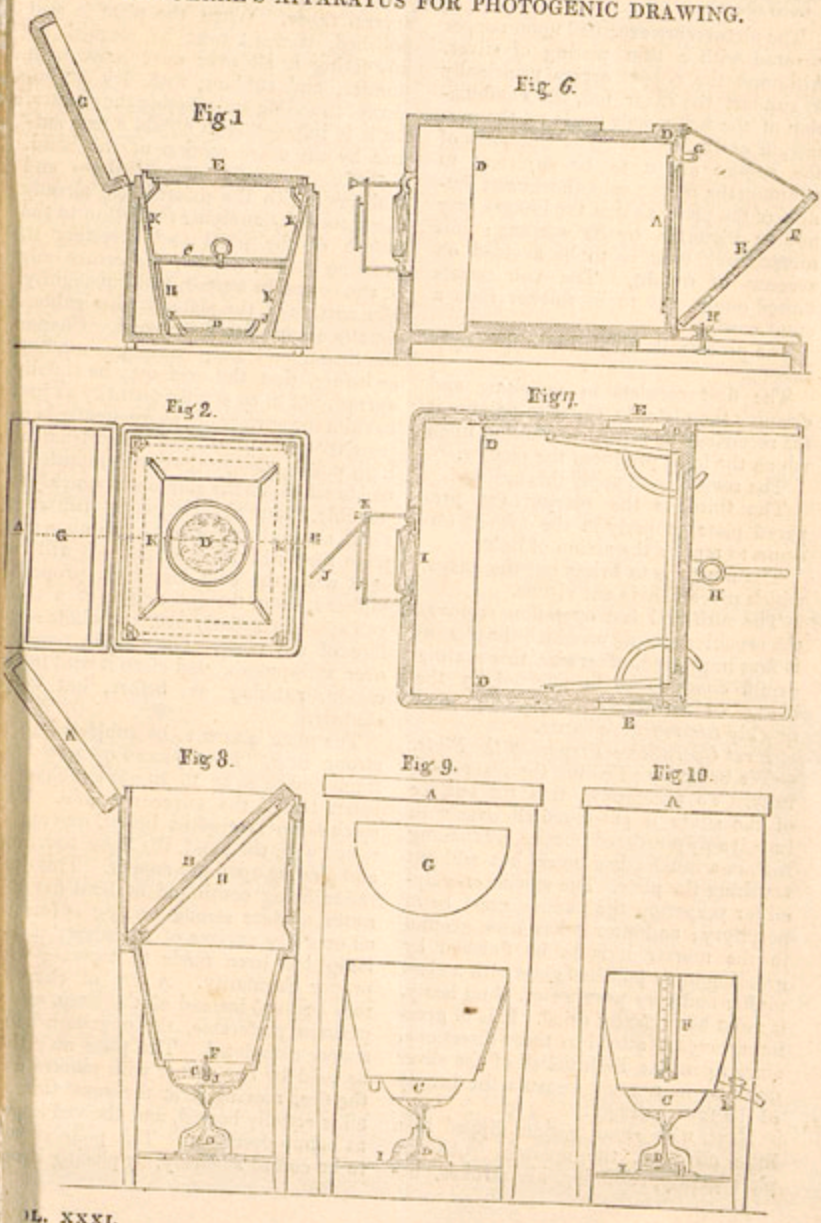
Daguerre

Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 842.] SATURDAY, SEPTEMBER 28, 1839. [Price 3d.

Printed and Published for the Proprietor, by W. A. Robertson, No. 166, Fleet-street.

DAGUERRE'S APPARATUS FOR PHOTOGENIC DRAWING.



DAGUERRE'S PROCESS OF PRODUCING PHOTOGENIC DRAWINGS — AND DESCRIPTION OF THE NECESSARY APPARATUS.

[*Abridged translation of M. Daguerre's own description, published by order of the French Government.*]

The pictures are executed upon copper covered with a thin plating of silver. Although the copper serves principally to support the silver foil, the combination of the two metals tends to the perfection of the effect. The thickness of the copper ought to be sufficient to maintain the perfect smoothness and flatness of the plate, so that the images may not be distorted by its warping; but unnecessary bulk is to be avoided on account of weight. The two metals united ought not to be thicker than a stout card.

The process is divided into five operations.

The first consists in polishing and cleaning the plate, in order to prepare it for receiving the sensitive coating, upon which the light produces the picture.

The second is to apply this coating.

The third is the placing the prepared plate properly in the camera obscura to receive the action of light.

The fourth is to bring out the image, which previously is not visible.

The fifth and last operation removes the sensitive coating on which the picture is first impressed, otherwise this coating would continue to be affected by the light, which would necessarily and quickly destroy the picture.

First Operation—Preparing the Plate.—We begin by polishing the plate carefully. To accomplish this the surface of the silver is powdered all over with impalpably powdered pumice, by shaking it from a muslin bag, over, but without touching the plate. The mortar employed for preparing the pumice must be of porphyry; and after it has been ground in the mortar it is to be finished by grinding upon polished glass with a glass muller and very pure water. And lastly, it must be perfectly dried. It is of great importance to attend to these directions, since upon the high polish of the silver depends in a great measure the beauty of the future design.

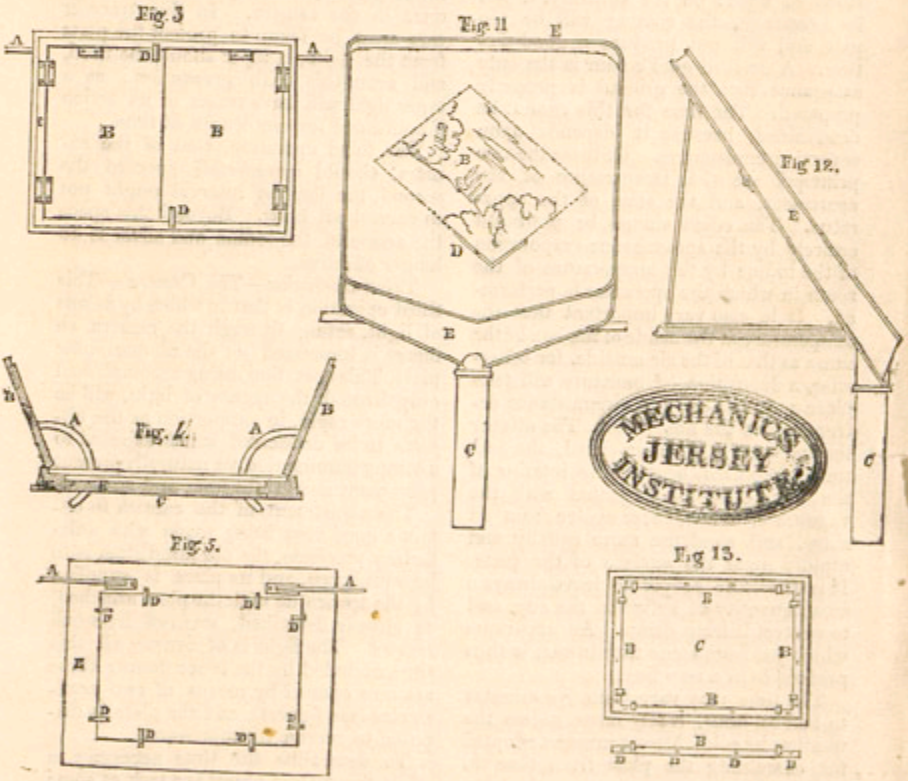
Next, with some cotton dipped in a little olive oil, the operator rubs the plate gently, rounding his strokes, beginning from about the centre. During this operation, the plate must be laid flat upon several folds of paper, care being taken to renew these from time to time that the tablet be not twisted from any inequality in the support. The pumice must be renewed and the cotton changed several times. When the plate is well polished, it must next be cleaned by powdering it all over once more with pumice, and rubbing with dry cotton, always rounding and crossing the strokes, for it is impossible to obtain a true surface by any other motion of the hand. A little cotton is now rolled up and moistened with the diluted acid already mentioned, by applying the cotton to the mouth of the phial and inverting it, pressing gently, so that the centre only of the cotton be wetted, and but slightly. The surface of the plate is now rubbed *equally* all over with the acid. Change the cotton and keep rubbing, rounding as before, that the acid may be equally spread, yet in so small a quantity as just to skim the surface. If, as frequently happens, the acid run into small drops from the high polish, change the cotton repeatedly and break down the globules as quickly as possible, but always gently rubbing, for if allowed to rest or to run upon the plate they will leave stains. It will be seen when the acid has been properly diffused, from the appearance of a thin veil spread regularly over the whole surface of the plate. Once more powder over with pumice, and clean it with fresh cotton, rubbing as before, but very slightly.

The plate is now to be subjected to a strong heat. It is placed upon a wire frame (made so as to support it above a spirit lamp,) the silver upwards. The spirit lamp is applied below, moving it round with the hand, the flame touching and playing upon the copper. This operation being continued at least five minutes, a white strong coating is formed all over the surface of the silver, if the lamp has been made to traverse with proper regularity. A fire of charcoal may be used instead of the lamp, and is perhaps preferable, the operation being sooner completed. The plate may then be held by one corner with pincers over the fire, moving it at the same time till all is equally heated, and the veil appear as before described. The plate is now to be cooled *suddenly*, by placing it on a

cold substance, such as a mass of metal or stone, or best of all, a marble table. When perfectly cold, it is to be again polished, an operation speedily performed, since the gummy appearance merely has to be removed, which is done by the dry pumice and cotton repeated several times, changing the cotton frequently. The polishing being thus completed, the operation of the acid is to be repeated three different times, dry pumice being powdered over the plate each time, and polished off very gently with the cotton, which must be very clean; care being taken not to breathe upon the plate or to touch it with the fingers, or even with the cotton upon which the fingers have rested, for the slightest stain upon the surface of the plate will be a defect in the drawing.

When the plate is not intended for immediate use, the last operation is not performed. Thus, any number of plates may be kept prepared up to the last operation. It is, however, indispensable that a last operation by acid as described, be performed on every plate, immediately before it be placed in the camera.

Second Operation—Coating the Plate.—The plate is first to be fixed upon the board, fig. 13, by means of the metallic bands with their small catches and pegs, as represented. Iodine is now put into the little dish, D, at the bottom of the



box, figs. 1 and 2 (front page). It is necessary to break the iodine into small pieces, in order to render the exhalation therefrom the more equally diffused, otherwise it would form circles on the plate. The cup containing it ought to be covered with a piece of gauze stretched on a ring. The gauze diffuses the vapours and regulates the evaporation of the iodine, and also prevents the sud-

den compression of the air on the lid being shut, scattering the particles of iodine, some of which reaching the plate, would leave large stains on the coating. The board is now placed in the box, the plate face downwards, the whole being supported by small brackets projecting from the four corners of the box; the lid G, is then closed. In this position the apparatus is to remain till the vaporization of the iodine has condensed upon the plate, sufficiently to cover its surface with a fine coating of a yellow gold colour.

If the plate be suffered to remain over the iodine too long, the gold colour passes into violet, and in this state the coating is not so sensitive to the impressions of light: on the contrary, if not long enough, the coating will be too pale, and will not produce a good picture. A decided gold colour is the only assurance that the ground is properly prepared. The time for this cannot be determined, because it depends upon several circumstances. Of these the two principal are the temperature of the apartment, and the state of the apparatus. The effect should be produced entirely by the spontaneous evaporation of the iodine by the temperature of the room in which the operation is performed. It is also very important that the temperature of the inside of the box be the same as that of the air outside, for otherwise, a deposition of moisture will take place upon the plate, a circumstance detrimental to the final result. The oftener the apparatus has been used, the less time is required, because the interior of the box being impregnated with the vapours of iodine, these evolve from all sides, and condense more equally and rapidly upon the surface of the plate. It is therefore proper to leave always a small quantity of iodine in the cup, and to protect it from damp. An apparatus which has been some time in use, is thus preferable to a new box.

The time may vary from five minutes to half an hour, rarely more, unless the weather be cold. Means must be adopted for examining the plate from time to time, and in these examinations the light must not fall directly upon the plate. When the operator desires to inspect it, he raises the lid of the box, and lifting the board with both hands, turns up the plate quickly; a momentary glance and very little light suffices. If it appear that the colour is deeper on one portion of the plate than on another, to equalize the coating the plate must be replaced, turning it one quarter round at each inspection. The process must be conducted in a darkened apartment into which the light is admitted side-ways, never from the roof—the door left a little ajar answers best. If too pale, the plate must be instantly replaced, till it attain the proper gold tone; but if this tint be passed, the coating is useless, and the operations must be repeated from the commencement.

When the coating has reached the proper colour, the plate with the board to which it is fixed, is slipped into the frame (figs. 3, 4 and 5) and adjusted at once in the camera. In this transfer care must be taken to protect the plate from the light; a taper should be used, and even this with precaution; as a taper light will leave traces of its action if continued for any length of time.

The third operation, that of the camera, should *immediately* succeed the second, the longest interval ought not to exceed an hour. Beyond this space the action of the iodine and silver is no longer effective.

Third Operation—The Camera.—This third operation is that in which by means of light, acting through the camera, an image is impressed on the photographic plate. This operation, being accomplished only through the agency of light, will be the more rapid, in proportion as the objects to be delineated stand exposed to a strong illumination, or naturally present prominent and bright lines and surfaces.

The adjustment of the camera to obtain a good view being made with satisfactory precision, the obscured glass is to be withdrawn, and its place is supplied by the apparatus with the plate attached, as already described, secured by small screws. The light is of course all this time excluded by the inner doors; these are now opened by means of two semicircles (see figures), and the plate is disposed to receive its impression.

To determine the time necessary to effect the desired object is a task of some nicety, because nothing is visible; and the photogenic effect depends entirely on the intensity of the light on the objects, the appearance of which is to be produced. At Paris, for example, this varies from three to thirty minutes.

The seasons, as well as the hour of the day, have considerable influence on the operation. The most favourable time is from seven to three o'clock; and a drawing which, in the months of June and July at Paris, may be taken in three or four minutes, will require five or six in May or August, seven or eight in April and September, and so on in proportion to the progress of the season. These are only general data for very bright or strongly illuminated objects, for it often happens that twenty minutes are necessary in the most favourable months, when the objects are entirely in the shadow. The latitude is of course a fixed element in this calculation. In the south of France, for example, and generally in all those countries in which light has great intensity, as Spain, Italy, &c., we can easily understand that these designs must be obtained with greater promptitude than in more northern regions. Practice is the only sure guide. It is, however, very important not to exceed the time necessary, in different circumstances, for producing a picture, because, in that case, the lights in the drawing will not be clear, but will be blackened by too-prolonged solarization. If, on the contrary, the time has been too short, the sketch will be very vague, and without the proper details.

Immediately the plate is withdrawn from the camera, it should be subjected to the next process; there ought, at most, not to be a longer interval allowed to elapse than an hour, between the third and fourth operations.

Fourth Operation—Mercurial or Disengaging Process.—By means of a funnel the mercury is poured into the cup C at the bottom of the larger vessel in the apparatus, figs. 8, 9, and 10, sufficiently to cover the bulb of a thermometer F. Afterwards, and throughout the remaining operations, no light save that of a taper must be used.

The board with the plate affixed is now to be withdrawn from the camera frame, and placed within the ledges of the black iron stand or vessel (figs. 8, 9, and 10), at an angle of 45°, the tablet with sketch downwards. It can be seen and examined through the glass G. The top A is then gently put down, so as not to raise up particles of the mercury.

The spirit lamp is to be lighted, and placed under the cup containing mercury, and allowed to continue till the thermometer, the bulb of which is covered by the mercury, indicates a temperature of 60° centigrade. The lamp is then immediately withdrawn; if the thermometer has risen rapidly, it will continue to rise without the aid of the lamp, but this elevation ought not to exceed 75° centigrade.

In a few minutes the faint tracery of objects begins to appear, as may be seen by looking through the glass G, by the light of a taper, using it cautiously, that its rays may not fall upon the plate. The operation is continued till the thermometer sinks to 45° centigrade; the plate is then withdrawn.

When the objects have been strongly illuminated, or when the action in the camera has been continued rather too long, this fourth operation is completed before the thermometer has fallen even to 55° centigrade. This may be known by observing the sketch through the glass.

The sketch may now be examined by a feeble light in order to be certain that the processes hitherto have succeeded. The plate is now detached from the board. The performance of the fifth and last operation may be deferred if not convenient; for the sketch may now be kept for months without alteration, provided it be not too frequently inspected by daylight.

Fifth Operation—Fixing the Impression.—The object of this process is to remove from the tablet the coating of iodine, which continuing to decompose by light the picture would otherwise be speedily destroyed.

One quarter of common salt and three-fourths of pure water (in bulk) is put into a bottle and shaken, and the saturated solution thus made is to be filtered through paper. Instead of the solution of salt one of hyposulphate of soda may be used, and is even preferable, because it removes the iodine entirely, which the saline solution does not always accomplish, especially when the sketches have been laid aside for some time between the fourth and fifth operations. It does not require to be warmed, and a less quantity is required.

Pour the solution into a square shallow trough of copper provided for the purpose, filling it to the height of an inch; pour water into another similar trough.

The plate is first to be plunged and withdrawn immediately from the water—the surface merely requiring to be moistened—then into the saline solution. The plate is moved about in saline solution by means of a little hoop of copper wire. When the yellow colour has been quite removed, the plate is lifted out with both hands, care being taken not to touch the drawing, and plunged again into the trough of pure water.

The plate on being withdrawn from the trough is instantly placed upon the inclined planes (figs. 11, 12); distilled water, hot but not boiling, is made to flow in a stream over its whole surface, carrying away every remaining portion of the saline wash. If hyposulphate has been used, the distilled water need not be so hot as when common salt has been employed.

About a quart of distilled water is required. The drops of water remaining on the plate must be removed by forcibly blowing upon it, otherwise in drying they would leave stains on the drawing. Very pure water should be used. To be assured of the purity of the water, let a drop fall upon a piece of polished metal; evaporate by heat, and if no stain be left the water is pure, Distilled water is always sufficiently pure without this trial.

After this washing the drawing is finished, it remains only to preserve it from the dust, and from vapours that might tarnish the silver. The mercury, by the action of which the images are rendered visible, is partially decomposed; it resists washing, by adhesion to the silver, but will not endure the slightest rubbing.

To preserve the sketches thus made, place them in squares of strong pasteboard, with a glass over them, and frame the whole in wood. They are thenceforth unalterable even by the sun's light.

The same plate may be employed for several successive trials, provided the silver be not polished through to the copper. But it is very important after each trial to remove the mercury immediately, by using the pumice powder with oil, and changing the cotton frequently during the operation. If this be neglected, the mercury adheres to the silver, and fine drawings cannot be obtained if the amalgam be present. They always in this case want firmness, neatness, and vigour of outline and general effect.

Description of the Engravings.

Fig. 1 is a section of the box for submitting the plate to the vapour of iodine, used in the second operation, down the middle of the apparatus by the line A B, of fig. 2, which is a plan; C is a lid, which fits accurately the interior, dividing the whole into two chambers. It is closed at all times, except when the operator is actually employed in coating the tablet. Its use is to concentrate the vapour of the iodine, and preserve the whole in a state for equally and rapidly diffusing the vapour, when the plate has been introduced. D is the cup in which the iodine is placed. E the small board with the plate attached, face downwards. Four small projecting supports, F, receive the four corners and retain the plate in the most favourable position for receiving the vapour of the iodine as it rises. Of course the cover C is then withdrawn. G is the lid of the box, always shut except when the plate is to be withdrawn for examination. H, supports for C. K, tapering sides all round, forming a funnel-shaped box within the other; the funnel-shaped interior diffuses the vapours of iodine, which thus spread as they rise. A circle of gauze is stretched over a ring, and placed upon the cup with the iodine. The vapour of which rising through this light covering, flows up equally, and not in clouds; the gauze also prevents the particles of this substance from flying about, and probably injuring the plate.

Figs. 3, 4, and 5, (p. 467) are three views of the frame into which the plate with its wooden tablet is put, on removal from the iodine process. The object of the apparatus is twofold—to adapt the plate to the camera obscura, and to protect the iodine coating from the action of light till the moment in which it receives the focal image. A, half circles which open and shut the doors B B; C, fig. 5, the plate with its wooden tablet fitted into the frame; back view of the plate fronting inwards, the door shut upon it; D screws to fix the tablet and plate, and to stop the doors; E thickness of the frame; F, fig. 4, plate: the whole represents the arrangement for receiving the photogenic impressions on the plate; the doors being open, the focal image

falls upon the prepared plate, and leaves its impress pencilled there by the rays of light proceeding from the natural objects.

Fig. 6, perpendicular longitudinal section of the camera obscura, as adapted to photogenic delineation. A, a ground glass by which the focus is adjusted. It is then removed, and the photographic plate substituted, as in C, fig. 7; B, a mirror for observing the effect of objects, and selecting points of view. For these purposes it is inclined at an angle of 45°, by means of the support L. To adjust the focus, the mirror is put down altogether, and the ground glass A used. The focus is easily adjusted by means of one part of the box D D silding within the other E E, as represented in the figures; when the focus is adjusted the box is fixed in position by the screw H. The mirror is retained in its place by hooks at F, which take into the eyes at G.

This instrument has the disadvantage of reversing the objects; but this can be easily obviated by substituting another mirror outside, as K J, fig. 7. This arrangement, however, injures the effect on the photographic plate from the loss of light. It increases the time of the operation by one-third of the whole.

Figs. 8, 9, and 10, are three views of the apparatus, used for the fourth operation,—submitting the plate to the vapour of mercury; fig. 8 is a section of the apparatus; fig. 9 front view of the same; fig. 10 the side in which the thermometer is placed; A, lid of the apparatus; B, back board with grooves to receive the small board and plate; C cup containing mercury; D, lamp with spirit of wine; E, small cock inserted obliquely, through which the mercury is withdrawn after the operation; F, thermometer; G, glass through which to inspect the operation; H, tablet with the plate as removed from the camera; I, stand for the spirit lamp, which is placed within the ring N, so as to be under the centre of the cup. All the interior of this apparatus should be black and varnished.

Figs. 11 and 12 represent the apparatus for the operation of washing the plate.

This apparatus is made of japanned white iron or tin; E, well for receiving the water that flows through the tube C.

Fig. 13, the board or wooden tablet upon which the plate is fixed for the purpose of undergoing the operations after the first one of polishing. It is fastened by means of the ledges, B B B B, to each of which are soldered two small projecting pieces or ears, these embrace the plate near the corners, and it is retained in position by small pegs, or better, screws through holes in the ledges, inserted by a handle or turn-screw. The purpose of the ledges is not solely to fix the plate, their more important use is to serve as a kind of frame to it, while undergoing the second process, the application of the iodine: without these the coating of iodine would not be equally diffused, for the vapour would condense more rapidly along the edges, and consequently, the coating would be too thin in the centre and too thick round the circumference.

THE "BRITISH QUEEN" AND "GREAT WESTERN"—MR. HALL'S CONDENSERS.

Magna est veritas et prevalebit.

Sir,—I appeal to you, whether in my *trashy* attempt to run down the engines of the *Great Western*, I have at all acted on the offensive;—whether I have done more than acting merely on the defensive? I contend that I have not stated a word more about the breaking of the frame-work and other injuries to the engines of the *Great Western* than was necessary to contradict the unfair comparison made between them and those of the *British Queen*. The warfare between the London and Scotch engineers was not commenced by me but by Mr. "Piston" *cum* "Observator." If what I have stated about the *Great Western* be untrue, why does "Piston," (to use his elegant phraseology) *shirk* the matter? Why does he not contradict me by stating that the framings of her engines are *not* broken in many places, that the cylinders and pistons are *not* galled nor furrowed, and that the boilers are not injured?

I hope that "Piston" will, in his future communications, confine himself to fair fighting, and use no foul play, or, in other words, that he will speak the truth, which I will prove to you he has, in many instances, violated, during his

combat with Mr. H., who, *poor man*, seems to have attracted all the thunder and lightning from the dread Mr. "Piston," and has diverted it not only away from me, but from all the Scotch engines and Scotch engineers. We ought *en passant* all to praise so good a conductor of the electric or *pistonic* fluid, by which we are, perhaps, saved from annihilation.

I venture to thank "Piston," on Mr. Hall's behalf, for the seven further advantages of the patent condensers, which are added to those enumerated by Mr. Hall.

In answer to the 11th and 12th, I say that it is untrue, that the additional expense of engines with his condensers, is so great as is stated, unless the engines have both the improved and the common condensers; but admitting, for argument's sake, that "Piston" has not exaggerated the additional expense, I will undertake to prove, to any competent scientific men, (except boiler makers and others who are interested in the rapid destruction of boilers and engines) that the immediate and consequential advantages and economy of Mr. Hall's condensers, will repay the additional expenses, inclusive of (to use "Piston's" witty expression) *my* patent right, within the first eighteen months, taking the average of ten or twelve years as the datum to calculate upon, within which period boilers supplied with salt and dirty water must be replaced three or four times.

Mr. "Piston's" 13th article is principally an attack upon Mr. Hall's principle of distillation, the rest being "all but leather and prunella." Now I assert that his principle of distilling *in vacuo*, whereby a large quantity of pure water can be produced without the application of any fire to the still, but merely by the heat of boiling water, is a most beautiful and scientific invention, of which he has reason to be proud. In article 14th, "Piston" speaks of the multiplication of pipes and cocks in the engine-room; I presume he means the pipes and cocks connecting the small vessel constituting the still, with the condenser whereby the distillation in vacuo is effected, the operation being stopped or commenced by the simple shutting or opening of such cocks; let any person examine this beautiful process, and I have no doubt but he will be of my opinion respecting its merit. But "Piston" should (joking apart) be candid; he should tell you that the use of more cocks and apparatus is done away with by these condensers than is added by them; for instance, the use of injection cocks, of the blow-out cocks, of the pumps and apparatus for feeding the boiler is done away with, and the brass linings of the air pumps and brass buckets and rods are unnecessary, on account of none but pure distilled water and a little oil entering into them. "Piston" states as follows:—"Of the multiplication of cocks and pipes in the engine-room to such an extent that a previous six months education at Basford is necessary to enable the engine-men to comprehend their nature and working." Now, I have no hesitation in stating that this is a mis-statement altogether. I have made the needful inquiries and am informed that not a single engineer aboard any of the many vessels to which Mr. Hall's condensers are applied ever was at Basford at all. I beg to refer Mr. "Piston" to the motto of this letter.

In answer to "Piston's" witticisms respecting Mr. Hall's method of cleansing the pipes, if ever necessary, (which, indeed, is seldom the case) I say that, like his distillation *in vacuo*, it is a most beautiful process, for if the pipes were not clean they can be rendered as perfectly so as when they were first put in, in a quarter of an hour, and that without stopping the engines; this is done by injecting into the top of the condenser, (through a half-inch pipe) a few gallons of solution of potash, which rushes through the pipes and cleans them perfectly; these few gallons are not sent into the boiler but are allowed to escape into the bilge. These things, at which "Piston" sneers, render the invention complete; Mr. Hall has perhaps as much merit from them, and from the practical management of his apparatus, as for his invention itself.

I really wish, Mr. Editor, that you could see this process, and that of the distillation *in vacuo*; I assure you you would be delighted with them, and be enabled to judge of the amount of "Piston's" disingenuousness.

In answer to "Piston's" statement respecting the additional weight of the patent condensers, I assert that it is grossly exaggerated, unless he means such en-