Received November 19, 1767.

L. *Experiments on the Diſtillation of Acids, volatile Alkalies, &c. ſhewing how they may be condenſed without Loſs, and how thereby we may avoid diſagreeable and noxious Fumes: In a Letter from Mr.* Peter Woulfe, *F. R. S. to* John Ellis, *Eſq; F. R. S.*

Title read December 17, 1767.

SIR,

Read Feb. 4, 1768.

IN the common manner of diſtillation there eſcapes a great quantity of fumes, which cannot be condenſed; and in ſeveral operations theſe fumes are very hurtful to the lungs. By the following method of diſtillation theſe fumes are totally condenſed, which makes a great ſaving in ſome diſtillations, and the operator is in no danger of being hurt by any pernicious vapours.

This new method conſiſts in making the fumes paſs by a ſmall glaſs tube through water, which hereby becomes charged with the vapours, that would otherwiſe eſcape.

Deſcription

Deſcription of the apparatus, TAB. XXV.

Fig. 1.

A a retort.

B a receiver, with a ſpout at bottom, for the diſtilling liquor to run into the bottle C; the recipient has alſo a ſmall opening on one ſide at D.

E a crooked tube $\frac{1}{10}$ and $\frac{1}{2}$ of an inch bore.

F a veſſel containing water.

The crooked tube E is fitted to the ſpout D of the receiver by means of a cork with a hole in its middle, and then well covered with lute; the other end of it goes to the bottom of the veſſel F, to the mouth of which it is fitted by a cork, with a ſemicircular notch in it as at G, but without any lute to faſten it, as there muſt be a ſmall vent for the eſcape of the elaſtic air, and this is the only vent in all the apparatus for that purpoſe. By this apparatus the fumes are obliged to paſs through the water in F, and there depoſit all they contain, except their elaſtic air.

In moſt diſtillations there is a quantity of air abſorbed at different times during the proceſs; and in this caſe the external air would preſs on the water at F, and force it by the tube into the veſſel C, which might ſpoil the diſtilled liquor. This may be prevented by letting air into the receiver or bottle C, by boring a hole through the lute; this however may be inconvenient, on account of the conſtant attendance which is neceſſary; but the following apparatus will prevent it. See figure 2. It

conſiſts

conſiſts in fitting an empty veſſel H, to the apparatus deſcribed before, See figure 1. By this means the water is forced into H, and by the ſtopper at L it may be emptied, and put back into the veſſel F, the crooked tubes D and I are fitted to H, by a cork with two oppoſite ſemicircular notches as at K, and then well covered with lute.

Experiment I.

On the diſtillation of ſal ammoniac with quick lime.

12 ℔ * of Britiſh ſal ammoniac, and 26 ℔ of quick lime were powdered, mixed, and put into the iron body A (fig. 3.); and when the apparatus † was luted, a gallon of water was poured on it through the orifice (b), which was immediately ſtopped; the lime growing hot produced a vaſt quantity of elaſtic air, which though highly charged with volatile alkaly was condenſed by the water in F, fig. 2. the air only eſcaping at the top of this veſſel with hardly any ſenſible volatile alkaline ſmell. Next morning, all being cold, another gallon of water was added as before, and a very ſlow fire made under the body for 14 hours, in which time there diſtilled near a pound of volatile alkaly; the fire was then made ſtronger, and continued in that ſtate for twelve hours more, in which time there was obtained, together with what was firſt diſtilled, 8 ℔ $\frac{1}{4}$ of volatile alkaly, ſtrong and fit for Eau de luce; this was taken out of the bottle and ſet apart. The veſſels being cool,

* In all the experiments averdupois weight was made uſe of.

† The ſpout of the ſtone head belonging to the body A, figure 3, is to be luted to the receiver B, figure 2.

two

two gallons more of water were put into the body, and the fire made as before, and continued till there was 7 ℔ diſtilled of weak volatile ſpirit; this anſwers better than water for a freſh diſtillation of ſal ammoniac and lime.

During the firſt 16 hours of the diſtillation, there continually eſcaped through the water of F elaſtic air very ſlightly charged with volatile alkaly, eſpecially when the water grew hot; but during the remaining time of the diſtillation, no elaſtic air was ſet free.

Two ſtone gallon bottles, with three quarts of water in each, were made uſe of to condenſe the vapours; and when one bottle was grown warm by the fumes, the other was put in its place, while it was a cooling in a veſſel of cold water; and ſo continually changed during the whole operation. The ſix quarts of water encreaſed by this means 2 ℔ and ½ in weight; and, by the following experiments it appears, that a pound of this vapour condenſed in the water is to a pound of the volatile alkaly, which was ſet apart for Eau de luce, as 140 to 76, which is nearly twice as ſtrong; therefore there was a ſaving of near 5 ℔ of volatile alkaly, which would have been loſt in the common manner of diſtillation.

The water of the two ſtone bottles charged with alkaline vapours was mixed, in order to reduce them to the ſame degree of ſtrength, and as much of it was put into a glaſs cucurbit as contained four ounces of the alkaline vapour; four ounces of the volatile alkaly, which was ſet apart for Eau de luce was put into another cucurbit of the ſame ſize, and

and diluted with water to the ſame volume of the other.

This laſt took 1 ℔ 3 ℥ of acid of vitriol, diluted with water, to be ſaturated, and did not grow hot; wheras the water containing the four ounces of alkaline vapours took up 2 ℔ 3 ℥ of the ſame acid of vitriol, and grew ſo very hot, that the veſſel could ſcarce be held in the hand, even after having been diluted at different times with two quarts of water. This ſhews that there is a great difference in the two, and that it is not intirely owing to ſtrength.

The heat produced by the vapours paſſing through the water, was tried at another diſtillation, and raiſed the quickſilver in Fahrenheit's thermometer to 110 degrees.

In rectifying cauſtic volatile alkaly with lime, there is likewiſe a very great quantity of elaſtic air ſet free, highly charged with volatile alkaly, which condenſes in water and heats it.

Water may be ſo ſtrongly charged with this vapour, that it will make very ſtrong Eau de luce, nay, much ſtronger than that which we ſaid before was diſtilled and ſet apart for Eau de luce: but it is neceſſary, as mentioned before, to make uſe of two ſtone bottles, changing them as often as they grow warm.

Experiment II.

On the diſtillation of the acid of ſalt by means of the acid of vitriol; for the apparatus ſee fig. 2.

* A green quart retort coated with loam was made uſe of for this experiment, and it was placed

* What goes by the name of a quart retort holds better than two gallons of water.

in a reverberatory furnace on a naked fire; 14 ℔ of common ſalt was put into it, and on that the like quantity of oil of vitriol, which had been diluted the day before with 7 ℔ of water; the retort was then immediately luted to the recipient, and the diſtillation conducted in the common manner: the operation continued 16 hours, when hardly any more liquor would come over with a ſtrong fire.

To condenſe the vapours, two ſtone gallon bottles with three quarts of water in each were made uſe of, as in the former experiment.

In this operation there was obtained 9 ℔ 5 ℥ and ½ of ſpirit of ſalt, which dropped into the bottle C; the ſix quarts of water in the ſtone bottles increaſed in weight 6 ℔ 12 ℥ and ½; the caput mortuum weight 18 ℔ 6 ℥; ſo that in this operation there was only a loſs of eight ounces, which is but $\frac{1}{70}$ part of the whole, which probably was moſtly elaſtic air.

Experiment III.

The ſame operation was repeated with a flower fire, which continued for 23 hours, after which time hardly any more liquor would come over with a ſtrong fire.

There were here produced 11 ℔ 10 ℥ of ſpirit of ſalt, in the bottle C; the ſix quarts of water increaſed in weight 3 ℔ 10 ℥, and the caput mortuum weighed 19 ℔ 4 ℥; the loſs was the ſame as in the foregoing experiment.

In order to know the different degrees of ſtrength of the acids produced in theſe two experiments, they

they were ſaturated with a fixed alkaly diſſolved in water.

Four ounces of the acid in experiment II, which diſtilled into C, took of the alkaline liquor to be ſaturated 13℥ 5℥ 2ʒ.

As much of the water * in experiment II, as contained 4℥ of vapour took to be ſaturated 1 ℔ 9℥.

Four ounces of the acid in experiment III, which dropped into C, took of the ſame alkaline liquor to be ſaturated 12℥ ½.

As much of the water of experiment III, as contained; four ounces of vapour † took to be ſaturated 2 ℔ 6 ℥.

Four ounces of oil of vitriol, which was to water in weight as 24 to 13, took of the ſame alkaline liquor to ſaturate it 1 ℔ 10℥ 7ʒ, which ſhews that oil of vitriol is not ſo ſtrong an acid as the vapour of ſpirit of ſalt, when condenſed in water and diſtilled ſlowly, as in experiment III.

From the foregoing experiments it appears, that 1 ℔ of the ſpirit of ſalt vapour, condenſed in the water in experiment II, is to 1 ℔ of the acid of ſalt, which dropped into C of the ſame experiment, as 200 is to 109, which is near double; and therefore the 6 ℔ 12℥ and ½ of the vapour, which condenſed in the water, is equal very nearly to 13 ℔ 1 ℥ of the acid which is diſtilled in C: ſo that by this method of diſtillation, this great proportion of acid is ſaved, and thoſe diſagreeable ſuffocating fumes avoided.

* The water of the two bottles was mixed together; for they were of different ſtrength.

† The water of theſe two bottles were likewiſe mixed together for the ſame reaſon.

In experiment III, 1 ℔ of the acid vapours, which condenſed in the water is to 1 ℔ of the acid of ſalt which dropped into C, as 131 is to 50, or as 2 $\frac{31}{50}$ to 1; and therefore the 3 ℔ 10 ℥ of acid vapours, which condenſed in the water, is almoſt equal to 9 ℔ and $\frac{1}{2}$ of what diſtilled into C.

It further appears, that the ſlower the diſtillation is conducted, the more concentrated are the acid vapours that condenſe in water. In order to ſee whether there was any difference in the ſtrength of the acid vapours, which were condenſed in the water from the firſt to the laſt of the diſtillation, the following experiments were made.

Five pound of common ſalt, with 5 ℔ of oil of vitriol were diſtilled in a tubulated retort, and three bottles with an equal quantity of water in each were made uſe of to condenſe the vapours.

The firſt bottle increaſed in weight 3 ℥, and during this time, which was twelve hours, there was no fire under the retort; that bottle being taken away, another bottle put under, a fire was made; this bottle increaſed in weight 1 ℔ and half an ounce, the third bottle increaſed 10 ℥ and a half.

As much water of each of the three bottles as contained one ounce and a half of the acid fumes was ſaturated with an alkaly diſſolved in water.

The water of the firſt bottle took to be ſaturated	11 ℥ $\frac{1}{2}$ a dram.
The ſecond bottle took up	10 ℥ 2 ℥ 2 ℈
The third bottle	10 ℥ 1 ℥
An ounce and half of oil of vitriol, which was to water, as 226 to 118 nearly, took up of the ſame alkaly	7 ℥ 6 ℥

By which it appears that the fumes, which firſt aroſe without fire, are ſtronger than the ſecond, and the ſecond than the third.

It appears further, that the moſt concentrated portion of the acid of ſea ſalt is the moſt volatile, and that in ſtrength it is to the oil of vitriol mentioned before, as 44 $\frac{1}{4}$ to 31.

* In order to try the purity of the acid vapours, which were condenſed in the water, and of the acid, which diſtilled into the bottle C, the following experiments were made, and are marked a, b, c, d.

(a) Four ounces of the ſpirit of ſalt of the 2d experiment, was perfectly ſaturated with 4 ℥ of whiting.

(b) Four ounces of the ſpirit of ſalt of the 3d experiment, was perfectly ſaturated with 4 ℥ of ditto.

(c) As much water as contained 4 ℥ of vapour of the 2d experiment, was ſaturated with 5 ℥ of ditto.

(d) As much water as contained 4 ℥ of vapour of the 3d experiment, was ſaturated with 6 ℥ of ditto.

The reaſon of uſing more whiting with ſome than with others, was on account of the different ſtrength of the acids; and as there was a greater quantity of whiting than neceſſary uſed in theſe experiments to ſaturate the acids, the undiſſolved

* This depends on the property of the acid of vitriol, and the acid of ſea ſalt, combined with a calcareous earth; for this earth, combined with the acid of ſea ſalt, forms a very ſoluble ſubſtance; whereas the ſame earth, with the acid of vitriol, forms a ſubſtance inſoluble (or almoſt ſo), called ſelenite.

part

part muſt conſiſt of whiting; and, if any acid of vitriol in the acids, of whiting and ſelenite.

In order to ſeparate the ſelenite from the whiting, a large portion of diſtilled vinegar was made uſe of, which diſſolves the whiting, it being a calcareous earth; and in order to promote the ſolution, heat was made uſe of.

The undiſſolved part of (a) being perfectly ſaturated with a ſufficient quantity of diſtilled vinegar, and afterwards repeatedly waſhed with pure water, and dried, weighed ½ oz. and 26 gr.

(b) treated as (a) weighed ½ oz. and 52 gr.

(c) treated as (a) weighed 39 gr.

(d) treated as (a) weighed 42 gr.

* One ounce of whiting treated as (a) left 7 gr.

From theſe experiments it appears, that the

Four ounces of acid marked (a) contain as much acid of vitriol as will make

½ an oz. leſs 2 gr. of ſelenite.

Four ounces of acid marked (b)

½ an oz. and 24 gr. of ditto.

Four ounces of the acid vapour marked (c)

4 gr. of ditto.

Four ounces of the acid vapour marked (d) none.

Hence it is evident, that the vapour of the acid of ſalt condenſed in water, when diſtilled ſlow, contains no acid of vitriol; and that even when it is diſtilled quick, it contains ſo ſmall a quantity as is not worth notice.

* As whiting contains ſome parts which are not ſoluble in diſtilled vinegar, it was neceſſary to know how much of this an ounce contained, which muſt be deducted in proportion to the quantity uſed for the experiments a, b, c, and d.

If

If 10 ℥ of ſea ſalt are diſtilled in the common manner with an equal quantity of oil of vitriol unmixed with water, there only diſtil 2 ℥ of ſpirit of ſalt; whereas, if diſtilled in this new manner, we not only obtain the like quantity, but likewiſe 4 ℥ and ½ half more, which are condenſed in the water; ſo that in making this concentrated ſpirit of ſea ſalt, there is a ſaving of above double the quantity, which would be loſt in the common method of operating.

Of the heat produced by the vapours of ſpirit of ſalt paſſing through water, ſpirits of wine, and oil of turpentine:

Three quarts of water were put into a gallon ſtone bottle, and made uſe of to condenſe the vapours, as in experiment the 2d, fig. F; in three hours and a half after the fire was made under the retort, the water in the ſtone bottle had acquired the degree of 212, which is the mark of boiling water in Fahrenheit's thermometer; and at this time there was ſcarcely 2 ℥ of ſpirit of ſalt diſtilled into the bottle, fig. C. The receiver and bottle C ſeemed cold to the touch; the water at F had increaſed 2 ℔ 3 ℥. Another like bottle with the ſame quantity of water being put in the room of this, in ſome time, acquired the ſame degree of heat. The fumes ſeem to condenſe very well until the water acquired a heat within twelve degrees of boiling water.

Spirit of wine rectified, made uſe of inſtead of water to condenſe the vapours, acquires a heat equal to 188 degrees; and it grows of a deep brown colour, though tranſparent.

Oil

Oil of turpentine applied to the ſame uſe acquires a heat of 12 degrees above that of boiling water, or 224 degrees; it becomes of a dark brown colour, though tranſparent, and has a diſagreeable bituminous ſmell. The thermometer not meaſuring more than 213 degrees, could not be left in with ſafety any longer.

Another time oil of turpentine was made uſe of to condenſe the vapours, which proceeded from 1 lb $\frac{1}{2}$ of ſal ammoniac, with 1 lb $\frac{1}{2}$ of oil of vitriol, and $\frac{3}{4}$ of a pound of water: here it did not grow near ſo hot, nor ſo high coloured, as in the other experiment, but was for the moſt part congealed.

The difference of theſe two experiments may, perhaps, be owing to the ſmallneſs of the quantity of the ingredients in the laſt proceſs; for in the firſt there was 14 lb of ſalt, 14 lb of oil of vitriol, and 7 lb of water.

Of the re-abſorbtion of Air in Diſtillations.

In all diſtillations a quantity of elaſtic air is ſet free in the beginning, but afterwards there is a re-abſorbtion of the ſame; the following experiment was made to ſhew how great it is in ſome caſes.

For the apparatus, ſee fig. 1.

One pound and a half of foreign ſal ammoniac was put into a retort, and 1 lb $\frac{1}{2}$ of oil of vitriol (previouſly diluted the day before with $\frac{3}{4}$ of a pound of water) poured on it, and a recipient well luted to it; the recipient had a tube 31 inches, well fitted and luted to it; and this tube was immerſed in a glaſs veſſel containing a quart of water.

The

	lb	℥	ʒ
The ſpirit of ſalt which was diſtilled, weighed	1	2	5
The quart of water increaſed in weight		5	4
The caput mortuum weigh'd	2	3	4
The loſs in the operation was only			3
	3	12	

The operation was continued till the ſal ammoniac began to ſublime.

When no more air eſcaped, which might eaſily be perceived by its ceaſing to bubble through the water, the veſſel of water was taken away, and the tube was immerſed in a baſon of quickſilver; the mercury roſe in the tube 23 inches and a half, whilſt the recipient was too hot to bear one's hand on it longer than half a minute; when the recipient was quite cold, the mercury roſe to 29 inches and $\frac{7}{16}$, and there was near one inch of ſpirit of ſalt on its ſurface. This experiment was tried the 11th of November, when the barometer was at 30 inches. In order to make this experiment ſucceed, it is of the utmoſt conſequence to lute well the veſſels.

On the Marine Æther.

The Marquis De Courtenveau, of the Royal Academy of Sciences of Paris, has publiſhed a very curious memoir in their Tranſactions, on the making of Marine Æther, by diſtilling ſpirit of wine with the * liquor fumans of Libavius; but no one, that I know of, has ſucceeded in making it with the pure ſpirit of ſalt. It was natural to conclude

* The liquor fumans is made by diſtilling mercury ſublimate with tin, and is compoſed of the acid of ſalt united with tin.

from the extreme great acidity of the fumes of ſpirit of ſalt, that Æther might be made by ſaturating rectified ſpirits of wine with them; and on trial I found it anſwer, though not in a large quantity.

The ſpirit of wine, charged with the acid vapours, muſt be diſtilled and cohabated, and then rectified with a ſlow degree of fire *.

The method that Monſ. Beaumé of Paris propoſed to make this Æther, and which did not ſucceed with him on account of his not being able to condenſe the fumes, anſwered well with me; and it conſiſts of combining the vapours of ſpirit of ſalt with thoſe of ſpirit of wine. The apparatus that I made uſe of for this purpoſe is deſcribed at fig. 4, and the proceſs is as follows:

Eight pound of ſea ſalt was put into the retort B, and two quarts of rectified ſpirit of wine into the retort D; three pints of the ſame ſpirits of wine were put into each of the glaſs veſſels I and K, in order to condenſe the fumes, one not being ſufficient; all being well luted and ſecured, the ſpirits of wine in D were made to boil, and then 7 lb of oil of vitriol was poured on the ſalt in the retort B, at ten or twelve different times, ſeven minutes between each time, leſt the mixture ſhould boil over; then a fire was made under this retort, and both fires kept up till the operation was over. The quantity of liquor in the veſſels I and K, increaſes conſiderably from the vapours that condenſe therein; and the veſſel I in particular grows very hot, and being

* As I have ſhewn before, that the vapours of the acid of ſalt, which condenſe in water, are free from the acid of vitriol, we may be certain, that the acid of vitriol did not contribute to form this Æther.

highly

highly charged with vapour is rendered incapable of condenſing any more; the vapours then paſs on to the veſſel K, and heat that alſo.

The liquor then that was diſtilled into the veſſel F, was mixed with the liquor of the veſſels I and K, then being * diſtilled, cohabated and rectified ſlowly with ſlacked lime, produced a very ſubtile penetrating Æther; it is very remarkable, that this, though free from acid, upon mixing it with water, cauſed a violent ebullition.

An expeditious method of making Nitrous Æther by Diſtillation, without Fire.

(See fig. 5.) Pour ſix ounces of the moſt concentrated ſpirit of nitre, little by little, on eight ounces of rectified ſpirit of wine, ſhaking the veſſel each time in which the mixture is made.

Then convey it by a long funnel through the opening of the head at C, into the matraſs A; the opening is afterwards ſecured by a glaſs ſtopper; in warm weather this mixture grows hot in five or ſix minutes, and diſtills in a ſtream into the veſſel E, and is over in about half an hour. Before the matraſs grows cold, a freſh mixture is put in as above, and ſo on for five or ſix times, till there is liquor enough diſtilled. This liquor being ſlowly rectified

* Spirits of wine was uſed likewiſe here to condenſe the vapours; and though the diſtillation was conducted with a very ſlow fire, yet the ſpirits of wine grew very hot. Spirit of wine was likewiſe uſed to condenſe the vapours in the cohabation, but they did not grow hot.

This liquor without cohabation affords Æther, but not ſo great a quantity.

with ſlacked lime, makes very fine Æther. The ſpirit of wine, which was put into the veſſels E and F to condenſe the vapours, is ſo highly charged with Æther, that it will ſeparate on waſhing with water. This ſpirit of wine is alſo an exceeding rich ſpiritus nitri dulcis.

What remains in the matraſs contains a quantity of ſpirits of wine, which may be ſeparated by diſtillation.

On the Diſtillation of the Nitrous Acid, ſee fig. 2.

The quantity that is condenſed in water during the diſtillation of this acid ſpirit is ſo ſmall, that it would be ſcarce worth ſaving, if it was not to prevent thoſe noxious fumes, which have ſuch an effect on the lungs of the operator, as frequently to make him ſpit blood.

Water highly charged with theſe fumes by repeated diſtillations becomes blue, and retains its colour *.

I once diſtilled, in an iron body with a ſtone head, 30 lb of nitre, with 60 lb of green vitriol, which I had calcined to whiteneſs, and was obliged to make uſe of two veſſels of water, as in fig. 5, at F and G, to condenſe the vapours: this water became

* Oil of vitriol was uſed in this operation, to ſet free the acid of nitre; and I found upon trial the fumes condenſed in the water to be a pure ſpirit of nitre: whereas, in the other operation, where calcined vitriol or copperas was uſed, the fumes contained ſome acid of ſalt. This led me to try the common green copperas, and I found it contained a portion of iron united to the acid of ſalt: whereas the Dantzick copperas or vitriol contains no acid of ſalt, and therefore is fitter to make an aqua fortis for the refiners uſe.

blue in one diſtillation, and continued ſo for 18 months, till I made uſe of it.

A great quantity of air was ſet free from the beginning to the end of the diſtillation, owing in a great meaſure to the acid fumes acting on the iron body; for if diſtilled in a glaſs or ſtone veſſel, the quantity of air is not near ſo conſiderable.

The nitrous fumes condenſed in water, in making the ſpiritus nitri fortis appear to be more acid than the ſtrongeſt oil of vitriol made uſe of for the experiments on ſpirit of ſalt.

Water is not heated by theſe fumes, owing probably to the ſmalleſt of the quantity which condenſes therein.

A further application of this new method of Diſtillation.

In the diſtillation of the oil of vitriol, a great part of the acid comes over ſulphureous, and is very hard to condenſe; but, by paſſing it through water, this condenſation is eaſily obtained: however, a greater quantity of water is neceſſary for this operation than for the ſpirit of ſalt, though the water becomes but ſlightly acid, yet it is greatly ſulphureous, and at the ſame time acquires no heat.

The ſulphureous acid obtained by other means, as by diſtilling the acid of vitriol with mercury, and other ſubſtances, is likewiſe condenſible.

Further, this ſulphureous acid of vitriol may, by two or three ſlow rectifications, be deprived of its acid; but it will ſtill retain its penetrating ſulphureous gas-like ſmell.

The

The vapours which ariſe in the deflagration of nitre, with charcoal, antimony, &c. commonly called Clyſſus, are very hard to condenſe; but, by making them paſs through water, their condenſation is thoroughly effected. See fig. 6.

In the rectification of Phoſphorus, if water is made uſe of to condenſe the vapours, it will become as white as virgin wax, and almoſt as pliable; which ſeems to be owing to the water, which prevents its burning.

In the diſtillation and rectification of the Vitriolic Æther, it is of advantage to make uſe of ſpirit of wine to condenſe the vapours, which otherwiſe might have been diſſipated.

Beſides theſe, a great many other things, too tedious to mention, may be condenſed in water, or ſpirit of wine, to a very great advantage.

I cannot conclude, without mentioning that this new method of diſtillation bids fair to diſcover the mercurial and colouring earths of Beccher; for by this method we can condenſe the moſt volatile parts of all ſubſtances, far better than by any other means.

And I muſt acknowledge that I received the firſt hint of it from the common apparatus for reviving mercury from cinnabar.

I am, ſir,

Your moſt obedient ſervant,

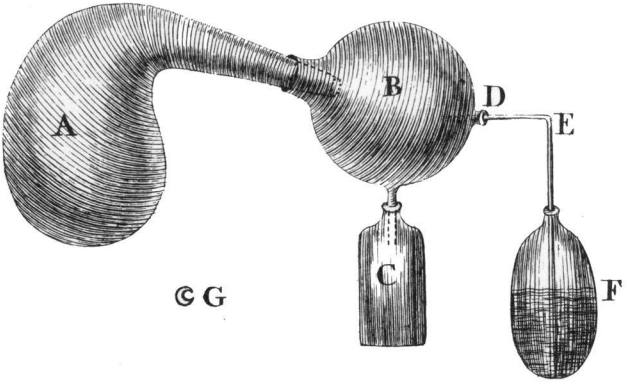
Clerkenwell,
Nov. 18, 1767.

Peter Woulfe.

To John Ellis, Eſq;
in Gray's Inn.

Expla-

Fig. 1.



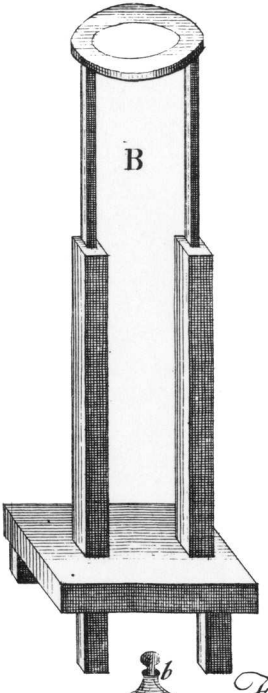
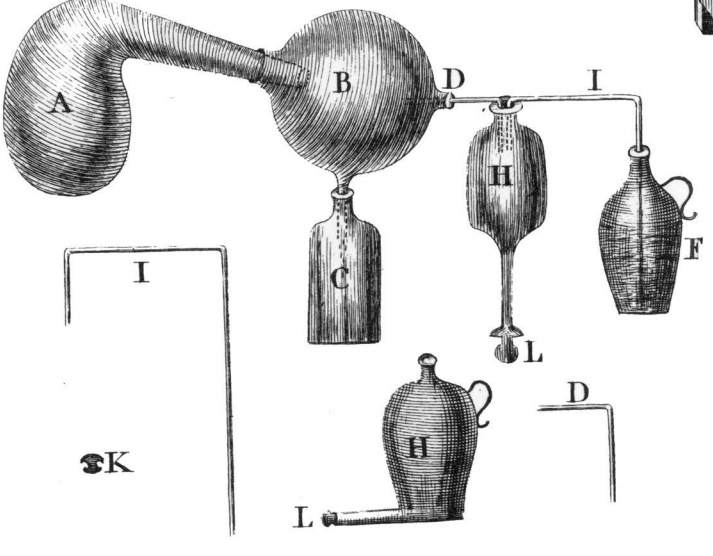


Fig. 2.



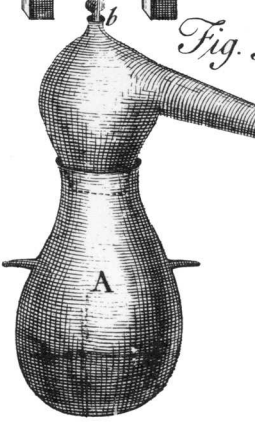


Fig.

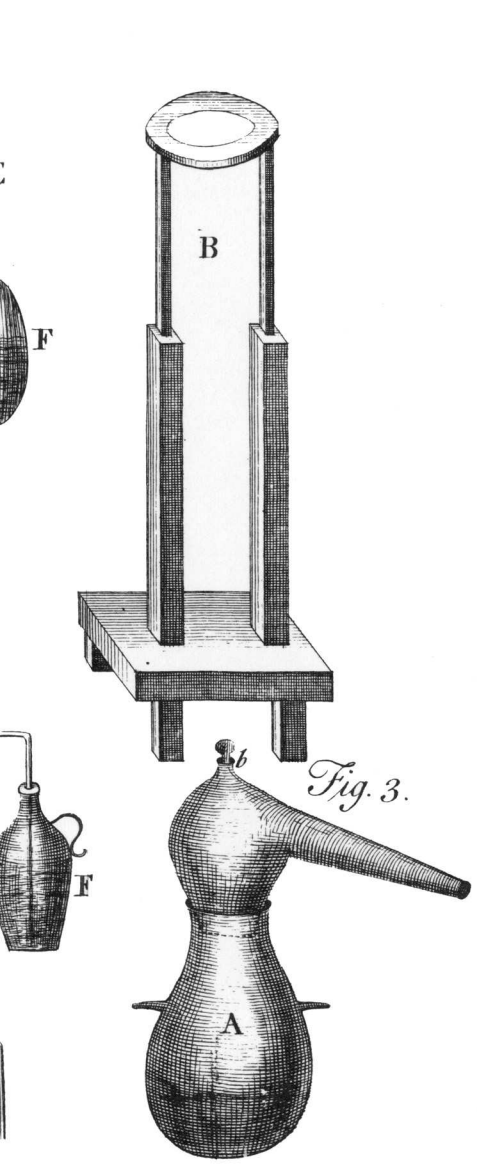


Fig. 3.

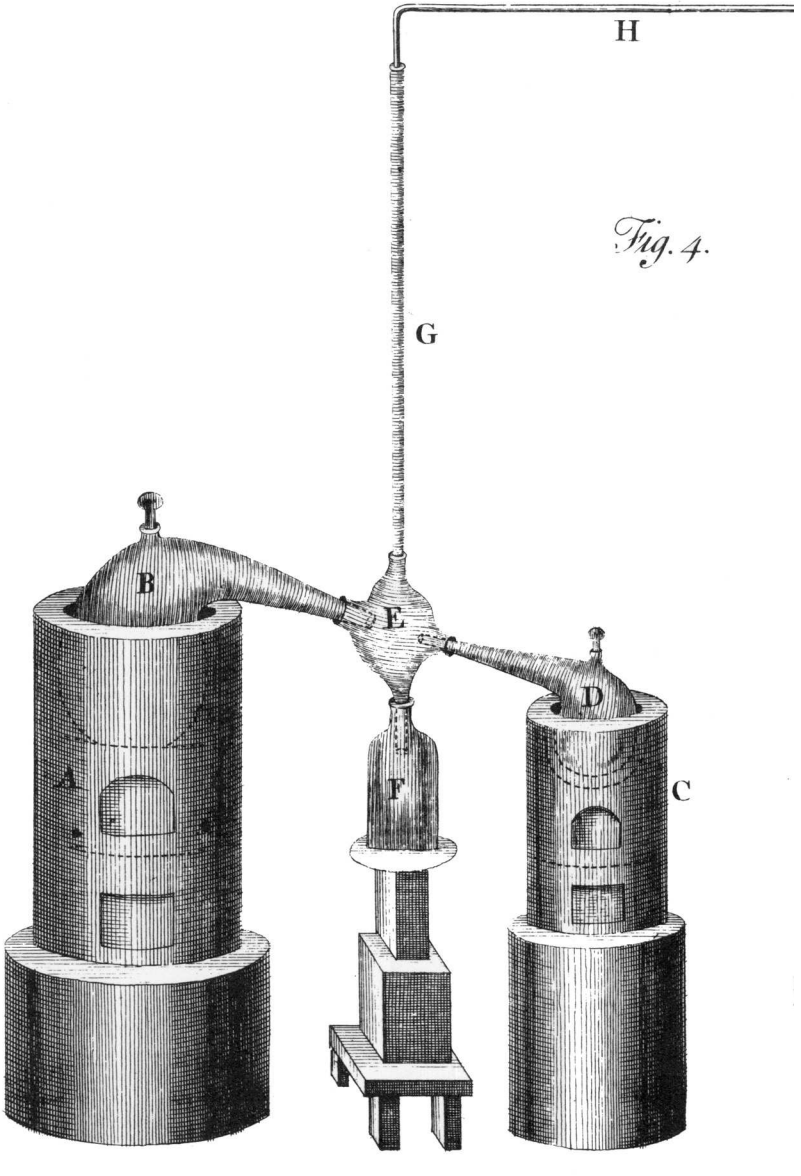


Fig. 4.

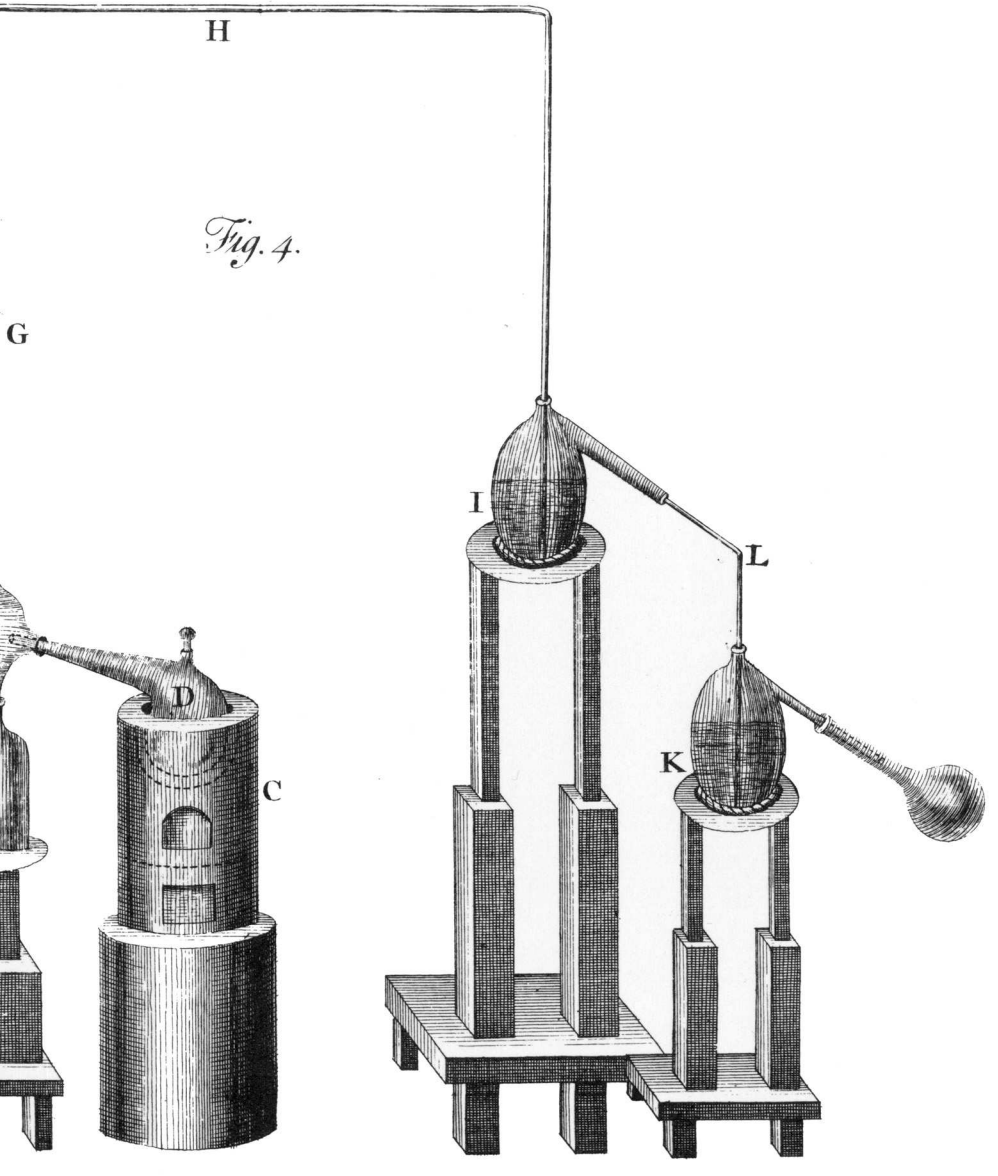


Fig. 4.

Explanation of Plate XXV.

Figure 1.

A, A glaſs retort.
B, A glaſs receiver.
C, A bottle to receive what diſtils.
F, A glaſs, or ſtone veſſel with water.
The recipient B, has a ſpout at the bottom, which conveys the liquor which diſtils into the bottle C; at the end there is a ſpout D.
E, A crooked glaſs tube $\frac{1}{10}$ and $\frac{1}{2}$ of an inch bore.
G, A cork with a ſemicircular notch to ſtop the bottle F.

Figure 2.

A, A glaſs retort.
B, A glaſs receiver.
C, A bottle to receive the diſtilled liquor.
H H, Glaſs or ſtone veſſels, with glaſs ſtoppers, ground and fitted to L L.
F, A ſtone bottle with water.
D, A crooked tube, as at E, fig. 1.
I, Another crooked tube.
K, A cork, with two ſemicircular notches to fit the crooked tubes to the veſſel H.

Figure 3.

A, An iron body with a ſtone head, which has a ſtopper at b.
B, A ſtand to ſupport the receivers and bottles.

Figure 4.

A, The furnace, in which is placed the retort B.

B, A glaſs tubulated retort, which is to be coated with loam up to B.
C, Another furnace.
D, A tubulated retort, fixed in a veſſel with ſand.
E, A ſtone veſſel, wherein the vapours of B and D are combined together.
F, A bottle to receive the liquor which diſtils.
G, A large tube fitted to E, about $\frac{3}{4}$ inch bore.
H, A crooked pipe about $\frac{1}{4}$ inch bore.
I and K, glaſs veſſels containing ſpirits of wine.
L, A crooked glaſs tube.

Plate XXVI.

Figure 5.

A, A glaſs matraſs about 4 $\frac{1}{2}$ feet high.
B, A glaſs head, with a ſpout and glaſs ſtopper C.
H, A glaſs tube.
P, The receiver.
E, The bottle to receive the liquor which diſtils.
F and G, Glaſs veſſels containing ſpirits of wine.
H H, crooked tubes.

Figure 6.

A, An iron or earthen retort.
B, The upper part of the retort, with an opening at top, which is to be ſtopped occaſionally.
CCCC, Crooked ſtone pipes.
DDDD, Glaſs receivers, containing water.
E, A crooked ſpout, proceeding from the laſt receivers, to let out the air that is ſet free in the operation.

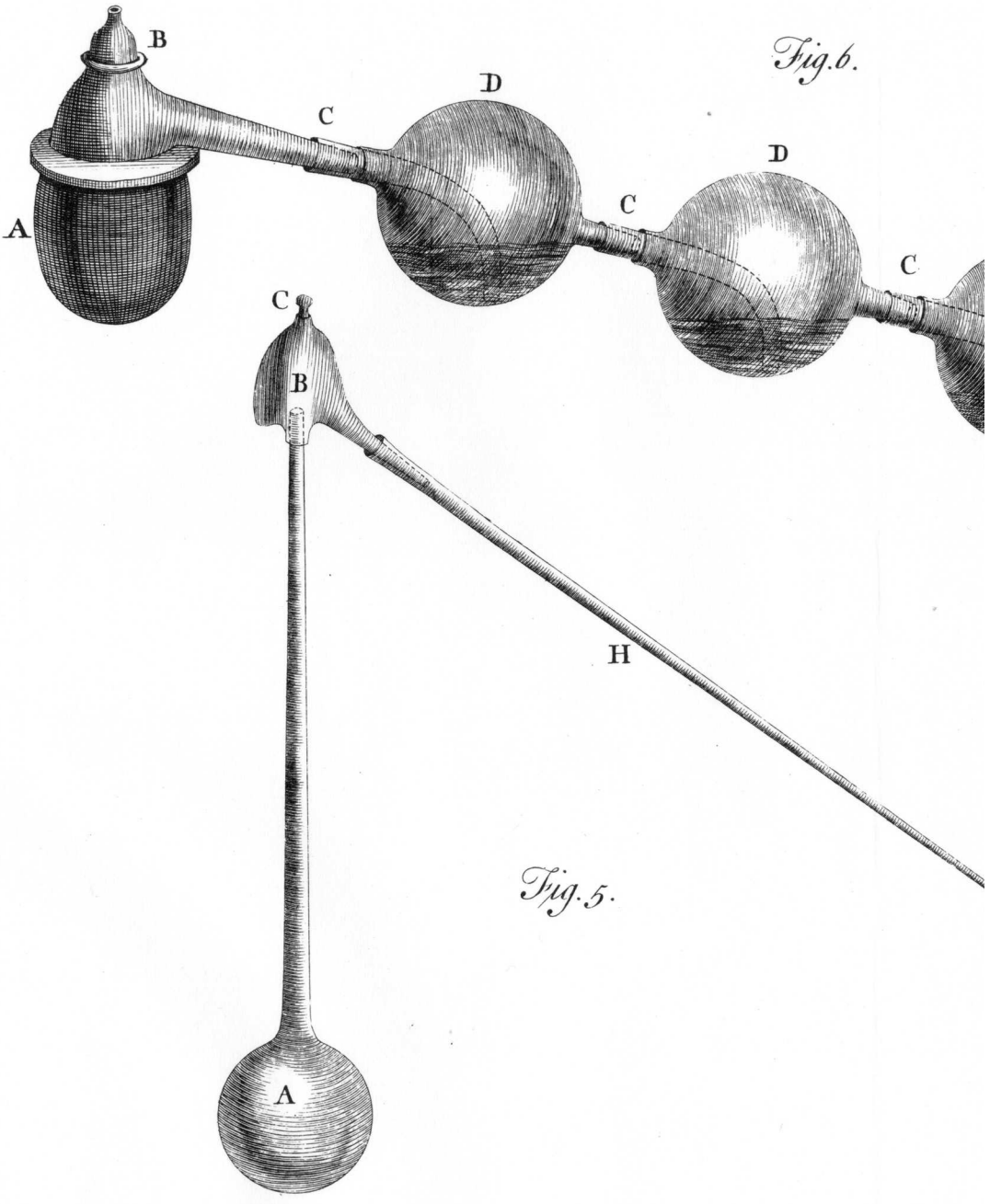
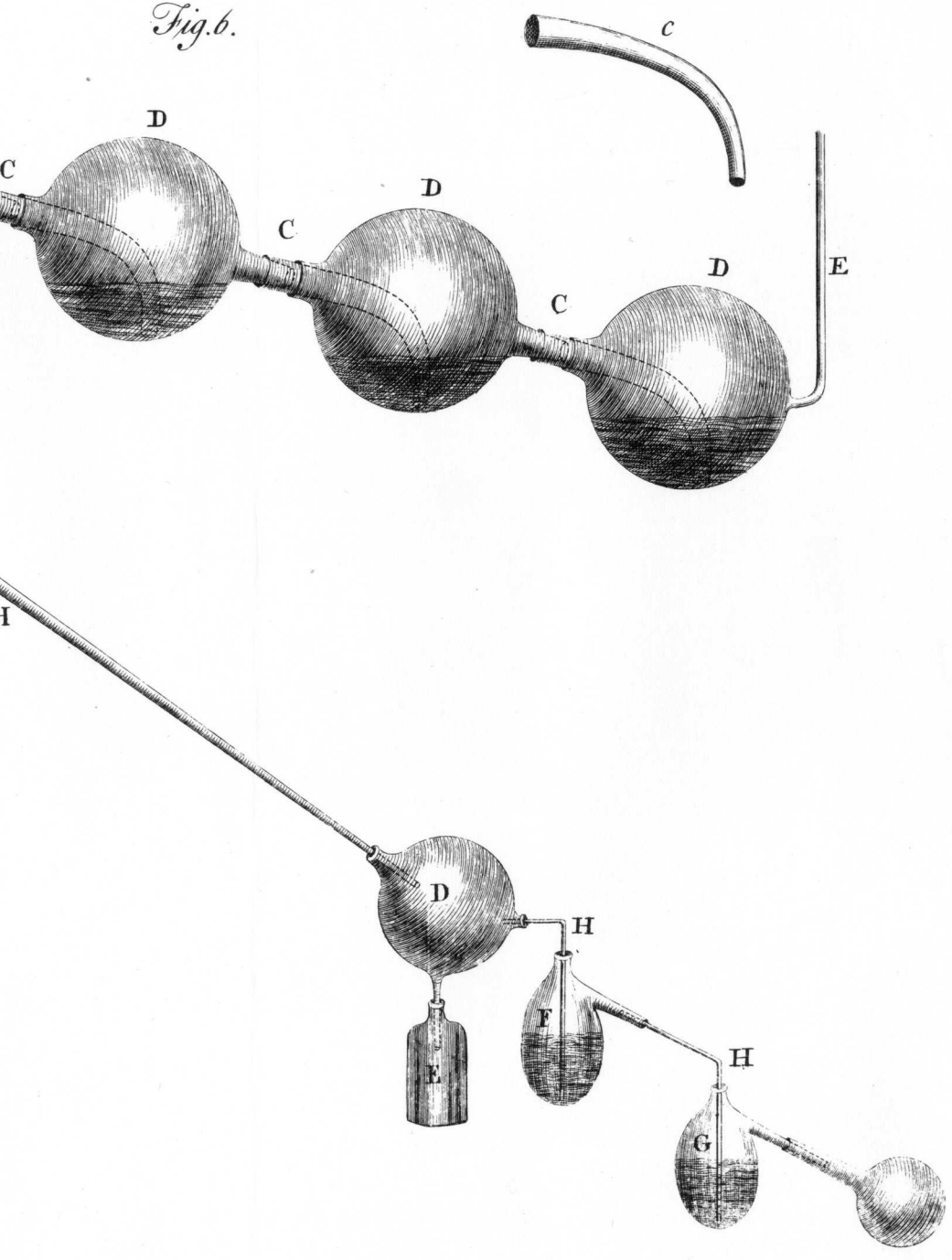


Fig. 6.

Fig. 5.

Fig. 6.



J. Mynde Sc.

Fig. 1.

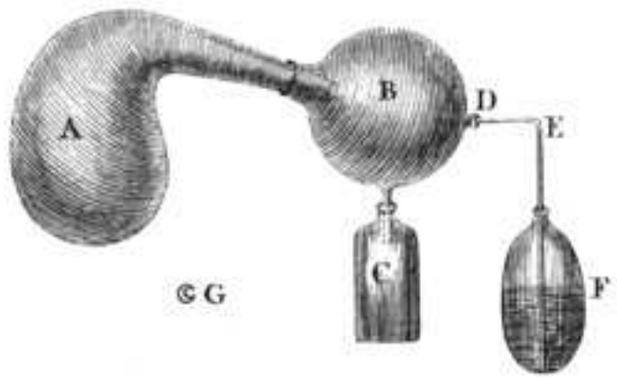


Fig. 2.

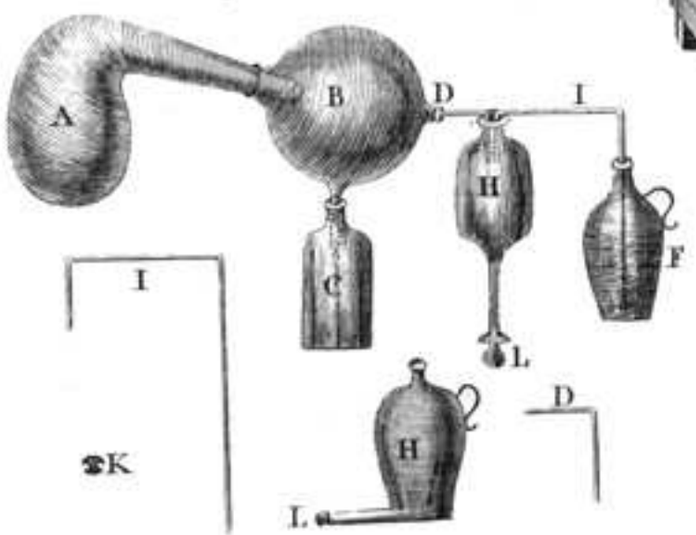


Fig. 3.

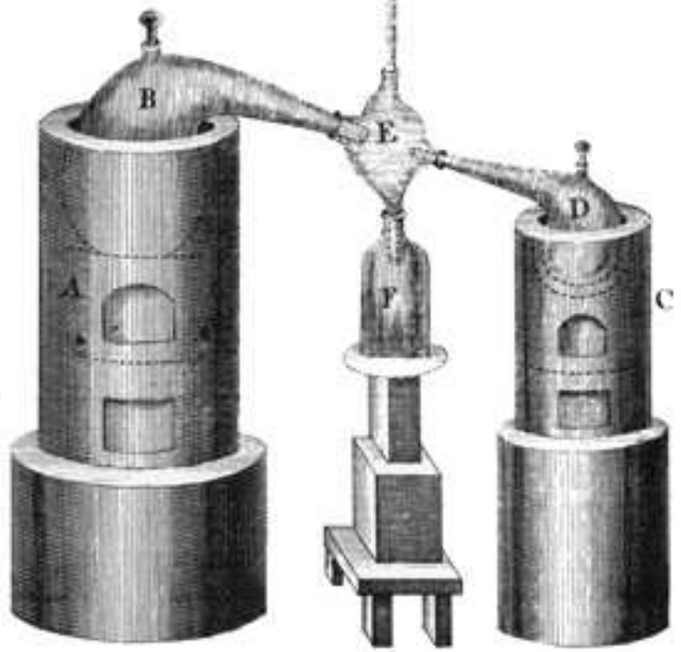


Fig. 4.

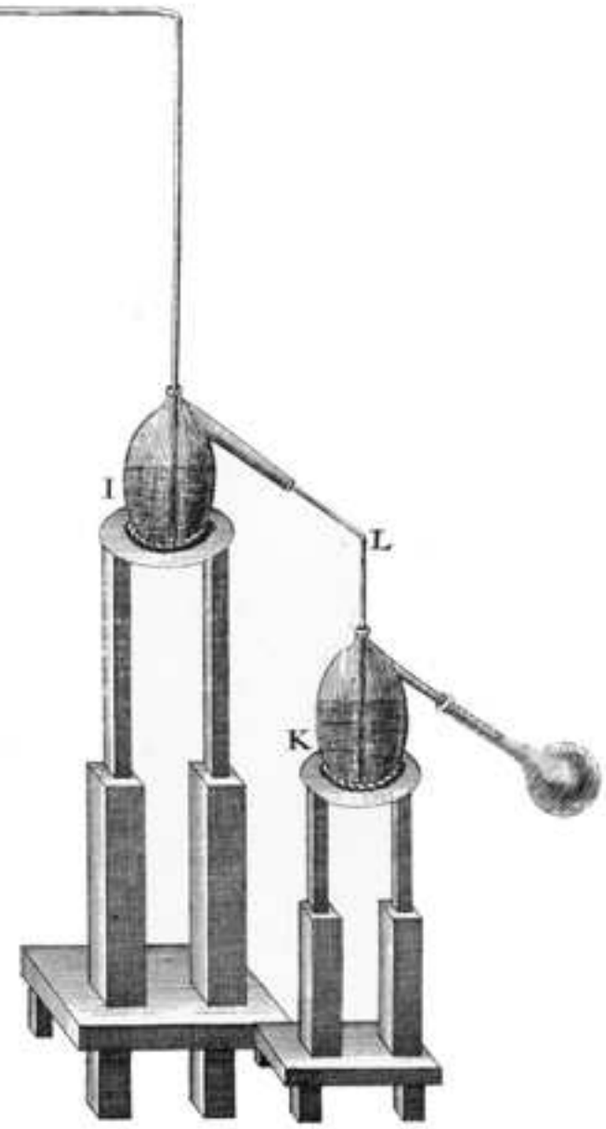


Fig. 6.

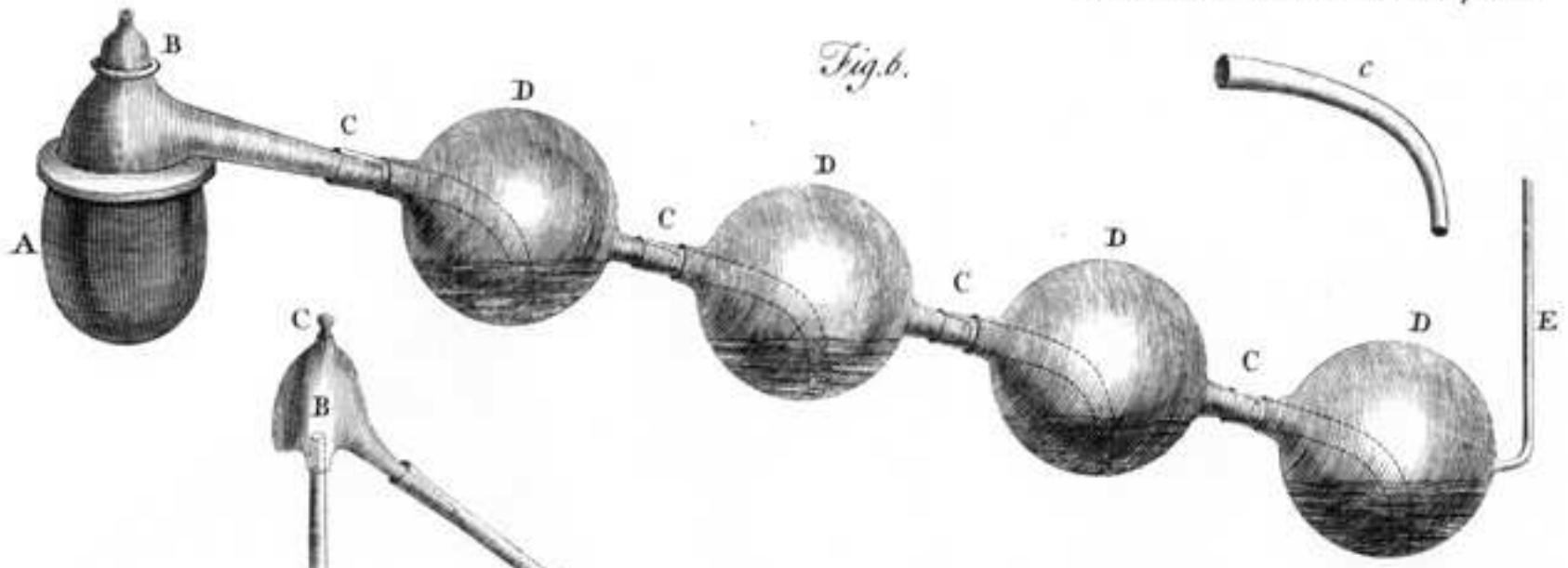
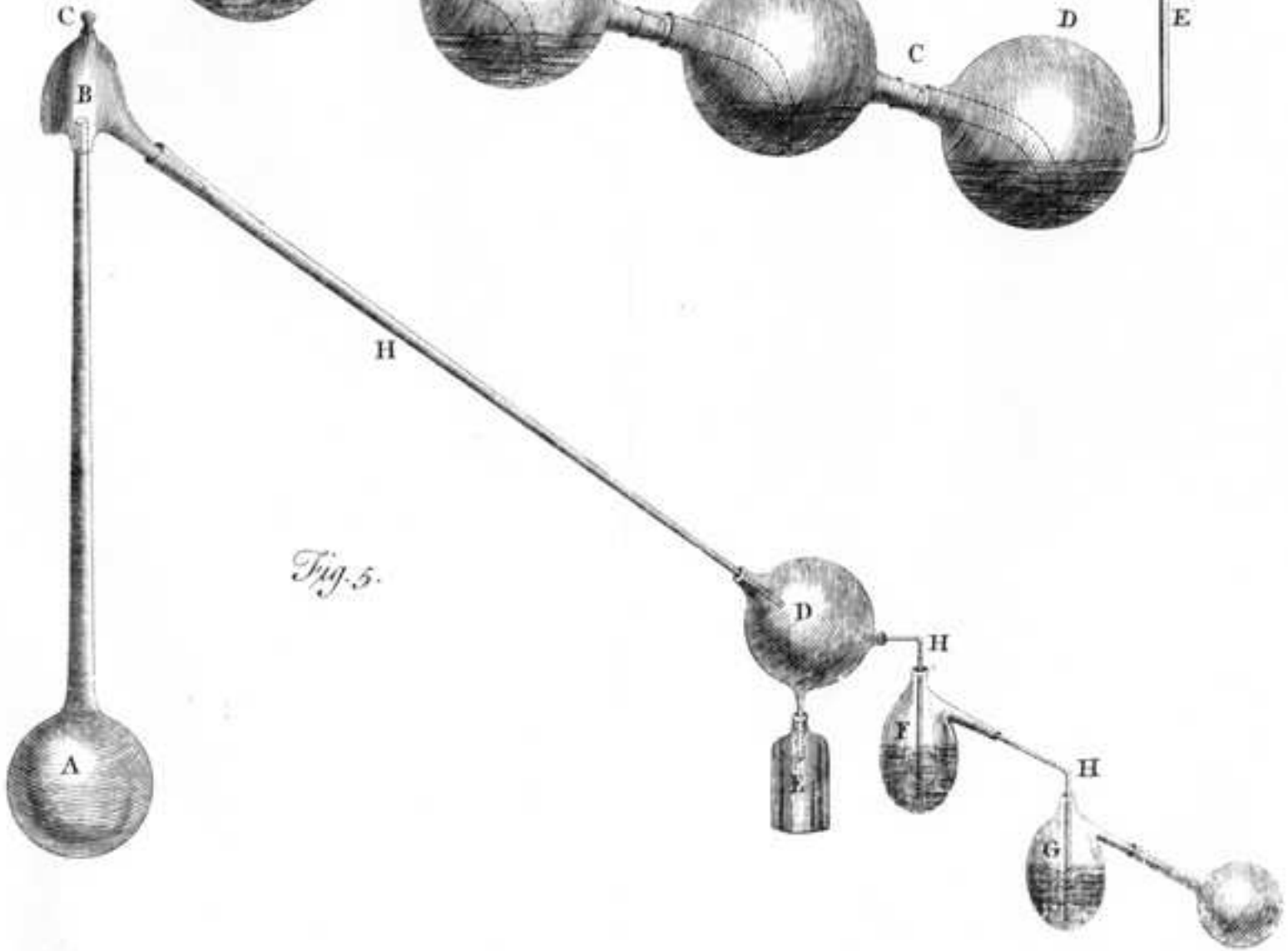


Fig. 5.



J. Mynde fc.