſs of the maſonry between the bottom of the furnace and of the flue, L M O, and the cavity of the arch beneath, is ſhewn by the ſhaded ſtripe, L M O, *b*, *d*, *e*.

Thus the expence of elevating the cocked grand boilers upon arches, is amply compenſated, by the

safest and most durable housing for the trash and fire-places on this leeward side. Thus also, the ash-pit under L N, opening by an arched way, shewn by the quadrilateral white spot *f*, *e*, below L, into the arched way *e*, *d*, *c*, *f*, which groins with the arched way *a*, *b*, *c*, saves a great deal of solid masonry, separates the bed of the furnace from the damp earth, and gives the most eligible avenue to the ash-pit of the teach furnace, and to that of the round bottomed grand boiler, which stands level with the teaches, but cannot be well represented in this diagram.

Now, if the reader will consider, that the registers, at R, and the gutters and cocks formerly described, cannot conveniently be used, without having some interval between them and the wall; and that, although the thickness of this wall should be only of two feet, between the teaches and the elevated cocked vessels, it will compel us to take an interval greater, by three feet, than would otherwise be necessary, between these vessels; he will readily perceive, that the distance of the elevated vessel, Q O S T, from the third teach, at P M, is greater by three feet, than would be necessary or proper if no house-wall, such as B, had intervened; consequently, that a diagram representing the original and best plan, would shew the elevated grand boiler, Q O S T, close to the register R; and would shew the whole masonry of this range of vessels, much shorter than it appears in the diagram before us.

These particulars are to be especially noticed, in any future references to this diagram, or to the masonry which it exhibits.

A leaden gutter, running in the masonry U Q P, delivers the cleansed juice from the cock, under U, into

into the curving of the third teach, above the arched flue M P.

The line *g*, which is the base of the wedge-like shaded spot above it, represents the distance of the third from the second teach, at the crown of the arch, under the saddle; and the spot itself shews the height and thickness of the saddle, from the fire-face beneath, to the top. In like manner, the line *h*, and the spot above it, are intended to shew the distance between the second and first teach, and the greater height of this saddle, to prevent the second teach from boiling over into the first.

The line *i*, *k*, shews the elevation and depth of the skipping-gutter, and the line *k*, *l*, shews the bottom and fall by which it delivers into a moveable wooden trough, placed under the leaden lip, *l*.

When the knee-wall has a height of about 24 inches above the floor, at the middle of the third teach, and the greater height which is necessary for the first teach, by reason of the greater height of its saddle; and it is duly considered that a greater height of the knee-wall, above the floor, greatly increases the labour of skimming and ladling forward, the floor will be level with the bottom of the first teach, or will be somewhat lower, along the whole length of the knee-wall.

It has been customary, in arrangements like this, across the floor of the house, to make the whole of the floor level, and consequently to compel the stoker to work from a ground much lower than I G, and to raise the trash as high as his head, which, to his great annoyance, meets the crown of his arch-way, at the height *m*, or near it.

This inconvenience, as well as the expence of housing the coolers in a very lofty building, may be seen in di-

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yers places: But it may eaſily be avoided, by building according to the diagram before us; which ſhews that the ſtoker may ſtand on the ground, I G, and work eaſily into the mouth-piece N, *m*, without raiſing the charge of traſh higher than his belly; and that the crown of the arch E C, over him, is ſo high above his head, as not to hurt him by its heat: And that to attain theſe ends, nothing more is neceſſary, than that the paſſage between the ſkipping-trough, *k*, *l*, and the houſe-wall at A, ſhould be higher, by two or three eaſy ſteps, than the general floor of the houſe. No inconvenience attends this elevation of the paſſage.

PLATE V, figure 1, repreſents a central vertical ſection of the round-bottomed grand boiler of this ſyſtem, and of the elevated cocked grand boiler, ſet to its proper fire.

The dotted line A B, figure 1, ſhews the elevation and fall at the ſaddle, over which the cleanſed juice is ladled from the round-bottomed grand boiler, C D A, into the third teach, on the ſide A B.

The ſemi-circular white ſpot, E, ſhews the elevation of the fire-door, and the ſmall quadrilateral ſpots ranged horizontally under E, ſhew the fire-bars and their diſtance from the bottom of the boiler, at D, and their height above the bottom of the aſh-pit, F G. As the ſhaded parts generally ſhew maſonry, the ſhading on the ſide, A H G, is broken by the ſquare white ſpot, G H, to ſhew that the avenue to the aſh-pit opens this way, or at leaſt that it does not open on the ſide of the fire-door, E.

The diagram ſhews that the vertical central line of the grand boiler, A I D C, is not coincident with the centre, E, of the fire-place, but is, according to the ſcale,

ſcale, about 12 inches to the left of the centre of the fire-place. It alſo ſhews, that the diſtance of the grand boiler from the fire-wall, on the ſide I, is twice greater than the diſtance on the ſide, D K, which is next the winding croſs-flue, K L. All this is neceſſary, in order that the flame may act advantageouſly on the ſide D I, of the grand boiler, inſtead of flowing by the ſhorter courſe, and with greater waſte, as it would otherwiſe do, from about E to D, and D K, the neareſt avenue to the chimney.

If the croſs-flue, between K and L, be duly barred, and the avenue, D K, be narrow as it is here repreſented, and the fire-bars and ſize of the fire-place be thus duly proportioned to the ſize of the grand boiler, there will be no more waſte flame from this ſingle grand boiler, than there would be if two grand boilers were ſet in the uſual manner, to a larger fire-place. For the interval, D K, may be conſidered as a narrow flue, preſenting its waſte flame advantageouſly to the half of the veſſel which lies on the ſide D K, whilſt the ſide D I, receives the firſt and chief impreſſion from the flaming fuel beneath.

In Mr. Grant's ſyſtem, hereafter to be deſcribed, as well as in this of Mr. Jones, the round-bottomed grand boiler, thus ſet to the fire-place, works excellently with a ſmall charge of fuel; and if, in ſetting two ſuch veſſels to one fire-place of greater extent, we make the ſtoker do more than he can with one grand boiler, we certainly make the furnace leſs fit for expeditious work; firſt, by increaſing the quantity of cane-juice *in tranſitu*; and ſecondly, by our being compelled to ſtop the work of both veſſels, whilſt we are evacuating or re-charging any one.

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But, where every thing must be subservient to the purposes of saving fuel and labour, as much as possible, in preference to that of making the best sugar in the greatest quantity, two grand boilers set to one fire, in the manner hereafter to be represented by the ninth plate, will best answer such ends.

The white stripe, M, is merely to shew a space which may be left empty, or may be filled with rubbish; or under which the foundation need not be deep or solid; because the masonry of the cross-flue L, is so light as to require no great care in regard to its foundation.

Plate V, figure 2, represents a central vertical section of the elevated cocked vessel, and its proper fire-place and masonry.

The figure slightly shaded, by means of concentric lines, and bounded by *a*, *b*, *c*, *d*, *e*, *f*, represents this vessel, and its leaden curving. The spot *f*, shews the circular flue on this side, opening into the cross-flue *f*, *g*; and *g*, *h*, shews the chimney-flue, which has its well under *g*, and its cleansing door to the left of *g*, as formerly described.

The ash-pit, fire-bars, fire-door, and fire-place, under the bottom of the vessel, *a*, *b*, being represented as heretofore, the diagram shews by what elevation and space the flame, beating upwards on *a*, *b*, turns by the lateral openings at *b*, into the circular flue represented by the white spot *b*, *c*, and thence winds around the vessel, to *f*, and thence passes by the cross-flue, *f*, *g*, up the chimney-flue, *g*, *h*, the height of which, above the vessel, is not regarded in this figure. It is for the purpose of shewing distinctly the course of the flame along *a*, *b*, into the lateral apertures near *b*, and thence into the

the circular flue, *b*, *c*, that the pier under that cock, at *b*, is not shewn in this diagram.

The line *i*, *k*, is the level of the stoker's floor, for working this vessel, whilst F G, figure 1, is the level of the stoker's floor for working the round-bottomed grand boiler: Or these respective floors of the stokers may be higher by the thickness of a pavement.

Of the shaded parts representing masonry, the side *i*, of figure 2, shews how much the foundation and lower parts of the chimney ought to exceed it in diameter, on this side especially. The white notch, at *l*, shews the place of the mill-gutters, and it is intended to shew the depth, with which this gutter turns through the curving into the cocked grand boiler, in the direction *l*, *c*. The white spot, bounded by the parallel dotted lines *b*, *m*, represents the cock of this vessel; the dotted line *b*, *n*, shews the bottom line of the gutter, and *o*, *n*, the upper edge of the gutter, which is continued in this course through the leaden curving, *n*, *c*, of the round-bottomed grand boiler, figure 1.

Where the cock passes through the masonry, a niche, such as is represented near *o*, on the left, is generally necessary, to make room for the lever to be employed in turning the cock.

PLATE VI is a ground plan, shewing, by the shaded parts, the thickness and extent of the masonry, a little above the broader foundation tier of Mr. Jones's system.

The undisturbed walls of the boiling-house are represented here, as in PLATE IV, by the dotted lines, A B, B C, C D, and the dotted lines within these, and near and parallel to them.

The shaded stripes E F, G H, shew the walls which

ſuſtain the great arch, which covers the ſtoker's traſh. The ſpace between G, and I, is a door-way of communication, arched above from G to I, and ſerving below to receive hot clinkers occaſionally: And, from the wall F K, to G I, where the wall H G is continued to I, over the deſcribed door-way, an arch covers in the narrower arched place of the ſtoker.

The break in the maſonry, K I, ſhews a paſſage left near the foundation, for a gutter to carry off the water, which the obliquity of the neighbouring ground muſt throw this way in heavy rains; the ſame break ſerves alſo to ſhew the courſe of the mouth-piece through this maſonry, at a greater height.

The white figure, L M, ſhews the aſh-pit, and the figure of the fire-place at the grating-bars; and the white interval, M N, ſhews the avenue to the aſh-pit, to be covered by an arch from the ſide M, to the ſide N.

The rectangular white figure, O N, ſhews the arched way under the bed of the teach furnace, to the aſh-pit, L M. From the ſame arched way, the aſh-pit, P, of the round-bottomed grand boiler, is acceſſible by its arched avenue, Q R.

In the baſement maſonry, there is no break at W, but it ſerves in the diagram, to ſhew the place of the mouth-piece, in reſpect to the fire-place P, and the aſh-pit avenue, Q R.

In order that the ſtoker might come cloſe to the mouth-piece, and its wall, U T, it was intended that an arched door ſhould be cut out of the houſe-wall, from U to T, to correſpond with the like arch, extending from the wall, S U, to the wall, T O.

It is adviſable thus to give the ſtoker the neareſt acceſs

ceſs to the fire-place, wherever it can be conveniently done; but, as it was inexpedient, in the preſent inſtance, to make ſo large an opening through the houſe-wall, a deviation was made from this diagram, by only continuing the bevelled aperture of the mouth-piece, through the houſe-wall, the outer face of which is in a line protracted from the line C D.

From the maſonry, on the ſide S U, to the maſonry on the ſide X T, an arch extends over the ſtoker's place, and this arch groins with the great arch which covers in the large area, *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, O, X, S, ſerving for the reception of dry traſh for two furnaces, which open to this area.

The part of *this* arch which covers *f*, *g*, *h*, O, ſuſtains the flues and maſonry of the elevated cocked veſſel, ſet to the flame of the teach-fire, and part of the floor around it; the part of this arch which covers *a*, *b*, *c*, *d*, *e*, *f*, O, ſuſtains the floor and gutters on the right and the flue of the lower round-bottomed grand boiler, and the quadrilateral flat pan, placed on this flue to the right, in a line parallel with U, S, *e*.

The quadrilateral ſhaded figure, *f*, *g*, is the baſement maſonry of the chimney, one flue, or half of which, ſerves the preſent ſyſtem, whilſt the other half, on the ſide *g*, is intended for a ſecond adjoining ſyſtem.

The avenue *f*, *e*, *i*, *k*, for the traſh carriers, is arched over to ſuſtain the floor above, and the back wall of this ſhed, which runs in the direction *i*, *k*.

The rectangular white figure, *l*, ſhews an uſeleſs ſpace, between which and *i*, *e*, is the broad baſement of the chimney on this ſide. The rectangular white figure, whoſe centre is at *m*, ſhews an arched place leading to *n*, the avenue to the aſh-pit, *o*; and the rectangular

break, *p*, ſerves to ſhew that the fire-door of this fire-place of the elevated cocked grand boiler, ſet to its ſeparate fire, opens to the ſtoker's ſmall arch-way or niche, *b*, *c*, *p*, and thence to the great arched area, *a*, *d*, *e*, *f*, *g*, *h*.

Between the leeward houſe-wall, running in the direction C D, and the outer face of the leeward or back wall, *i*, *k*, ſtood a large ſhed or outer building, erected for elevated boilers or clarifiers, and preſenting deep-founded maſonry of walls and chimnies; and requiring but little to be added or taken away, to ſerve according to the deſcription of this diagram; and this, together with the infirm ſtate of the houſe-wall, C D, was the reaſon for giving this baſement a greater extenſion, than would be otherwiſe eligible.

Syſtem for CHARLES GRANT, *eſquire, at Hopewell, St. Mary's.*

THE chief purpoſes in the conſtruction of this ſyſtem, were the following: Firſt, That two nearly ſimilar, ſhould be accommodated to the area and ſituation of the houſe; ſecondly, that the veſſels formerly in uſe ſhould ſerve; and thirdly, that the improvements hereafter to be mentioned, under diſtinct heads, and reſpecting duration, convenience, regulation of the draughts, and quick work with the ſmalleſt quantity of liquor *in tranſitu*, ſhould have fair trial, under a patronage ſo liberal and ſo weighty as that of Mr. Grant.

The ſtripe, A B, PLATE VII, ſhewing various ſhades and breaks, repreſents the breadth and courſe, and more than one half of the length, of the leeward houſe-wall. The rectangular lightly ſhaded ſpot, C D, in

the course of the leeward house-wall, shews the place of an high arched door-way, opening from the boiling-house on this side, to the new building or shed for elevated vessels, on the other side next the chimney. The ascent from the boiling-house floor, on this side of C D, to the floor of the shed on the other side, is by three steps, represented by three parallel and equidistant stripes on the side of C D, and near it: And it is to be understood, that the door, C D, and the described steps, are at the centre of the whole length of the leeward house-wall, A B.

As similar things are generally represented in these diagrams by similar means, the reader will easily perceive, that the three black circular spots, between E and F, represent three teaches; that the white space, immediately bounding these, defines intervals between the teaches, and between the teaches and the side-walls of the furnace; and that these last are shewn, as formerly, by the stronger shading.

The break, by the lighter shade, crossing the house-wall, and looking from *l*, towards the centre of the third teach, shews the place of an aperture for cleansing the bed of the furnace there: The like break, pointing to the second teach, shews the aperture serving here: And the larger funnel-like break, in the house-wall, near the first teach, shews the niche for admitting the stoker; and also the place of the mouth-piece, which opens, not to the vertical central line of the teach, but to the centre of the fire-place, which is at six inches to the right, as has been shewn in the vertical central section, PLATE V, figure 3; in which the teach K, appears hanging so much nearer to the boundary at N, than to the boundary at L, of the fire-place.

The

The white bent ſtripe, E G, PLATE VII. ſhews the flue of this furnace, leading to the elevated cocked grand boiler; which is repreſented by the great circular black ſpot, between G and H.

The manner in which the flue, E G, leads the flame to the central parts of the bottom of the elevated cocked veſſel, and in which the flame is made to return to the ſide of this veſſel, neareſt to G, and then to circulate around the veſſel, before it reaches the croſs-flue H, and the chimney-flue I; may be ſeen in the deſcription of the like parts of figure 2, and figure 3, of PLATE V.

The white bent ſtripe E K, PLATE VII, ſhews the courſe of the waſte-flue, towards K; and the concentric curved dotted lines, between K and H, point out the flexure of the waſte-flue, which is neceſſary in its paſſage to H, and the chimney I, in order that it may run in maſonry, completely ſeparating its cavity from that of the great flue, under this elevated cocked veſſel.

The lightly ſhaded quadrilateral ſpot at L, ſhews the place of an arched ſloping aperture, by which the flue, E G, is to be acceſſible, for cleanſing and regulating. The like aperture, M, is to ſerve for the flue O, P.

The dotted parallelogram below G, ſhews the ſituation of the regiſter of the great flue, E G; and the like figure, near K, ſhews the regiſter of the waſte-flue, E K.

The great circular black ſpot, between N and O, repreſents a round-bottomed grand boiler, ſet near to the third teach, and at the ſame level, or nearly ſo.

The ſaddle between O and E, is made ſloping, to drain any liquor that falls from the ladle, in throwing over, from the lip of the curving near O, to the mouth of the teach-curving near E. There is alſo a declivity

of

of this saddle, to drain any liquor that falls, to a line in the direction O E, to prevent any lodgement on the leaden cover of this saddle.

The white stripe, which encircles the grand boiler, N O, shews the interval by which the flame sweeps around this vessel, from the fire-place beneath, to the cross-flue O P P, and thence to the chimney-flue, Q.

The slightly shaded funnel-like spot, T W U, shews the place of the stoker's niche in the house-wall, and of the mouth-piece opening to the fire-place at W. And, as a mouth-piece always points to the centre of the fire-place, the contiguous parts of the diagram shew, that the centre of the fire-place is 10 or 12 inches to the left of the central vertical line of the grand boiler; in order that the flame may rise freely, and spread wide and high in the interval, on the side N, of the grand boiler; and may pass by a slender current, around the boiler, on the side O.

The diagram, PLATE V, figure 1, serves here to shew how much the fire-place of a round-bottomed grand boiler, such as this of PLATE VII, is made narrower than that of a teach furnace; and how fuel is saved; first, by making the side of the vessel next the flue, to stand, as it were, in the flue: For the interval D K, figure 1, PLATE V, is merely a flue, compensating by its width, for the smallness of the distance between the vessel and the fire-face of the furnace, at the side D K: Secondly, the saving is made by the smaller area of the cross-flue K L, the draught of which may be diminished at pleasure, by a bar of loose bricks, placed across at K; to which spot there is easy access by the arched aperture M, PLATE VII, serving for the flue O P.

Here it is to be observed, that in barring the flue at

O,

O, it is beſt to place the bricks with their ends pointing to the grand boiler, N O, and advanced towards it, ſo as to narrow the interval between them to three inches, and to compel the flame to circulate around the grand boiler, on this ſide, inſtead of flowing freely upwards from the fire-place, directly to the bottom of the flue at O.

Theſe latter particulars might have been mentioned in the deſcription of figure 1, PLATE V; but, as any waſte-flame there, is turned to good uſe; they were reſerved for this ſyſtem of PLATE VII, which has not yet a ſhallow rectangular pan on the flue, but which will eaſily admit of this improvement.

The white narrow ſtripe, R S, PLATE VII, ſhews the courſe of a gutter leading from the cock R, of the elevated cocked grand boiler, to the round-bottomed grand boiler, S N O.

As the deſirable celerity in the proceſs of boiling, depends, in a great meaſure, on the velocity with which the upper cocked grand boilers can be charged and diſcharged, the cock R is large, the gutter R S has a fall of an inch or more, and a depth of 8 or 9 inches at R, by a width of about 6 or 7 inches; and delivers at S, by a depth of 6 or 7 inches, and a width of 7 or 8 inches; in order that the liquor may flow rapidly from the cock quite open, without daſhing over the gutter.

As this cock muſt have a pier to ſupport the incruſtation which is to defend it from the flame; and as the lateral apertures, which are to turn the flame, from the central parts of the bottom of this elevated cocked veſſel, backwards and upwards into the circular flue, on the ſide of the veſſel neareſt to the flue E G, and

furtheſt from the avenue H, by which the flame eſcapes to the chimney; one of theſe lateral apertures is made on the left of the pier, near R, to a width of about 24 inches, by a depth of 7 inches.

In order that the flame may mount as well to the ſide of the veſſel, near K, as to that near R, a pier like that at R, is placed to meet and ſupport the part of the bottom of the veſſel, neareſt to K: And to the right of this pier, the ſecond lateral aperture is made equal to the firſt.

But if nothing more were done, in reſpect to an elevated cocked veſſel, whoſe cock points in the deſcribed direction, the flame could not riſe with ſufficient efficacy to the ſide of the veſſel, between R and K; becauſe this is out of the courſe of the draught which will naturally tend, by the ſhorteſt courſe, from the lateral aperture near R, to the place of exit at H, on this ſide; and by the like courſe on the oppoſite ſide, from the aperture at K, to the exit at H. Therefore, a lateral aperture, of about 12 or 15 inches in breadth, but ſhallower than the former, is made, between the crown of the arch of the great flue, G, and the bottom of the veſſel, to deliver flame upwards to the ſide of the veſſel next G; and to this part of the circular flue, which is moſt remote from the place of efflux at H.

The break, C D, through the leeward houſe-wall, A B, ſhews the place of a central door-way, opening from the great boiling-houſe to the ſmaller outer building, which houſes the elevated cocked veſſels: And the ſhaded and parallel ſtripes, near to C D, and below them, are intended to ſhew an aſcent, by two or three ſteps, from the boiling-houſe to the outer building.

As the fire-door of the round-bottomed grand boiler,

N O, is at W, the avenue to the ash-pit is on the side N of the ash-pit; and opens to a large arched avenue, which is common to the round-bottomed grand boiler, N O, and a similar grand boiler belonging to a similar set of vessels, in the same boiling-house, along the same wall, and to the right of the door-way, C D. The diagram shews a small part of this set on the left, and the distance of it from the set on the right.

Between these sets then, is an arched place, accessible by a door, under the door C D, and whose roof sustains that part of the floor of the boiling-house, which reaches from the masonry of the grand boiler on the right, to that of the grand boiler of the like system on the left. At this part of the floor, the quadrangular figure distinguished by parallel dotted lines, shews the length and breadth of the arched way beneath.

The quadrilateral figure, *a*, *b*, *c*, *d*, *e*, *f*, which is distinguished by transverse parallel dotted lines, serves to shew the clear length and breadth of an high arched way, serving to house trash and stokers for both systems, and to sustain so much of the floor of the outer house, in which the elevated vessels are placed: This arched way groins with another, whose clear area is shewn in like manner by the dotted figure *e*, *f*, *g*, *h*; and whose arch covers the trash and the stoker appointed to the post, T U; and also sustains the corresponding part of the floor above, belonging to the outer house.

A corresponding arched way, of which only a small part appears at *a*, *b*, belongs to the second system on the left.

In the outer house or shed, the elevated cocked grand boiler, X Y, is set level with that on the right. X being the farthest part of the sides, from the flue Y,

a small

a ſmall pier is placed at X, and the two lateral apertures are made on either ſide of this pier.

As the cock *i*, and the incruſtation upon it, leſſen the depth of the circular flue hereabouts, it is made as much wider, near the cock, as is neceſſary to compenſate for its deficiency in depth; and, where the circular flue approaches towards Y, the place of efflux of the flame, a ſmall bar is made at *m*, to equalize the diſtribution of flame, and the depoſition of duſt in the circular flue.

Whenever the cock and incruſtation of an elevated cocked grand boiler, tend to prevent an equal diſtribution of the flame, around the ſides of the veſſel, and by the longeſt courſe in which it may be applied to them, expedients of this kind are to be uſed; for the efficacy of the flame is as the extent, and alſo as the length of courſe by which the metallic ſurface preſents itſelf to the flame.

After the diagram, PLATE V, figure 2, and the deſcription already given of an elevated cocked grand boiler, ſet to its ſeparate fire, it is ſufficient now to ſay, that for this cocked grand boiler, X, Y, PLATE VII, the fire-door is on the ſide *e*, *d*, of the ſquare baſement maſonry, *d*, *e*, *h*; and the avenue to the aſh-pit is on the ſide *d*, Z; and may be on the ſide *e*, *h*, if it be bricked up ſo high that no cinders ſhall ſpread to the poſt, T U, of the ſtoker of the lower round-bottomed grand boiler.

Of the elevated cocked grand boiler laſt-mentioned, the cock *i* can deliver rapidly by a deep gutter, *i*, *k*, S, like that above deſcribed, into the round-bottomed grand boiler; or it may deliver filth and waſhing liquor, by the part *i*, *k*, of the gutter, to *k*, *l*, the waſte

gutter: And the course of the gutter R *k* S will shew, that the other elevated cocked grand boiler to the right, may, in like manner, deliver its cleansed charge rapidly into the round-bottomed grand boiler; or may deliver filth or washing liquor into the waste gutter, *k*, *l*; according to the use made of the stoppers of these gutters.

It is deemed unnecessary to offer a ground plan and central vertical section of this system; because the descriptions concerning the figure, height, and width of ash-pits, ash-pit avenues, mouth-pieces, niches, arches, flues, elevated cocked vessels, and their gutters, and divers other particulars exhibited in the fourth, fifth, and sixth plates, are applicable here.

This, or any system which serves to save the labour and delay of ladling forward from the greatest boilers, by a quick efflux of their charges to lower vessels, and which is contrived to afford the safest and most durable housing for the trash at the stoke-holes, by the same arched masonry which sustains the elevated vessels, gives ample compensation for the first expence.

It may easily be seen, in PLATE VII, that the intervening house-wall, A B, makes the distance between the vessels in the boiling-house, and those in the outer shed, greater by about three feet, than it would otherwise need to be; and that the vessel G H especially, might be set nearer to the third teach, and to the round-bottomed grand boiler, N O, if the original wall-plate and roof, over this place, had been laid so as to admit, that a wide arched aperture might be made through the house-wall, from *k* to *l*.

In working the elevated cocked vessel, G H, it is rarely or never necessary to close the great flue which leads

leads the flame to it: For it is sufficient that the waste-flue be opened to take off a part of the flame, for the short interval necessary for the efflux of a charge by the described gutter, and for the like influx of fresh liquor from another vessel presently to be described.

By a trivial alteration of the direction of the cock R, and its gutter, this system will admit a flat quadrilateral shallow pan, on the flue O P P, to serve like that at Twickenham, for the greater economy of the fuel of the round-bottomed grand boiler, N O.

The second system of Hopewell boiling-house, and the nearer to the grinding-mills, is similar to the first, in all things that claim any particular notice, except the following.

A vacant clarifier, of about 6½ feet in diameter, is set on a wide expanse of the flue of the round-bottomed grand boiler, at a height from which it can supply the recent and heated juice, by quick charges, to any boiler of either system: And the clarifier so placed, stands instead of an elevated cocked vessel, set to its separate fire, like that at X Y, in the first system.

To guard against the losses which might arise, from a stoppage of the work of the boiling-house, by the failure of some part of the equipage; and to accommodate the process to the fluctuating supplies from the mills, it is better to have two systems of mean power, than one that is competent to the greatest work which the estate can require.

A system of mean power is that, which employs a fire to work teaches in the reverberatory, and a grand boiler at the flue, in the advantageous and economical manner described in the FIRST PART, and in these later pages; and which employs another fire to work

work one or two grand boilers, which can ſupply the teaches with cleanſed and concentrated juice.

By the temporary arrangement above-mentioned, the maſon has reduced the ſecond ſyſtem at Hopewell, to the ſtate of a mean ſyſtem; and this deviation from the original plan renders it expedient, that the author ſhould ſhew how he would conſtruct a mean ſyſtem in this houſe, or in any boiling-houſe which requires that the teaches of two ſyſtems ſhould range in a line, along the leeward houſe-wall.

As Hopewell houſe can admit, that an arched aperture ſhould be made through the houſe-wall, at the ſecond ſyſtem, for the purpoſe of placing the elevated veſſels of the outer houſe, cloſer to the veſſels in the boiling-houſe; and as a deſcription of one of two ſimilar mean ſyſtems, which may ſerve, at the ſmalleſt extent and expence of houſing, may be highly uſeful in many places, the following diagram is drawn accordingly:

Of a mean ſyſtem, for a houſe admitting two along the leeward wall, and requiring only two fires for each ſyſtem, aided by an heated mill-ciſtern.

In PLATE VIII, the ſtripe A B, ſhews the courſe of the windward houſe-wall; the ſtripe A C ſhews a gable-wall; and C D ſhews the courſe of a perforated wall, or of walling and pillars, ſupporting the roof at the leeward ſide.

The line B E, or a parallel line to the right or left of it, is to be conſidered as the midline of ſeparation, between the ſyſtem of veſſels to the left of D, and another ſuppoſed to be perfectly ſimilar, and to the right of D.

The

The diſtance between theſe ſyſtems will, of courſe, depend on the length of the boiling-houſe.

The teaches, their ſide-walls, the apertures for cleanſing and barring, the ſloker's arched niche, the place of the mouth-pieces, the flues, the elevated veſſels, the gutters, and divers other things, are repreſented by the means adopted in former diagrams; and nothing is neceſſary here, but to advert to the following particulars.

So long as the elevated cocked veſſel, W F, is uſed as a clarifier, little or no flame or fire paſſes beyond this veſſel, by the flue F G, more than is neceſſary towards the maintenance of the draught of the chimney-flue G. For the ſpace and fire-face around this veſſel, is not only deprived of the flame during the time of charging and diſcharging the juice, and the time of waſhing out the filthy bottoms; but is chilled by the great expanſe which the emptied veſſel then preſents to the open air: And even whilſt the flame acts in this ſpace, and on this fire-face, they are prevented by this extent of metal, cooled by the crude juice, from conceiving the heat which they would, under other circumſtances, ſoon acquire.

It is then in this particular uſe of the elevated cocked veſſel, that the obſervations of the FIRST PART of this work are ſtrictly applicable, in reſpect to the expediency of keeping the chimney-flue duly heated. But when a veſſel thus ſet, with the utmoſt advantage, to the flame of a teach-fire, is uſed only as a grand boiler; when the flame acts in the ſpace, and on the fire-face around it, inceſſantly, or with very little interruption; and when the heat here accumulates, as the abſorption

abſorption by the boiling charge abates; then this extenſive fire-face becomes red hot, and flame paſſes beyond the veſſel, in much greater quantity than is neceſſary for maintaining the draught of the chimney: And, in this caſe, the ſurplus may be very uſefully employed, in heating the crude juice now gathering in a ſhallow pan, to the amount of a charge, capable of repleniſhing an evacuated boiler quickly, and of yawing in ſix or eight minutes, where the cold juice could not be yawed in a double or triple time.

By the obſervation of theſe and other things, when veſſels, firſt uſed as clariſiers, were afterwards generally employed as grand boilers; and by the obſervations made at Twickenham, where the deſcribed long ſhallow flat veſſel was firſt tried; I am now perſuaded, that great advantages may be attained, by making the flue F G, or a longer flue, to widen from F, ſo that the flame may ſpread by a ſhallow channel, on the whole bottom of a quadrilateral mill-receiver, as long as this repreſented by the large quadrilateral black ſpot, between F and G, or much longer: And I am of opinion, that a veſſel which thus keeps only one of the four ſides of the croſs-flue cool, will not deaden the draught of the chimney, unleſs it be made unneceſſarily long and wide.

Where the fall is ſcanty, this laſt mentioned veſſel will neceſſarily be a mere expanſe of the mill-gutter, and the lips and bottoms of both will correſpond in elevation.

The method of making ſuch ſhallow pans at a very ſmall expence, of thin copper ſheets; of preventing them from bilging by heat, or by the tread of negroes; and of preventing the inconveniences which might ariſe from

from the alternate expanſions and contractions of metallic plates of great length; will be deſcribed under the head of the NINTH PLATE.

The large circular black ſpot, I, H, K, repreſents a round-bottomed grand boiler, which is ſet level with the teaches; or which may be ſet a few inches lower, if the ſcantineſs of the fall from the mill ſhould require it. At this diſtance of the grand boiler from the the third teach, the ladling from one to the other is quite eaſy; for the curvings of theſe veſſels bevel towards each other, ſo as to make the ſummit of the ſaddle between them ſufficiently narrow.

If a cloſer approximation of theſe veſſels to each other ſhould be required for a ſhorter houſe, nothing hinders the round-bottomed grand boiler to be ſet nine inches nearer to the third teach; for the maſonry between them will ſtill be thick enough.

In the great circular black ſpot, which repreſents this grand boiler, appears a difference in the deep ſhading, between H I, and K. This difference together with the circular dotted line on the ſide H I, is intended to ſhew how the grating and the mouth-piece beneath, ſtand in regard to this veſſel; and to ſhew that the central vertical line of the grand boiler, is nearer to the flue K, by 10 inches or a foot, than the centre of the grating. This poſition of a round-bottomed veſſel, in regard to its fire-place, is more diſtinctly ſhewn in PLATE V, figure 1; and the reaſon for it appears in the deſcription of that central vertical ſection, at page 79.

As the mark for the ſtoker's niche, is not ſo diſtinct in this diagram as in the former, it is neceſſary to obſerve, that the quadrilateral white ſpot, M L, ſerves to

ſhew the place of this niche: The white quadrilateral long ſtripe K N, ſhews the courſe of the croſs-flue, which paſſes over the ſtoker's niche, and widens in its courſe from K where it receives the flame, to N where it runs under, and opens to the bottom of an expanded mill-gutter, or mill-receiver, repreſented by the great black rectangle, between N and O.

For the reaſon formerly mentioned, the greateſt length and breadth that can ever be advantageouſly choſen, is given to the expanded mill-gutter, N O: But it is not adviſed, that it ſhould conſiſt of one veſſel of this great length: For every uſeful purpoſe of ſuch a veſſel may be more conveniently anſwered, by ſetting two quadrilateral flat pans to make the rectangle. In this caſe a flat iron bar, of one inch in thickneſs, is to be placed acroſs the flue, where the pans meet; there to ſuſtain their bottom borders, and any mortar or ſand which may intercede the neighbouring ſides: In this caſe alſo the gutter, which is to communicate the juice from one pan to the other, is to have a width of four or five inches, and its bottom flat and level with that of each pan.

Where the fall will permit, a better method ought to be adopted. The pan furtheſt from the fire, or any pan neareſt to the chimney, ought to be ſet ſo high as to deliver its juice into the lower pan, above its lip; or at ſome height above its bottom.

The gutter which is to lead a charge from a rectangular pan, into the cocked grand boiler, ought to be wide, as formerly repreſented, and ought to be made at that part of the pan which is neareſt to the curving of the cocked grand boiler.

Thus the juice would run from the mill, upon the bottom of the pan placed between F and G: Thence it would

would run by a short gutter into the pan near O; and from this it would fall by a short gutter into the deeper and contiguous pan near N; and, by a gutter from the nearest part of this pan to the masonry of the cocked grand boiler W F, it would run quickly into this vessel, on the removal of the stopper of this last-mentioned gutter, in order to re-charge the cocked grand boiler.

The arched masonry sustaining the elevated vessels, and housing the stokers and their trash, is the same here as it is at Hopewell; or as it will be, when the stoker at the teach-furnace is housed by an arch, as it was intended. But, to illustrate this, the stripe C Q is drawn to represent a pier-wall of this stoker's arch; the course of its second and parallel pier-wall, being shewn by the stripe R T; at which last, the stoker's arch groins with another arch, which runs from R, T, to the right, and to groin with the arch over the place of the stoker of the round-bottomed grand boiler.

The area C Q, T R, distinguished, as formerly, by parallel dotted lines, shews the extent of the floor of the teach-stoker's arched place, and that this arch turns from C Q, to T R, and opens outwards between the wall C Q, and the wall T S. The area distinguished by parallel dotted lines, to the right of S T, shews the extent of a place arched from the wall at S G, to the wall at T F, to save masonry and enlarge the place of trash: For this arch groins with the arch W, X, Y, U, on the right.

The area marked by dotted lines, so far as this diagram will permit, to the right of R T, shews the place of the arch which groins with the arch of the teach-stoker on the left, and with the arch of the grand-

boiler ſtoker on the right; and the area covered by this latter arch is ſhewn, by the quadrilateral figure, and parallel dotted lines, within U W X Y.

In this arrangement, which is highly eligible, for the proximity of the veſſels, the ſhortneſs of the gutters and flues, the extenſion of the rectangular pans, and divers other advantages; the leeward boiling-houſe wall, C D, muſt be perforated at the level of the flues where they point athwart it; and the width of this perforation muſt not be leſs than 10½ or 11 feet; or, two arched perforations muſt be made to the width of about five feet each, on either ſide of a middle pier, which ought to be near W, and clear of the flue there.

It would confound the other objects exhibited at W, if any mark for a pier or pillar were made there: But near C, a circular ſpot, inſcribed in a darker ſquare ſpot, is ſhewn; and the like appears at D, in order to point out the intermediate central line, in which a pier or pillar is to ſtand, near W; and in which the deſcribed apertures are to give the workman eaſy acceſs on all ſides, to the cock of the elevated veſſel, and to the regiſters and gutters.

The avenue from the boiling-houſe to the outer ſhed, is to be between the two ſimilar ſyſtems, as it is repreſented in PLATE VII, at C D: And the workman will have the extent of floor, between the dotted line S R, (which ſhews the inner face of the ſlender ſide-wall of the outer ſhed) and the elevated cocked veſſel; and between the ſame ſide-wall, and the next ſhallow quadrilateral pan; in which extent he can take the poſt at which he is leaſt annoyed by vapour, or can moſt eaſily catch the ſcum. And the avenue to this place may be acroſs the flues, if there be no pier at W: Or acroſs

at

at O, on a board laid there, over the colder ends of the pans, where there is no danger.

The diagram shews a large interval between the shallow quadrilateral pans and the chimney; and this interval is necessary: For the flues G, and P, are here represented as being bounded by walls of only nine inches in thickness; and so indeed they are at the height of 12 or 18 inches above the pans. But at the pans, and where the apertures of the cross-flues tend to weaken the chimney-walls, these have a thickness of 15 or 18 inches, and spread into the described interval, towards the pans: And, whenever it is necessary to lay a gutter in this interval, to convey juice from the mill, directly to a second system on the right of this, the interval between these pans, and the flues of the chimnies, must be still larger.

The area bounded by the boiling-house walls B A, A C, C D, and the central line B D, across the floor, measures, according to the scale, 29 feet; and this competent breadth of the floor, between the windward and the leeward walls, is less than fifteen feet: A house, therefore, 15 feet broad by 58 long, in the clear, would be fully sufficient to house, with a roof of proper height, two such sets of teaches and contiguous round-bottomed boilers: And an house of this small breadth would cost much less than the broader usually employed; and the ventilation of it would be better, as the proportion of the heighth to the breadth is greater.

A boiling-house of almost twice this breadth by the described length, would be requisite, if the coolers were to be laid within it, in the position which contributes best to the largeness of the grain of the sugar; which position will appear in the Ninth Plate. But, according

according to the economical and commodious plan, now in view, the coolers ought to be placed in a slender cheap shed, reared to the wall A B, or to the wall A C; affording due ventilation; and receiving the liquid sugar by one straight short trough, which is the least apt to gather clots without grain or capacity to rid the melasses.

The clear area of the outer shed, between the nine-inch wall on the side S Y, and the boiling-house wall C D, measures 16 feet 8 inches: And, between the nine-inch wall at S R, and the midline D E, of two systems, it measures 21 feet 9 inches. The outer housing then, for two systems, measures in the clear 43 feet 6 inches in length, by 16 feet 8 inches in breadth. The arches which support this outer shed, may be made of bricks set edgewise, and need not any deeper set, unless the bricks be very soft. The expence of these arches, which house trash, and avert the danger of fire, properly belongs to these purposes: And but little expence attends the slender weather-walls and roof of this low shed, which serves just as well as any loftier and more expensive house, for these vessels; some of which evaporate little or nothing; whilst only two evaporate into an expanse of 43 feet 6 inches, by 16 feet 8 inches, not constantly, but during the boiling there.

It has been the disadvantage of every system hitherto constructed with a view to economy in fuel, that in proportion to the advance made towards the accomplishment of this purpose, the quantity of liquor, *in transitu*, has been increased injuriously: But, in the system of PLATE VIII, for the described clean and quick work, by small charges, which will be found the best

in

in every point of view: a quantity of liquor, *in tranſitu*, not exceeding 800 gallons, will ſuffice for all the veſſels except the expanded mill-gutters; in which the detained liquor fluctuates between twenty gallons, and 200; and may ſometimes ſwell to 800 gallons.

From what has been already experienced in Hopewell ſyſtem, in which the fire-place of the round-bottomed grand boiler is much ſmaller than that of the teaches, it may be fairly preſumed, that this ſyſtem of PLATE VIII, if not yet competent to the work of twenty-four hogſheads of ſugar, or of more, from good juice, in a week, may be made competent to it, by enlarging the fire-place of the round-bottomed grand boiler, to equal that of the teaches.

It will be no eaſy buſineſs to deviſe any ſyſtem for two fires, that will ſerve better than this, to make ſugar quickly, and cleanly, with a ſmaller quantity of temper, a ſmaller quanty of juice *in tranſitu*, and with greater economy of fuel.

If the rectangle N O, conſiſt of two flat pans; the pan N, next to the grand boiler H I K, may be conſidered and uſed as a grand boiler; and then we ſhall have three grand boilers, namely, the cocked elevated boiler W F, the round-bottomed grand boiler H I K, and the quadrilateral boiler N.

The two ſhallow quadrilateral pans, next the chimney, will heat the juice as faſt as it arrives from the mill, to make a charge. The pan at N will receive this charge, without requiring any ſtoppage of the flame, during the efflux of its former charge, or the influx of this: The charge may be detained here, for tempering, yawing, and ſkimming; or it may be paſſed on ſooner, if it ſhould be wanted in the cocked

grand

grand boiler W F; the ſhortneſs of this paſſage preventing all loſs of temperature. When the charge of W F has been further cleanſed and concentrated, it will run rapidly by a ſhort deep gutter in warm maſonry, and with the leaſt loſs of temperature, into the round-bottomed grand boiler H I K; and any fragments of unſlacked temper will remain in the upper flat-bottomed veſſel, or in the cocked grand boiler. The charge further evaporated and ſkimmed in the lower grand boiler, will be ladled into the third teach; which thus will receive nothing but what is clean, and ſo hot at the boiling point of inſpiſſated juice, as never to check the work of the third teach; as poorer boiling juice would do inevitably.

In this way of proceeding, much leſs than the uſual quantity of temper ſerves: For juice thus heated, at the moment of expreſſion, by running into pans or liquor previouſly hot, is quickly diveſted of the elaſtic acidulous gas or air, which ordinarily engages a part of the temper, and turns it to the nature of whiting or powdered chalk. In this way, there is the ſmalleſt interruption of the action of the flame, and the ſmalleſt or no loſs of temperature once acquired: There are four ſtages of depuration in diſtinct veſſels, which prevent the mixture of any crude foul liquor with the enriched and cleanſed: The utmoſt force of the fires is applied to the enriched liquors, which require the greateſt heat for their boiling temperature, and which may be boiled with the utmoſt celerity conſiſtent with perfect cleanſing: And the reſiduary flame, after ſerving two elevated veſſels employed in the firſt depurations, is exhauſted on thoſe which, by heating the crude juice reduce the time of yawing, to one half or a third of that which would otherwiſe be expended.

Formerly

Formerly it was feared that this heating, vulgarly called ſcalding the juice, before the temper has been uſed, might be injurious: Now it is known to be highly uſeful, when this heat is immediately acquired. Formerly it was alſo apprehended, that the extenſion of the juice, to a ſurface uncommonly large and expoſed to the air, might be hurtful; but now it is apparently by time, and not by extenſion of ſurface to the air, that the juice takes damage. In reſpect to cleanſing, the deſcribed ſhallow veſſels have a great advantage over all others; for they never burn to, and the looſe dirt may be wiped away at every evacuation, and whilſt the flame acts on them with the uſual force.

To reſerve other particulars of this ſyſtem, for diſtinct heads which will ſerve for all, I ſhall conclude the deſcription of this ſyſtem, with an intimation peculiarly applicable to it.

When the deſcribed means of quickly diſcharging and repleniſhing a cocked veſſel, ſet to the flue of a teach-furnace, are employed, there is ſeldom or never any occaſion for cloſing the great regiſter, until the proceſs of ſugar-boiling is to ceaſe. In general, the chaſms by which it leaks cold air inwards, ought to be ſtopped with iron fitted to them; and, for the ſhort time of diſcharging and repleniſhing this veſſel, it will be ſufficient to divert the flame from it, by opening the regiſter of the waſte-flue.

Of the expenditure of fuel, by the waſte-flue, in theſe ſhort intervals, ſomething may be ſaved, by turning this flue, to open upwards to the bottom of the quadrilateral pan F G; inſtead of allowing it to paſs on directly, as in former ſtructures, to the chimney-flue G.

Of a SYSTEM *intended for the honourable* SIMON TAYLOR, *and eligible for* SPACIOUS HOUSES, *where the* FALLS *will not ſerve for* ELEVATED GRAND BOILERS: *And of particulars regarding divers* SYSTEMS, *and referred to this place.*

THE boiling-houſe of Holland eſtate has height and breadth, proportionate to its length of 110 feet in the clear: And three ſets of teaches, with two grand boilers to each, have ranged here, along the leeward houſe-wall, ſo as to leave room for a coal pan, at either end of the houſe.

The ſhort and eaſy navigation from the ſea, to this houſe, renders it expedient that the coal-pan ſhould have place in any future arrangements here, to ſerve as occaſional auxiliaries, but not as neceſſary parts, of the equipage to be employed in ordinary: And, as it is certain that, with or without theſe pans, more than the neceſſary work of this houſe can be executed by two ſyſtems of teaches and grand boilers, conſtructed according to the advices of theſe pages, and each having the advantage of an heated mill-gutter and mill-receiver, but no more than two fires; and, as the intended ſyſtems are to be ſimilar in ſtructure and in power, only one of them is to be delineated, in its proper half of the houſe.

To employ the preſent ſpacious building, and to render it unneceſſary that any outer houſing ſhould be erected, for the veſſels that are to be placed on the croſs-flues, for the economy of fuel, the two propoſed ſyſtems are to range, like the veſſels now uſed in three, along the leeward wall: And this is to be done in a manner conformable, not only to the fall at this houſe, which

which is scarcely sufficient for cocked vessels elevated above the teaches, but suitable to the scantiest falls of other houses, which may adopt an arrangement of this kind.

But the accommodation to scanty fall, is not the only recommendation of the system now under consideration: For, whilst others, by their elevated vessels, serve better to lessen the labour of ladling forward, and also to stop any heavy dirt on their flat bottoms; this compensates, by the cheapness of its masonry, and by saving the expence, leakage, and trouble attending registers.

The candid and attentive reader of the foregoing descriptions and diagrams, will, on the first view of PLATE IX, perceive, that things similar to those already exhibited, are distinguished by similar means; and will expect little more in this place, than a concise description of the particulars which are peculiar to this system.

A B C D represent, in the usual manner, the windward, the gable, and the leeward wall, of that half of the house which is furthest from the mill: A D being a middle line, distinguishing this from the nearer half.

The black circular large spot, near E, shews a coal-pan set to its proper fire-place for sea-coal; and, between E and F are shewn, as formerly, a small interval for flame, if any be left, around the bottom border of the pan; and also the cross-flue, and the small chimney which serves for fuel of this kind.

The diagram shews, by the usual means, the teaches, the mouth-piece opening to the right of the centre of the first teach, the stoker's niche, and the cleansing apertures through the leeward house-wall, and pointing

to their respective teaches; but, as no elevated central vessel is to be used, a fourth teach is admitted, in the line of the first, second, and third.

As the fourth teach is to receive liquor, which has been worked in a first grand boiler, and then further cleansed and inspissated in a second grand boiler; and as liquor of this density requires the greatest heat that can be obtained at this extremity of the furnace; it would be quite injudicious to increase the disadvantages of the greater distance of the fourth teach from the fire-place; and of the more exhausted flame which acts on it; by making its capacity and charge greater than those of the third teach: And we ought rather to aid the fourth teach, by every thing that is practicable in its place.

With this view, the diagram shews the fourth teach no larger than the third; and a vertical central section, in the manner of that of PLATE V, figure 3, would shew the height and capacity of its curving to be less, by about two inches of the depth.

The diagram, PLATE IX, moreover shews that the space, around the fourth teach, is narrower than that of the third, in order that the flame, and the heat of the encompassing walls, may be more strongly impressed upon it: And, if a central vertical section, similar to that of PLATE V, in respect to the slope of the bed of the furnace under the teaches, were to be given, in illustration of PLATE IX, it would shew the interval for the passage of flame, under the bottom of this fourth teach, smaller than that of the third teach.

For these purposes, and for strengthening the saddle between the third and fourth teaches, by lessening the span of the arch, the side-walls of the reverberatory of the

the first, second, and third teaches, are shewn bending inwards at this saddle; but not so much as to interrupt the course of the flame around the fourth teach, to the flue G; of which it is to be observed, that the width is only eighteen or nineteen inches: This, with a depth of 20 inches from the crown of the arch, will give free passage to a mason, when any pointing or repairs, from within, may be wanted; and it will give a surplus of aperture for the draught, which is to be moderated by barring across at G, with loose bricks.

This bar will serve every purpose that can be attained by narrower inaccessible flues; will easily be reached from the arched aperture *f*, G, and will make the work of the furnace equally brisk at all times, until ashes accumulate in the flue, to the height of the bar, on which nothing will rest before this time; and until the quantity is such as would entirely choke an ordinary flue, in the long course from G to H, and thence to the chimney-flue I.

The large black rectangle, extending between G and U, and thence to the left, towards the chimney I, represents a shallow flat-bottomed vessel, set on the widened flue in its rectangular course, from G towards U, and thence to H.

Divers things which appertain equally to this system, and to the preceding, having been referred to this place, for the sake of brevity, we are now to introduce them in the order in which they are most conveniently admissible, in this description of PLATE IX.

In regard to the rectangular form of shallow vessels, exhibited in this and in the preceding plate, it is to be observed that, wherever the distance between the chimney and the boilers within the house, is so great

as that represented in PLATE VIII, which admits a straight quadrilateral pan, of sufficient length to lie with one end at O, and with the other end near N, or much nearer to the grand boiler, H I K; especially if the flue, K N, be bent a little more to the right; a vessel of this last-mentioned figure is preferable to one of the rectangular figure, N O; because the straight quadrilateral vessel may be made more easily, and may more conveniently be strengthened in all parts, by the means presently to be mentioned.

But, wherever the described distance is short, as it appears in PLATE IX; and will not admit a straight quadrilateral pan of sufficient length, on a flue running straight from G to H, a preference is to be given to a vessel of rectangular form, like that of PLATE IX; because it affords the longer extent of bottom presented to the flame, in the longest and most convenient course from the fourth teach to the chimney; and because the rectangle may be made out, consistently with the intended means of strengthening the vessel, by two straight quadrilateral pans joined by a very short and wide gutter, or by a large square tube, fit to deliver the juice freely from one pan to the other, along their bottoms.

In this case, the longer quadrilateral pan would make the part G U; and the shorter, extending from this to H, would make the remainder of the rectangle, G U H.

Every shallow flat-bottomed vessel, of this and other systems, ought to be placed, as near as the circumstances will permit, to that mouth of the cross-flue which receives the flame from the furnace; in order that the extent of masonry may be the smaller; and

that

that the unoccupied part of the flue, between the furnace and the shallow vessel, may have the smaller length of masonry by which any heat can be wasted into the air.

This rule has been observed in PLATE IX, which shews the shallow vessel approached towards the mouth G, of the teach-flue, as nearly as is consistent with the masonry of this vessel, and with the business of ladling over from the grand-boiler K L, to the teach on the right.

The quadrilateral pan, shewn in Mr. Jones's system, PLATE IV, was placed merely with a view to an experiment, made under great apprehensions of some inconveniencies, which might attend the use of a vessel of this kind: But, as none have been experienced, that pan, or rather a longer pan, ought to be placed in conformity with the present rule.

If the diagram, PLATE VIII, had been drawn according to this rule, the end N, of the vessel N O, would appear extending much nearer to the mouth K, of the flue K N; but then the diagram could not well serve to shew how the pan is to be placed, when the fall will not permit any considerable elevation of it above the stoker's niche, at M L: And the delineation for this case was preferred, because it serves for ordinary cases, by the mere addition of the short rule;—"Let the pan N O, reach as near to K, as the circumstances will permit."

The length of unoccupied flue K N, PLATE VIII, is drawn in subservience to the following circumstances:

As this flue passes over the stoker's niche M L, he ought to have an interval of six or eight inches, between his head and the crown of the arch; and, as the heat

would

would reach him through a crown of half brick thickneſs, he ought to have it of nine inch maſonry, to ſecure him from annoyance. To this height of the floor of the flue, above his head, we have to add the depth of the flue, and the thickneſs of the arch which covers it, between the grand boiler and the flat pan.

Then, on the ſuppoſition that the ſtoker's floor is not ſo low, as to compel him to double labour, in raiſing the traſh much higher than his ſtomach, before he can introduce it into the mouth-piece, the bottom of a pan placed over his head, muſt be diſtant from it by about thirty-ſix inches.

But the aſſumed ſcanty fall does not allow the pan to be placed ſo high; and therefore this end of the pan, inſtead of being approached to K, near the grand boiler, is thrown back to N; where the flue runs to it, not directly over the crown of the arch of the ſtoker's niche, but aſide, where the flue finds greater depth of maſonry above the concave face of the arch; and where the flue by widening on the ſide L may, with the ſmaller depth, have ſufficient aperture for the flame.

Thus it is to be underſtood, that it is only in the caſe of extreme ſcantineſs of the fall, that this pan is not to be placed cloſe to the grand boiler.

In the ſyſtem of PLATE VIII, in that of PLATE IX, and in every other that has a ſhallow pan placed on a flue; this laſt ought to widen, immediately at its entry under the pan, to a figure correſponding with that of the pan, and to a breadth leſs than that of the pan, by only three inches: For it is not neceſſary, that more than one inch and an half, of the bottom border, ſhould reſt on the wall at either ſide; and it is not expedient, that a greater part of the bottom ſhould be defended from the flame.

The

The syſtem PLATE IX, admits two round-bottomed grand boilers, O K and K L, to be worked by one fire placed under the boiler K L; of which the mouth-piece and ſtoker's niche are ſhewn, in the uſual manner, looking outwards, towards *b*, *a*. At O, appears the croſs-flue, which receives reſiduary flame from the furnace of the grand boilers, and which delivers it under the bottom of the quadrilateral pan, O X. Along this bottom, the flue is to have the deſcribed width, until it delivers by the ſloping croſs-flue P, into the chimney Q.

If a ſhorter pan ſhould be preferred, it may be laid on a flue running ſtraight from O, *k*, to the chimney-flue Q; but in ſo doing, care is to be taken that the aſh-pit avenue, hereafter to be mentioned, ſhall be eaſily acceſſible.

In working two grand boilers by one fire, we cannot avoid the inconvenience of ſtopping the fire and the work of both veſſels, as often as any one requires to be entirely evacuated and re-charged. But, to compenſate for this, one ſtoker ſerves for veſſels which, if ſet to ſeparate fires, would require two. In conſideration of this ſaving in labour, and of the length of the houſe, and of the utmoſt economy of fuel, the two grand boilers are thus admitted in preference to one. But for two ſuch veſſels, each meaſuring five feet and nine or ten inches in diameter, at the mouth, it is neceſſary that the fire-place ſhould be as large as that of a teach-furnace, and ſhould have grating of the ſame extent.

As the figure M L, PLATE VI, does not repreſent the length and width of the fire-place of a teach-furnace, with ſufficient accuracy; it is proper here to

ſtate, that the meaſure preſcribed in the FIRST PART is 54 inches by 50, at the grating; and that the ſame meaſure is intended for every teach-furnace of this SECOND PART.

In ſetting two ſuch round-bottomed grand boilers to one fire, it is highly injudicious to place the fire under that which firſt receives the crude juice, as has been generally done heretofore. Calling that at O K, which receives the crude juice, the firſt grand boiler; and the other, K L, the ſecond boiler, which works juice previouſly cleanſed and concentrated to ſome degree, in the firſt; we are to conſider that the denſer charge of the ſecond grand boiler, requires the greater force of fire to maintain its rapid boiling; and for this purpoſe it ſhould be placed neareſt to the fire; and we may obſerve that the flame, which paſſes beyond this veſſel, is ſufficient for the proper work of the firſt grand boiler; becauſe its charge will boil at a lower temperature, and ought rarely to boil vehemently: For, if its firſt and moſt pernicious crops of ſcum, be not ſkimmed off as faſt as they form at the ſurface, they will be broken back into the juice, the more as the commotion of boiling is greater; and they will thus be the more apt to give a ſtain and foulneſs, never to be entirely corrected by any ſubſequent ſkimming.

The ſecond grand boiler, K L, muſt alſo be the next to the teaches, in order that its cleanſed and enriched charge may be ladled forward, with the leaſt labour and the ſmalleſt loſs of temperature. The diagram accordingly ſhews the ſecond grand boiler, K L, next to the teach G. At the interval between theſe veſſels, the ſaddle is to have the ſlopes formerly deſcribed, in order that none of the liquor which may drip from the ladle, ſhall reſt there.

In

In the black ſpot which repreſents the grand boiler K L, may be diſtinguiſhed a figure not ſo deeply ſhaded, and having two oppoſite ſides circular, and the other two ſtraight; and having not only the form, but the dimenſions, of a grating for a teach-furnace. This is to ſhew, in conformity with the inſtructions and reaſons offered in the foregoing pages, that the centre of the fire-place or grating, is to be ten or twelve inches to the right of the vertical central line of the grand boiler above it; as the flame is to flow to the left.

As the bed of this furnace, from the deſcribed grating, and along K, and as far as O, is to be concave, in accommodation to the figure of the teaches at the bottoms and the ſides next the walls, and in the manner of the teach-furnace deſcribed in the FIRST PART; and as the deſcribed fire-place is, in like manner, to be bounded on the flat ſide near K, by a bridge or elevation of the bed of the furnace, above the grating, in order to prevent the traſh from ſpreading from its proper place on the grating, to accumulate on the bed; and as this bridge is to conform, at the top, to the deſcribed concavity of the bed, of which it is a part; and is to have, at its loweſt central part, an height of about nine inches above the grating; to this height the maſonry is to riſe, plumbed on the ſide L of the fire-place, exactly like that of the bridge on the ſide K.

From the fourth courſe of bricks, above the grating, on the ſide L, and around the grand boiler, as far as the bridge on the flat ſide K, the circular maſonry, at the fire-face, is to bevel outwards to give ſpace for the circulation of flame, ſimilar to that repre-

ſented by the white circular ſtripe encompaſſing the grand boiler, from L to N on one ſide, and from L to M on the other. This circular white ſtripe is intended to exhibit the different diſtances of different ſides of the grand boiler, from the neighbouring fire-faces of the maſonry, at the height of the ſpring of the under-pinning; and to ſhew, that from the fourth brick above the grating, the fire-place is to bevel gradually, in the circuit from N to L, and from M to L, and in riſing towards the under-pinning; ſo as to leave, at this height, an interval of about fifteen or ſixteen inches, between the boiler and the circular wall at L, and a ſmaller interval of ſeven inches, near M and N; and ſo as to make the large interval at L, to narrow gradually to the ſmaller on the ſide of the mouth-piece, and to that on the oppoſite ſide.

Thus the flame will be determined to riſe moſt freely into the wide ſpace on the ſide L, and to that half of the veſſel which is on this ſide; and will be reſtrained from flowing directly from the fire-place to the diſtant grand boiler, O K.

In the ſame manner, the diſtance between the firſt grand boiler O K, and the circular ſide-wall, at the height of the ſpring of the under-pinning, is ſhewn to be ſix inches, in the circuits M O, and N O, and to the place of the flue O; excepting that, at the commencement of each of theſe circuits, the interval is ſeven inches, as ought to appear near M and near N.

A grand boiler, ſuch as K L, ſeldom or never requires a draught ſo quick as that of a firſt teach, nor ſo deep a charge of traſh; and therefore, the height of the bottom above the grating, ought not to exceed 28 or 29 inches: The diſtance of the bottom of the

grand

grand boiler, O K, from the concave bed of the furnace, ought not to exceed twelve inches. From this interval, along the length of the bed, the fire-face is to ſweep upwards, conforming as nearly as it may to the lateral ſwell of the veſſel, until the interval is ſix inches, at the ſpring of the under-pinning, in the manner deſcribed above.

Having given theſe appropriated menſurations, we may now ſay, in general terms, that the grand boiler, K L, is to be ſet nearly in the manner of a firſt teach, as it is repreſented in figure 3, PLATE V; and, in regard to the grand boiler O K, PLATE IX, the manner in which the interval for the paſſage of flame is to conform to the figure of this veſſel, on the ſide O, is to be ſimilar to that repreſented at D K, PLATE V, figure 1.

The height and form of the leaden curving of the grand boilers O K, and K L, PLATE IX, and for thoſe of all the preceding ſyſtems, are to be the ſame as are repreſented at C and A, figure 1, PLATE V; and at *e* and *d*, figure 2.

In PLATE IX, the diſtance between the firſt grand boiler O K, and the ſecond K L, is made eighteen inches, according to the ſcale. In a ſhorter houſe, a ſmaller interval might be made to ſerve; but here the larger is preferable, becauſe it admits a broader and ſtronger ſaddle-arch. The fire-faces of the ſide-walls of this furnace, are moreover ſhewn bending inwards, at M and at N, with the like view of ſtrengthening the ſaddle-arch, by leſſening the ſpan, which would otherwiſe be exceſſively wide, and would require an inconvenient height of the crown, above the ſpring.

Reverting to the ſhallow pan G H, we are to conſi-

der

der that its office will vary, when the juices vary much in richneſs; and that it will ſometimes boil, eſpecially when the flue is not ſufficiently barred at G. It is therefore expedient, that the depth of this veſſel ſhould be three or four inches greater than is neceſſary for containing a charge for the firſt grand boiler, O K, into which the pan G H is to deliver, by the gutter *a*, *b*, *c*. This will prevent the liquor from ſlopping over, when it is moved by a plunger, to equalize the heat at both ends of the pan, or when it boils up ſcum.

This advice is applicable in the ſyſtem PLATE VIII, and in every ſyſtem that has a veſſel of this kind, receiving flame immediately from a teach-furnace, or grand boiler furnace, and preparing a competent heated charge for a grand boiler.

The fall of Holland houſe allows any eligible depth of the veſſel G H; but more than 12 inches will not be neceſſary; for, at a depth of eight inches, with this length and breadth, it will hold a ſufficient charge of 305 gallons; and at a depth of nine of the 12 inches, it will contain 343 gallons.

The height at which this veſſel is to be placed on the flue, is to be no greater than will ſerve for the delivery of its charge, by a fall of about two inches, into the grand boiler O K, five or ſix inches above the copper lip, by a gutter, *a*, *b*, *c*, depreſſed in the curving near *c*. This gutter is to receive the liquor at *a*, from a tube of about two inches and an half in diameter, flatted where it joins the bottom of the pan, but perfectly round at the outer mouth, in order that it may eaſily be ſtopped tight with a wooden plug. Nothing forbids the uſe of a ſtop-cock, but the expence of one ſo large, and of the copper-ſtay, which it would require

quire for its fixture to a veſſel made of thin copper ſheets.

By this wide tube, we attain the great advantage of rapid efflux, which is to be provided for, by a ſuitable depth and width of the gutter *a*, *b*, *c*. This, at the end *a*, ought to have a depth of eight inches, by a width of ſeven; but towards the end *c*, it may leſſen gradually to ſeven by ſix inches.

A veſſel of this uſe may be ſet much lower for a ſcanty fall, by allowing only an inch for the fall of the gutter, and only two inches for the delivery of the liquor over the copper lip, and through the leaden carving, into the grand boiler. The only inconvenience is, that the ſcum is apt to riſe into this extremity of the gutter, and to reſt in it.

As it will ſeldom or never be neceſſary, that crude juice ſhould be detained to any conſiderable depth, in the long quadrilateral veſſel O, X, the chief uſe of it being to exhauſt the flame which eſcapes beyond the grand boilers, and to lead the juice, in an expanded and heated mill-gutter, to the pan G H; a depth equal to that of the mill-gutter, with two inches more to prevent the liquor from ſlopping over by any neceſſary agitation, will ſerve for this veſſel O X: For, at ſix inches of its depth, it will contain one hundred and ninety-ſix gallons; which is more, by almoſt the whole quantity, than ought to be detained here, when the other pan, G H, can hold a quantity ſufficient for the charge of the grand boiler, O K.

At Holland houſe, the bottom of the pan O X, ought to be ſet one or two inches higher than the lip of the veſſel G H; and the gutter leading from the former to the latter, over its lip, is to run from R to

S,

S, by the ſhorteſt courſe: A gutter of two inches in width will ſerve here; and its ſtopper is to be placed near R, when the pan G H is highly charged.

But in defect of fall, in other places, ſuch a pan as O X may be ſet much lower, to deliver by a gutter running from R to S, into a pan like G H, not over the lip, but lower down, through the ſide, and within ſix or eight inches of the bottom, if not lower. For it is not neceſſary, that the pan G H ſhould retain the utmoſt charge of a grand boiler; ſince it may be ſupplied immediately with the liquor collected in the pan O X, to complete a charge.

The mill-gutter which is to ſupply the pan O X with crude juice, is to deliver into it at the hotteſt part, near *k*, above the lip at Holland houſe; but near to the bottom wherever the fall is ſcanty. Thus the juice will receive the utmoſt heat of this pan, at the end next the fire, at the moment of influx, and will ſtream from this part along the whole expanſe of the bottom, to the end X R, and thence by a gutter from R to S, into the pan S H G, until it is charged.

After the time expended in charging this laſt mentioned pan, by the mill-ſtream heated in its courſe on the bottom of the ſhallower pan, there will be but a ſhort interval between the moment of the repletion of the pan S H G, and that of its diſcharge into the round-bottomed grand boiler O K: And it is only for this interval, that the gutter leading from R to S, is to be ſtopped, or that any conſiderable quantity of juice is to be detained in the pan O X. For the preference of theſe pans to every other kind of veſſel, is founded on their ability for the utmoſt ſaving in fuel, and the quickeſt work, with the ſmalleſt quantity of

liquor

liquor *in tranſitu*; and theſe things are to be attended to, in ſetting and working ſhallow pans of any other ſyſtem.

As the cold liquor from the mill is to flow conſtantly into the ſhallow ſtraight pan O K, and will carry forward the heat of this veſſel to the charge of the pan H S G; and as it will happen but rarely, and for a very ſhort interval, that the liquor is to be ſtopped in the pan O X, or that it can acquire a yawing heat there, from a flue barred as the flue O ought to be; this pan requires no houſing over the half which extends beyond the boiling-houſe wall D C, towards the chimney; and, like any other mill-gutter, it needs no other cover than that of a light lid, made of thin boards; which will beſt ſerve to prevent the diſſipation of the heat of this veſſel into the air, and to throw off rain.

During the vigorous action of the four teaches and the two grand boilers of this ſyſtem, the conſumption of liquor will generally be ſo rapid, as to allow very little time for the charge of the pan G H to acquire a yawing or boiling temperature: For, whilſt the grand boiler O K is repleniſhed with charges ſcalding hot, if not boiling, its furnace will have almoſt twice the ordinary efficacy in boiling off, becauſe little or none of its fuel or time will be expended, in the uſual way, in heating cold charges to the boiling point. In general, therefore, the pan G H will be employed in heating charges towards the boiling temperature, and not in boiling off; and, for this office, it needs no other cover than a light, moveable, folding lid, made like the former, of thin boards, to ſcreen that part of it which reaches beyond the houſe-wall to the chimney.

For the baſement of croſs-flues and pans, thus to

be covered, nothing better is neceſſary than ſlender walls to ſuſtain the ſides of the flues, and rubbiſh to fill the intervals to the height of the pavement of the flues: But at Holland-houſe, and wherever the convenience of the workman will be preferred before a rigid economy in houſing, a ſhed may be made to cover the pan G H, if not to extend to X, and to houſe both pans and their gutters, and the negro who attends them: And, for this caſe, the diagram is made to ſhew the moſt eligible baſement maſonry of the ſhed.

The place for the ſtoker and his traſh, ought always to be covered with an arch of maſonry; and ſuch an arch, having a proper ſpan from T to U, and a proper length from the houſe-wall outwards to T U, and alſo the neceſſary pier-wall on the ſide T S, like that ſhewn on the ſide U, with the thickneſs U W, will ſerve for the baſement and floor of a ſhed, to houſe the veſſel G H and its gutter *a*, *b*, and ſpace enough beſides for the negro attending theſe. Between T U and the houſe-wall D C, the dotted lines parallel to T U ſerve, in the uſual manner, to ſhew the area and courſe of the ſtoker's arch: and to diſtinguiſh theſe from any other that may be added.

When once it is reſolved that the pan G H ſhall be houſed, there will be ſome inducement to ſupport the flue and outer end of the other pan in the ſame way, and to extend the ſhed over it; although this be for the mere convenience of a covered floor between the two pans: For, when the houſe-wall, and a parallel baſement-wall of the chimney, at R S, preſent excellent abutment-walls without expence, a ſlender arch reſting on theſe, will appear to be the cheapeſt ſupport of the outer end of the flue and pan O X: And an extenſion

extenſion of the ſame ſlender arch, from the ſide R towards S, there to groin with the ſtoker's arch, will give a continued floor, marked by parallel dotted lines, from one pan to the other.

Nothing that regards the houſing of theſe pans ſhould have been admitted in the diagram, were it not in contemplation of the probability, that it may often be highly adviſable to bar the teach-flue but little at G, and to let the pan G H work as an auxiliary grand boiler; for then the fourth teach will undoubtedly work the better.

A ſhallow pan for this ſyſtem, or for any of the former, may be made for a fourth or fifth of the expence beſtowed on any other flat veſſel of equal capacity and effect: For it may be made of copper ſheets, no thicker than thoſe employed for ſheathing frigates; becauſe the neceſſary ſtrength is attainable by the manner of ſetting it to the flame.

Although in the latitude of ſpeech we call it flat-bottomed, it is not adviſable that the bottom ſhould be accurately flat: For the repeated expanſions and contractions of the metal, by heating and cooling, would ſoon force a bottom that was truly flat, with ſo great an expanſe, into prominences and depreſſions: And, in order to prevent this, the bottom ought to be concave, to the depth of about a quarter of an inch, along the length and the middle: For the only inconvenience of this bent of the bottom is, that at the termination of a day's work, or when the pan is to be entirely evacuated, the ſmall portion of juice, which would lodge in the central depreſſion, is to be ſwept into the gutter.

To ſtrengthen the upper border and the ſides of the

veſſel, the lip is to be turned outwards, to the breadth of an inch or more, in order that it may be nailed on a ſcantling of wood, on each ſide of the pan: Each ſcantling, for one of the longer pans, is to have a breadth of five or ſix inches, by a thickneſs of three inches; and is to reſt, by the breadth, on the parapet of brick-work, which is to be built to the ſides and ends of the pan. Each end-lip of the pan may be ſupported in like manner, on ſhorter ſcantling; but generally, the mere breadth of the lip, and the reſting on the parapet, give ſtrength enough at theſe ends.

The flue being made to the width already deſcribed, under the pan, in order that each ſide-wall may ſuſtain a lateral bottom border of the veſſel, to the breadth of one inch and an half; where there is fall enough from the mill, the end of the pan next to the fire-place, is to reſt on the crown of the arch of the flue, for the breadth of an inch and an half: But otherwiſe, this end may reſt on a thin bed of clay or tiles, placed on a flat iron bar, an inch or more in thickneſs, and covering the flue cloſe by the arched part; and the face or termination of the arch may meet this end of the pan. Where the flame is ſtrong, the iron is apt to burn the copper, if nothing of the earthy kind intercedes them. The other end of the pan, next the chimney, is to be ſupported in the ſame way; but here the flat bar may be uſed in any caſe. The ſide-walls of the flue, under the pan, need not exceed nine inches in thickneſs; and they ought to be provided with apertures, by which the duſt may be ſwept out once in a year.

If the border only were thus ſupported, the greater part of the bottom could not well endure the tread of

a

a negro; who, through habit, will rather enter the veſſel to waſh it, than ſtand by it to cleanſe with greater eaſe. Therefore it is to be ſecured by the following means, which may be ſeen at Mr. Jones's houſe.

Where the flue ſpreads to the deſcribed width of thirty-nine inches, a depth of eight inches is more than is neceſſary for the quickeſt draught at this place: But, in conſideration of an internal wall, which is to ſupport the pan at the middle, through the greater part of its length; and of the moſt convenient beveling of the narrower arched part of the flue, into the wider and ſhallower part, the depth of the flue at the end of the pan next the fire, ought to be made as near to fifteen inches as the circumſtances will permit; but at the other end of the pan, the depth may be as much leſs as the width will permit, conſiſtently with the requiſite area of two ſquare feet; of which about $1\frac{3}{4}$ will ſerve for draught, and the remainder will be barred at firſt, and will afterwards be occupied by duſt.

From the middle, then, of this floor of the flue, under the pan, a nine-inch wall is to riſe ſo high, that by the intervention of a looſe brick laid on the wall, at every eighteenth inch of its length, as well as at each end, the pan may be ſupported at the central parts of the bottom. This wall ought to be ſhorter than the bottom of the pan, by about fifteen inches at each end; and that end which meets the flame, ought to be beveled or rounded, to throw the flame equally to each ſide, as is done at Twickenham.

In order that the bottom may be perfectly level, and may bear permanently and equally on the deſcribed points of ſupport, ſeveral openings to admit a man's arm, are to be left in one of the ſide-walls; by which

the

the loose bricks on the middle wall are to be adjusted, after the further side of the pan has been well placed on its side wall, and the nearer side has been propped to the requisite level: Then this latter side-wall is to be completed.

A pan, thus set, will have no part of the bottom distant from a support of brick or mortar, by more than nine or ten inches; and it will be as firm as any circular cocked vessel, made of equal capacity at a quadruple expence: For the sides of this last must have substance, to suit the juncture with the bottom, which must have a thickness still greater, to sustain its own weight, and that of a charge of two or three thousand pounds of liquor, between points of sustenance that are distant from each other, by $5\frac{1}{2}$ or six feet, or more.

The pan rested by the bottom border on the brick-work, is also to be supported by a slender parapet of brick-work, rising from the side and end walls, to sustain the described scantlings and lips. But in building this parapet, it is to be remembered, that the chief expansion of the vessel will be at the bottom, on which the flame is to act; and, that if the parapet be made to touch the sides and ends near the bottom, the pan will be bilged, or the parapet will be broken and leaky of air. For two inches, therefore, of the height, the parapet is to be distant from the bottom border of the pan, by about one-tenth of an inch, at each side; and by a quarter of an inch or less, at each end: But above this height, the parapet may be close to the pan, in rising upwards to the scantling or the lip. The described narrow intervals will soon gather sooty webs, to prevent the flame from acting above the bottom of the vessel.

All

All that has been lately said of the flat pans, is applicable in every system that admits such vessels.

The semi-circular spot at *d*, in the knee wall M *d*, of the round-bottomed grand boilers, shews the place of a niche, for the reception of a pail; and also serves to shew the place of a scum bason, made in the saddle above, and which is to receive the scums of both these boilers, and to deliver them by a short tube into the tub; provided this method be preferred to that of skimming more economically, into a shallow moveable tub, hereafter to be described.

The like spot at *e*, in the knee wall, between the third and fourth teach, shews the place of a similar niche, and of the scum bason above it, in the leaden bench.

The aperture by which the flue G is to be accessible, for the purposes formerly described, is shewn by the quadrilateral spot *f* G: The like aperture marked at *f*, belongs to the flue O of the grand boilers.

In the course of the house wall D C, may be seen four quadrilateral spots, each marked with *g*, and shewing the place of a cleansing aperture for the grand boiler, or the teach to which it points.

The stoker's niche, and the place of the mouth piece belonging to the first teach, are shewn by a funnel-like spot, like that described in preceding diagrams; so also is the niche and mouth piece belonging to the grand boiler K L.

As the ash-pit of the grand boiler, K L, ought not to open to the stoker's niche, it must be accessible by an avenue, the course and width of which is marked out, by the dotted line above K, and the parallel and equi-distant dotted line below K; and then by dotted

parallel

parallel lines, forming right angles with these, and discernible in their parallel passage across the house-wall; one to the right, and the other to the left of the cleansing aperture *g*: For nothing hinders an ash-pit avenue to open outwards, under a wide and high lateral cleansing aperture.

Near the second and first teach, dotted lines similar to these in their parallelism, and in their course through the house wall, shew the place of the ash-pit avenue, and of its wide opening outwards through this wall.

D A being the mid-line of the length of the house, if any slight shed should be made, to house the extremities of the flat pans next the chimney, it ought to be common to this system, and to a similar system to the left of D A: And the avenue to this shed, ought to be in the mid-line D A, between both systems. The stripes and breaks *k* D *i*, are accordingly made, to shew the half belonging to this part of the house, of any steps and door way that may be made subservient to the outer shed.

Between the mid-line D A, and the pan ⊙ X, there is a distance of six feet; and consequently between this pan, and a similar pan of another similar system on the right, there will be an interval of twelve feet at Holland house: And all that exceeds a passage of $3\frac{1}{2}$ or four feet in width, will be superfluous.

The mere inspection of the diagram will teach, that two systems of this kind may meet, without leaving any interval; provided the aperture *k*, be made at *t*: And the measure of the diagram will shew, that a house of 87 feet in length, and requiring no coal-pans, would serve for two similar systems of this kind, each consisting

ſiſting of teaches, grand boilers, and quadrilateral veſſels; and with this length, a width of thirteen feet would be ſufficient, if the coolers were to be placed in an outer ſhed.

The ſpacious area of Holland houſe admits the coolers to be placed in the beſt manner, within it. The particulars regarding coolers, and contributing to the perfection of the grain of the ſugar, are to appear under a diſtinct head: And here we are only to ſhew the moſt eligible poſition of them relatively to each other, and to the firſt teach, in a houſe of this breadth.

In the courſe of the knee wall and bench, and between the firſt teach and the coal pan, the lightly ſhaded ſpot, *l m*, which is ſemi-circular near *l*, and which narrows from thence to *m*, ſhews the ſite of the fixed leaden ſkipping trough, which is depreſſed in the maſonry, and can ſerve equally for the ſkips from the firſt teach, and for thoſe which may be occaſionally made from the coal-pan. The ſaddle between theſe veſſels is to have the ſlopes formerly deſcribed; to turn away the drippings of the ladle, from the ſkipping-trough; and to prevent them from reſting on the ſaddle.

The lines bounding the ſlender white ſtripe, which runs from *m* to *n*, ſhew the length and breadth of a moveable wooden trough, which is to lead the liquid ſugar into the coolers; one of which is repreſented by the quadrilateral figure, whoſe centre is at *p*, another by the like figure marked *q*, a third by the figure at *r*, and the fourth by the figure marked *s*.

The trough *m n*, in its preſent poſition, will deliver by the end *n*, into the cooler *r*; and when it is properly ſtopped by a tranſverſe ſliding gate, it will deliver by a ſide gate at *o*, into the cooler *p*.

By moving the end *n* of the trough, and only this end, a few inches to the right, the ſame trough will, in the deſcribed manner, deliver into the cooler *s*, directly forth; or into the cooler *q*, by the ſide gate *o*; which ought to be thus within the reach of a workman ſtanding between the firſt teach and the cooler *q*.

Thus each cooler is acceſſible by its whole length; and one light moveable trough ſerves for the four coolers, by a length not exceeding twelve feet, and ten or eleven inches; and with the ſmalleſt riſque of its gathering clots, which injure the grain and obſtruct the riddance of the melaſſes.

POSTSCRIPT.

AS it was late in the autumn, before a competent engraver could be found, to undertake this business; and he being a foreigner, is impatient to return to his native country; it was necessary that the order and extent of this SECOND PART, should be made subservient to the progress of his work, and the nature of his engagement; and it was expedient that those engravings should have priority, which were most wanted for the illustration of the print, and for the early notification of the things which ought to be provided, for the improvement of the boiling-house.

These pages have accordingly been chiefly emp'oyed, in descriptions of the equipage for the manufacture of muscovado sugar; and divers subjects, originally intended for this SECOND PART, have been necessarily transferred to a THIRD PART, which must await the completion of other engravings, and cannot be published before the month of May.

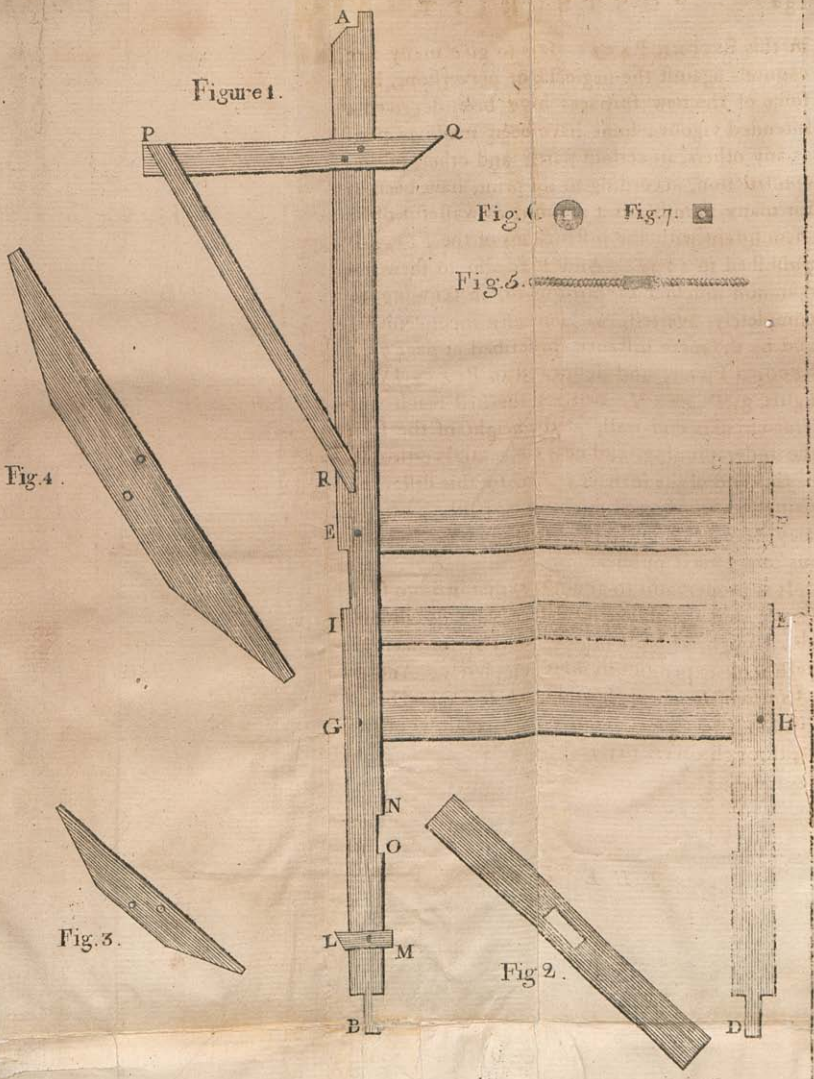
In regard to the intended THIRD PART, it is expedient here to announce, that it is to contain the promised discussions, and divers others arranged under distinct heads: It is to shew the art of working these systems of vessels and furnaces to the best effect, with due economy of fuel, and with the smallest quantity of liquor in hand: It is to recapitulate and amplify divers important advices, which have been expressed, perhaps too concisely for popular reading, in the FIRST and

in

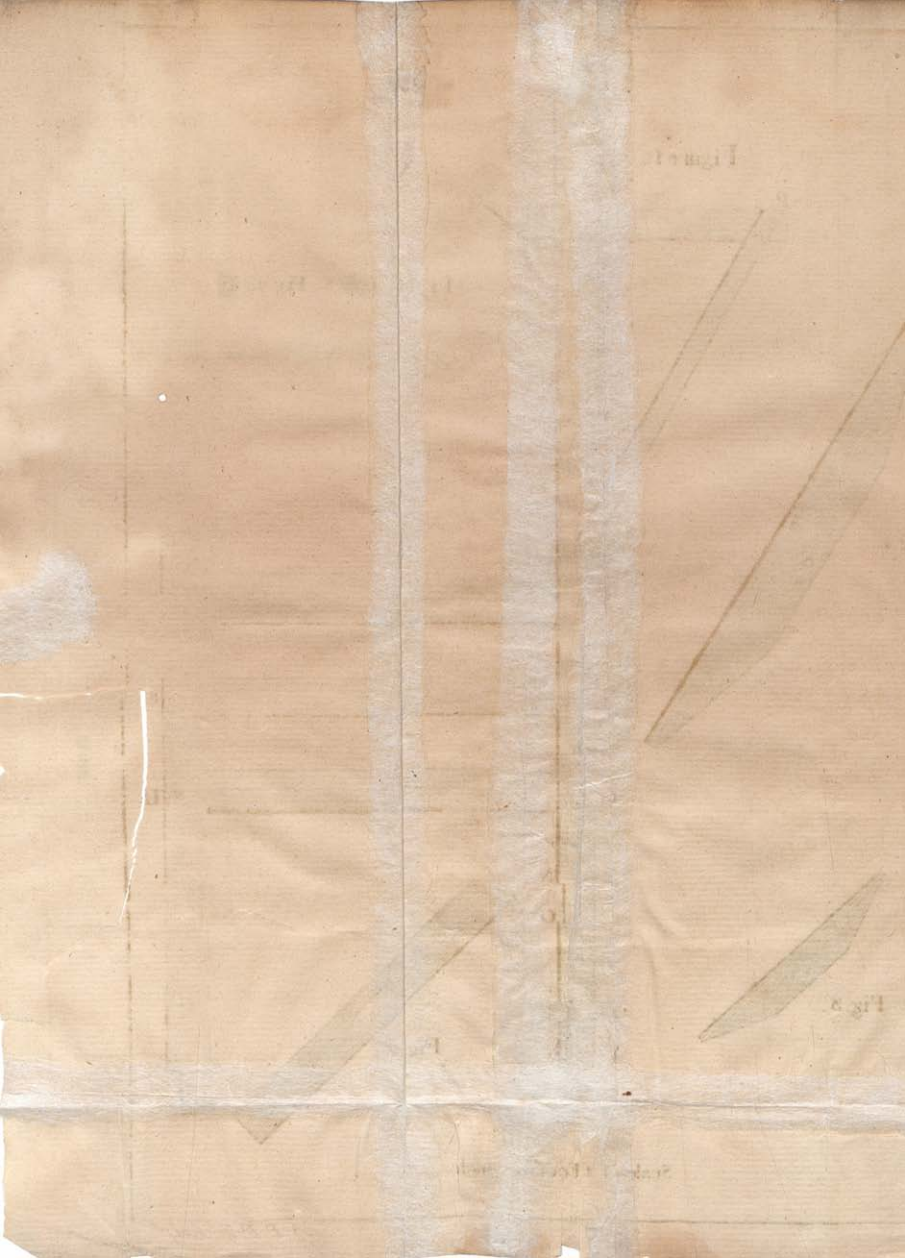
in this SECOND PART: It is to give many neceſſary cautions againſt the neglects, or perverſions, by which ſome of the new furnaces have been deprived of the intended vigour; ſome have been made as periſhable as any others, in certain parts; and others of the trueſt conſtruction, according to the print, have been worked for many months, in a manner, as waſteful of fuel, as inconſiſtent with the inſtructions of the FIRST PART, publiſhed in 1797: And it is alſo to ſhew how the common miſchief of burning-to, in ſkipping, is moſt completely averted, without any inconvenient aids, and by the mere diſtance, preſcribed at page 75 of this SECOND PART, and delineated in PLATE IV, and in figure 3, PLATE V, between the firſt teach and the ſemi-circular end-wall, at the height of the ſpring of the under-pinning, and near the central vertical ſection of this end of the furnace: And to this diſtance, it is requeſted that ſpecial attention be paid, by thoſe who may have occaſion to conſtruct teach furnaces, previous to the next publication.

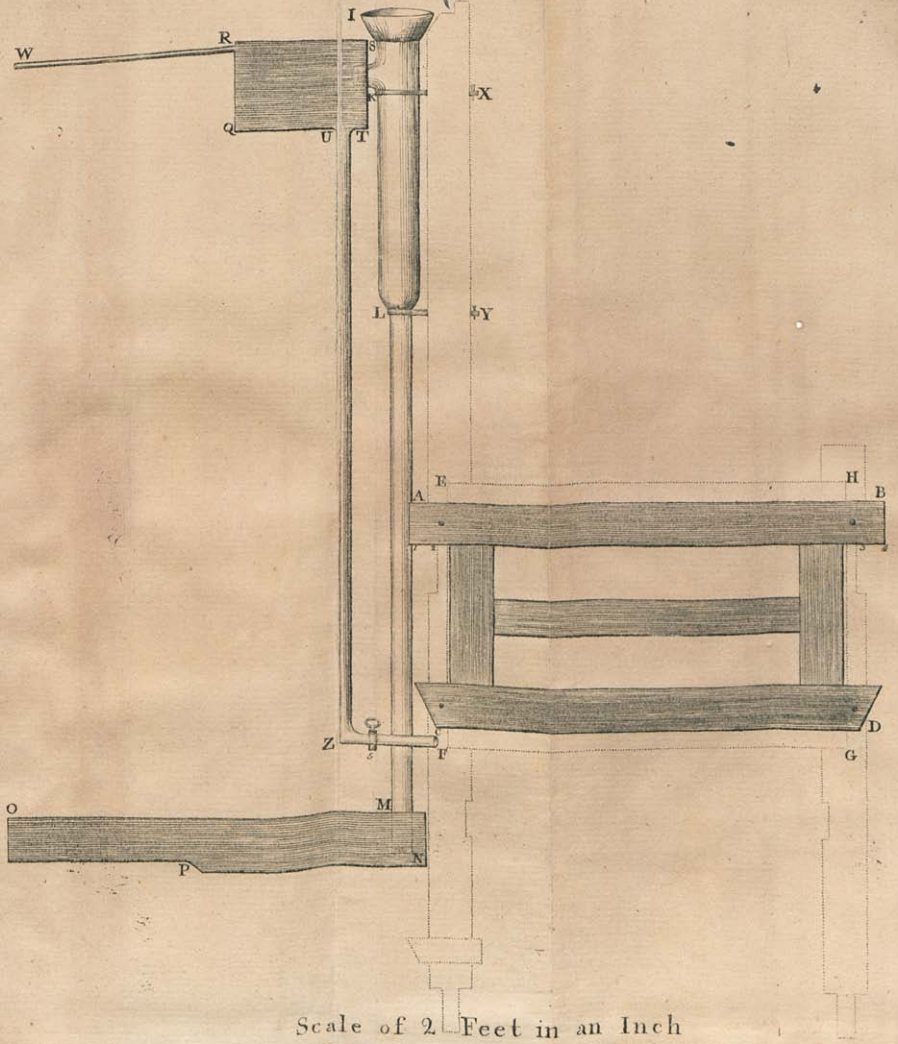
It is proper alſo to announce, that it is to ſhew the ſimple and durable contrivance, already adopted by Mr. Hough, at Nutfield, St. Mary's, for drying mill-traſh moſt expeditiouſly and completely: And that it is to teach the cheapeſt and quickeſt method of drying COFFEE, by the inſtantaneous percolation of heated air, through diverſities.

THE END.



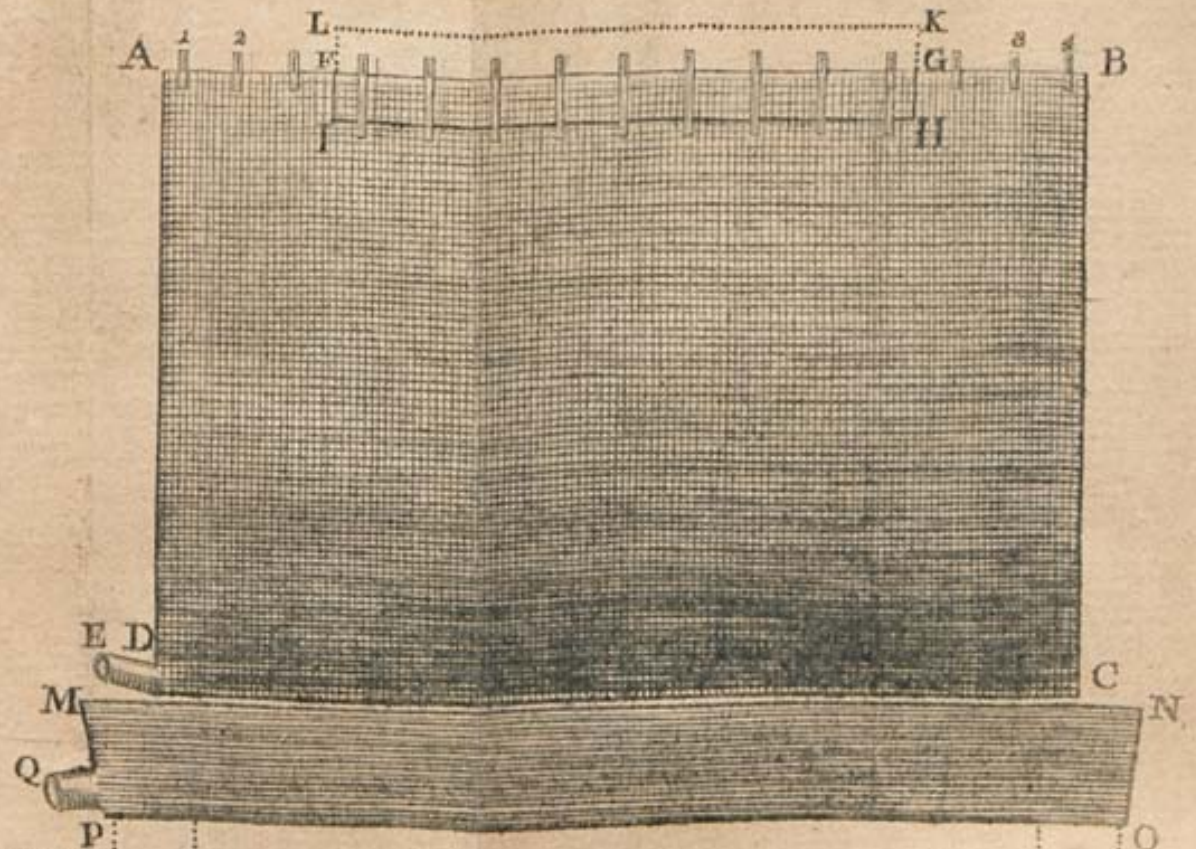
A. P. Folie Sculp.





Scale of 2 Feet in an Inch

A. P. Folie Sculp.



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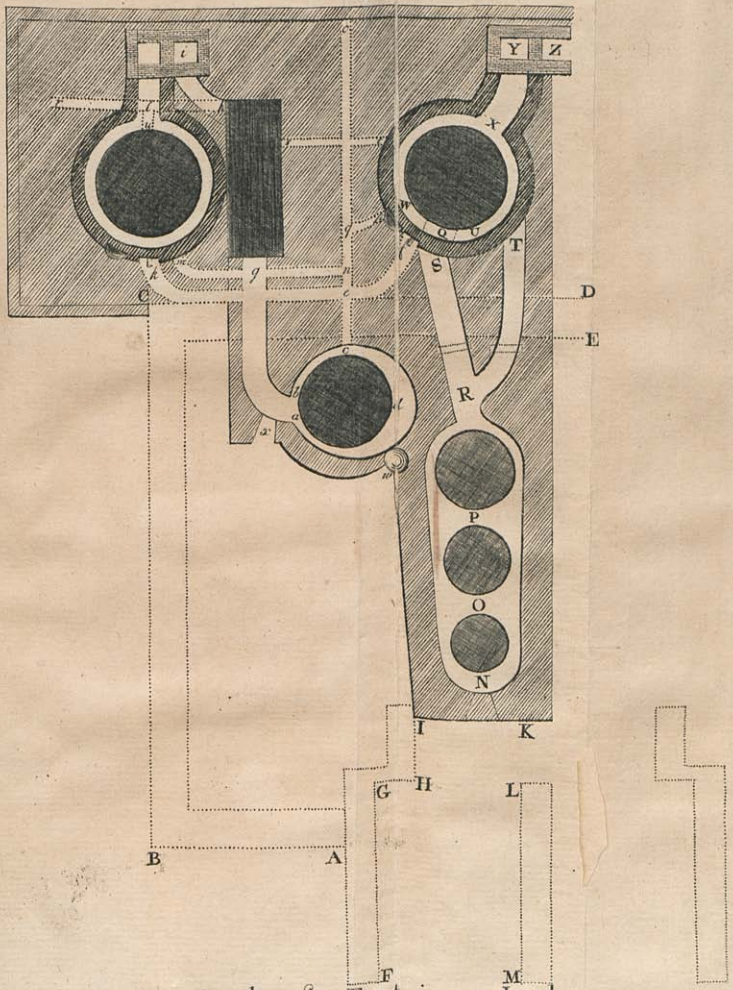
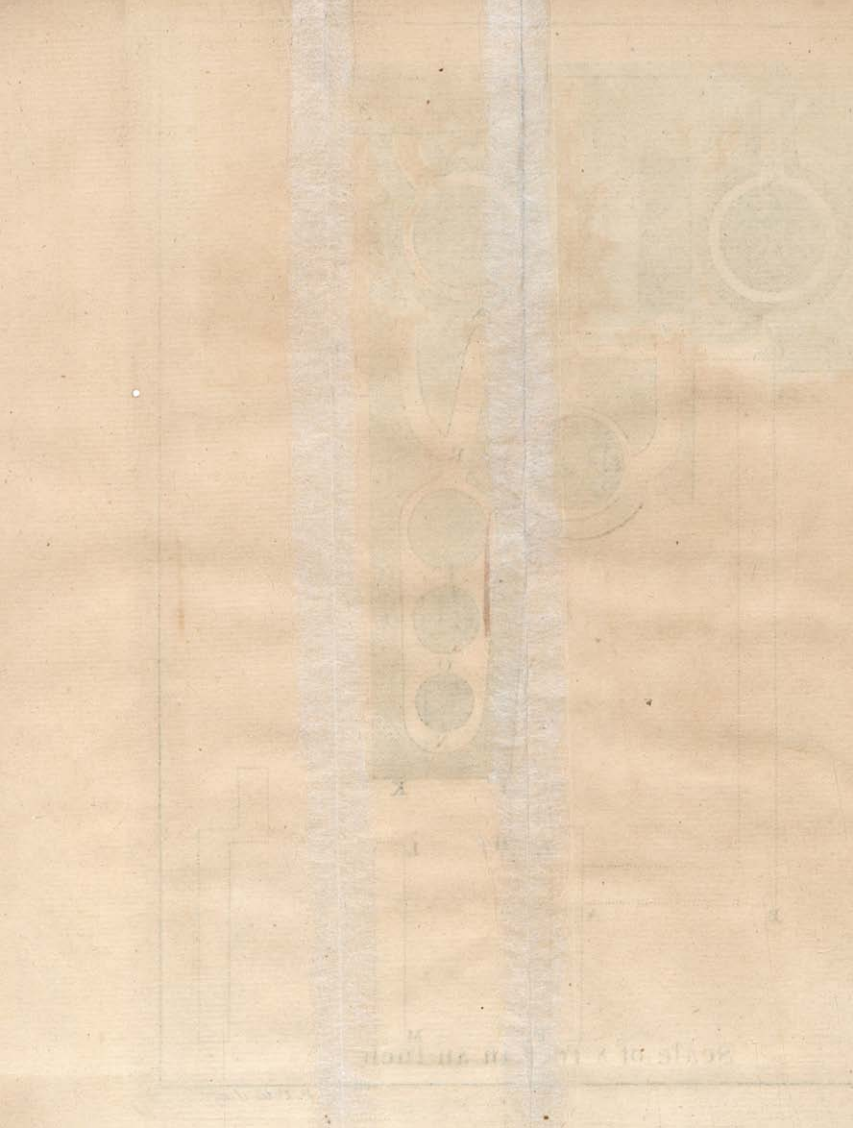
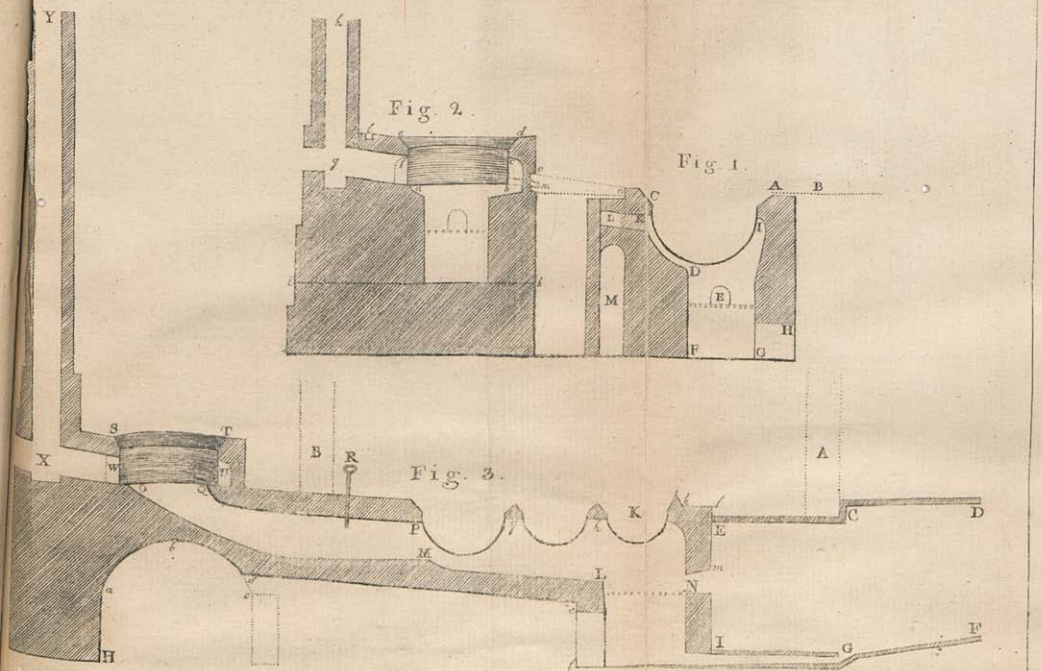


Scale of 8 Feet in an Inch

A. P. Folie Sculpt.





Scale of 8 Feet in an Inch

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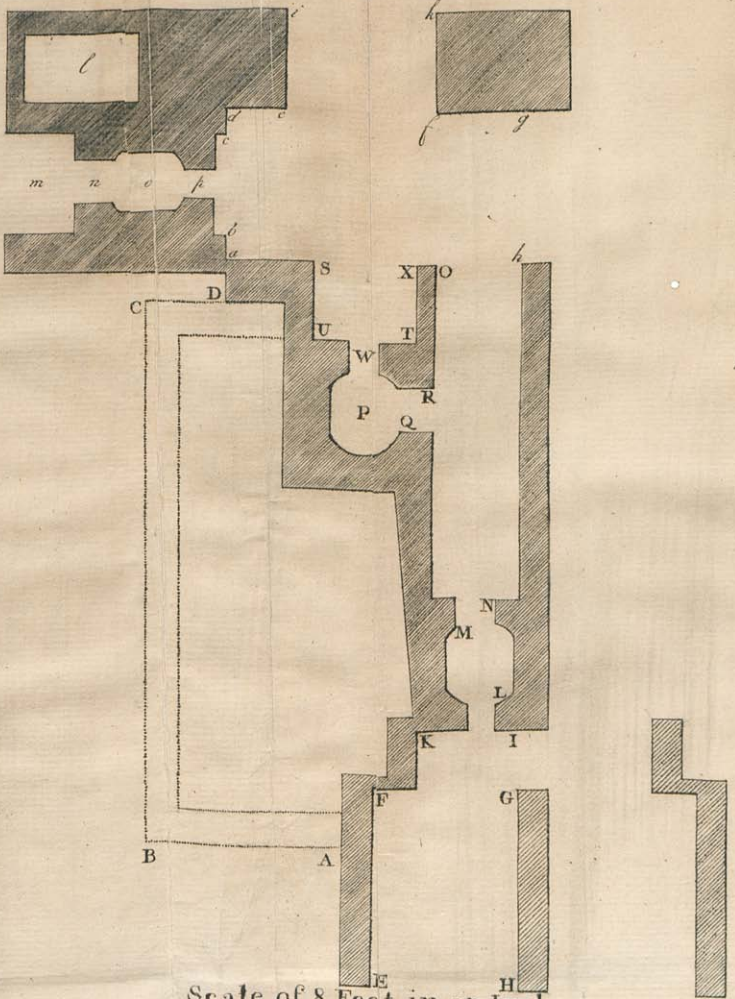

Scale of 8 Feet in an Inch

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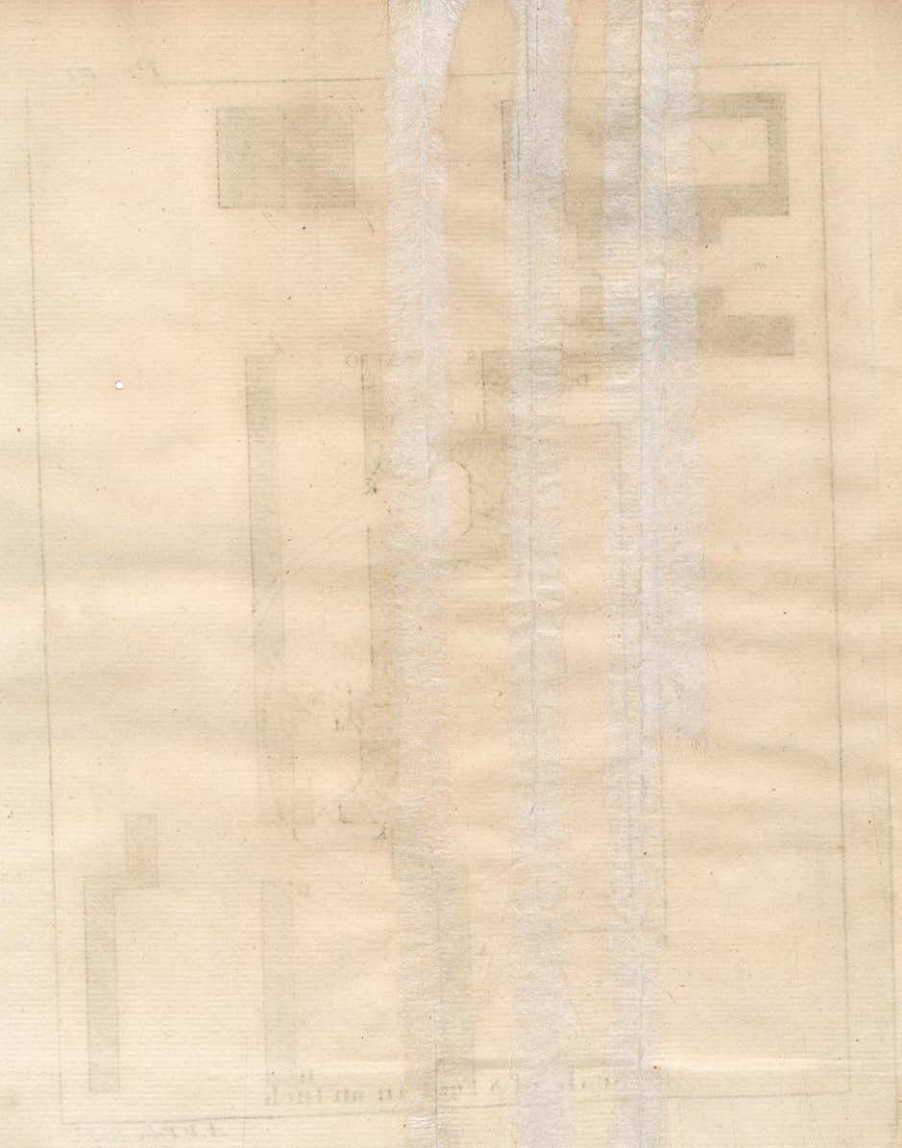
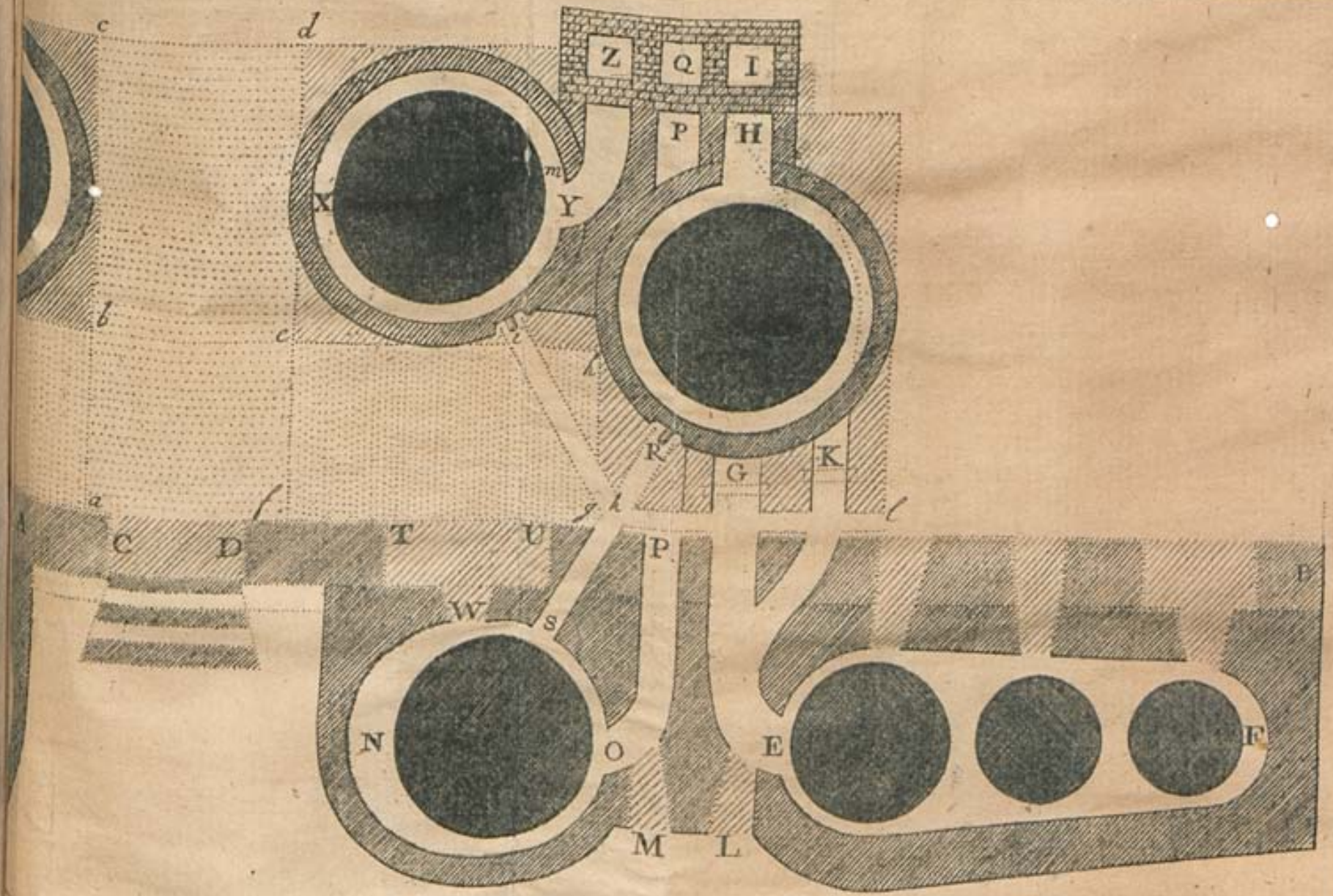
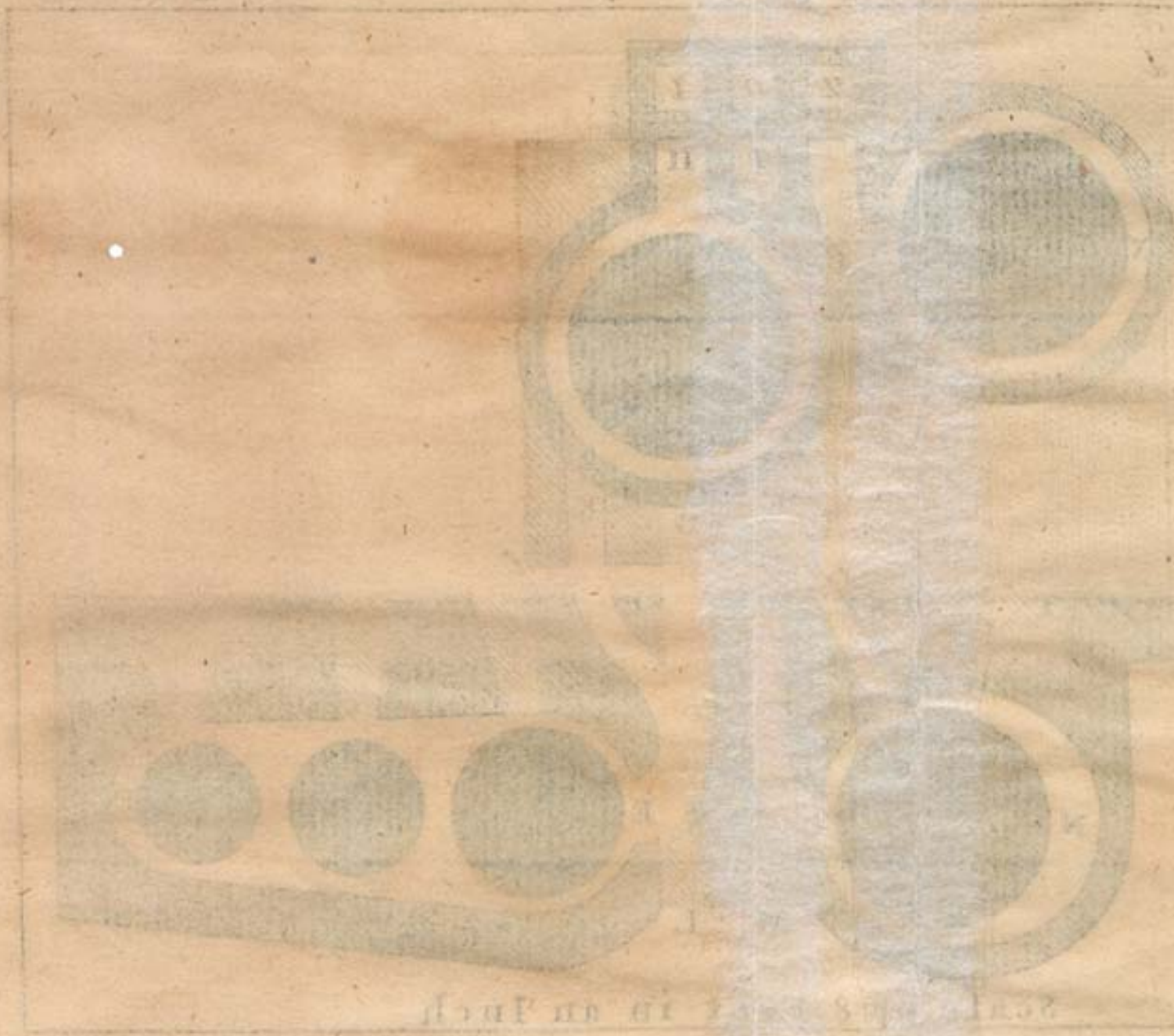
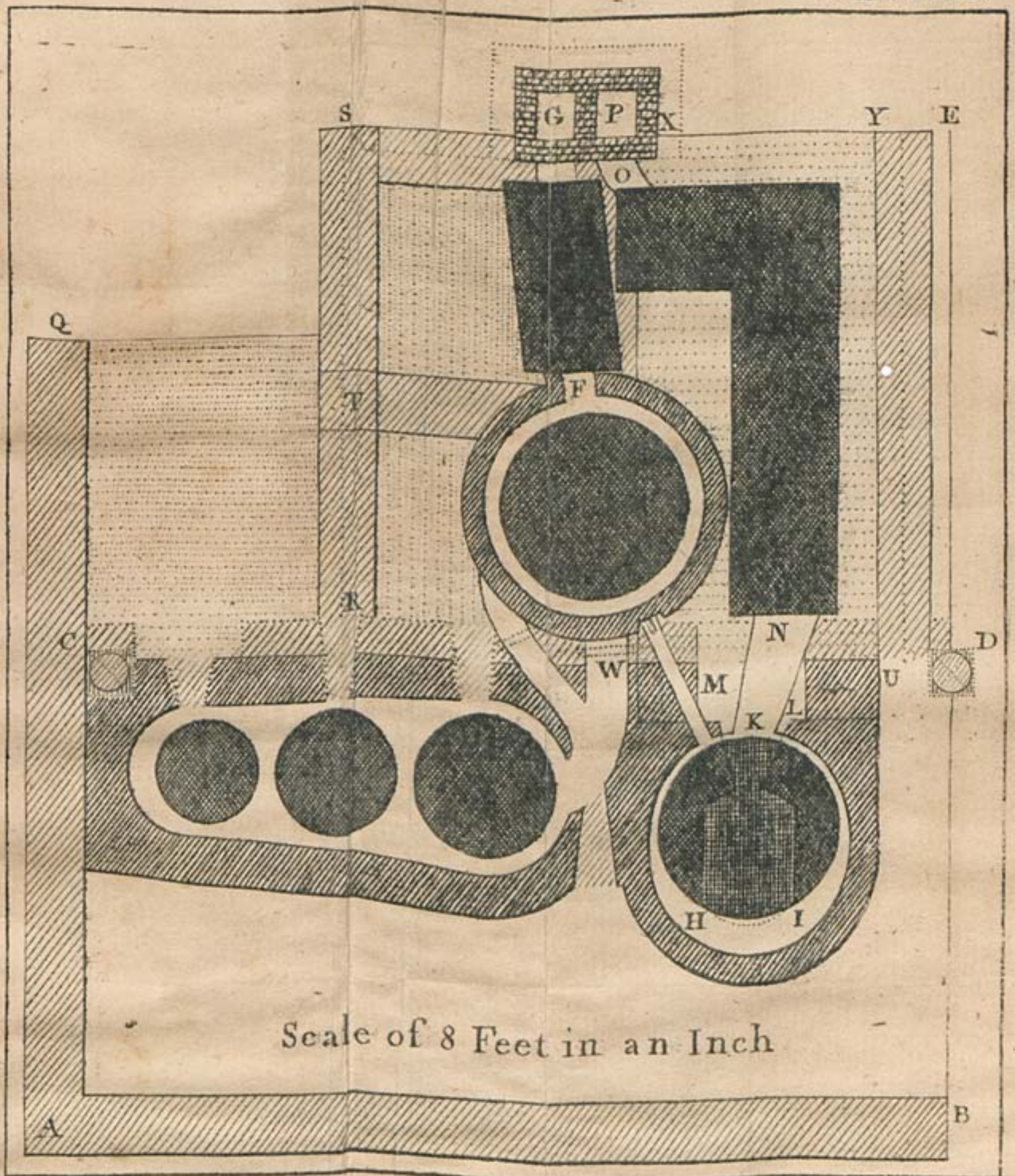




Scale of 8 Feet in an Inch

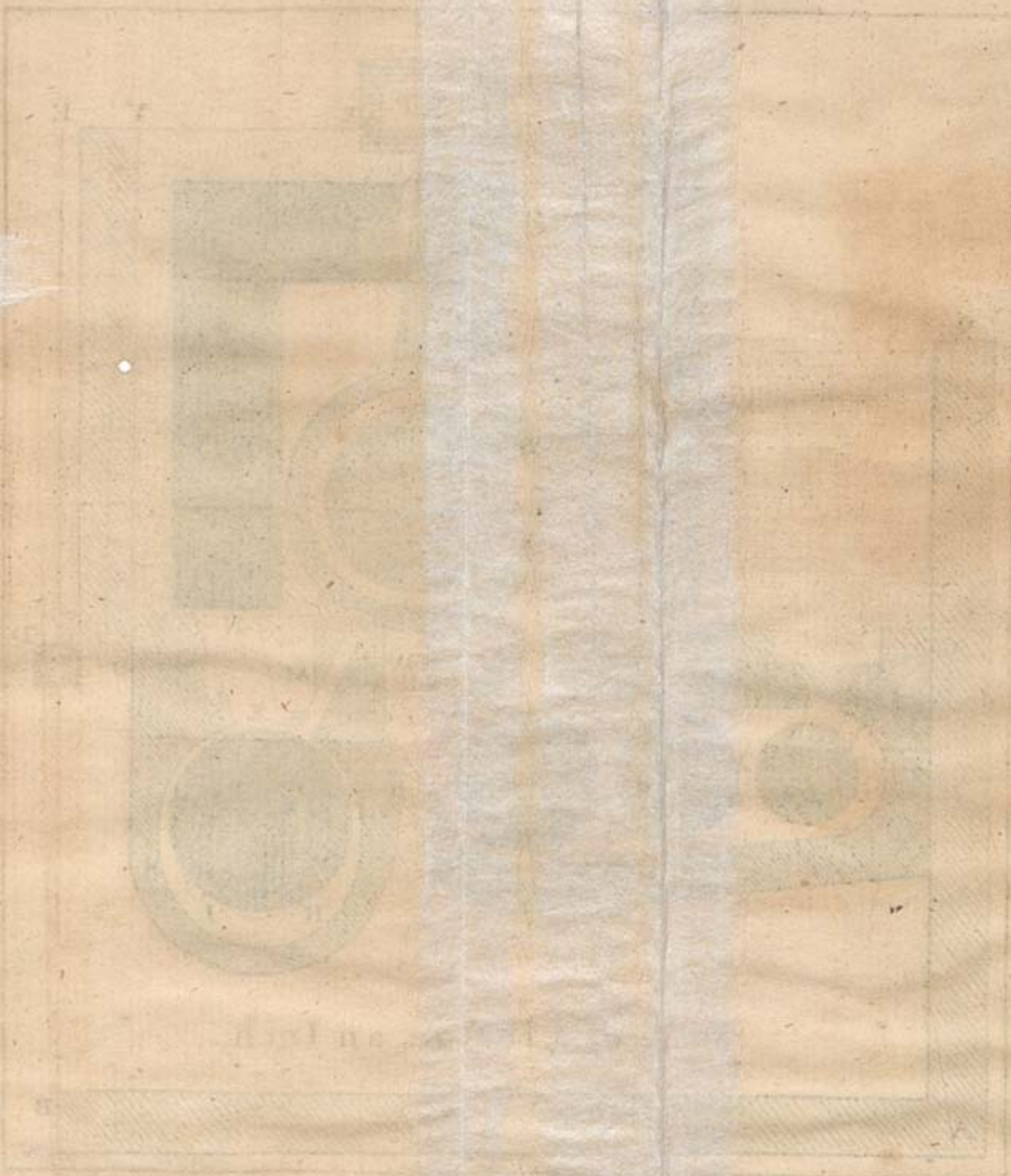
A. P. Folie Sculpt.

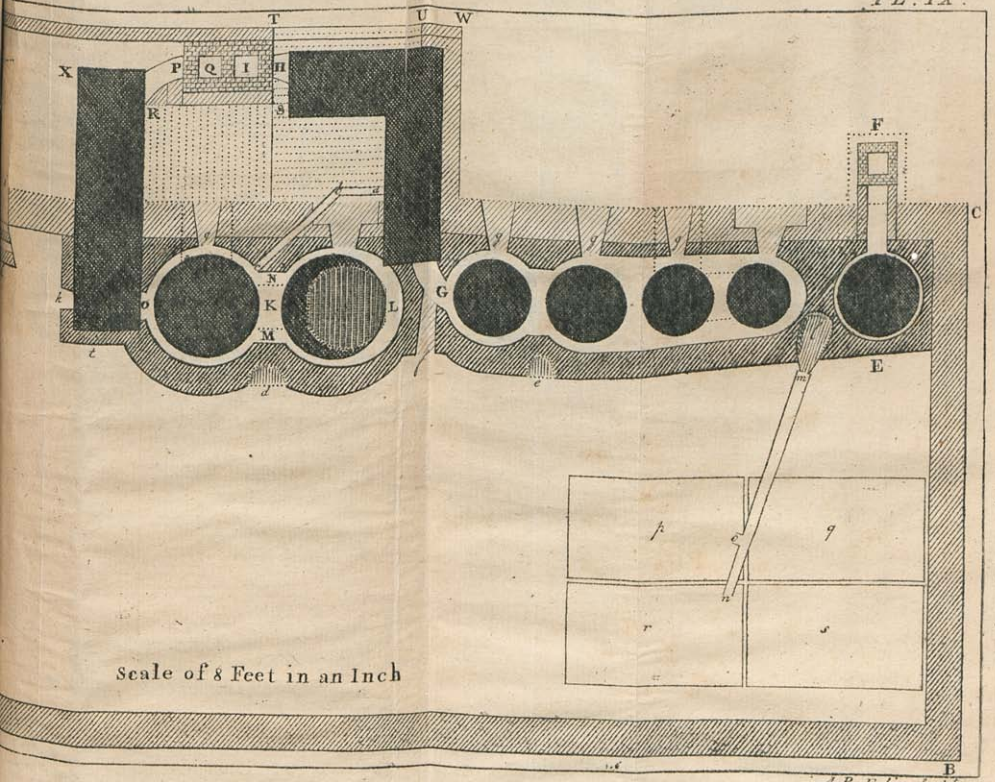




Scale of 8 Feet in an Inch

A. P. Folie Sculpt.





A.P. Felix Sculpt.