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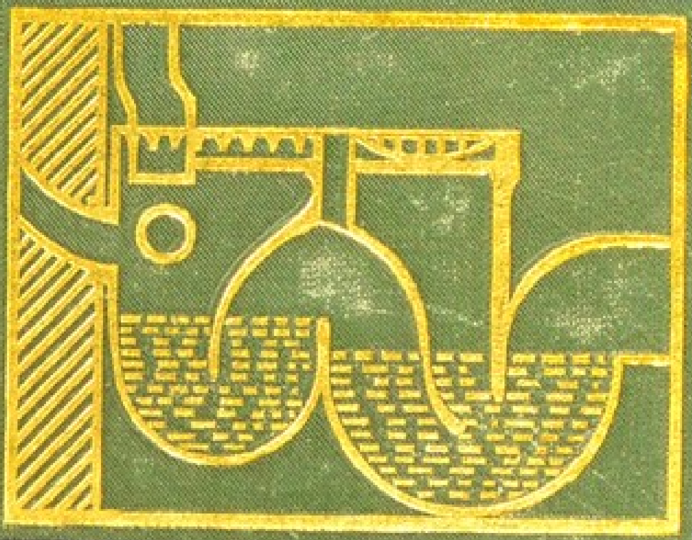

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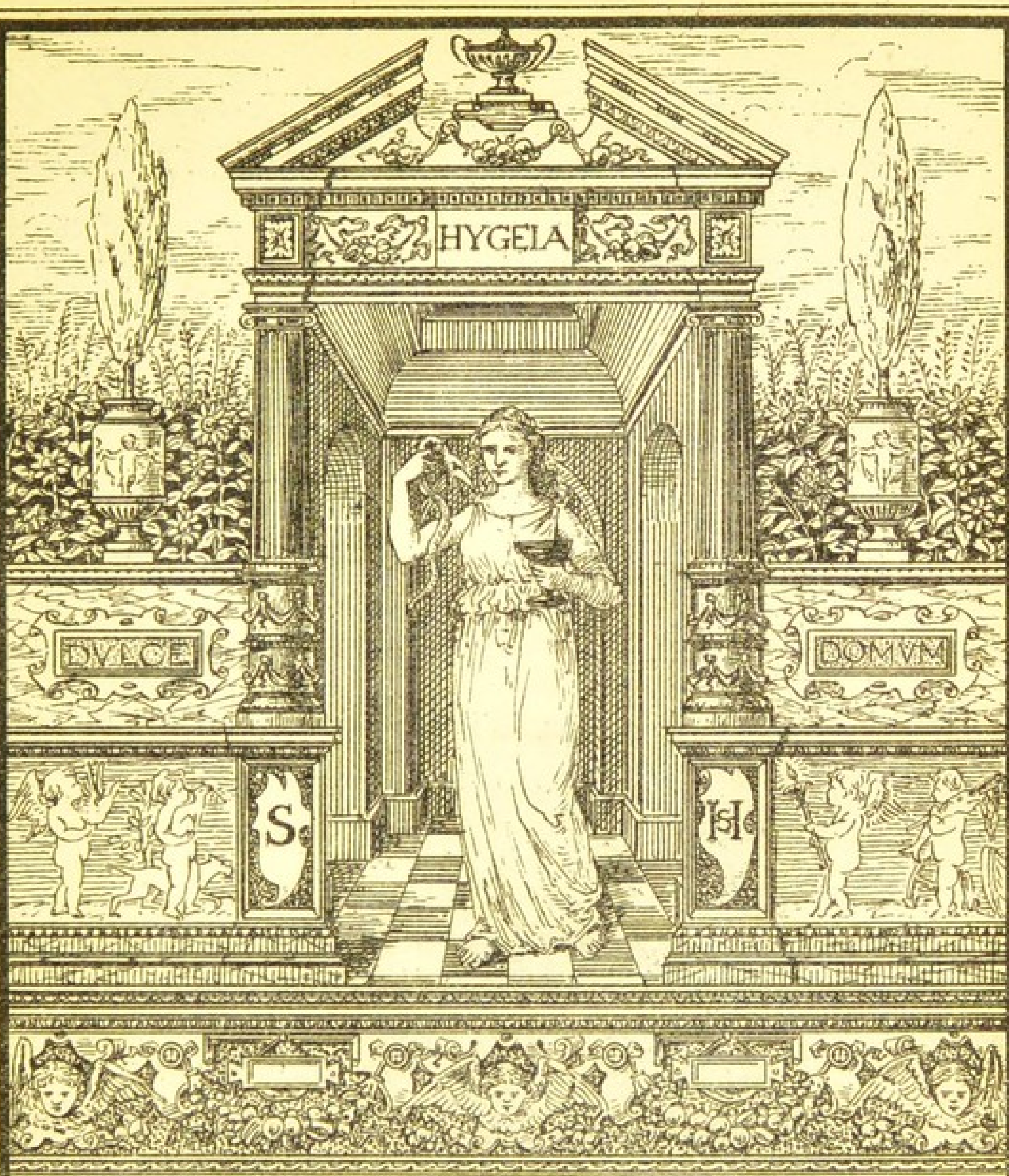

The Plumber and Sanitary Houses.

A PRACTICAL TREATISE *on the* PRINCIPLES *of* Internal Plumbing Work, *or the* Best *means for* effectually *excluding* NOXIOUS Gases *from our Houses.*

BY

S. Stevens Hellyer

Second Edition.

LONDON:
B. T. BATSFORD, 52, HIGH HOLBORN.

4/6

Shirley F. Murphy Esq.

With the Author's Compliments

DEDICATION.

To the

DESIGNERS AND BUILDERS OF HOUSES,

HEAD-WORKERS AND HAND-WORKERS,

THIS LITTLE WORK

IS,

WITH ALL DUE RESPECT,

Inscribed,

BY THEIR OBEDIENT SERVANT,

S. STEVENS HELLYER.

CONTENTS.

ILLUSTRATIONS.

DIAGRAMS.

PREFACE.

THERE are a "thousand gates to death!" Few are wider, or open more readily, than those in our own homes, when unlocked by noxious gases or bad air from drains, &c.

How many deaths have been caused by a polluted water-tank, a brick cesspool, a foul drain, a diseased water-closet trap, a bottled-up soil-pipe, a sink "*bell*"-trap? Is not the very name ominous, and ought it not rather to be called a "death-bell-trap?" At any rate, it sets the death-bell ringing occasionally.

All England was alarmed some time ago when it heard one of these gates to death rattling upon its hinges, and threatening at every moment to fly open—under the influence of one of the evils enumerated above—for a royal prince to pass through. Another puff of bad air, and who knows how wide the gate would have opened?

"Shut this gate," is the gratuitous advice given to passengers as they ride along on our railways, and look out upon the broad acres. But both the *hard* seated and the *comfortably* seated observers of this advice alike ride on, careless of the notice, for they cannot touch the gates, even with their longest fingers, and the gate that is open for any stray beast to go through must be open still.

But the gates of which I speak can be reached, and shut too, by every house-maker, if he will but take the trouble and precaution. To aid him in this most *wholesome* work, and to help him to put a padlock upon such gates, is the aim of the writer in this little treatise.

In every house a water-closet may be considered a necessity, and a slop-sink a convenience. By English people lavatories and baths, fitted up with hot and cold services, would, I suppose, be considered a luxury. Well, so is a bed, but few John Bulls would care to sleep without one, if they could at all manage to buy it. And where cleanliness is valued, and the funds are at all elastic, a bath should be provided in every house. Of course it is not necessary to have hot water laid on to it, but in case of illness it is a good provision, and the comfort of it in the winter is worth one or two decorated ceilings.

. But this treatise is not to show the comforts and conveniences of such sanitary fittings as have just been referred to, but to prove that it is possible to have all these things, without the smallest fear of making them *inlets* for foul air or noxious gases, and, in fact, that if the principles laid down in the following pages are strictly adhered to, there will be *no* foul air in any of the soil, waste, or drain pipes to escape into our houses, for a constant stream of fresh air will always be passing through the whole of the pipes.

Under the old system these sanitary conveniences generally *advertised themselves*, especially in hotels and places of that kind, and all that one had to do in such buildings was to follow the scent, like a hound after a fox, by the dictates of an organ which is very useful, but which one does not care to abuse in such a way, for, to say the least, it is an offensive way of following up a thing.

It is then from no desire to "ventilate" the writer's thoughts, or to "*air*" his ideas in print, but to give the public the benefit of his experience—an experience gained by a thorough examination of the working of the *old way* of doing these things, and by many practical and costly experiments on the *new way*, as laid down by the following principles, that the author has written this treatise.

It may be worth while to say that these principles have been thoroughly tested, and that the internal plumbing work in some of the most important houses in the kingdom has been carried out upon these principles with a complete success.

For any imperfections in this little work, the writer's apology is that his pen is quite new, and his ink is unused to travel in such a channel. But go ye forthe, ye lyttle booke, and do ye work of *ventilation*, if not in the minds of the people, at least in the pipes and drains of their houses.

21, *Newcastle Street, Strand,*
London.

PREFACE AND INTRODUCTION TO THE SECOND EDITION.

THE first edition of this little book was made larger than was at first intended, not because booksellers, like bakers, count thirteen to the dozen, but because the Author wanted some little time to elapse before issuing a second edition. In this, however, he is agreeably disappointed, for the book, having found favour with the public, is already in need of a reprint. The chief fear in this reissue is that, as the book has grown so much larger, holders of the original copies will be somewhat dissatisfied, especially as the price of the new copies has been but little increased, though the cost of reproduction has been considerably enhanced by the additional illustrations. The family tailor must often be puzzled to know when to *turn* the *youth* into a *man*. His coat cuts into as much cloth as the father's, yet he dare not charge the father's price for it—poor goose!

This treatise was dedicated to *head-workers* and *hand-workers*, hoping to gain the audience of both classes, and to stimulate all concerned—and that surely is every *house-dweller*—to take greater interest in *Sanitary Plumbing*. No house is safe for a human being to live in—much less, therefore, to become his *home*—where the plumbing-work (or house-drainage) is in an *un*sanitary state. Call in the surveyor before taking a house by all means; but call in an expert—the sanitarian—and medical* man too, if need be, to certify that the house is in a perfectly sanitary condition, and then take possession, and make it "Home, sweet Home."

What a happy day it will be when the *hygiene* of a dwelling-house, as well as the style of its architecture, shall receive its due consideration—when the three most essential, and at the same time the most inexpensive, things in the world shall be let freely into our homes: when *fresh air*

* The shoemaker should stick to his last.

shall be made to circulate, not only through every room and cupboard in the house, but through every waste-pipe, soil-pipe, and drain; when *light*, the revealer, shall be made to shine into every corner of a dwelling, to shame dirt and filth away; when *pure water* shall be made to flow through every draw-off cock in the house; and when the want of these hygienic essentials shall "no more hurt nor destroy" in homes of peasant or king.

The public are largely indebted to medical men and civil engineers for taking up this question, the greatest of the age; not only because of the knowledge that such men, when they have studied the subject, can bring to bear upon it, but also because they can seriously and conscientiously advise householders to *put their drains in order* whenever they find them defective: whereas a sanitary engineer cannot at all times do this without creating a suspicion that he has selfish interests to serve.

There is no lack of wisdom in the sanitary world now, for a host of "sanitary engineers" have sprung up, like the 500 Clan Alpine warriors of Roderick Dhu, at a moment's notice. It is true they have been following other professions all their life; but a "fresh door" is open here, and "Right about face!" is the order of the day, which they gladly obey, and turn in to "fresh fields and pastures new."

The writer has been trying to trace the course of the first edition of this book, and he is saddened to find that whilst it has circulated very freely among *head-workers*, it has only sparingly passed into the hands of *hand-workers*. He believes this is not because the latter class cannot afford to buy the book—for less than one day's wage would purchase a copy—but because many of the old plumbers do not take sufficient interest in their work to make it sanitarily perfect. They have *bottled-up* soil-pipes, waste-pipes, and drains all their "professional" lifetime, or only ventilated these in a half-inch way; they have "united" *pan-closets* to *D-traps* ever since they used the "*cloth;*" and now they stand unmoved by the wants of the time, unmoved by the charms of Hygeia, and cry, "What the plumber hath joined together, let no sanitarian pull asunder." No!

better *destroy* than divorce such generating evils —at any rate, it is quite time they were extinct. No doubt, if they were sent in pairs—the pan-closet and D-trap, not the old-fashioned plumber and his mate—to Dr. Darwin, it would help him in his evolution theory, for the one must have grown out of the other.

The writer does not want to make a profit out of the *knowledge-seeking hand-worker* (for, like the majority of men, his means are but small) ; on the contrary, the author is anxious to help him ; and therefore any dozen plumbers clubbing together and buying a dozen copies of this volume shall receive them at *two-thirds* of the published price.

The *plumbing-work* at Marlborough House, Buckingham Palace, and in scores of noblemen's and gentlemen's houses in various parts of the country, has been reconstructed on the principles laid down in the first edition of this book, and further shown and illustrated in this second edition.

This second edition consists of an Appendix of six chapters, in which the subjects treated of in the previous edition are dealt with in greater detail; whilst a topic of much importance, on which nothing was written in the other edition, has here been fully considered—viz., *Cowl-testing*.

The knowledge of Sanitary Plumbing is spreading rapidly, both in England and America; though in each country it is chiefly levelling downwards. In the latter country, the bad principles of internal plumbing are not so thoroughly ingrained in the plumber as in the former country, and are therefore more easily eradicated. But while the claim to greater *theoretical knowledge*, with the desire to increase that knowledge, might be given to the *American* plumber, the claim to greater *practical skill* must be yielded to the *English* plumber—that is, as far as the writer is a judge.

It is, of course, of very great importance that the man who *plans* a work—the *head-worker*—should thoroughly understand what he plans; but it is equally important that the man who *does* the work—the *hand-worker*—should understand it too; not only the *practical* part of what he has to do, but the *theoretical* part also: for during the progress of the work, *he* will be ever on the *spot*, and if his eyes are open, he will see (especially if it be Sanitary Plumbing) many little things which will help or mar the whole thing, just as these things are treated *per se:* whereas the head-worker, the man who planned the thing, will often only revisit the work, Rip-van-Winkle-like, when all is changed, when the chief work is all hidden over and *in situ.* Then, *Educate the hand-worker!* should be the cry of all who wish for true progress in sanitary matters.

In this busy age, when the swiftness of time can only be checkmated by labour-saving inventions; when printer, postman, and telegraph-boy combine to give the worker no rest; anything that saves time is of value. Therefore the writer has added largely to the illustrations in this second edition, whilst he has added but little (in comparison) to the letter-press; knowing that a five minutes' study of any well-illustrated scheme will give the student a better understanding of it than an hour's reading, for a *page* of illustrations is worth a *book* of description.

The main object of this book is to illustrate and explain how Plumbing and House Drainage may be made sanitarily perfect. If, in doing this, the Author has largely illustrated his own Sanitary Appliances, it is because he is best acquainted with them, and from no desire to shut the door upon other "Fittings" which may be equally good.

21, *Newcastle Street, Strand,*
London.

THE PLUMBER & SANITARY HOUSES.

CHAPTER I.

TRAPS.*

It is impossible to exaggerate the importance of having efficient traps to the various sanitary fittings inside our houses; for what are they but *doorways* to the drains and sewers? The *dip* of the trap may be considered as the door, and if by such doors we cannot shut off these lower regions, they become worse than useless, and leave the house exposed to the deadly attacks of foul air or noxious gases from these drains and sewers. Traps doorways to drains.

I am not about to discuss the merits or demerits of each individual trap now in use, for their name is legion, nor to consider at any length the material of which traps should be made, but I must remark that the material should be of such a kind as can be easily and *securely* jointed to the waste-pipe, with which it should be *perfectly united*, for any defect here—*i.e.*, in the jointing of Traps legion. Material.

* Continued, pp. 143—185, in the Appendix.

the trap to the waste—would allow any bad air in the waste to escape through it into the house. And if the waste-pipe is not trapped at the foot, or if it does not discharge with an open end, then any noxious gases in the drain can travel up the waste-pipe, through the defective jointing, into the house.

Lead.

Further, as lead is the best material for wastes (as I hope to show under the head of "Soil-pipes," Chapter II., page 29), so it is also the best material for traps for all fittings *inside* our houses, not only because of its special fitness for soundly jointing to waste and soil pipes of lead, but also on account of its smoothness, non-corrosiveness, and durability.

Stone-ware.

In yards, areas, and *out-door* positions, where the trap is connected directly with the drain-pipe, and where it does not so much matter if a small defect occurs in the jointing, as it is in the open air, there is nothing better than stoneware syphon-traps. And as the drain-pipe is of the same material, the connection with the trap can be better made. Moreover, these traps are clean, smooth, non-corrosive, and very durable, but care should always be taken that these traps are made with a proper water-dip; as a general rule, they are *insufficiently dipped to be of any value as a trap*.

Cast-iron.

Such corrosive material as *cast-iron* should never be used for trapping off places where urine and such like corrosive matters are likely to pass through them.

Traps independent of the fitting.

All traps fixed inside a house should be *separate* and *independent* of the fitting, be that what it may, which is to be fixed upon them, and be made *fixtures* in a very complete way with the soil or waste pipe to which they are to be attached.

And then, when the "fitting" gets out of order, whether water-closet, urinal, slop-sink, or whatever the fitting may be, it can be removed for repairs without interfering with the trap or exposing the house to the drain.

But when the trap forms a part of the fitting, and is in "one piece" with it, it cannot be removed for repairs without exposing the waste, and through the waste the drain, to the house; leaving it in fact in free and open communication with the soil or waste pipe in which the fitting was fixed. And, if there is no trap at the foot of the soil-pipe or waste-pipe, any bad air can pass freely up from the drain into the house.

Connection of the trap with the waste very important.

But there is another and stronger reason why the trap should be independent of the fitting. The *junction* of the "fitting" with the *trap* is *unimportant*, as this jointing is on the *trapped side* of the waste and drain; but the junction of the *trap* with the *waste* is of the utmost importance, as *that* is on the *untrapped* side of the waste or drain, and any defect here would at once allow any bad air or noxious gases in the waste or drain to escape through this defective jointing into the house. When any sanitary "fitting" and traps are all in *one piece*, and the material of which it is made is earthenware, or cast-iron, how is it possible to make a perfect and *durable* connection with a soil or waste pipe which is of another material? The ordinary way of making such connections is by a *cement joint*, made of putty, or white or red lead, or almost anything, but such a joint is always *breakable*. A rough cleansing of the apparatus, a shaking of the floor, or a little sinking of the building, and the connection is broken, and the house left exposed to the air of the soil or waste pipe, without any protection as far as the trap is concerned. But if the connection does not get broken in this way, the cement in time dries up, and leaves the joint unsound, and the evil is that this joint may remain unsound for some time before it is discovered; for it is not like a water-leak in a pipe, it is only an air-escape; and you cannot find it out, either, as they find out gas leakages; you know there is an unpleasant smell, but you cannot trace it with a light, but only in the way a dog turns up a rabbit—by the nose.

No sanitary fitting

No sanitary fitting *inside* a house should be without a trap. This trap should be as *close to the* "*fitting*" as possible, to prevent any length of waste-pipe from being untrapped on the house side of the pipe, as it is sure, sooner or later, to get corroded, and become (more or less) offensive. Whatever unpleasant smell of air there may be in a pipe may as well be made to blow away through the air-pipe outside the house, and this can always be done by keeping the trap close to the "fitting," and ventilating the waste.

inside a house without a trap.

There may be nothing terribly injurious in leaving an *ordinary* waste-pipe, say a lavatory-waste, entirely untrapped, provided the *discharging end* is *open* to the *air* at the foot, and that the pipe is not directly over a drain. And there is nothing terribly injurious, I suppose, in going into a room filled with stale smoke from a dozen cigars and old pipes a few hours after the smokers have left the room, and yet who would care to live or sleep in such a room?

Nothing *terribly* injurious from a waste with an open end, though untrapped at the foot.

The kind of trap must, to some extent, depend upon circumstances. When a trap is likely to remain in disuse for some months together, as in country mansions, it ought to have a greater *dip*, and contain more water, to allow for evaporation, than a trap in daily use.

The kind of trap to use.

The most important thing in a trap is its self-cleansing powers—*i.e.*, that every part of the inside

Self-cleansing.

of a trap shall be washed by its own action in the passage of the water through it.

Free from corners.

It is also important that every trap should be free from all corners, or places where any foul matter can accumulate and generate noxious gases.

Water-dip.

Any trap which in its action is self-cleansing, and which is *sufficiently water-dipped* to prevent syphoning out, and back draughts from coming through, may be used with safety, provided it is of a smooth and non-corrosive nature.

Substance of lead traps.

When the trap is made of lead it should be equal in substance to lead weighing 7 lbs. or 8 lbs. to the superficial foot, according to circumstances; in no case should it be less than equal to 6-lb. lead; and where any quantity of hot water is likely to pass through, it should not be less than 8-lb. lead.

Cap-screws in traps.

Traps with a cleansing "cap and screw" attached (see Figs. 8 and 9) are always very convenient when fixed to lavatories and sinks, &c. &c., or at the *foot of soil-pipes*; but to water-closets, and places of that kind, they are of no value, for the hand can always get down to the trap through the apparatus. When a trap has a "cap and screw" attached to it, care should be taken to see that this cleansing screw-cap is *below* the water-dip, and on the *house-side of the trap*—*i.e.*, it should be under the level of the water in the trap. Where this cannot be done, through insufficiency of room or any other cause, then the cap and screw should be fixed on the *inlet*-side of the trap, and never on the outlet or drain side, except when the trap itself is *outside the house.* The screw-cap will need to be taken off occasionally, to cleanse the trap, but, unfortunately, you cannot depend upon everybody, and though it may be screwed up all right at one time, it may not be at another; then, if this screw-cap is on the *drain*-side of the trap, any air in the drain will work its way through this imperfect connection into the house. This may go on for some time before it is discovered where the foul air is coming from. But when the screw-cap is *under* the water, it is not only below any air in the pipe, but it is in a place that would show at once if it were not perfectly sound. And when it is on the inlet or *house side* of the trap, if it is not quite tight, it does not so much matter, because it is on the trapped side of the waste and drain.

FIG. 1.

FIG. 2. SECTION.

Bell-trap.—The "bell-trap" is one of the oldest traps now in use. It is generally employed

Bell-trap worse than useless.

for trapping off waste-pipes to sinks, and surface drainage, but it is *worse than useless.* The small pipe, Fig. 2, which stands about half-way up in the body of the trap, and which forms the dip, obstructs the free passage of the water through the trap, and makes the lower part, *b*, a receptacle for dirt, which ought to pass into the waste-pipe without any obstruction.

Then, again, there is no room for any body of water to pass through this trap: a glance at the Section, *c*, Fig. 2, will show this. This sluggishness in emptying might have done very well in an age when time was of little value, and the people treated years as we do days. But it will not do now for servants to wait half an hour for a sink to empty itself through a bell-trap. And they take care not to do this, for they soon remedy this evil by pulling or knocking off the "bell-grate." But the remedy, most assuredly, then becomes worse than the disease, for by removing the grate they have virtually destroyed the trap, and exposed the drain to the house, and the cold nasty air from the drain soon makes its way into the warmer atmosphere of the house.

Water-dip too shallow.

Apart from all this a bell-trap is imperfect, for the water-dip, as a rule, is only about three-eighths of an inch—perhaps, in some cases, it may be a little more—therefore the slightest back draft or "puff" of air in the drain or waste soon enters the house, or the water in the trap soon evaporates, and leaves it uncharged.

Antill's patent trap.

Antill's Patent Trap.—Fig. 3. This is a great improvement upon the bell-trap, and by the arrangement of its water-dip it remains as much trapped with the grating off as on. But it is far from what a water-trap should be: the water-dip is insufficient to shut out any strong current of air in the waste-pipe, and from the peculiarity of its construction it is not self-cleansing; any sediment getting into the compartment A, Fig. 3, is almost sure to remain there, and the compartment B cannot be got at to be cleaned out, and the covering over this compartment makes a lodgment for grease and dirt; also there is no free passage for water to pass through the trap quickly. The partitions are soldered with copper-bit, and the lead is too thin to last long.

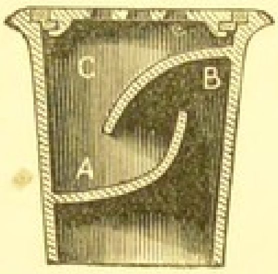

FIG. 3. SECTION.

D-trap favourite with plumbers. Inside of an old trap disgusting.

D-trap.—This old-fashioned trap, Fig. 4, is a great favourite among plumbers, and is in very general use. It is difficult to understand why plumbers should like this trap, especially for water-closet uses, except it is that having so much to do with them—as undertakers with dead

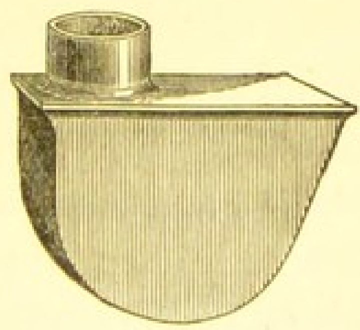
FIG. 4.

bodies—they think little or nothing at all about the thing. If anybody (but a plumber) could see the *inside* of this trap after it has been in use under a water-closet, say for half a dozen years, he would be disgusted with the sight, and would certainly prohibit its use in any house of his own. And yet most plumbers, though they have seen the inside of a hundred traps, go on fixing them as a matter of course, and would, if they could, rise out of their very graves to fix yet another.

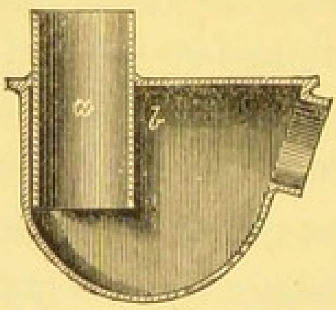

FIG. 5. SECTION.

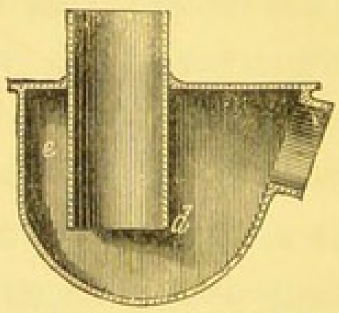

FIG. 6. SECTION.*

The dip a collector for filth, and the impossibility of cleaning it.

The dip-pipe, *a* (see Section, Fig. 5), goes down more than half-way into the body of the trap, and is made to dip into the water from half an inch to an inch and a half, according to the ideas of the maker. This dip-pipe, entering so far into the trap, forms a sort of collector for all kinds of filth upon its *outer side*, where it is *impossible* to get at it to clean it away. Moreover this trap, from its peculiar construction, is full of corners and places for filth to accumulate

* This is a section of a D-trap which was made by a plumber from the country, between thirty and forty years of age.

in, without any chance of its ever being washed out, for with the utmost desire to cleanse such a trap, it is impossible to get at the part *b*, Fig. 5; and round on the *outer side* of the dip-pipe (next the top part of the trap) and the space between the dip-pipe and band of the trap, *e*, Fig. 6, with any kind of brush or cleansing instrument, so that whatever collects about the inside of a trap of this kind must remain to corrode and make it foul.*

Dip fixed too far away from the "band," or fixed not far enough down into the trap, or too far.

There is also much ignorance displayed by some plumbers in fixing the *dip-pipe* in this trap, which often gives rise to another evil: Instead of fixing it close to the "band" of the trap, as shown in Section, Fig. 5, they fix it an inch or so away, as shown by Section, *e*, Fig. 6, and thus diminish the passage-way, *d*, to the outlet, and at the same time giving more room for filth to aggregate round the pipe between the dip and the band, *e*. Then, again, the dip-pipe is either not fixed far enough down into the trap, or it is fixed too far down. When the dip is not low enough, it gets insufficiently water-trapped, and allows any air in the waste or soil-pipe to blow through it into the house; but when the dip-pipe is too far down in the trap, it obstructs the free passage of the discharge, and stops up the trap.

Made by apprentices or anybody.

But these evils of the dip-pipe do not, of course, occur when the trap is made by a skilled plumber; but unfortunately everybody, not ex-

* See Plate VIII., showing a view of the inside of an old D-trap.

cepting the apprentices, is set to work making up D-traps, when there is nothing else to do, and so the trap may be right or wrong, as it happens. The best place for all such D-traps is the melting-pot when it is seven times heated.

Cast-lead trap self-cleansing, made in two shapes and various sizes.

Patent Cast-lead Trap.—The most self-cleansing lead trap now in use is the patent cast-lead trap, as Figs. 7, 8, and 9: there are no soldered

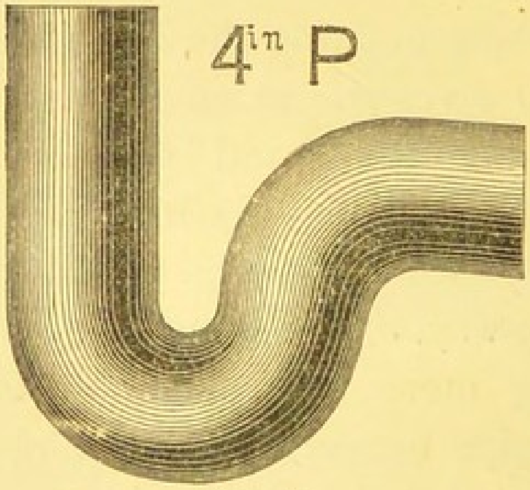

FIG. 7.

seams or corners about them for anything to adhere to, as will be seen by a glance at the illustrations.

This trap is made in two shapes, to fit horizontal and vertical wastes from it; and in sizes from 4 in. to 1½ in., as the clear diameter of the water-way through the trap.

Made of soft lead.

These traps are made of the softest and purest lead, and are as smooth inside and out as pipe made by hydraulic pressure. The substance of the lead is regulated, but the strength is equal to milled lead 7 lbs. and 8 lbs. to the superficial foot. It consists simply of a round pipe cast into the shape somewhat of a reaper's hook in the one case, as Figs. 7 and 9; and in the other somewhat of the letter S, as Fig. 8. Figs. 7 and 9 are known in the trade by "P" or "Half S," and Fig. 8 by "S."

Strength.

A cap and screw are attached to the smaller size traps, as shewn in Sections, Figs. 8 and 9, for cleaning-out purposes, and for unstopping the

Cap and screw for cleansing purposes

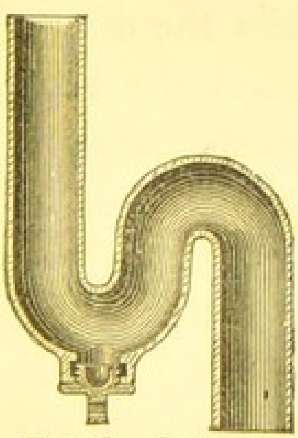

Fig. 8. Section.

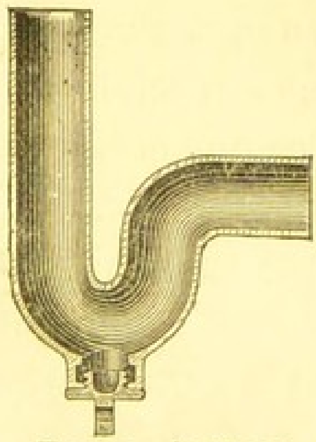

Fig. 9. Section.

waste-pipes on which they are fixed when necessary. The 4-in. trap, Fig. 7, can always have a cap and screw soldered to it when fixed in places where the hand cannot be put into the inlet, or dip-part, of the trap; but this can always be done when they are fixed under a water-closet or slop-sink, and also when there is a $4\frac{1}{2}$-in. rim and grate over the inlet, as to a scullery-sink, &c., and then, of course, a cap and screw is not needed.

Syphoning action. Traps liable to be unsyphoned unless well ventilated.

On usage every part of the inside of this trap is scoured out by friction, and being a round-pipe trap there are no corners where anything can accumulate or become foul. The only objection to this trap is its syphoning power, which, at the same time, is one of its merits, for it is this suction power of the discharge passing through it which keeps it clean. Acting on the principle of the syphon, it is liable when a large body of water is thrown suddenly into it—as from a slop-pail—to be syphoned out, *i.e.*, untrapped. A pail of water thrown quickly into the trap fills the discharging orifice or receiving waste-pipe, and the suction at once commences; and if the waste-pipe is a long length of vertical piping, without proper ventilation, the syphoning action will continue until it has pulled the water out below the dip—the water-lock of the trap—when it immediately gets air and stops the syphoning. And then, unless there is some water behind (from the "fitting") to drain into the trap, to recharge it, it will allow the air in the waste-pipe to escape through the trap into the house. But this defect is easily remedied. A ventilating-pipe fixed on the out-go of the trap, or on the branch waste near the trap, will at once break the syphoning action of the discharge, and free the trap from too great a suction power of the passage through the waste-pipe.

The patent cast-lead trap is especially adapted for lavatories, sinks, baths, water-closets, &c. &c. But the size of the trap is of importance, and for water-closets, slop-sinks, baths, *tip-up* lavatories, and scullery-sinks, it should be not less than 4-in. traps, but the smaller size, 3 in., 2 in., and 1½ in., may be used for plug wash-hand basins, draw-off sinks, and other fittings, according to circumstances. Size of traps to use for various fittings.

"Mansion" Water-closet Trap or "V-Dip" Trap.—This trap, Fig. 10 (also see Section, Fig. 11), Mansion water-closet trap.

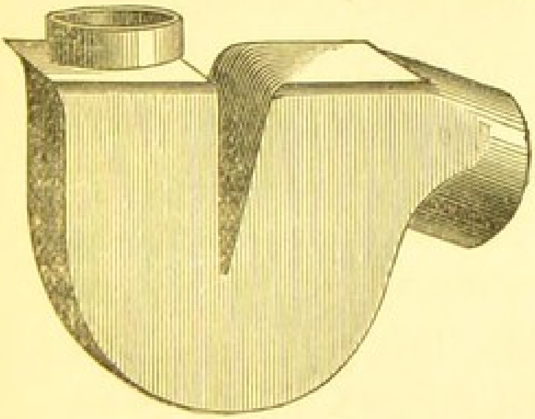

FIG. 10.

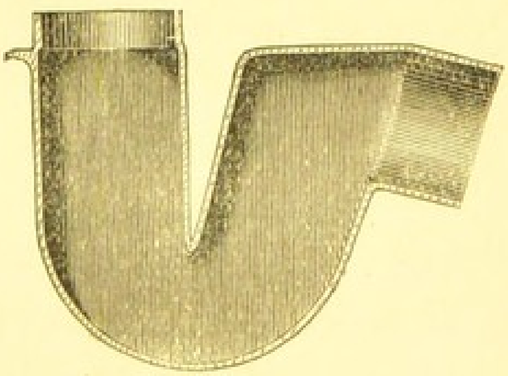

FIG. 11. SECTION.

is almost the same in principle as the patent cast-lead trap. It differs from it in this, that whilst the patent cast-lead trap is a *round-pipe* trap, this is a *square-pipe* trap, with a *round outgo.* And the former is made by machinery, without solder, and the latter by hand, with soldered angles.

Can be made by any skilled plumber.

This trap, in any size, can be made by any skilled plumber, with lead of any substance to suit the purpose for which it may be required. But the weight of the lead should never be less than 6 lbs., and 7-lb. or 8-lb. lead should be used for water-closet traps, and never less than 8-lb. for hot-water wastes.

Specially adapted to prevent syphoning.

This V-dip trap is specially adapted to prevent a too great syphoning action in the passage of the discharges through the waste-pipes or soil-pipes, and to allow for evaporation, when unused for months together, as is often the case in country mansions.

Specially fitted for valve closets, &c.

It is specially constructed for *valve* water-closets and slop-sinks, where the discharge is sudden and direct into the trap, and in such a volume as at once to fill the orifice of the outgo, and to commence a syphoning action unless checked; and also for places where the traps and fittings remain idle for months, without a drop of water passing into them. The water-dip should not be less than $1\frac{3}{8}$ in., and for such places as just referred to the *dip* should be $1\frac{1}{2}$ in.—this is equal to a 4-in. dip in a round-pipe trap 4 in. diameter.

Self-cleansing.

Like the patent cast-lead trap, it is free from all places where any foul matter can accumulate, and in its action it is self-cleansing—every part of the inside being washed by the passage of the water through it.

This trap is little known, though many hundreds have been fixed in most important houses with entire success. The expense is against its extensive use—it is nearly three times as costly as the "patent cast-lead trap," but where cost is no object, and the pipes are insufficiently ventilated, it is a valuable trap to use. Where there is a great syphoning action upon the traps, caused by long lengths of vertical soil or waste pipe, and where evaporation has to be considered, it is the most efficient trap that can be fixed. (See "Trap-ventilation," Chapter VIII., page 64.)

Little known.

Expense against its extensive use.

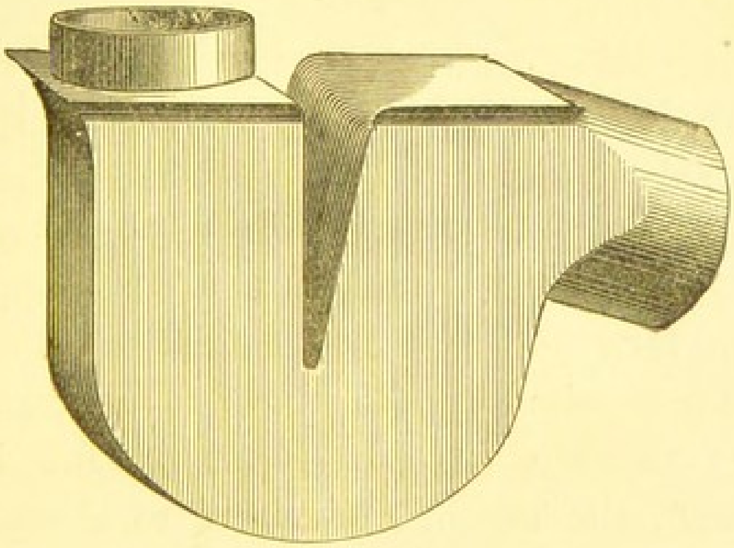

FIG. 12.

Soil-pipe Trap.—This soil-pipe water-trap, Fig. 12, is similar in principle to the "mansion," or "V-dip" trap. It is specially constructed for fixing at foot of soil-pipes, and connecting the same with drains. There are two sizes—one for

Soil-pipe trap in lead.

4-in. and $4\frac{1}{2}$-in. soil-pipes, and the other for 5-in. and 6-in. soil-pipes; but of course they can be made in any size, as required by circumstances.

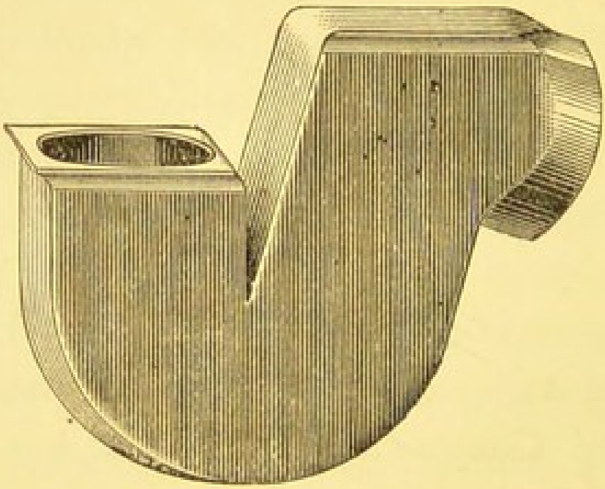

FIG. 13.

Descrip-tion.

Figs. 12 and 13 show this trap in lead—Fig. 12 for vertical soil-pipe, and Fig. 13 for "horizontal." The substance should always be strong, and never less than lead 7 lbs. to the superficial foot, and for good work 8-lb. lead should be used. Any skilled plumber can make this trap. In Fig. 13 the dip, or inlet, is kept a few inches lower than the top of the outgo, to allow for a horizontal soil-pipe to come into it without much increasing the depth of the trap (see Fig. 14, showing this trap fixed). The cheeks and band are of the same width at every part of the trap, except at the outlet, and so arranged as to give a water-dip of $1\frac{1}{2}$ in. The outgo of the trap is rounded to fit the drain-pipe, and also to give a clear course for the waste-discharges, to prevent any lodgment of foul matter when passing through the trap. The outlet of the trap can be lengthened to suit any position by soldering a piece of soil-pipe to the outgo.

Lead soil-pipe trap fixed inside and outside a house.

Fig. 14 shows a section of this lead soil-pipe trap, fixed immediately *outside* the external wall of the house, with all its connections. These soil-pipe traps should never be fixed *inside* a house if

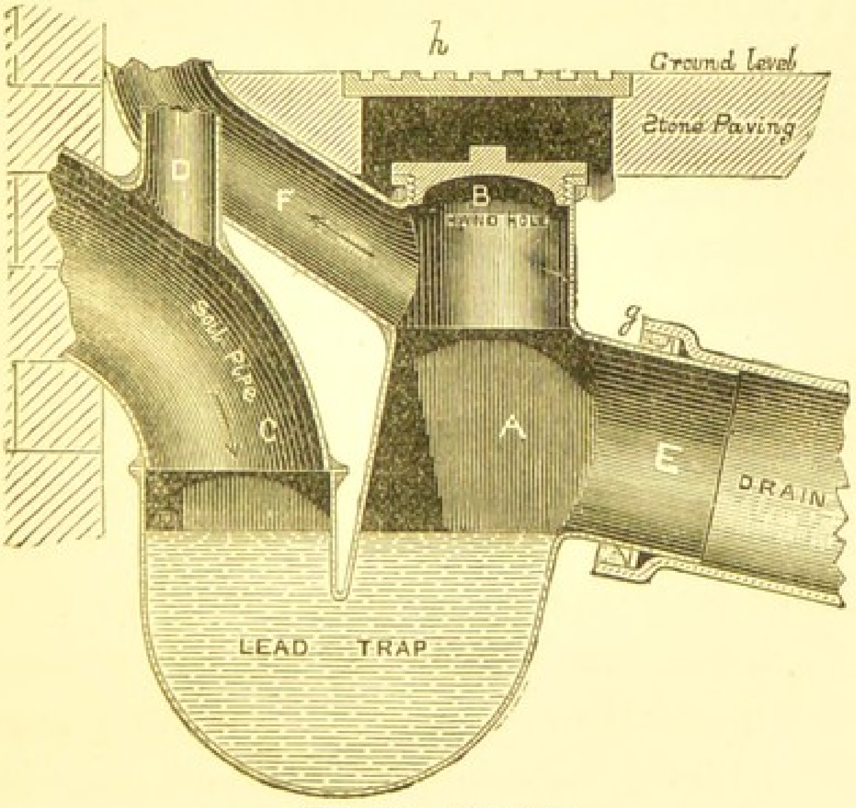

FIG. 14. SECTION.

there is any possible means of fixing them *outside*. When they are fixed inside the house, the outgo should be taken through the wall of the house, and connected with the drain-pipe outside, so that if the connection becomes defective, the drain-air can escape into the open air; and also, when the screw-cap, B, Fig. 14, is removed for the inspection of the trap, or drain, or for cleaning out same, the drain will be exposed to the external air, instead of inside the house.

A, Fig. 14, shows a section of this trap with its water-dip of $1\frac{1}{2}$ in.; B, the hand-hole, with a cap and screw over it—this is a *short* piece of $4\frac{1}{2}$-in. lead pipe soldered on the top of the trap, with a brass cap and screw soldered on the top of it; C, the soil-pipe coming through the wall; D, air-pipe, or "foot-ventilation" to the soil-pipe; E, connection of the outgo with the drain-pipe; F, ventilating-pipe to drain and trap; *h*, a moveable galvanised iron cover let into stone paving over the screw-cap to the trap, for access to it without disturbing anything.

Air-pipes separate. Ventilating branch drains.

The air-pipe, D, Fig. 14, must never be connected with the ventilating-pipe, F, Fig. 14, from the drains (see "Foot-ventilation," Chapter VIII., page 57). Where the main drain is properly ventilated, and there is only a very short length of branch drain between this soil-pipe trap and the main drain, it is not necessary to have a ventilating-pipe, as shown at F, Fig. 14. But where the branch drain is a long length of piping, then it is important to have this ventilating-pipe, so that every part of the drain shall be properly ventilated.

Soil-pipe trap in cane-coloured ware. Connections with trap.

Fig. 15 shows a pottery-ware trap,* which the writer specially designed for fixing at the foot of soil-pipes. It is more suitable than lead for this purpose, and being fixed *outside* the house, the jointing is not of the same importance as connec-

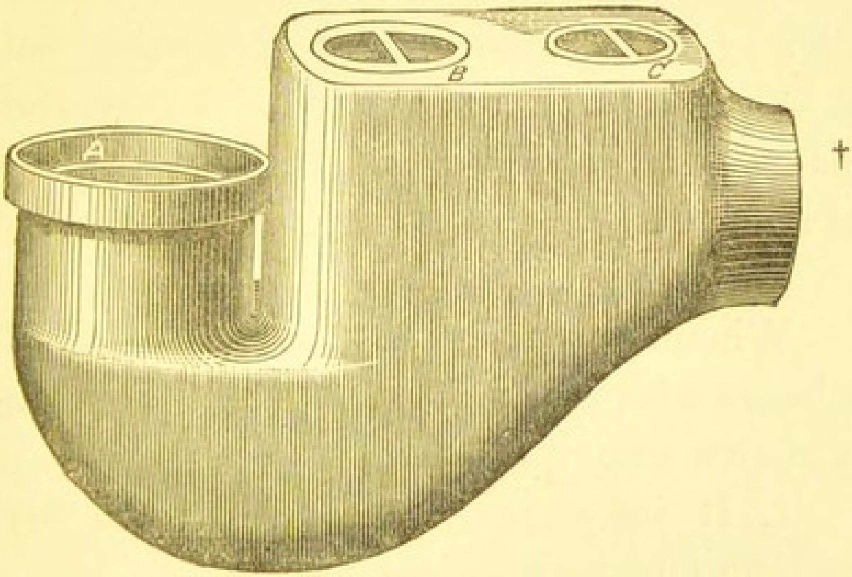

FIG. 15.

tions when inside the house. It is a round-pipe trap with a *water-dip* of $2\frac{1}{2}$ in. The inlet is kept low down, to receive the soil-pipe when it is brought through the external wall of the house, as shown in the lead soil-pipe trap, Fig. 14. But of course it is equally well adapted for receiving vertical soil-pipes. The soil-pipe can be "tafted" at the end, or a lead flange can be soldered at the foot of the pipe, as shown at *g*, Fig. 14, and fitted

* These traps are made in two sizes for 4-in. and $4\frac{1}{2}$-in. pipes, and for 5-in. and 6-in. soil-pipes, to fit 6-in. drains. † See Figs. 53 to 58.

into the socket of the trap at A, Fig. 15. The waste-discharges will then drive everything foreign out of the trap; but when the soil-pipes are *branched* into the dip of the trap, foul matter is splashed all over the inlet part of the trap to make it filthy. B, Fig. 15, is a movable cap for the hand to get into the trap to clean it out, and C, Fig. 15, is a provision for ventilating the drain at this point when necessary. A galvanised iron plate can be fixed over the hand-hole of this trap, as shown to lead trap, *h*, Fig. 14.

Advantages of such a trap.

When a long length of soil-pipe is fixed *inside* a house with many closets upon it, the advantages of such a trap at its foot are great.

Intercepts drain.

1. It intercepts the drain-air, and makes it seek an outlet *outside the house.*

Always charged with water.

2. Being under the ground-level, the water does not evaporate, or if it does, it is but very little, and being at the foot of the soil-pipe, it does not get syphoned out.

Water-barrier between drain and house.

3. When there is a defect in the soil-pipe inside the house, through age or any other cause, this trap stands as a water-barrier at the foot of the pipe, to prevent any drain-air passing up and escaping through such defect into the house.

A protection when other traps fail.

4. When any trap or traps upon such a stack of soil-pipe get uncharged by evaporation (through want of usage), or become untrapped by

the syphoning action of other waste-discharges through the pipe, then this trap at the foot is the only protection between the drain and the house.

Of course it will be absolutely necessary when such a trap is fixed at the foot of the soil-pipe, to *ventilate* the soil-pipe at the top, or the air in the pipe will be *bottled up*, and the remedy prove worse than the disease. But no soil-pipe should be without such a ventilation in any case. Ventilation necessary.

It will also be *very advantageous* to have a *second air-pipe*, or "foot-ventilation," to allow a Double ventilation.

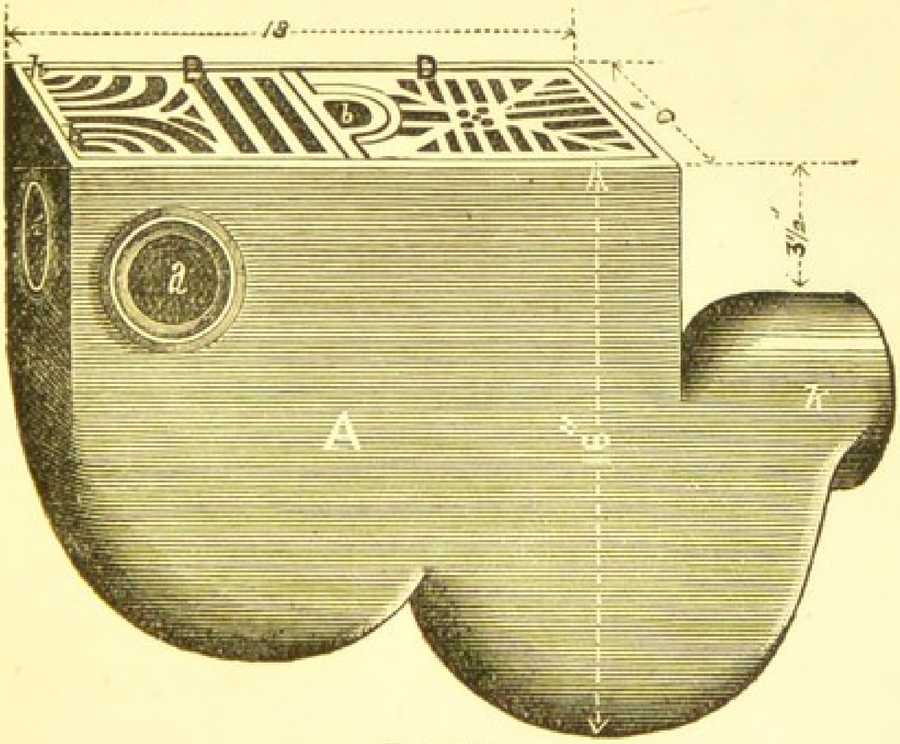

FIG. 16.

current of *air* to pass through the entire length of soil-pipe, and to provide an *escape* for the air driven down by the discharges. (See "Soil-pipe Ventilation," Chapter VIII., page 57 ; also Plate 1, between pages 28 and 29, showing such an air-pipe fixed.)

Waste-receiver and drain-interceptor.

Patent "Triple-dip Trap, or Waste-receiver and Drain-interceptor."—The writer has taken out a patent for this trap. It can be made in any size, but the size, as given in Fig. 16, is large

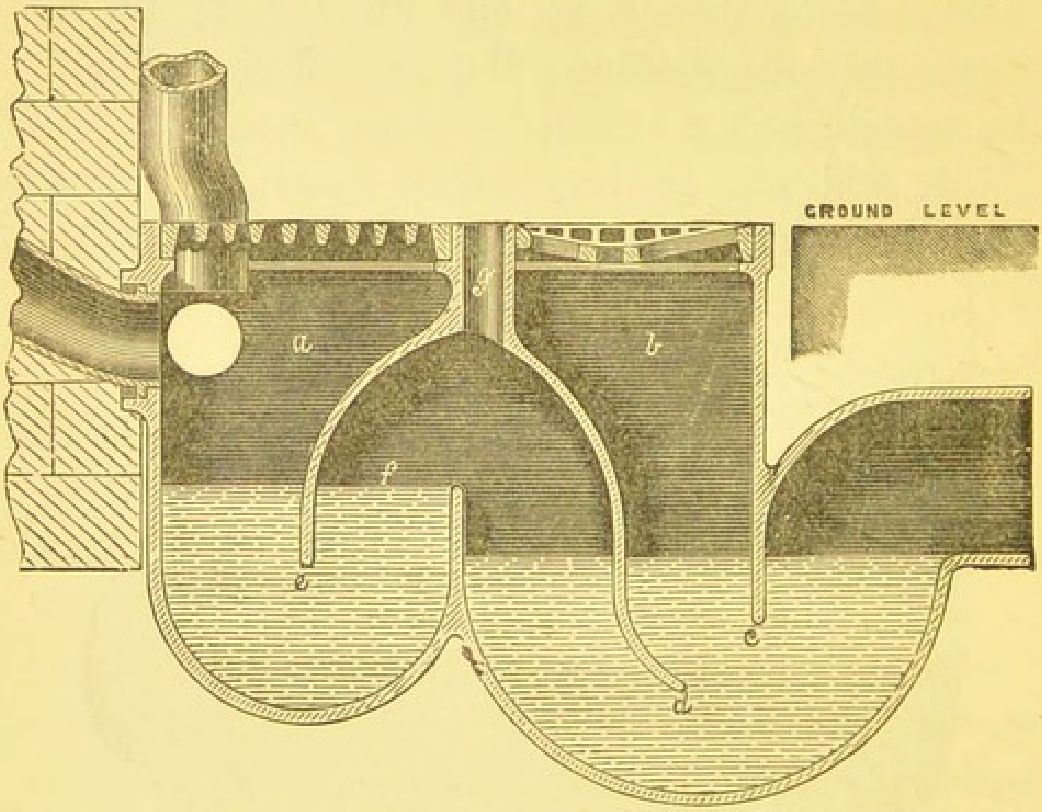

FIG. 17. LONGITUDINAL VERTICAL SECTION.

enough for almost every purpose for which it should be used. The trap is made in cane-coloured pottery-ware. Fig. 16 shows a view of this trap, and Fig. 17 a section.

Made in two compartments.

This trap is divided into two compartments, and arranged so that the water in the one compartment is kept separate from that in the other, to prevent the one polluting the other, if the water should in any way become foul.

The compartment *a*, Fig. 17, is used exclusively for receiving waste-pipes from baths, lavatories, sinks, and such-like wastes, but *not for sewage wastes.* Section and description.

The compartment *b*, Fig. 17, is for taking away the surface drainage, when the trap is fixed in the area, yard, or any such place; and also for providing a way of escape into the open air for any strong current of air blowing through the drain, and for preventing its passing into the waste-receiving compartment, where the ends of the various waste-pipes are left open.

There are *three* water-dips (or water-locks) in this trap, and before any noxious gases from the drain can get to the waste-pipes emptying themselves into the waste-receiving compartment, they must push their way through two separate bodies of water and three water-dips—*i.e.*, a depth of $3\frac{3}{4}$ in. at the first two dips, and another depth of 2 in. at the third dip. The dip *c*, Fig. 17, goes down into the water $2\frac{1}{2}$ in.; the dip *d*, Fig. 17, goes down $1\frac{1}{4}$ in. lower into the same water. The dip *e*, Fig. 17, is in another compartment, and goes down into the water $2\frac{1}{2}$ in. Three water-dips.

Suppose a strong current of air to be blowing up through the drain, and to force its way through the *first* dip, *c*, Fig. 17, it would at once escape Difficult for any current of air to pass from the drain to the waste-pipes.

into the external air through the compartment *b*, Fig. 17, for the *second* dip, *d*, Fig. 17, is 1¼ in. lower in the water. But even supposing this strong current of air in the drain forces itself under dip *d*, as well as *c*, into the compartment *f*, Fig. 17, it would at once escape through the air-pipe, *g*, and would never get into the compartment *a*, under the *third* dip, *e*, Fig. 17.

Gratings at top.

The top of the trap is protected by two separate galvanised iron gratings, as shown in Fig. 16, that to the waste-receiving compartment is fitted to the pipes entering into the trap, and that to the other is sunk to receive the surface-water.

Means for receiving the waste-pipes.

Means are provided by a countersunk hole, as *a*, Fig. 16, in each of the three sides of the waste-receiving compartment, to receive "horizontal" waste-pipes, and when not required, such holes are filled up with a stopper, of the same ware as the trap, made for the purpose; or the waste-pipes can be taken in at the top, as shown in Fig. 17. When the pipes enter at the top they must not go more than 3 in. into the trap, or down to the same level as the pipes entering at the sides, so that the *ends* in each case may be left *open to the atmosphere*. This "waste-receiver" should always be fixed a yard or two away from windows and doors. (See Plate 3, Fig. 4, showing this trap fixed.)

Open ends

When waste-pipes are made to discharge *over* a grating, or trap, the pipe being cut off a foot above the grating, according to the present mode of terminating such waste, a nasty mess is made all round such gratings or traps ; and when large bodies of waste water are delivered through them, a great deal of splashing occurs, and the filth is washed about everywhere at the foot of the waste-pipe. Evils of waste-pipes discharging *outside* gratings.

CHAPTER II.

SOIL-PIPES, OR WATER-CLOSET WASTES.

Chases should be left for all pipes.

In all new buildings proper chases should be left or provided in the walls for the several pipes that will be required in the plumbing-work, and more especially for the soil, waste, and service pipes; and all such pipes should be cased in with wood framings with hinged doors, or movable casings, for easy access to the pipes.

Soil-pipes, size according to the number of water-closets upon the stack.

Soil-pipes receiving water-closet discharges ought never to be less than $3\frac{1}{2}$ in. in diameter, and when several closets empty themselves into the same stack of soil-pipe, the size of the main soil-pipe should be increased in proportion to the number of water-closets on the pipe, and likely to be used at the same time. As a rule, 4 or $4\frac{1}{2}$ in. soil-pipe is large enough for any purpose, except in very large houses, where there are from a dozen to a score of water-closets upon one stack of pipe; then the diameter of the pipe should be increased to 5 inches; but this rarely occurs, except in large hotels and warehouses. Of course, all soil-pipes should be *round*, as they are more self-cleansing, and not so liable to get foul.

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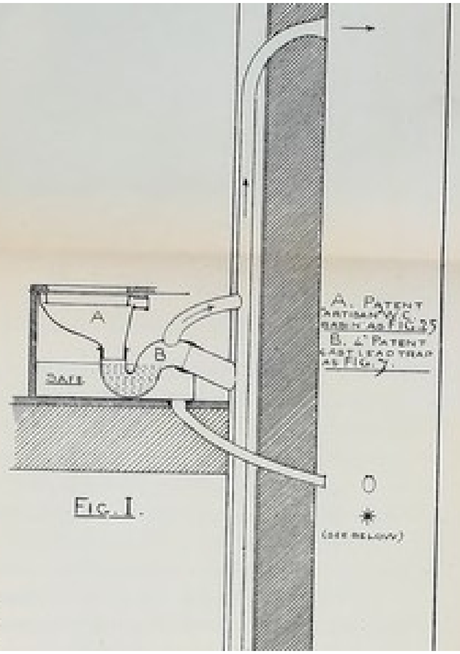

FIG. I.

It ought not to be necessary to say a word on the material of which soil-pipes should be made; but as there is a tendency in some quarters to use cast-iron, it may be well to look at this matter, and see what advantage *lead* has over *iron*. Material for making soil-pipes.

Lead soil-pipe is smoother and cleaner in its action than cast-iron pipe, and is therefore more wholesome; and, being of a closer texture, it is not so corrosive, and is consequently more durable. Lead smoother, cleaner, and more durable than iron.

Lead soil-pipe can be bent to suit any position, and when in its place is more *compact* than cast-iron pipe, and does not occupy so much room. More compact.

Then the joints and connections of lead soil-pipes are more to be depended upon than the cement-joints with iron pipe. Joints.

Urine is very corrosive, and acts much more on cast-iron than on lead. But not only is this corrosive action going on *inside* an iron pipe; there is another action taking place on the *outside* of the pipe when it is in cast-iron. The atmosphere of the house condenses on the pipes, and *rusts*, and eats its way into the pipe—so that whilst a corrosive action is wearing away the pipe on the inside, a similar rusting action is eating away on the outside. Of course, painting it periodically would prevent the atmospheric action; but this would involve a constant expense, and the back part of the pipe would not be got at even then. But with a lead soil-pipe, the action of any con- In iron soil-pipe, corrosion inside and rust out.

densation is merely nominal; and hence, lead soil-pipes (when they are without soldered seams) are as sound on the *outside* years after they have been in use as they were when first fixed.

Difficulty in making reliable joints.

Then there is the difficulty of making *sound and reliable joints* in cast-iron soil-pipes with the lead branches, or with the traps, when the latter are of lead. And, I suppose, no man, with any sanitary knowledge of water-closet work, would recommend iron traps for water-closet use. There would not, of course, be the same difficulty in making a sound and durable joint if the two metals to be united were the same.

Iron pipe too thin to caulk in lead.

As the pipe generally used for soil-pipe, when cast-iron is required, is only of the ordinary rain-water pipe substance, the joints cannot be caulked in lead (the pipe is too thin to stand the knocking required for this) and are therefore made in *cement*—a very vague sort of thing, meaning anything or nothing; for *any sort* of *stopping* by some people is called "cement;" and there is this danger attending such joints—the front part of the pipe is often stopped; the back, or part next the wall, *un*stopped—because it cannot be reached.

No safety in cement joints.

With such joints as those referred to in the last paragraph there is no safety. The stopping may be imperfectly done, or may dry up, or the joint may be broken; for the two pipes are not really *united* by such a connection. And this joint, when broken, will allow any bad air in the pipe to escape *insidiously* into the house; for, unfortunately, a leakage of *soil-pipe air* does not show itself like water, or proclaim itself like gas, but in a cowardly sort of way stabs you in the dark, or kills you by a slow kind of poison—a thousandth part of an inch at a time.

But supposing a stronger pipe is used, so that the joints can be caulked in lead. This simply overcomes the difficulty of jointing, while the other evils remain. It involves the expense of lead without securing its advantages, for the corrosion, &c., referred to takes place as before, and the unwholesomeness is quite as great. Moreover, when a leak occurs in *iron* pipe, it cannot be soldered as in lead, and there is no help but to cut it out bodily. What is it worth as old material? Why, hardly sufficient to pay for taking it away. On the contrary, lead soil-pipe can be repaired when a leakage occurs, and when no longer fit for its original purpose it can be sold for *about* half its original cost.

If a stronger pipe, evils, except that of jointing, remain the same.

All lead soil-pipe should be strong, and *never* of *less* substance than lead 6 lbs. to the superficial foot; but where cost is not the first consideration, and durability is required, the strength should be increased to 7 lbs. or 8 lbs., according to circumstances.

Strength of lead soil-pipe.

Chases in walls.

Proper chases should be provided in building the walls to receive all soil-pipes when fixed inside the house, for there is no better way of fixing funnel-pipes than on "blocks;" but this can only be properly done when the pipes are fixed in chases.

Blocks.

These blocks can be made of wood or stone, but the former is the cheaper, and is all that is necessary; they should be let into the wall at two opposite sides, the right hand and the left looking at the pipe, and they should be 2½ in. or 3 in. thick, according to the weight of the pipe to be fixed upon them.

Distance apart. Centre support.

A block every 10 feet—which is the length of all lead funnel-pipes made by hydraulic pressure—*may* be all that is necessary for *air-pipes*, but for soil and waste pipes there should *always* be a *supporting-block* in the *centre—i.e.* a lead flange soldered to the pipe, and made to rest on a wood block similar to the block-joints; or a lead tack should be soldered to the pipe, about midway between the block-joints, as an additional support, or the pipe will be liable to "bag out," and break away at the joints All funnel-pipes, air, soil, or waste, between 3 in. and 6 in. diameter, should have this supporting-block in the centre, regardless of the substance of the pipe.

Block-joint.

Fig. 18 shows the best way of making this block-joint at the connection of the two pipes.

The top of the block is countersunk, or rather rounded off, where the pipe passes through, and the end of the pipe is rounded back upon it, with a lead flange underneath, and the two pipes are then soldered together, as shown by Diagram,

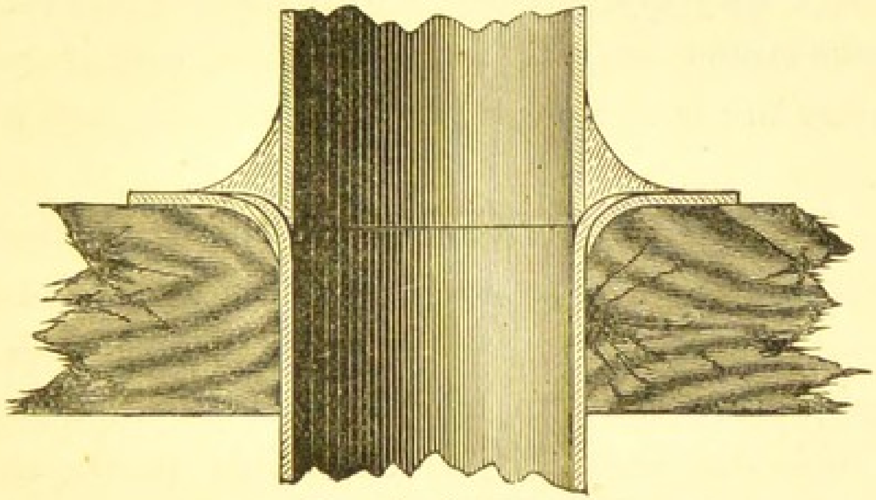

FIG. 18. SECTION.

Fig. 18. It takes more solder this way, but when the pipe is tafted back at right angles, as is often the case with some plumbers, the lower pipe is liable to break away at the taft.

When there are no chases, and the pipes are fixed on tacks, the tacks* should be strong, never less than of 7-lb. lead, and large enough to cover three joints of the brickwork, for soil-pipes, and two joints for air-pipes under 3 in. diameter—viz., 10 in. by 9 in. the large size, and 7 in. by 6 in. the smaller size; the largest part being soldered to the pipe so as to get three wall-hooks in the one and two in the other. These tacks should not be

Tacks: size and distance apart.

* See Plate XXI.A, facing page 274.

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more than about 3 ft. apart, and they should be fixed alternately to the right and left hand of the pipe.

Soil-pipes continued through the wall before connected to drain.

All soil-pipes, when fixed inside a house, should be *continued through the external wall* before they are connected with the drain, as these connections are liable to breakage, and if made inside the house, would let the drain-air into it.

Trap at foot of soil-pipe outside the house.

Every *stack* of soil-pipe, when fixed inside a house, should have an efficient *water-trap* at its foot, at the connection of the soil-pipe with the drain. And this trap, if possible, should be fixed *outside the house* in an accessible position. It should be fixed a little under the ground, to prevent the water from evaporating in summer and freezing in winter. A cap and screw should be soldered over it for occasional inspection, or cleansing, when necessary. (See Fig. 14, showing such a trap fixed; also Plate 1, Fig. 4.)

Shuts out drain-air.

This trap is more important than many allow. It *shuts out* the drain from the house, preventing noxious gases passing from the sewer and drain into the soil-pipe. I say this deliberately, knowing it is of the utmost importance that all pipes, whether soil, waste, or drain pipes, should be as *open* as possible; but then *no drain should be allowed to ventilate itself through a soil-pipe, when that soil-pipe is fixed inside a house*, and especially if it is a great length of piping. This trap, fixed as it is at the bottom of a pipe, always gets a good rush of water upon it to keep it clean, and when made on the principle laid down at page 6, there is no danger of its becoming foul.

Soil-pipes perish. A foot-trap shuts off the drain in case of defect.

Again, lead soil-pipe, like everything else, in time perishes, and if a defect occurs, through age or accident, what is to prevent the air from the drain (and perhaps sewer) passing through such defect into the house? But with an efficient water-trap, as Figs. 12 and 14, at the foot of a soil-pipe, the drain is shut off—at any rate, to a great extent; and the worst that can occur, in case of any such defect in the soil-pipe, is that the air in the soil-pipe itself may come into the house; but as the soil-pipe, under the principles of this little work, would be *ventilated both at the top and bottom*, there would be no noxious gases or injurious air to come into the house.

There is another reason why great lengths of soil-pipes, with many water-closets upon them, should be trapped at the foot. Sometimes some of the water-closets upon the stack remain in disuse for weeks together, when the house in which they are fixed is not in full occupation. The result of this often is that the unused water-closet traps become uncharged, through evaporation and other causes, and then, if there is no trap at the foot of the soil-pipe, what is to

D 2

prevent the air from the drain (and perhaps sewer as well) passing through the uncharged traps into the house? But I have said enough to show the value of this trap. (See "Soil-pipe Trap," Fig. 14, Chapter I., and the advantages summarised, page 22.)

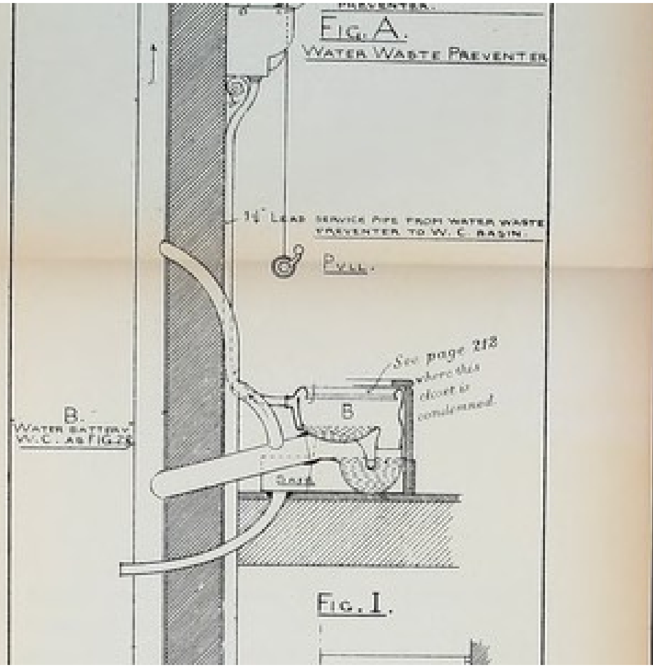
Important to ventilate the drain, and not to bottle it up.

Now, while it is important not to ventilate the drain through the soil-pipe inside a house, it is *more important still not to bottle up the air in the soil-pipe*, or, what is worse, shut up the drain. *Soil-pipes and drains cannot be too open, or too much ventilated*, and the nearer the ventilation of the drain is to this soil-pipe trap, the more effectual will the whole be.

If the drain cannot be ventilated separately, it is better that it should be ventilated through the soil-pipes by doing away with this foot-trap, rather than it should not be ventilated at all. (See "Ventilation of Soil-pipes and Drains," Chapter VIII. See Plate 1, between pages 28 and 29, showing a stack of soil-pipe fixed with water-closets upon it; air-pipe at top, ventilation at foot, and branch air-pipes from traps into same complete. Also see Plate 2, between pages 36 and 37, showing a stack of soil-pipe fixed *outside* the external wall, with another mode of ventilating the pipe at the foot, &c.)

prevent the air from the drain (and pe… sewer as well) passing through the … traps into the house? But I have said … to show the value of this trap. (See "… pipe Trap," Fig. 14, Chapter I, and the … tages summarised, page 22.)

Important to ventilate the drain, … hile it is important not to … the d… h the soil-pipe inside a hou…



CHAPTER III.

SLOP-SINK WASTES.

BEFORE entering into the subject of slop-sink wastes, it may be well to say a word upon the trap which should be fixed under it, even at the risk of repetition, for where there is no valve or check between the trap and house, as in this case, the trap becomes even more important (if possible) than it is, for instance, under a *valve* water-closet apparatus. Any defect in the trap through an insufficient water-dip, &c., will at once allow any foul air in the waste-pipe to come through the trap, and then it is inside the house; for there is nothing to check it in the slop-sink itself, which is simply a conductor of the slops into the trap or waste proper.

The trap important, as there is no other check between the house and waste.

Slops are generally thrown into such places in pailfuls, and the disturbance of the water is very great in the trap under it. And, if there is an extensive length of waste-pipe from it, and the ventilation of the pipe is defective, the trap is almost sure to be uncharged by the rush of water through the waste, unless it has a proper water-dip.

Slops thrown down in pailfuls disturb the water in the traps.

Traps independent of the sink.

Again, such traps should always be independent* of the slop-sink, and when up-stairs or inside the house, should be connected by a *wiped soldered joint* to the lead waste-pipe. Trap, Fig. 7, page 12, is a very good one for this purpose, but it ought never to be less than 3 in., and then the end can be bossed or reduced to 2½ in., the size of the branch waste, giving the trap a water-dip of not less than 2½ in. This will prevent its being unsyphoned, and will shut out all back draught through the waste-pipe.

Size of waste.

When there is only one slop-sink, a 2½-in. pipe is large enough; but when there are three or more, and these are on different levels, the main waste should be 3 in. in diameter, with 2½-in. branches from it to the various slop-sinks.

Strength of pipe.

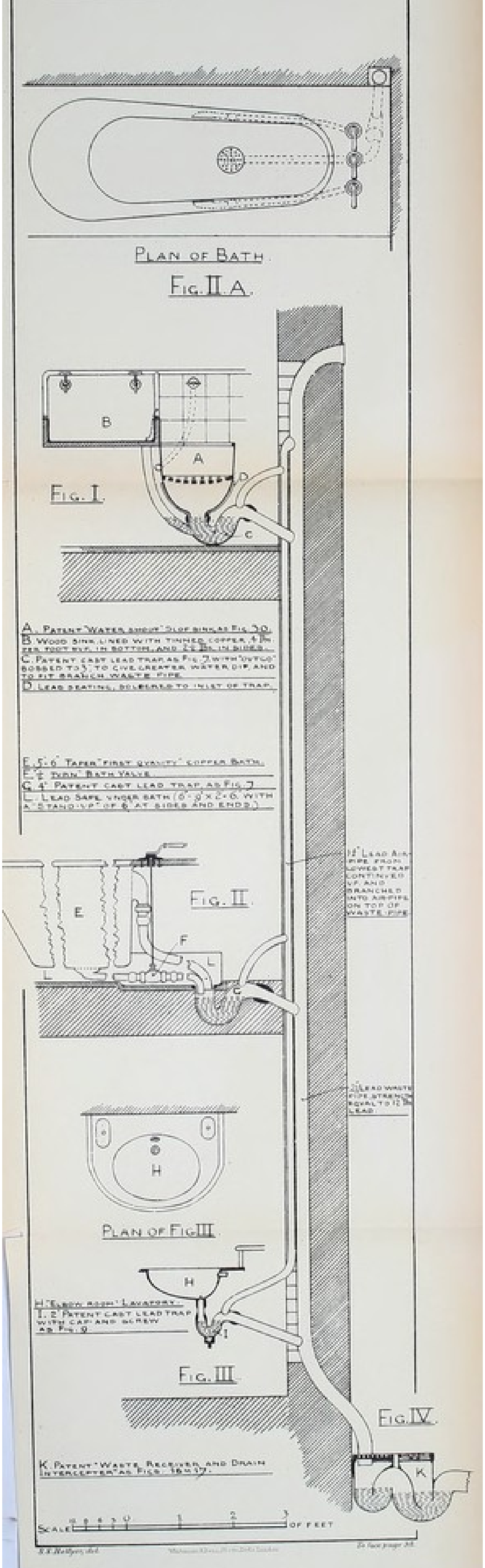
This pipe *should never be less* in substance than lead 8 lbs. to the superficial foot; and when there is a great deal of washing up, and a hot water "draw-off" cock over it, this should be increased to from 8-lb. to 12-lb. lead, according to the character of the house and the elasticity of the purse.

Empties with open end into waste-receiver.

Where possible, this waste-pipe should empty with an *open end* into a waste-receiver, just as the general wastes do, except, perhaps, when it has a long length of waste-pipe with several slop-sinks

* See "Traps independent of Fittings," page 3.

Plate III.


Plan of Bath.
Fig. II A.
B
A
D
C
Fig. I.
A. Patent "Water shoot" Slop sink, as Fig. 30.
B. Wood sink, lined with tinned copper, 4 lbs. per foot sup. in bottom, and 2½ lbs. in sides.
C. Patent cast lead trap, as Fig. 7, with "outlet" bossed to 3", to give greater water dip, and to fit branch waste pipe.
D. Lead seating, soldered to inlet of trap.
E. 5'-6" Taper "first quality" copper bath.
F. ½ turn Bath valve.
G. 4" Patent cast lead trap, as Fig. 7.
L. Lead safe under bath (6'-9" × 2'-6" with a "stand-up" of 6" at sides and ends.)
1½" Lead air-pipe from lowest trap continued up, and branched into air-pipe on top of waste-pipe.
E
Fig. II.
F
L
L
G
2½" Lead waste pipe, strength equal to 12 lb. lead.
H
Plan of Fig III.
H
H. "Elbow room" Lavatory.
I. 2" Patent cast lead trap with cap and screw as Fig. 9.
I
Fig. III.
Fig. IV.
K
K. Patent "Waste Receiver and Drain Interceptor" as Figs. 16 & 17.
Scale 12 9 6 3 0 1 2 3 of feet

upon it, and they are much used for emptying chambers into the sink, and the waste-receiver is under, or near, a window of the house (which it never should be); then the *end* of this pipe should *dip into the water*, to prevent the whole length of pipe sending out its bad air to be "sucked" in at the window. Such a waste-pipe, in time, is anything but "sweet," for chamber utensils are freely emptied into it, and all sorts of slops. When the end of this pipe dips into the water of the waste-receiver, it should have an air-pipe not *less* than 1½ in. in diameter taken out at the foot, and carried 10 or 12 feet away from the nearest window, and left with a grated end, to allow a current of air to pass into the waste-pipe, to keep it wholesome.

This waste-pipe must always be ventilated at the *top*, as described for other wastes; and when there are many *branches* from the main wastes, such branches should have air-pipes as well. (See "Trap-ventilation," Chapter VIII., page 64.) Also ventilated at top.

This pipe should be fixed on blocks, in the way described for soil-pipe fixing (see last chapter); or, if no chases are provided for it, it must be fixed on tacks, as explained for soil-pipe fixing. (See Plate 3, showing a slop-sink fixed, and waste-pipe from it complete.) Mode of fixing.

CHAPTER IV.

CISTERN-WASTES.

At the very commencement of this subject of *general wastes*, let the following rule be laid down, and be as binding as the laws of the Medes and Persians :—

Rule for general wastes.

No waste-pipe, other than a water-closet waste, should under any circumstances be directly connected with a drain or sewage-waste; and *in all cases such wastes should be taken through the external wall of the house, and discharge with an open end into a "waste-receiver,"* or place properly prepared for receiving such wastes.

Wastes to cisterns turned into overflows by Act of Parliament.

Cistern-wastes.—According to the rules of the London Water Companies, legalised by Act of Parliament, there are now to be no wastes to cisterns in the London radius, and so the comfort of the householder has been ignored; the water to be delivered is to be *so pure* that it will never require changing, however long it remains in the cistern, and the cistern will, therefore, not need any cleaning out.

Overflow at the top no use for

True, the Metropolis Water Act provides for *overflow-pipes* in each cistern, but the water will not jump up to the top of the cistern to go through this pipe when you want to clean it out. cleaning purposes.

And the size of this pipe—viz., *half an inch* in diameter—is of little use to the householder, however valuable it may be to the water companies; for how can a half-inch pipe, without any pressure upon it, take away the full charge from an *inch* ball-valve, with a pressure of from 40 to 70 ft. head-of-water upon it? Of course, when there is the constant service, a much smaller size ball-valve can be fixed; but even then such an overflow-pipe will not be large enough to take away the delivery, say from a ⅜-in. valve, when it is kept open by a small stone washed up under the seating of the ball-valve, or when the valve itself becomes defective.

Any size overflow allowed by some water companies.

Many of the water companies are gracious enough not to insist upon this small size overflow-pipe, and allow any size that may be required, provided that it is made to discharge where their servants can see if the water is wasting through a defective ball-valve, &c. And this they are justified in doing, for such trumpery ball-valves are used in many cases that they waste more water than the whole house consumes for its legitimate use.

Size of overflow should be twice the

The size of the overflow-pipe should be determined from the size of the service, and the pressure of water likely to be upon the ball-valve. An size of the service.

overflow fixed to a cistern on the ground floor requires to be larger than an overflow fixed to a cistern on the third and fourth floor, if served from the same pipe and by the same size ball-valve.

As a rule, about *twice* the size of the service will give the size of the overflow, except in the smaller size services, but *no* overflow-pipe from a cistern supplied direct from a rising-main should be less than an inch and a quarter in diameter.

Should never discharge directly over a drain-trap.

No overflow or waste-pipe from a cistern should discharge *directly* over a grating to any trap fixed immediately over a sewage drain. The water in such traps evaporates in the summer, and often leaves the trap uncharged; or impurities are thrown off by the water in this trap, or sewer-gas escapes through it; and when there is this cistern-waste or overflow over it, the gas passes at once into the pipe, and is drawn up through the pipe, by the warmth of the house, to the water in the cistern. And it is useless to put a trap in this pipe to prevent this, for there are no means of keeping it charged without a great waste of water.

The waste, or overflow, should always discharge some few feet away from the drain-trap, and a channel should be formed from it to the trap, to conduct the waste water, when the cistern is being cleaned out, into the trap.

Where possible, there is no better way of fixing this waste than by taking it into a gutter, with a copper-hinged flap soldered on the end of the pipe. Of course the end of this waste-pipe must never be fixed near the outlet end of a ventilating-pipe from a drain or soil pipe, or the vitiated air will pass through the waste to the water in the cistern, as before explained.

No better way of disposing it than taking it into a gutter

When the cisterns are too low for taking the waste from them into roof gutters, or where there are no roof-gutters to take them to, the pipe should be continued down through the house to the nearest surface-trap, *discharging some few feet away from the trap in all cases*, for reasons assigned above.

It is sometimes almost impossible to fix a waste-pipe in this way, except by a pipe as long as from " John-o'-Groat's to Land's End." When this difficulty occurs, and where there are no water companies to interfere, there is no better way of surmounting it than by the following plan, which may be adopted with the utmost safety :—

Take an *overflow-pipe*, at least twice the size of the service-pipe, from the top of the cistern to the *nearest external wall* of the house, and let it stand two or three inches beyond the face of the wall, with a copper-hinged flap, 1, Fig. 19, soldered on the end of the pipe, to prevent birds building in it, and stopping it up, &c., and also to shut out the draught in case of frost. The

Sometimes this is too expensive, then follow this method.

Overflow outlet lower than inlet.

outlet end of this overflow-pipe should always be a foot or more below the inlet in the cistern, to give a pressure of water upon the copper flap to keep it open during an overflow (see Fig. 19. H and I). Having provided an overflow-pipe—*i.e.*, for a failure in the ball-valve, the next important thing is to provide proper means for cleaning out the cistern. Fix a brass washer and waste connection in the cistern bottom in the usual way, and as this is only for cleaning out purposes, and not an overflow-pipe and waste combined, the size need not be more than 1 in. or 1¼ in. Then take an *under-waste* of 1¼ in. diameter lead pipe from it to the nearest rain-water pipe-head, as shown at F and G, Fig. 19; or, if there is no rain-pipe near or in the vicinity of the cistern, or if the rain-water is collected, then take the pipe into the nearest slop-sink trap, making the connection of the pipe with the trap at least 2½ in. below the water-line. And from this brass washer and waste in the cistern bottom, fix a standing pipe, as E, Fig. 19, and continue it up to the top of the cistern, with the *end*, D, *soldered over*, to act simply as a *plug* (an ordinary plug and washer with a long chain would answer the same purpose, but it is not so easy of management as the standard lead plug just named. If the chain-plug were pulled out by accident when the cistern was full of water, it would be difficult

Under-waste.

Standing-plug.

to replace it; but there would be no difficulty with a standard plug, which by force could be instantly replaced).

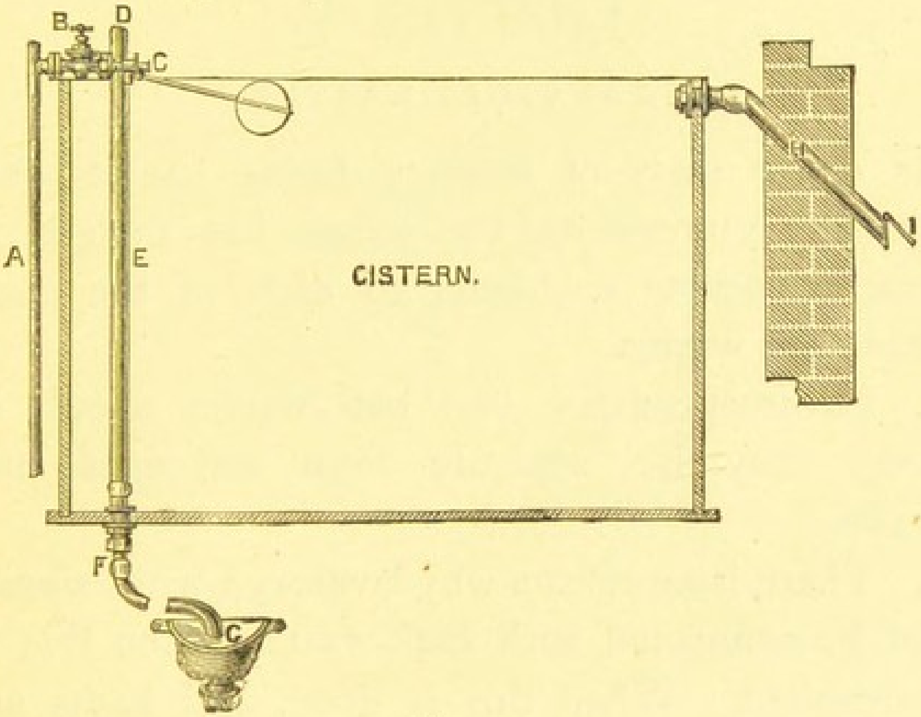


Fig. 19.

With an arrangement of this kind, how can any air, foul or otherwise, pass through this pipe, with a *sealed end* at the top of the cistern? The only danger about such a mode is that it may not be properly done; but, at any rate, all cisterns *not* used for drinking-water could have their wastes disposed of in this way, and there would be this advantage about it, that at the same time the cistern was being cleaned out the soil-pipe drains would be flushed out as well.

No danger in connecting with rain-water pipe.

CHAPTER V.

LAVATORY-WASTES.

Every waste has its own special requirements.

As every class of sanitary fitting has its own special requirements, the writer has thought it wise to devote a chapter to each of the more important wastes.

Separate from soil-pipe, &c.

Lavatory-wastes, like bath-wastes, should in every way be separate from soil-pipes and drains.

May be connected with bath-wastes.

There is no reason why lavatory-wastes should not be connected with bath-wastes, when this is convenient. When this is done, and baths are fixed upon the same main waste, and on higher floors as well, there ought to be an air-pipe taken out of the *branch wastes** on the lower floors, and carried up into the air-pipe at the top of the waste, to prevent the discharges from the upper baths unsyphoning the small traps to the lavatories. There can be no danger from such syphoning out of the traps, when the waste-pipe is open at the discharging end, and also at the top through the air-pipe; but if the traps are unsyphoned, the entire length of main waste will be exposed to the house, and the unpleasant air from soapsuds, if

* As shown in Plate 3, and described on page 64.

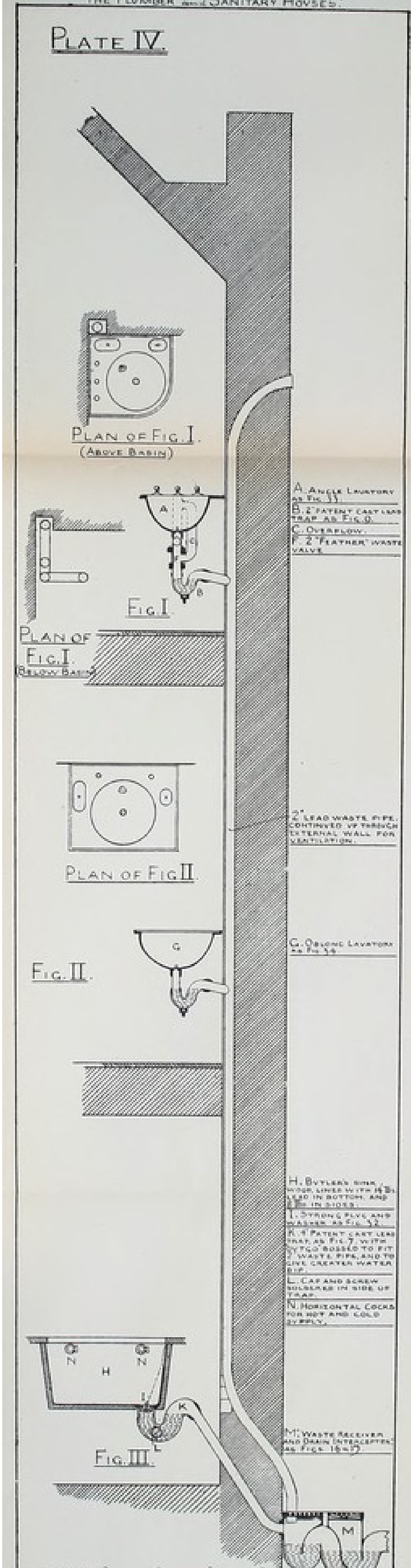


PLATE IV.
PLAN OF FIG. I.
(ABOVE BASIN)
A. ANGLE LAVATORY AS FIG. 33.
B. 2" PATENT CAST LEAD TRAP AS FIG. 8.
C. OVERFLOW.
F. 2" "FEATHER" WASTE VALVE.
A
B
C
FIG. I.
PLAN OF FIG. I.
(BELOW BASIN)
2" LEAD WASTE PIPE, CONTINUED UP THROUGH EXTERNAL WALL FOR VENTILATION.
PLAN OF FIG II.
G. OBLONG LAVATORY AS FIG. 34.
G
FIG. II.
H. BUTLER'S SINK, WOOD, LINED WITH 14 lb. LEAD IN BOTTOM, AND 8 lb. IN SIDES.
I. STRONG PLUG AND WASHER AS FIG. 32.
K. 4" PATENT CAST LEAD TRAP, AS FIG. 7, WITH SPIGOT BOSSED TO FIT 2" WASTE PIPE, AND TO GIVE GREATER WATER DIP.
L. CAP AND SCREW SOLDERED IN SIDE OF TRAP.
N. HORIZONTAL COCKS FOR HOT AND COLD SUPPLY.
N
H
N
I
K
L
FIG. III.
M. WASTE RECEIVER AND DRAIN INTERCEPTER AS FIGS 16 & 17.
M
SCALE
0
1
2
3
OF FEET

not injurious, is offensive, and may as well be made to go outside as inside the house.

The waste discharges from a wash-hand basin are not quick enough—"tip-up" basins excepted—with an ordinary size waste-pipe to uncharge the traps fixed upon the same waste, and therefore it is not necessary, when there are no baths upon it, to fix air-pipes from the branches to relieve them.

Not necessary with lavatory-wastes.

Where there are no bath-wastes to receive lavatory-wastes, they should be taken down, and discharged into a "waste-receiver," as shown in Figs. 16 and 17, pages 23 and 24, with an *open end*, or made to empty themselves over a place properly prepared for receiving such wastes.

As soap is corrosive, and adheres to the pipe, the waste should never be smaller than $1\frac{1}{2}$ in. diameter. And if more than one basin is fixed upon the same waste, the size should be proportionately increased up to 3 in.

Waste never smaller than $1\frac{1}{2}$ in.

A "patent cast-lead trap," with a cleansing cap and screw, as shown in Plate 4, Figs. 1 and 2, should be fixed immediately under each lavatory basin, and soldered to the branch waste, and this branch waste should be taken into the main waste with as great a fall as practicable.

Lead trap.

The main waste should, in every case, be taken out through the external wall at the top, a few feet above the highest branch waste upon it, to act as a ventilating-pipe. (See Plate 4, showing a lavatory waste-pipe fixed complete.)

Main waste turned through the wall at top to act as air-pipe.

CHAPTER VI.

BATH-WASTES.

Wastes too small; bath should empty in two minutes.

WASTE-PIPES from baths are nearly always fixed too small to empty a bath in reasonable time, occupying as a rule from five to ten minutes. This is a great inconvenience and discomfort when the temperature of the water wants changing, or a second bath is needed. Of course, it depends as much upon the discharging-cock to the bath as upon the size of the waste-pipe; but there is no reason why a bath should not empty itself in two minutes with a proper provision.

Size and strength.

No bath-waste, as a rule, should be *less* than 2 in. diameter; and as large bodies of hot water pass through it, it should be *stronger* than ordinary waste-pipes.

Should discharge into a waste-receiver.

In all cases, such wastes should discharge into a *waste-receiver* with an *open end*, and it should never be connected direct with a soil-pipe or drain. (See Fig. 4, Plate 3).

Larger wastes where there are several baths.

Where there are *many* baths upon one waste-pipe, and they are much used, as in hospitals, &c., the waste ought not to be less than 3 in. diameter, and the substance should be equal to lead of

10 to 14 lbs. to the superficial foot, according to the work it will have to do.

Great care is required in fixing a *long length* of vertical waste-piping, when it receives the wastes from several baths, to allow for expansion and contraction. A bath full of *hot* water is discharged into the waste from one floor, and this is often immediately followed by a bath of *cold* water from another floor. And if the pipe is confined too much, especially at the junctions with the branch waste-pipes, it is in time sure to break away. Instead of the usual soldered joint *in such cases*, it should be fixed as follows :— Great care required in fixing to allow for expansion.

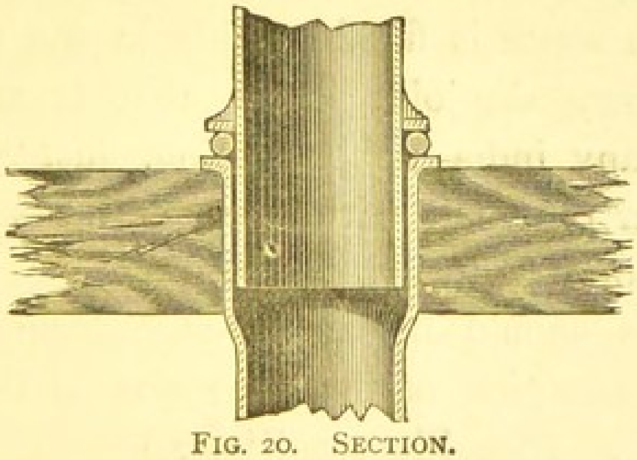


FIG. 20. SECTION.

Such waste-pipes should be fixed on "wood-blocks," one at every 6 ft., and instead of the ordinary soldered flange-joint, the connection should be made by a "slip" socket-joint, to allow for the expansion and contraction of the pipe; and this joint should be made air-tight by an india- Mode of fixing.

rubber seating (an india-rubber ring) under a flange-joint soldered to the foot of the upper length, as Section, Fig. 20. The branch wastes should be connected immediately above these joints; but the branches should never be confined by brick or cement-work, and should never be very short—it is better to make a bend or two in the branches than have them too short to allow for expansion and contraction in the main waste. If this slip-joint should become defective, and allow air to escape through it, no harm can result, because the waste-pipe is both open at the bottom and top. And it is not like a urinal or soil-pipe waste, where foul matter is thrown down. When this main waste is fixed outside in the open air, an ordinary slip-joint is all that is necessary, without any india-rubber seating, just as a lead rain-water pipe, but with stronger tacks to carry it, on account of its greater weight.

Air-pipe. There should be an air-pipe from the top of this waste-pipe of the same size as the waste-pipe itself. (See Plate 3, Fig. 2.)

CHAPTER VII.

SINK-WASTES, ETC.

Plugged Vessels.—Perhaps this is the best place to remark that all vessels with plugs, whether lavatories, sinks, baths, &c., should have *overflow-pipes;* which should be of sufficient capacity to take away the full charge of the supply to such vessels, and prevent an overflow of water, should the servant leave the supply-cock open. If the water companies insist, there is no reason why this overflow-pipe should not be taken through an external wall, and made to show itself, according to their regulations for baths; but it ought to be sufficient to take it into the waste-pipe from the vessel *above* the trap, or into the side of the trap itself—*well under the water-line.*

All plugged vessels should have over-flows.

Wastes to Housemaids' Sinks.—When these sinks are immediately adjoining a slop-sink, the waste-pipe may be taken directly into the trap under the slop-sink, and disposed of at once. (See Plate 3, Fig. 1; also Fig. 31.) This connection must be made on the *inlet* side of the trap, or $2\frac{1}{2}$ in. below the water-level in the trap—that is, the *top* of the outlet end of the waste, at

Sink-wastes can be connected with slop-sinkwastes.

the junction, must be 2½ in. or more *under the water*, to ensure a proper dip of water, and to prevent any air in the main waste coming through.

When there are no slop-sinks near it, the waste-pipe should be taken down and discharged into such a "waste-receiver" as Fig. 16, page 23, or a place properly prepared for receiving such wastes, with an *open end*. (See Chapter V., "Lavatory-wastes.")

Strength of waste and size.

The waste-pipe should be of lead of *medium* strength, and never less than 2 in. in diameter, and should be well supported with lead tacks soldered to the pipe, and secured to the wall by hooks made for such purposes.

Trap to sinks.

The patent cast-lead trap is specially adapted for attaching to such sinks and trapping off the wastes, but the size should not be *less* than 2 in., and when the waste-pipe is larger than 2 in., then a 3-in. or 4-in. trap should be used, with a screw-cap soldered to it for cleansing purposes.

Plug-washer, character of grating.

Just a word on the grating to the plug and washer. Gratings with *round holes* are time-wasters and temper-provokers, for the water only dribbles through such things. There ought to be no place for any lodgment round the side of a sink-grating, and whatever grating is used should be such that the waste water can pass through quickly, as in a cobweb grating (see Fig. 32).

Scullery-sink Waste.—It is a vexed question what to do with the grease from a scullery-sink. It chokes up traps and wastes, and in time drains as well. And when that *old offender*, *the bell-trap*, is used, it becomes a further source of evil. The scullery-maid swears, and the poker bangs, until the top—"even a worm will turn"—turns up, and though the bell-grate goes *out*, the smell comes *in*, and noxious gases from the drain too, and then, of course, "*it is a nuisance.*" Scullery-sink. Evils of grease. The old bell-trap.

Nothing less than a 4-in. patent cast-lead trap, as Fig. 7, page 12, should be fixed to a scullery-sink, with a 4½ or 5 in. brass rim and movable grate over it in the bottom of the sink. And from this trap a 3 or 4 in. lead waste-pipe should be taken through the external wall and discharged into a grease-trap formed *outside the house;* the lead waste-pipe should be made to dip into this water about 3 in., to prevent the end of the pipe being stopped up, &c., by the grease which always accumulates on the top of the water in the grease-trap. From this waste-pipe, which is trapped at both ends, take a 2-in. air-pipe a foot or two up from the waste-pipe, to relieve it, and to keep it as wholesome as possible. Then, if any air from the drain should be blowing through the grease-trap, it will escape through this air-pipe, instead of pushing its way through the sink-trap into the house. Trap to sink. Waste. Air-pipe on top of waste.

Grease-trap.

This grease-trap* should not be too large, nor too small. It must to some extent depend upon the work it will have to do; but, as a rule, 2 ft. 6 in. by 1 ft. 6 in. is large enough for any place.

In brick and cement.

The best way of making this trap is in brick, well lined with Portland cement, and having a dip-stone in the centre, with a water-dip of 3 in. or more.

The inlet compartment should have a movable *grating* over it for cleaning-out purposes, and the other compartment should be sealed over—when any windows or doors are in any way near it—with a piece of York stone, and be well cemented down.

Outside the house.

This trap should always be outside the house, and the nearer the ventilation of the drain is to it, the better.

* See Grease-trap, Figs. 72 and 73.

CHAPTER VIII.

VENTILATION TO SOIL-PIPES, WASTE-PIPES, TRAPS, AND DRAINS.

"VENTILATE! ventilate! ventilate!" * should be the cry of all occupiers and builders of houses. Ventilation.

Everybody is beginning to admit the necessity of ventilating soil-pipes and drains, but it is astonishing what ignorance exists upon this subject of pipe-ventilation. The old *bottled-up* soil-pipes in some of our country mansions (to tap which would be like tapping a gasometer) do not want ventilating more than the theories of some would-be scientific ventilators. Ignorance existing upon soil-pipe ventilation, &c. Bottled-up pipes as full as a gasometer.

Soil-pipe Ventilation.—All soil-pipes should be properly ventilated by a pipe, whose size, while varying with circumstances, should in *no case* be less than 2 in. internal diameter. Soil-pipe ventilation.

Where there is an extensive length of vertical soil-pipe, receiving branch pipes from water-closets on several floors, the air-pipe at the top of the soil-pipe should be increased in size in proportion to the number of water-closet apparatuses likely to be used at the same time, and the length of the stack of soil-pipe. It often Demand for air in soil-pipes. Air-pipe same size as soil-pipe.

* See Chap. XXIII.

happens, in full and large houses, that the contents of several water-closets are discharged at the same time into the main stack of soil-pipe. The *demand for air* in such a case is very great. Wherever this is likely to occur, it is necessary to fix an air-pipe of the same size as the main pipe, or to continue the soil-pipe right up to the outside of the roof.

Acts both as an inlet and outlet.

Many suppose that this *air-pipe on the top of a soil-pipe* is solely for ventilating the soil-pipe—that is, for providing an *exit* for any noxious gases which may be generated in the soil-pipe. But the truth is, this air-pipe is both an *inlet* and an *outlet* pipe.

Inlet during the passage of the discharge.

During the discharge of a water-closet, especially if it be a *valve* water-closet, the soil-pipe wants air, and air it will have; for if there is no air-pipe on the soil-pipe, it will pull out the water in one or more of the water-closet traps upon the stack of soil-pipe, and draw in *air* through such traps. This is very easily understood if considered.

A handle of a water-closet apparatus is pulled up quickly, and the contents discharged suddenly through the trap into the soil-pipe. This discharge forms itself at once into a sort of *water-plug*, and in its passage down the soil-pipe acts as a pump-piston, and pulls everything behind it, unsyphoning all the traps on its way to the drain, if not properly ventilated at the top. If any reader doubts this *demand for air* in the soil-pipe during the passage of the discharges, let him go on the top of his house, where there is an air-pipe, and place his pocket-handkerchief over the mouth of the pipe, and then order a *valve water-closet*—say on the second or third floor—to be filled with water and quickly discharged. He will then have a practical illustration of the pulling power in a soil or waste pipe during the passage of large bodies of water through it, and will return to his arm-chair a wiser, though perhaps a sadder, man, for probably he will have lost his pocket-handkerchief down the soil-pipe.

Outlet when soil-pipe is not in use.

When the fittings and pipe are at rest, this air-pipe acts as a ventilating-pipe, and allows any bad air to escape through it to the external air above it. (See Plates 1 and 2, showing a stack of soil-pipe with ventilating-pipe from top to outside of roof.)

Air-pipe at the foot of soil-pipes.

*Foot-ventilation of Soil-pipes.**—Having shown the necessity of a ventilating-pipe from the *top* of a soil-pipe, it remains to consider what advantages are to be gained by a ventilating-pipe fixed to the *foot* of a soil-pipe—*i.e.*, by giving it a *second* air-pipe. The advantages of this second air-pipe, or "foot-ventilation," are greater than

* See Plates XI. to XVII., also Fig. 52.

will be conceded, except by those who have gone thoroughly into the matter, and proved its value.

Its value tested practically.

The writer has thoroughly tested the working of this *second* air-pipe during the last seven or eight years upon soil-pipes and slop-sink waste-pipes, and in every case with the utmost satisfaction. Wherever a soil-pipe or slop-sink waste-pipe has consisted of an extensive length of vertical piping (receiving several branch waste-pipes from the various floors), with a water-trap at its foot to intercept the drain, this second air-pipe, or foot-ventilation, has been adopted with entire success.

Two advantages.

There are two important advantages gained by this air-pipe at the foot of a soil-pipe, and—

Air-pipe at foot prevents any disturbance in the various traps.

1. This air-pipe, at the foot of a soil-pipe, prevents any disturbance of the water in the various traps fixed upon the pipe, as it provides an *exit* for the air (driven down by the waste discharges) at the *foot* of the pipe.

When a body of water—as from a *valve* water-closet or slop-pail—is thrown suddenly into a soil or waste-pipe, it exerts two influences, the one a *pulling*, and the other a *driving* force. The former action, the pulling, or suction power, was considered under the head of "Soil-pipe Ventilation," page 56, and this is always *behind* the discharge, or "water-plug;" the latter, or driving force, we are now considering, and this is always before, or *under*, the discharges.

Waste-discharge passing through a pipe drives all the air in the pipe before it.

The volume of water thrown down into the soil-pipe forms a sort of *water-plug* in the pipe, and whilst it acts as a piston, pulling or sucking everything after it, it also acts as a forcing-plug, and drives everything before it. Now when a soil-pipe is air-sealed at its foot by a water-trap, where is the air in the pipe, which this water-plug is forcing down before it, to go to? The pipe in its normal state is always full of air, and this must go somewhere. The pressure of this water-plug will prevent its passage to the air-pipe at the top of the soil-pipe, and escaping in that way, and so (when there is no air-pipe at the foot) it must force its way through some one or more water-closet traps below the discharge into the house.

How to test the experiment.

If any reader doubts whether the air in a soil-pipe is forced through a water-closet trap, where there is no foot-ventilation, by the discharge of a water-closet on a higher level, let him test it. He can easily do this by going into the lowest water-closet on the soil-pipe, say in the basement, and getting the apparatus removed, and then sending some one to discharge a valve water-closet at the highest point, on the third or fourth floor; and if *he* is not satisfied about it after making such an experiment, his tailor will be—if he stands anyway near the trap—for whatever was in the trap before he made the experiment will be sent out of it into the room. The writer has seen the contents driven out, in such experiments, to a height of three and four feet above the trap. When this occurs, the house is without any protection as far as this trap is concerned.

An air-pipe at the foot of more value than a dozen at the top.

Some will say, "A *larger air-pipe* fixed at the *top* of a soil-pipe would obviate such an evil;" but the writer's experience is that it would not. An air-pipe as large as a tower will not counteract the *forcing power* of this *water-plug* when passing through a soil-pipe, and more especially if the soil-pipe is only 4 in. diameter; but a small air-pipe at the foot of the soil-pipe at once relieves it—in fact, an inch pipe at the *foot* (provided that the soil-pipe is ventilated at the top as well, by a medium-sized air-pipe) is of more value than a dozen air-pipes at the *top*, each of the same size as the soil-pipe itself. But this *air-pipe* at the *foot* of a soil-pipe ought never to be less than 1½ in. internal diameter; 2 in. pipe will be more effective. This will be found to be large enough for almost any soil-pipe ventilation at its foot.

Constant change of air in the pipe.

2. This *air-pipe* at the *foot* of a soil-pipe is extremely valuable, for by this means a constant change of air is taking place right throughout the entire length of pipe, to render it wholesome, and to prevent any air from becoming stagnant in any part of the pipe. For when the soil-pipe is not

in use, this *second air-pipe* at its foot acts as an air inlet.

With such a system of ventilation to the soil-pipe, or to waste-pipes, it is impossible for noxious gases to be generated in them, for a stream of fresh air is always passing through the pipe. (See Plates 1 and 2, showing two modes of fixing ventilating-pipes at the foot of soil-pipes.)

A word or two on the air-pipes themselves.— In every case where air-pipes from soil-pipes or drains are fixed *inside* a house, they should be of lead, for reasons explained under "Soil-pipes," Chapter II., page 29. The *wiped* soldered joint can always be relied upon, and we thus prevent any air from escaping through the pipe-jointings to the house.

Air-pipes themselves.

The size of the air-pipe at the *top* of a soil-pipe should *never be less* than 2 in. internal diameter; and when there are two closets upon the same stack of soil-pipe, the air-pipe should be increased in size to 2½ or 3 in. When the soil-pipe is of any great length, and there are several water-closets upon it, the air-pipe should be the same size as the soil-pipe itself—*i.e.*, the soil-pipe should be continued up to the outside of the roof.

Top air-pipe never less than 2 in. dia.

The size of the air-pipe at the *foot* of a soil-pipe must depend to a great extent upon circumstances. When there is a long length of

Size of pipe for foot ventilation.

soil-pipe, it ought to be larger than when it is only a short length; but a 2-in. pipe is almost large enough for any circumstances, as explained above.

Fixed away from breathing-places.

If there are no windows or doors near, this air-pipe need only be taken a foot or two above the connection with the soil-pipe, with the end *enlarged*, and grated with copper wire, to prevent birds building in it. (See D, Fig. 14.) Then the air can escape out through, or pass into it, according to the needs of the soil-pipe. If there is much traffic near this air-pipe, it should be taken up 15 ft. or more above the ground-level, so as to prevent any one inhaling the air which would be sent out through this pipe when any of the water-closets were in action.

In towns and cities houses too crowded to fix such pipes through a wall.

But this method is generally impracticable, except in country houses, where there is ample space. In towns and cities, where the houses not only elbow each other, but keep one another upright by leaning against each other, it is impossible to stick out a pipe from one house without sticking it into the side of another. In such circumstances another plan must be adopted. Take a 2-in. lead pipe from the foot of the soil-pipe (as near the drain-intercepting trap as possible), and continue it up, inside or *outside* the house, according to circumstances, and terminate it in the *open air* at the most convenient place, remembering that the nearer the outlet, or inlet, of an air-pipe is to the soil-pipe, the more perfect will be the ventilation; but it is important to keep such outlets away from all breathing-places, for a soil-pipe or waste-pipe, even ventilated in this way, can be offensive (especially when in use), and send forth an unpleasant smell.

The *positions* of such *outlets*—as, in fact, of all ventilating-pipes—should be well considered. In no case should such outlets be near a drinking-water cistern, or the bad air emitted by these pipes will be imbibed by the water in the cistern. (See "Water-contamination," Chapter XV., page 120.)

Positions of air outlets important.

When this second air-pipe, from the foot of a soil-pipe, is carried up above all windows, as just explained, it can be made to serve a double purpose, by receiving the branch air-pipes from the various water-closet traps fixed on that stack of soil-pipe. (See Plate 1, showing such an air-pipe fixed from the foot of a stack of soil-pipe, and receiving the branch air-pipes from traps, complete).

Trap-ventilation.—When two traps are fixed upon one waste-pipe without a ventilating-pipe to relieve them, and give them air, like two negatives in one sentence, they destroy each other.

Trap-ventilation to prevent unsyphoning.

All water-closet traps, slop-sink traps, and traps where large bodies of water are thrown quickly down, should be ventilated, to prevent one trap syphoning out another. This is not so essential where there is a *double* air-pipe in the waste—one at the top and one at the foot. But where there is this *second* air-pipe going up to the roof, as described above, there is no great additional cost in this. All that is necessary is to take a *two-inch* lead air-pipe from the top of the trap—*the outlet side of the dip*—and branch it into the air-pipe from the foot of the soil-pipe, as it is on its way up to the roof (see Figs. 1, 2, and 3, Plate 1).

Offensive air from water-closets. Branch ventilation.

Everybody must have noticed on using some water-closets, where the ventilation in the pipes was imperfect, the offensive gust of air emitted into the room on pulling up the handle of the water-closet apparatus. But where there is this *branch ventilation* from the trap under it, *except it is a pan water-closet apparatus*, this cannot occur, for what air is in the pipe or trap, when it is disturbed by the discharge from a water-closet, is sent up through the air-pipes from the trap to the roof.

Advantages of trap-ventilation.

This *trap-ventilation* is not without its advantages. It forms a valuable auxiliary to the "foot-ventilation," in preventing one trap from syphoning out another; but it also saves itself from being unsyphoned by its own discharge. And such an advantage is worth gaining, for when a water-closet or slop-sink is fixed upon a long length of horizontal piping, say, during the passage of a discharge through this, it is without any ventilation on the trap-side at all, for the passing contents fill the pipe, and shut out whatever ventilation there may be in the main waste into which it is branched; and, then, the want of air behind this discharge gives it a suction power, as explained elsewhere, and a tendency to syphon out the water in the trap, leaving it uncharged. But where the trap is ventilated all this is obviated. Moreover, it provides an escape for any bad air or impurities thrown off by the water in the trap, and prevents anything being generated in the pipes, as it gives a circulation of fresh air throughout every part of it. (See Plates 1 and 2.)

Slop-sink Waste Ventilation.—Waste-pipes to slop-sinks should have the same system of ventilation as soil-pipes.

Ventilation to General Wastes.—Waste-pipes emptying themselves with an *open end*—and all general wastes should do this—do not require a *second* air-pipe, or *foot-ventilation*, for they ventilate themselves at the foot: the end of the pipe

Ventilation to general wastes.

being open, any air driven down by a discharge at once escapes into the open air. And, as the pipe is not in any way connected with the drain, there is not the same *necessity* for ventilation at the *top* of such wastes. But there is a great advantage in it.

Air-pipe at the top advantageous.

The *top-ventilation should not be dispensed with*, especially if there are several traps upon the same waste, as the air-pipe at the top prevents any disturbance of the water in the various traps when one is in use. Of course, when large bodies of water are thrown down, the action will be the same as explained in Chapter II., page 58; but such wastes as we are now considering, as a rule, do not receive any sudden discharges, at any rate sufficient to keep the pipe filled up to the last drain of water in the vessel discharged. Moreover, such ventilation allows a constant change of air in the entire length of waste-pipe to keep it wholesome.

The ends can be taken anywhere.

Such air-pipes can be taken just through the wall,* and left almost anywhere, as nothing injurious can come out of a pipe so open and free to the external air, though it is as well to take it a few feet away from any window or door, to prevent the warmer atmosphere inside the house "sucking" in the colder air from such pipes. (See Plates 3 and 4.)

* See Plate 4.

Ventilation to Drains.—Drain-ventilation is so closely connected with soil-pipe ventilation, and so essential to the proper working of the whole, that I cannot forbear saying a few words upon this important subject, though I may be hardly considered to have any concern with it in this treatise. But what would be the use of putting a damping course right round the walls of a house, and leaving a water-spring in the centre? or, what would be the use of filtering drinking-water into a cistern and leaving a cuttle-fish at its bottom? So what would be the use of purifying all the soil-pipes and waste-pipes *inside* a house by a complete system of ventilation, and then leaving a *cuttle-fish sort of drain* outside to generate noxious gases, and from its foul retreat to send up poisonous air through all these pipes?

Drain-ventilation.

Cuttle-fish drain.

The drain to every house should have *two ventilating-pipes at least*, one at the lowest, and the other at the highest point, or as near these points as possible, so that a constant current of air may pass throughout the drain to keep it wholesome.

Every drain should have two ventilating-pipes.

These air-pipes should be taken up against the side of the house (or tree) ten or twelve feet above all breathing-places, and twenty or thirty feet away from all windows.

When a house is in full occupation the air from such pipes is extremely offensive, and care should be taken that they pour out their unpleasant contents in such places as not to offend anybody.

The vitiated air from ventilating-pipes beats down like smoke from chimneys.

Some people imagine that if such ventilating-pipes are taken a foot or two above a window, there will be no offence from them. Such people must be *near-sighted*, or wear opaque glasses, or they would have noticed smoke beating down on a dull heavy day, and in gusty weather, to a great many feet below the chimney-tops. And what occurs with smoke from the chimney occurs with the vitiated air sent out of these ventilating-pipes; they should therefore be taken high enough to avoid any offence from them. Of course, the nearer such outlets are to the drain the more effectual will be their ventilation.

Long drains cannot be too much ventilated.

In large houses, especially in the country, where there is often a long length of drainage, it is impossible to have too much ventilation in the drains.

Care taken to avoid long branches of drain.

In planning the drainage system round a large house, great care should be taken to *avoid long branches from the main drain*, unless such branches can be ventilated, for no length of drain-pipe should be without ventilation, or the means of a current of fresh air passing through it.

Make rain-water pipes act as air-pipes.

It is very advantageous and economical to make (wherever it is practicable) rain-water pipes act as ventilating-pipes to the drain. As these pipes are *outside* the house, it is of little moment if the joints give way a little, but they should be well stopped when near any window.

Rain-water pipes flush the drains.

But such rain-water pipes will not dispense with the two ventilating-pipes before referred to, for during a great down-pour of rain they would be doing their more legitimate work, and cease their double action of ventilating and conducting. Then again, rain-water pipes help to flush out the drains and keep them clean and wholesome.

Air-pipes from drains *out side* the house.

No ventilating-pipe from a *drain* should be taken up *inside* a house if the drain can by any possibility be ventilated by carrying up an air-pipe *outside;* but rather than not have any ventilator at all, it is better to take a pipe through the house or anywhere.

When *in-side* should be in lead.

But when such pipes are taken up *inside* the house, they should be of *lead* with *wiped soldered joints*, to insure their being absolutely air-tight and sound in every part.

Means for creating a current of fresh air in the drain.

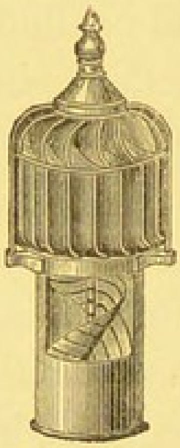
The following plan* is a very good one for insuring a current of fresh air in the drain. From the two ends of the drain, the highest and lowest points (the extreme ends), fix a ventilating-pipe, and continue same up above all breathing-places, and away from all water-cisterns. At the top of one of these ventilating-pipes fix an *Archimedean screw ventilator*,† as Fig. 21, to draw the air out;

Archimedean screw ventilator and cowl.

* See Plates XIX. and XXI.

† See Cowls, Plate XXIII., and Tables No. 1 to 6, pp. 291—300.

and on the top of the other ventilating-pipe fix a *revolving cowl*, as Fig. 22 (to act the reverse way of chimney-cowls), with its mouth *against* the wind—*i.e.*, for the wind always to be blowing in at one end of the drain and to be drawn out at the other. The screw ventilator should be



* Fig. 21.

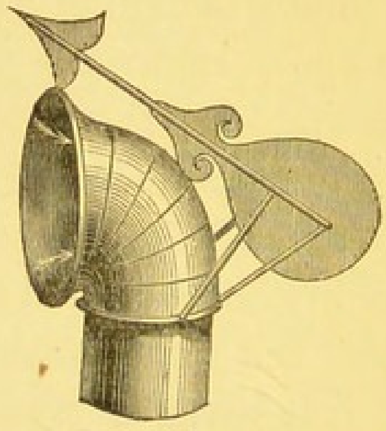


Fig. 22.†

on the ventilating-pipe at the highest end of the drain, and the *inlet-cowl* on the lowest. The *induct*-pipe should be kept as short as possible to obtain better results. An arrangement of this kind was fixed by us at a mansion in Norfolk, about three years ago, to ventilate a water-closet on the ground floor; with two pipes taken up to the roof, with an air-inlet cowl, as Fig. 22, on one, and a cowl with a reverse action on the other.

* Howorth's Patent Revolving Archimedean Screw Ventilator.

† Beard, Dent, and Hellyer's *Air-inlet Revolving Cowl.*

CHAPTER IX.

WATER-CLOSETS.*

Water-closet rooms next external walls for light and ventila-tion.

It may be worth while, on the threshold of this subject, to say something as to the rooms where the water-closet apparatus are fixed. Water-closets should always be placed next an external wall for ventilation and light. The rooms should be *lofty* and airy, and, if convenient, should have a small lobby at the approach for privacy. *No water-closet should be built without proper means of ventilation*, and if this cannot be effected by the window, a zinc tube can always be made to conduct fresh air into the room by fixing an air-brick in the external face of the outside wall, and taking a zinc pipe, say 6 in. by 3 in., from the air-brick to the skirting of the water-closet room. A brass hit-and-miss ventilator should be fixed to this zinc tube (whether it comes through the skirting, or is brought up through the floor), to shut off the current of air when it is too great. It is not only necessary to bring fresh air *into* the room, but also necessary to provide a *means* of *escape* for the air *in* the room; and this should be done at the highest point or ceiling-line, so that any odour left in the room after the usage of the water-closet

Proper means of ventila-tion.

Inlet of air at the lowest point, out-let at the highest.

* Continued, Chap. XIX.

may escape without finding its way into the house.

A water-closet apparatus, however efficient, will not remove the evil of a bad trap or soil-pipe.

Water-closet Apparatus.—Many imagine that an offensive *water-closet* can be remedied by simply fixing a new *apparatus* in lieu of the old one. As well might a policeman put a new hat upon a drunkard's head and expect it to make him sober, as for a plumber to put a new water-closet apparatus upon a foul or defective trap and expect thus to make a wholesome water-closet. "What's bred in the bone will come out in the flesh" is an old adage; and, what's bred in the trap or soil-pipe will come out into the closet, unless a proper escape is made for the gases to go another way.

A wholesome closet.

A wholesome water-closet does not so much depend upon the apparatus as upon the traps and soil-pipe in connection with it, though of course the character of the water-closet apparatus is by no means unimportant.

Water-closet apparatus in every variety, but two classes, the "valve" and "pan," most in use.

Water-closet apparatus are made in every variety of shape and size, and fitted up under almost every principle that ingenuity can devise or genius invent. But the *two* classes of water-closets most in use are the *valve* and the *pan* closets. The former takes its name from the *valve* which keeps the water in the basin (and not from the *supply-valve* attached to the apparatus, as many suppose, and thereby make serious mistakes.

for the pan-closet is also fitted up with a supply-valve attached to it). The "pan-closet" takes its name from the *copper pan* which keeps a small quantity of water up in the basin. The valve water-closet apparatus is chiefly fixed in good houses for private and visitors' use, and the pan for servants' use. Let us examine the merits of each.

The *valve* water-closet apparatus (see Section, Fig. 23) consists (apart from the working fittings) of a deep glazed earthenware basin, A, Fig. 23, which is kept about two-thirds full of water by means of a valve, B, at the bottom, and from this valve there is a short conducting-pipe,* C, Fig. 23, into the trap. No part of this apparatus can therefore in any way become foul or offensive, for there is no place where soil can accumulate. And if the handle E, Fig. 23, is only properly pulled up, *i.e.*, as far as it will go, at each usage of the water-closet, for the valve to be drawn back as shown in Section, this basin can be kept as clean, and as free from unwholesome matter, as a toilet basin in a bed-room.

On using this closet the soil passes at once into water, and directly the handle is pulled the

* This conducting-pipe, or "container" as it is called by the trade, is made in cast-iron. These conductors are much cleaner when *porcelain enamelled* on the inside, and the additional cost is very trifling.

deposit is carried right away by a good body of water (retained in the basin for the purpose) into

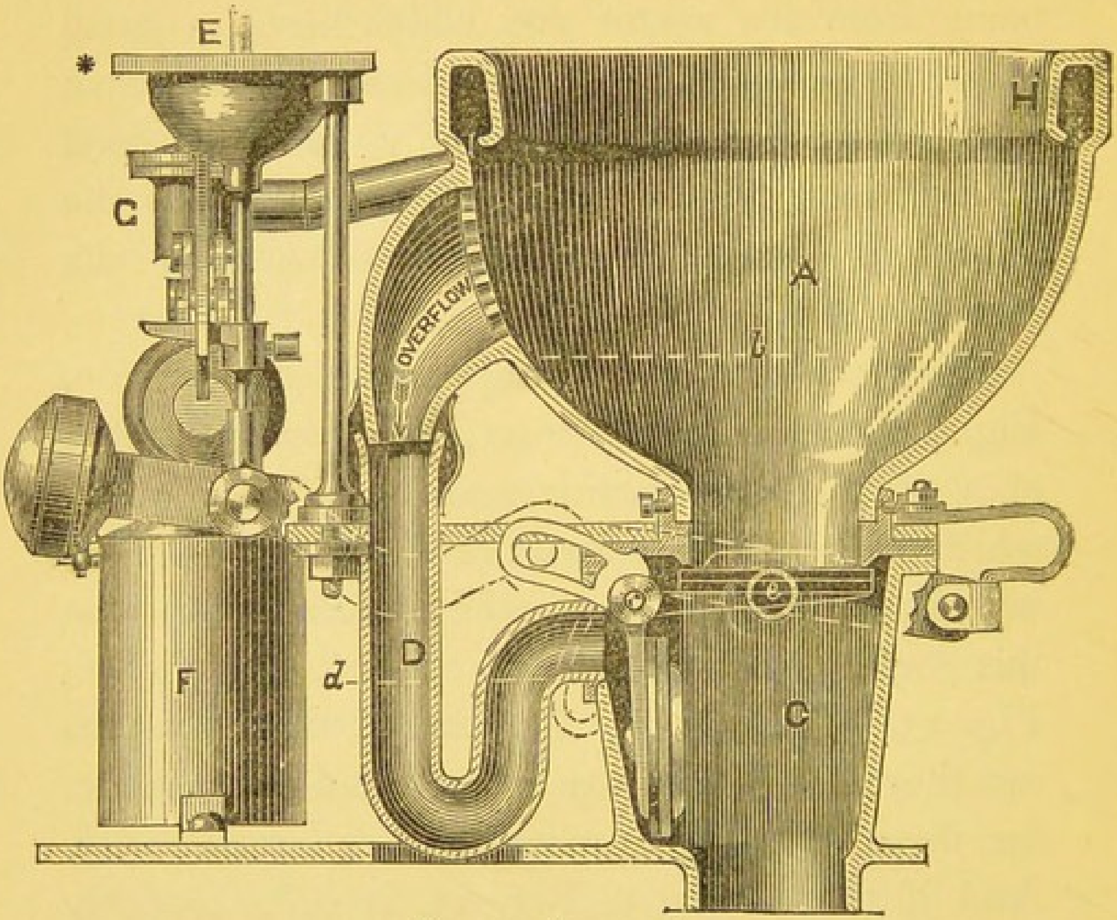


FIG. 23. SECTION.†

A. Earthenware water-closet basin, with flushing rim, H.
l. Water-line in basin.
B. Valve to keep water in basin.
C. Conducting-pipe into trap.
D. Overflow-trap.
E. Pull-up.
F. Copper Bellows Regulator, with regulating cork.
G. Supply Valve.
e. Air-pipe to ventilate space between basin-valve and water in trap.

* Sunk dishes are great receptacles for dirt, and when made of brass are difficult to keep clean. It is a great improvement to have them encased with porcelain-ware (to match the basin) as they not only look nicer, but are easier cleaned. The best plan is to have a "pull-up" ivory knob connection, to work through the stile of the water-closet seat, as shown at P, Plate 3, and D, Plate 2.

† See Figs. 75 to 79.

the lower regions, without touching the basin or soiling the apparatus.

Of course, such a closet requires a good supply of water to keep it clean, and the trap and soil-pipe, &c., attached to it, wholesome, but so does every water-closet apparatus.

Valve closet wants proper usage.

No doubt a *valve* water-closet wants proper usage, but so does a chronometer. But with careful usage it will work *many years* without needing anything done to it, and will certainly last as long as a *pan* water-closet. And when the basin-valve is fitted up with an india-rubber seating, as Fig. 23, if the water leaks out of the basin after it has been in use for some time, all that is necessary to remedy this is to change the india-rubber seating, which anybody can do, and this seating or india-rubber flange, when so wanted, can be sent through the post by writing to the maker of the water-closet.

If with india-rubberseating, valveeasily repaired.

To be good, a *valve* water-closet is somewhat expensive, but better pinch elsewhere than here—do away with a piece of needless furniture, or leave out some of the questionable ornamentation, rather than not have a good wholesome water-closet.

A *valve* water-closet is the most clean, wholesome, and efficient extant, nor is it likely to be superseded, for there is no part of it that can, with proper usage, become foul and nasty, or get out of order.

The most wholesome and efficient closet extant.

And if the plumbing-work in connection with this apparatus is done under the principles laid down in this treatise, it might be fixed, as it has been, in a bedroom, without the slightest risk to one's health, though it is always advisable to partition it off from the sleeping apartment.

When fixed in a bedroom.

When this closet is fixed in, or immediately adjoining, a bedroom, for invalid's use, there should be a ventilating-pipe, as *e*, Fig. 23, $1\frac{1}{2}$* inch in diameter, taken out of the conducting-pipe, C, Fig. 23, and carried through the *external wall*, with a perforated end to prevent any strong current of air blowing into this compartment in frosty weather, and freezing the water in the trap. This pipe can be taken anywhere, so long as it is a few feet away from any window, as there is nothing injurious to come from it, but it must not, on any account, be connected with any other pipe —air-pipe or what not. (See Plate 1, Fig. 2, showing this air-pipe from the apparatus fixed complete.) But it is only necessary to ventilate such an apparatus when it is fixed immediately adjoining a bed-room or living-room.

Trap independent.

See Plate 1, Fig. 2, shewing a valve water-closet apparatus fixed complete. The trap is quite independent of the water-closet, as, in fact, all good closets should be.

Difficult to understand how such

Pan water-closet apparatus (see Section, Fig. 24). The writer has always been puzzled to

* See Fig. 75, also Fig. 2, Plate XI.

understand how this apparatus has become so great a favourite with the public, and been so extensively used by the craft. The only bliss that the public can have about so foul a thing is

a closet should be used.

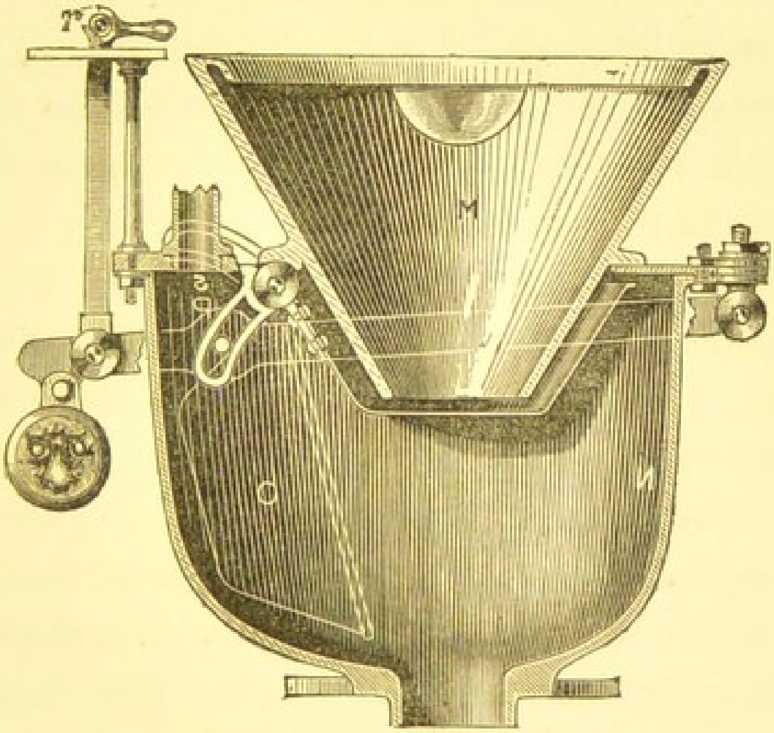


FIG. 24. SECTION.

'ignorance" of its nature, but what excuse to make for the plumber I know not, except that it was the custom of their fathers to fix a *pan-closet*, and this has become a law with them.

Description.

The *receiver*,* N, Fig. 24, is a large cast-iron receiver, or vessel, for the copper pan, O, to work inside, and to receive its contents when the water-closet is used. The vessel, O, is a copper

* This receiver is called by the trade a "container"—well, it does contain all sorts of nastiness after it has been in use a little while.

pan* (tinned on the inside) for keeping water to a depth of from 3 in. to 4 in. in the basin, M. This basin is made of glazed earthenware in various shapes and colours, and with "fan" water-spreaders or flushing rims.

Principle of working.

On pulling up the handle, *r*, Fig. 24, the contents of the basin, M, after usage, are thrown into the receiver, N, by the copper pan, O, and pass into the trap under the apparatus. But a glance at this apparatus in Section, Fig. 24, will show the impossibility of keeping it wholesome. The deposit is dashed against the side of the "receiver," N, by the tipping out of the pan, O, and is splashed from side to side of the receiver and all over the *outer side* of the *copper pan*, before it finally finds its way into the water-closet trap and soil-pipe. This filth, splashed about over the receiver and copper pan, is left to corrode, and to be added to by each usage of the closet, for it is impossible to get at it to clear it away, and especially the *under or outer side* of the copper pan, the *back part* of the *receiver* where the copper pan is hinged, and the *under side* of the top, P. Moreover, the basin, M, though made of pottery-ware, gets completely corroded with soil and urine up to the water-line on the *outer side* next the copper pan; and there is

Filth splashed about over the apparatus and left to foul it.

Basin gets corroded and nasty.

* This apparatus takes its name from this "pan," and not from the basin, M, Fig. 24.

no means of getting at this, nor is there any friction in the passage of the discharge to wash it away. The only way to thoroughly cleanse a closet of this description is to take it to pieces and burn off the corrosion over a fire.

Apparatus not shut off by the copper pan.

It is supposed by many that the copper pan, O, Fig. 24, when at rest, shuts off, by the dip of the basin into its water, the "container," N. Well, it does so, *but very imperfectly*, for any bad air in the "container" can always escape through the holes in its side where the axis is hinged. And if it does not escape there, it can easily find its way through the *air-hole* in the top of the "container," unless there is an air-pipe from it, which is very rarely the case. This air-hole in the top of the "container" is to give vent to the apparatus when in action, to allow the discharge to pass freely from the basin into the container.

Air-vent.

Air-bound.

Without this *vent* the *container* would be air-bound, or nearly so, by the water-dip of the basin at the top, and of the trap at the bottom, at the first moment of the discharge, and also when at rest, except that the joints at the axis bearings are never quite air-tight.

The filthy container exposed to the house when in action.

Moreover, every time the handle of such a water-closet is pulled the whole of the *filthy container* is entirely *exposed to the house*, for the copper pan is drawn back on one side by the action of the closet, thus leaving it to send out what foul air is displaced by the body of water passing through it. The "puffs" of nasty smells which such apparatus send up, after they have been fixed for some time, are enough to make one wish for the old-fashioned privy again.

Air-pipe from it.

Where such an apparatus is used, an *air-pipe*, *s*, Fig. 24, should always be taken from the vent-hole at the top of the container through the external wall, and its diameter should not be less than $\frac{3}{4}$ in. This air-pipe* must not be connected with any other ventilating-pipe, to soil-pipes, traps, or what not, but must go out separate to the external air.

Enamelled iron containers.

These water-closets are very much improved by using "containers," or receivers, N, Fig. 24, *enamelled with porcelain on the inside*, and the extra cost of this is only about seven or eight shillings.

Earthenware ditto.

These closets are still further improved by *white glazed earthenware* "containers," but these are liable to breakage in transit and in fitting them up, unless great care is taken.

Pan-closet being con-

Having condemned the *pan water-closet ap-*

* To remedy the evil of a bad-smelling container a plumber is sometimes called in, and he at once fixes an air-pipe from the top of the container, and takes it into the air-pipe of the soil-pipe. The evil, by such means, is only augmented, and the remedy becomes worse than the disease —the writer knows of many such cases—the thing is so palpable that it is too absurd to explain.

paratus entirely, it becomes necessary to find a substitute for it, since it is quite clear that a *valve-closet* is too expensive for general use. There is no difficulty, as far as *out-door* water-closets are concerned, for there is always plenty of air around such closets to blow away any unpleasant smell arising from an imperfectly-cleansed basin. But in the *in-door* water-closets the character of the water-closet basin must be more fully considered, as any unpleasant smell arising here would soon spread over the house.

demned, a substitute to be found.

The most important part here—in the servants' *in-door* water-closet as well as in the best water-closet in the house—is the trap. And it is quite as important to have an efficient trap to the common as to the best water-closet in the house. For it is of little use to provide proper means for excluding the soil-pipe air generated in one part of the house, and leaving other parts exposed by an *inefficient* trap.

The most important part of a water-closet is the trap.

In deciding upon the kind of water-closet to use for servants, workmen, &c., where a *valve* water-closet would be too expensive, or be likely to receive too rough usage, there is nothing more simple, or cleaner, or more durable than a white glazed earthenware basin. Such basins are made in every variety of shape and size, but many are made without any adaptation for the work they have to do.

Servants' water-closet.

As this basin is simply for conducting the deposit into the trap, it is obvious that the smaller it is the better, and the less surface there is about it the cleaner will it be kept; for the supply of water to it will not have to travel over so much ground, but will be more confined and concentrated upon the work it has to do, viz., that of cleansing the basin and washing out the trap.

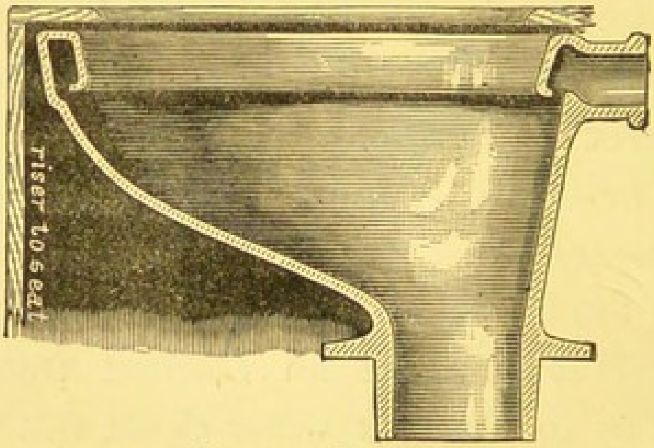


FIG. 25. SECTION.

Self-cleansing water-closet for the employé class.

Patent "Artisan" Water-closet Flushing-rim Basin.*—This is a basin (see Fig. 25, Section), which the writer has specially designed for artisans' dwellings, and places where it is important to have a *simple* and *self-cleansing* water-closet, and where a *valve* water-closet, as Fig. 23, would be too expensive.

It is made for the *deposit* to *pass at once into the water of the trap without touching* the basin.

Small to get thoroughly washed.

It is as small as practicable, so as to confine the water, and give it as little surface to wash as possible.

* See Figs. 89 to 93, and Plate XVII.

The flushing-rim round the top of the basin is so regulated, and the configuration of the basin is such, that the water immediately on coming into the basin converges towards the outlet, and concentrates itself upon the trap, to drive everything foreign out of it. Moreover, the trap is independent, and can be of lead or earthenware, according to circumstances, and fixed *above the floor-line,* where it can be got at, at any time, without disturbing anything. (See Plate 1, Fig. 1, showing this water-closet fixed complete.)

When *up-stairs,** this trap should be in lead, because its connection with the soil-pipe can be made by a *wiped* soldered joint, but when fixed in the area, or anywhere *where the door opens to the external air*, the jointing with the soil-pipe or drain-pipe is not so important, if the drains are well ventilated, for any escape through a defective jointing at the outgo of the trap would blow away. And as the trap would probably in such positions be directly connected with a drain-pipe, there could be nothing better than *glazed earthenware traps*, which being of the same material, could be securely and easily jointed to the drain-pipe. The great evil of earthenware

Lead trap when up-stairs. Earthen-ware trap elsewhere.

* *All "up-stair" water-closet traps*, and traps to fittings *inside* a house, are important. Whether the trap is under the *best* or *commonest* water-closet, it must be effectual, as also must be the connection of the *outgo* with the soil-pipe. Of what use is it to lock the *front door* and leave the *back door* unlocked?

traps is that they are made with an insufficient water-dip, or water-lock, to be of any value as a trap.

Traps for fixing to the "artisan" closet.

A special glazed earthenware trap is made to go with the "artisan" basin, with a water-dip of not *less* than $1\frac{1}{2}$ in. for *out-door* positions, and when connected directly with the drain. When connected with a lead soil-pipe, a lead trap, as Fig. 7, can be fixed as shown on Diagram, Fig. 1, Plate 1

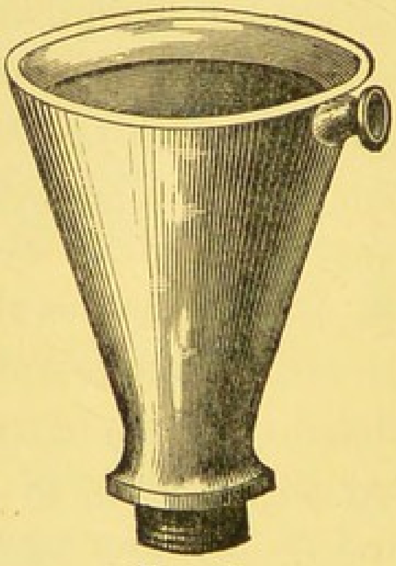


FIG 26.

Conical-shaped closet-basins ought never to be used.

"*Hopper*" *Closet-basins.*—The old-fashioned "hopper" water-closet basin, conical-shaped, as Fig. 26, whether the "long" or "short" hopper, ought never to be used, even in the very poorest water-closet. The soil on usage *falls on the side of the basin*, and as the basin is generally *dry*, hardly any amount of water-pressure brought to bear upon it will wash it off. There it is left a "fixture," like the basin itself, which the *out-going* tenant is generous enough to leave behind him for the *in-coming* tenant to see, and have the benefit of without anything to pay.

The *dribbling* supply of water which is generally laid on for such water-closets is hardly enough to *wet* the basin—it never attempts washing it. How is it possible for such closets to be kept clean and wholesome? Dribbling supply.

It is astonishing to think that such water-closet basins as just described should be used by the hundred, when a "Beggs'" or a "Sharp's" water-closet basin costs but a trifle more.

"Beggs'" and "Sharp's" water-closet basins are infinitely superior to the "Hopper" closets just described. They are much the same in principle and shape as the "artisan" water-closet; the latter has a different flushing-rim from Beggs', and is *straighter at the back for the deposit to escape the side of the basin.* Sharp's basin is larger at the back, and more tapering than Beggs' basin, but the flushing-rim is better regulated for the distribution of the water-supply. "Beggs'" and "Sharp's" water-closet basins.

Patent "Wash-out" Water-closet Basin (see Section, Fig. 27).—This water-closet was invented by the writer, but patented by Mr. Rowley, potter (Mr. Woodward's representative), to whom it was entrusted to be made. This water- "Wash-out" water-closet basin.

closet basin is specially designed to hold a body of water in the bottom of the basin, to receive the soil and prevent its adhering to the sides of the basin. The flushing-rim round the top of the basin is such that the water is carried round to the front, where it streams down and

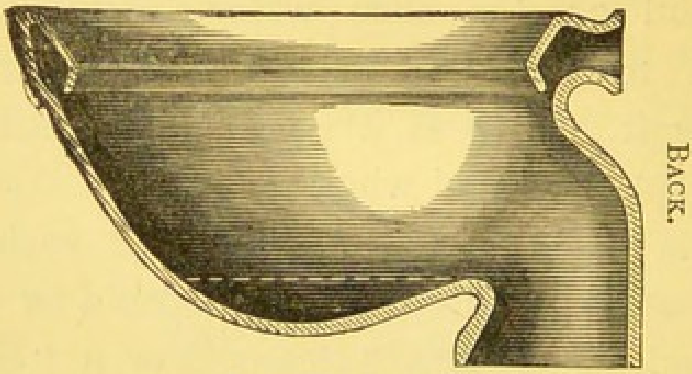


FIG. 27. SECTION.

washes the contents of the basin out into the trap under it.

The *outlet* of the basin being at the *back*, where everything is exposed to view, is somewhat objectionable. And, as the water has to travel round the rim from the back to the front, its power is diminished, but with a good pressure of service-water upon it, it makes a better closet than the "hopper."

Water-battery water-closet basin.

Patent "Double-inlet," or "Water-battery" Water-closet Basin* (see Fig. 28).—This "water-battery" water-closet is *similar* in principle and shape to the "wash-out" closet-basin, and has in

* See Fig. 94 and letterpress, on the same page, condemning this closet.

fact grown out of it. The writer has patented it, as he considers it an improvement on the "wash-out" closet.

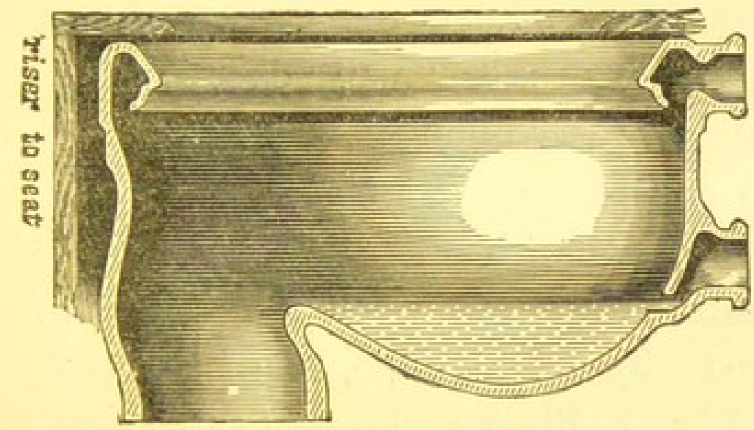


FIG. 28. SECTION.

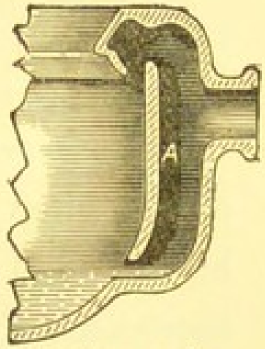


FIG. 29.*

It is made to retain a body of water in the bottom of the basin, as shown in Section, Fig. 28, for the *soil on usage to pass at once into water;* and the *outlet* is in *front*, and screened, therefore, from sight by the seat.

Water retained in the bottom to receive the deposit.

The water is brought in on the *opposite side* from the *outlet*, by a separate inlet-arm (see Section, Fig. 28), just on the level of the standing water in the basin, and when the handle of the closet, or valve-pull, is used, this inlet drives everything out of the basin. At the same time the water is taken round the top of the basin, through a hollow rim, by another inlet from the same service-pipe, and the perforations in the rim are so regulated that whilst the basin itself is thoroughly

Inlet for service supply.

* Fig. 29 shows another mode of bringing in the water, and which is equally effective when under a good pressure.

washed out, a *direct* stream of water is poured down into the trap, to drive everything foreign out of it. The basin is also made with *one inlet-arm*, by a pipe connecting the two inlets together, as shown at A, Fig. 29, and which is equally effective with a good pressure of water upon it.

Lead or earthenware trap under it.

A *lead* trap should be fixed under this water-closet when connected with lead soil-pipe inside a house. An earthenware trap accompanies it when connected direct with a drain-pipe, or fixed out-of-doors. (See Fig. 1, Plate 2, showing this water-closet fixed "up-stairs.")

Variety of closets in use.

There is such a variety of water-closets now in use that to attempt to describe each individual closet would take more time and space than the writer can afford. Let it suffice to say that nearly every water-closet made comes under the principle of one or other of those already described.

It is not my intention here to name the best makers of water-closet apparatus, for each maker has his own speciality, but the workmanship and material in some (as in everything else in this world) are so vastly superior, that it does not require a finger-pointer to point this out, but an open eye to see it.

Common sense in selecting the right closet.

All that is wanted in selecting a good water-closet is common sense. *Go to a good house of business*, and select a closet according to the principles laid down in this chapter, and you will have done one great thing towards obtaining a wholesome water-closet; but remember that the most important item in this matter is the plumbing-work in connection with it.

CHAPTER X.

WATER-CLOSET SAFES AND SAFES UNDER CISTERNS.

Safes under water-closets.

Safes under Water-closet Apparatus. — To prevent damage to ceilings by an overflow of water from the apparatus, either through a "stoppage of the water-closet" or a break-down of the supply-valve, a safe should be fixed under each water-closet apparatus, on the floor-level, when the closet is *up-stairs*, or over an important ceiling.

Made of lead.

This safe should be made of lead, 4, 5, or 6 lbs. to the superficial foot—according to the character of the other work in connection with it. It should be turned up at each of the four sides from 4 to 6 in., and soldered at each angle. It should be made a few inches larger than the external size of the apparatus, so as to cause the water overflowing the apparatus to fall inside the safe.

Soldered to the trap.

When the trap is *under* the floor, the safe should be carefully soldered to the trap; but if it is fixed *on* the floor, with a horizontal branch soil-pipe from it, the safe should go under the trap, and be soldered round the outlet or branch soil-pipe, unless it stands high enough to admit the safe without interfering with its "stand-up."

Waste-Pipes from Safes.—The old method of fixing these wastes is very objectionable, nor is it of any value as a waste. The pipe, generally only of a diameter of ¾ in., is taken from the safe right into the water-closet trap. Now, when a water-closet gets stopped up, it is generally by a stoppage in the trap. Of what use can this little safe-waste be in such a case? And if the supply-valve should break down at the same time, where is the overflowing water to go but on the ceilings? Old method.

There is another objection to this mode of disposing of this waste. When it is connected with the water-closet trap, this waste-pipe is often inserted into the trap about the water-level, so that the smallest disturbance of the water in the trap allows any air in the soil-pipe to escape through this pipe into the house. Connection with the trap in wrong place.

The more modern method of fixing a separate trap under the safe, and connecting it with the soil-pipe by a 2-in. waste-pipe, is a great improvement on the old plan, but this is only an imperfect way of providing means for taking away the overflow from a closet. The more modern method.

There is no fear of any *overflow* of water with a 6-in. D-trap, and a 2-in. waste-pipe from it into the soil-pipe; but there are *two* evils attending this method. Two evils.

Trap becomes unsyphoned.

1. This safe-trap is *charged* by the *usage* of the water-closet in connection with it, and by this closet only; so that when other water-closets are in use upon this stack of pipe, and this water-closet remains in disuse, the water in this trap becomes unsyphoned, or it evaporates, and any air in the soil-pipe pushes its way through the *uncharged* safe-*trap* into the house, and will continue to do so until its own water-closet is used and the "weeping-pipe" recharges the trap.

Weeping-pipe stops up.

2. The "weeping-pipe"—which is connected at one end with the service to the water-closet basin, while the other end is made to discharge into the safe-trap—often fails in its service. A little sediment gets into the pipe, and after a time it becomes stopped up, and fails in its charges to the safe-trap, which soon becomes dry, and leaves the house exposed to the soil-pipe.

Proper way of fixing safe-wastes.

The proper way of fixing safe-wastes is to take a pipe from the safe and continue it through some external* wall of the house, *without connecting it in any way with the soil-pipe or any other pipe.* (See Figs. 1 and 2, Plate 1, showing such a waste-pipe fixed complete.) The shorter this pipe is, the better, and care is required in fixing it, or the ceilings adjacent to the water-closet had better be insured. Its size must depend upon the size of the *service* to the water-closet, and the *pressure* of

Size of pipe.

* See Fig. 2, Plate XI.

water upon the supply-valve to the apparatus. But a 2-in. lead waste-pipe is large enough for *any* waste to a water-closet safe.

Outlet end lower than the inlet.

The outlet should always be a foot lower than the inlet end; and the inlet end should be opened out a little larger than its diameter, and soldered to the safe with a counter-sunk soldered joint, so as to give all the water-way possible into the pipe, and to ensure a pressure upon the copper flap, to keep it open when the closet is overflowing.

Copper flap in end of pipe.

A copper hinged flap should be soldered on the discharging end of all such waste-pipes, to prevent birds building in the pipe, and also, when from water-closet safes, to prevent the wind blowing through the pipe—for it can whistle through this pipe in a very objectionable way at times. (See Plate 2, Figs. 1 and 2.)

Cistern safes and wastes.

*Cistern-safes.**—All slate and iron cisterns, when fixed inside a house and over important ceilings, should have lead safes under them a few inches larger than the cistern itself, and the wastes from them should be treated in every way described for water-closet safes.

* See Plate XV.

CHAPTER XI.

SINKS.—SLOP-SINK—PATENT "WATER-SHOOT" SLOP-SINK—HOUSEMAIDS', OR DRAW-OFF, SINKS—SCULLERY-SINKS—VEGETABLE-SINKS—OVERFLOWS.

Place for emptying slops.

Slop-sink.—A slop-sink, *i.e.*, a place for emptying slop-pails, is not so essential as a water-closet; but no house of any dimensions should be without one, not only as a convenience for the servants and a means of saving labour, but also as a protection to the water-closet apparatus.

On every floor in large houses.

In all large houses, mansions, club-houses, hotels, &c., there should be one slop-sink (or more) on every floor, and especially on the bedroom floors, and where much washing is done in keeping them clean.

When there are no slop-sinks servants throw them down the water-closets.

When there are no slop-sinks, the servants are sure to empty their pails down the nearest water-closet, and this they do, generally, leaving the slops to find their own way through the basin, trap, and soil-pipe, without even pulling up the handle of the apparatus to give it a free passage, or taking the smallest trouble to wash it away—no matter what may be the contents of the slop-pails. Then these corrosive matters from the chamber utensils are left in the water-closet where they have been discharged, to foul the apparatus and trap for hours, and to send forth their unpleasant smell until the next legitimate use of the water-closet occurs.

But if no proper places are provided where the servants can empty their pails, what are they to do with the slops? Are they to take them down to their own water-closets in the area—which are certainly better adapted to receive them? What! lug a pail of slops right down through the house to splash their own water-closet seats all over! Well, that is hardly like the English servant of the period.

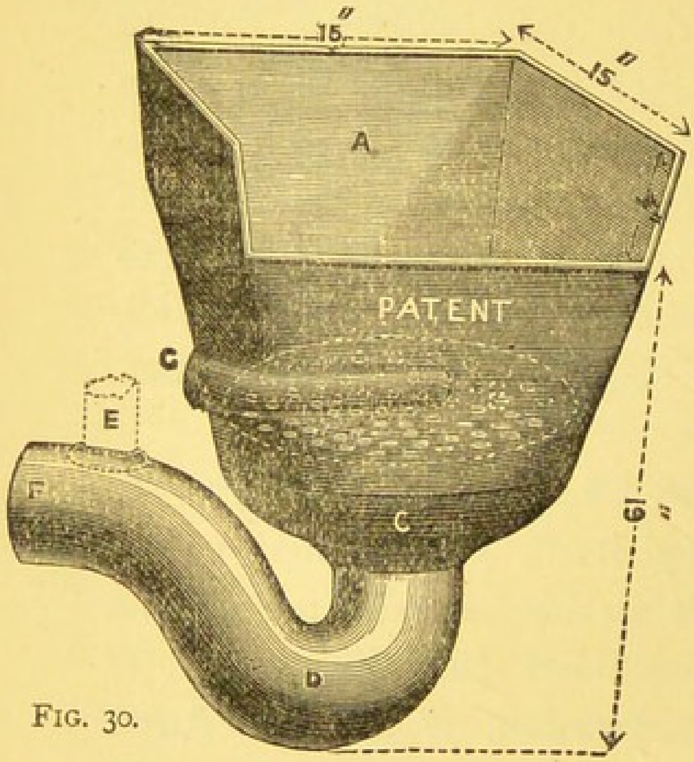
A slop-sink can be formed in many ways. It can be fitted up by itself, or attached to an ordinary housemaid's washing-up sink; and thus the two may be combined (see Fig. 31). If cheapness is a consideration, it may be fitted up in a most inexpensive and simple way—in addition to the cost of the waste. All that is necessary is a pottery-ware basin (white inside), large enough to receive a pailful of slops, and for this an ordinary water-closet hopper will do very well. There should be a lead tray over it, standing up about 6 in. at the back and the two sides, and about 2 in. in the front, to prevent splashings over it; and this tray should fall towards the basin with the lead bossed down a couple of inches into it.

Many ways of forming a slop-sink.

"Water-shoot" slop-sink.

*Patent "Water-shoot" Slop-sink.**—This is a sink, Fig. 30, which the writer has specially designed for receiving slops from pails and chamber utensils.

It consists of a deep hemispherical-shaped basin with a 3-in. clear water-way outlet at the



A. Sink.

B. Screen or Grating.

C. Lead Seating.

D. 4-in. Patent Cast Lead Trap — Soldered to Lead Seating:—The *out-go*, F, can be turned round to any point to suit position of waste-pipe.

E. Air-pipe.

FIG. 30.

bottom. At the top of the basin three sides are made to stand up about 6 in. high, to prevent splashings over the basin, and the other side is lowered down to 2 in. high, to receive slop-pails, &c.

Grating or screener.

It is fitted on the inside with a strong white glazed earthenware screener,† or grating, to arrest flannels, soaps, brushes, or anything which might accidentally be thrown away with the slops.

* See Figs. 109 to 113.

† Bars are now put across the outlet and the screener done away with, as careless servants allowed the screener to get dirty on the under side.

A means is provided, through an inlet-arm, G, Fig. 30, in the side of the basin, for flushing out the sink with water, and keeping it clean. Means for flushing.

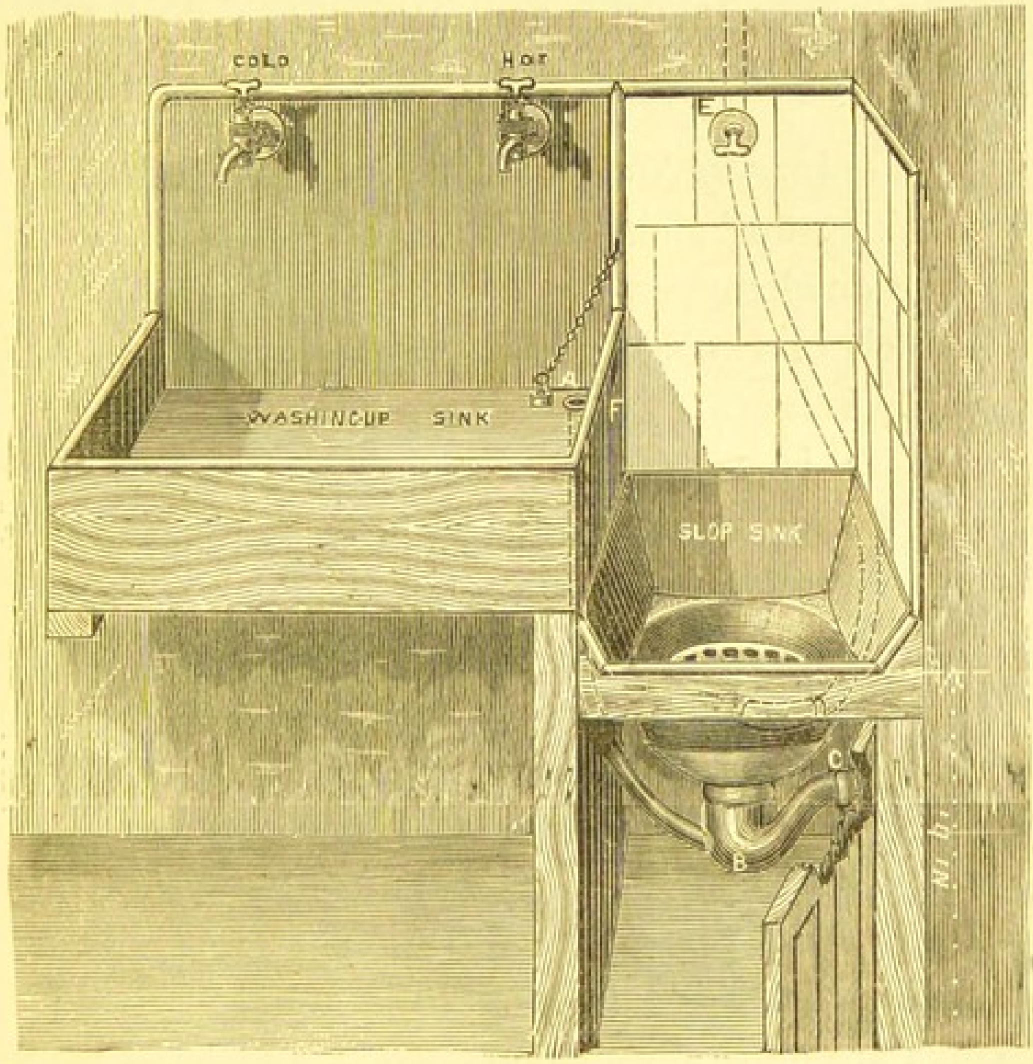


FIG. 31.*

The sink itself is made of cast-iron, enamelled all over on the inside with *white porcelain enamel*, to prevent corrosion, and make it a clean sink. The configuration is such that there is no place of lodgment in any part of the sink for anything to remain in it to make it unwholesome. Porcelain enamelled on the inside.

H

* See Plates XII. and XIV.

Lead trap under the sink.

This sink, when fixed up-stairs or inside a house, having a lead waste-pipe from it, should always have a lead trap under it, as shown on Plate 3, Fig. 1. (See Fig. 31, showing a "water-shoot" slop-sink with a housemaid's sink combined.)

Washing-up Sink and Slop-sink combined.—The "washing-up" sink, Fig. 31, is a wood sink, lined with tinned copper, the back of which is taken up an inch or two above the hot and cold draw-off supply-valves, to prevent splashings against the wall. A is a plug and washer, as Fig. 32, and from this a 2-in. lead waste-pipe is taken into the trap under the slop-sink.

The slop-sink in the diagram is a patent "water-shoot," as Fig. 30, with a 4-in. patent cast-lead trap, B, Fig. 31, as Fig. 7. A lead "seating" is soldered on the top, or inlet, of this trap, to receive the slop-sink, and the *outgo* of the trap, C, is *soldered* to the waste-pipe.

Draw-off sinks.

Housemaids', or Draw-off, Sinks.—Housemaids' sinks are generally made of wood, and lined with lead, because they can be quickly made and easily adapted to any position. They can be made at an hour's notice, of any size and shape.

Lead not danger-ous to crockery-ware.

When the substance lead is of the proper strength, they are as durable as stone or slate, and are not liable to breakage like other sinks. Moreover, as the material is yielding, lead sinks are not so dangerous to crockery-ware as slate or pottery-ware, &c.

Common pantry plugs too flimsy.

These sinks should never be fitted with the common *pantry plug and washer.* The holes in such washer-gratings are small and round, and the waste water takes too long to run through, and these things are made so flimsily that servants soon destroy them.

Strong plug with cobweb grating

All such sinks should be fitted with a *strong* sunk plug and washer (see Fig. 32), with a grating formed in the shape of a cobweb in the bottom, for the water to run quickly through, and for durability.

Bottoms to slope to waste.

All sink-bottoms should be made to slope to the waste, which should be fixed in one of the two back angles of the sink, so as to be out of the way of anything to be washed up in the sink.

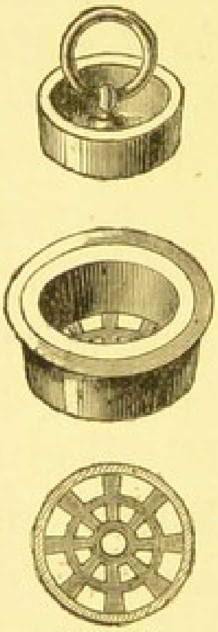


FIG. 32.

Poor economy in using thin lead.

There is often a very poor economy shown in the lead linings to sinks, 5-lb. and 6-lb. lead to the superficial foot being the general rule, and 7-lb. and 8-lb. the exception. Now the cost of the stronger is so very little more than the weaker, that it is a wonder that the lighter lead should ever be used for such purposes. There are only a few superficial feet in an ordinary sink, and the extra cost of 8-lb. lead in lieu of

6-lb. in a bottom would rarely exceed half a crown—and this amount the plumber would require to be paid simply to get him to *look* at the light sink after it had been in use a few months, and what he would want to *repair* it goodness knows.

Substance lead to use with hot-water supply.

Sinks with hot-water draw-offs over them, and when they have much work to do, should have 7-lb. lead sides and 10-lb. bottoms, or, if cost is no object, 8-lb. sides and 12-lb. bottoms.

Tinned copper sinks.

Scullery-maids' Sinks, where there is rough usage, and a great deal of rough work in connection with hot-water washings-up, should be made of deal, and lined with tinned copper not less than 4 lbs. to the superficial foot in the bottom, and $2\frac{1}{2}$ lbs. at the sides. These sinks are very durable, and as they are of a smooth substance they can be kept clean and wholesome, and they are nothing like so damaging to crockery-ware as material of an unyielding nature as slate, iron, stone, and pottery-ware, &c. Fig. 31 shows a "washing-up" sink lined with tinned copper as just described.

Substance.

Slate sinks for washing vegetables.

Vegetable-sinks.—Sinks for washing up vegetables should always be made of slate, in which there is nothing poisonous. These sinks do not want enamelling. They should never be less than a foot in depth, and there should be a partition across the centre, with a plug-and-washer grating in each compartment, so that both compartments may be filled with water at pleasure, and the one used for washing the vegetables and the other for rinsing them.

Overflows to Sinks.—All sinks with *plugs and washers* over the waste should have *overflow-pipes*, which should be of sufficient capacity to take away the water-supply of the service-valve or valves, should they become defective, or be left open by accident. The cost of such an overflow is nothing in comparison with a ceiling; and all that is wanted is to take a 2-in. pipe out of the top of the sink and continue it down to the trap under the sink. **Overflow-pipes.**

The pipe should be opened out where it is connected with the sink to, say, 3 in. or 4 in. by $1\frac{1}{2}$ in. or 2 in., to give all the water-way possible without decreasing the depth of the sink.

CHAPTER XII.

BATHS.

Baths as scarce as fountains in a desert.

INSTEAD of a bath in a house being the exception, it ought to be the rule. But one may as well look for a fountain in a desert as for a bath in any of our old English houses or modern ones even, below a large rental. It is not too much to say that there are scores of villages in England without a single bath in the entire village, except, perhaps, in the rector or squire's house. And many of our towns are scarcely better off, I am afraid, in this respect.

Villages without a bath.

The cost frightens.

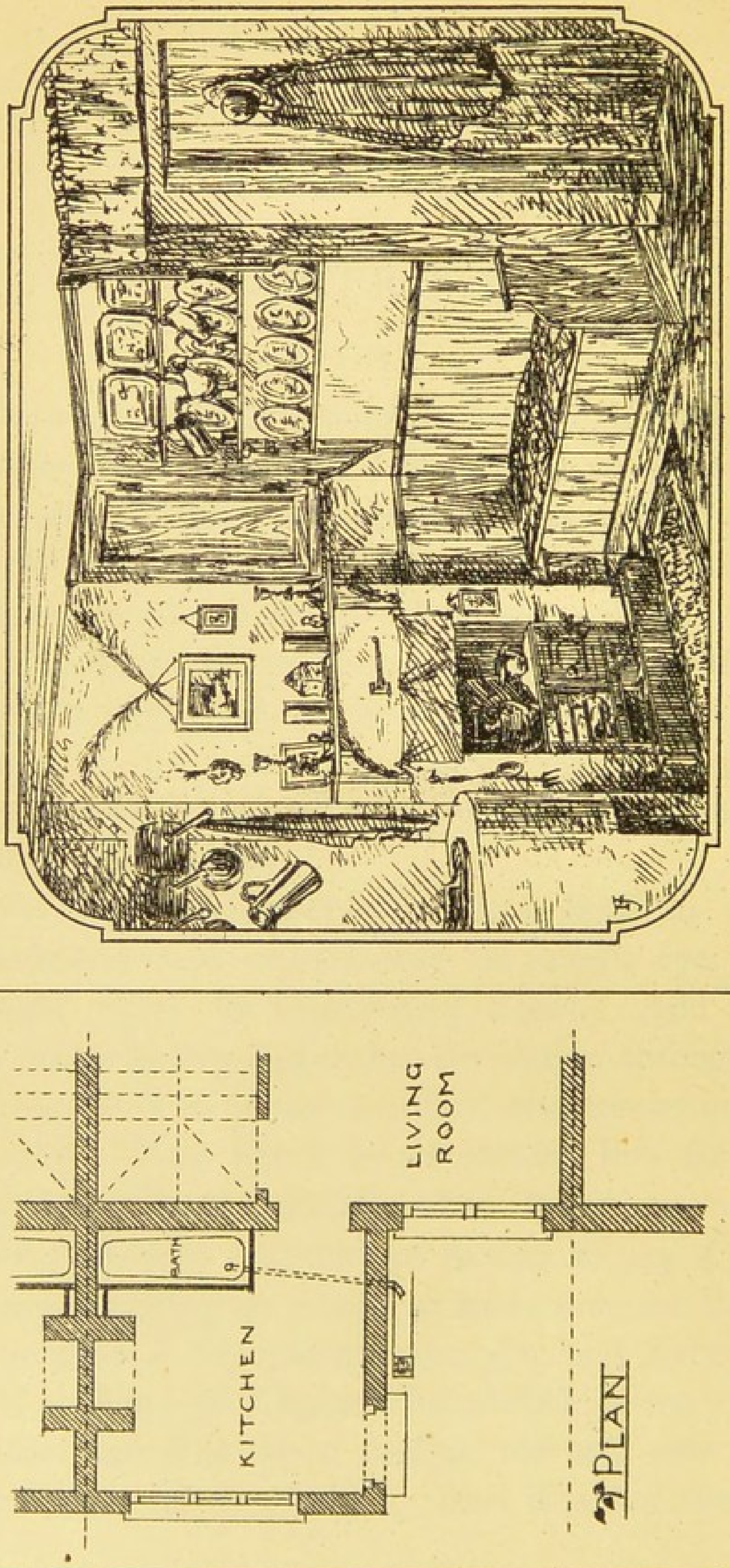
To mention a bath-room to a landlord or householder is to paint before his mind's eye, in a single word, the Bankruptcy Court. And to talk about having hot-water circulation throughout a house is to plunge landlord and tenant into *hot water*. And yet it is astonishing how far a sovereign will go, especially when drawn out into a *thin gold wire*. Instead of having to pay £30 or £40 for fitting up a bath, as many imagine, this can be done at any cost between £10 and £100.

Can be fitted up at any price.

A make-shift bath better than none.

If a West of England broadcloth is too expensive, fall back upon fustian, for any coat is better than no coat at all. And if a luxurious

PLATE V.



BATH IN KITCHEN.

bath-room, with all its convenient appurtenances, cannot be afforded, have a *make-shift* one; for "cleanliness is next to godliness," and any kind of bath is better than none at all.

A bath in every house.

Everybody should be induced to cultivate a habit of personal cleanliness by a bath fitted up with hot as well as cold water laid on, if possible, in every house. And the poorer the family the greater the need, perhaps, for such a bath.

Difficult to find any spare room for a bath except in the kitchen.

It seems the fashion for *large* families to crowd themselves into *small* houses, because, I suppose, "necessity has no law" with them, and they are only too glad to get any house entirely to themselves. It is difficult in such cases to find a room, or part of a room, that can be spared for fitting up a bath. But rather than not have a bath in the house, it would be better to fit one up in the kitchen. Nor is this such an unreasonable place as at first seems, for in such houses as we are considering there would be no servants, and if there were, it would not materially alter the case, as they could be sent into another part of the house when any of the adults wanted a bath. The advantages of such a position for a bath would be somewhat as follows:—

Advantages of such a position.

Kind of bath to save expense.

1. It could be fitted up at a trifling cost. The bath should be of cast-iron, enamelled on the inside, taper shape, with circular ends, and

rounded bottom, to take as little water as possible. These baths can be purchased for about fifty shillings, are much more durable than zinc or tinned iron, and do not require any wood "cradle" to support the sides. A plug and washer should be fitted in the bottom, and from this a $1\frac{1}{4}$-in. or $1\frac{1}{2}$-in. lead waste-pipe should be carried through the external wall, and discharged with an open end into a stone channel, leading into a surface-trap. This waste would not require any trap, but it must not be *connected* with any other waste, or with the drain.

Enclosed to look like a seat.

2. The bath could be enclosed in a wood casing, to look like, and to answer the purpose of, a *seat;* the cover should be hinged to the back rail, and made to open against the wall, and to button there with wood buttons, when the bath is in use.

Close to boiler for hot water.

3. Being close to the kitchen boiler, a few cans of hot water could be thrown into the bath without any labour or extra expense in heating it.

Near the cold-service.

4. As the service-pipe to the feed-cistern (which supplies the boiler) would be close at hand, it would be inexpensive to lay on a cold-water service-pipe with a draw-off tap to the bath.

Always a fire for comfort.

5. As there would always be a fire in the kitchen, the children could have the comforts of it when taking their Saturday night's bath,

without any extra cost or additional labour to the poor overworked mother. (See Plate 5, showing bath fixed in a kitchen.)

Having explained the most economical way of providing a bath in the poorest houses, a few words will suffice on baths for good houses, remembering that the chief object in writing this treatise is to deal with the media, or conductors, or what may be considered as the vital parts of all such fittings. (See Plate 6, showing a best bath fitted up complete.)

Baths for good houses.

*Copper Bath.**—There is nothing better for good houses than a "first quality" taper *copper bath* (see Plate 3, Fig. 2 and Fig. 2A), with circular ends and rounded edges, tinned and well enamelled on the inside. It is *very durable*, and after years of wear, can be re-enamelled, and made as new for about a fourth of its cost, and when past repair can be sold as old metal for about an eighth of its original price.

Copper baths.

Rufford's or Finch's Porcelain Baths are clean and durable, and nothing can be better for public baths or hospitals; but for private houses they are too heavy and cumbersome, and take too long to heat to the same temperature as the water, when a hot bath is quickly wanted.

Porcelain baths for hospitals, not so good for private houses.

* See Figs. 105 and 106.

Different lengths required.

Again, these baths are only made 5 ft. long; but as all men are not of the same stature, baths should not all be of the same length. A 5-ft. bath may be long enough for a Zaccheus, but how is a Saul to stretch himself out in such a bath? though a 5 ft. 6 in. bath is long enough as a rule for the present race of men, for there are *not* giants in these days.

Marble baths.

Marble Baths, when cut out of the solid, look extremely nice, and their appearance in the summer-time is very inviting; but in the winter, when a hot bath is needed, or when a bath is needed for invalids, they not only look cold, but strike so.

Variety of bath-valves and cocks.

There is such a variety of *bath-valves* and *bath-cocks*, that it will not be worth while to examine the merits of each. Let it suffice to say that *valves*—of whatever description—are always easier to "open" and "shut" than metal *ground-in plug-cocks*. The "screw-down" and "diaphragm" valves take so many turns of the handle to open or shut, and the water-way is so obstructed, that they are never likely to be extensively used, though they are very easy to open

Valves.

The "*quarter-turn*" *round-way valve* gives a larger water-way, and has this additional advantage—it opens and shuts at a quarter-turn of the circle.

"Quarter-turn" valves.

(See Plate 3, Fig. 2, showing this kind of valve fixed.)

When *plug-cocks* are used, they should be made of *gun-metal*, especially for the hot-water supply. Where there is a great pressure, gland stuffing-box cocks, with solid bottom, should be used—the only objection to them is the difficulty of opening and shutting them after they have been in disuse for a short time. Bath-cocks.

When *valves* are used, the waste-valve should never be less than $1\frac{1}{4}$ in., but $1\frac{1}{2}$ in. or 2 in. is necessary when the bath is required to be quickly emptied.

When plug-*cocks* are determined, the waste-cock should be $1\frac{1}{4}$ in. as a rule, and round water-way. Or if a bath is wanted to empty in less than two minutes, a 3-in. *feather waste-valve** should be used with a pull-up connection through the top. This valve is easy to open, and will give a clear water-way equal to a pipe 2 in. in diameter, and is not so expensive as a large size waste-valve or cock. Feather waste-valve.

The service and waste pipes, with their valves, should always be considered, so as to provide for a quick supply and discharge. The service-water should never be brought into the bath through the waste-pipe, or the dregs of the previous bath may get washed back again. Rapid supply and quick waste.

* See Figs. 103 and 104.

Service inlets; hot water not too high, to avoid steam.

According to the Metropolis Water Act the supply-pipes must come into the bath above the water-line, but this is too high for the hot-water service, as when a hot bath is needed, the water, if very hot, would fill the room with *steam*. The pipe should be brought into the bath a few inches above the bottom (in either of the two sides, or at the foot), and when the water is very hot the bath could be filled up to a few inches above the hot-water inlet with cold water before turning on the hot-water service; this would prevent steam from coming into the room.

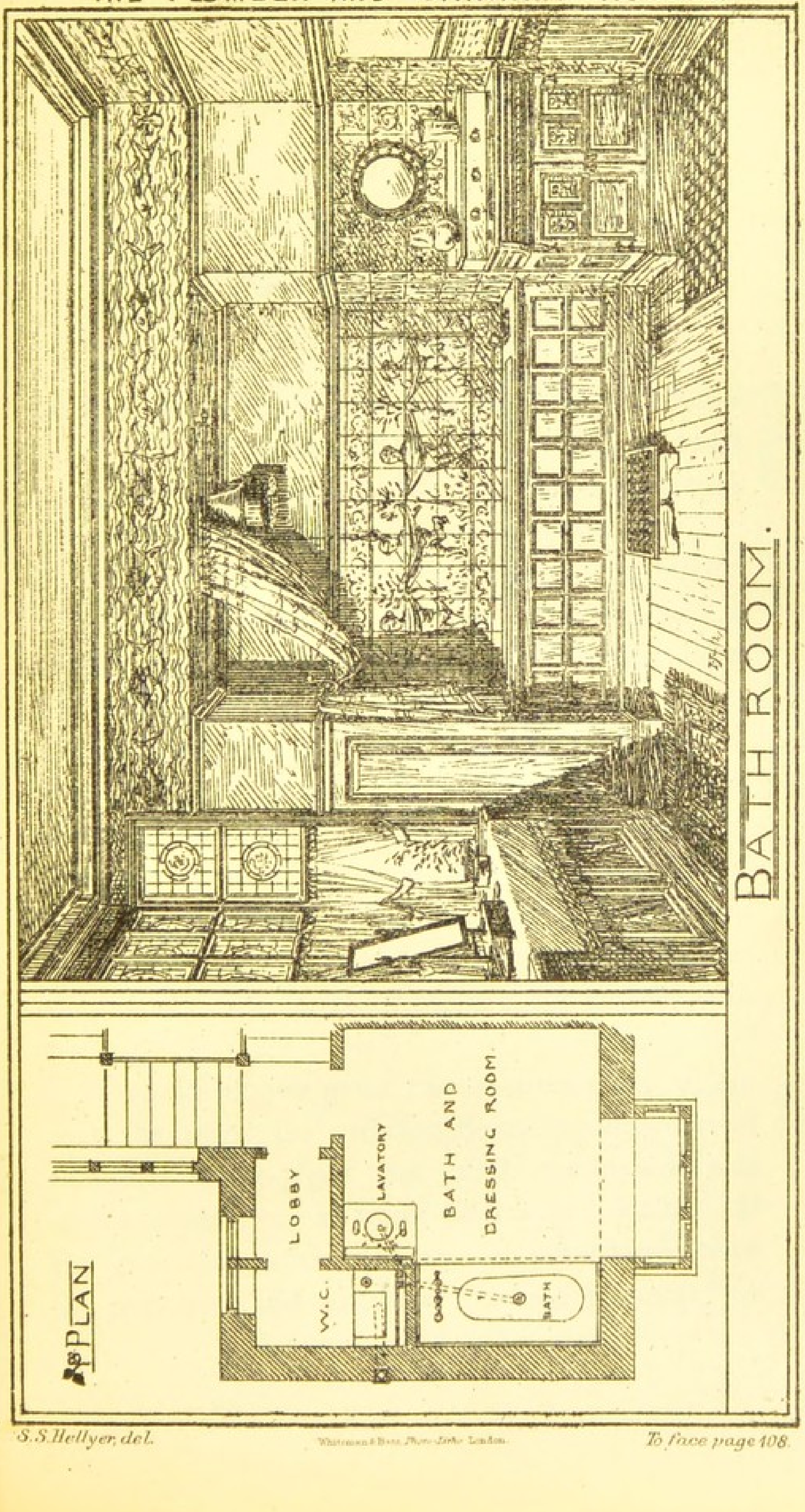
Waste connections.

The waste-connections of baths are generally made too small, and then, whatever size the main waste may be, the bath will take a long time to empty. There should be a *large* tinned copper saucer fitted on the under side of the bottom of the copper bath, about the centre of the bottom, with four or five rings of holes in the bottom over the saucer, and from this saucer there should be a 1½-in. or 2-in. tinned copper waste-pipe leading to the waste-valve at the head or foot, as the case may be, to give a good passage of water to the main waste directly the waste-valve or cock is opened to discharge the bath. (See Plate 6. See "Bath-wastes," Chapter VI. Also Plate 3, Fig. 2., showing bath fixed, with waste-pipe, &c., all complete.)

Large for the water to run away quickly.

PLATE VI.

THE PLUMBER AND SANITARY HOUSES.



S. S. Hellyer, del.

Whiteman & Bass, Photo-Litho London.

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CHAPTER XIII.

LAVATORIES.

It is a great convenience to have a wash-hand basin on the ground floor of all middle-sized houses—near the entrance-hall or garden-entrance —to save taking casual visitors up-stairs, &c. Wash-hand basin on the ground floor.

In large houses, where expense is no object, it is a great saving of servants' time to have a lavatory in all the dressing-rooms of the principal bedrooms, with hot and cold water laid on. And in dressing-rooms.

In hotels and places of that kind the expense of fitting up a lavatory in connection with each bedroom would soon be saved in servants' labour. And there would be this advantage with this arrangement, that hot water would always be ready at hand without the trouble of ringing the bell for it, or waiting for a servant to fetch it. And bed-rooms in hotels.

It would require great care in such cases to see that the traps are sufficiently water-dipped, and that the waste-pipes are well ventilated, and disconnected from all other wastes and drains. If the plumbing-work is done in accordance with the principles laid down for "Lavatory-wastes" in Care in fixing traps and wastes.

Chapter V. there will be no danger of any bad air or noxious gases from such fittings.

Great variety of styles.

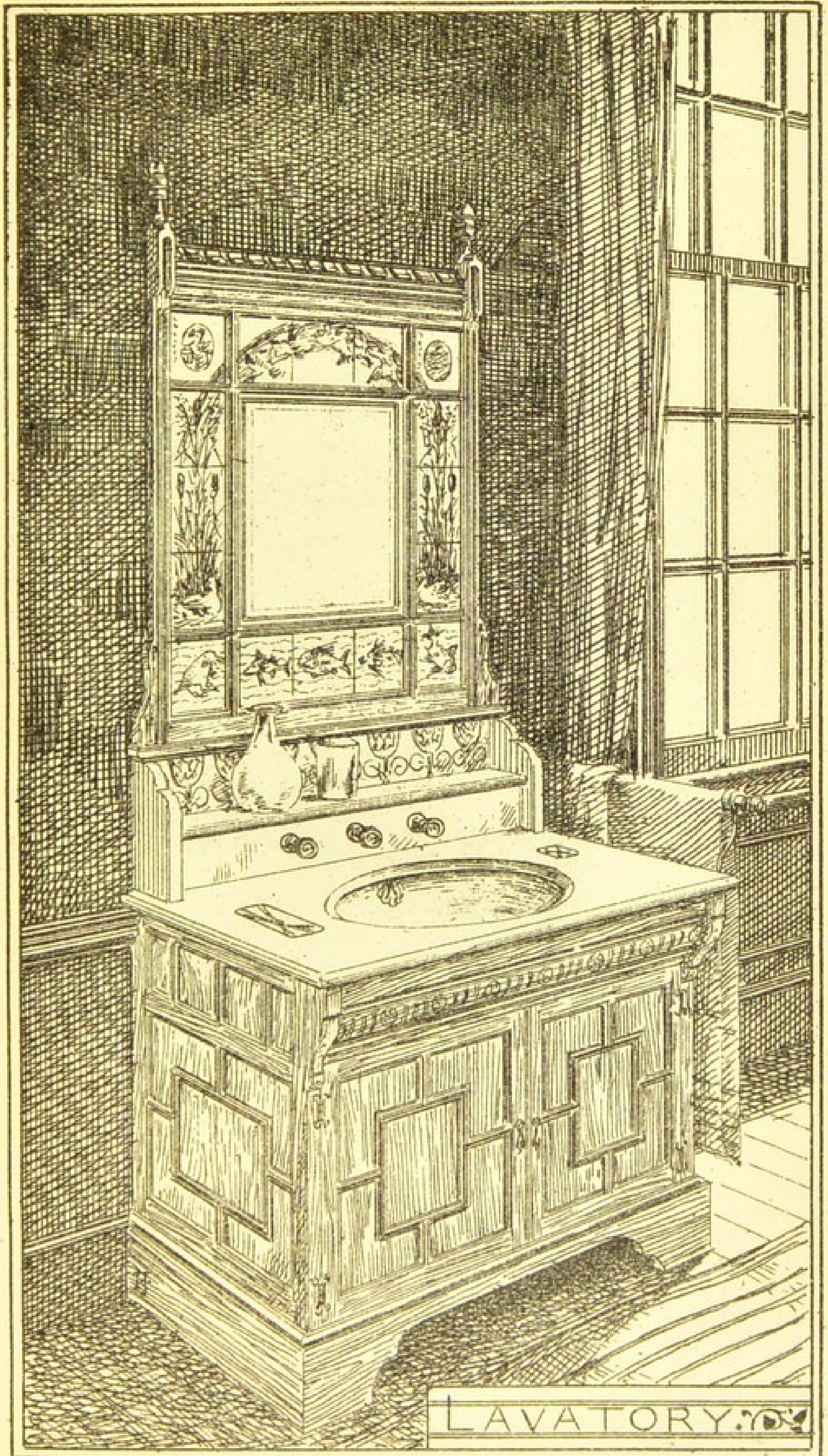
Lavatories can be fitted up in a variety of styles, from a simple plug-basin, with a cold-water draw-off tap over same, to a gold fancy wash-hand basin, with marble top, and sinkings in it for soap and brush, and waste-pipes or drainers from same, together with marble shelf at back for brush and comb, pier-glass, &c., hot and cold water being laid on with ivory-mounted fittings for opening and shutting supply and waste-valves, the whole being enclosed in an elaborate piece of furniture. (Fig. 1, Plate 7, shows a lavatory of this kind.)

Angle lavatory and fittings.

Fig. 33 shows an *angle lavatory* (made in white glazed earthenware, marbled, or in white and gold) with a front rounded corner for the basin to be large while only occupying a small space. The sinking for the basin is deeper than in the usual lavatories of this kind, and there is a sinking for soap and brush, with drainers from each into the basin, and a small skirting at each of the two sides. Under the basin is a shelf for a chamber utensil. The supply-valves for hot and cold water are opened by a pull-up knob connection on the top, and are self-closing, or they can be made to stand open when there are no water companies to interfere and the water is bountiful. The waste-valve is also opened by a pull-up

PLATE VII.

THE PLUMBER AND SANITARY HOUSES.



S. S. Hellyer del.

Whiteman & Bass, Photo-Litho, London.

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knob on the top, and will discharge the basin in *five seconds.* (See Plate 4, Fig. 1, showing this lavatory fixed.)

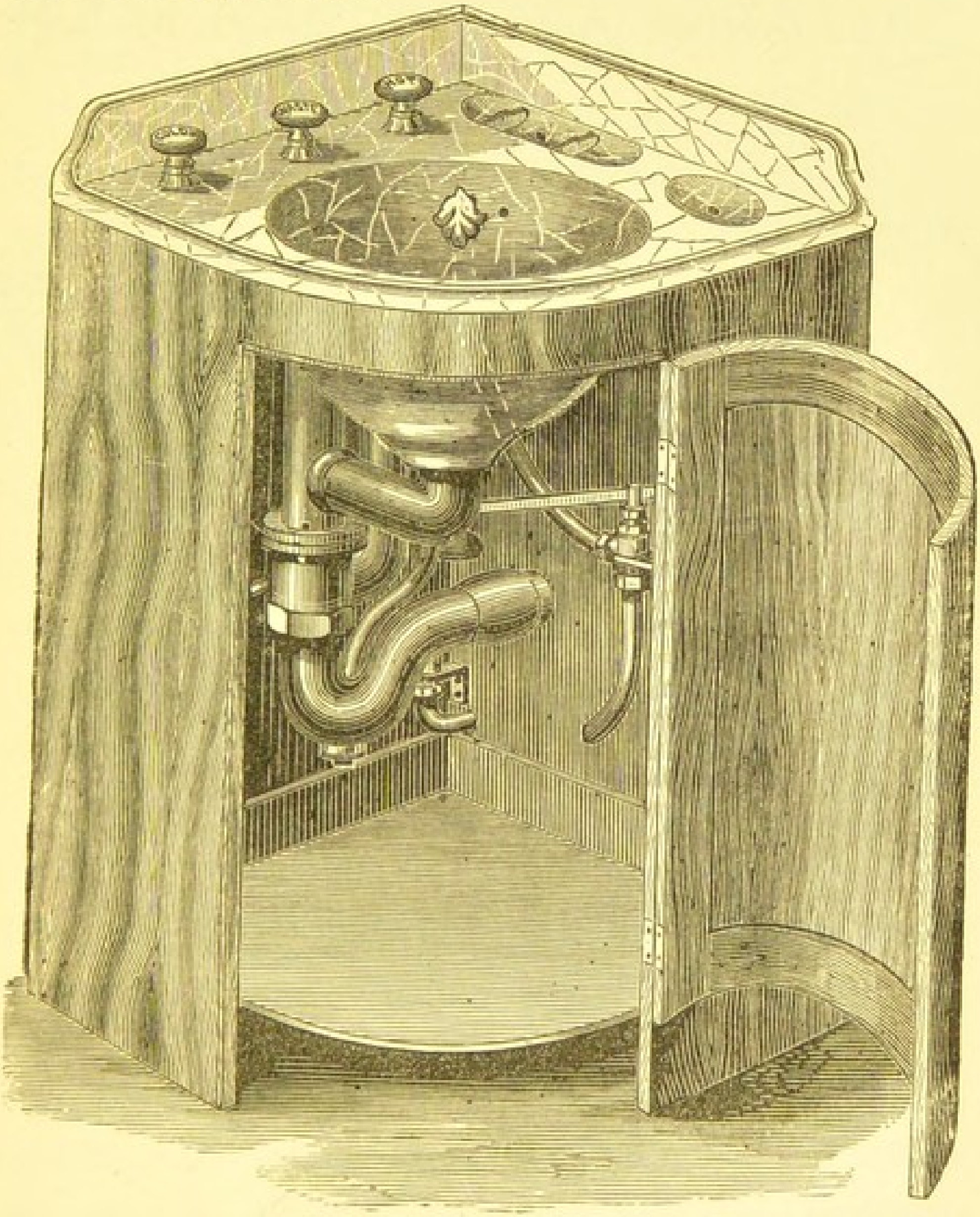


FIG. 33.

Fig. 34 shows an oblong lavatory which can be fitted up in a similar way to the last, or as shown in the diagram, with cold pull-up supply and waste valves, while the overflow is direct **Oblong ditto.**

from the basin into the trap. (See Plate 4, Fig. 2, shewing this lavatory fixed.)

Overflows.

The overflow-pipes should always be large

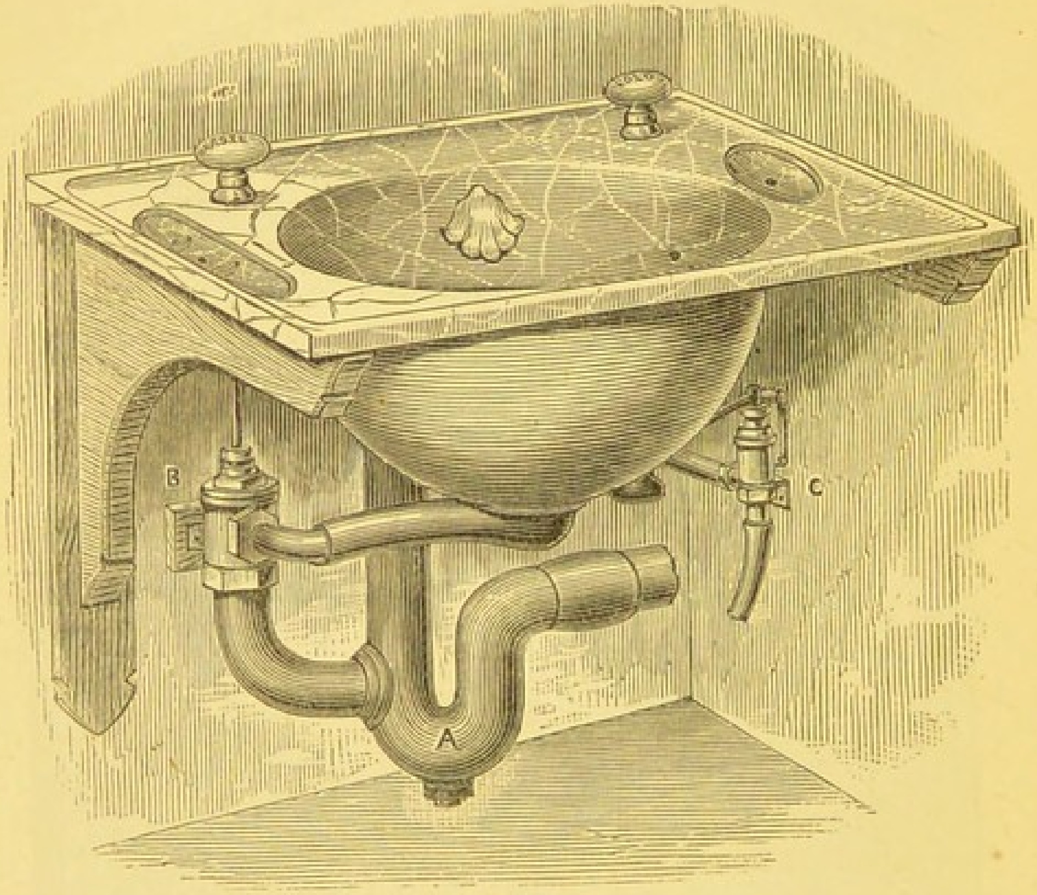


FIG. 34.

enough to take away the water should the service-valve be left open, to prevent damage by an overflow.

Emptying basins, plugs and washers.

When plug-basins are used, the plug and washer is generally so small that it takes a minute or two to empty a basin, but there is no reason why an *inch* plug and washer with cross-bars (to prevent rings or pieces of soap washing through) should not be used; with such a plug-waste a basin of 16 in. internal diameter could be emptied in less than half a minute.

A "feather" waste-valve, as shown to lavatory, Fig. 33, will empty an 18 in. internal diameter basin in seven seconds: this is surely quick enough for anybody. Feather-valve.

"*Tip-up*" *Lavatories.*—These certainly empty the basin quickly, but they are deficient in cleanliness, nor are they the kind of lavatories to use in a bedroom and places where the slightest unpleasant odour from stale soap-suds would be objectionable. The water is *turned* out of the basin into a large *receiver*, where it splashes about on its way to the waste-pipe. And unless this receiver is cleaned, or rinsed out, the soap-suds are left to dry upon the sides of the receiver, and to send out into the room any unpleasant smell which strongly-scented soap (when used) can give. Tip-up basins. Receiver gets dirty.

Moreover, the contents of the basin are discharged so suddenly into the waste-pipe, that, unless it is of good size, they will unsyphon the traps upon it (except they are ventilated) in their passage through the waste to the drain. (See "Lavatory-wastes," Chapter V., and Plate 4, showing same fixed.)

CHAPTER XIV.

URINALS, ETC.

Urinals objectionable in private houses.

Urinals are objectionable things to have *inside a private house*, for they are indecent in appearance, and are liable to become sources for bad smells unless properly fitted up, while to keep them clean and wholesome they consume a good deal of water. As such places are chiefly necessary when there is a smoking or billiard room in the house, they should be fixed for the convenience of such rooms.

Urine corrosive.

Urine is so corrosive that it ought to be discharged into water, to be diluted, before passing into the waste-pipe; or water ought to be brought into the urinal-basin when it is used, to neutralise the effect of the urine upon the waste-pipe, &c., and prevent its becoming corroded and nasty.

Urinal-places light and airy.

Urinal-places cannot be too light and airy. The frequent use of such places by many persons will soon make the urinals offensive, unless they are properly constructed and the place well ventilated.

Urine confined to narrow limits.

Urine should never be allowed to spread itself over a large surface, but should be confined into as narrow limits as possible, to economise the supply of water, which should be so arranged as to conduct it right away.

Urinal-stalls with backs and divisions going down to the floor, and with "aprons" to catch the "droppings"—whether in painted cast-iron, or slate, or enamelled slate—are but an imperfect way of providing accommodation for the public. Urine is discharged all over the lower part of the back and sides of the divisions without a chance of its being washed away (except when the attendant flushes out the place, perhaps, once a day), for the perforated supply-pipe only sends little channels of water down the *backs*, and as for the "aprons" and divisions, it does not even touch them, for, unlike the gun of our friend Pat, it cannot shoot round the corners.

Urinal-stalls an imperfect arrangement.

Fig. 35 shows a good arrangement for public urinals. The basins, A, are kept about half-full of water, to dilute the urine, and a constant change of water can be secured by opening the supply-valve, F, just sufficiently to allow the water to dribble into the basins, and then, once a day, or oftener, the waste-valve can be opened, and the urinals and waste-pipes thoroughly *flushed out.* The divisions are *dwarfed—i.e.*, they are taken down to within 16 in. of the floor, thus leaving a clear and open space under the entire range of urinals, free from all corners where dirt can accumulate. If the *top* of the divisions are 4 ft. 9 in. or 5 ft. from the

Basin arrangement for making urine into water; divisions dwarfed.

floor, this will be quite high enough, but to take them up to 6 ft. or 6 ft. 6 in. is to waste material, for nobody would crane his neck over a 5-ft. division to look into the next compartment, unless he had the neck of a giraffe, and did not know

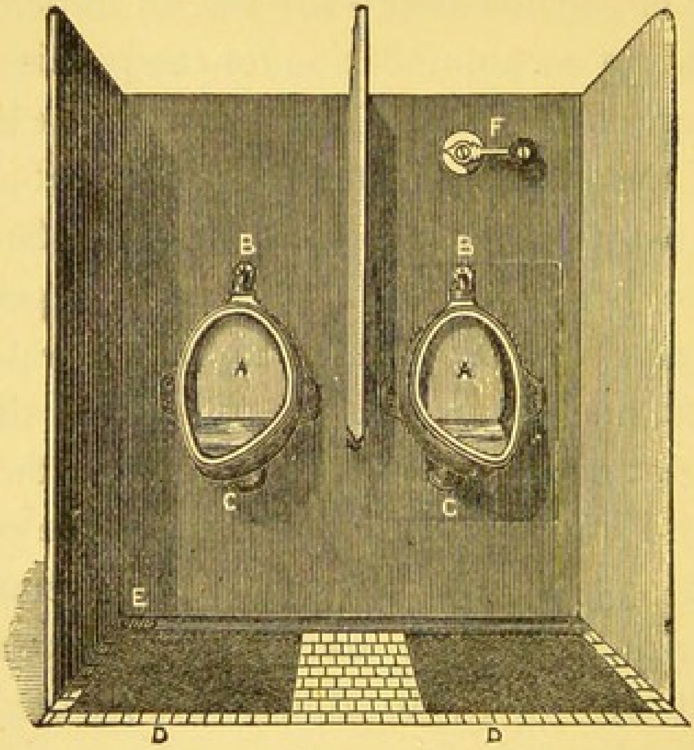


FIG. 35.

Slate channel.

what to do with his head. There should always be a *slate* or stone channel formed in the floor, along the back of the urinal range, and the floor should be sloped towards it, and immediately in front of each basin there should be a galvanised cast-iron platform-plate, D, Fig. 35, about 19 in. square, to stand upon when using the basin. This plate should be let into the stone, and rabbeted into the slate channel, and the top

Platform.

should be made *rough* like the sole in a hob-nail boot, to conduct any "droppings" into the channel, and also to prevent the feet taking them up and carrying them about the place.

Channel waste.

It is important to have a large waste from the channel, and as all such places should be outside the main building, there will be no difficulty in bringing the drain-pipe right up to the urinals, and making good the same with a 4-in. earthenware trap under the slate channel outlet. A 4½-in. brass rim, with a straight barred movable grating, E, Fig. 35, should be fixed over the inlet of the trap, for the hand to get at it when necessary.

Urinal-waste.

The waste-pipe from the urinal-basins must be carried along at the back of the range with branches to receive each basin. The branches should be made with 3-in. patent lead pipe, equal in substance to 9-lb. lead, or heavier, and the main waste should be of the same strength, but the size should not be less than 4 in.

Urinal-basin with treadle-action.

Fig. 36 shows a urinal-basin (with marble back and sides) supplied by treadle-action (see D, Fig. 36). This arrangement is more economical with the water, and better adapted for private places, perhaps, than the arrangement just described. Directly the feet are placed upon the *platform-grating*, D, the supply-valve is opened, and the water continues to flow into the basin until the feet are removed—*i.e.*, all the time urine is passing into the basin water is flowing into it as well. Under the platform-grating there is a

Safes.

porcelain-enamelled cast-iron safe,* to catch any droppings, which are immediately washed away by a supply of water branched from the service-

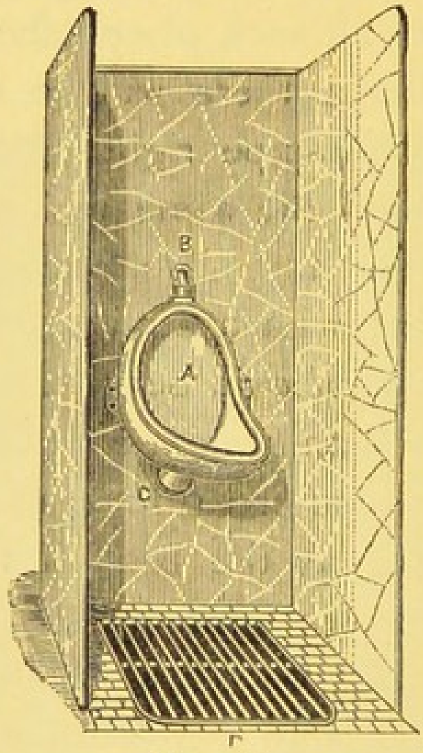


FIG. 36.

pipe to the basin. It is important to have a good supply of water, and when the cistern or head-of-

Supply-valve.

water is not over 20 ft., a ¾-in. treadle supply-valve should be used; above that head-of-water a ½-in. valve will be large enough. These valves require to be *strongly* and *well made*, and as they are self-closing, the *springs* require to be extra

Air-vessels.

strong, and to prevent concussion in the service-pipe, by the sudden closing of the valve, air-vessels should be fixed in the service.

* See Fig. 102.

CHAPTER XV.

WATER, AND ITS STORAGE.

PURE water is of such importance in every household, that it ought to be the question of questions before renting a house or erecting one: Is the water supplied to this house *pure?* or can I get pure water here?

Importance of pure water.

A stream or river, polluted by the sewage of a village, town, or city, cannot be the proper source of our *drinking*-water. It is hardly possible, with our present system of filtration, to make the water taken from such sources at all times absolutely pure and fit for drinking.

A polluted stream not the proper source.

But supposing such water to be filtered, and made wholesome, it will be difficult for the drinker to disassociate from his mind the fact that the water he is drinking has been before consumed in a similar way, and perhaps many times. Such an idea will hardly help a sick man to get better.

Where there is an insurmountable difficulty in getting a sufficient supply of *pure* water for both drinking and general household use, would it not be worth while to arrange *two* systems of supply to each house, one highly filtered and

Double supply.

made pure at any cost, and the other roughly filtered for water-closet and general use?

Storage capacity.

Care should always be taken to provide storage capacity for at least two days' consumption, in case of *non-supply* by the water company, or a *break-down* of any of the *service fittings* in the house. "One leak will sink a vessel" is an old adage, and one leaky tap or valve will empty a cistern. To store, therefore, all the water in a house in *one* cistern, is a worse policy than to put all the eggs into one basket; and, most assuredly, where this is done it will one day be found to be literally a cistern which holds no water.

Water should not be stored all in one cistern.

Place of storage.

Supposing you have been fortunate enough to obtain pure water, the next important consideration is the place of its storage, to prevent contamination.

Remote from all outlet air-pipes.

Water for drinking purposes should be stored remote from all places where bad air or noxious gases are likely to occur. And it is of the utmost importance *to store it away from all outlets to ventilating-pipes, from soil-pipes, general wastes, or drains.*

And not over water-closets.

It should not be stored directly over a series of water-closets or urinals, as is sometimes the case, and where the vitiated air of the rooms in which such apparatus are fixed can have easy access to the water.

Water absorbs air, just as a sponge does water; and when any impure air is near, the water will soon become impregnated with the impurities of the air surrounding it. Water absorbs air.

The strong painty smell of a newly-painted room is decreased by placing a pail of water in the room. A few hours after the water has been placed there, a coating of an oily nature will be seen floating on its top, proving that the water has been imbibing the vitiated air in the room. Pail of water in a newly-painted room.

And when a cistern of water is near a foul water-closet, or an outlet of a ventilating-pipe from a soil-pipe or drain, the impurities in the bad air are imbibed by the water in the cistern, which becomes contaminated just as the pail of water does in the painted room. Impurities of bad air imbibed by water.

A great deal of ignorance exists upon this subject of water-contamination. Many imagine that by putting a partition in a cistern, as Fig. 37, and dividing it thus into two compartments, that they have done all that is necessary to keep the two waters entirely separate from each other. Ignorance concerning water-contamination. They then confine one compartment to drinking purposes, and the other to water-closet uses, leaving the tops of each compartment open, even connecting them together by a waste-pipe, which takes the overflow from the two compartments. Now, the water in these two compartments is Cistern with a partition.

The two waters separate as the Siamese twins.

about as separate as the late Siamese twins, and the protection thus secured as reliable as the ostrich's, when it hides its head in the sands, and leaves its body exposed to the huntsman's shots. For if the water in the water-closet service compartment becomes contaminated, what is to prevent the impurities from flying off from this body of water, and passing over the top of the partition to the water in the drinking compartment?

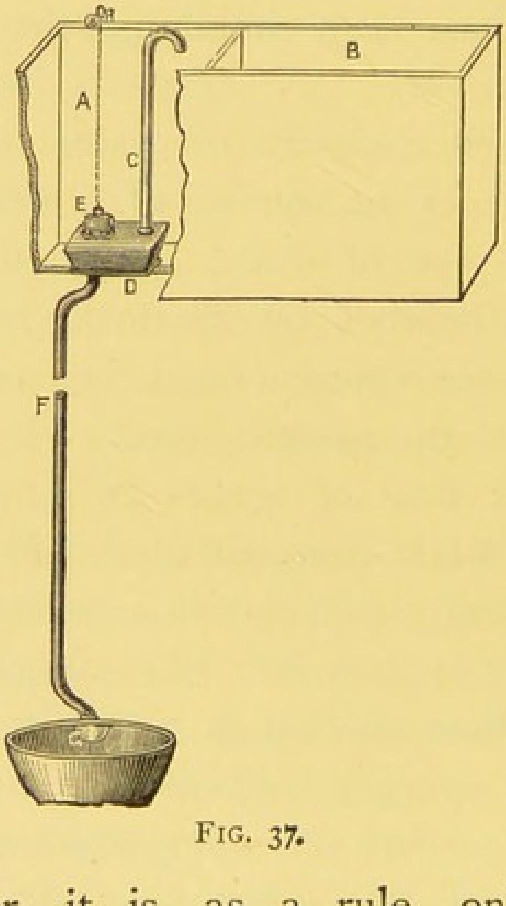


FIG. 37.

Service-box supply the medium of conveying bad air to the cistern-water.

Moreover, it is, as a rule, only when a *service-box supply* (see D and F, Fig. 37) is used for serving a water-closet apparatus, that the water in the cistern which supplies the apparatus gets contaminated: and one of the chief means of this is the air-pipe, C, to the service-box, which is always taken up to about the level of the top of the cistern, so that it is almost as near one compartment as the other; and if it contaminates the water in the one compartment, it will speedily vitiate that in the other.

Contamination of cistern-water by water-closets.

It is supposed by many that it is impossible to supply a water-closet apparatus without in some way or another contaminating the water in the cistern from which the water is taken. But this entirely depends upon the *service fittings* by which the water-closet is supplied.

A "*supply-valve*" action.

A water-closet served by means of a *supply-valve* attached to the apparatus, no matter how near or distant the cistern or reservoir may be, always leaves the service-pipe between this valve and the cistern full of water; how then can any air—good or bad—pass back through this water-charged pipe to the cistern? Moreover, this valve is, in its normal position, always closed, and acting thus as a stop-valve, it most effectually shuts off all communication with the cistern, and becomes a *double* check to the passage of any air from the water-closet apparatus to the cistern.

A service-box allows the air from the apparatus

A water-closet supplied by a service-box, as shown in Fig. 37, always leaves the service-pipe, F, empty, and in direct and open communicato pass up to the water in the cistern.

tion (through the air-pipe, C), with the cistern which supplies it with water; and there is nothing to prevent any bad air which may be in the water-closet from passing up behind the "fan" of the basin, through the service-pipe, F, and service-box, D, into the air-pipe, C (to the service-box), and from this air-pipe into the cistern, A and B. But supposing this air-pipe to the service-box to be taken farther away to discharge into the open air instead of into the cistern, which is rarely if ever done, there is still a direct communication between the service-box in the cistern and the water-closet, and this communicating-pipe is always empty; and any bad air in the basin is sure to ascend into this pipe, and directly the valve, E, is open in the service-box will escape into the cistern. Thus in the one case—with the supply-valve attached to the apparatus—it is impossible for the cistern-water to be contaminated by supplying a water-closet, and in the other case—the service-box action—it is hardly possible to be otherwise.

Impossible to contaminate the water in the one case and easy in the other.

Cistern-cleaning.

Cisterns, like chimneys, want cleaning out periodically, and in every case proper means should be provided for this purpose, and an easy access made to each cistern—especially to the *drinking-cisterns*—so that any servant of the household may get at the cisterns to clean them out, and see that everything is right.

Access.

The "Metropolis Water Act of 1871" simply provides for an *overflow-pipe* to prevent waste of water, and to act as an *indicator* to the water companies when the ball-valve is defective. But this is not enough; every cistern should have a *waste-pipe* for cleansing purposes as well (see Fig. 19). And if this waste-pipe cannot be made to answer the *double* purpose of overflow and cleansing pipe, the cistern should have a separate waste, as it is absolutely necessary for the cisterns to be cleaned out occasionally, to keep them wholesome, and if proper means are not provided for this, they will only be imperfectly cleansed.

"Water Act" and overflows.

Overflow waste in one or in two separate pipes.

If anybody doubts the necessity of this periodical cistern-cleansing, let him take a broom and stir up the water in any cistern in his house after an interval of six or nine months since the last cleansing, and then dip a glass into the cistern and take it out full of water, and, after looking at it through a microscope, drink it off, or stand convinced of the necessity of cleaning out cisterns periodically. (See "Cistern-wastes," Chapter IV.)

Periodical cistern-cleansing.

All cisterns or reservoirs for drinking-water should be made of slate, and never of lead when it can possibly be avoided. Cisterns for water-closet and general use can be made of lead, or any material which may be most convenient.

Slate cisterns.

Lead cisterns.

Safes under cisterns.

Slate and Galvanised Iron Cisterns should in every case, where they are fixed over ceilings, have a lead* safe under them, with an overflow-pipe from the safe discharging through an external wall. Lead cisterns, of course, do not require any safe. (See "Safes," Chapter X., page 92; also "Cistern-wastes," page 45.)

* See Plate XV., facing page 264.

CHAPTER XVI.

WATER-SUPPLY.*

It was not the original intention of the writer to say more than a word or two upon services; but it is useless to have a fountain unless there is sufficient water to play it. And a good supply of water is so essential to the thorough cleansing of a closet, that he has thought it better to devote a chapter to water-supply services.

Original intention to say only a word or two on services.

Like Mrs. Glass, you must first catch your hare before you can cook it, and so you must get the water into the house before you can use it. Water, like almost everything else now-a-days, is *delivered.* It has neither to be fetched from the town pump, nor drawn up by a windlass, nor pumped up from the well in the yard, but is supplied to almost every house in city, town, and village by water companies, under certain rules and regulations. There can be no doubt that such water companies have a perfect right to make their own rules, within certain limits, but these should always be for the benefit of all concerned, and not solely for the shareholders. Poor shareholders! how the people waste their water! But how conservative the shareholders are of their water! It is a pity they cannot have a

Water delivered to houses by water companies under certain rules and regulations.

* Also see Chap. XX., pages 218 to 237.

Flow and return.

"flow and return circulation" to each house from their mains. Well, all the harm that we wish them is that they may always have a reserve of this beverage for their own consumption without anything to add to it. And as for the people who wilfully waste their water, they should be made to collect what they waste, and then be dipped in it by the water companies' servants.

Trumpery ball valves.

Flimsy fittings soon begin to leak.

Water companies can hardly be too strict, or look too sharply after their water, for there are such trumpery ball-cocks and ball-valves used, that they are really nothing less than water-wasters. And the general service supply fittings are, in many cases, of such a flimsy character that they break down almost as soon as they are used, and, like an icicle under the rays of the sun, begin to "drop, drop," until there is no more water left in the cistern to drop through such leaky valves. This is where the water companies should save. But to limit the supply of water to a water-closet or urinal, where it is so essential for health and cleanliness, is a step in the wrong direction. The means taken for the prevention of waste, and the appliances sanctioned, or insisted upon, by the various water companies, are so poor that it is hardly too much to say that more water is wasted under the new system than under the old. It is hardly likely that anybody—even to spite the water company which supplies his house

Limited supply to water-closets and urinals.

New appliances water-wasters.

with water—would care to stand with his nose over a water-closet apparatus on purpose to waste water, and if he does open the valve to flush out the water-closet and soil-pipe occasionally, he does a good thing for himself and his neighbourhood, for he helps thereby to keep his sanitary arrangements wholesome.

Rising main of lead, and certain strength.

The size of the main service into the house from the water company's main must generally be determined by the water company, though there is no difficulty in deciding upon the necessary size, which varies with circumstances. The pipes must be of lead, and of a certain strength for the metropolis, according to Act of Parliament. (See "Table of Pipe-weights," page 133.)

Stop-valves in main outside and inside house.

A stop-valve, with a "cock-box" over same, is required by the water companies to be fixed in each branch from their main, somewhere outside the house, for the sole use of the *turncock*. But it is always advisable to fix another stop-valve in the rising main, directly after the pipe has entered the house, for the occupant's use in case of accident to the rising main itself, or a breakdown of any of the ball-valves fixed upon it.

Also in each branch.

In *large* houses, where there are several cisterns, and especially where there is a *constant service*, it is advantageous to have a stop-valve in each branch, fixed just behind, and connected with, the ball-valve, as B, Fig. 19, page 45, to shut the water off one cistern, when necessary, without interfering with the supply to other cisterns.

Stop-valves in services from cisterns.

Stop-valves should be fixed in every service-pipe out of a cistern in convenient position, and as near the under side of the cistern as possible. It is necessary, in all such cases, when a good pressure and body of water are required, to have the stop-valve one size larger than the service-pipe, as all such valves obstruct, more or less, the free passage of the water through them, and are not like round-way stop-cocks, where the water-way is the same as in the pipe itself—full bore and straight through. The pipe between the cistern and the valve may be of same size as the valve itself.

Supply of water to closets: two gallons allowed.

*Water-closet Supply.**—The quantity of water allowed by the various water companies, and made legal by Act of Parliament, is two gallons for each usage of the closet. "Tell it not in Gath, publish it not in the streets of Askelon!" Two gallons of water to carry away a deposit in a water-closet through some scores of feet of soil-pipe and drainage, flush these pipes out after its passage, and cleanse the whole! This is about as difficult a thing as making bricks without straw.

Where and

One is curious to know how and where

* See Chap. XX.

this exact quantity of water was calculated, and on what sort of water-closet it was tried. If one might make a guess, one would say it must have been somewhere in the dark, and if measured in pints it must have been on the principle of the baker's dozen. Let us look at the thing practically, *i.e.*, with an open eye. Suppose it takes two gallons of water for a water-closet fixed in the basement (where we have guessed the discovery to have been made), to cleanse the closet after usage, wash out the trap, and deliver the deposit into the sewer, how much water will it take for a closet fixed on the second or third floor at the rear of the building, with about fifty feet more soil-pipe, and fifty or sixty feet of additional drainage? Why, it would require this quantity of water to wet the pipe, and two or three such discharges to thoroughly cleanse the closet, trap, soil-pipe, and drain after the passage of the soil through it, and to keep it wholesome. The fact is, some closets require more water than others to keep them clean and wholesome, apart from their positions. And it must be quite evident, even to the most conservative of shareholders, that when a water-closet is fixed a long way off from the sewer or main drain, it must require a good supply of water to keep it, and all its appurtenances, in a sanitary condition.

how calculated.

Some closets require more water than others.

Valve and regulator supply.

Where there are no companies to interfere, there is no better way of supplying a water-closet with water than by an attached supply-valve and regulator to the apparatus, *if well made.* With this arrangement the water rushes into the closet-basin directly the handle is pulled; and one or two flushes can be given, according to circumstances, to flush out the apparatus and soil-pipe. To do this effectually it is necessary to have a large-enough valve and pipe.

Ignorance on water-pressure.

A great deal of ignorance exists upon water-pressure and the size of the pipe necessary to give a good flush of water to a closet; and, astonishing as it may seem, few people are more ignorant in this matter than plumbers. A small *feed-cistern* will give just the same pressure as the largest tank in the world, if fixed on the same level. What is wanted is height to give pressure, and where head-way of water cannot be obtained, then the service-pipe must be increased in size—not to give pressure, but to deliver a greater volume of water into the closet when the handle is pulled. The following table will give the size of the valve and pipe necessary according to the head-way of water above the water-closet apparatus :—

Head of water and not bulk.

Table of sizes of pipes and valves.

TABLE SHOWING SIZE OF SERVICE-PIPE AND VALVE TO GIVE A GOOD FLUSH OF WATER.

Head-of-water, *i.e.*, Height of Cistern (bottom) above w.c. Apparatus.	Size of Pipe and Valve for *flushing-rim* Closets.	Size of Pipe and Valve for *fan* basins.
4 feet and under 8 feet. . .	1¼" pipe or 1½" pipe, and 1¼" valve.	1¼" pipe and valve.
9 feet „ 12 feet. . .	1¼" pipe and ditto.	1" pipe and 1" valve.
13 feet „ 18 feet. . .	1" pipe and ditto.	¾" pipe and ¾" valve.
Above 18 feet.	¾" pipe and 1" valve.	¾" pipe and ¾" valve.

TABLE SHOWING WEIGHTS OF LEAD PIPE PER YARD.†

—	½ in.	¾ in.	1 in.	1¼ in.	1½ in.	2 in.
"Extra strong" lead pipe—*Water Companies' weights—as per Metropolis Water Act*, 1871	6 lbs.	9 lbs.	12 lbs.	16 lbs.	21 lbs.	28 lbs.
"Strong" service-pipe. . .	* 4½ lbs.	* 7¼ lbs.	* 10½ lbs	14 lbs.	18 lbs.	24 lbs.
"Service-pipe," *light* . . . "Strong *waste*-pipe," same strength as "light" service-pipe	* 3½ lbs.	* 5⅔ lbs.	* 8½ lbs.	12 lbs.	16 lbs.	21 lbs.
"Warning-pipe"—Pipes "discharging with an *open end*" *minimum strength, as per Metropolis Water Act*, 1871 .	3 lbs.	5 lbs.	7 lbs.			
"Waste-pipe"	. . .	. . .	. . .	* 10½ lbs	12 lbs.	18 lbs.

Soil-pipes and waste-pipes made by hydraulic pressure, above 2 in. and under 6 in., made in any weight *to the strength of sheet lead*, from 6 lbs. to 14 lbs. per foot.

* Within a fraction of the exact weight.

† See Table, p. 275.

Water-waste prevention a vexed subject.

*Closet-supply by Water-waste Preventers.**— The subject of water-waste preventers for supply to water-closets and urinals is such a vexed one, and there is such a variety of these things now in use, that the writer forbears entering into the subject at all. And though he has taken out patents for water-waste preventers, he believes, and his experience justifies his belief, that for the most part these so-called *water-waste preventers* are more *water-wasters* than the well-known water-closet supply-valve and regulator, when well made, except in certain circumstances; for instance, where there is any number of boys using the closets, and in public places; but in private houses the supply-valve and regulator is preferable, for in this case there is only *one* valve to get out of order, and if this is of good workmanship, it will shut off almost any pressure, and is, moreover, very durable and easily repaired when out of order. But in the other case, at any rate with the *majority* of the water-waste preventers, there are *three* valves—viz., the ball-valve to the feeder, the two-gallon supply-valve, and the supply-valve to the water-closet, any one of which getting out of order is liable to waste the water company's water.

Valve and regulator supply preferable, only *one* valve to get out of order in this case.

Water-waste preventing valve separate from

When a water-waste preventing *supply-valve* is used, it should have a small feed-cistern, and never be fixed in a drinking-water cistern, as the

* See Chap. XX.

communicating or service-pipe from such valve to the water-closet apparatus in its normal state is always *empty, and open for any air in the water-closet basin to pass up to the valve in the cistern*, and when the valve is open, the air can easily pass into the cistern-water, and contaminate it.*

drinking-cistern.

Water-supply by Water-waste Preventers.—The size of the service-pipe from water-waste preventers to *water-closets*, according to the Metropolis Water Act of 1871, must be $1\frac{1}{4}$ in., and to *urinals* 1 in.

Size of services from water-waste preventers.

From all water-waste preventing arrangements *with cisterns*, there must be an overflow-pipe taken from the cistern, and carried through the external wall, where the water companies' servants can see it. This pipe is to act as an indicator when the ball-valve is leaking. But there is no provision in the Act for indicating to the water companies' servants when any of the other valves are leaking in connection with such a water-waste preventing apparatus.

Overflow-pipes.

This overflow-pipe must be of lead, and, according to this Water Act, it must be $\frac{1}{2}$ in. diameter, but this is not large enough, for it should never be less than *twice* the size of the ball-valve which supplies the apparatus, to prevent damage by an overflow of water, should the ball-valve fail to act.

Twice the size of the ball-valve.

* See remarks on service-box supply, page 122.

Where several, branched into one.

Where there are several water-waste preventers in a range, or on several floors over a tier of water-closets, it is better to branch the overflows into one main overflow-pipe, and to take this down and discharge it in the area, or where it can be seen. (See Plate 2, Fig. A, showing a water-waste preventer fixed, with 1¼-in. lead service-pipe from it to water-closet basin.)

CHAPTER XVII.

HAND-WORKERS.*

VICTORY on the battle-field depends, no doubt, to a large extent upon the general; but in vain will be all his plans for conquest unless he can depend upon his soldiers. To fight battles successfully there must be trained soldiers, and to build sanitary houses there must be skilled workmen. A word or two then, before closing this small treatise, to *hand-workers*—the interpreters into bricks and mortar of the plans and ideas of the *head-workers.*

The workman is on the *spot*, and can see, if he is an intelligent tradesman, when this is right and that is wrong. Upon his skill and industry the success of any work chiefly depends. What is wanted is for every man to take an interest in his work, and to throw what skill and energy he possesses into it.

No man should rest satisfied with himself until he has thoroughly mastered his trade. Take the craft of plumber—how few understand the trade thoroughly, practically and theoretically? With some *anything* is " near enough ;" but nothing is near enough unless it is *exactly right.* It takes

* Continued page 306.

just the same time to make a disfigured joint that it does to make a symmetrical one; just as long to fix a crooked pipe as a straight one; and it takes no longer to put the trap in the right than in the wrong place; nor is any time saved by making the *connections* anywhere, instead of exactly in the right position.

The costly labour of indolent men, and the destructive labour of unskilled workers, eats up, or wastes, the productive labour of the industrious and skilled tradesman. And to compensate for this non-productive labour of the idlers and the incompetent, inferior materials are often used, and tricks are resorted to which are a disgrace to all concerned.

If every worker earned his wages before holding out his hand to receive them, and remembered that if he is not building his *own* house, he is helping to build a house for somebody, and that this somebody will want the same *protection* and comfort from it that he would himself, were he going to live in it — if all concerned remembered this, *scamping-work* would be killed at the roots.

The public are not free from blame in this matter. Competition is good and healthy—it keeps the rust out of our activities; but *over*-competition is injurious, as when *because* one man offers to do a work for half a crown, another will do it for a florin. But when the public find a man ready to give a guinea in exchange for a sovereign, they may be sure of one thing, that though it has the *guinea-stamp* it will not have the *guinea-gold*—something is out of square about it.

Union is strength, and hence men combine together into union societies. Trades-unions have, no doubt, done a good work, but they are far from being an *unmixed* good, and the man who falls back upon a society instead of depending upon himself levels the hills which he should manfully climb. Trades-unions are terrible *levellers*; they level upwards sometimes it is true, but they level downwards like ballast in a ship: chain eagles to turkeys, skylarks to bats. They unite the indolent and incompetent to the industrious and skilled, and then strike an average for the value. And whether a man is worth a shilling a day, or a shilling an hour, he must be paid according to the societies' rules, so much for every hour's work, whatever the worth of the workman. And yet the men who receive alike their 10d. per hour, or whatever the rate may be, differ as the stars.

The best trades-union for a man to join is to unite *his heart to his work;* such a man will not want any help from societies; wherever employed he will not be long in passing from the outer circle of casual hands into the inner circle of regulars, where he will be respected as a workman and a friend. And from this inner circle there rises a spiral staircase, and when once his foot is upon it, he will find that it ever leads upwards.

Builders of other men's houses, but not builders of your own! But why build ye houses only for others to own? Why are ye not yourselves your own landlords? The fault is your own. The advance in wages in the last few years, if you care to use it rightly, would enable every skilled mechanic to purchase a house for himself, through any of the Building Societies, in about twelve years. Take the money spent in drink — these constant "little drops" — and appropriate it to buying your own house, and before twelve years have passed over your head you will each have a cottage of your own for your old age, and your constitution and you yourself will in every way be the better for your so doing. This is not depriving yourself of your dinner-beer or supper-beer, but simply abolishing these costly "little drops" at all hours of the day, which are good for neither body nor mind, and cost on an average weekly more than one day's wages. Hence the majority of artisans work one day a week, or two months of every year, to satisfy a *habit* which ought never to have been formed.

Let me speak specially to the twice fourscore men in our employ. For nearly a century and a half men skilled in all kinds of lead-work have been going in and out of the "old plumbers' shop, near the Strand." But never in any period of its history have the men, as a body, understood so thoroughly the principles of internal plumbing-work as at the present time. What your grand-fathers did is not enough for you; the matter is *ventilated* more, and the why and wherefore of things sought out. The workmanship and thought put into the work by many of you is marked with such individuality that the writer has only to see the work to know the worker. With some of you the tendency is to rather *overdo* your work, *i.e.*, to *waste labour* upon it after it has already been well done; this is so much power lost, a gilding of fine gold.

All are still in the school-house learning, and many of you have a great deal to learn; but keep on learning until you have thoroughly mastered the trade, and by your skill and intelligence, honesty and sobriety, elevated, not yourself only, but the craft as well.

APPENDIX.

CHAPTER XVIII. (*See* CHAP. I.)

TRAPS.

D-TRAPS, TRAPS WITH CHECK-VALVES, "ECLIPSE" TRAP, SYPHON TRAPS, "V-DIP" TRAP OR "ANTI-D-TRAP," "SOIL-PIPE" TRAPS, "VENTILATING DRAIN-SYPHON AND SEWER-INTERCEPTORS," "DRAIN INTERCEPTOR," "FLUSH-TANK," "GREASE-INTERCEPTING TANK," &C., &C.

First edition.

IN the *first edition* of this book the writer devoted a chapter of twenty-seven pages to traps; and though he by no means exhausted the subject, he said enough, as he thought, to guide most men in selecting or making the right kind of trap for every sort of sanitary fitting fixed inside a house. He adds another chapter here, illustrating and explaining additional traps, invented since the publication of the first edition.

Traps—care in selecting.

Perhaps no sanitary fitting wants more care in selecting than a trap, for if it be either faulty in construction, or bad in principle, or both, it will soon become the *foulest thing* in or about the house. And when once it has become foul, not all the waters of all the water companies combined would make it *perfectly* clean again, especially if it is only allowed to *dribble* into it two gallons at a time—the quantity graciously allowed by most companies for "washing" (?) out closets and their belongings.

Arch-offenders, Bell-trap and D-trap.

Take, for instance, the *two arch-offenders*, the Bell-trap and the D-trap—used still by the hundred. Shade of Hygeia! Could anything be less adapted for sanitary uses, more ill-considered, and less sound in principle? The Bell-trap is only of very questionable value when the *top* is *down*, and the trap full of water; but who ever saw the top "*down*" and the trap full of water? As for the D-trap, no man living ever saw a *wholesome* one after it had been in use for half a year. And yet D-traps with the accumulations, not of half a year only, but of a score of *years*, are *breathing* out their *venomous filth* by the half-dozen or more in thousands of mansions and houses throughout England: people are too wise to use D-traps in Scotland and America.

Unfit for any position.

The writer has seen more *old* D-traps, perhaps, than any man living, but he has never yet seen one fit for any position—except, perhaps, to put *under* the *sink of iniquity*, wherever that may be. He knows that he is *considered* to have too strongly condemned the D-trap in the first edition (pp. 9-12), but only by those who are *wedded* to it, and who, having noses, smell not; so he has had a *faithful drawing* made of an *old*

PLATE VIII.

THE PLUMBER AND SANITARY HOUSES.

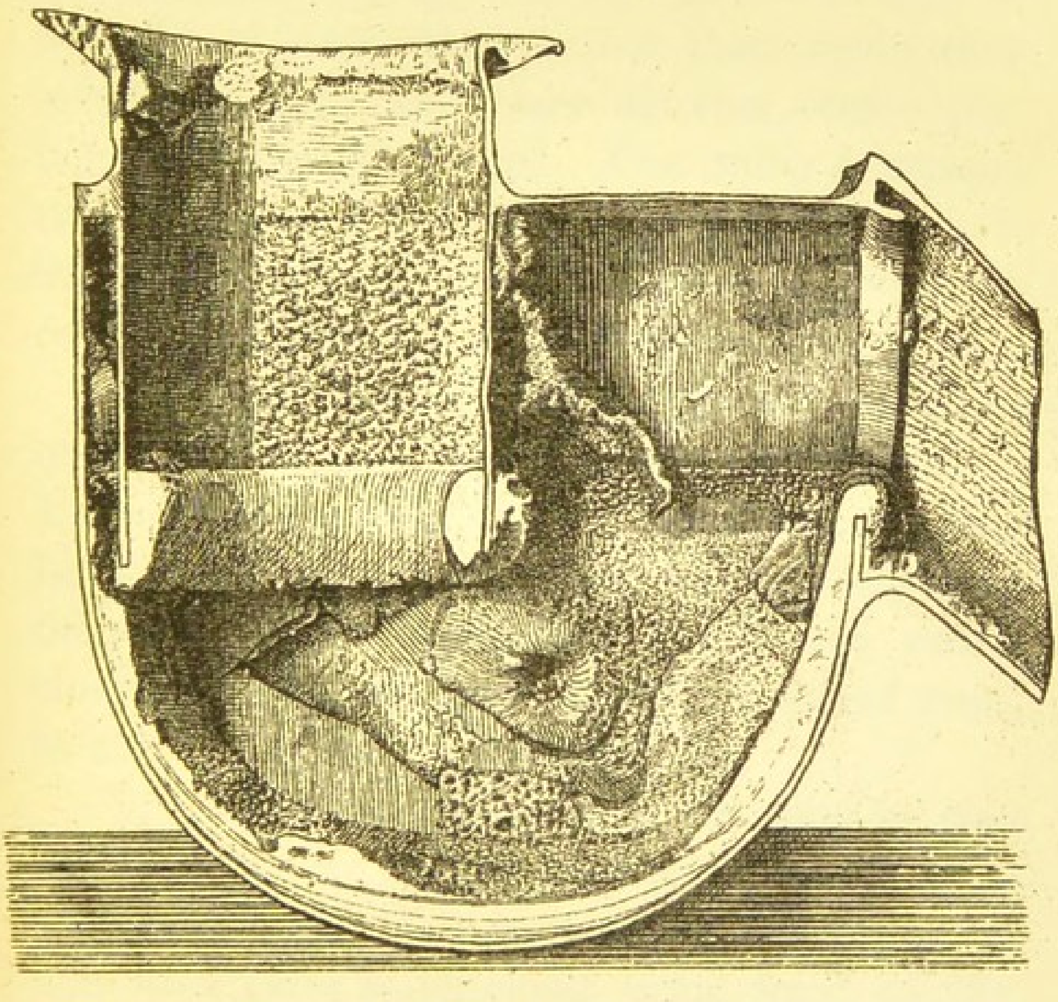


FIG. 38.—Section, showing an *internal* view of an *old* D-trap:—See page 145, also pages 9 to 12.

Hellyer, del.

Whiteman & Bass, Photo-Litho, London.

To face page 144.

D-trap,* and, unless such *noseless people* have eyes which see not, he thinks a sight of it, as shown in Plate VIII., without any *colouring*, will convince them that, after all, an old D-trap *is* a foul and filthy thing. If this is not enough to teach them better than to use them again, they are like Romeo, in a very different sense—past help, past cure, past hope. One thing is certain, that the day of the D-trap is over, and that it is literally "going to the *pot*"—where we have consigned thousands during the last few years.

The good of traps at all is now being as much questioned by *some* as the good of the Turks in Europe. They find, however, that they cannot be dispensed with altogether, and so they limit them to certain positions; and hence water-closets are being advertised *with* or *without* traps, to suit the whims of the specifiers.

Good of traps at all.

W.C.'s without traps.

The writer is willing to admit that in *some* cases, and under *certain* conditions, traps may be dispensed with. For instance, he has no objection to a *valve* water-closet being fixed on Mr. Norman Shaw's principle, provided the entire length of the soil-pipe from it does not exceed (say) 4 ft.; and also that there are no windows

* The trap shown in Plate VIII. has been drawn with great care, and faithfully represents a *general view* of the *inside* of an *old D-trap*. Scores of such traps come into our stores every month; but the trap from which this view is taken was cut out of a block of buildings where there are scores more just like it.

near, through which the surrounding atmosphere, vitiated as it often would be by the offensive matter coming out of the soil-pipe, would come into the house—*i.e.*, that effluvia from offensive motions may not *go out through the soil-pipe, and in through the windows.*

Traps necessary.

But though the writer would allow water-closets (and plugged vessels, *provided the plugs had springs to keep the outlet always sealed*) to be fixed *without* traps under the conditions just explained, he would *not* allow water-closets, or any other *sanitary fitting*, to be fixed *without* traps on a *long length* of soil-pipe or waste-pipe, even though such pipes were trapped at the foot, or discharged with an *open end;* for it is *impossible* to pass large bodies of foul matter through such pipes without fouling them.

Waste-pipes fouled.

Waste-pipes, either from water-closets, urinals, sinks, lavatories, or baths, will in time become foul; for, sooner or later, they get *in*sufficiently flushed out with water at the time of usage, and the offensive matter passed through them is allowed not only to *stain*, but to *dry* and *corrode* upon the pipe. Let the sceptical reader, if there be one, cut out a piece of waste-pipe, the one he thinks the sweetest in his house, and fixed on the principle we are now examining—a pipe which an exhaust-cowl on the top has been doing its best to sweeten, by drawing fresh air into it—

and when he has got the piece of pipe in his hand, let him put his finger inside and "scrape" it round, as one has seen the children do with the treacle-jars they are taking home to their mothers; and then let this *anti-trap-man* put his stained finger to his nose, and say how he would like fifty or a hundred feet of that kind of piping sending its offensive matter into the rooms of his house. Perhaps some will say, "You have forgotten the *cowl* on the top of the pipe." Well, no! the writer has neither forgotten the cowl, nor the *wind* on which the cowl is dependent. (See Chapter XXIII., on *cowl-testing*.) Anti-trap-man.

When water-closets are fixed *without* traps, the house is only "protected" from the *soil-pipe-air*, and perhaps *drain-air* too, by a *mechanical valve* or *seat* fixed somewhere on the outlet of the water-closet basin, and which at times *must* get out of order. When this occurs, what is there in the water-closet apparatus to prevent the noxious gases escaping into the house? Again, water-closets are often used by careless people, who pull the discharging-handle (if they pull it at all) in such a way as to catch some of the solid excrement, or paper, under the basin-plug or valve. In such cases, this plug or valve is *imperfectly seated*, and the water not only leaks out of the basin—leaving it dry for the next user of the closet—but the *soil-pipe air finds an easy passage*, through W.C.'s without traps.

such imperfect seating of the valve, *into the house.*

Trapless closets.

A *tier* of trapless closets may, therefore, in the way just referred to, become more or less *air-feeders* and help, in their little but stinking way, to satisfy the demands for air made by the several fires on the various floors of the house. For the top of the soil-pipe, being open to the atmosphere, would allow the colder and heavier air outside in the winter-time to push its way through the pipe —notwithstanding the strongest *upcast* cowl that could be put upon it—to the warmer and lighter air inside the house; and the drawing power of the several fires would help to pull the air through such defective valve seatings as we have just been considering.

Water-traps.

But where there *are water-traps* under water-closet apparatus, the great ocean of cold *air* will press, or blow, down into the soil-pipe in vain, for the *water-lock* of efficient traps will prevent its passage through the closets into the house. Nor will the strongest fire pull any *soil-pipe* air through a well-sealed *water-trap* fixed under a closet; and, therefore, traps must be of great advantage.

Value of traps.

As a further proof that traps are of great value for keeping out soil-pipe air, it may be stated that the author has often had several valve-closet apparatus *taken up for repairs* in large buildings where they were fixed on *one* stack of soil-pipe, leaving the *traps only* to protect the house from the soil-pipe; and, though such closets have been away for several days together, he has never known that anybody has detected the slightest offensive smell as having passed through any of the traps. Yet no stack of *soil-pipe* or even *waste-pipe* could be left for half an hour *without* a trap in such a case, without becoming an offence to everybody in the house.

Traps and sewer-gases.

What the *value* of *water-traps* may be for keeping out *sewer-gases* (none would exist of sufficient account to trouble about if the house drainage was carried out on the principles laid down in this work) the writer leaves for chemists * to determine. But it is worth while to notice this fact, that though the author has seen *hundreds* of old D-traps with the tops *eaten through* by noxious gases, on the *outgo side—i.e.*, the *drain* side—of the dip, he has

* Since writing this chapter on traps a most important contribution has been made to sanitary science. Dr. Carmichael, M.D., C.M., read his paper, "An experimental investigation into the trap and water-closet system, and the relation of the same to sewage products, gaseous and other," at the Philosophical Society of Glasgow, on the 18th of February, 1880. In this paper Dr. Carmichael says :—"*Water-traps are, therefore, for the purpose for which they are employed, that is for the exclusion from houses of injurious substances* contained in the soil-pipe, perfectly trustworthy. They exclude the soil-pipe atmosphere to such an extent that what escapes through the water is so little in amount, and so purified by filtration, as to be perfectly harmless; and they exclude entirely all germs and particles, including, without doubt, the specific germs or contagia of disease, which, we have already seen, are, so far as known, distinctly particulate."

rarely, if ever, seen a trap where the gases have eaten through it on the *house* side of the dip or water-lock. The answer to this naturally is, "Yes, when the gases have passed through the water-lock of the trap, they easily escape through the water-closet apparatus into the house." But the fact that they eat their way through the *top* of the trap, instead of passing at once through the water-seal, proves that water is of value in keeping out even noxious gases.

Water-seal.

Traps as air-barriers.

It should be a *sine quâ non* that all traps should be *self-cleansing* in their action. Traps inside our houses ought only to be wanted to answer the purpose of *air-barriers*, or *wind-guards*, and never for a moment treated as *protectors against sewer gases.* They should be made to stand like *sentinels* between the "sanitary fitting" (be it closet, sink, lavatory, or bath) and the waste-pipe, to guard the house from any air, good or bad, travelling through such pipes.

Traps free from checks.

The author prefers traps to be *free from all checks*, so that the *discharges* may pass *freely* through them to the waste-pipe without any impediment. But where it is impossible to leave the discharging end of the waste-pipe open to the atmosphere, or where the waste-pipe is of considerable length, and where the "*fitting*" itself cannot be moved, it is better, perhaps, that the trap on such a waste-pipe should have a double check—such a trap, for instance, as WARING'S "*sewer-gas check-valve*," as shown in Fig. 39, or BUCHAN'S "*syphon-trap with check-valve*," as shown in Fig. 40. These traps are wonderfully alike in principle. They are similar in shape to the patent cast lead S-trap, but they have this addition—

Traps with checks—Waring's and Buchan's.

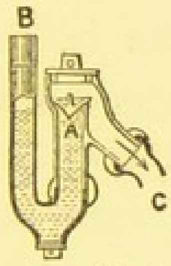


FIG. 39.—SECTION.

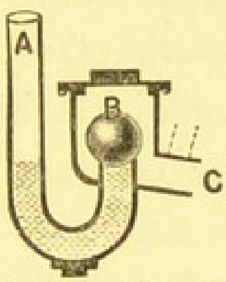


FIG. 40.—SECTION.

immediately over the standing water of the trap, on the outlet side next the waste-pipe (at A, Fig. 39, and B, Fig. 40), a metallic or other valve is made to *seal* over the passage-way to the waste-pipe, when this is out of use. (See Sections, Figs. 39 and 40, showing this.)

The Bower trap.

BOWER'S "*patent sewer-gas trap*," Fig. 41, is also made with a *double check;* but the *extra check* is on the *house side* of the standing water of this trap, at E, leaving the water (as in other and ordinary traps) exposed, and to be impregnated with the gases, *when they exist*, in the pipe. And should this extra check become imperfect (as it would through dirt, &c., getting under the seat-

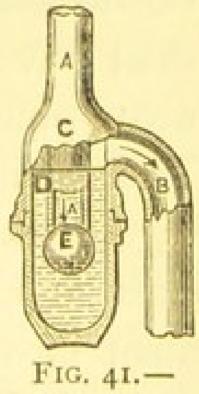


FIG. 41.—SECTION.

ing of the ball), such noxious gases would pass through this trap as easily as through the ordinary syphon trap. But that is not the chief objection to this trap. The body or well of the trap, into which the *dip-pipe* enters several inches to form its *water-seal*, must from its very construction become filthy, though it is advertised as "self-scouring." Another objection is, that the power by which this check, E, is formed has to be overcome by the discharges before they can pass through the trap—*i.e.*, the discharges into the trap must first force down the india-rubber ball or float, E, (buoyed up though it be by the standing water in the trap) before they can push their way through to the waste-pipe.

Traps to prevent waste-pipes becoming ventilators.

When traps are fixed as shown in Plates XI., XII., and XIV., with the *main* waste-pipes and soil-pipes *open* to the atmosphere at both the *upper* and *lower* end, and the traps themselves are ventilated, all that is wanted is, that such traps shall have a sufficient *water-lock* to *prevent* the waste-pipes becoming *air-inlets* to the house. There will be no need, in such cases, of check-valves to exclude noxious gases, for when they exist at all they will not, with such an arrangement of ventilation, press their way through the *water-lock* of the traps, but will escape through such ventilating pipes to the open air.

The "Eclipse" trap.

Fig. 42 shows a *longitudinal vertical section* of Smeaton and Son's *patent cast lead* "*Eclipse*" *trap*, with an *internal view* of the *dip-pipe*. Why the patentees have called this trap the "*Eclipse*" the writer fails to see, except that they mean by it that they now intend to have nothing more to do with "d's," and so *drop this letter out* at the *end* of the word "*eclipse*," as they have done at the *beginning* of the word *trap*. The title is misleading in more senses than one, as the trap is *eclipsed* in more senses than one. It is pretty considerably eclipsed when under a water-closet, for instance, and still more so when fixed (as it generally would be) between the floor and ceiling.

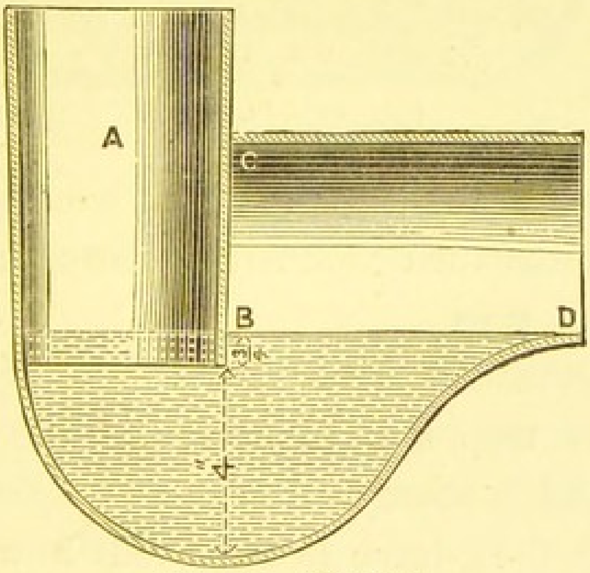


FIG. 42.—SECTION.

Dip insufficient.

But let us examine the trap a little. The inlet-pipe, or dip A, is all that can be desired *as far as it goes*, but it does not go far enough, only dipping into the water a little over ⅝ths of an inch, Trap not self-cleansing.

say $\frac{3}{4}$-in. Surely this is a great oversight on the part of the makers, for they cannot consider that $\frac{3}{4}$-in. is a *sufficient water-lock* for a trap that is to *eclipse* all other traps. *If* the moulds can be altered, the patentees should see that not another trap is sent out with so small a *water-lock*. Again, the trap is *not* self-cleansing. The *outer side* of the circular partition, or dip-pipe, which goes down into the body of the trap, and which forms the *water-lock* just referred to, from B to C, Fig. 42, and E to F, Fig. 43, would rarely, if ever,

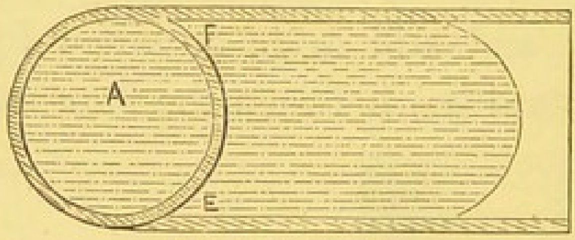


FIG. 43.—PLAN.

get thoroughly washed, though it would often get *splashed* with such offensive matter as passed through the trap.

Collecting-places for filth.

Again, the *two recesses*, E and F, between the top of the trap and the level of the standing-water, would become *collecting-places for filth*, and when once they have become foul how will they get cleaned? The water sent down into the trap would not turn sharply round the dip at E and F, and go up to the underside of the top of the trap to C, with any scouring process to clean away the filth collected there, but would pass out of the trap at once, at D. A further evil is that the *standing-water* on the *outgo* side of the trap, from B to D, Fig. 42, is too large, as it is about two-thirds larger than the area of the inlet, and so does not stand a proper chance of being driven out at each flush of the closet. (See Plan, Fig. 43, showing this.)

The writer also considers it a mistake to have formed this *circular partition* (see Plan, Fig. 43), which is to shut out the soil-pipe air from the house, *inside* the trap, especially as the trap, being a kind of lead *box*, *would not disclose* either an *air-leakage* or a water-leakage in the partition, which at times might occur through a flaw in the casting; and in such a case, any bad air in the soil-pipe would have an easy access to the *house-side* of the trap. But notwithstanding all the writer has said about this trap, he considers it superior to the old-fashioned D-traps. Partition wrong.

The Du Bois Traps, of America, can be made in *any* shape to suit circumstances, but the general form is similar to the "patent cast lead traps" shown at Figs. 8 and 9, page 13. The *Du Bois Traps* are made by hydraulic pressure in the same way as lead pipe, and they can be made with any depth of *water-lock*. They are perfectly *self-cleansing*, but, like the patent cast lead traps just referred to, they must "Du Bois Traps."

be ventilated (as every trap should be) to prevent syphoning.

"V-dip Trap."

The writer has designed a special form of trap for *lessening the syphoning action* of discharges when passing either through the trap itself, or through the soil or waste-pipe on which such traps are fixed. Fig. 44 gives a *perspective view* of this trap, and Fig. 45 shows a *section* of it. The writer has called this trap

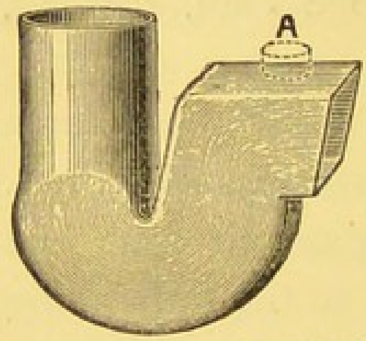


FIG. 44.—*View* of "*V-dip*" Trap.

the "V-dip" Trap, or "*Anti-D-trap.*" It is the same in principle as the "Mansion" trap (pages 15–17), though it is an *improvement* on the *shape* of that trap, as will be seen by a glance at the two traps (Figs. 10 and 44). The *inlet* part of this "*V-dip*" *trap** is perfectly *round*, as shown at Fig. 44, similar in fact to the patent cast lead trap, but the *outlet* part is like a square pipe with the *angles rounded.* This outlet part of the trap is specially enlarged to *prevent the discharges filling the outgo* as a sort of *water-plug*, and syphoning or drawing the water of the trap after it, and thereby *un*-trapping it.

* See Plates XI., XII., and XIV., showing these traps fixed to valve-closets.

There is no part of this trap where any excrement, or foreign matter, can accumulate. And when a flush of water is sent through it the water previously in the trap is driven out by the incoming water, and thus a change of water takes place in the trap every time the closet is used. At

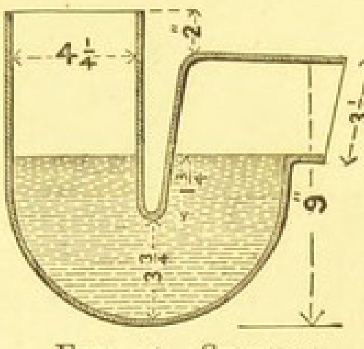


FIG. 45.—SECTION.

the same time every part of the trap is *washed* by the friction of the water flush in its restricted passage to the soil or waste pipe. This "*V-dip*" *trap* has a *water-lock* of $1\frac{3}{4}$ inches, as shown in Section, Fig. 45.

This trap is made of the softest and purest lead—equal in substance to sheet lead 8 lbs. to the superficial foot—without solder of any kind; and, as it is made by machinery, it is only about half the price of the "Mansion" water-closet trap.

Combination Soil-pipe Trap.

The writer has had so many inquiries for his *lead* "*soil-pipe*" *trap*, as shown in section, Fig. 14, page 19, that a year or two ago he designed and patented a soil-pipe trap in *stone-ware*, for fixing externally to suit *any position* either of the soil-pipe or drain.

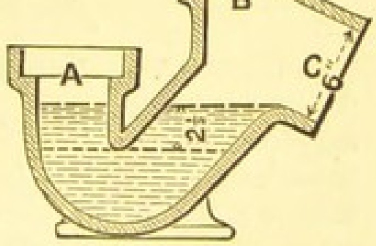


FIG. 46.—*Vertical Section* of "Combination Soil-pipe Trap."

This patent "*Combination soil-pipe trap*" is specially constructed for trapping off drains from the soil-pipe, for *ventilating the drain* (when required at this point), and also for forming an *air-induct to the foot of a soil-pipe.*

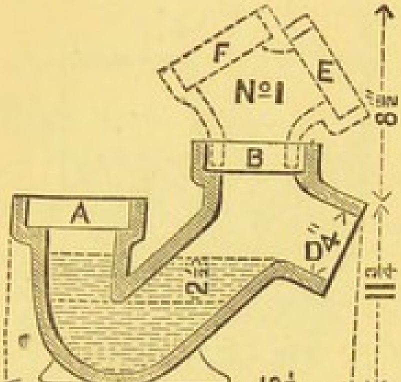


FIG. 47.—*Vertical Section* of "Combination Soil-pipe Trap" with "Connecting-piece" for ventilating the drain, and for access to Trap.

It is a *round-pipe* trap, and in its action is thoroughly *self-cleansing.* The body of the trap is purposely made a little smaller than the inlet, to insure its being thoroughly flushed out whenever the soil-pipe is used. And though it has a *water-lock* of 2½ ins. to *ward off* the *drain-air* from the soil-pipe, it only holds such a body of water as is easily driven out by the discharge of a flush of water through any of the water-closets, &c., upon the soil-pipe.

Connecting-pieces.

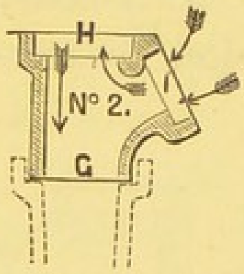


FIG. 48.—Section of "Connecting-piece" for *Horizontal* Air Inlet to Soil-pipe.

This *trap* and its *connecting-pieces* are so arranged that the *discharges must* always *fall vertically* upon the *face* of the *standing-water in the trap*, and thus the *previous water* in the trap *must be changed* every time a flush is passed into the stack-pipe on which the trap is fixed.

The position of this trap, at the foot of a soil-pipe, prevents the water from ever being syphoned out. And as the trap would always be *under-*

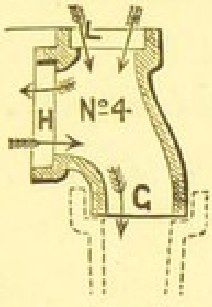


FIG. 49.—Section of "Connecting-piece" for *Vertical* Air Inlet to *Horizontal* Soil-pipe.

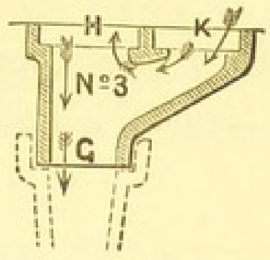
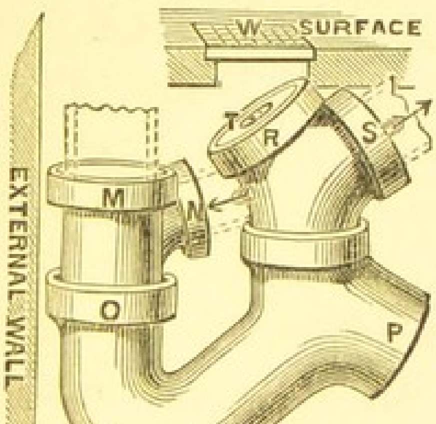


FIG. 50.—Section of "Connecting-piece" for *Vertical* Air Inlet to *Vertical* Soil-pipe.

ground, the water in it would rarely, *if ever*, evaporate, nor would it be likely to get frozen.

This trap can be *rigged* up in many ways to suit circumstances. Fig. 51 shows a view, in *per-* Trap rigged up.



M. Soil-pipe.
N. Foot Ventilation.
S. Ventilation of Drain.
T. Access to Trap and Drain.
W. Galvanised Iron Movable Cover.

FIG. 51.—*Perspective View* of a "Combination Soil-pipe Trap," for 4-in. or 5-in. Soil-pipe.

spective, of a *patent* "*combination soil-pipe trap*," with *double connecting-piece*—"NO. 1"—for forming access to trap, T, and for ventilating drain, S;

and, also, with *connecting-piece* (as "No. 2," Fig. 48) for "horizontal" *air-induct*, N, to foot of soil-pipe, M. (See D, Plate 14, showing such a trap fixed.)

Fig. 52 shows a section of this trap (*without* the *double connecting-piece*, "No. 1"), giving

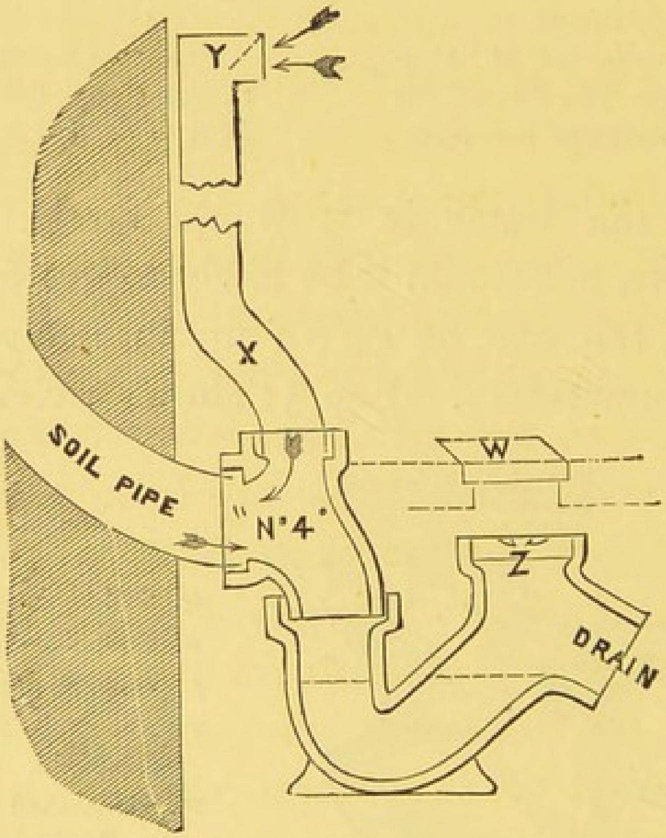


FIG. 52.—*Vertical Section* of Trap, showing *Induct-pipe* and "Mica-valve" over same.

access, Z, to trap, and with *connecting-piece* "No. 4" (Fig. 49) fixed on the *inlet* side of the trap, to receive "horizontal" soil-pipe, and for air-induct-pipe, Y and X, to foot of soil-pipe.

When this *air-induct-pipe*, X, stands just under a window, it is advisable to fix a *mica valve* at Y to prevent any *exit* of *foul air*, and to allow fresh air to pass into the soil-pipe at this point. (See Figs. 53 to 56 on Plate IX, showing *four* other ways of *rigging up* this trap; but the illustrations speak for themselves.) Trap with Induct Pipe and Mica Valve.

The flushes of water following the *waste* or *sewage discharges* through any of the *connecting-pieces*, Nos. 2 to 4, Figs. 48, 49, and 50, are made to fall *vertically* upon the *standing-water* of the *trap*, to drive out its previous contents and to keep the trap wholesome. Vertical Force of Discharges.

The *outgo* (P, Fig. 51) can be turned round to any point to suit the drain. The "connecting-pieces" can also be turned round in their sockets to suit any position of the pipes, &c. Outgo.

These traps are *specially designed* for fixing in *confined places where any offensive air*, *driven down by the discharges* through the soil-pipe, could not readily get away, and where there would be a possibility of such vitiated air coming into the house through a window or door near such a trap. Confined Places.

In *open places*, where there is no such risk, it is better to fix such a trap as shown at Figs. 57 and 57*a*,* as the *disconnection* from the drain would be *absolute*. Open Places.

* See Plates XI., XII., and XVII., showing this trap fixed at the foot of a soil-pipe.

Variety of ways of rigging up Trap.

As this "combination soil-pipe trap" can be rigged up in such a *variety of ways*, the Author has given several views showing this.

Fig. 46 shows a *section* of this trap with a 6-*in. outgo;* but the trap is always sent out with a 4-*in.* outgo, unless *ordered* 6-in.

Fig. 47 shows the same, but with a 4-in. outgo, and with a "No. 1" "connecting-piece" for ventilating the drain, and for access to trap.

Figs. 48, 49, and 50 show sections of *three* "connecting-pieces" for connecting soil-pipes with the trap, and for giving air to same.

Fig. 51.—See explanation following the illustrations, page 159.

Fig. 52.—See explanation following the illustrations, page 160.

Figs. 53, 54, 55, and 56, on Plate IX., show *four other ways* of fitting up this trap, but the illustrations speak for themselves.

"Sewer-interceptor."

The author has designed and patented another form of trap for *disconnecting* soil-pipes from drains, and drains from sewers or cesspools. See Figs. 59—64, pages 166 to 171, illustrating and explaining same for intercepting *sewers* from drains.

Fig. 57 shows this trap for *fixing* at the *foot* of a *soil-pipe*, and *disconnecting the drain from same.* The 4-in. and 6-in. (see Figs. 62 and 63,

THE PLUMBER AND SANITARY HOUSES.

PLATE IX.

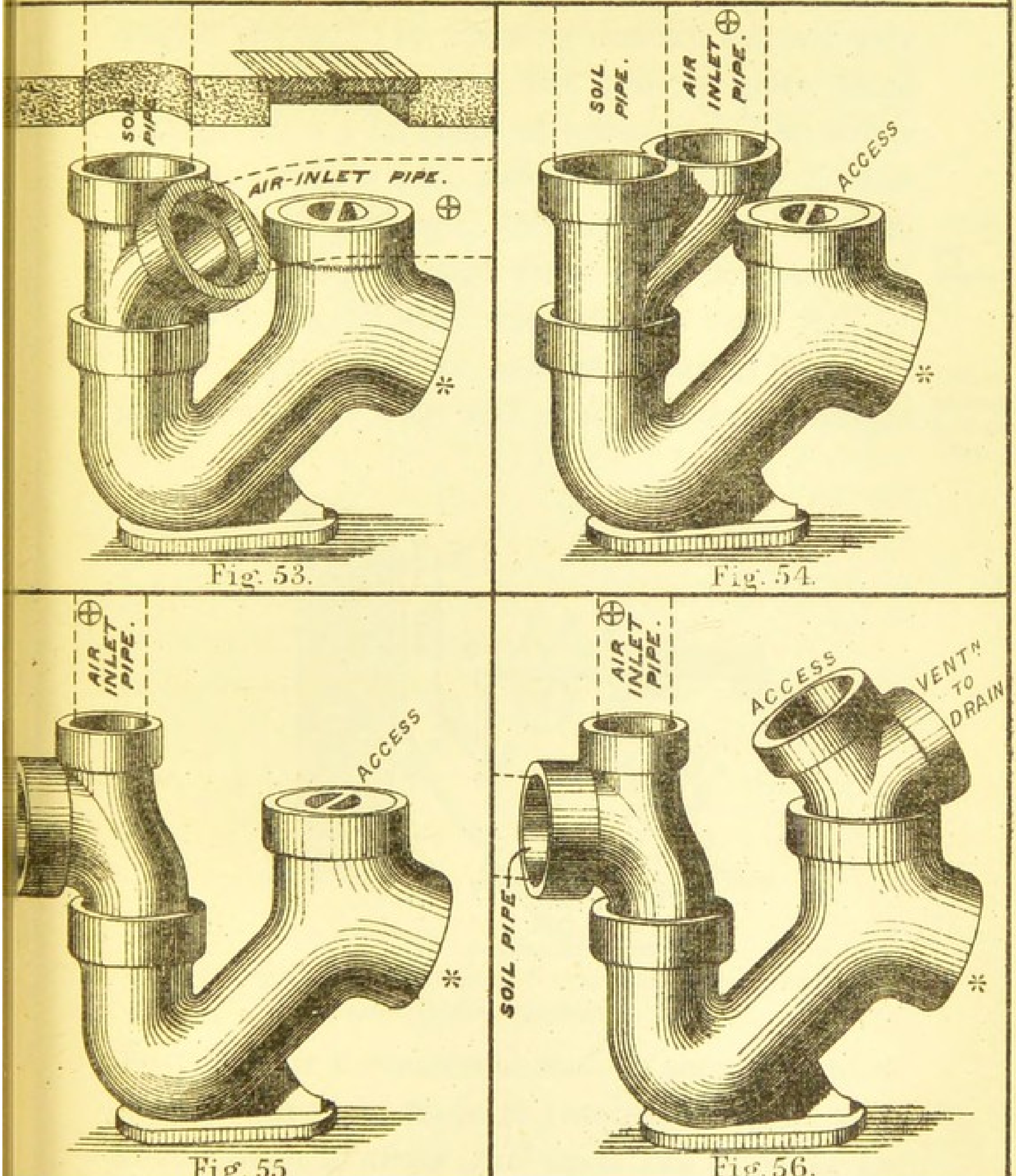


Fig. 53. Fig. 54. Fig. 55. Fig. 56.

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VIEWS showing *four* ways of rigging up the author's patent "COM-NATION SOIL-PIPE TRAP."—See Figs. 46, 47, 51 and 52, showing four ore ways.

* The "out-go" here is shown for a 6-inch drain, but the trap is also ade with a 4-inch out-go.

⊕ Foot-ventilation.

pages 169 and 170, showing dimensions) are only used for this: in fact, the 4-in. is quite large enough for a 5-in. stack of soil-pipe. The writer considers that a 4-in. patent "*Ventilating Drain-syphon and Soil-pipe Disconnector*," as section, Fig. 57, is large enough for a stack of 4½-in. soil-pipe with six or nine water-closets upon it. "Soil-pipe" Disconnector.

Fig. 57 shows a *sectional view* of such an arrangement. The soil-pipe, whether brought Disconnecting Soil-pipe Trap.

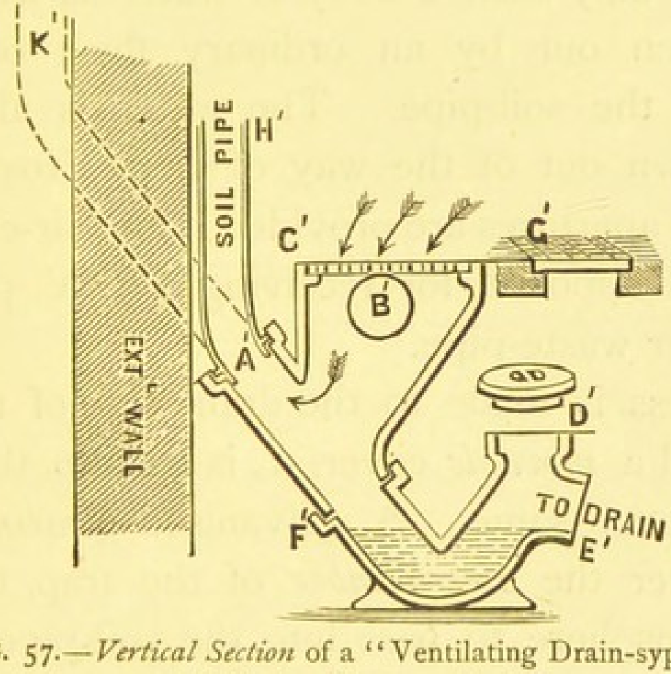


FIG. 57.—*Vertical Section* of a "Ventilating Drain-syphon and Soil-pipe Disconnector."*

down outside the external wall, as shown at H′, or inside, as at K′, is made to enter the trap at A′, so as to obtain a *direct fall* upon the whole of the

* Several of these traps have been fixed at the bottom of soil-pipes with half-a-dozen or more of closets upon them, and in places where there is a great deal of traffic, but there has never been any offensive smell noticeable: in fact, no bad odour can ever be detected, for the stream of air passing into the soil-pipe (through the grating) is at the rate of about 70 feet linear per minute, as registered by an anemometer.

surface of the standing-water in the trap, to drive it out and change the contents of the trap every time the soil-pipe is used. There is no place—no nook or corner—where any filthy matter can accumulate to contaminate the surrounding air. As will be seen by a glance at the woodcut, there is only a small surface of water exposed for throwing off impurities or for evaporation; and though a dip or water-seal of 3 in. is obtained, there is only such a body of water as will easily be driven out by an ordinary flush of water through the soil-pipe. The water is also kept well down out of the way of Jack Frost.

Two apertures are provided in the air-chamber, at B and opposite, for receiving a R.W. pipe,* or any other waste-pipe.

Access to Trap.

Access is made to the drain side of the trap at D, and a *movable* cover, G′, is let into the stone paving over same. A galvanised *grating*, C′, is fixed over the *air-chamber* of the trap, to allow the atmosphere to pass into the soil-pipe at this point, thus making the disconnection from the drain perfect. See Fig. 60, showing size of traps for 6-in. drain, and Fig. 62 for 4-in. ditto.

Air inlet to Soil-pipe.

When the drain is near the surface, and there is not sufficient depth to fix the disconnecting-trap as shown at Fig. 57, a trap as shown at Fig. 57*a* can be fixed, as the disconnection from the drain

* See Plates XI. and XX., pages 252 and 272.

would be quite as perfect. This trap can be had with a 4-in. or 6-in. outgo. The trap is large enough to receive, at A, a 4-in. or 4½-in. lead

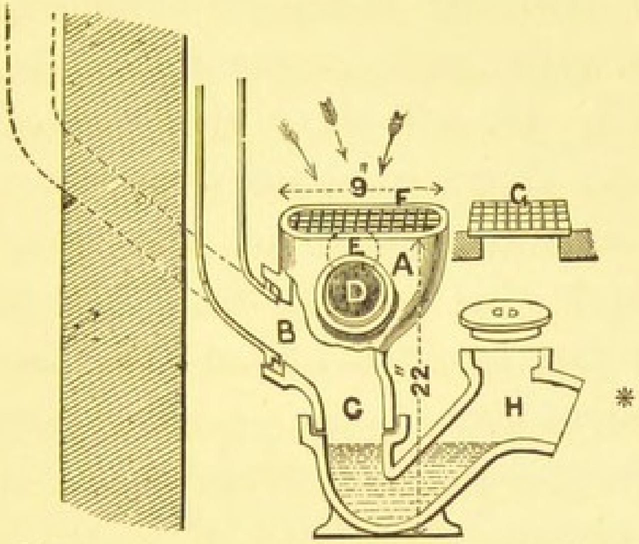


FIG. 57*a*.—*Vertical Section* of "Trap and Soil-pipe Disconnector."

soil-pipe; and a 4½-in. soil-pipe is large enough to take half-a-dozen, or more, water-closets.

One of the most defective traps is the well-known *drain-syphon*, though used by the thousand; yet this *Bashi-Bazouk* kind of trap is set to guard the house in its most vital part. Drain-syphon.

This trap is bad in principle and faulty in construction. The *passages* through such a trap

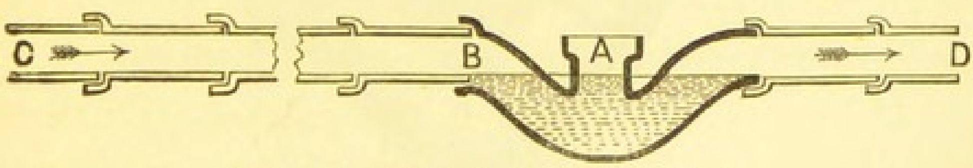


FIG. 58.—Section of a Drain-syphon.

must always be *very sluggish*. The discharges from the drain into it only just *gravitate* through

* The *outgo* is made for a 4-in. or 6-in. drain.

the trap, without any attempt at cleaning out its filth, for often the entire length of drainage would have to be filled up to its *head* before *half a pound* of *pressure* could be brought to bear upon the water, at B, of the trap. A glance at C to B, Fig. 58, will show this at once. The *solids* stand about, at B, until a greater body of water is sent into the drain, when they *move* on a stage and *float* up into the "inspection-hole," A, unless that is already filled; and finally, after having taken some hours—perhaps days—in the transit, they *drain* themselves out, at D, into the common sewer.

"Ventilating Drain-syphon and Sewer-interceptor."

Figs. 59 to 64 show a *water-trap* which the

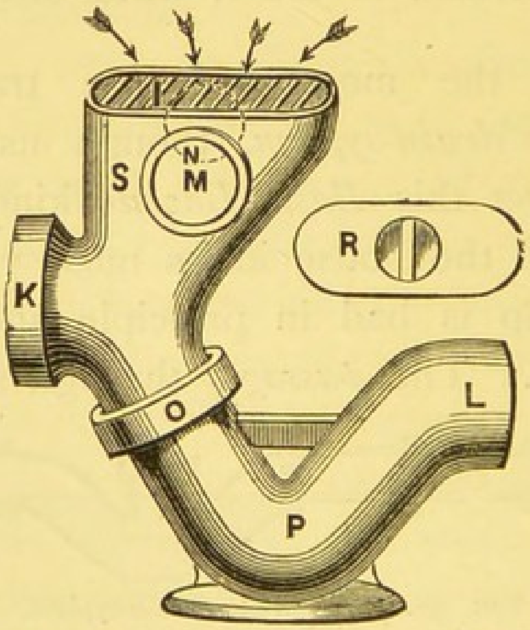


FIG. 59.—*Perspective View* of a 6-in. "Ventilating Drain-syphon and Sewer-interceptor."

writer has patented, and designed to remedy the defects of the drain-syphon just alluded to, and which he has called the "*Ventilating Drain-syphon and Sewer-interceptor.*"

These traps are made of *stoneware*, and are specially constructed for intercepting, or rather Disconnecting sewers and tanks from the house-drain.

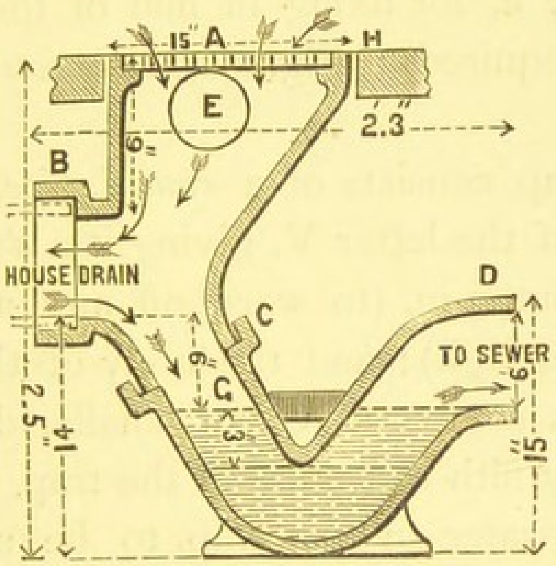


FIG 60.—*Vertical Section* of a 6 in. "Ventilating Drain-syphon," &c.

disconnecting, sewers and sewage-tanks from the house-drain. The smaller sizes are adapted for *disconnecting* soil-pipes from drains. (See Fig.

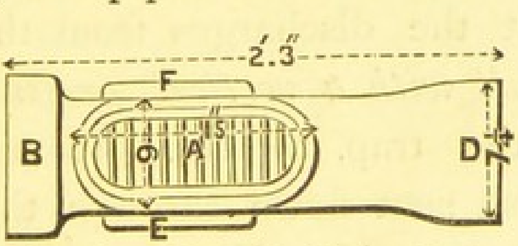


FIG. 61.—*Plan* of a 6-in. "Ventilating Drain-syphon and Sewer-interceptor."

57, showing this; also see Plates XI., XII., and XVII., showing such a trap fixed.)

This patent "*Ventilating Drain-syphon and Sewer-interceptor*" is at present only made in Sizes of Trap.

three sizes—viz., 4-in., 6-in., and 9-in., as the latter size is large enough for any purpose for which it is likely to be used. Fig. 62 shows a 4-in., Figs. 59 and 60 a 6-in., and Fig. 63 a 9-in. Fig. 59 shows a *perspective view* of this trap (with its stopper, R, for fixing in lieu of the grating, I, when so required); Fig. 60 a *section*; and Fig. 61 a *plan*.

Construction of Traps. The trap consists of a *round pipe*, shaped in the form of the letter V, giving it a *dip* or *water-seal* of about 3-in. (to ward off any air seeking to come through); and the body of the trap—P, Fig. 59—is comparatively of smaller diameter, to prevent any filth collecting in the trap, and also to allow the water in the trap to be more easily driven out by the flushes from the drain. The *inlet*, G, Fig. 60, is of *extra depth*, as shown, so as to allow the *standing-water* in the trap to be 6 *in. below the outlet* from the drain. By this arrangement the discharges from the drain *are made to fall with a vertical pressure* upon the water in the trap, to drive it out with the smallest flush sent down through the drain. A glance at the section, Fig. 60, will show this. The drain will thus empty itself, and at the same time allow more room for ventilation in it.

Air-chamber. The *upper part* of the *trap* is considerably enlarged, and is continued upwards, as shown at S, Fig. 59—and also in the other figures—for the *admission* of *fresh air* into the house-drains. When this part of the trap is not high enough to reach the surface of the ground, it should be continued upwards in brickwork, as shown in

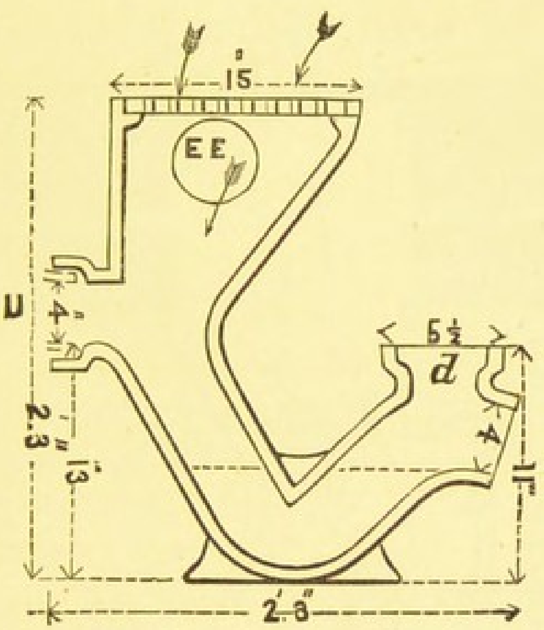


FIG. 62 —*Vertical Section* of a 4-in. "Ventilating Drain-syphon and Sewer-interceptor."

section, Fig. 63, and the *grating*, 1, should be removed from the top of the trap and let into a stone, as shown, for the *fresh air to pass freely into the house-drain.*

When this trap is used for *disconnecting sewage-tanks* from the main drain in *country houses*, there is absolutely no danger attending it whatever, if the drains are properly ventilated; nor is there any danger in using them for *disconnecting* the *sewers* from the *house-drain* in *town houses*, if proper care be taken in selecting the right position

No danger in using such open traps.

for fixing them. When there is *no* "*area*,"* or when the drain is brought into the house under a covered way where no air can get at the trap, or where any gases passing from the sewer *through the trap* would *escape into the house*, then it is

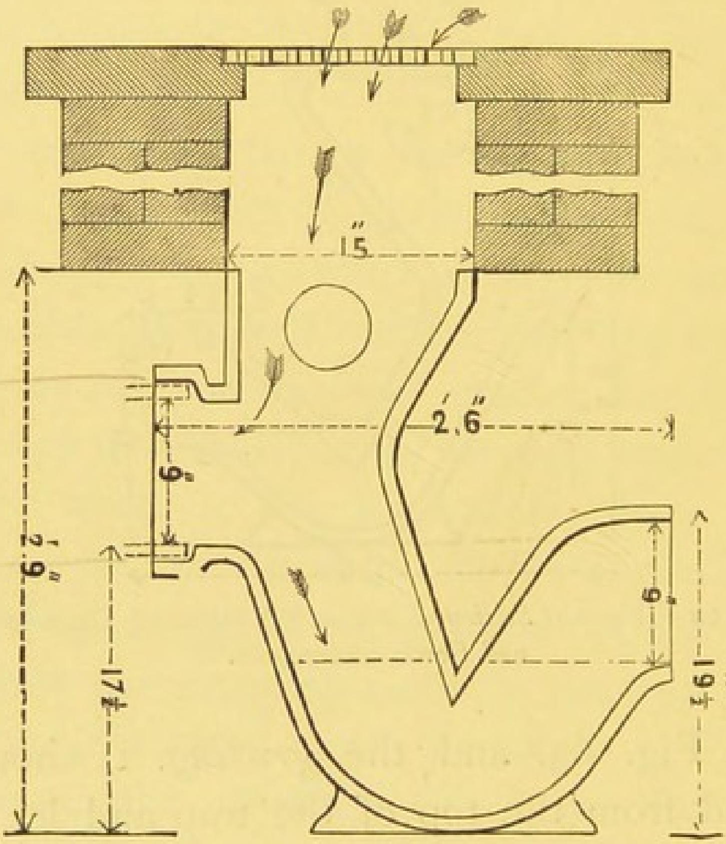


FIG. 63.—*Vertical Section* of a 9-in. "Ventilating Drain-syphon," &c., showing Manhole.

better to *seal* over the *top* with a *stoneware cover*, R, as shown at Fig. 64; and in such cases a 4-in. pipe, as A A, should be taken from a corner of the area (farthest away from all windows), and continued under the paving in drain-pipe *b* to the

* See Plates XX. and XXI., showing treatment of drainage where there is an "area." Ditto (Plate XX.), showing treatment of drainage where there is a "covered way."

air-chamber of the trap at B B, with which it should be connected. Inlet socket-holes are purposely made in the *air-chamber* of each trap for receiving such pipes—as shown at M and N, Fig. 59, and F and F, on *plan*, Fig. 61.

A *mica-valve* should be fixed on the top of the air induct-pipe, A A, as shown at C C, when fixed near a window, to prevent back draught; but this mica-valve should be so fixed as not to interfere with fresh air passing into the induct-pipe.

Mica-valve over Induct-pipe.

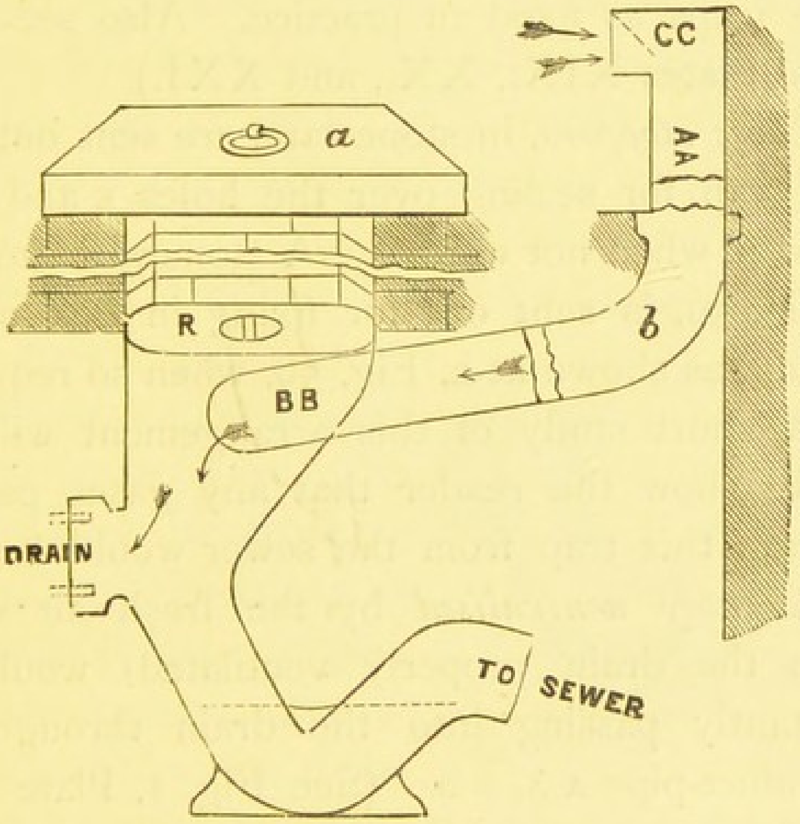


FIG. 64.—View of a 6-in. "Ventilating Drain-syphon" with Air Induct-pipe.

Movable Cover over Manhole.

When the *top* of the *air-chamber* is not within reach of the ground surface, a *manhole*, as shown at Fig. 64, should be formed in brickwork, for access to the trap for the removal of the stopper R, and for inspection of the trap and drain when necessary. A *movable* stone should be fixed over this manhole, as shown at A in the above diagram. (See Plates XII. and XVI., showing these traps as fixed in practice. Also see drain plans, Plates XIX., XX., and XXI.)

Loose stoppers, in stoneware, are sent out with each trap, for sealing over the holes E and F, or M and N, when not wanted. A stoneware stopper, R, Fig. 59, is sent out for fixing in lieu of the grating, as shown at R, Fig. 59, when so required.

A short study of this arrangement will not fail to show the reader that any gases passing through this trap from the sewer would be *very considerably neutralised* by the fresh air which (with the drain properly ventilated) would be constantly passing into the drain through the air induct-pipe A A, B B. (See Fig. 1, Plate XX., showing such a trap fixed.)

Buchan's Traps.

Fig. 65 shows a vertical section of Mr. Buchan's patent *ventilating drain-trap*. The "*drop* of 2 in. or so which the water gets in falling from the drain-branch, A, into the well of the trap" at C is very valuable, though its value would have been increased if the drop had been *twice* as great. The *dip*, or *water-seal*, of $1\frac{1}{2}$-in. is hardly sufficient to allow for evaporation when the trap is out of use for days together, as would sure to be the case at times when fixed in many places, especially as a stream of air would be constantly passing just over the exposed surface of the water in the well of the trap to *lick* it up—*i.e.*, to induce evaporation.

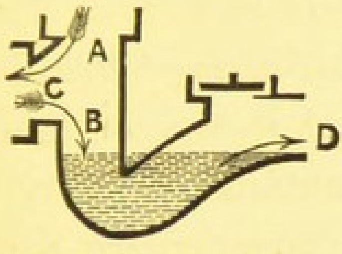


FIG. 65.—SECTION.

This trap is sound in principle, and by its cheapness is put within the reach of every builder.

Fig. 66 shows a *perspective view* of Mr. Weaver's "Ventilator Trap" for fixing to drains, &c. This trap is a great *improvement* upon the ordinary *drain-syphon*. Its *chief* value is its *fresh-air inlet* A, and this would be increased if the inlet pipe were made *more open* to the atmosphere, *i.e.*, if the *perforated* top, A, were entirely removed. It has one great demerit, viz., the *want* of a drop between the drain branch and the level of the standing-water in the trap, as explained in the evils of the drain-syphon (page 165). The *water-lock* of $3\frac{1}{2}$ *in.* would make it all the more difficult for the discharges through the drains to *flush out*

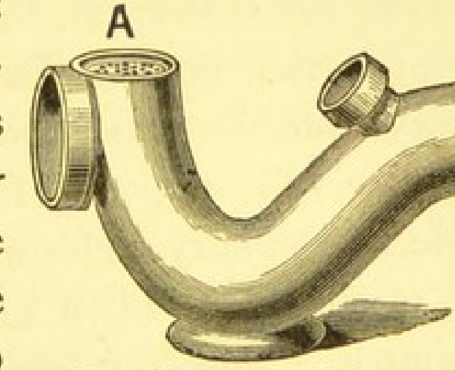


FIG. 66.—View of Trap.

this trap. How doctors disagree! The *water-lock* in this trap is $3\frac{1}{2}$ *in.*, but in the last trap that we were considering, it was only $1\frac{1}{2}$ *in.*

Field's "Flush-tank."

Mr. Rodgers Field's Patent Self-acting "Flush-tank."—Fig. 67 shows a *vertical section* of this tank and *syphon-pipe*, D, for the automatic emptying of the tank. Perhaps the proper place for considering this tank would have been under the head of "Drains," Chap. XXII., but as it is made to answer the purpose of a trap, it may as well be considered here.

Valuable for certain purposes, but not for sinks.

This apparatus is very valuable for many purposes, as for collecting rain-water for the flushing out of drains; but it is hardly the thing to use for collecting the waste-water discharges from certain sinks, unless it is kept some distance away from the windows and doors of the house.

We will suppose * this tank is fixed just outside the scullery window (and where no doubt it is often fixed) of a gentleman's house in the country. The cook and scullery-maid empty *all sorts of slops* down the scullery-sinks, greasy water from the soup and dinner plates, green-water (hot and strong) from the saucepans, soapy

* Everybody knows that Mr. Rodgers Field is much too good a sanitarian ever to have intended that this tank should be fixed in such a position. He invented this tank, I believe, for *collecting* the *general wastes* of a small house, to pass them in larger bodies into the drain, instead of allowing each sink-waste to dribble separately into it; and for this purpose, where there is a long length of drainage, it is very valuable.

water from the wash-hand bowl, and sour milk cans are scalded out and drained into this common receptacle. And this goes on from day to day until the tank is nearly full to the brim, at which point it may remain for several days, for the discharges into the tank would often not be rapid enough to start the syphon; but, by and by, the syphon-pipe is charged, and this stagnant body of water is syphoned out. No, not out! for from a sixth to an eighth of its water would be left behind, as shown at G, as the syphon would draw air, and cease to act, so that the filth which would be constantly settling down in the tank would remain there until the tank was cleaned out by hand, which one is afraid would not be often, as it is too deep to get at conveniently.

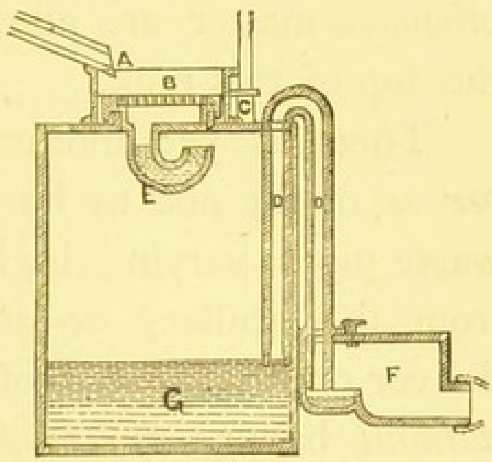


FIG. 67.—VERTICAL SECTION.

Water in the tank unchanged

Again, at times the family would leave their country house for their town house, just when this tank was about half or two-thirds full, and then sometimes this stagnant water, or miscellaneous mixture, would remain unchanged for consecutive weeks or months. This would be remedied by taking one or two rain-pipes into it to charge the syphon-pipe every time it rained.

Filth on the top.

Another fault in this tank is that the slops from the various sinks discharge *over* the grating, B, of the trap, at the top of the tank, so that bits of grease, soap, boiled cabbage, or such-like offensive matter are allowed to splash about on the top of this tank.

Waste-pipes as ventilators to house.

There is yet another evil, though the tank *per se* ought not to be blamed for this. The waste-pipes, varying in length from 5 to 15 feet, from the scullery or other sinks, are made to deliver on to the top of the grating to this tank *without* having *any trap* at all upon the waste-pipe. Such pipes, therefore, become *air-inlet* pipes to the house, *i.e.*, the air is drawn into the house at A, through a stinking pipe.

This tank, holding say a couple of hundred gallons, with a larger syphon-pipe, would be very valuable to fix at the head of the drains where it could collect rain-water on some high level, and then send it out with some force into the drains.

"Triple-dip" Trap.

The Author's patent "*Waste-receiver and Drain-interceptor*" (pp. 24–27, and illustrated by Figs. 16 and 17, and by Fig. 68) is *not intended* for receiving waste-pipes from *scullery-sinks*, as it is *not constructed* for *collecting grease.* There are *three* apertures (A, A, A) in the *waste-receiving compartment* for taking waste-pipes from sinks, lavatories, baths, &c., from bedroom floors; and two apertures (N, and opposite) in the *drain-inter-*

cepting compartments for taking R.W. pipes or drainage wastes from areas, &c. But this trap is too expensive for *general use*, and a simple "drain-

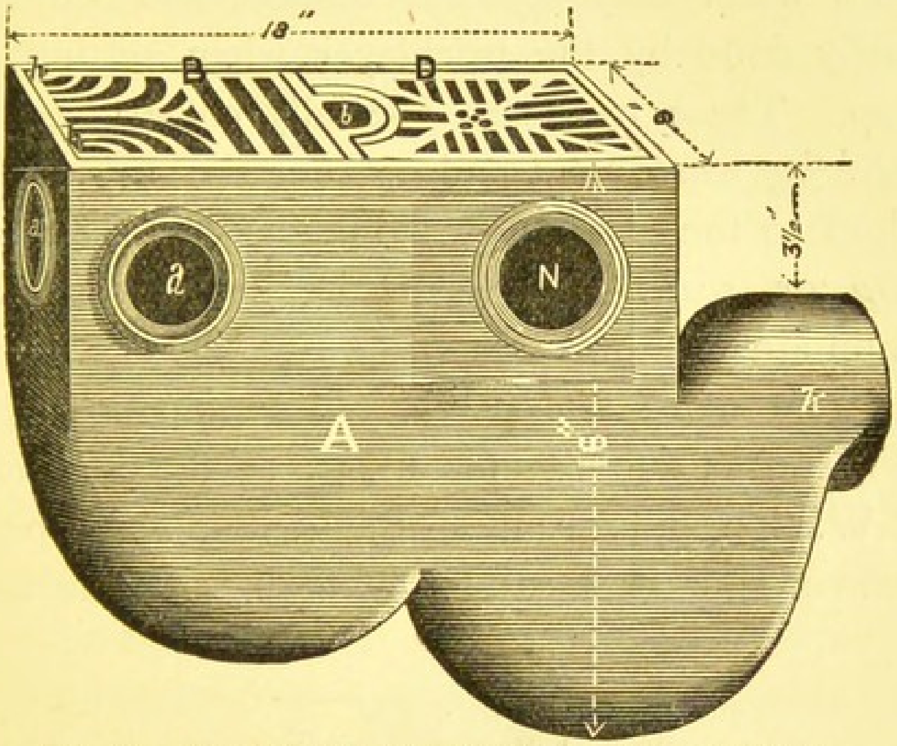


Fig. 68.—*Perspective View* of a "Waste-receiver and Drain-interceptor" or "Triple-dip" Trap.

interceptor" is all that is wanted for ground-floor sinks, &c., and sinks and lavatories which are not near to bedrooms.

The Author, a year or two ago, had the *intercepting half* of this trap remodelled and made in *three sizes*, to suit varying circumstances, and he has called this trap the *"Drain-interceptor."† "Drain-interceptor"—three sizes.

These "*Drain-interceptors*" are made in *stone-*

* See "Grease-trap," or "Grease-intercepting Tank" (Figs. 72 and 73, pp. 181–2).

† These traps are not constructed to take sewage wastes.

ware, with *movable* gratings of strong galvanised iron over the tops; and *loose stoneware covers* are sent out with each trap to *seal up the holes* in the sides when they are not wanted, and which is easily done by the bricklayer when setting the trap. These traps are specially constructed for *receiving waste-pipes*, and *exposing* the *ends* of such pipes to the *atmosphere*. They have a *water-lock* (*dip* or *water-seal*) of $2\frac{1}{2}$ in., to shut out the drain air, as shown in section, Fig. 70.

The *small size* ("No. 1") Drain-interceptor (Fig. 69) is suitable for fixing at the foot of a R.W. pipe, and for taking the waste-pipe, or pipes, from a sink or lavatory, or both. At the same

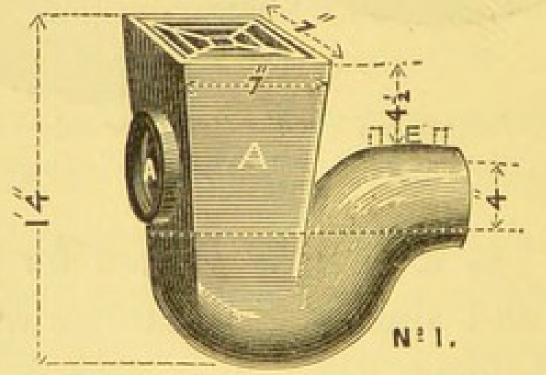


FIG. 69 — *View* of "Drain-interceptor," *Small Size*, or "No. 1."

time this trap can be made to take off the surrounding surface-water. The R.W. pipe and waste-pipes are made to enter the trap through the aperture, A, at the sides.

The *medium size* ("No. 2") "Drain-interceptor" (Fig. 70) is for fixing in yards or areas, to drain away the surface-water, and also to receive one or two R.W. pipes, sink and bath wastes, &c. Countersunk holes for receiving a 4-in drain-pipe are made in *each* of the *three* sides for this purpose; but smaller-sized pipes, or lead waste-pipes, can be connected with this trap. The

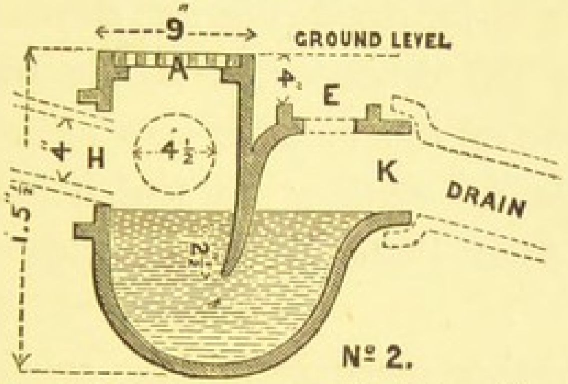


FIG. 70.—*Section* of "Drain-interceptor," *Medium Size*, or "No. 2."

waste-pipes should be made to go into the trap, as shown at H, and be cemented in. The drain can be ventilated from the top of the outgo (at E) of this trap. The outgo, K, is made to enter the socket of a 4-in. drain.

The *large size* ("No. 3") "Drain-interceptor"

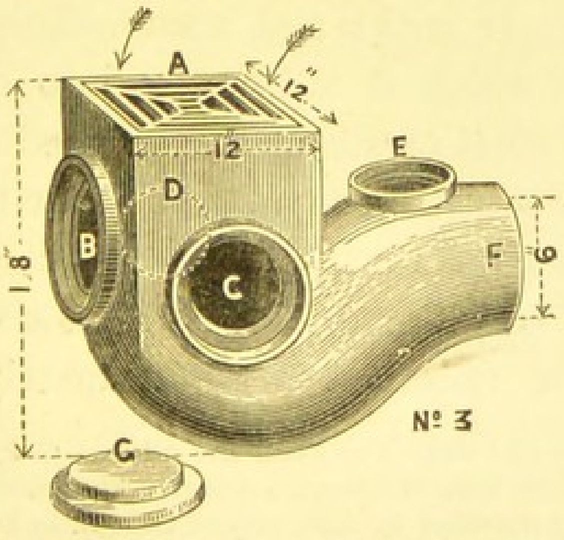


FIG. 71.—*View* of "Drain-interceptor," *Large Size*, or "No. 3."

is also provided with *three countersunk* holes in the sides, B, C, and D, for receiving 4-in. drain-pipes or other waste-pipes, and, when so ordered, the hole B can be enlarged to receive a 6-inch drain-pipe. The outgo, F, is made to enter the socket of a 6-in. drain-pipe; E shows a hole for ventilating the drain, or for access to the drain; G shows one of the loose covers as sent out with these traps for sealing up the holes when not wanted. (See Plate XIX., showing such a trap fixed).

The Author recommends the *smaller** sizes, as they will be found large enough for most purposes for which they are likely to be wanted; for unless these *large* traps get well flushed out occasionally they become offensive.

Grease from scullery sinks.

One of the most troublesome things to deal with, especially in large country houses where much company is kept, is the *grease from the scullery sinks.* It sticks and accumulates on everything with which it is brought into contact, and though all sorts of means are adopted for catching it, it is so subtle when in solution with *hot* water that it escapes through the finest grating and gets away into the drain, where it congeals and becomes a nuisance. Unfortunately, too, the

* Wherever *foul water* is collected and allowed to stand in a vessel, it is likely sooner or later to become a source of danger, therefore keep the traps *small* that the water in them may be changed by every flush passing through the trap.

scullery sink seems to be always the remotest sanitary fitting from the emptying-place of the drainage; and when the drains are laid down without the cement jointings being cleared inside, as is often the case, the grease accumulates about such joints until the whole drain becomes foul. The grease should always be collected, and never be allowed to pass away into any *long length* of drainage. When there is only a *short* distance for it to travel, it can then be passed at once into the cesspool or sewer.

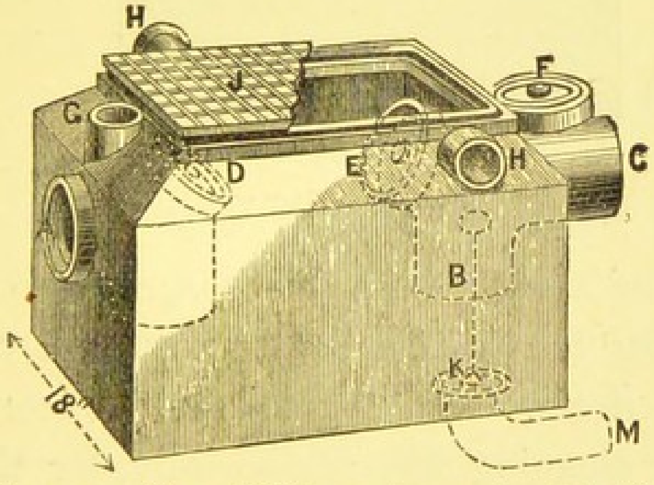


FIG. 72.—View of "Grease-intercepting Tank."

The author has patented a "*Grease-trap*," or "*Grease-collecting Tank*," which he has had made in *two* sizes in stoneware, to suit large and small houses. Fig. 73 shows the *larger* size. Grease-traps.

The greasy water from the scullery sinks is discharged through a pipe a few inches below the level of the standing-water in the tank, as shown in section Fig. 73, to prevent the grease stopping up the pipe, and also to prevent the incoming water from disturbing the *congealed head* of the water in the collecting-tank. The *gross fat* of the hot greasy water discharges gets *congealed* in its transit from N to O through the *cold* water kept in the collecting-tank for the

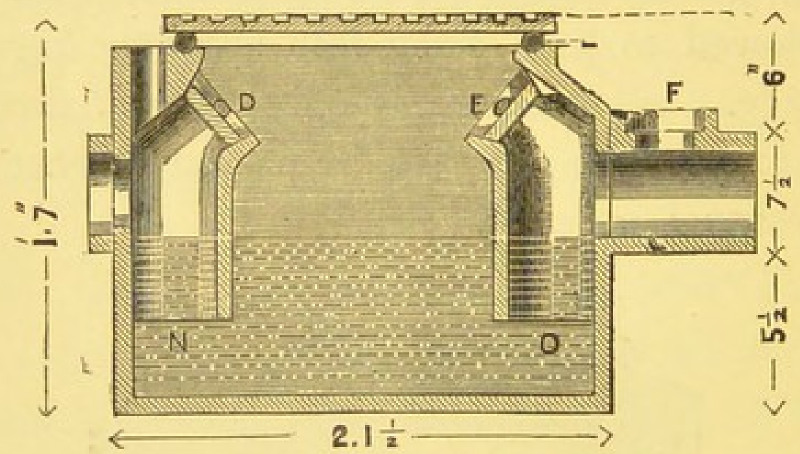


FIG. 73.—SECTION.

purpose of cooling the discharges into it, and suspending the grease before any of it can pass into the drain. Of course this collecting-tank will want cleaning out periodically, for the water when surcharged with grease will cease to absorb any more, and then, unless the tank is cleaned out, the congealed grease will be driven into the drain. The mouth of the outlet pipe, B, is kept a few inches below the level of the "standing-water," to trap it and prevent the drain air from coming out, and also to prevent pieces of congealed grease floating down into the drain.

Air-vent to waste-pipe.

An *air-pipe* is fixed on the outlet end of the discharging waste* into this grease-trap, and carried up to the surface, as shown at G, Fig. 72, to allow the atmosphere to pass into the waste-pipe, to dilute any gases which may get into it.

Access to waste-pipe.

Access is made to the *waste-pipe*, at D, for cleaning-out purposes when necessary, and a *hand-hole* with a *movable* cover is made at E, over the mouth of the drain, for inspection or cleansing purposes. Provision is made on the *outgo* of the trap, at F, by a *countersunk hole*, for *ventilating the drain*, and when this is not required the hole can be sealed over by *bedding* down in it the loose cover always sent out with the trap for this purpose.

A *ground-in* brass *plug* and *washer* is fitted in the bottom of the tank with a galvanised iron handle, as shown at K, for *flushing out the tank* when so ordered, and when this cannot be used, through want of fall in the drain, the hole can be sealed over with the loose stoneware plug sent out with each trap for the purpose.

Flushing-plug.

This *flushing-plug* arrangement is a great *convenience for cleaning out the tank, and flushing out the drain.* The grease is shovelled out of the tank, and then the plug is drawn out, and the dirty water is emptied with a great rush into the drain. The tank can then be filled up two or

* See Fig. 115, p. 250.

three times with *hot water* (from the hot draw-off through the sinks) and emptied into the drain with a good cleansing force.

Space for grease.

Plenty of space is made between the level of the standing-water and the cover, for the grease to float upwards, as shown in section, Fig. 73.

India-rubber packing is fitted into the groove, at L, on the top edge of the tank for the galvanised iron cover, J, to *bed* down upon, to *seal* over the tank, and for easy removal, or the cover can be bedded down with putty.

Provision is made at H and H for ventilating the tank. Of course, only one air-pipe is wanted, but the *two* socket-holes are made so that the air-pipe can be taken from either end to suit circumstances. Loose stoppers are sent out with each

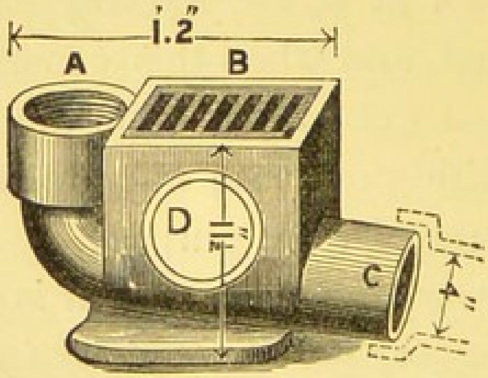


FIG. 74.

trap for sealing over either or both holes when not wanted, or they can be filled in with cement.

Fig. 74 gives a perspective view of a *stone-*

ware "Ventilating Drain-connector,"* or rather *dis*-connector, which the Author has patented for fixing at the bottoms of R.W. pipes and waste-pipes, and for connecting same with *branch drains* leading to an *intercepting-trap* branching into the main drain, as shown at Fig. 118, page 271. The socket *inlet*,† A, is made large enough to receive a 4-in. cast-iron rain-water pipe; but, of course, a smaller pipe can be made good into it. The *outgo*, C, is made to enter the socket of a 4-in. drain-pipe, but when the drain is only 3-in. a diminishing-pipe can be fixed to the shoe-piece to suit the size of the drain. This *outgo*, C, can be turned round to any point to suit circumstances. The grating, B, is made to take away, to give both access to the drain and rain-water pipe.

An aperture is made in the side of the ventilating and access chamber, as shown at D, and also in the side opposite, for receiving a 4-in. (or smaller) drain when so required.

This "Ventilating Drain-connector" is also made with a *straight inlet socket*, instead of the elbow one shown at A, when so ordered.

(Plate XIX., facing page 268, shows several of such "Ventilating Drain-connectors" fixed.)

* See Fig. 118, page 271; also see Plates XIX. and XXI.

† *Sockets* to receive various sized cast-iron *Rectangular* R.W. pipes for connecting with the *inlet socket*, A, of this "connector," can be made in lead.

CHAPTER XIX.

WATER-CLOSETS (*continued from page* 89).

Valve-closets.

As only a *section* of a *Valve*-closet apparatus was given in the *first edition* (Fig. 23, page 74) of this book, the Author gives a *perspective view* of it here (Fig. 75), showing the *whole* of the apparatus

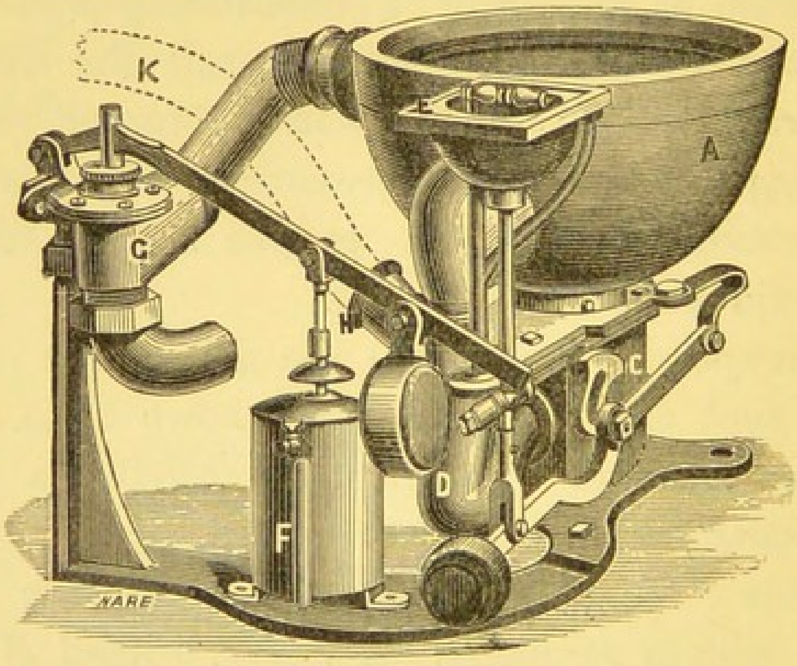


FIG. 75.—*Perspective view* of a Valve-closet with Valve and Regulator Supply apparatus.

with its *valve and regulator supply* complete, and *vent-pipe*, K, to *valve-box*.

The *flushing-rim* of the basin, A, has been *improved*, and the apertures in the rim are now so well arranged that *every part* of the basin is thoroughly washed with water every time the handle, E, is pulled.* And to *ensure a good flush* of water to cleanse the closet and trap and flush out the soil-pipe as well, a supply-valve,† G (called "1½-in."), having a clear water-way in the smallest part of 1⅜-in., is fitted to the water-closet apparatus when necessary; so that with only a few feet head of water, nearly a gallon per second passes into the closet when the handle is pulled up. Large Supply-valves.

The *overflow-trap*, D, is also *enlarged* to two inches, to prevent the basin overflowing,* when the basin-valve is closed by a too sudden dropping of the handle, E. Overflow.

The "*conductor*," or *valve-box*, C, is *porcelain enamelled* on the inside, to keep it clean and wholesome,‡ and also to prevent corrosion. "Conductor."

A *ventilating arm*, H, is formed in the *valve-box*, C, and from this arm a piece of 1½-in. (or 2-in.) lead pipe should be taken, as shown by the dotted line, K, through the external wall of the Vent to ditto.

* These closets are fixed throughout Marlborough House and Buckingham Palace. They are also fixed at Osborne House and in scores of mansions throughout the kingdom.

† A 2-in. supply valve (1⅝-in. *clear water-way*) can be had when necessary, *i.e.*, when there is only two or three feet head of water to the closet.

‡ The Author has had one of these valve-closets with an *enamelled* conductor and vent-arm in use in his own house for several years, and it is as clean now as when it was first fixed, and the result is the same wherever they have been used.

Vent-pipe to W.C. apparatus.

house, where the end of the pipe should be left *open* to the atmosphere. (See Plates XI., XII., and XIV., showing such vent-pipes fixed.) Great *care* must be taken in fixing such vent-pipes to see that they *rise sharply* from the *arm*, H, of the "conductor," to prevent anything from the discharges through the closet lodging in them, and also to prevent *splashings* through such vent-pipes.

Vent-pipe of importance.

This *ventilating-pipe* from the "conductor" or "valve-box" of the closet is of great *importance.* (*a*) It allows the *overflowing* water of the basin to pass *freely* through the *overflow-trap* and the *closet-trap*, as it gives the "valve-box" *air*. (*b*) It prevents the *overflow-trap*, D, from being *unsyphoned.* (*c*) It provides an *escape* for any *noxious gases* which may be thrown off by an offensive stool left unwashed out of the trap, or which may have worked their way *through the water-seal* of the trap through the imperfect ventilation of the soil-pipe. It often happens that the deposit is only partly washed out of the trap,* and the part left in the trap remains there decomposing until the closet is used again, which may not be for some days.† The noxious gases thrown off by this excrement pent up in the trap

Deposit only partly washed out of trap.

* See traps unwashed out, page 224.

† The Author has often found this to be the case. He noticed this in one of our large mansions a few days since.

can only escape in an ordinary valve-closet by coming into the house, and this they do in time *through the overflow-trap or imperfect seating of the basin-valve.* And when the handle of the closet is pulled, and a fresh discharge is sent down into the valve-box, such a *puff of foul air* is driven out into the room as might well make the owner of a nose wish he had a neck as long as a giraffe's, to lift it up out of the way.

Valve-box ventilated.

But when the *valve-box* is *ventilated*, as explained above, and as shown at Fig. 2, Plate XI., and also on Plates XII. and XIV., any noxious gases thrown off by the excrement remaining in the closet-trap would escape through such vent-pipe to the external air. And when the closet-*trap* is also ventilated, as shown on Plates XI., XII., and XIV., and this should always be done, another escape would be provided for the gases thrown off from any fæces left in the trap.

No overflow-trap.

To abolish the *overflow-trap* from valve-closets, as some suggest, and to fix a *separate overflow-pipe* (unless it is done with great care) may prove a remedy worse than the disease. The Author had this tried about ten years ago, and discovered not only its difficulties, but also its disadvantages.

W.C. unfairly used.

When a closet is used by ladies and by children for *one* of the purposes of nature only, the handle of the closet is often not pulled up at all to discharge the contents of the basin, but the liquid excrement is left to run away through the overflow; therefore, to allow a valve-closet to overflow into any long length of separate piping is to create a nuisance. In fact, unless the overflow-pipe were kept unusually high, the excrement (or the *standing-water* of the basin largely impregnated with excrement) during the use of the closet for both purposes of nature would be running away through the overflow-pipe, and fouling it, without any means of washing out the pipe and making it wholesome again. And if the overflow were kept *high*, the *standing-water* in the basin, when the supply-valve leaked, or when the handle of the closet was dropped too quickly, would often be too high for any comfortable usage of the closet.

Complaints were often made of the nearness of the water to the seat in the *old* valve-closets where the overflow-arm was kept near the top.

Overflow through wall.

Again, when the *overflow-pipe* is carried out through the external wall, there is great difficulty in finding a proper place of discharge for it. And if it required any long length of piping—the evil of which we have just been considering—it would want *trapping* and *ventilating* similar to other waste-pipes. There would also be the danger of such a pipe (after it had become fouled by the overflowing excrement) becoming an air-inlet pipe to the house, as well as the discomfort of cold air blowing up against the person using the closet.

Overflow to re-charge trap.

Another disadvantage in separating the overflow from the closet apparatus is that when the closet handle is dropped very suddenly, the *basin-valve* is closed too quickly to allow any water to drain into the closet trap to *re-charge* it, supposing the discharge to have in any way unsyphoned it. But where there is a good overflow-trap connected with the apparatus, as shown at D, Fig. 75, the overflowing water from the basin passes through this trap every time the closet is used, well flushing it out, and at the same time *re-charging* the *closet trap* when unsyphoned.

Closet in a bedroom.

When a closet is wanted in a *bedroom* for the special use of *invalids*, then of course every step should be taken to prevent the possibility of any noxious gases or bad air coming through it, or any of its belongings. In such a case, the soil-pipe should not only be disconnected immediately on passing through the external wall, but the *overflow-pipe* should be *separated* from the W.C. apparatus, perhaps, as well. The Author has had a closet basin specially modelled with an overflow arm formed upon it for taking a *short* piece of pipe from it through the wall to the external air. To prevent any cold air blowing

Separate Overflow.

through this pipe, the *mouth* of the overflow-arm is brought out of the basin *well under the water-line*, as shown at B, Fig. 76, and the pipe is continued up on the outside of the basin as high as possible, to prevent droppings and overflowings through it. A short piece of $1\frac{1}{2}$-in. or 2-in. lead pipe should be taken from the overflow arm, A, and continued out through the wall to the atmosphere, with a copper-hinged flap soldered on the end of it. Or where there is a lead safe under the W.C. apparatus, this overflow-pipe from the closet-basin can be made to discharge over the mouth of the overflow-pipe to the safe.

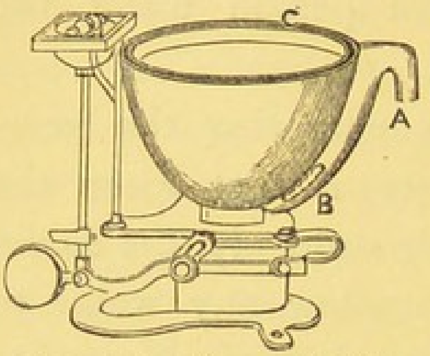


FIG. 76.—View of Valve-closet, with Overflow to go through wall.

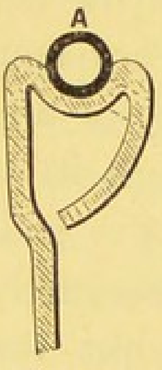


FIG. 77.—Section of Basin Rim with india-rubber packing, A.

India-rubber packing on top of basin.

To prevent any cold air blowing under the seat to the person using the closet, the Author has designed a valve-closet basin with a groove in the rim to receive a packing of india-rubber, as shown at A, Fig. 77, and C, Fig. 76. A piece of india-rubber tube, A, is fitted into the groove on the top of the basin, and the seat, resting upon it, makes it air-tight, thus *preventing any effluvia passing under the seat*—during the time the closet is in use—as in ordinary closets, and also preventing any cold air coming to the occupant.

The *seat* of a W.C. is worth some consideration. As a rule, W.C. seats are fitted up as if they would never want taking down again. But the happy householder who has managed to get W.C. seat.

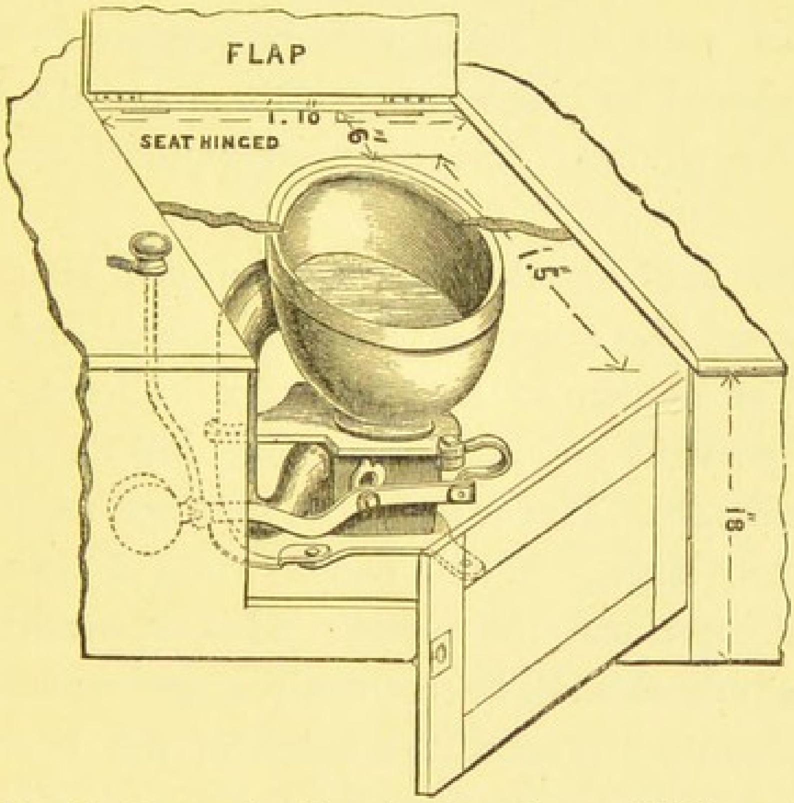


FIG. 78.—Perspective view of a Valve-closet and W.C. seat.*

to the other end of his life without the bother of having his W.C. seat taken down, ought to have a *seat* in "another place," as well as in his House of Commons. If the *seat* and *riser* are *hinged*, as shown at Fig. 78, there would be no necessity for taking down the seat at all; for the

* See Plate X, showing W.C. *seat perforated* for ventilating same.

closet apparatus could easily be removed by the plumber for repairs, when necessary, and the owner could himself turn off the supply of water, or regulate it when so required. The *flap* is of very little use, especially in public water-closets, and is therefore better dispensed with entirely, to prevent dirt accumulating behind it, and also to save expense. When flaps are used, more room should be given between them and the seat-holes for clothes. See figured dimensions, Fig. 78.

Flap.

Seat-hole.

The seat should be made to *sail* about *an inch over the inner edge of the closet basin all round*, as shown to the "Vortex" Closet, Fig. 86, to prevent any excrement touching the rim of the basin, &c. The *holes* in the seat are, as a rule, made too large. When people want a sitz-bath they do not use the closet; what is wanted is such a hole as shall be convenient, and as shall at the same time protect the sides of the basin as much as possible, by keeping the *hole* in the *seat* about an inch *smaller* all round than the *basin*. It is also very convenient to have the *edge of the seat-hole within* 3 *in. of the front edge of the seat*, and the Author's closets are all so made that this can easily be arranged in fixing the seat, if the joiner's eyes are only opened to the desirability of so doing. The riser should be kept quite close to the closet-basin, and then allowing 1¼ in.

for the width of the basin-rim, this will still leave the seat an inch for sailing over the basin.

Fig. 79 shows a *valve-closet* fixed with a *knob-pull* working through the stile of the W.C. seat. Knob-pull.

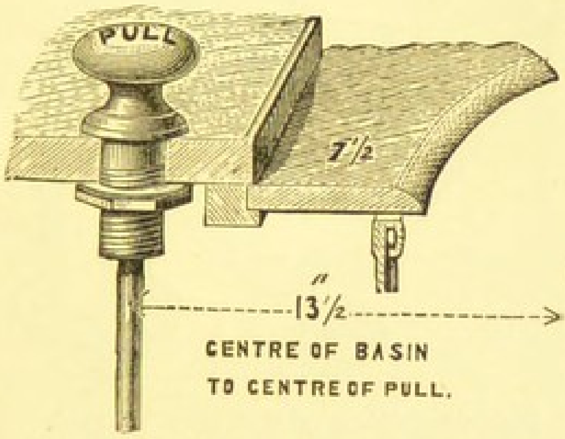


FIG. 79.—View of "Pull" through stile of seat.

With such an arrangement, there is no dish for dirt to collect in; and as the *knob* is made of *ivory*, there is nothing about it to require cleaning, as is the case with *brass* plates, or brass* dishes and handles. (See Fig. 79, showing a view of such a knob-pull.) When a *knob-pull is used*, as shown at Figs. 78 and 79, *the flap can be closed before the contents of the basin are discharged.* This would be a very great advantage to closets bad both in character and principle, but to good closets, fitted up in a sanitary manner, no such advantage would be wanted.

Fig. 80 shows a perspective view of the Author's patent "VORTEX" Closet and trap in "Vortex" Closet.

* Fig. 75 shows a *porcelain ware* dish, E, to match basin—let into a brass frame—with an ebony or an ivory handle.

one piece. Fig. 81 shows a *transverse vertical section*, and Fig. 82 a *plan.*

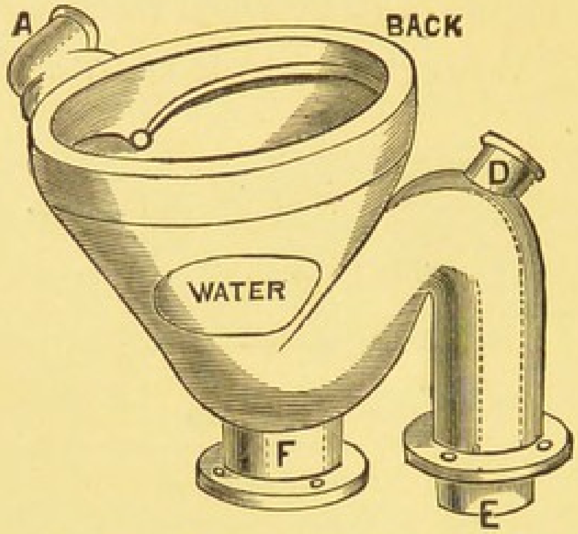


Fig. 80.—View of "Vortex" Closet.

This closet is made in finely glazed *white ware*, but the *inside* of the *basin* can be had coloured ("Indian-pearl" or "mauve") when so wanted.

This closet * was specially designed by the Author to combine the advantages of his "*Artisan*" and "*Water-battery*" closets, without their disadvantages.

Trap of ditto.

A trap is formed in this closet in conjunction with the basin, as shown at Figs. 80 and 81, in such a manner that the *mouth* or dip of the *trap* forms the *bottom* of the *basin*. By this arrangement, a body of water is always made to stand in the *bottom of the basin*, or in the *inlet of the trap*, to receive the deposit. The water standing in the basin, or in the mouth of the trap, is about

Standing-water to receive deposit.

* The "Artisan" closet is the best to use in exposed positions as a protection against frost.

5 in. deep, as shown in *section*, Fig. 81, having an exposed surface of about 9 in. by 6 in., as shown

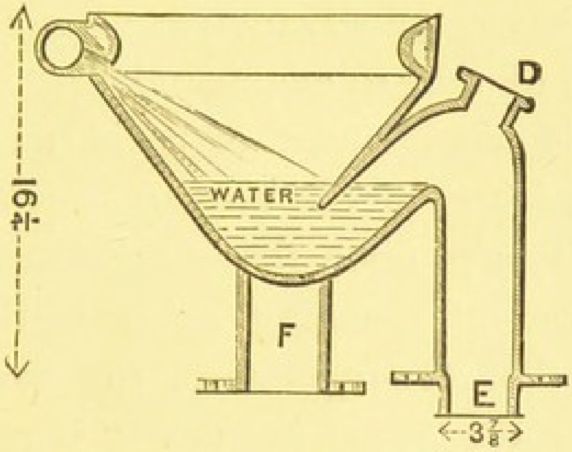


Fig. 81.—Section of "Vortex" Closet.

on *plan*, Fig. 82. The *configuration* of the *basin is such that the excrement shall not touch the sides* before passing into the standing-water in the closet.

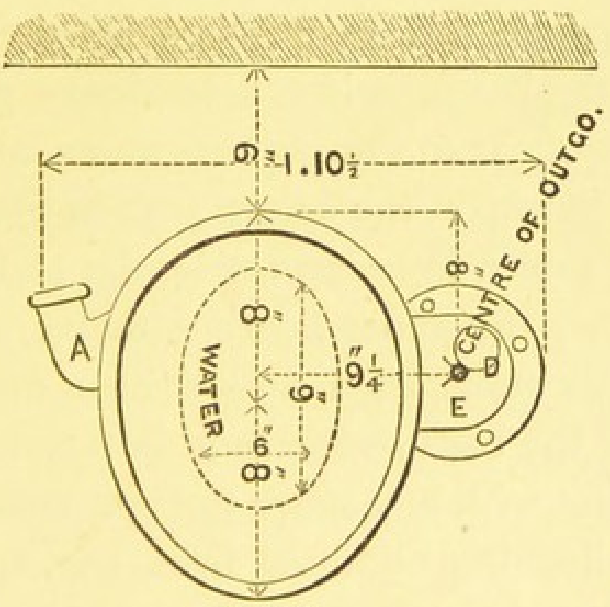


Fig. 82.—Plan of "Vortex" Closet.

On using this closet, the *deposit must fall* directly *into the mouth of the trap*. And as the closet is so formed that the mouth of the trap shall always be full of water, the deposit must pass into water, the advantages of which it would be a waste of time to enumerate.

Force of supply.

By this arrangement of basin and trap, the full *vertical force* of the *incoming water supply* is brought to bear upon the *standing-water* of the *trap*, instead of spending its strength upon the *basin*, and then *flowing* out of the basin into the trap, as is the case in the "Water-battery," "Wash-out," and "Excelsior" kind of closets. Hence, with any fair flush of water, no excrement is left behind, either in the basin or trap, but both are well washed out after every usage of the closet.

Washing out Paper, &c.

There was at first some difficulty in washing out the paper, for, buoyed up by the standing-water in the basin, it has a tendency to float on the surface. Two thin jets of water are directed from the rim upon the centre part of the standing-water, as shown in section, Fig. 81, and such jets, falling upon any paper floating there, cause it to be instantly submerged and driven down to the bottom of the basin, whence it is instantly carried away, along with any other foreign matter, by the vigorous flushing obtained from the apertures in the flushing-rim, and from the peculiar configuration of the basin.

This "*Vortex*" Closet can be supplied with water like other closets in various ways, but as its efficiency depends to some extent upon the *flush*,

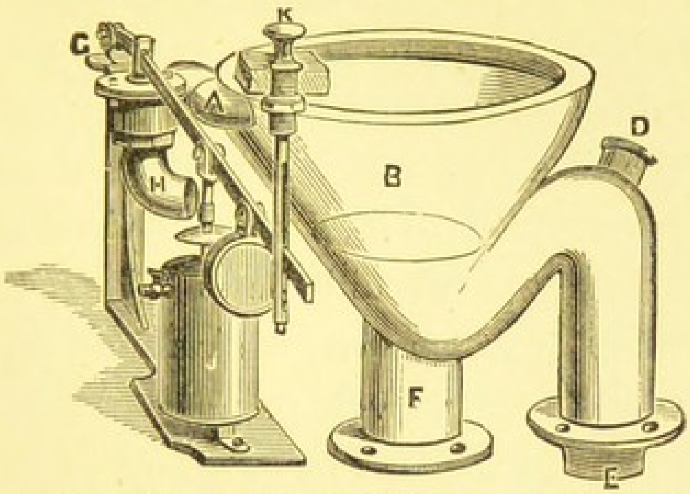


FIG. 83.—View of "Vortex" Closet with Valve and Regulator Apparatus.*

it is important that the right kind of supply should be used.

Service-box action.

(1) It can be supplied by the well-known *service-box* arrangement, where the cistern is directly over the closet, or within easy cranking distance, but the service-box should not be smaller than 9 in. by 6 in., and 6 in. deep, and the service-pipe should not be less than 1¼ in.

Valve and Regulator.

(2) It can also be supplied by a *Valve and Bellows-regulator* arrangement, as shown in Fig. 83, but the size of the valve, H, is of great importance. A 2 *in. valve*, as shown at H, giving a clear water-way, in its smallest part, of 1⅝ in. full, is made to go with the closet, when the cistern which is to supply it is only 4 or 5 ft. above the seat. But when the cistern stands 6 ft. or 7 ft. above the

* I prefer this mode of supplying this closet.

seat, *i.e.*, when there is over 6 ft. head of water, a $1\frac{1}{2}$-in. valve (giving a *clear water-way* of close upon $1\frac{1}{2}$ in.) is quite large enough to give an efficient flush of water with $1\frac{1}{2}$-in.* service-pipe. When the head of water is greater than 8 ft. or 10 ft., a smaller-sized valve still should be used. (See table showing size of pipes and valves, page 133.)

Size of Valve.

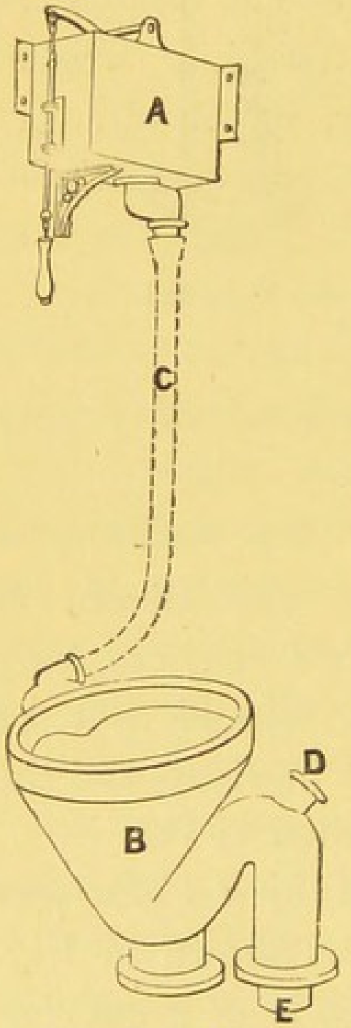


Fig. 84. — View of "Vortex" Closet with "Sluice" Apparatus.

Knob-pull.

The *pull-up knob*, K, is fixed in the stile of the water-closet seat, so as to allow the *seat* to be *hinged* and opened to get at the apparatus without taking down the seat; by this arrangement the flap can be closed, while the handle is pulled up to flush out the closet.

"Sluice" supply.

(3.) Fig. 84 shows another mode of supplying this "Vortex" Closet. An apparatus, A, called the "*Sluice*,"† which the writer designed, and which he has patented, is fixed about 4 ft. or 5 ft. above the seat, in one of the angles of the closet—usually the left facing the seat—and a

* When the head of water is only 5 ft. or 6 ft., 2-in. service-pipe should be used.

† See page 228, showing a perspective view of this "Sluice."

service-pipe, $1\frac{1}{2}$ in. in diameter, is fixed from the apparatus to the closet, as shown by the dotted line, C. A service-pipe can be laid on to this "*Sluice*" apparatus by a $\frac{1}{2}$-in. pipe from the nearest general service-pipe, thus *separating the water-closet supply from the drinking-supply*, as well as, perhaps, saving a long length of a larger service-pipe. This "Sluice" apparatus is very valuable, as, when once the handle is pulled, a flush of two, or—if water is not limited—of three gallons of water is *ensured*, and this without waiting to hold the handle. It is made to give a flush of three gallons of water in six seconds. *It can also be fitted up with a water-waste-preventing valve, according to the rules of the water companies.*

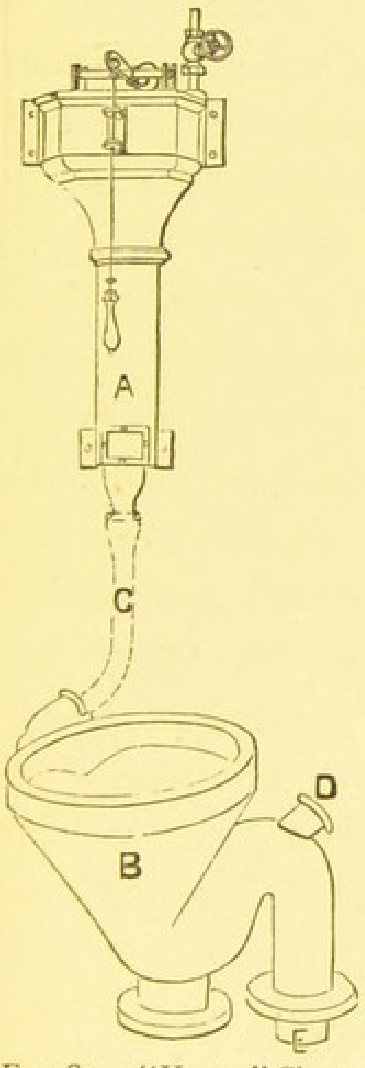


Fig. 85.—"Vortex" Closet with "Cataract" supply.

(4.) Fig. 85 shows this closet supplied by an apparatus somewhat similar to the last. The Author patented this apparatus, A—which he has called the "Cataract"—to give a more *rapid* flush of water. It is made to give *three* gallons of water in *three seconds!* The apparatus can be fixed in either angle of the

"Cataract" supply.

water-closet facing the seat, and from this apparatus a 2-inch pipe is laid on to the closet-basin, as shown by the dotted line, C. A service ($\frac{1}{2}$-in. pipe is large enough) must be laid on to the ball-valve of the apparatus. If the *top* of the "cataract" is kept four feet above the seat, a *good flush will be obtained;* but the higher it is kept the greater will be the force of the water rushing into the basin. I prefer the "SLUICE" apparatus to the "CATARACT" for some places.

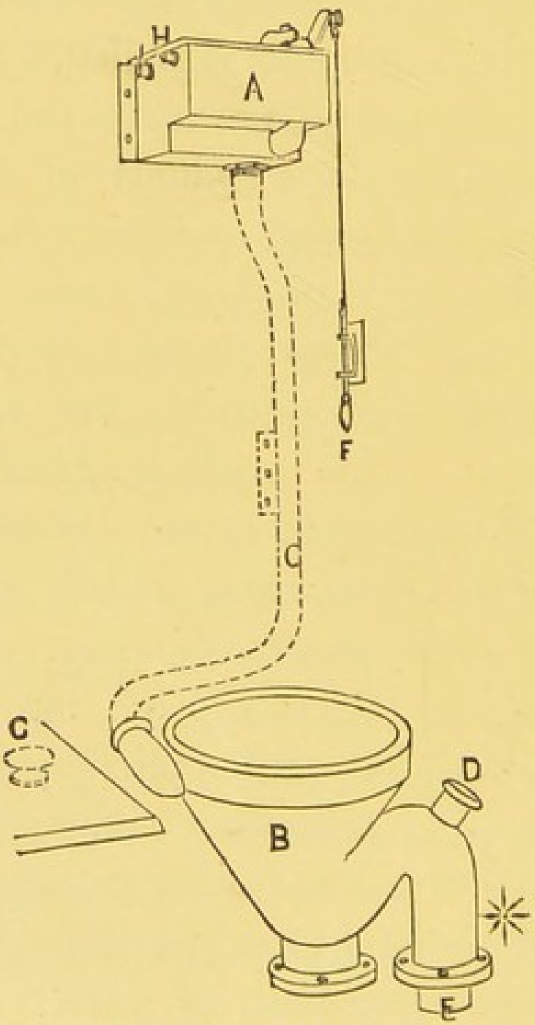


FIG. 86.—"Vortex" with Water-waste-preventer.

* See Fig. 87, showing connection with soil-pipe.

(5.) This closet can be supplied with a *Water-waste-preventer*, as shown at A, Fig. 86. The Water-waste-preventer should be kept up at least four feet above the seat to get a good force of water into the closet, and the service-pipe, C, should not be less than 1¼-in.; a 1½-in. pipe would be better. (See Fig. 100, page 231, showing a perspective view of this Water-waste-preventer, A.) The *pull* can be fixed as shown at F or C. W.W. preventer supply.

(6.) It can also be supplied with Messrs. J. Tylor & Son's "Patent MODEL WASTE-NOT CISTERN-VALVE," and also by Ross's Patent Water-waste-preventer. But it will not work well with everybody's Water-waste-preventer, as the "flush" from most Water-waste-preventers is only a "dribble."

The *connection* of this "Vortex" Closet with the *soil-pipe* is of very great importance, for the smallest leakage in the jointing would allow any Connection with Soil-pipe.

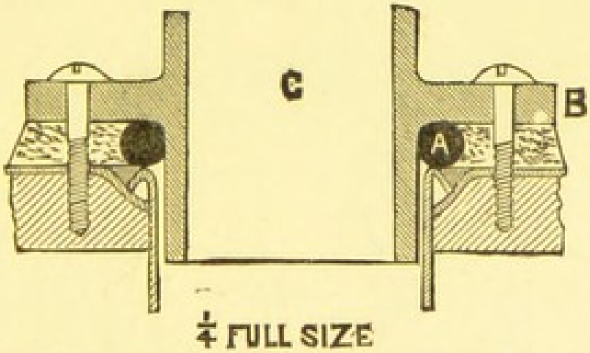


FIG. 87.—Section of jointing with Soil-pipe.

gases in the soil-pipe to come through it into the house. A *soft* india-rubber ring, A, is sent out with the closet for fixing between the flange, B, of the outgo and the "tafted" end of the soil-pipe or safe, as shown at Fig. 87.

The closet is secured in its place by *two* legs (as shown at Figs. 80 and 81) screwed down to the floor, and, in *addition* to the india-rubber ring, which can be made to perfectly seal the jointing, the *space* between the flange of the outgo and the "tafted" end of the soil-pipe or *safe* can be well caulked with spun yarn and red and white lead.

Connection with air-pipe.

When an *air-pipe* is fixed to this closet it should be very *carefully connected* with the socket-arm, D. The pipe should be caulked in with yarn and red and white lead, and made further secure by an india-rubber "sheath" tied to the pipe and arm of the closet with copper wire, similar to the service-pipe connection, or a brass connection should be fixed to the arm.

Seat-hole.

The water-closet *seat* should be made to *sail* over the basin, a little more on the *left-hand* side, to well cover the jets, than on the right, as shown

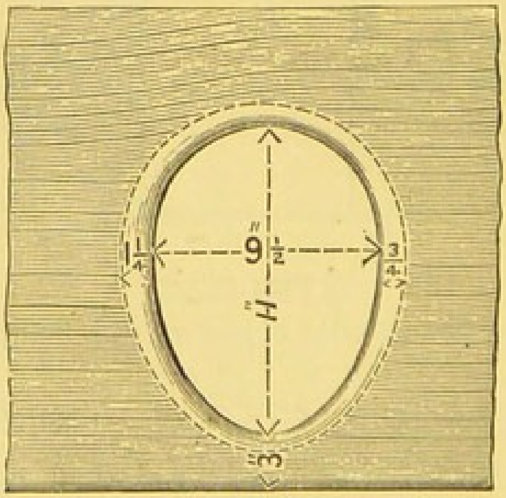


FIG. 88.—Plan of Seat-hole.

in Fig. 88. The dotted line shows the *inner* edge of the basin-rim. As shown, the hole in the seat is about 2 in. smaller in diameter than the closet-basin.

The patent "ARTISAN" CLOSET,* described on pages 82 and 83, where also a *sectional view* is given, is found in practice to be almost perfect. Hundreds of these closets have been fixed in various parts of the country, and there has never been a complaint against one of them. (See Fig. 89, showing a perspective view of this closet.) "Artisan" Closet.

A larger deposit and a greater quantity of paper are washed out of this closet with a *two-* "Self-cleansing."

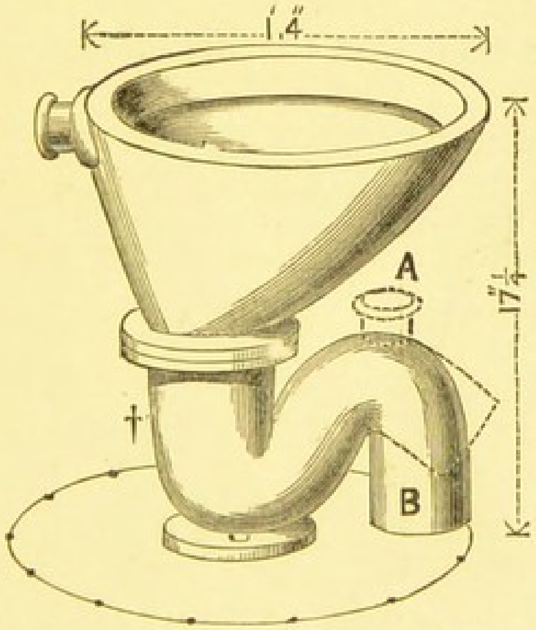


FIG. 89.—View of "Artisan" Closet and Trap.

gallon flush than with any other closet that the writer is acquainted with. And not only is every

* This closet is specially adapted for fixing in exposed positions, where frost would freeze any water retained in the basin or damage it.

† See footnote on page 206.

part of the *basin* thoroughly washed, but the *trap* of the closet is also thoroughly cleansed. The force of the water is not broken as in the "*Water-battery*," and closet basins of that kind, but it rushes down the sides of the basin direct from the flushing-rim into the trap. It is, therefore, very rarely that any paper, or other foreign matter, remains in the trap, and with any good method of supply, giving two gallons of water at one flush, nothing ever remains.

No water to get frozen.

This "*Artisan*" Closet is specially adapted for fixing in exposed positions, as no water stands in the basin to get frozen.

The only objection to this closet is that the

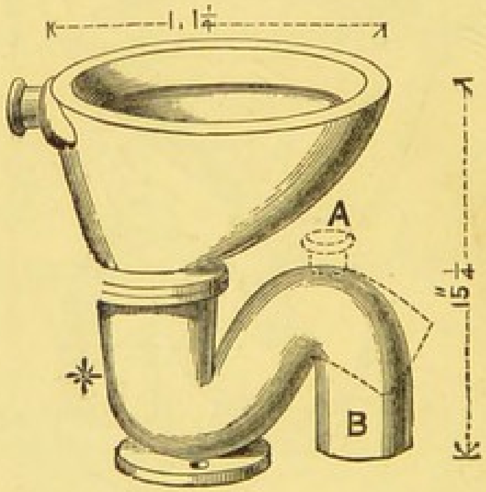


FIG. 90.—View of "Artisan" Closet for *Children's* use.

deposit is apt, at times, to fall on and adhere (the basin being dry) to the front sloping side of

* *Lead* traps should be used when fixed to *lead* soil-pipes, as shown at Fig. 92; see Plate XVII., showing "Artisan" Closets, with *lead traps*, fixed complete. N.B. The *outgo*, B, of this trap can be turned round to any point to suit circumstances. See Fig. 89 showing this.

the basin, in lieu of falling direct into the water in the trap, as it ordinarily does. In such a case, the subsequent removal of the adhering deposit is less expeditiously accomplished, but with a good flush of water the basin is always well cleansed.

A smaller-sized "Artisan" Closet *basin*, as shown at Fig. 90, is made specially for the use of *schools*, as with a smaller closet basin there is less surface exposed, and, at the same time, a greater flush is obtained, as the incoming water is more concentrated.

Fig. 91 shows the "*Artisan*" Closet supplied with a *Valve and Regulator*, and as the valve, C, Valve and Regulator supply.

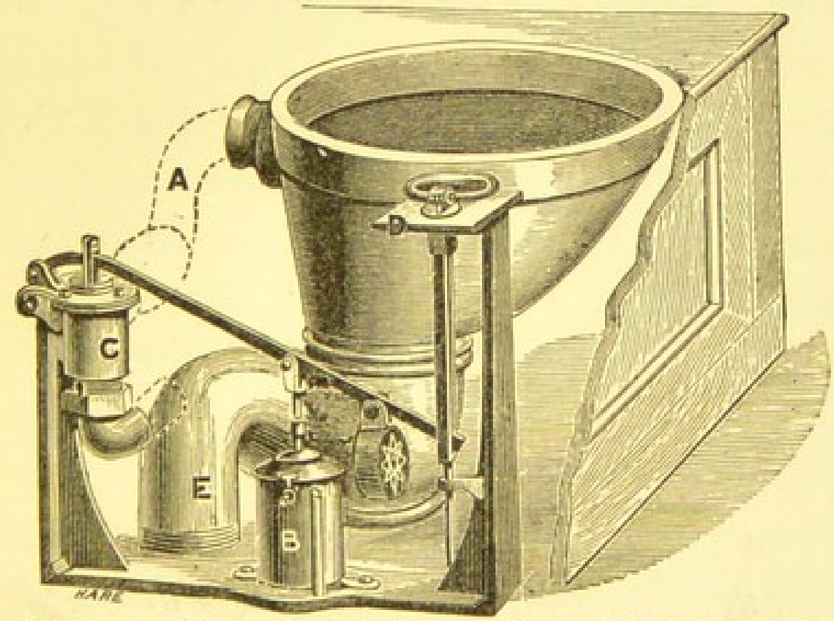


FIG. 91.—View of "Artisan" Closet with Valve and Regulator Supply.*

is made in *three* sizes—1 in., $1\frac{1}{4}$ in., and $1\frac{1}{2}$ in.—a

* This closet can be supplied by the "Sluice" Apparatus, Fig. 98, p. 228, which gives it a capital flush.

good flush of water can always be obtained, even though the *head of water* be only a few feet above the level of the W.C. itself. The advantage of this arrangement is that the supply-pipe can be taken from the nearest *general service-pipe.** (See contamination of water through the W.C. supply-pipe, pp. 121—123.) When the head of water is under 5 ft. or 6 ft., *i.e.*, the vertical height between the *bottom* of the cistern and the *top* of the W.C. seat, the supply-valve should be 1½ in., and the service-pipe should not be less than 1½ in., though 2 in. would be better, if cost is no object, and there is plenty of water. (See table of sizes of valves and pipes, p. 133.)

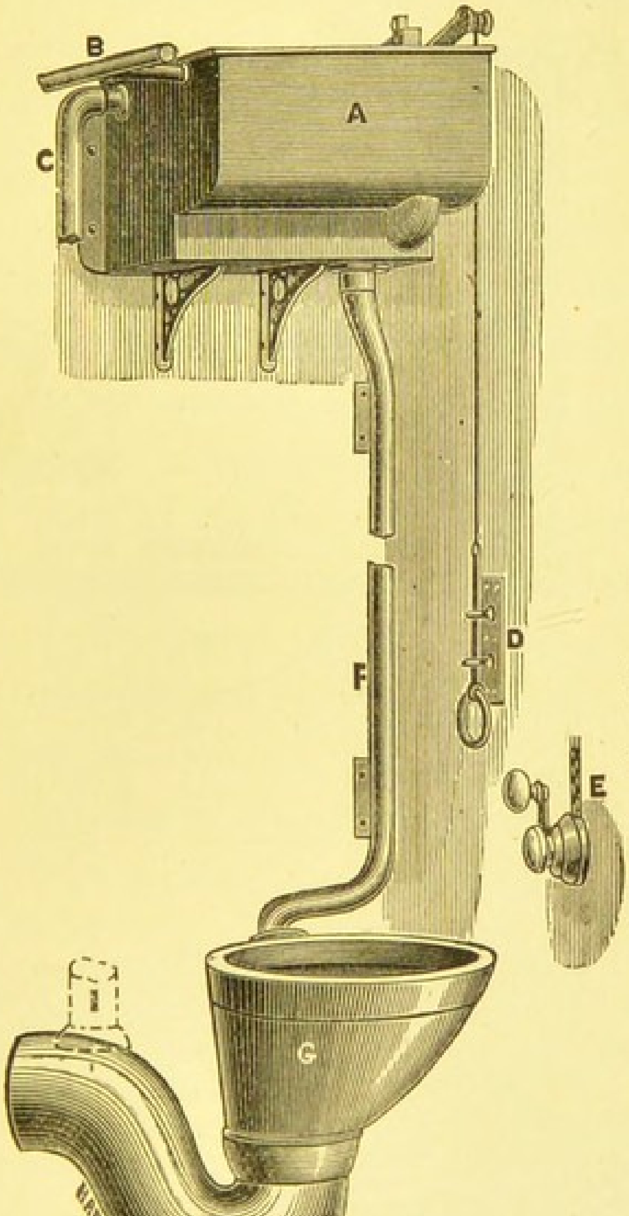
Service-box action.

The "Artisan" Closet works well with almost any form of water-supply. The old-fashioned *service-box* and *round-valve* arrangement (where the cistern is over the closet, or near enough for working the valve with the usual cranks and wires) gives the closet a capital flush, and keeps the basin clean and wholesome; and there is this advantage about such a mode of supply—that the service-pipe is always empty, and is therefore free from frost. But where a *service-box* supply is used, *no service-pipe supplying any draw-off tap* must be taken from the same cistern, for reasons explained on pp. 122—124.

* To prevent mistakes it should be laid down as a fixed rule, that no water-closet should be supplied direct from a cistern or service-pipe supplying water for dietetic purposes.

W.W. Preventer supply.

Any water-waste-preventing cistern arrangement, giving a *flush* of *two gallons* of water, will



See Plate IXA, and p. 237.

FIG. 92.—View of "Artisan" Closet with Lead Trap and W. W. Preventing Supply Cistern.

supply this "Artisan" Closet, and keep it clean. Fig. 92 shows a *Water-waste-preventing Cistern*, A, fixed in one angle of the closet a few feet above the seat, so as to get a good rush of water

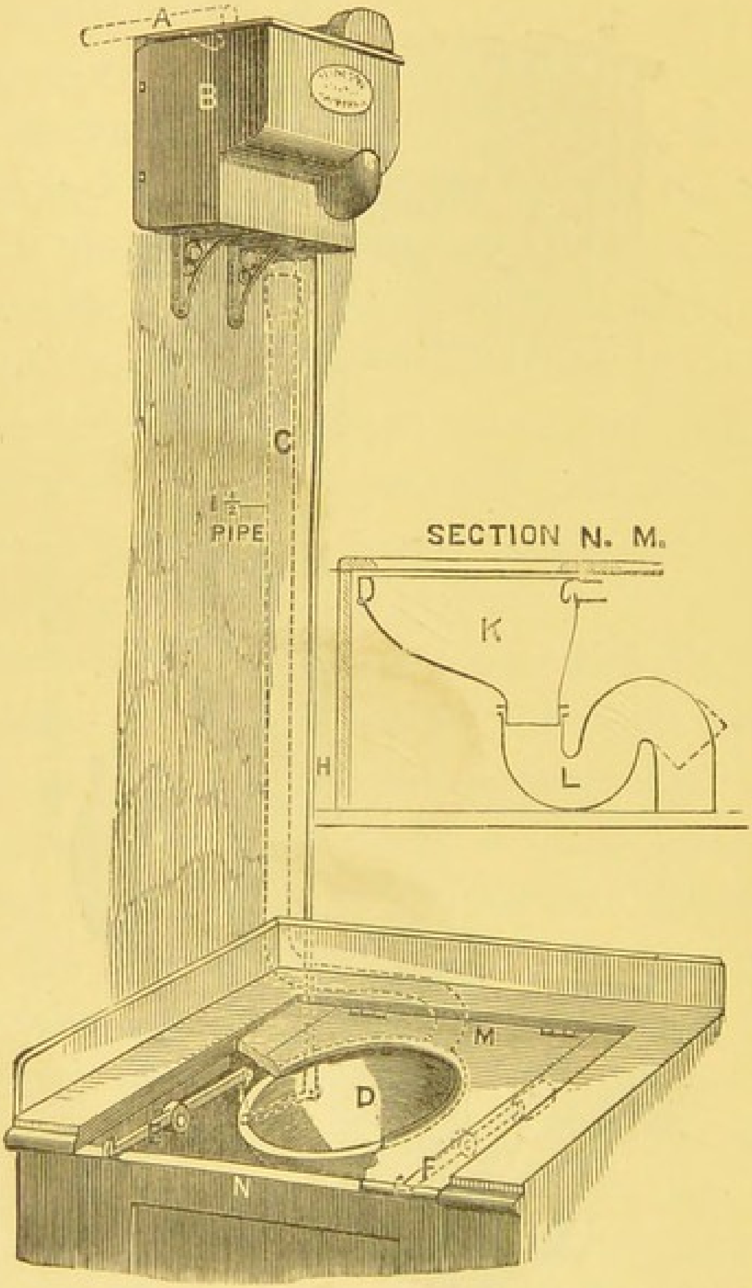


FIG. 93.—View of "Artisan" Closet with *Seat-action* arrangement and *W. W. Preventing Cistern* Supply, B.

into the basin, G, when the handle, D, is pulled. The service-pipe, F, should never be less than

1¼ in., but when the water-waste-preventer, A, is only 3 ft. above the W.C. seat, the service-pipe should not be less than 1½ in. The service-pipe, B, which need never be more than ½-in., to supply this water-waste-preventer, can be taken from *any* other supply-pipe near at hand. An *overflow-pipe*, an *inch* in diameter, should be taken from the water-waste-preventer, as shown at C, and carried through the external wall where it can be seen, in accordance with the rules of the London water companies. Where there is a *range* or *tier* of closets, the *overflows* from the water-waste-preventers can be *branched into one general overflow-pipe*, and then this pipe should be made to discharge somewhere in the *open air* where it can be seen.

Fig. 93 shows an "*Artisan*" Closet, with *water-waste-preventer* (as explained in the last paragraph) and SEAT-ACTION supply. The illustration speaks for itself. This closet is supplied by a *seat arrangement*. On sitting upon the seat, the supply-valve over the service-pipe, G, is *shut* by the movement of the brass rod, H, and the supply-valve to the water-closet service compartment, B, is opened, allowing two gallons of water (or such quantity as may be arranged) to pass into this compartment, where it remains until the person using the closet rises from the seat, when the supply-valve over the pipe, C, *rises too*,

Seat-action closet.

and the two gallons of water rush down through the service-pipe into the closet.

"Water-battery" closet condemned.

The Author is not satisfied with his patent "WATER-BATTERY" Closet. (See *section*, Fig. 28 and description of closet, pages 86—88.) A *view* of this closet is given here, Fig. 94, for the reader to more easily understand what follows.

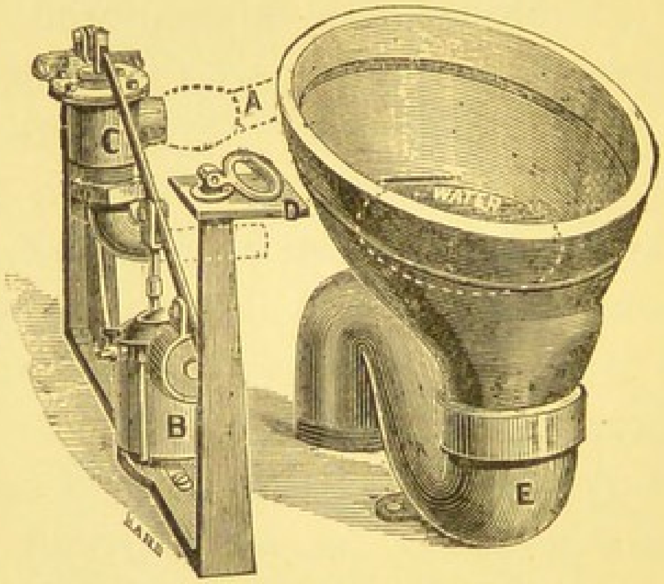


FIG. 94.—View of "Water-Battery" Closet.

It is found, in practice, that the *excrement* is washed at times with such force—where the pressure of water is great—against the *top part* of the *outgo* of the *basin* as partly to *stick there*. And when there is only a sluggish supply to the closet, the *whole* of the deposit is *not washed* out of the basin by a *single flush of water*.

There is another objection which applies to all closets of this description: the *first force* of the incoming supply of water is spent upon the *bottom of the basin*, and by the time it reaches the trap its strength, or cleansing force, is gone, and the water then gravitates through the trap in a most unselfish kind of way, taking little or nothing with it. In fact, one flush of water of only two gallons never thoroughly cleanses the trap of this closet—and this is the truth with most closets. And so, though the writer has been to some expense in modelling and patenting this closet, he condemns it.

Fig. 95 shows a *transverse vertical "section"* of "*Pearson's Patent Trapless 'Twin-basin' Water-closet.*" The Author has been so often asked his opinion respecting this closet that he gives it here; especially as what he has to say about it applies to a great extent to the whole batch of *trapless* closets now before the public. As we are *seeking after perfection* in the sanitary appliances of our houses, any fitting (especially a water-closet) that will not bear the closest examination in its smallest detail should be put on one side as unfit for its purpose. Trapless closet.

As its name discloses, this trapless "*twin-basin*" closet has *two* basins—not for the purpose of *double* use—for *twins* to enjoy each other's company in using one closet together, as old women cronies often do with old-fashioned *double-holed* seats in country privies; but one basin, or com- "Twin-basin."

partment, A, is for *receiving the deposit*, and one, B, for the automatic *supply-valve*, D, to work in. The two basins are connected together, as shown in *section*, upon one trunk, or outlet, like the letter Y, and on *plan* look like two O's joined together—one O being a little larger than the other. A *dwarf partition*, C, going down from the top to within a few inches of the

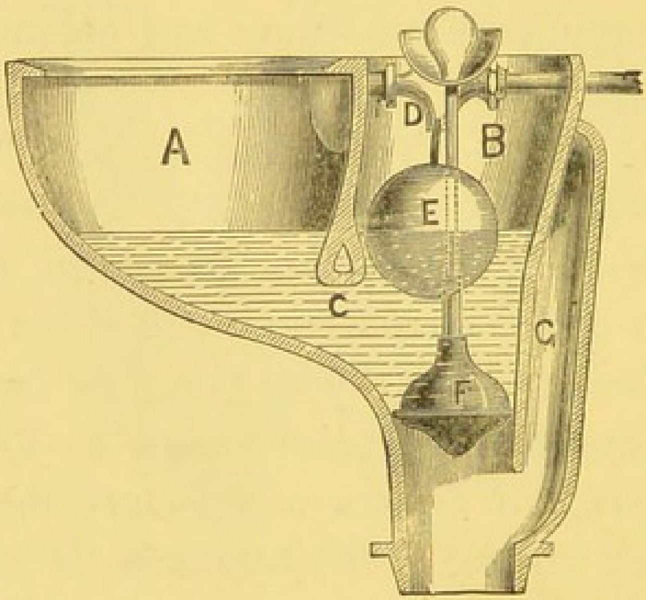


FIG. 95.—Section of the "Twin-basin" Closet.

bottom, divides the upper parts of the two basins, but the lower parts of the two basins are in *direct* and *open* communication; so that *anything which may be put into one basin can pass freely into the other.* The water stands at the same level in the two basins, and is kept there by the *plug-valve*, F.

Sides coated with filth

When the closet is used, the *excrement* deposited into the larger basin, or closet proper, *finds an easy passage* under the dwarf partition into the *side-basin* or ball-valve compartment, B; and, therefore, the sides of this compartment must very soon become *coated over with filth*, as well as the copper ball or float, E, itself. This evil is further augmented by the fact that the incoming water would have no cleansing effect upon this "side-basin" at all, as the water only *gravitates into this basin;* but perhaps it is considered that, as *this* basin is "out of sight," being *under* the seat, it is also "out of mind!" "Out of sight," &c.

Again, the *top* part of the *plug-valve*, F, must get coated over by the settlement of the liquid excrement upon it, more or less, every time the closet is used. And, as it would always be drawn up out of the way of the incoming flush, for the contents of the basin to pass out, it would never get properly cleansed. Plug-valve.

The absence of a trap to this closet is a further evil. The solid excrement, or paper, deposited in this closet, would at times get caught under the seating of the plug-valve, F, and when the water had thus leaked out of the basin, *soil-pipe air*, and perhaps sewer gases too, would have an *easy passage* through the *imperfect seating* of this *plug into the house.* And the escape into the house of this soil-pipe air would continue until the closet was used again, which in some cases Absence of trap.

would not be for hours, or days, together. And, to add to these evils, the basin would not only be *empty*, but it would be *dry* as well, giving the deposit a fair chance of *sticking to the place where it fell*.

Water leaked out of cistern.

If the reader's attention is not wearied, the writer would like to point out two other evils in connection with this closet. (*a*) When the *basin-plug*, F, has *leaked* out the water of the *basin*—the evils of which we have just been considering—the leakage still continues until it has *emptied the cistern*, which supplies the closet, for the supply-valve, D, is shut by the *floating* up of the *ball*, E, and this can only be done when the basins are full to their regulated height of water.

Overflow.

(*b*) The overflow is formed on the side of the closet. It is taken out of the *bottom* of the *side-basin*, and then carried up to within a few inches of the top, when it is brought down again and made to enter the closet just below the basin-plug. The mouth of the overflow* is *grated* over, but though this may keep out the *solid* excrement, it will not keep out the *liquid* excrement, and this part of the overflow must in time get very foul, as it would never get properly washed out. But this is not the chief evil of this overflow, for the *water-lock* of this overflow is dependent upon the soundness of the

* I understand an improvement has been made in this overflow arrangement.

plug. When this plug leaks the water out of the basin, it also leaks the water out of the overflow-pipe, except just a little which is kept in its mouth by the saucer-shaped form of the pipe where it is connected, but the *higher* perforations over the mouth of the overflow stand only just below, if they do not stand above the water, so that any noxious gases in the pipe would find an easy passage through this overflow (when the basin is empty) to the house.

Overflow defective.

CHAPTER XX.

WATER-SUPPLY TO WATER-CLOSETS, ETC. ETC.

Supply of Water important.

THE supply of water to Water-closets, as indeed to all vessels with waste-pipes where polluted water is discharged into them, is so very important that, notwithstanding all the Author said on this subject in the first edition (Chap. XVI.), he returns to the subject again here.

Adequate quantity wanted.

It ought to be laid down as an *axiom* that no supply of water is adequate to the purpose of keeping a water-closet, or any other such "fitting," with its belongings, *wholesome*, unless it *more than equals* in force and volume the body of polluted water discharged into such fittings.

Laws compelling adequate flushes.

Instead of making *rules to limit* the supply of water, as water companies are doing all over the kingdom, to such sanitary fittings as *water-closets* and *urinals*, *laws* ought to be enacted *compelling adequate flushes* of water to all such water-wanting "vessels."

Water by measure-glass.

Why, in the name of common sense, should the two most thirsty, and often most filthy, things in a house have a limited supply of water—a supply only about half equal to its purpose?

"*Pour out*" the water (through the taps) into your lavatories and sinks, and "*let it flow*" day and night through the waste-pipes into your drains; but give it to your water-closets and urinals, as doctors give medicine, by *measure-glass*, for, poor things! they may be *feverish*; if not just now, they are likely to be by-and-by—yes, *very likely*, with such homœopathic treatment.

"Take care of the spigot and leave out the bung," would be a good *hat-band* for water companies' servants. "Don't forget the *Rules*, and mind, you know, they are according to *Act of Parliament*, 'two gallons of water,' by *measure—not a drop more*—to *cleanse* (?) out the water-closet apparatus, trap, soil-pipe, and drain, and flush the whole of the *motion* into the sewer." "But it was such an *offensive stool*, Mr. Water-company, and the *patient* was suffering from *fever*. May we not have another tea-spoonful?" "Another tea-spoonful! Why, *sensitive noses*, you must think we are *made of water*. No, you must wait until the excrement has dried upon the soil-pipe, and by that time the *water-saver* will be re-charged, and you can *then* have a *second* flush. But, stay, if you are only in want of *water*, go to the nearest *sink*, and *draw as much as you like without stint or hindrance*, for, according to *our rules*, there is *no* limit to *such draw-offs*, though

"Spigot and bung principle."

we must show some *sign* of 'screwing' even here, but it is only in the '*screw-down*' tap." Well, there must be *bungling* in a world where there are so many *bunglers*, and if the *spigot* is sometimes mistaken for the *bung*, it is excusable, especially when nothing stronger than water is to come out of it.

More water.

Every sanitarian should lift up his voice against such limitations of water to such sanitary fittings, and never cease crying, like Oliver Twist, for *more* water until a quantity of double, or even treble, the present amount is allowed for water-closets and urinals when so wanted.

Treat W.C.'s as deodo-risers.

One would suppose, not only from the rules of water companies, but also from the way in which people (especially servants) treat water-closets and such-like fittings, that they were *deodorisers*. Everybody knows how a chamber-utensil, if left half-full of urine, will smell if kept in a room for only a short time, and yet nine servants out of ten will empty such matter into a closet, and leave it there or thereabout for any length of time, without any attempt to *wash* it away.

Fittings want washing.

Servants receive *standing orders* to wash out every day, or other day, the halls and entrances to our houses, but they are rarely ordered or expected to wash out the water-closet apparatus, sinks, lavatories, &c., though the traffic through such fittings is greater and the matter much dirtier than anything that comes from the bottoms of our boots. In every house of any dimensions a turk's-head brush should be kept, as shown at Fig. 96,

Brush for cleansing closets.

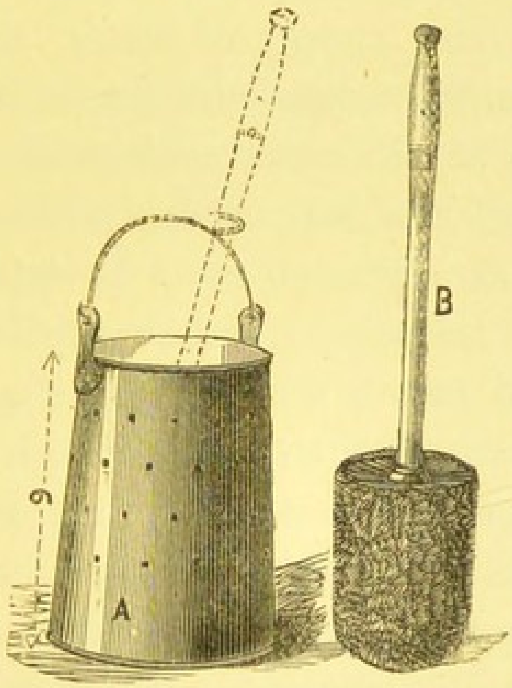


FIG. 96.—View of Can and Closet-brush.

for the purpose of washing out the closet-basin and "conductor" of the apparatus; *i.e.*, the closet-basin should be well washed round with this brush, B, and then the brush should be pushed down into the trap as far as it will go, and well rubbed up and down for a few seconds, the water being allowed to pass through the closet all the time; and, after well rinsing the brush, it should be put back into the perforated can, A, as shown at Fig. 96, and the can hung up in the house-maid's closet.

Supply of water to W.C.'s important.

The *supply of water* has much more to do with keeping water-closets and such-like fittings *wholesome* than most people imagine. A water-closet with its belongings would be found in a better sanitary condition after six years' usage with an *efficient* supply of water, than it would after six months' usage with an *inefficient* supply. A moment's consideration will show this. Let us suppose—and the supposition will be *inside* the facts—that an offensive stool is deposited either in a pan or valve-closet, and that this fæcal matter is discharged into a long length of 4-in. soil-pipe in such a manner as to pass through it as a sort of plug, staining, as it would more or less, the whole of the inside of the pipe all the way down; and suppose that the water which is to wash this filthy matter out and clean the pipe is only allowed to *dribble* into the closet in such a way as to run down *one* side of the pipe—*i.e.*, that the water-supply to wash out the filthy motion is only sufficient in force and *volume* to cover *one-third* of the area contaminated by the offensive matter passed through the pipe. What would be the state of the unwashed part of the soil-pipe after six months' usage? Unless the supply of water is greater both in force and volume than the polluted water discharged through such pipes, they will never be kept perfectly wholesome. It would be possible to allow the collected water of the

London water companies to pass through a polluted water-closet in such a manner as not to cleanse them, as it would be possible for a gunner to keep firing off gunpowder a grain at a time for ever and ever without getting the shot out of his gun.

When the supply of water is not equal to the demand, *i.e.*, when the *flush* of water to a water-closet, slop-sink, urinal, or such like fitting, is not enough to cover the whole area of the waste-piping and drainage contaminated by the discharges of offensive matter through them, the waste-piping soon becomes incrusted with excremental matter, and when once this has corroded the piping, no amount of flushing will make the drainage absolutely clean again. One usage of a water-closet, or urinal, with an *in*-efficient supply of water,* will *foul* it more than a dozen usages with an *efficient* supply. *Drops* of water may *wear away stone*, but *drops of water* will *not*

Supply not equal to the demand.

* The author's plan is to fix a neat white porcelain tablet lettered in gold in sight of

After† using the Water-Closet, pull up the handle TWICE, as far as it will go, and hold it there a second or two each time.

any person sitting down on the closet seat.

† It is a good plan to send a flush of water through the closet *before* using it, to prevent the excrement sticking upon any part of the basin or soil-pipe.

clean away filth. A day's drizzling rain will leave the streets as dirty, and often dirtier, than they were before, but a sharp shower of rain for a few minutes will make them clean, and that too with a much less quantity of water.

Traps not cleared.

It would, perhaps, surprise most people to be told that in nine cases out of ten the deposit is not washed *wholly* out of the *trap* with *one* flush of two gallons of water. This is especially the case with water-waste-preventing valves fixed under the water-closet seat. If the hand be put down into the trap (and it might be put into a worse place) after the closet has been used—with only a 2-gallon flush—fæces together with paper will be found remaining in the trap.

Glass window in

The Author had a glass window put to the side of a water-closet trap and fixed under a valve-closet, to see the actual working of it, and he found that one flush of water of two gallons (or a long *dribbling* supply of three times that quantity) never wholly freed the trap of foreign matter.

Shelve W. Companies' rules.

Let us *shelve* water companies' rules for a time, and think only of the *needs* of water-closets, &c., and the best way of supplying them with water to keep them perfectly wholesome.

Underhay's Regulator.

There is no better way of supplying a water-closet than by a *good* "SUPPLY-VALVE AND REGULATOR." This arrangement is known as *Underhay's*, but his patent expired some years ago, though Mr. Underhay holds another patent for what he considers a better kind of *regulator;* but his oldest child is entitled, as the writer thinks, to inherit the chief place in value.

This arrangement can be *attached* to the closet *apparatus*, as shown at Fig. 75, page 186, or it can be fixed *separately* as shown at Fig. 83, and also Fig. 97, p. 226. Attached to closet, or separate.

There is this *great advantage* with such an arrangement, viz., that *any number* of closets can be supplied with branches from one *general* service-pipe, the *main*-pipe being increased in size accordingly. But the *chief* advantage is, that *directly* the handle of the closet is pulled, to get rid of the deposit, the water *rushes* into the basin to wash it out before the basin-valve (in a *valve-closet*, or the copper pan in a *pan-closet*) is closed. With a *service-box* action, or a *water-waste-preventing* cistern arrangement, the interval between pulling the handle and the water coming into the basin amounts to several seconds, and the *valve* or *pan* is often closed before the basin is washed out. Advantages of a Valve and Regulator.

For *flushing-rim* closets, and for a *good flush* of water, it is necessary to have *large-size valves*, unless there is a good head of water over them. (See Table showing size of service-pipes and valves, page 133.) As a rule, water-closet makers do not make these valves large enough, but since the writer introduced the " $1\frac{1}{4}$-in." and " $1\frac{1}{2}$-in." valves some years ago, other makers have increased the sizes of their valves also

Size of valves.

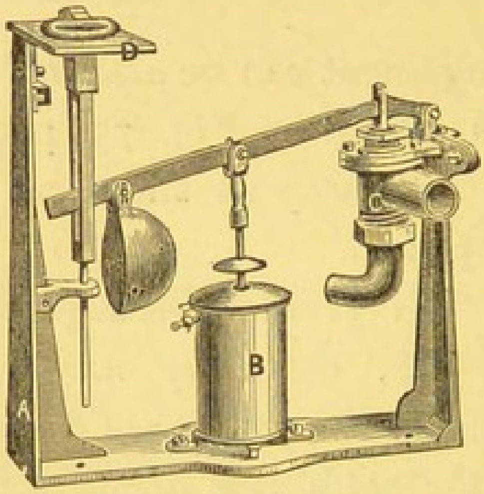


FIG. 97.—View of " $1\frac{1}{2}$-in." Valve and Regulator.*

from $\frac{3}{4}$-in. to 1-in., and in some cases from 1-in. to $1\frac{1}{4}$-in. But $1\frac{1}{4}$-in. is not large enough where the cistern is only a few feet above the closet apparatus.

Fig. 97 shows a " $1\frac{1}{2}$-*in.*" *valve*, C, with a *copper bellows-regulator*, B, brass pull-up handle and flat plate, D, fixed complete on a cast-iron frame, A. This sized valve with a 2-in. pipe laid on to it from the cistern—though the cistern be only 4 or 5 ft. above it—will give a good flushing force to the supply of water to cleanse out the basin-trap and soil-pipe. But the writer has designed a *larger-size*† valve than this, which

* A good supply-valve on this principle is not likely to waste as much water as nine-tenths of the so-called water-waste preventers.

† See *size* of valve to "Vortex" Closet, page 199.

he uses for flushing out closets when water is plentiful. The *little stopcock* shown on regulator, B, is for the purpose of *regulating* the *quantity* of water to the water-closet. This cock can be so turned as to allow the *air* to pass out of the "bellows-regulator" *quickly* or *slowly*, thereby allowing a small or large quantity of water to pass into the closet.

Another advantage is—and this is the stone on which the water companies' *turncocks* break their keys—that by this arrangement one, two, or three flushes may be given in rapid succession. And if the Author's largest-size valves are used, and the service-pipes are proportionately large, a *flush* at the rate of *three gallons in six seconds* may be made to pass through his *flushing-rim closets* to *scour* out the basin-trap and soil-pipe; and there is no more extravagance in this than in firing an 80-ton gun to sink the enemy's boat instead of firing a thousand rifle shots upon it, and leaving it where it was—a menace, perhaps a destructive force, to one's self.

Advantage of rapid flushing.

Fig. 98 shows an apparatus, which the writer has patented, for giving a *rapid flush of water*, and to INSURE this flush every time the handle, A, is pulled. It is specially adapted for the use of lazy people and for servants, who never hold up the handle of a water-closet long enough to thoroughly wash out the closet after using it.

Apparatus for flushing closets.

The cistern part is made in cast-iron, and galvanised* all over, but the valves are made in gun-metal. The union, E, of the ball-valve is carried up through the top to allow the cistern to

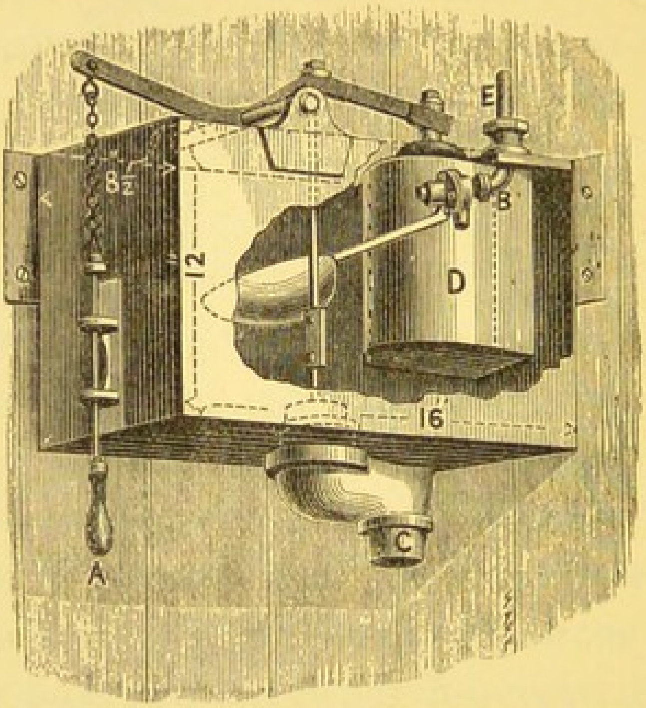


FIG. 98.—View of "SLUICE" Apparatus for Flushing out W.C.'s, &c.

stand close to the wall, and for easy connection with the service-pipe without any cutting away. A stop-valve is fixed, at E, for shutting off the water-supply when so ordered.

Three-gallon flush.

This apparatus is made to give a *flush* of *three*† gallons of water at *each* pull of the handle; and this body of water is made to pass into the closet-basin (when it has a flushing-rim) in *six* or *seven*

Advantages.

* Or it can be protected from rust by Prof. Barff's *Rustless Process*.

† It can be fitted up with a *water-waste-preventing valve* to give *two* gallons of water (at each pull of the handle), in accordance with the rules of the water companies.

seconds! though the apparatus may be only 4 ft. above the closet-seat. Other advantages gained by this apparatus are (1) the *closet must have its flush of three gallons* when once the handle, A, is pulled; (2) it *separates* the *water-closet supply* from the *general service* or *drinking-supply* pipe; (3) it can be supplied by a small pipe, ½-in. being quite large enough to charge it with water (see Fig. 84, p. 200, showing this apparatus fixed over a "Vortex" Closet.

This "*Sluice*" *apparatus* can also be used for supplying a *slop-sink*, or a *range* of several urinal basins.* Flush for slop-sinks and urinals.

Instead of the pull, A, the valve can be opened by a door-action arrangement when so required. Door-action.

Fig. 99 shows another apparatus, which the writer specially designed and constructed for *flushing* out water-closets. "Cataract" flushing apparatus for water-closets.

As will be seen by a glance at the woodcut, this apparatus is made to fix in any angle of the closet, and, like the apparatus we have just been considering, the union (D) of the ball-valve is carried up through the top for easy connection with the service-pipe.

It is made in cast-iron, and protected from rusting by Professor Barff's "Rustless Process."

* This "Sluice" apparatus is equally well adapted for flushing out slop-sinks and urinals.

An *overflow-pipe* is *formed* in the angle at the back, emptying below the valve into the outlet, C; $1\frac{1}{2}$ or 2-in. service-pipe should be laid on to the water-closet basin from the outlet, C; it will not

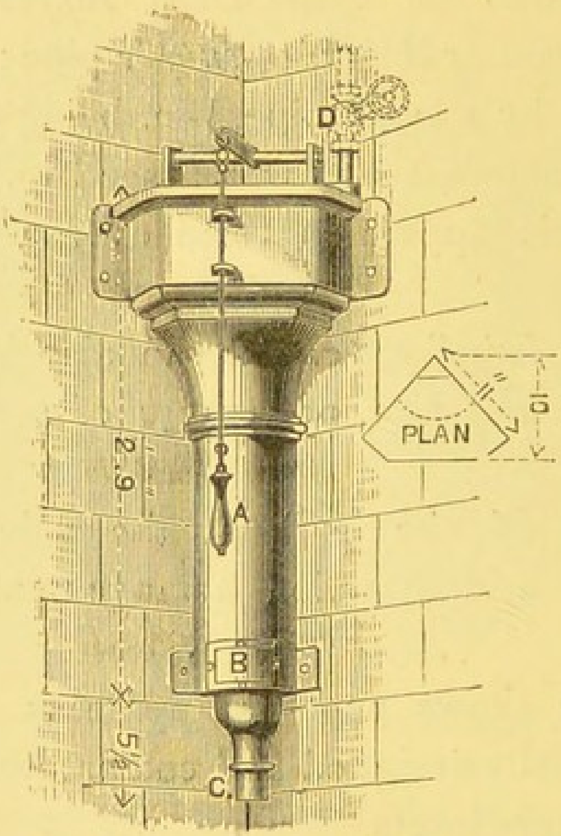


FIG. 99.—View of "CATARACT" apparatus for flushing out W.C.'s.

take more than 2 or 3 ft. of pipe to do this; and $\frac{1}{2}$-in. supply-pipe should be laid on to the ball-valve; a stop-valve, D, is fixed in combination with the ball-valve when so ordered.

Three gallons in three seconds.

This "Cataract" supply apparatus gives a flush of *three* gallons of water in about as many seconds!

Fig. 100 shows a galvanised cast-iron *water-waste-preventing cistern arrangement* in accordance with the rules of the London water companies. The Author specially designed this for fixing

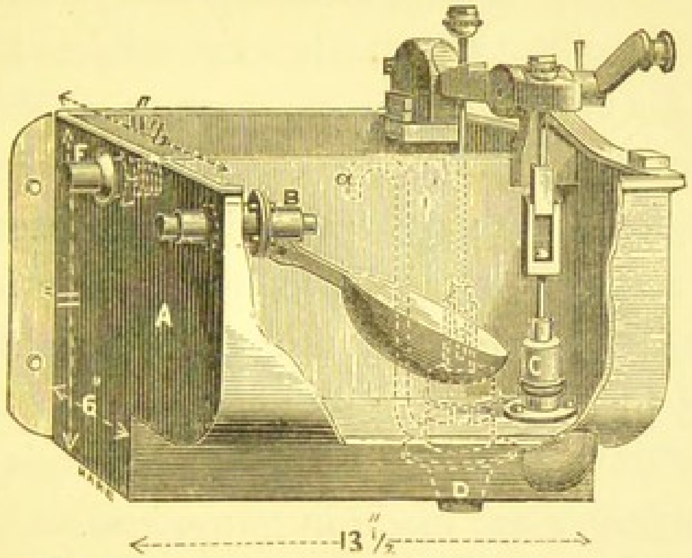
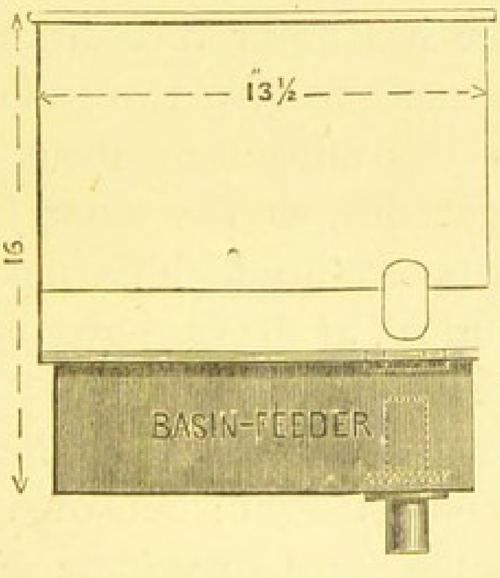


FIG. 100.—View of W.W. Preventer for Supplying Water-Closets.

(where water companies insisted upon having water-waste preventers) to *flushing-rim* closets.



See Plate IXA, and p. 237.

FIG. 101.—W.W. Preventer with "Basin-feeder."

It is a *double-valve* arrangement, as shown at C and D, and one valve is made to shut before the

Basin-feeder.

other is opened. The valves are so arranged that only two gallons of water can pass into the closet with one pull of the handle, but this is made to rush into the closet as quickly as possible. Fig. 100 is made for supplying closets having *no* valves in the basin (the "hopper" class of closet), and Fig. 101 for supplying *valve* or pan-closets. A body of water is retained in the "basin-feeder" (Fig. 101) for *re-charging* the *closet-basin* after the handle of the closet is in its place.

The valves and connecting links of this water-waste preventer are made in gun-metal.

Tip-up W. W. Preventer.

The Author took out a patent, some few years ago, for a *tip-up* water-waste preventer, but he has always had so strong an objection to a *limited* supply of only two gallons of water to water-closets that he has never brought it before the public. It is made to give two gallons of water, and there is this advantage about it, that the closet must get this, as the water is *tipped* out into an outer cistern-head with a pipe leading to the closet or urinal, as the case may be.

W. W. Preventing-valves.

Water-waste-preventing-valves * for fixing *under* the water-closet seat have this advantage, that they are out of sight; but when such valves interfere with the force or volume of the water-supply (as they generally do) to the closets, they become a nuisance, or soon allow the closets to be.

* This kind of valve is quite unfit for supplying *flushing-rim* closets.

Braithwaite's patent "SYPHON" water-waste-preventing arrangement (Fig. 101*a*) is valuable, as it *ensures* a certain quantity of water being given when once the handle of the apparatus is pulled. The quantity of water can be regulated, from one to a dozen gallons, according to circumstances, the *vessel* in which the "syphon" is fixed being made of a corresponding size. *There are no valves about it to get out of order*, and this is one of its chief merits. The only objection to it is that the *flush* is too *sluggish* in its passage into the closet to be of any *great* value as a *cleansing* power. These patent syphons are made in two sizes, 1¼ in. and 1½ in.; but the larger size is the preferable one, as it gives a quicker flush.

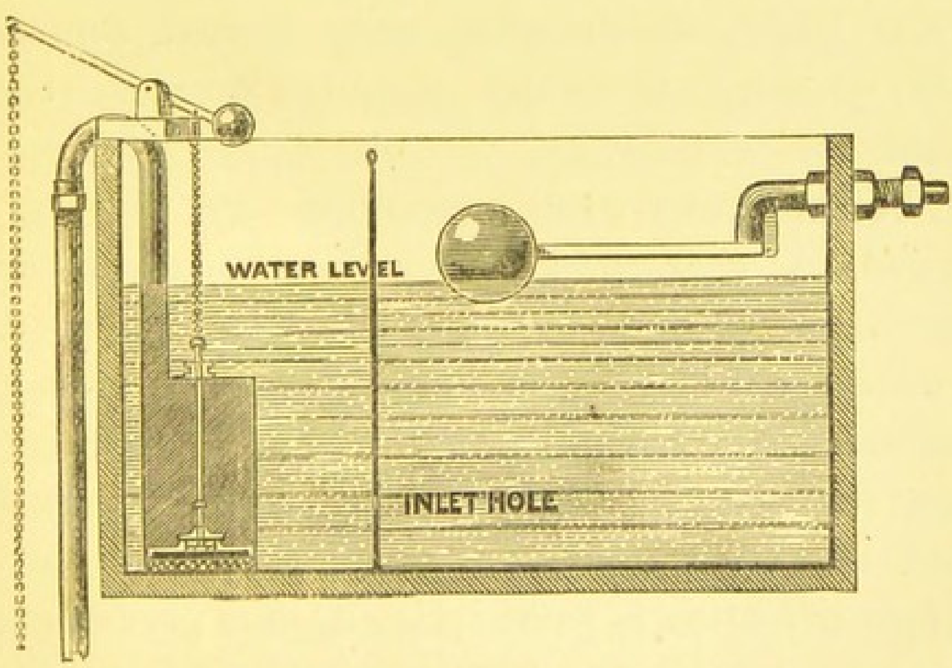


FIG. 101*a*.—Braithwaite's "Syphon."

Urinal supply.

SUPPLY OF WATER TO URINALS.*—The London water companies *limit* the supply of water to a urinal to *half* a gallon to a usage; therefore such water-waste-preventers should be used as will give this body of water in the *shortest time*, so as to secure as great a flush as possible with it. The writer patented some years ago a *tip-up* water-waste-preventer which turns half a gallon of water out into a receiver, and sends it down through the urinal with a good flushing force for keeping it clean directly the supply handle is pulled; but this water-waste-preventer is too expensive for *general* use, except where wanted for supplying a *range* of urinal basins. Messrs. J. Tylor and Sons, of Newgate Street, have a *water-waste-preventing urinal valve*, with a neat cap for connecting same to the inlet-arm of the urinal basin, which, when once opened, *insures* this quantity of water passing through the basin.

W. W. preventer.

Door-action.

When water-waste-preventers are not required, a *door-action* service-box arrangement can be fitted up to give a good *flush* of water to a urinal or urinals every time the door to them is opened. And the advantage of such an arrangement is that the *urinal* basin is well wetted with clean water, by the opening of the door, before any urine is passed into it, thus preventing

* See Chapter on "Urinals," pp. 114—118.

the urine from so easily adhering to the sides; and the urine is again flushed out when the person opens the door to leave the place.

Treadle action.

Fig. 102 shows a *perspective view* of the Author's *Treadle-action* flushing apparatus for

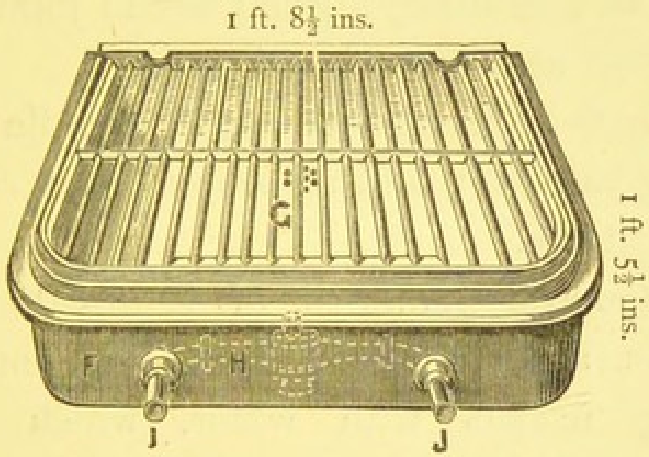


Fig. 102.—View of "Treadle-Action" Urinal Apparatus.

supplying a urinal with water during the whole of the time it is being used. A service-pipe is laid on to the union J, and a $\frac{3}{4}$-in. pipe is taken from the union I to the inlet-arm of the urinal basin. See Fig. 36, p. 118, showing this arrangement fixed. The grating is made *wide* to *insure the feet resting upon it*, when the urinal is used, to open the supply-valve. The bars of the grating are feathered off at top and bottom to prevent droppings hanging to them, and the supply-valve and flush-pipe are recessed under the urinal frame to prevent any droppings falling upon them. The *frame* in which the

Treadle grating.

grating works is 2 in. larger each way than the size of the grating shown in the diagram. The outside size is 2 ft. by 1 ft. 9½ in. The grating and frame are *galvanised*, or they can be "anti-corroded," by Prof. Barff's Rustless Process. The frame is specially made for tiles to bed upon it, and to make a good sound jointing with it, as shown at Figs. 36 and 102.

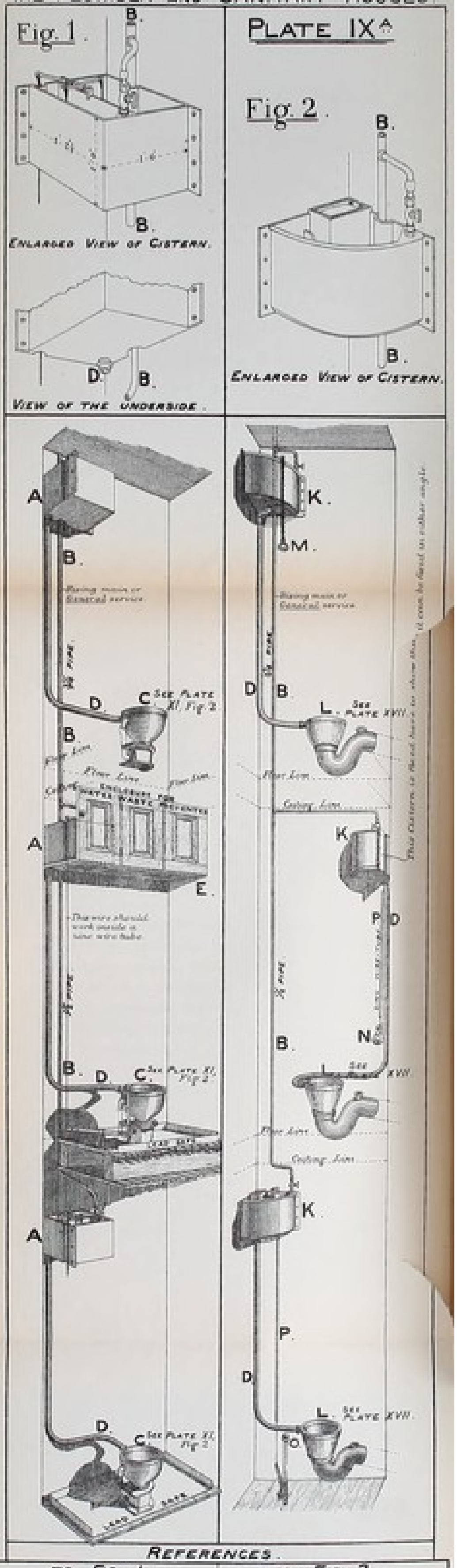
Safe.

The *safe* under the grating or treadle is made of strong cast iron, and *white porcelain enamelled* all over inside.

Mr. George Jennings, of Lambeth, has designed an automatic flushing arrangement for supplying urinals with water, which is very valuable, as it ensures the urinals supplied by it being periodically washed out independently of all personal attention upon them.

"Flush-tank."

Mr. Rodgers Field's "FLUSH-TANK" is specially adapted for flushing out a range of urinals, especially at Railway Stations. The tank could be fixed in some convenient place over the urinals, where the rain-water from the roofs could be brought into it and collected; and then every time there was a sharp shower the syphon would be started, and the urinals flushed out with water that otherwise would run away without doing the smallest good. An *auxiliary supply* could be laid on to this "Flush-tank" from the general service-pipe, and the tank filled with water for



REFERENCES.

TO FIG. 1.

A—Valve Closet W.W. Preventing Cistern,* for ensuring a rapid flush of 2 gallons of water, with Basin-feeder, &c., &c., complete.

B—¾" (or ½)" Lead Service Pipe, to supply the several Cisterns **A**.

C—Valve Closet, with *Flushing-rim* basin. For fuller detail, see Fig. 78, p. 193; and Fig. 2, pl. xi.

D—1¼ in. Lead Service Pipe, from the Cisterns **A** to the Closet Basin. Where the Cistern **A** is more than 5 ft. *above the seat*, 1¼ in. Pipe is large enough.

E—Enclosure, with hinged Door, to conceal the Cistern **A**. To look better the framing is carried right across the end of the W.C.

TO FIG. 2.

B—½ in. Lead Service Pipe, to supply the several Cisterns **K**.

D—See Reference Letter **D**, Fig. 1.

K—W.W. Preventing Cistern,* with SYPHON arrangement for ENSURING a 2 gallon flush of water when once the handle is pulled. This Cistern can be made to give a *three* gallon flush when there are no W. Companies to interfere.

L—"Artisan" Closet. See Figs 89—91.

M, **N** and **O** show three ways of working the Cistern **K**. **M** shows a simple Chain and Ring; **N** a "Crank-pull," fixed on the wall; and **O** a "Knob-pull," for working through the seat.

* These Water Waste Preventing Cisterns are so arranged that they can be easily fixed in either angle. Another great advantage is that the general Service Pipes **B** can pass down behind the Cisterns (the backs being recessed for the purpose) without any cutting away.

Note.—The Cisterns are provided with an overflow arrangement, but where they are fixed under any of the London Water Companies, a separate overflow must be fixed. This can be done in one of three ways—(1) An inch pipe can be taken from each Cistern, and made to discharge outside the external wall separately; or (2) instead of going through the wall, it can discharge into the safe of the Closet, and waste itself through the overflow pipe of the safe; or (3) the overflow pipes from the *tier* of W.W. Preventing Cisterns may be branched into one general overflow pipe, each pipe discharging outside the external wall of the house, where it can be seen.

flushing out the urinals as required. The *general* service-pipe from the syphon of the Flush-tank to the urinals should *not be smaller* than 1¼ in., with 1-in. or ¾-in. *branches*, according to circumstances, to the basins or stalls.

PLATE IX.A shows two tiers of water-waste-preventing cistern arrangements for *flushing* out closets.

Fig. 1 shows a view of a *tier* of W. W. PREVENTING CISTERNS for supplying VALVE-closets (as Fig. 78, p. 193), in the most efficient way obtainable, with a two-gallon flush. This valve-closet flushing-cistern apparatus is made on the double-valve principle, and it is so arranged that, directly the handle is pulled, two gallons of water are made to pass rapidly into a compartment leading to the closet—sufficient water being retained for recharging the basin should the handle of the closet be held up too long.

Fig. 2 shows a view of a *tier* of water-waste-preventing *valves*, fixed in compact angle-cisterns, with syphon arrangements for ENSURING a *two-gallon** flush when once the handle (M, N, or O) is pulled. This apparatus is specially designed for supplying the "Artisan" closet, but it is equally good for supplying all the hopper class of closets.

* When there are no water companies to interfere, this apparatus is made to give a *three-gallon* flush.

CHAPTER XXI.

BATHS * AND THEIR WASTES; SUNDRY SINKS, &c.

Quick discharges.

Baths and their Wastes.—The value of quick discharges for keeping the house drainage clean and wholesome is so great, that the writer returns to the subject, notwithstanding all he said about it in the 1st edition, Chap. XII., pp. 102—108. Every time a bath is emptied, from 40 to 60 (according to the size of the bath, and the height it is filled) gallons of water are sent through the waste-pipe and drain; and the value of this body of water for cleansing the drainage will always depend upon the *quickness of its*

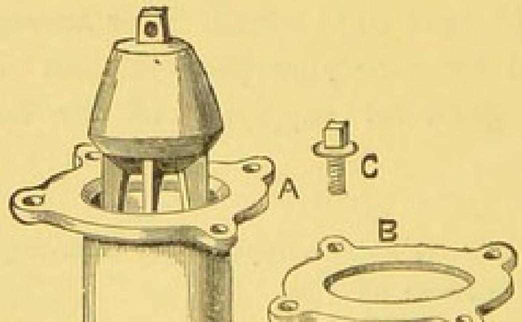


Fig. 103.—View of "Feather Waste-valve."

discharge. When it is allowed to run, or rather *drain* away, at the rate of 4 or 5 gallons per

* See Chap. XII., pp. 102—108.

minute, as is generally the case with most of the baths fixed, the volume of water is not large enough to fill the pipe or to give any cleansing force to the discharge. But when the bath is *made to empty itself in a couple of minutes* or less—*i.e.*, at the rate of about 30 gallons per minute—a *good cleansing force* is obtained, and the drainage well washed out every time a bath is used. There is no difficulty in emptying a bath at this rate with a *feather waste-valve*, as shown at Fig. 103, provided the waste-pipe of the bath is 2 in., and also that there are about 70 holes over the mouth of the waste for the water to pass quickly into it.

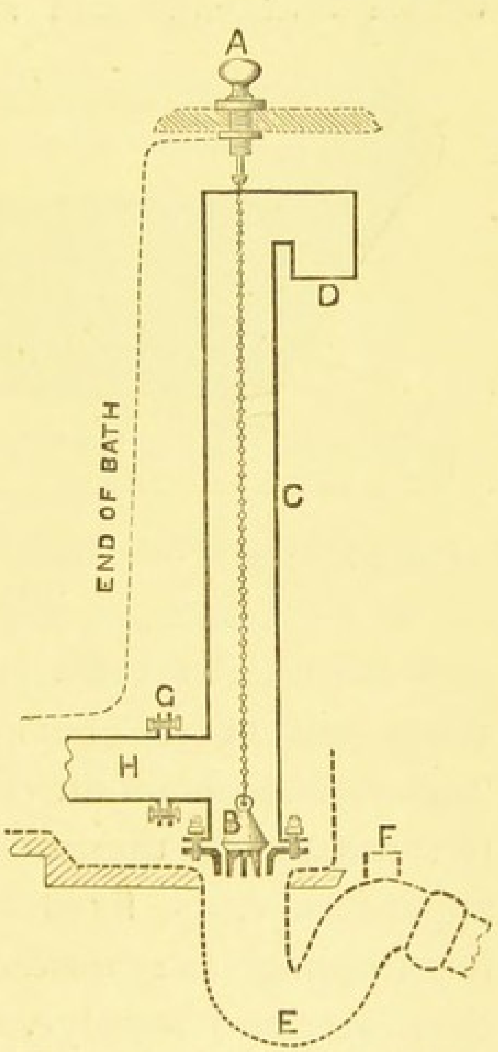


FIG. 104.—"View of "Feather Waste-valve" fixed.

Fig. 104 shows this *feather waste-valve* fixed. B is the valve itself, with its outlet discharging directly over the trap, E. C is a 3-in. lead standing-pipe, and D the place of its overflow. This overflow-pipe can be taken through the external wall or continued down to discharge over the mouth of the trap, E. The standing-pipe is connected to the waste-pipe of the bath by a flanged joint, bolted together for easy separation when necessary. The trap is ventilated at F.

Fig. 105 shows a 5 ft. 6 in. taper copper bath, with round ends and *rounded edges* to bottom

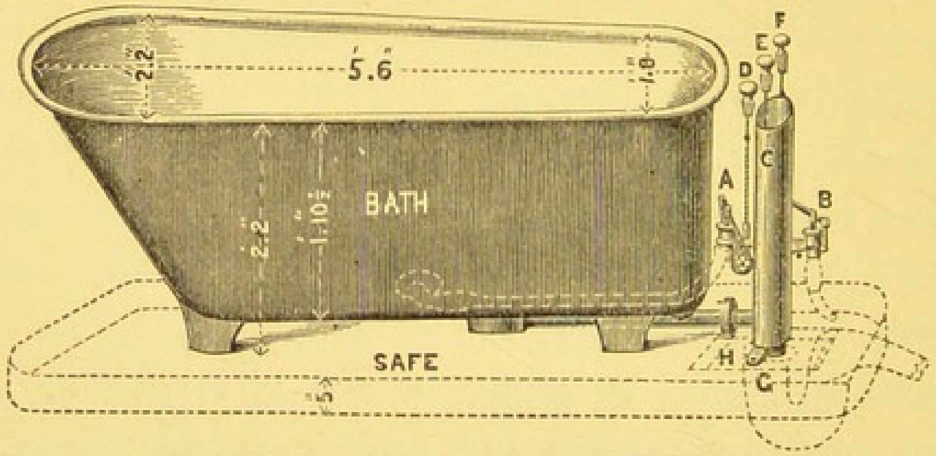


FIG. 105.—View of Bath with Supply-valves and Waste and Overflow Apparatus.

and brim. An extra large waste-pipe (2 in.) is taken out of the bottom, with an *extra large "saucer"* to obtain an extra "ring" of holes over the mouth of the waste. A galvanised iron apparatus, C, is fixed at the end of the bath, for forming the waste-valve and forming the overflow; and supply-valves, A and B, are fixed on brackets to this apparatus for supplying the bath with hot and cold water, and the service-pipes are taken into the sides * of the bath, as

* See pp. 107—108 for position of inlets to bath according to the Metropolis Water Act.

shown by the dotted lines, Fig. 105. The valves (D, E, and F) for "hot," "cold," and "waste" are opened by a pull-up knob arrangement, as shown in *quarter full size* at Fig. 106. The knobs are made of *ivory*, and the plates are *nickel plated.* The trap* should be fixed immediately under the *outlet* of the *waste apparatus,* as shown at G; and a lead safe should be fixed under the bath, as shown in dotted lines. A *sinking*, to form a sort of tray, should be made, as shown at H, to prevent any droppings spreading over the bottom of the safe, and also to give room for connecting the waste apparatus to the bath. When such a bath is fixed over an important ceiling, it is as well to fix an *overflow-pipe* to the *safe* of the bath, as a double security. This overflow-pipe should be made to discharge outside the external wall of the house, with a copper hinged flap on the end of it.

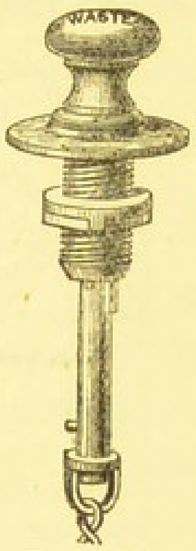


FIG. 106.—View of Valve-pull.

Fig. 107 shows a similar bath to the one just described, but with "*quarter-turn*" supply and waste-valves instead of "*pull-up*" valves: but this arrangement is not so good, as the bath takes longer in emptying, even though a 2-in. waste-valve is used.

* See Plate XIV., facing page 260, showing a trap and bath fixed.

This figure is given chiefly to show the *enclosure*, with its hinged door for access to the valves. When a bath exceeds 2 ft. 3 in. in height —*i.e.*, from the *floor* to the *top* of the enclosure

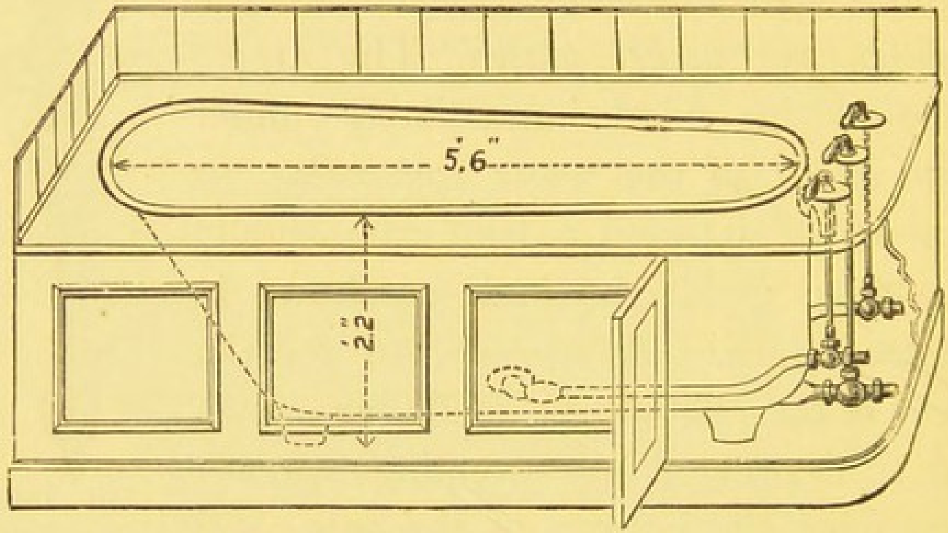


FIG. 107.—View of Bath and Enclosure.

—it ought to have a step for the convenience of getting in and out of the bath.

Walls tiled.

A nice finish is given to a bath—where it would be too expensive to tile the walls as shown on Plate VI., p. 108—by putting a margin of tiles* round the top of the bath, as shown lined out in Fig. 107.

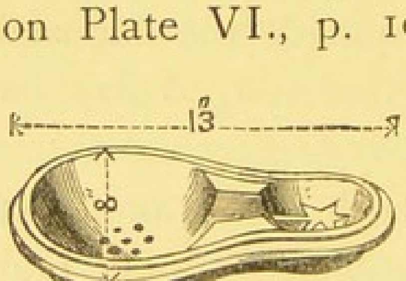


FIG. 108.—View of Sponge and Soap Tray.

Sponge-tray.

Fig. 108 shows a perspective view of a *white-ware soap and sponge* tray, which the Author designed for fixing in the tops of baths. No *long* piping should ever be taken from it, for sooner or

* Tiles are now made to suit everybody's taste and everybody's purse.

later it would get unwholesome. If it is not convenient to put a small arm or horn in the *side* of the bath, 2 in. or 3 in. down from the top, to receive the draining-pipe, from A, from this tray, a cork should be put in the outlet, and the tray emptied occasionally.

SLOP-SINKS.—The writer said enough in the first edition * of this book to show the *value* of *Slop-sinks*. He therefore simply illustrates one or two more ways of fitting up and fixing the Slop-sink shown at Fig. 30, p. 96; giving some short explanation of each arrangement, and illustrating one or two newly-designed sinks. Slop-sinks.

Fig. 109 shows a *perspective view* of the patent "WATER-SHOOT" Slop-sink, with mahogany enclosure complete. A *valve and regulator*, for flushing out this sink with water, is fixed *inside* the enclosure, with a pull-up knob, S, in ivory, standing through the top for opening the valve. This sink can be fixed anywhere, to suit circumstances, and made to look like a *piece of furniture*, as shown at Fig. 109. The top or flap is hinged, and shuts down to hide the sink. Where there are no housemaids' closets, and room for a slop-sink is *scarce*, there is no reason why such a sink (as shown at Fig. 109 or Fig. 110) should not be fixed in a water-closet, espe-

* Chapter XI., pp. 94—98.

Mem. See view of Nursery Bath, page 251.

cially when there is room for it. See Plate X., showing a slop-sink, as Fig. 109, fixed next to a

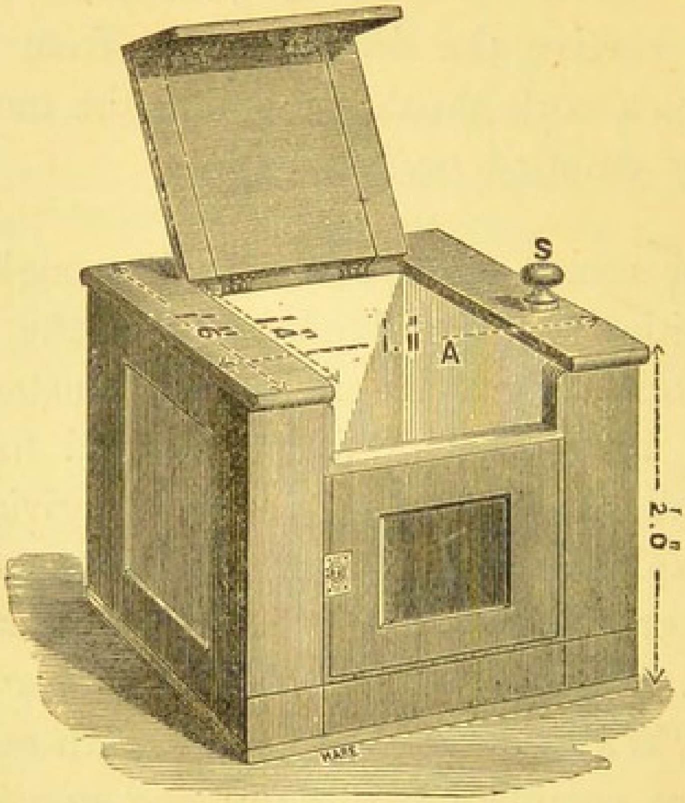


Fig. 109.—View of Slop-sink and Enclosure.

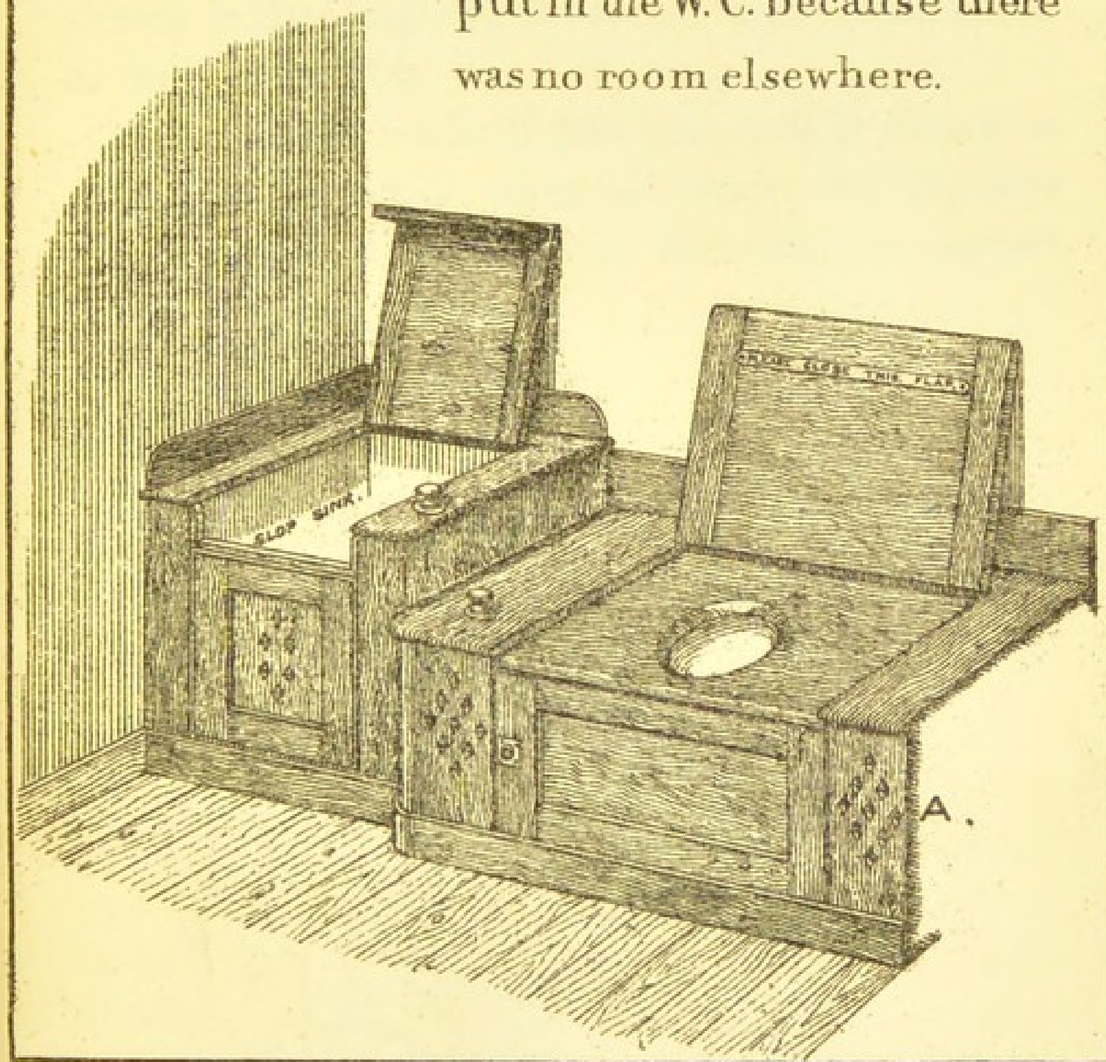
water-closet apparatus. Also see Plate XIV., showing same fixed with its belongings complete.

Draw-off and Slop-sink combined.

It is so *very convenient* in a large house to have a *place* for *drawing off water*, and for *emptying slops*, on each of the chamber floors, and it is so *difficult* in most houses (constructed as they generally are, without proper regard for the sanitary wants of the house) to find *space* for fitting up a housemaid's closet, that the Author has patented a very *compact* sink, Fig. 110, for fixing in the *angle* of a room—such, for instance,

PLATE X.

Fig. 109A:—The Slop-sink is put in the W.C. because there was no room elsewhere.



S. S. Hellyer, del: Whiteman & Bass Photo-Litho London.

To face page 244.

Perspective view of a SLOP-SINK and WATER-CLOSET.—See Plate XIV., showing plans of pipes and fittings.

as a bath-room, lavatory, water-closet, or on a landing. The sink looks neat in itself, but it can be enclosed, as shown at Fig. 110, in any kind of wood to match the surroundings; and with a flower-pot and flowers, or a plant, as shown in the diagram, it can be made ornamental as well as useful.

The sink is made of cast iron, and is *porcelain enamelled* in *white* ware all over the exposed inner surface. The sides of the sink are carried

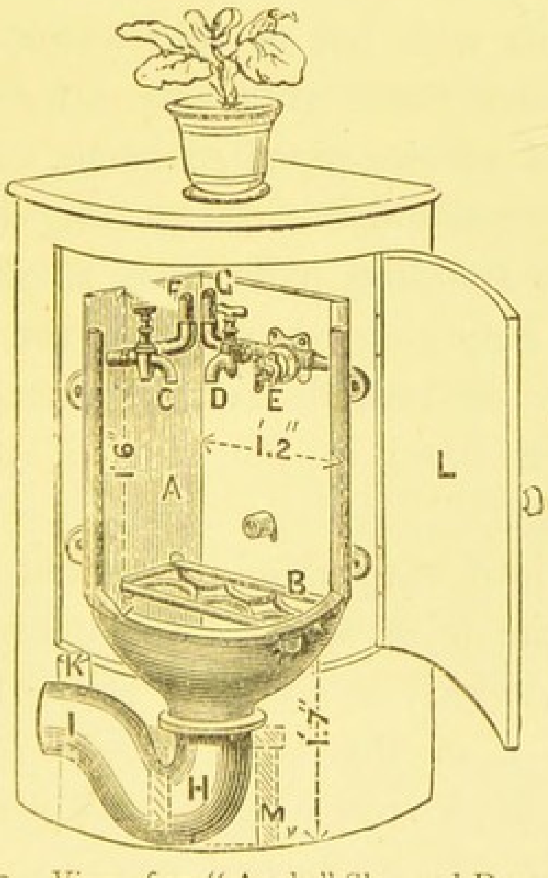


FIG. 110.—View of an "Angle" Slop and Draw-off Sink.

up to a height of 18 in. above the basin part, to protect the walls from splashings; and the front edges of the two vertical sides, as well as the front of the sink, are recessed to receive an *inch* copper perforated pipe, which is fixed to the sink for flushing-out purposes. A large water-way *stop-valve* is fixed, at E, for supplying this flushing-pipe. Cross-bars are fixed across the out-let—which is 3 in. clear diameter—to prevent anything passing into the waste-pipe when accidentally thrown into the sink with the slops.

Draw-off cocks are fixed at C and D, for filling jugs and pails with hot or cold water, and union connections are fitted at F and C, for connecting hot and cold service-pipes to same.

A strong galvanised iron grating is fitted to this sink, for standing pails upon, as shown at B; but when emptying slops into the sink, the grating can be turned back against an india-rubber buffer fixed in the side of the sink to receive it.

A 4-in. lead trap should be fixed under this sink, with the inlet *tafted* back upon the wood platform, M, which is fixed to support the sink. The outgo, I, of the trap can be bossed and reduced to fit a 3-in., 2½-in., or 2-in. pipe as required. It can be turned round to any point, to suit the position of the waste-pipe. An *air-pipe* should always be taken off the top of the trap, as shown at K, but this is best fixed by the plumber on the spot. This sink is very easily fixed.

Shallow sink.

Fig. 111 shows a *shallow* slop-sink for fixing on the floor, or on a platform raised a few inches above the floor. This sink is made of strong cast iron, and is *white porcelain* enamelled on the inside. The back and two sides are made to stand up 8 in., and the front 6 in. An *extra large* grated outlet (tapering from about 5½ in. diameter at top to 4 in. diameter at bottom) is fixed in the bottom of the sink, to take slops freely away. Draw-off cocks can be fixed over the sink in the usual way, and the walls flashed with lead.

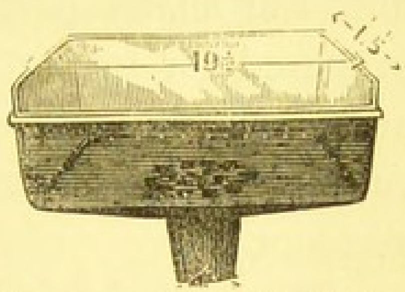


FIG. 111.—View of a shallow Slop-sink.

Earthen-ware sink.

Fig. 112 shows a *strong white-ware* sink,

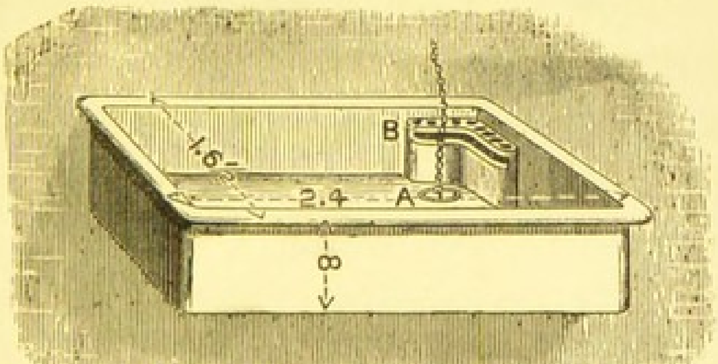


FIG. 112.—View of "Nursemaid's" Sink.

with an extra large overflow arrangement, B, formed in same, which the Author specially designed for fixing in housemaids' closets for washing up nursery articles, &c. The sink is made about an inch in thickness for extra strength. A large brass sunk plug, A, and grated washer with fly-nut, is fixed in the bottom of the sink, and the shank part of this washer is specially prepared for taking away the overflowing water, and conveying it into the waste-pipe, when the supply-cocks to the sinks are left open by accident.

Nurse-maid's Sink arrangement.

Fig. 113, shows this "NURSEMAID'S" *sink*, A,

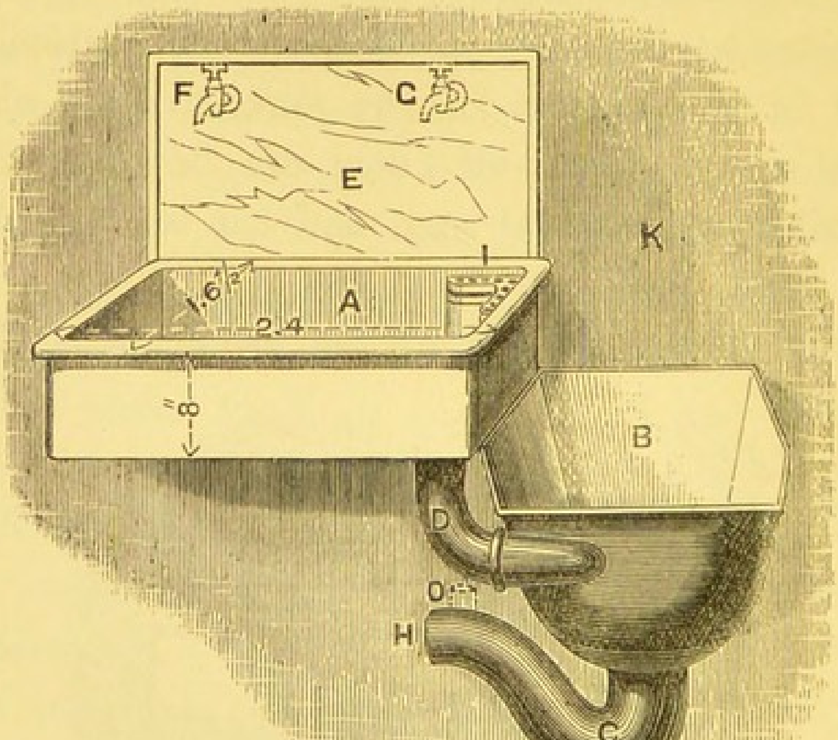


FIG. 113.—View of "Nursemaid's" Sink and Slop-sink combined.

fixed in combination with the "WATER-SHOOT" *slop-sink*, B. The waste-pipe from the white-ware "washing-up" sink is taken into the inlet-arm of the slop-sink, as shown at D; and as it is a 2-in. pipe, a *good flushing* out can be given to the slop-sink by filling the "washing-up" sink with (hot) water, and pulling out the brass plug. Eight gallons of water can be sent down in about as many seconds! A piece of marble skirting can be fixed at the back, as shown at E, and at the end when so required. Hot and cold draw-off cocks can be fixed, as shown at F and G, for supplying the sink with hot and cold water. A 4-in. patent cast lead trap, C, is fixed under the slop-sink, with a lead "seating" to bed the sink in; and the outgo, H, is bossed and reduced to fit a 2½-in. waste-pipe. The outgo of the trap can be turned round to suit the position of the waste-pipe. An air-pipe should be fixed to the trap, as shown at O.

White *tiles* can be fixed at the back, K, and side, over the slop-sink, as shown at Fig. 31, p. 97.

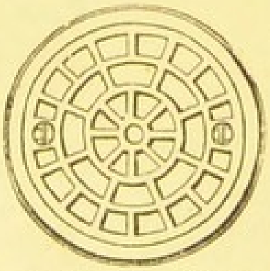


FIG. 114.—"Cob-web" Grating and Rim.

"Cob-web" grating.

It is a great advantage to be able to *flush* out sink wastes; but that can rarely ever be done, as such *small* gratings are fixed over the mouth of the waste-pipe, and the *perforations* are so *fine* that water only just *leaks* through them. The writer designed a brass grating some years ago, which he calls the "Cobweb" grating, for fixing in sink-bottoms; and when this pattern grating is fixed, as it should be, an *inch larger* than the diameter of the waste-pipe —the inlet of the trap being bossed out for the purpose—as shown at J, Fig. 115, there is no difficulty in getting a good flush of water through it.

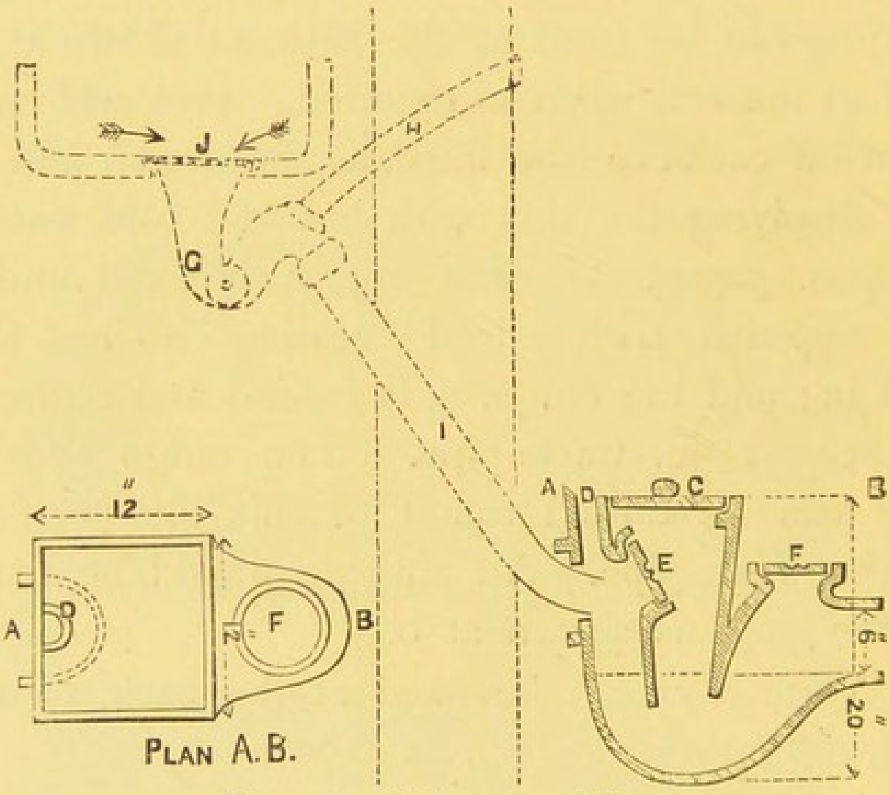


FIG. 115.—Sink-waste and Traps.

Scullery sink and traps.

Fig. 115 shows the *large* size "Drain-intercepting trap," used as a *Grease-trap*,* and the *connection of the waste-pipe from the scullery sink with same.* D is an air *induct* pipe into the discharging end of the 3-in. waste-pipe, and H is a 1½-in. ventilating pipe to the trap of the sink,

* See Figs. 72 and 73, showing another kind of Grease-trap.

for the atmosphere to pass right through the whole length of waste-piping.

The waste-pipe, as shown in Fig. 115, is only a *short length*, and is therefore not so much in need of the ventilating pipe, H, as it would be if it were much longer.

Fig. 115*a* shows a perspective view of a Nursery Bath which Messrs. Clark & Co., of

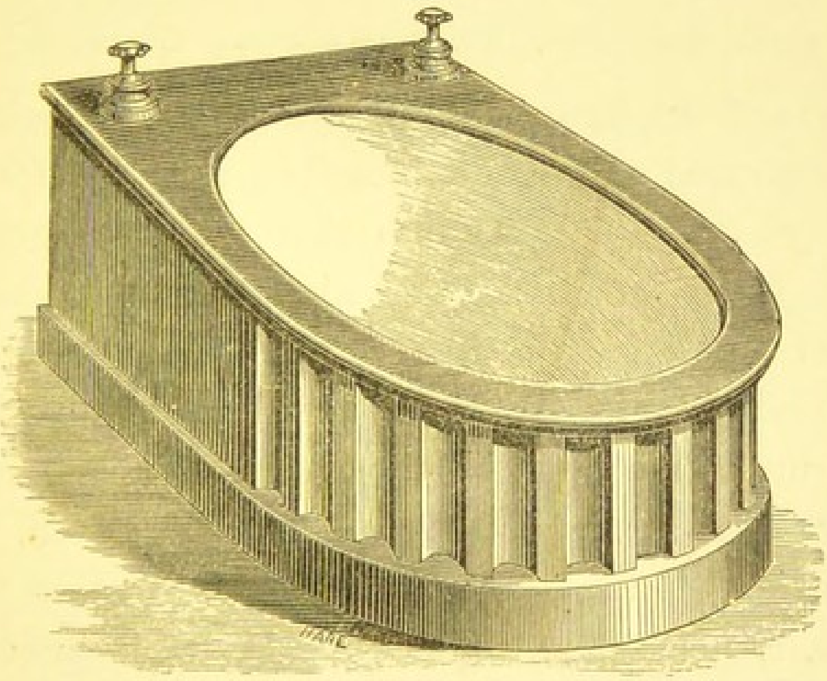


FIG. 115*a*.—Children's Bath.

Wolverhampton, specially designed for economising water. Cold water is laid on to the bath, and a waste-valve is fitted to it for emptying the bath. When hot water is wanted, a canful from the nearest hot-water draw-off tap will suffice. As this is a very strong bath, the children can swim their toy-boats in it without wasting much water.

CHAPTER XXII.

GENERAL ARRANGEMENT OF SANITARY APPLIANCES.

SOIL-PIPES, WASTE-PIPES, VENTILATING-PIPES, DRAINS, &c. &c.

SANITARY appliances inside our houses should be concentrated as much as possible, not only for the sake of economy—though that would be greater than many imagine—but also for the sake of better sanitary results.

Economy.

Places of fittings ill-considered.

The *positions* of water-closets, baths, sinks, &c., are often most *ill-considered* with regard to their chief requirements—light, ventilation, and drainage. Such "fittings" are often *placed here, there, or anywhere* about the house, like the corn-ricks one sees in Ireland (and in many parts of Scotland too) in all parts of the field—for "shure and isn't one part of the field as good as another?"

Advantages of concentrating W.C.'s, &c.

As one tree will carry many branches, but must have trunk and roots, if only one branch be upon it, so a *stack* of soil-pipe will take the *branches* from *many* water-closets, but must have the same belongings, at top and bottom, if only

PLATE XI.

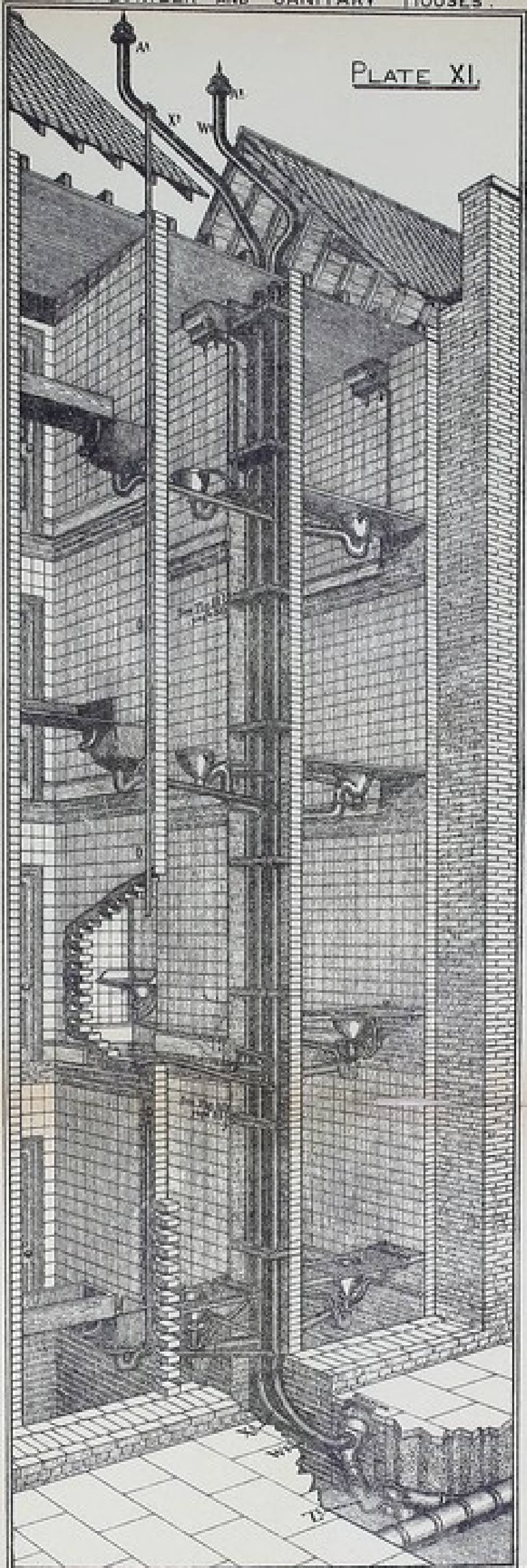
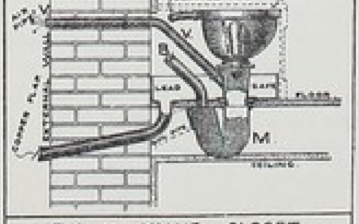


FIG. 1.—Perspective view of a stack of soil-pipe, X^2, with a double tier of water-closets upon it; and a stack of waste-pipe, W^2, with a tier of sinks, and a double tier of lavatories upon it.

See *plans* of pipes and "fittings," Plate XII., and geometrical views of the above pipes, Plates XII. and XIII.

Fig 2.



VIEW OF VALVE CLOSET SHEWING VENT-PIPE, TRAP, & SAFE-WASTE.

one water-closet be branched into it. The *economy*, therefore, in fixing water-closets, or sinks, &c., in *tiers* will at once be seen, and it will not take many words to show that *better sanitary results* will be obtained by concentrating such fittings in *tiers*, instead of spreading them over the house with a long length of drainage to each. When water-closets, slop-sinks, lavatories, baths, &c., are fixed in *tiers*, as shown on Plates XI. to XVII., there is only a *short* length of *branch* piping to wash out to get the discharges into the *main* soil or waste-pipe, where discharges and *flushes* from the various fittings are constantly passing through to keep the pipe wholesome. But when water-closets, or slop-sinks, &c., are fixed *singly* in various parts of the house, and especially when fixed on the upper floors, there is often from 30 to 60 ft. of soil-pipe or waste-pipe to cleanse after each usage of the "fitting," besides a long length of branch drainage. The consequence is, that where any such long length of drainage exists from a single closet, it rarely gets properly flushed out.

Grouping of sanitary appliances.

The drawings, Plates XI. to XIII., are specially made to show how to *group* sanitary fittings together on various floors, and to perfect their belongings. It was found almost impossible to show the arrangements clearly on one drawing, and so *three separate* Plates are given to illustrate the sanitary arrangements in a supposed building for letting out in offices. *Double sets* of water-closets and lavatories are shown on each floor of a four-storeyed * house, for the use of chiefs and their clerks, and a combined sink arrangement for washing-up and emptying slops is provided on each floor for the housekeeper's use. Plate XI. gives a *perspective view*, and Plates XII. and XIII. *geometrical elevations*, with *plans* of pipes and fittings. The only difference is that the sink and lavatory waste is shown on Plate XI. (W 2), as emptying into the "Ventilating Drain-syphon and Sewer-interceptor" at the foot of the soil-pipe; whilst in Plates XII. and XIII. it is shown, at W, as emptying into a *separate* "Drain-interceptor"—either plan can be adopted to suit circumstances. For the reader's convenience and *easy reference*, the writer has given a Table of References, with explanations, in the letter-press opposite each plate.

Table of Reference to Plate XII., with some Explanation.

Note (1). The position of the *vertical* pipes in the *elevation* is not strictly correct according to the *plan*. For the sake of clearness the pipes are placed side by side, instead

* There is no reason why additional storeys should not be added with the same arrangement of pipes. The *main*-pipes are quite large enough for two or three more storeys.

of one behind the other, and they are kept farther apart for the same purpose.

(2.) Also, for the sake of clearness, the lavatory basins are not shown at all on this plate, but a geometrical elevation is given of them in Plate XIII.

(3.) A *perspective view* of the same arrangement is given on Plate XI.

A.—*Trap ventilation, or air-escape-pipe.* This is a 2-in. lead air-pipe taken out of the *lowest* trap, and continued up above the *highest*—receiving the *branch* air-pipes from the closet-traps on the various floors on its way—where, at C, it is branched into the *main* air-pipe to the soil-pipe. See Chap. VIII., pp. 63—5, giving the advantages of such ventilation.

B.—*Branch air-pipes to water-closet-traps.*—A 2-in. lead air-pipe is taken from the *top* of the *outgo* of each water-closet trap on the various floors, and branched, as shown, into the ascending air-escape-pipe, A.

B.W.—*Branch wastes to sinks.*—3-in. lead pipe, same substance as *main* waste, W.

D.—*Trap ventilation to sinks.*—This is the same arrangement for preventing the traps from syphoning, as explained under reference letter "A," except that this escape-pipe is carried right up through the roof to the atmosphere. Where there are no windows near, there is no reason why it should not go out through the external wall directly after receiving the branch air-pipe from the highest trap, as shown at E^1, Plate XIII.

E.—*Trap ventilation to lavatories.*—1½-in. lead pipe branches into 2-in.

F.—*Waste-valve to lavatories* (1½-*inch*).—See Fig. 34, p. 112.

G.—*Overflow-pipe to lavatories.*—2-in. lead pipe.

H.—*Overflow-arm to water-closet basin.*—This is an *extra large* arm with a 2-in. lead trap (with a *water-seal* of 2-in.), for conveying the overflowing-water into the "conductor" of the water-closet apparatus. See D,

Fig. 23, p. 74; also see Figs. 75 and 76, pp. 186 to 192.

J.—"*Artisan*" *closet, with Lead Trap.*—See Fig. 25, p. 82; also see Figs. 89—93, pp. 205—210.

K.—"*Vortex*" *closet and Trap in one piece.*—See Figs. 80—86, pp. 196 to 202.

L.—*Valve water-closet.*—See Fig. 23 and pp. 73 to 76; also see Figs. 75—79, pp. 186 to 195, and Fig. 2, Plate XI., showing a large view of this closet fixed.

L.Y.—*Lavatory*, as Fig. 34, p. 112.

M.—"*V-dip*"-*Trap, or Patent Cast-lead* "*Anti-*"*D-Trap.*—See Figs. 44 and 45, pp. 156, 157.

N.—"*Patent Cast-lead Trap.*"—See Fig. 7, p. 12.

O.—"*Washing-up*" *sink.*—See Fig. 31, p. 97; also see Figs. 112 and 113, pp. 247 and 248.

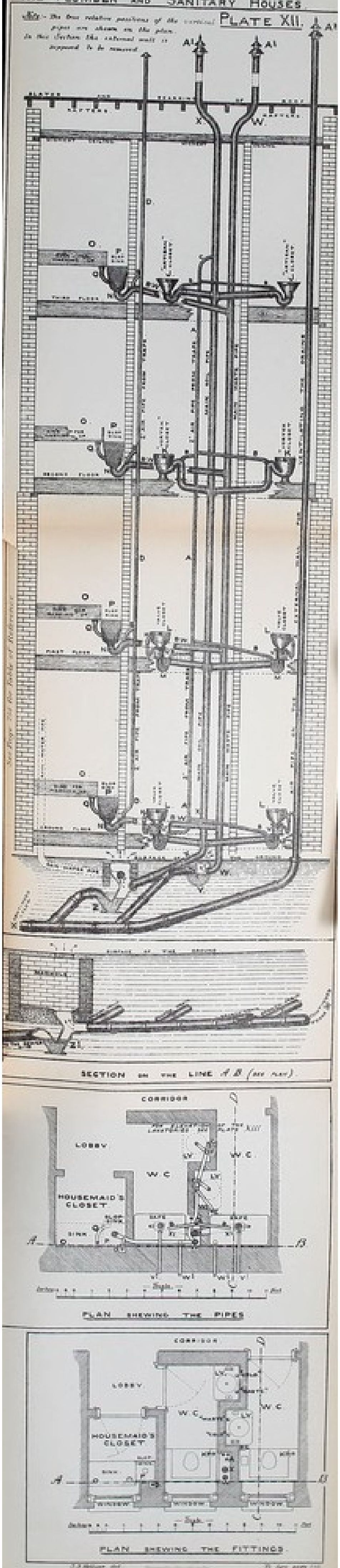
P.—*Patent* "*Water-Shoot*" *Slop-sink.*—See Fig. 30, pp. 96, 97; also see Figs. 109 and 110, pp. 244 and 245.

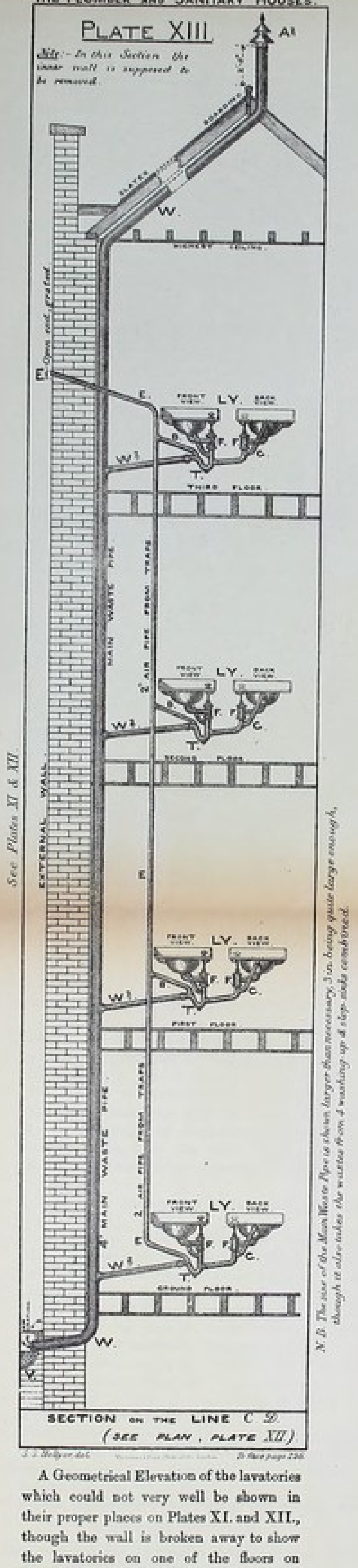
Q.—*Waste-pipe from washing-up sink into slop-sink.*—A 2-in. lead pipe is taken from the brass waste and connected with the arm of the slop-sink, and this pipe is made to answer the *double* purpose of emptying the sink and *flushing* out the slop-sink.

V and V 1.—*Vent-pipe to* "*conductor*" *or* "*valve-box*" *of water-closets.*—A $1\frac{1}{2}$-in. lead air-pipe is taken from the *vent-arm* of the "conductor," and continued through the external wall of the house, with the end wired across, and left open to the atmosphere. See Fig. 2, Plate XI.; also see Fig. 75, and reasons for same, pp. 186 to 188.

* W.—*Main waste-pipe to sinks and lavatories.*—This is a $3\frac{1}{2}$-in. *lead pipe*, made by hydraulic pressure, of an *even substance all round*, and equal in weight to sheet lead 10 lbs. to the superficial foot. Of course this pipe can be made of *any strength*, from 5 lbs. to 12 lbs., to suit both purse and circumstances; but when *hot water* is laid on to the sinks and lavatories the pipe ought to be *stronger* than when only cold

THE PLUMBER AND SANITARY HOUSES.





A Geometrical Elevation of the lavatories which could not very well be shown in their proper places on Plates XI. and XII., though the wall is broken away to show the lavatories on one of the floors on Plate XI.

REFERENCES.

A³ —"Double-cap" ventilating cowl.— See Fig. 119, page 268

B —1½-inch branch air-pipe from traps.

E —Trap-ventilation or air escape pipe.—2-inch lead pipe.

F —Waste-valve, 1½-inch.—See Fig. 34, page 112.

G —Overflow-pipe to lavatory basins.—2-inch lead pipe.

LY—Lavatory as Fig. 34, page 112.

T —2-inch "Patent cast lead trap," with screw cap.

Mem. See Plans , Plates XI. and XII.

water is laid on. This waste-pipe is made to discharge, with an *open end*, into a "drain-interceptor," Y; and the same-sized pipe is continued up through the roof, with a *ventilating-cowl* on *top* of same. This $3\frac{1}{2}$-in. *main* waste-pipe takes the *branch wastes* from four "washing-up" and slop-sinks combined, and eight lavatories; but it is quite large enough to take the branch-wastes from additional storeys where the building demands it.

W^2.—*Branch waste to lavatories.*—2-in. lead pipe. See Plate XIII.

* X.—*Stack of soil-pipe taking a double tier of water-closets.*— This is a $4\frac{1}{2}$-in. lead pipe, made by hydraulic pressure, and equal in substance to sheet lead 8 lbs. to the superficial foot. It is shown in the illustration, on Plates XI. and XII., as discharging with an *open end* into one of the Author's patent "soil-pipe disconnectors," or "ventilating drain-syphons," Z. (See reasons for this, page 226). The soil-pipe, X, is continued up through the roof with a ventilating cowl on top, so that the fresh air can pass into the pipe at the lowest end and out at the highest.

X 1.—*Branch soil-pipe.*—4-in. soil-pipe; $3\frac{1}{2}$ in. is large enough when the traps are ventilated, as shown on Plate XII.

Y.—"*Drain-interceptor*" (medium size). See Figs. 69 to 71, pp. 178 and 179.

Z.—"*Soil-pipe disconnector.*"—See Figs. 57—64, pp. 163—171.

Soil-pipes are generally fixed larger than necessary. 6-in. and 5-in. pipes are often used where $4\frac{1}{2}$-in. and 4-in. (or $3\frac{1}{2}$-in.) would be the better sizes. The advantages gained by fixing the *smaller* sizes are (1) *saving of expense;* (2) Small soil-pipes.

* The *soil* and *waste*-pipes are shown larger in the drawings than is necessary in practice.

neatness of appearance*, especially when fixed on the external face of a building, and compactness as well as saving of room when fixed inside; and (3) *better sanitary results*, as a greater cleansing force is obtained in the two-gallon flush of water through a small than a large pipe.

When soil and waste-pipes discharge with *open* ends, as shown on Plates XI. to XIII., they can be of *smaller sizes* than when they discharge into the *drain direct*, or into *air-sealed* traps. Such pipes can also be of smaller diameter when the *traps* are all ventilated as shown on Plates XI. to XVII. $3\frac{1}{2}$-in. lead soil-pipe with such an arrangement is quite large enough to take a tier of two (or even three) water-closets; 4-in. pipe is large enough to take a tier of half-a-dozen; and $4\frac{1}{2}$-in. pipe will take a *double* tier of four or eight closets in all, as shown on Plates XI. and XII. And this can be done without any risk of unsyphoning the traps, especially if "*V-dip*" *traps* are used.

Sizes of soil-pipes.

It may encourage many to fix soil-pipes with *open ends* to know that a large number of such open-ended pipes and traps have been fixed as shown on the above Plates in very important places with great success. The Author had *two* stacks of soil-pipe fixed, within a few yards of each other, about eighteen months ago, almost

Soil-pipes with open ends.

* See Fig. 1, Plate XXIA, page 274.

precisely similar to that shown on Plate XI., with a large number of water-closets upon each. But as the gratings over the tops of the drain disconnecting traps were right in the footway of a narrow public thoroughfare, and as the parties chiefly concerned in the erection of the building would have been too nervous to have sanctioned any such open ventilation, nothing was said about the arrangement of such ventilating traps, and the gratings were supposed by all concerned, except the writer, to be simply covering the ends of R.W. pipes. As a proof of the safety of such an arrangement, it may be mentioned that though the closets upon each of the two stacks of pipes just referred to have been in great use for about a year; though thousands of people have walked over the gratings; and though office windows are within 8 ft. or 10 ft. of them, no one has ever noticed the slightest disagreeable smell from the arrangement. Whenever the writer has examined these ventilating traps, he has found them to be quite free from any offensive odour, and moreover has always found the atmosphere to be passing *into* the discharging end of the soil-pipe at this point, and not *out* of it.

Care in fixing open traps.

Care must be taken in fixing such open traps, for when currents of air can blow over them, as when fixed in a passage-way, the *soil-pipe air* will be drawn *out* through them—*i.e.*, the atmo-

R 2

spheric pressure will be removed from the discharging end of the soil-pipe by the *wind blowing over the open top of the trap*, and a *blow-down* will take place in the soil-pipe, as explained elsewhere.

Table of Reference to Plate XIV., with some Explanation.

Plate XIV. illustrates tiers of Water-closets, Sinks, Baths, and Lavatories in a supposed Three-storey Country House.

Note (1). For the sake of clearness, all wooden casings, seats, enclosures, service-pipes, &c., are omitted on the "section," Fig. 1, but they are shown on the "plans" at the foot of the plate.

(2) Also for the sake of clearness, the *vertical* pipes, F and G, are shown on one side of the lavatories instead of behind them. For their true position see *plans* of "Pipes" and "Fittings" at the foot of the plate.

(3) The first and second floors are precisely similar.

(4) The connections of the branch waste from the baths with the *main* waste are shown at B B, but the baths themselves are not shown on this "section," for the sake of clearness. A *longitudinal vertical section* is given of the bath (Fig. 2) on one floor—and the two upper floors are alike: also an *end view* of the bath is shown at Fig. 3.

A.—Double-cap ventilating top.—See Fig. 119, p. 288.

A A.—Double-cap ventilating top.—See Fig. 119.

A^1.—*Valve water-closet apparatus, with ventilating pipe to "conductor."*—See Fig. 23, and pages 73—76: also see Figs. 75—79, pp. 186—195.

A^2.—"*Vortex" closet and trap in one piece.*—See Figs. 80—87, pp. 196—203.

PLATE XIV.

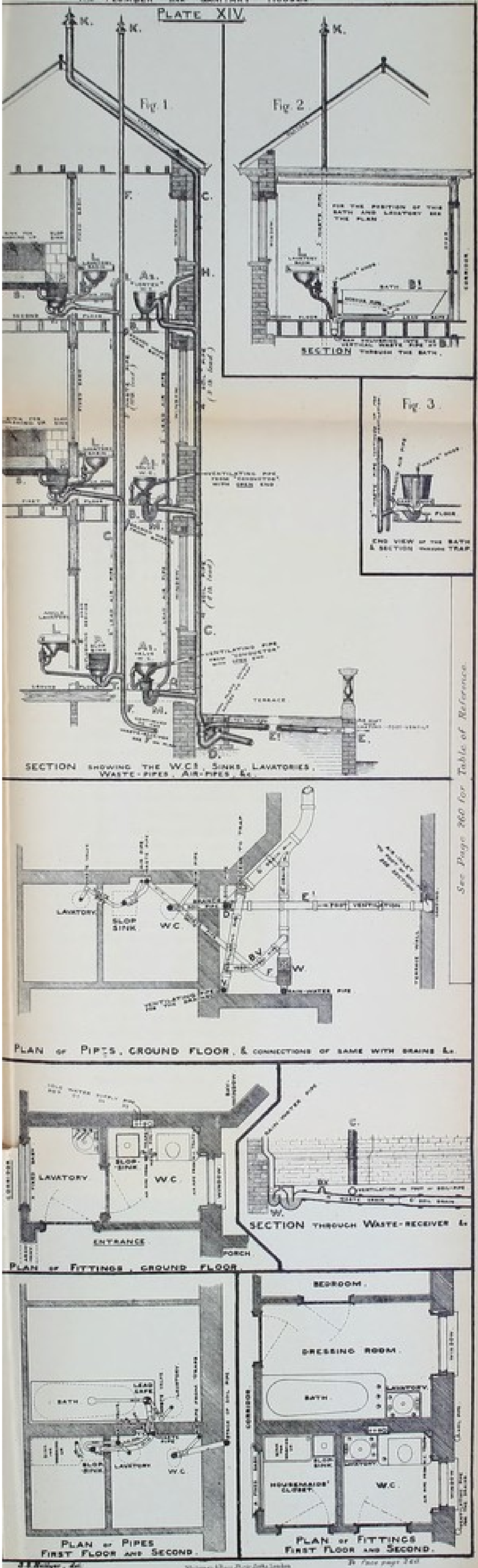


Fig. 1.
Fig. 2.
Fig. 3.
FOR THE POSITION OF THIS BATH AND LAVATORY SEE THE PLAN
SECTION THROUGH THE BATH.
END VIEW OF THE BATH & SECTION THROUGH TRAP.
SECTION SHOWING THE W.C.S SINKS LAVATORIES, WASTE-PIPES, AIR-PIPES, &c.
TERRACE
LAVATORY
SLOP SINK
W.C.
VENTILATION
RAIN-WATER PIPE
PLAN OF PIPES, GROUND FLOOR, & CONNECTIONS OF SAME WITH DRAINS &c.
CORRIDOR
ENTRANCE
PORCH
PLAN OF FITTINGS, GROUND FLOOR.
SECTION THROUGH WASTE-RECEIVER &c.
BATH
BEDROOM.
DRESSING ROOM.
HOUSEMAIDS' CLOSET.
PLAN OF PIPES FIRST FLOOR AND SECOND.
PLAN OF FITTINGS FIRST FLOOR AND SECOND.
See Page 260 for Table of Reference

B.—*2-in. lead branch waste from baths* on first and second floors.—See section, Fig. 1, and end view, Fig. 2, on Plate XI.

B¹.—*Copper bath.*—See Figs. 105—107, pp. 240 and 242.

B.V.—*Branch ventilation from branch drain into main ventilation.*

C.—*A 4-in. stack of 8-lb. lead soil-pipe, taking the branch soil-pipe from a tier of three water-closets.*—This soil-pipe is trapped at the foot, and *fresh air* is taken into the soil-pipe, from the terrace wall, at E, some 30 ft. or more away from the trap, D, as the dining-room window is immediately over the trap. The soil-pipe at the top is continued up to a few feet above the ridge for ventilation.

D.—*Patent "combination soil-pipe trap."*—See Figs. 46—56, pp. 157—162.

E. and E¹.—"*Foot ventilation" to soil-pipe.*

F.—*A stack of 3-in. 10-lb. lead waste-pipe,* taking the branch-wastes from the lavatories, sinks, and slop-sinks on the ground, first, and second floors, also the bath-wastes from the first and second floors.

G.—*Trap ventilation or air escape-pipe.*

H.—*Connection of air escape-pipe with main ventilating pipe.*

K.—See B.V. above.

L.—*Lavatory.*—See Figs. 33 and 34.

M.—Cast lead "*V-dip" trap.*—See Figs. 44 and 45, pp. 156–7.

O.—*Safe to water-closet apparatus.*—See Fig. 2, Plate XI.

P.—"*Water-shoot" slop-sink.*—See Fig. 30, pp. 96—97; also see Figs. 109 and 110.

S.—"Washing-up" sink.—See Fig. 31, page 97; also see Figs. 112 and 113.

T.—*4-in. patent cast lead trap, with "outgo" bossed to 3 in., and with a 3-in. brass cap-and-screw soldered to ditto.*

V.—*Ventilating pipe at head of drain.*—This pipe is taken off at the top of the *outgo* of the soil-pipe trap, for the purpose of preventing any matter flowing into it, as there would be no means of flushing it out again.

Very serious errors are often made through want of such precautions.

W.—*Patent "waste-receiver and drain-interceptor."*—See Figs. 16 and 17, pages 23—24.

Soil-pipes near breathing-places.

When soil-pipes discharge themselves into a drain *immediately under a window*, or close to a porch, or doorway, where any of the occupants of the house are likely to stand about, or perhaps sit down for a little time, it is better to fix another kind of trap, as shown at D, Plate XIV., with the mouth of the air induct-pipe removed some little distance away, as shown at E on the same plate, so that the vitiated air driven out by the discharges through the soil-pipe may not come out where they can give offence.

Induct-pipes with mica-valves.

When no convenient place can be found for leaving the mouth of the induct-pipe open to the

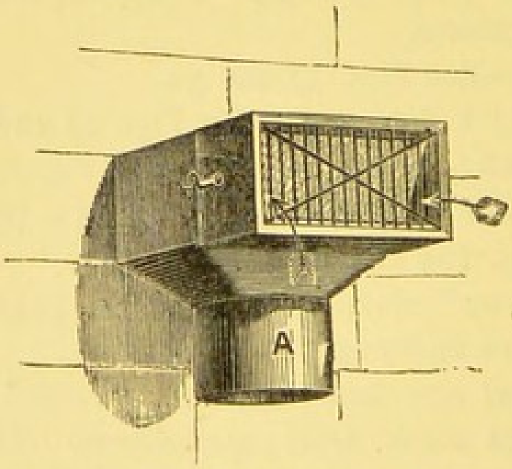


FIG. 116.—View of "Mica-valve"—Vertical.

atmosphere, a *mica-valve* can be fixed over it, as shown at Figs. 52 and 64, and also as shown on

Plate XV., Plate XIX., Fig. 1, and on Plate XX., Fig. 2.

Fig. 116 shows a *perspective view* of a "*mica-valve*" for fixing on the top of a *vertical* induct-pipe, and Fig. 117 shows a view of one for fixing on the end of a *horizontal* air induct-pipe. They are made in various sizes, to fit pipes from 2 in. to 4½ in. diameter.

These mica-valves are encased in strong zinc,* but of course they can be made with any other

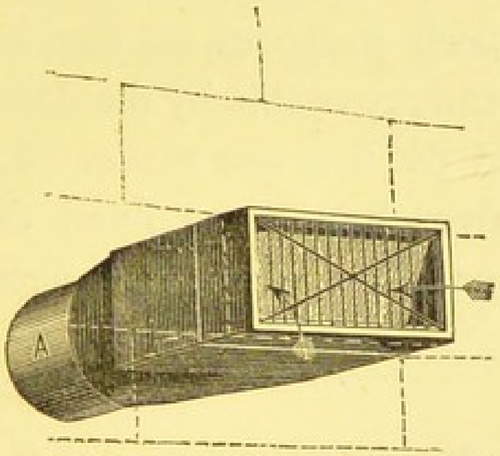


FIG. 117.—View of "Mica-valve"—Horizontal.

material—in copper, or stoneware, to suit circumstances. The mica-flap is protected by a movable wire guard, as shown in the cuts.

When these mica-valves are fixed on the tops of the induct-pipes to soil-pipes, drains, &c., directly any discharge is sent into the soil-pipe, the mica-flap is closed by the pressure of the soil-pipe air behind it, and the air driven down

* These valve-flaps are now being made in copper with cast iron cases.

by the discharges is made to escape through the air escape-pipe of the traps; or, when no such air escape-pipe exists, then the air is compressed into the induct-pipe, except what escapes back the soil-pipe through the discharges. Immediately the discharge has passed out of the soil-pipe, the compressed air in the induct-pipe rebounds back into the soil-pipe, and the upcast of air goes on again—the atmospheric air passing freely through the mica-valve.

The Author claims to be the first to use mica-valves for such purposes as just explained, and believes he can prove this by the date of his design when he had the first one made. Large numbers of these valves have been fixed during the last three or four years with great success.

Table of References to Plate XV., with some Explanation.

Plate XV. shows a stack of Soil-pipe with three "Vortex" Closets upon it; also Cistern and Service-pipes to supply same.

A.—*Patent "Vortex" closet and trap in one piece.*—See Figs. 80—87, pp. 196—204.

A[1].—*Ditto with valve and regulator supply.*—See Fig. 83, p. 199.

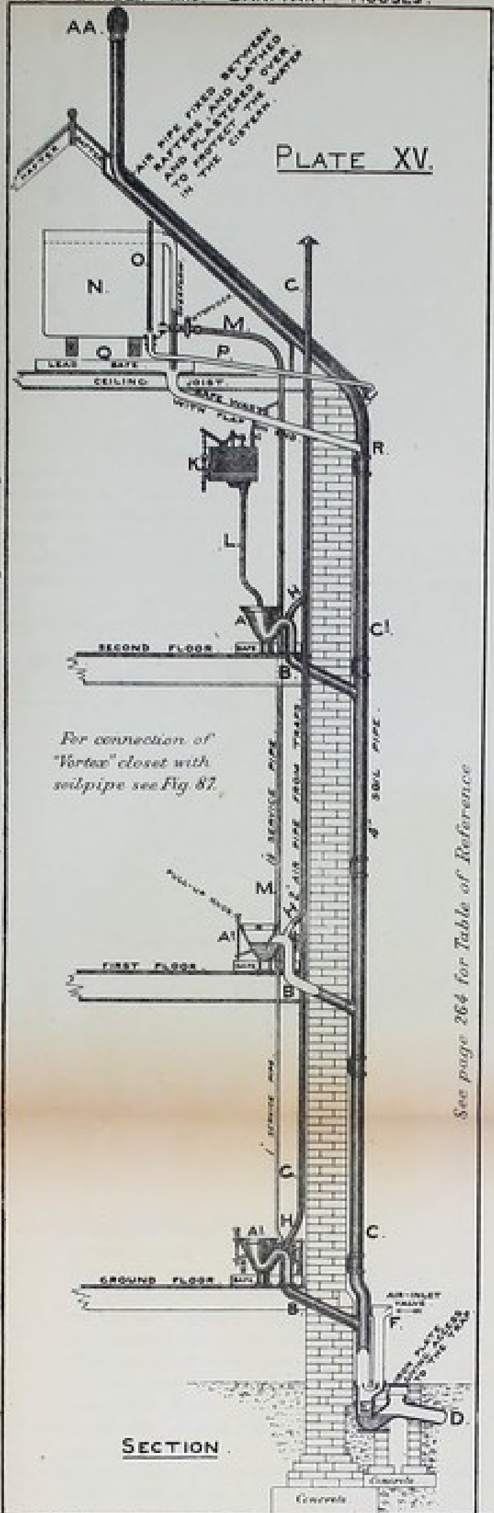
A A.—*Copper wire domical grating.*

B.—*Branch soil-pipe.*

C.—*Main soil-pipe.*—This is a 4-in. (7-lb.) lead pipe. It is fixed outside the house, and secured to the external face of the wall by two large lead tacks, soldered to the

PLATE XV.

See Plate IXA for Services to Water Closets by Water Waste Preventing arrangements



See page 264 for Table of Reference

FIG. 1.—A view of three "VORTEX" closets, with their soil-pipes, services, and safes, &c., &c.

NOTE.—For the sake of clearness the safe-wastes are not shown (except on plan, Fig. 2), and the *branch* soil-pipes are not shown in their correct position with relation to the wall and *main* soil-pipe, but are turned round in order to show themselves better. Also, for the sake of clearness, the air-inlet-pipe F is shown in front of the soil-pipe, but in reality it would be one side.

See Table of References, page 264.

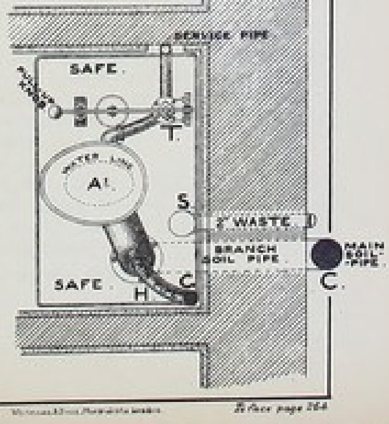


FIG. 2.—PLAN of "Vortex" closet (ground and first floor), with its supply-valve, safe, &c., &c.

SECTION

Fig. 1.—A view of three "Vortex" closets, with their soil-pipes, services, and safes, &c., &c.

Note.—For the sake of clearness the safe-wastes are not shown (except on plan, Fig. 2), and the branch soil-pipes are not shown in their correct position with relation to the wall and main soil-pipe, but are turned round in order to show [illegible] better. Also, for the sake of clearness, the [illegible]-pipe B is shown in front of the soil-pipe, but in reality it would be one side.

See Table of References, page [illegible].

Fig. 2.—Plan of "Vortex" closet [illegible], with its appliances, safe, &c.

pipe about every 7 ft., with three wall-hooks in each. A lead astragal is soldered to the pipe in a line with the top and bottom of each pair of tacks, to make the soil-pipe look neat, as shown on Plate XXIA; and the pipes are jointed together by a *strongly*-made *copper bit** soldered joint immediately above the top astragal of each pair of tacks.

E.—"*Combination soil-pipe trap.*"—See Figs. 46 to 56, pp. 157—162.

F.—*Foot ventilation.*—This is an air induct-pipe for the admission of fresh air into foot of the soil-pipe, with a mica-valve over its mouth to prevent any vitiated air coming out at this point.—See Fig. 116, p. 262.

G.—*Trap ventilation or air escape-pipe*, to prevent any syphoning action on the closet-traps, and to ensure that every part of the soil-pipe is ventilated.

H.—*Ventilating branches from outgo of water-closets* into the ascending air escape-pipe.

K.—*Patent* "*Sluice*" *apparatus for flushing out closet.*—See Fig. 98, p. 228.

L.—$1\frac{1}{2}$-*in. lead service-pipe from* "*Sluice*" *apparatus to water-closet.*

M.—$1\frac{1}{4}$-*in. lead service-pipe*, to supply the "Sluice" apparatus on the second floor, and the water-closets on the first and ground floors.

N.—*Cistern.*—See Fig. 19.

O.—*Standard-plug for emptying cistern.*—This is a lead pipe soldered to the brass waste at the bottom end, and having a sealed (soldered) end at the top. The overflow-pipe discharges into the overflow-pipe of the safe under the cistern.

P.—*Under-waste to cistern.*

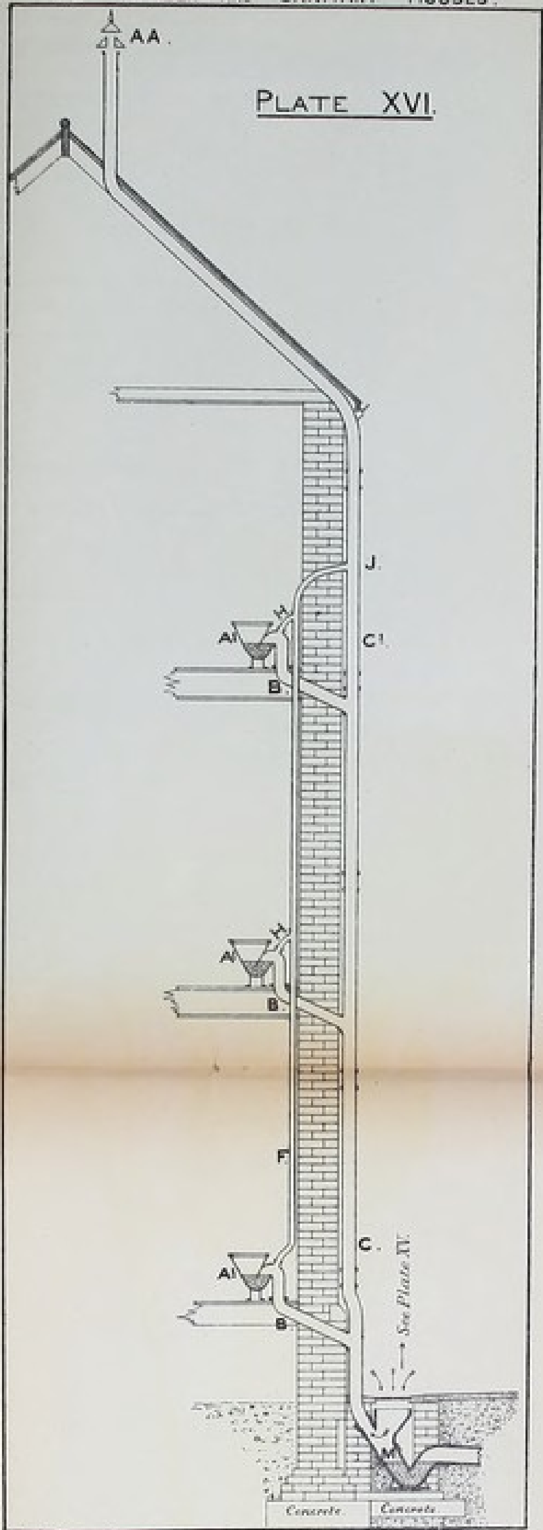
R.—*Copper hinged flap soldered on end of overflow-pipe* to prevent birds building in same, and to prevent cold air passing through the pipe in winter, and freezing the water in the cistern.

* See Plate XXIA, page 274.

S.—*Overflow-pipe to safe.*—This is a 2-in lead pipe taken from the safe, and carried through the external wall with a copper hinged-flap soldered on the end of the pipe.

Escape-pipe from the traps.

When *soil-pipes* discharge with *open ends*, as shown on Plates XI., XII., XVI., and XVII., the value of carrying the air *escape-pipe from the traps* out to the atmosphere *separately* is not so great as when the discharging end is less open to the atmosphere—as, for instance, when it is taken into a trap as shown on Plate XV. In the former case the air driven down by the discharges through the soil-pipe finds a *ready outlet* through the *open top* of the trap, but in the latter case a special barrier is put over the mouth of the induct-pipe, at F, to prevent any vitiated air coming out at this point, and the soil-pipe air is sent up through the air escape-pipe (H, G, Plate XV.) to the atmosphere outside the roof. But when the air escape-pipe from the traps is carried into the *main* ventilating-pipe of the soil-pipe (unless the discharging end of the soil-pipe is perfectly open) the *air* sent *up* through the escape-pipe is brought into collision with the air drawn *down* the ventilating-pipe by the discharges through the soil-pipe. In such cases it is better to take this ventilating-pipe from the traps right out to the atmosphere, as shown at E^1, Plate XIII., and G, Plate XV.



S. S. Hellyer, del.

To face page 266.

A Geometrical Section of a stack of 4-inch soil-pipe, with three "VORTEX" closets upon it.

EXPLANATION,

The *closets* and *soil-pipe* shown here are similar to those shown on Plate XV., the only difference being in the terminations of the soil-pipe at top and bottom; and also in the *connection* of the air-pipe from the traps with the ventilating-pipe **J**, to the soil-pipe.—See reasons for these variations, page 266.

REFERENCES.

AA—"Double-cap" ventilating cowl.

A^1—"Vortex" closets and traps in one piece.

B —Branch soil-pipes.

C —4-inch lead soil-pipe, fixed with astragals and tacks, continued up from **C^1** to **AA** for ventilation.

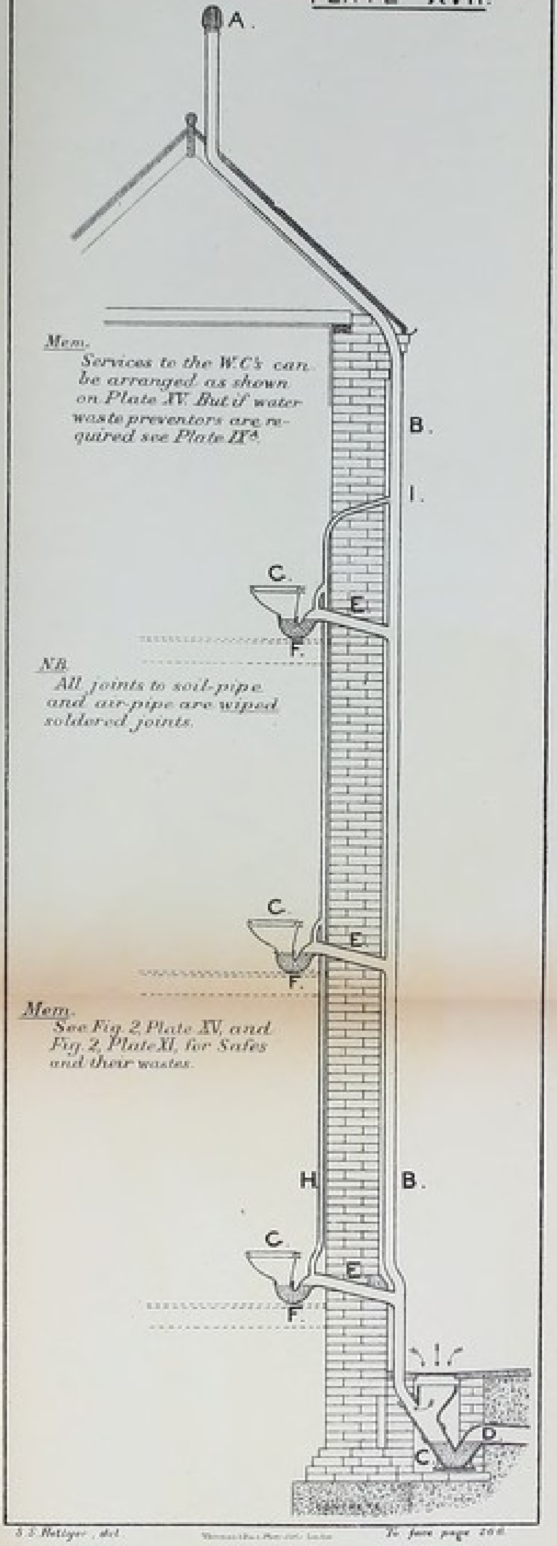
F —2-inch lead ventilating pipe to traps—air escape pipe.

H —2-inch lead branch air-pipes from traps.

M —4-inch "ventilating drain-syphon and soil-pipe disconnector."—

See Figs. 57 & 57^a pages 163 - 165

PLATE XVII.



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A Geometrical Section of a stack of 4-inch lead soil-pipe with three "Artisan" closets upon it. See Plate IXA for mode of supplying same by Water Waste Preventors.

REFERENCES AND EXPLANATION.

A—Domical grating—for cheapness.

B—4-inch soil-pipe, 6 lb. lead.—See reference letter C, page 264.

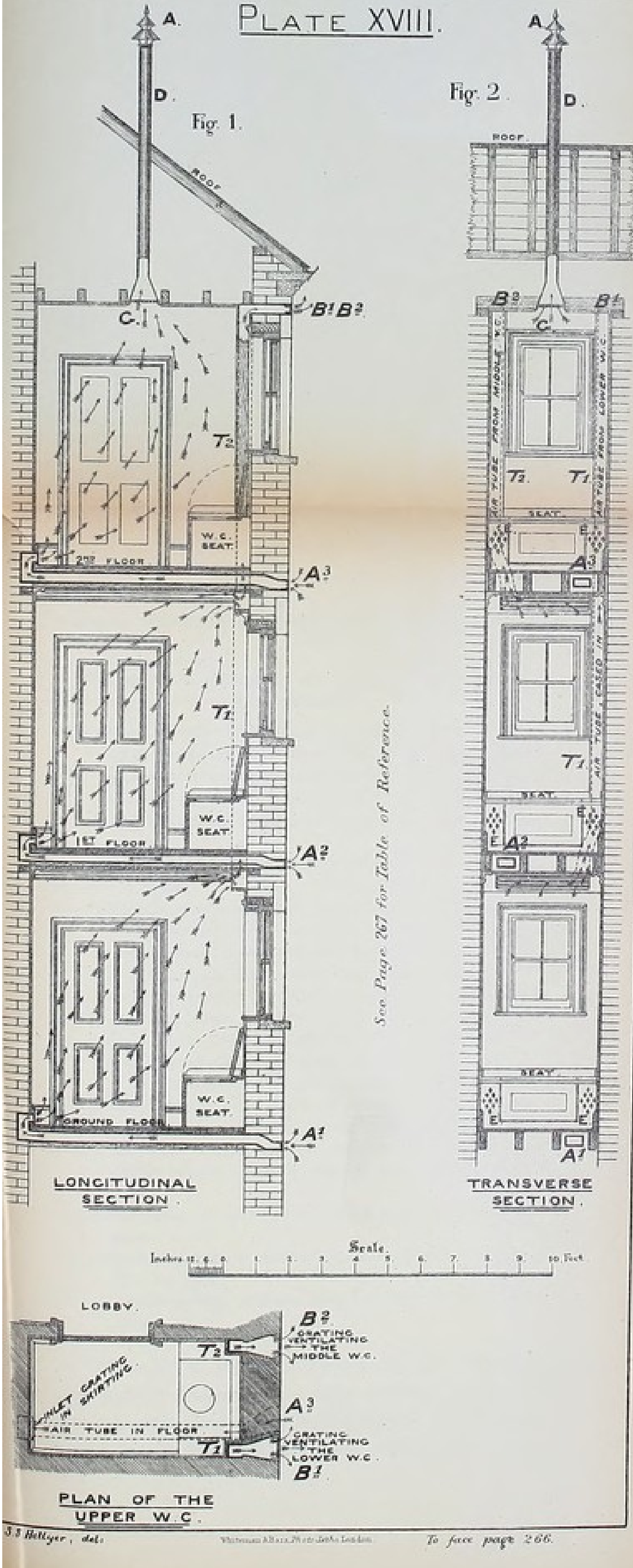
C—"Ventilating drain-syphon and soil-pipe disconnector."—
See Fig. 57, page 163.

F—4-inch "Patent cast lead traps."

G—Patent "Artisan" closet basin.—See Figs. 89 - 95, pages 205 - 210.

H—Trap ventilation.—A 2-inch lead air-pipe is taken from the top of the lowest trap, to prevent the traps syphoning, and continued up (receiving the branches from the upper traps on its way) above the highest trap, when it is branched into the *main* ventilating pipe to soil-pipe at I.

PLATE XVIII.



See Page 267 for Table of Reference.

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Table of References to Plate XVIII., and Explanations.

A[1].—*Fresh-air inlet to water-closet, ground floor.*—A zinc tube, about 6 in. by 3 in., is fixed between the joists, as shown at A[1] on *transverse section*, with an air-brick in the external wall for the admission of fresh air, and a hit-and-miss grating is fixed in the skirting to regulate the same.

A[2].—*Fresh-air inlet to water-closet, first floor.*

A[3].— *Ditto ditto second floor.*

B[2].—*Air-outlet from water-closet, first floor.*—A zinc tube is taken from the ceiling-line of the first-floor water-closet, and continued up through the second-floor water-closet, as shown in the *transverse section*, and out at B[2].

D.—*Ventilating-shaft to second-floor water-closet.*—This is a zinc shaft taken from the ceiling-line of the second-floor water-closet, and continued up through the roof with a cowl on top of same to prevent blow down. A hit-and-miss circular grating can be fixed over the mouth of this pipe when in a private house to prevent the cold air coming in during severe frosty weather, but when this is done the shaft should be hoppered out at bottom to nearly twice its size, as represented at G.

E.—*Perforations in water-closet-seat*, for circulation of air in same.

T[1].—*Ventilating-shaft to water-closet, ground floor.*—See B[1]; also see *plan.*

T[2].—*Ventilating-shaft to water-closet, first floor.*—See B[2] and *plan.*

Plate XIX. shows a Drainage Plan, which the Author designed for a large country house, on the principles laid down in this book. The house has been in full occupation for over a year, but Drainage Plan.

no bad smell has ever been detected in any part of the whole system; in fact, as far as it can be examined, the drainage is as wholesome to-day as it was after the first week's usage.

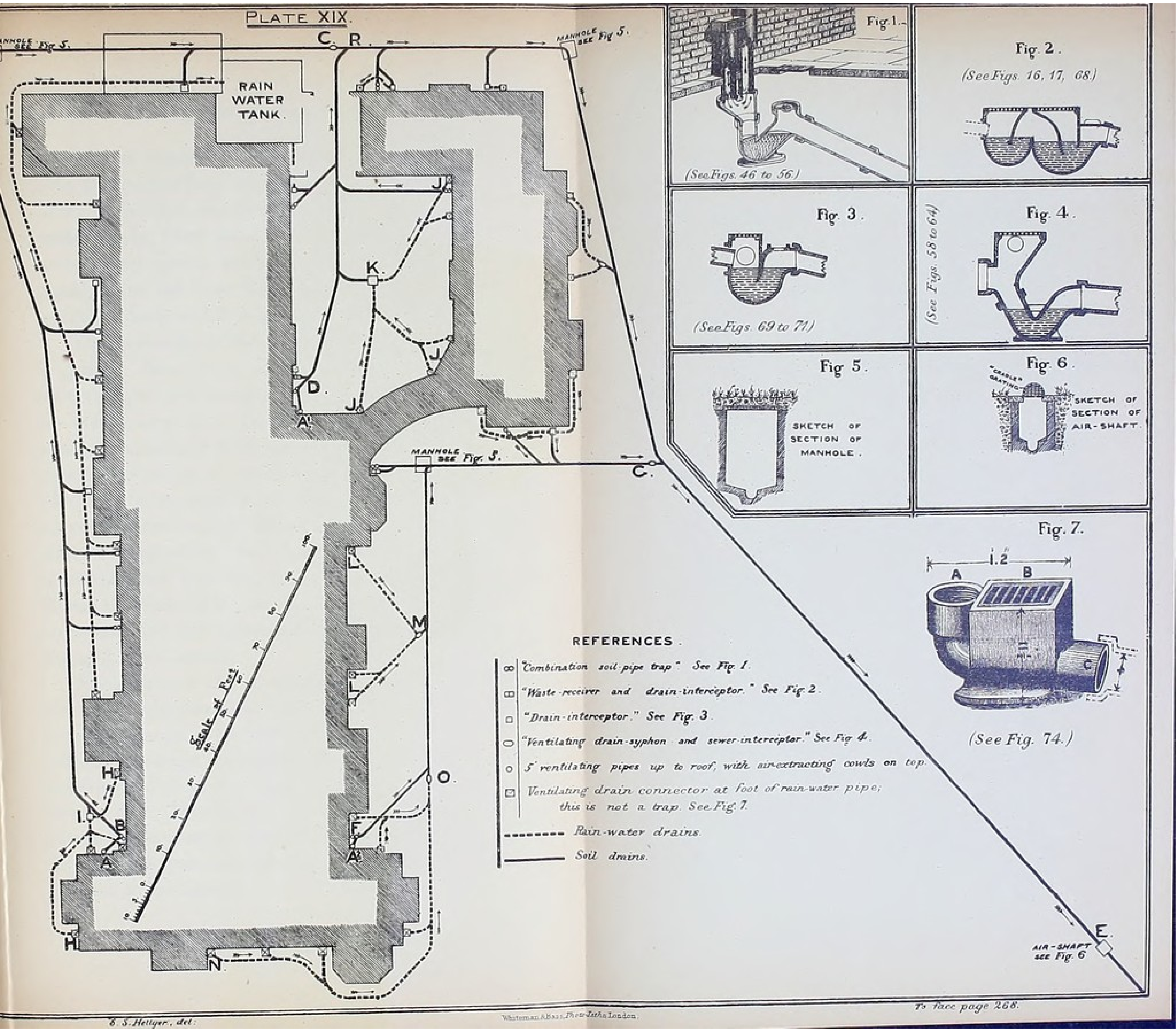
Sections. The drainage is divided into *three* sections:—(1) To bring the *inlets* for fresh air *nearer* to the ventilating-pipes, or *outlets*; and (2) to *insure* a continuous air-flush through the whole system of drainage.

There is not a foot of drain-pipe *inside* the house.

No long branches. The main drain is *specially planned* to *avoid long branches*, for where long branch drains exist, unless they are ventilated, the air in them must soon become foul.

The *waste-pipes* from the sinks, lavatories, and baths are all brought through the external wall and made to discharge with *open ends* into ventilating "drain-interceptors," as shown at Figs. 69 and 70.

Pipes localised. The soil-pipes are all *localised*, *i.e.*, the soil-pipes discharge *separately* into *ventilating* "*soil-pipe traps*," as shown at Fig. 1, Plate XIX. By this means the *drain-air* is shut out from the discharging end of the soil-pipe, and a *stream* of *fresh air* is made to pass into it through the short air-induct-pipe, H. A mica-valve is fixed over the mouth of the induct-pipe to each stack of soil-pipe to prevent any vitiated air escaping through



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it, as it was impossible, without great expense, to take them away from the proximity of windows. *More* open traps, as shown at Figs. 57 and 57*a*, could not be fixed here, as the leaves from the surrounding plants would soon cover over the gratings, and the loose earth from the flower-beds would be liable to fall in and stop up the traps.

Advantages of localising soil-pipes, &c.

The advantage of localising each stack of pipe is greater than many people imagine. When several pipes are brought into one main drain—no matter how open the drain may be, or how great the stream of fresh air passing through it—there is no means of distributing the air, and *one* pipe may be thoroughly *air-cleansed* while *another* may not have enough air passing through it to shake an aspen-leaf. But when *each* stack of pipe is *disconnected* from the drain or *intercepted*, as shown on Plate XIX., each soil-pipe then becomes an *upcast*, and the circulation of atmospheric air through it is constant.

Inlet and outlet.

Each stack of soil or waste-pipe should, therefore, have its own *inlet* and *outlet*, to secure a constant change of air taking place in it. And so with the drainage. Long branch drains should be disconnected from the main drain by a trap, as shown at C, Plate XIX., and a ventilating-pipe should be *fixed* at the *head* of such branch drains for the air to pass into the drain at the lowest end and out at the highest.

Drain-openings.

The drain empties itself into a ditch about half a mile away from the house, and *openings* are made over the drain, as shown at E, Plate XIX., and Fig. 6 on the same plate, about thirty yards apart.

As before explained, the drainage is divided into *three* sections:—A "*Ventilating Drain-Syphon*" is fixed at C, to give this section its own ventilation; another "Ventilating Drain-Syphon" is fixed at G, to give this lower section a separate ventilation as well. Each drain has, therefore, its own ventilation. The atmospheric air is drawn into the main drain at the opening, E, and out through the 5-in. ventilating-pipe, A^1. It is also drawn in at C, and out through the ventilating-pipe, A. And it is further drawn in at G, and out through the ventilating-pipe, A^2. The three ventilating-pipes, A, A^1, and A^2, are carried up (outside the house) well above the roof projections, with an extracting cowl on each.

Rain-water.

The bulk of the rain-water is collected into a rain-water-tank, as shown; but the rain-water from two or three rain-water-pipes is collected into a "drain-intercepting-trap" at the *head* of *each* drain, I, P, and K, as shown by the dotted lines, and it is then taken into the soil-drain. Thus when a sharp shower of rain falls, a tolerable flush is sent through the drain from the collective rain-water-pipes.

Instead of fixing a *trap* at the bottom of *each* rain-water-pipe, and connecting it with the drain, it is better to fix an *intercepting-trap* here and there, *near the main drain*, as shown on Plate XIX., or a "flush-tank," as Fig. 67, p. 175, and collect the rain-water into it, so as to send the *col-*

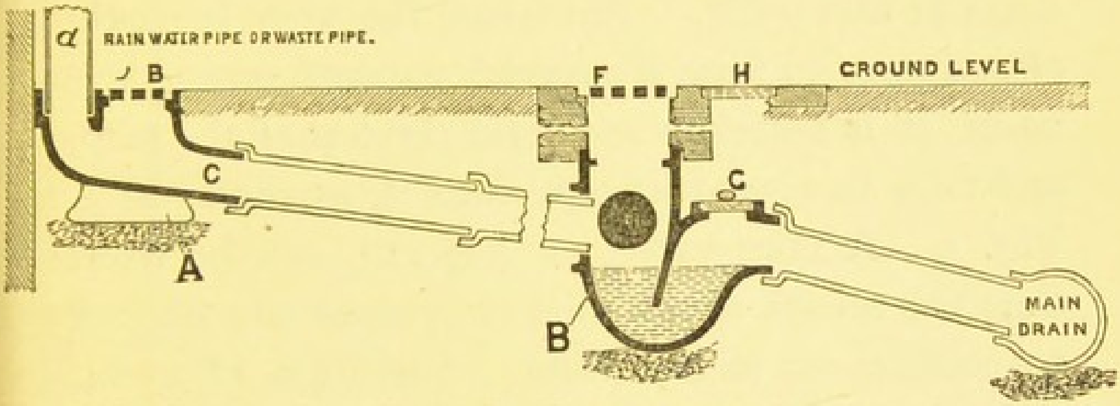


FIG. 118.—Section of a "Ventilating Drain-connector," showing its connection with a R. W.-pipe and Drain.

lected water with *some force* into the drain. Such an arrangement would do away with the questionable value of traps at the bottoms of rain-water-pipes, and, at the same time, it would avoid the evils of long branch drains. The Author has designed a stoneware "Ventilating Drain-connector" for fixing at the bottom of rain-water-pipes and waste-pipes. Fig. 74, p. 184, shows a *perspective view* of it, and Fig. 118 a *section*, at A. This diagram, Fig. 118, explains itself: B shows the "*intercepting-trap*" fixed close to the main drain, and A the "*Drain-connector*" fixed at the foot of a rain-water-pipe. See Plates XIX. and XXI.

Intercepting sewers.

Plate XX. shows two ways of trapping off the sewer from the house and giving air to the drain. When the area is fairly open to the atmosphere an *open* "*Ventilating Drain-syphon*" can be fixed, as shown in section, Fig. 1,* with the grating, G, over the top, for the admission of fresh air into the drain at this point. But when the area is partly closed over to form a covered passage-way to the vault, it is better to seal over the top of the trap, and take an air-induct-pipe into it, as shown at A, Fig. 2. A mica-valve, as Fig. 117, can be fixed over the mouth of the pipe to prevent any vitiated air coming out at this point. See Figs. 58 to 64, and pp. 165—171, explaining the advantages of fixing such traps as shown here, Plate XX.

Drains inside a house.

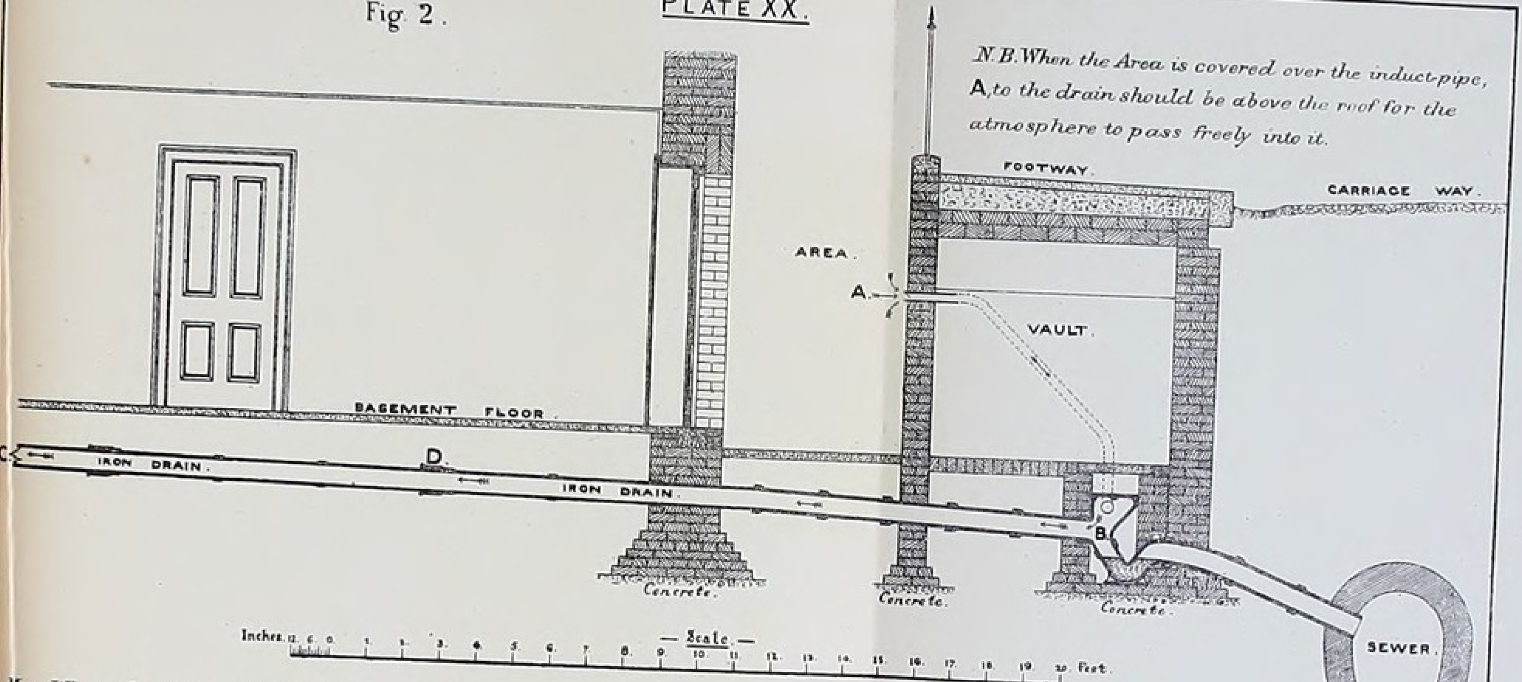
In towns it is generally impossible to keep the drains outside the house; but there is no reason when they are brought into the house why they should be of *stoneware* pipe with *defective jointings*. *Strong* cast-iron water-mains should be used, as shown on Plates XX. and XXI., well coated inside and out with solution, or, better still, protected from rusting by Professor Barff's Rustless Process, and the jointings well caulked with lead. Where it is practicable, the drain should be carried above the floor of the basement, where it can be seen.

The waste-pipes should discharge with *open*

* See *Plan*, Plate XXI.

PLATE XX.

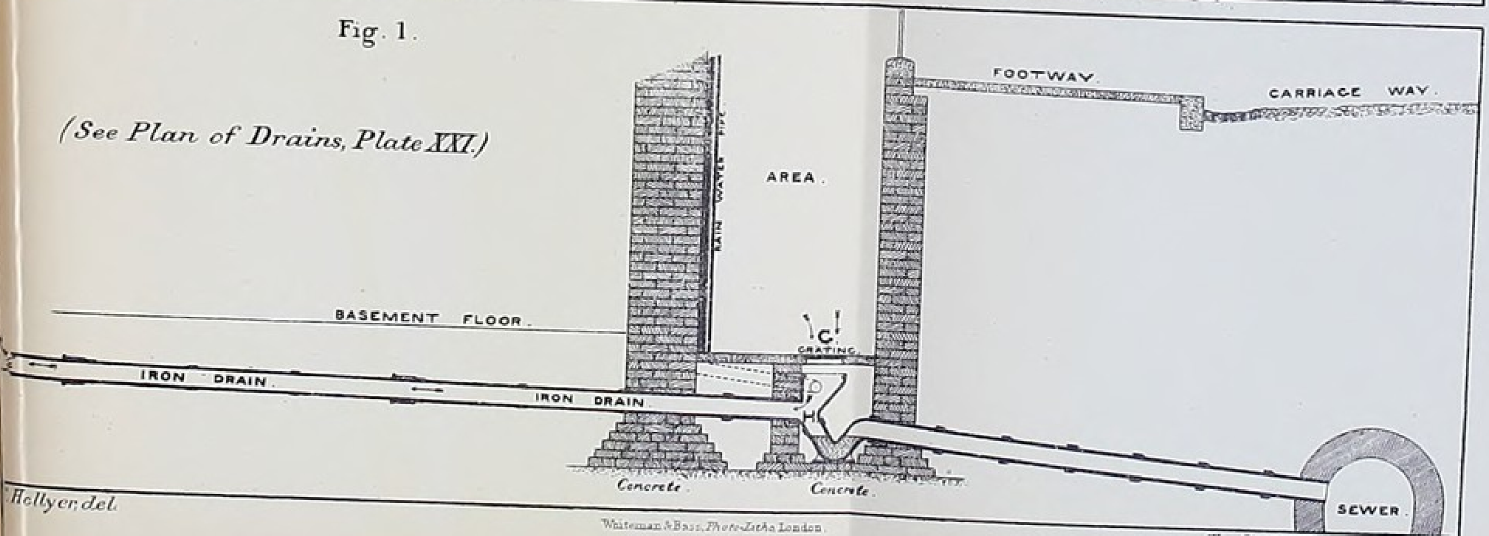
Fig. 2.



Mem.-When a Sewer-flap is insisted upon, the Syphon should still be used as shown here, as there is no perfect seal with a flap.

Fig. 1.

(See Plan of Drains, Plate XXI.)



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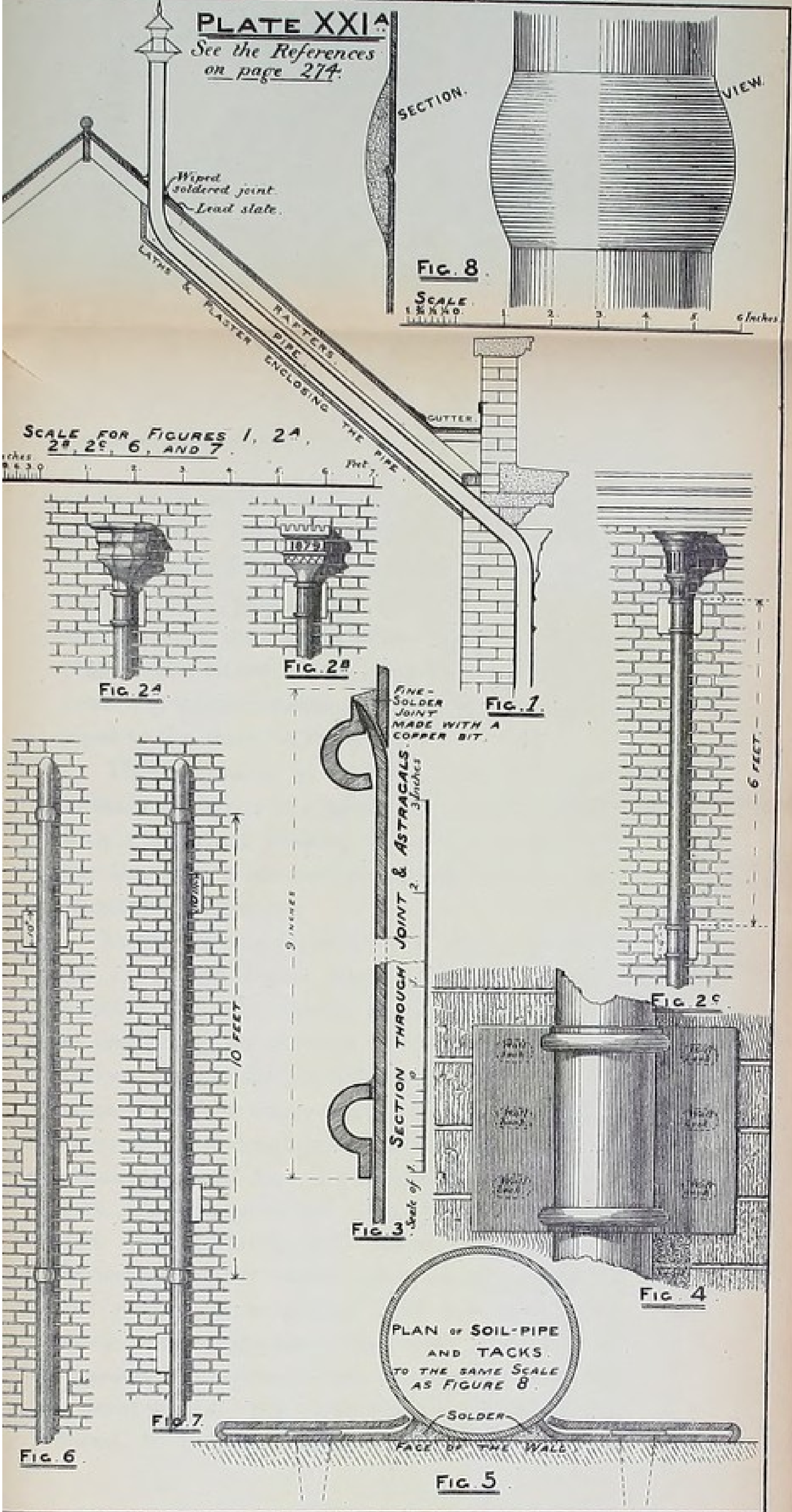

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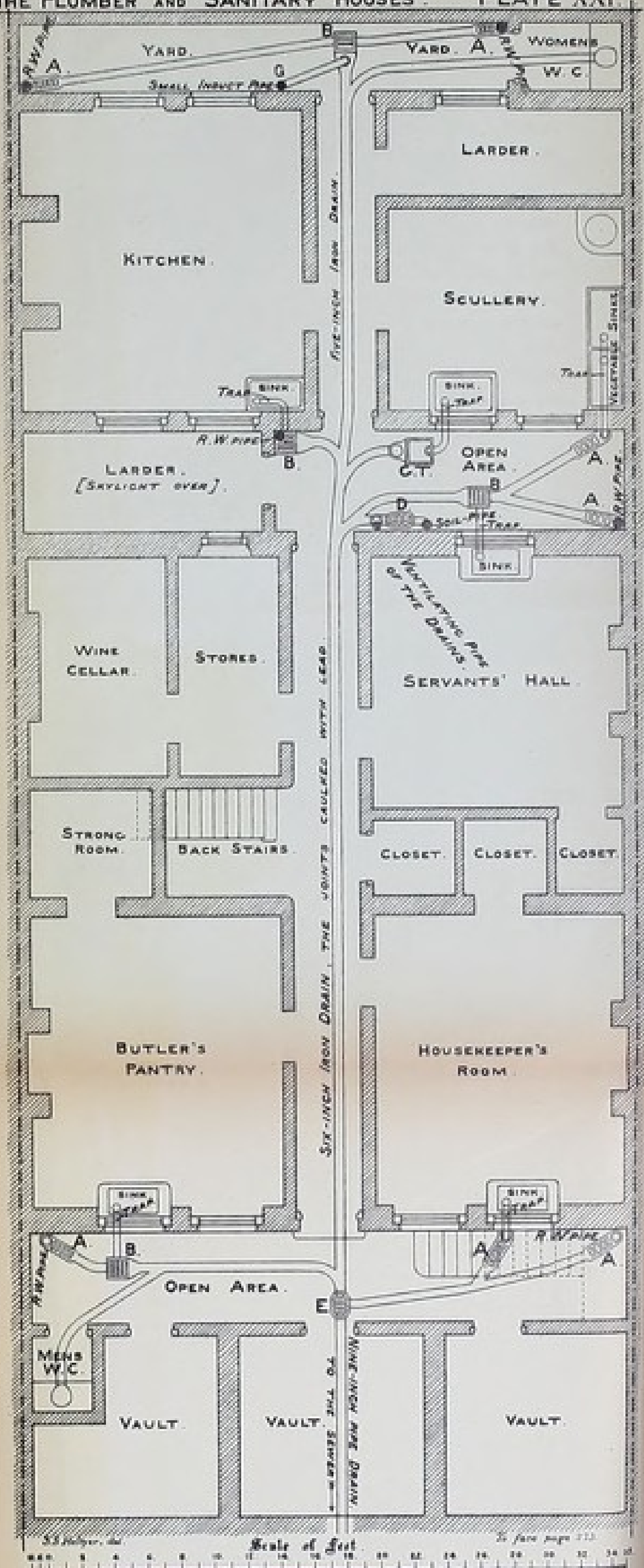
N.B.-The ends of the soil-pipes should be tinned before the pipes are put together.



THE DRAINAGE OF A TOWN HOUSE.

[SEE THE REFERENCE TABLE ON PAGE 273]

NOTE 1.—As the *roof* over the kitchen offices is only a *low one*, the upcast ventilating-pipe of the drain is carried up, at **F**, on the *face* of the external wall of the *main building;* and, to prevent any stagnant air taking place between the head of the drain and this point, a *small induct*-pipe is fixed at **G** ; care must be taken to see that such induct-pipe (**G**) is not too large, or it will interfere with the main inlet for fresh air at the discharging end of the drain—at **E**.

NOTE 2.—The upcast-pipe (**F**) should, where practicable, be taken from the *highest point* of the drain; but where to do this the *bends* in the pipe would be largely increased, or where it would take a long length of "horizontal" piping, it is better to ventilate the drain where the upcast would be direct and vertical—as shown at **F** on this plate.

ends into *intercepting-traps* in the areas, as shown on this Plate (XXI.) and also on Plates IV., XIII., and XIV., and the soil-pipes treated as shown on Plates XI. to XVII. Where it is impossible to localise the soil-pipes—*i.e.*, to give each pipe its own ventilation, as explained on p. 269—great care must be taken to see that the drain is properly intercepted from the sewer, and that the atmospheric air can pass freely into the drain.

TABLE OF REFERENCES TO PLATE XXI.

A.—" *Ventilating Drain-connector.*"—See Fig. 74, p. 184, and A, Fig. 118, p. 271.

B.—" *Drain-interceptor.*"—See Figs. 69—71, pp. 178, 179.

D.—"*Soil-pipe Disconnector.*"—See Fig. 57*a*, p. 165.

E.—" *Ventilating Drain-syphon and Sewer-interceptor.*"—See Figs. 58—64, pp. 166—171 : also in *Section* Plate XX.

F.—5-*in.* (*or* 6-*in.*) *Ventilating-pipe to drain.*—This pipe should be carried up to the very highest point of the roof, so as to stand several feet above all projections, and an extracting cowl should be fixed on top of same.

G.—2-*in. Induct-pipe* to prevent stagnant air taking place in any part of the drain. This pipe should only stand a foot or two above the ground; when the drainage between this pipe and the main ventilating pipe of the drain is of greater length than shown on this plate, a mica-valve, as shown at Fig. 116, should be fixed on the top of this induct-pipe.

G.T.—"*Grease-intercepting trap.*"—See Fig. 115, p. 250. Also see Figs. 72 and 73, p. 181.

Mem.—In getting out this plan of a Town-house Drainage, the *bath and lavatory waste-pipes* have been forgotten, but they can be taken down where convenient, and made to discharge, with *open ends*, into one of the

"Drain-intercepting" traps, marked B, or they can have another "Drain-intercepting" trap fixed to suit circumstances.

PLATE XXIA shows several ways of fixing *lead* soil and ventilating pipes; also *lead heads* for *masking* pipes where they bend through a wall to avoid going over a parapet, &c. &c.

Fig. 1.—*Section* showing the soil-pipe continued up to the highest point of roof for ventilation, with a *lead head to mask the pipe where it turns through the wall.*

„ 2 C.—*Elevation* showing lead soil or ventilating pipe fixed with tacks and *astragals;* also a lead pipe-head to mask the pipe where it turns through the wall.

„ 2 A and 2 B.—*Lead pipe-heads* for *masking* soil or ventilating pipes where they bend into a wall.

„ 3.—*Section* through the *astragals* and *jointing* of pipes.

„ 4.—*Elevation* of ditto, and of the tacks.

„ 5.—*Plan* showing tacks (of 7 lb. lead) soldered to pipe and folded back to cover, to protect the heads of the wall-hooks.

„ 6.—*Elevation* of a lead soil-pipe with *wiped* soldered joints, and *four* 10 in. tacks (of 7 lb. lead) soldered to every 10 feet length.

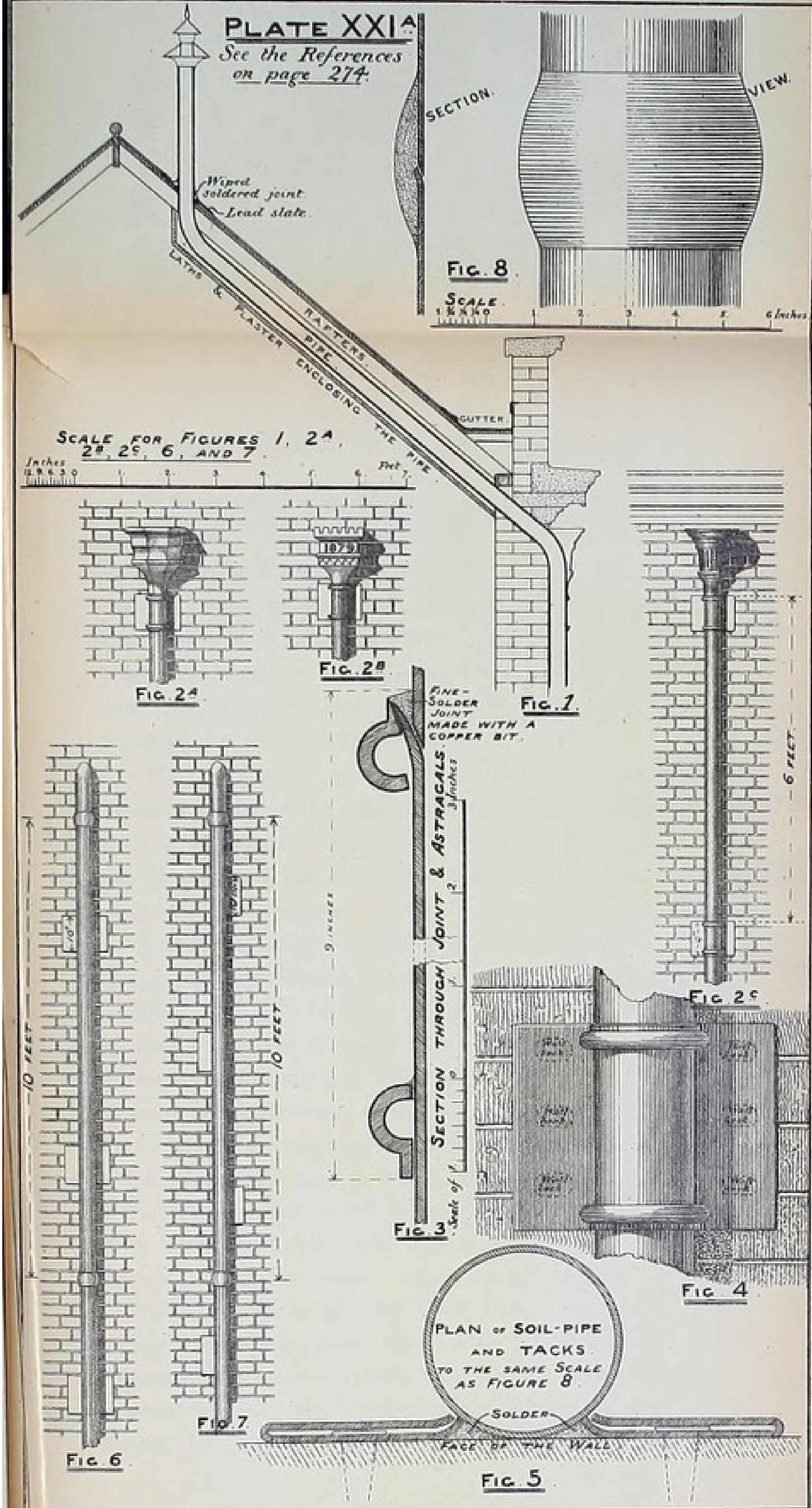
„ 7.—*Ditto*, but with *three* tacks to every 10 feet length.

„ 8.—*Elevation and Section* of a *wiped** soldered joint (Plumbers' joint); the joint is made long to strengthen the pipe, as well as to give it a better appearance.

Concentration.

The Author concludes this chapter, as he began it, by insisting upon *concentration.* Avoid all long lengths of branch-drainage, and limit the number of water-closets to the requirements of the household. Never place any sanitary "fitting" where light and air cannot freely reach it,

* For a wiped soldered *flanged* joint, see page 33.



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N.B.-The ends of the soil-pipes should be tinned before the pipes are put together.

and always see that such places can be *easily* kept wholesome. Insist upon the *separation* of all *cistern-wastes* from other wastes, and keep the ends of such pipes away from all places where any foul air can reach them, from ventilating-pipes, water-closets, sinks, and dust-bins, to prevent any contaminated air passing through the pipes to the water in the cisterns.

The Sanitarian is bound to see that every sanitary appliance in a house is properly supplied with a sufficient flushing apparatus for cleansing the drainage, or his modern improvements will be of questionable value. Flushing apparatus.

In the *old* way of draining a house the air in the pipes and drains was confined as much as possible, and only allowed to escape in the form of noxious gases through the water-seals of the various traps, or the gas-holes they had made in the pipes. Old way, air confined. But *now* every waste-pipe, every soil-pipe, every piece of drainage,—whether long or short, —has, or *should have*, a ventilating-pipe. New way, pipes open. Now if such drainage-pipes are allowed to get foul, as they most certainly will unless they are well flushed out with water, what an aggregate of foul stinks will be poured forth from the multiplied ventilating-pipes from the hundreds of thousands of houses in this metropolis. Pray for a great wind? Yes! and move your house, my friend, to the wind side of the breeze. *Air-*

flushes will help to sweeten the pipe, but good *water-flushes* are necessary after each usage to keep it wholesome.

Fittings over Sewers.

If we could only fix our closets, urinals, sinks, and lavatories directly over the sewers, how soon we should arrive at what Dr. Richardson would be able to call Salutland; and if this could have been done a year or two ago, what a war of words, and a purse of gold, would have been saved on the water question; for less than one-half the water now used would suffice to keep these fittings in such positions wholesome.

TABLE SHOWING WEIGHTS OF LEAD PIPES OF VARIOUS SIZES AND STRENGTHS, FOR USE ACCORDING TO CIRCUMSTANCES.

All lead pipes should be made by hydraulic pressure, and great care should be taken to have the pipe of even substance all round.

——	Class A.		Class B.	Class C.	Class D.
SOIL-PIPE.—$3\frac{1}{2}$-in., 4-in., $4\frac{1}{2}$-in., and 5-in.—equal in substance to *sheet* lead per superficial foot	lbs. 10	or lbs. 9	8 lbs.	7 lbs.	6 lbs.
[Thickness of lead . .	$\frac{5}{32}$	$\frac{9}{64}$	$\frac{1}{8}$	$\frac{7}{64}$	$\frac{3}{32}$]

——	Class A.	Class B.	Class C.	Class D.
VENTILATING-PIPE. — $2\frac{1}{2}$-in., 3-in., $3\frac{1}{2}$-in., 4-in., $4\frac{1}{2}$ in., and 5-in.—equal in substance to *sheet* lead per superficial foot .	8 lbs.	7 lbs.	6 lbs.	5 lbs.
[Thickness of lead . .	$\frac{1}{8}$	$\frac{7}{64}$	$\frac{3}{32}$	$\frac{5}{64}$]
Ditto.—2-in. air-pipe, weight per *yard lin.*	18 lbs.	16 lbs.	14 lbs.	12 lbs.
Ditto.—$1\frac{1}{2}$-in. air-pipe, weight per *yard lin.*	14 lbs.	12 lbs.	11 lbs.	9 lbs.

——	Class A.	Class B.	Class C.	Class D.
WASTE-PIPE.—*Cold* water wastes—				
	10 lb. lead.	9 lb. lead.	8 lb. lead.	7 lb. lead.
3-in. pipe, weight (about) per yd. lin.	25 lbs.	23 lbs.	20 lbs.	18 lbs.
2½-in. ,, ,, ,, ,,	21 lbs.	19 lbs.	17 lbs.	15 lbs.
2-in. pipe, weight per yard lin.	24 lbs.	21 lbs.	18 lbs.	16 lbs.
1½-in. ,, ,, ,, ,,	18 lbs.	16 lbs.	14 lbs.	12 lbs.
1¼-in. ,, ,, ,, ,,	14 lbs.	12 lbs.	10½ lbs.	—

——	Class A.	Class B.	Class C.	Class D.
DITTO.—*Hot* water wastes—				
	14 lb. lead.	10 lb. lead.	9 lb. lead.	8 lb. lead.
3-in. pipe, weight (about) per yd. lin.	35 lbs.	25 lbs.	23 lbs.	20 lbs.
2½-in. ,, ,, ,, ,,	29 lbs.	21 lbs.	19 lbs.	17 lbs.
2-in. pipe, weight per yard lin.	27 lbs.	24 lbs.	21 lbs.	18 lbs. or 16 lbs.
1½-in. ,, ,, ,, ,,	21 lbs.	18 lbs.	16 lbs.	14 lbs.
1¼-in. ,, ,, ,, ,,	16 lbs.	14 lbs.	12 lbs.	10½ lbs.

N.B.—For Weights of *Services and weights of Rising*-mains*, see Table showing same, p. 133.

TABLE SHOWING THE *OUTSIDE* AS WELL AS THE *INSIDE* DIAMETER OF CERTAIN STRENGTH PIPES.

Inside diameter .	½-in.	¾-in.	1-in.	1¼-in.	1½-in.	2-in.
Outside ,,	⅞	$1\frac{5}{32}$	$1\frac{15}{32}$	1¾	$2\frac{1}{64}$	$2\frac{9}{16}$
*Weight per yard	6 lbs.	9 lbs.	12 lbs.	16 lbs.	21 lbs.	28 lbs.

Pipes from ½" to 1" inclusive are made in *Lengths* of 15 ft., or in *Coils* of 60 ft.

Pipes from 1¼" to 2" inclusive are made in *Lengths* of 12 ft., or in *Coils* of from 40 to 50 ft.

Pipes from 2½" to 6" inclusive are made in *Lengths* of 10 ft.

* Lead *Rising-main*, London water companies' weights.

CHAPTER XXIII.

VENTILATION, OR COWL-TESTING, BUT NOT AT KEW.

Ventilation should be the alpha and omega of the Sanitarian, and as ventilation means nothing more or less than *changing the air*, let us see something about the *air* itself before seeing how to change it.

In speaking of the *atmosphere*, in his book on "Physiography," Professor Huxley says :—

"On accurately examining a given measure of atmospheric air, it was found that it contained about one-fifth its bulk of the gas oxygen, and four-fifths of nitrogen . . . The following table shows the densities, or specific gravities, of the three gases which compose the atmosphere :—

Nitrogen	0·9713
Oxygen	1·1056
Carbonic-acid Gas	1·5203

"The term *specific gravity* is used to denote the weights of equal bulks of different kinds or species of matter, compared with some known standard. Air is the standard used in the comparison just made, and it is seen from the figures that if a given bulk of atmospheric air weighs 100 lbs., then the same bulk of nitrogen weighs 97 lbs., the same volume of oxygen 110 lbs., and of carbonic acid 152 lbs. Hence it might be assumed that the atmosphere would consist of three strata or layers (like the mixture of quicksilver, water, oil), with the nitrogen as the top layer, and the carbonic acid at the bottom. As a matter of fact, however, this is not the case. All gases tend to intermingle with each other, so that when different gases are mixed they soon produce a uniform mixture in spite of differences in their relative weights; in fact, the particles of the heavy gas rise, and the particles of the light gas fall, until they are completely diffused through each other. In consequence of this property, the composition of the atmosphere is kept practically uniform, although local variations within narrow limits may be detected. . . . Atmospheric air is, in fact, about 800 times lighter than an equal bulk of water. . . . It is found by actual weighing that 100 cubic inches of air, under ordinary conditions, weigh about 31 grains; in other words, it requires 13 cubic feet of air to weigh a pound avoirdupois. . . . The air in Westminster Hall reaches to the enormous amount of nearly 75 *tons!* . . . It is found that our atmosphere exerts a pressure of nearly 15 lbs. (14.73 lbs.) on every exposed square inch of surface. . . . But the pressure downwards is exactly neutralised by the pressure upwards. . . . The air in a room presses on the ceiling not less than on the floor, and on each of the walls not less than on the ceiling."

Now the work of the Sanitarian will never be done until he can so scheme—either with or without the aid of mechanical appliances—that a *constant change* of atmospheric air shall be made to take place, not only in every bedroom, living-room, bath-room, water-closet and housemaid's-closet, but, also, in every waste-pipe, soil-pipe, drain, or enclosed place where the air in it is likely to be contaminated. Work of the Sanitarian.

The difficulty in arranging for the air to be changed in such places as those just enumerated Supply of air.

ought not to be insuperable, especially as this purifying fluid—atmospheric air—has not to be sought after, like water, but *moves* about everywhere within "about fifty miles of the earth's surface," *ready for use wherever it can be wanted.* As, therefore, every projection above the earth's surface is literally bathed with this atmospheric air, and when it is remembered that its pressure is nearly 15 lbs. to the square inch, it will be seen at once that the difficulty is not in getting it *into* a place but getting it *out.* So *insidious* is the air that it will insinuate itself into places where light could not enter. The difficulty in making the air *circulate—i.e.*, pass *in* and *out*—is lessened by the fact that it is in perpetual motion.

As the Author is chiefly concerned here with the ventilation of waste-pipes, soil-pipes, and drains, he will leave room-ventilation out of consideration—except as far as Cowls are advantageous for dwellings as well as drainage—and consider at once the advantages to be gained by the use of cowls in assisting the circulation of air through pipe drainage, &c.

"Ye cowl and ye monk."

If it is not "ye *cowl* which makes ye *monk*," it certainly is not the cowl which makes the ventilation. But as the cowl formed a fitting cap to the monk, so a cowl (or ventilator) forms a fitting top to a ventilating-pipe; though its power, when there, for causing an *upcast* of air through the pipe is not so great as some suppose, but it certainly is greater than the Cowl Testing Committee of Kew would have us believe.

In our first edition the Author explained that, whilst he thought it necessary to put cowls on the tops of ventilating-pipes to *drains*, he considered *plain caps* quite sufficient for fixing on the tops of ventilating-pipes to *waste-pipes* and *soil-pipes*. He now, however, considers that cowls should be fixed on *all* ventilating-pipes for *foul air*, not so much for assisting the *up-draught* as for *preventing* a *down-draught*, especially where the air *blown down* through such ventilating-pipes would come out near a window or door, where it could be *sucked* into the house. Cowls on pipes.

The Author has been *testing* cowls *off and on* for the last two or three years, to see the relative value of cowls over open pipes; and to find out the most efficient cowls in the market. But as it was not his intention to publish any results of such testings until within the last six or nine months, he has up to that time no reliable facts to give. Since then various* cowls, as shown on Plate XXIII., have been tested with great care, and the readings of the anemometers will be tabulated later on. Cowl-testing.

For the purpose of making simple tests, about a couple of years ago the writer had *two* 4-in. Pipes for testing cowls.

* See Plate XXIII., facing p. 291.

lead pipes fixed, as shown on Plate XXII., with soldered joints to prevent air leakage. The pipes are fixed outside the Author's factory, and are made to follow precisely the same course to prevent one pipe, or cowl, having an undue advantage over its rival. The pipes start from about 18 ft. above the ground level, and are continued up to a height of about 50 ft., the tops standing 6 or 7 ft. above the roof projections.

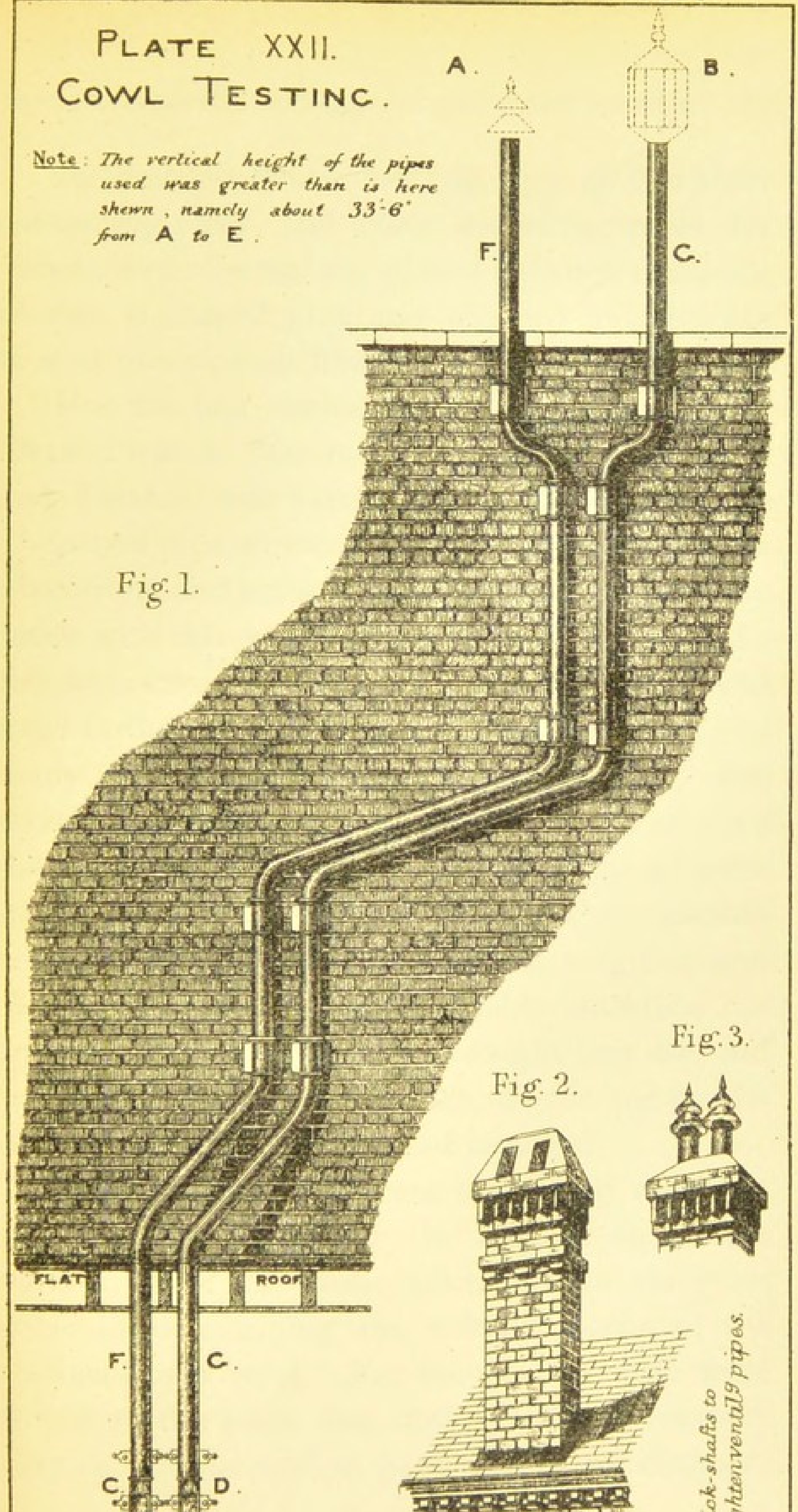
These two pipes are bent to suit the position of the building, and in this particular more resemble ventilating-pipes as fixed in practice than if they went up straight. The pipes are kept about a foot apart, except at the top, where they are bent away from each other, as shown on Plate XXII., and made to stand about 4 ft. apart to prevent one cowl screening the wind from the other.

U-shaped connecting pipe.

The pipes for one of the chief systems of testing are connected together at bottom by a 4-in. rectangular pipe bent in the shape of the letter U, with the ends rounded and socketed to fit the ends of the 4-in. pipes. The front face of the U-shaped pipe is made of glass, with a well-fitted *glass sliding-door*, as shown at E, Plate XXII., for inserting an anemometer inside the pipe, or other testing appliance, and for letting air in at the bottom of one or both pipes for various experiments.

PLATE XXII.
COWL TESTING.

__Note__: *The vertical height of the pipes used was greater than is here shewn, namely about 33'-6" from* A *to* E.



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A throttle-valve is fixed in each of two short connecting-pipes, and these connecting-pipes for various experiments are placed between the limbs of the U-shaped pipe and the two upcast-pipes to shut one pipe off from the other. Throttle-valve.

For the first simple testing of COWLS *versus* OPEN PIPES a "fan-meter," made by Negretti and Zambra, was fixed in one of the limbs of the U-shaped pipe where it could be seen through the glass front, and many interesting experiments were made with this arrangement. Afterwards to make the tests more reliable, another "fan-meter" was fixed in the other limb of the U-shaped pipe, and many more interesting trials were made. But though such tests were satisfactory as far as one's judgment was concerned, and enabled one to settle in his own mind the relative merits of the various cowls tested, there were no figures to guide one. And so, to arrive at some reliable statistics, the writer had two anemometers brought into use, and with the aid of these he is able to give the results of many testings as tabulated later on. Simple mode of testing.

TABLES Nos. 1 and 2 are interesting as showing how the cowls vary in themselves in the various trials, but these tables are of no great value in determining the *relative* merits of the various cowls tried. For though the cowls were tested on the same day, and in rapid succession, they cannot be said to have had *equal* chances ; Tables Nos. 1 and 2.

for the state of the wind, as well as the atmosphere, not only at times varies from hour to hour, but from minute to minute, and second to second. But in these single trials each cowl had the advantage of being tested on the same pipe and by one anemometer.

Cowls against Open pipes, Table No. 3.

TABLE No. 3.—A cowl is fixed on the top of one of the pipes, when testing Cowls against Open pipes, and the top of the other pipe is left open to the atmosphere. An anemometer is then placed inside the U-shaped pipe (through the glass door E), so that any air travelling through the pipe must pass through the anemometer. At the end of an hour a reading of the anemometer is taken, and the cowl changed over to the other pipe where it works for another hour, when another reading of the anemometer is taken. If the cowl has drawn the air through the open pipe in both cases it proves that the cowl is better than the open pipe.

"Pull, Devil! Pull, Beggar!" principle.

TABLE No. 4.—The cowls shown on Plate XXIII. have all been tested one against the other on the U-shaped pipe in the manner just explained with Cowls against Open pipes, on what the Author calls the "Pull, Devil! Pull, Beggar!" principle, and the results of such testing are given in Table No. 4, p. 293. One cowl was fixed on one of the pipes and another cowl on the other, as shown in dotted lines on Plate XXII., with an anemometer just inside the glass door, E. The cowls were then left for an hour, when a reading of the anemometer was taken, and the cowls changed over (for each cowl to have the like advantages or disadvantages), and another hour's trial was made. It matters little how much the cowls may have struggled with each other for the mastery during the hour's trial, the cowl which pulled in air through both the pipes proved itself to be either the best for *assisting an upcast* or *preventing a blow-down.* As a friend eloquently put it: "If two men clasp each other round for a trial of strength in the Strand, at Waterloo Place, the man who finally pulls his adversary to Charing Cross, or Temple Bar, proves himself the stronger of the two, no matter how far they may have pulled each other up and down the Strand in the struggle." But any disadvantage of getting a good grip through corpulency or other impediment should, of course, be allowed for.

TABLES Nos. 5, 6, 7 and 8.—This series of testing was made without the U-shaped pipe. An anemometer was fitted at the foot of each of the 4-in pipes, with the trial cowls at the top. By this means two cowls were tested simultaneously under almost precisely similar circumstances. To make this series of testing as perfect as possible, the cowls were tested for *one hour* on pipes, F

Double trial of two cowls simultaneously.

and G, when a reading of the anemometer was taken, and the cowls changed over for each cowl to have a trial, of one hour, on both pipes and both anemometers.

Pipes differ.

Though the two 4-in. pipes, as shown on Plate XXII., are similar in every particular, as explained before, one is found to be a better up-cast pipe than the other. To correct the workings of these two pipes the cowls were made to work half the time on each pipe—on Tables 3 to 7—to make the conditions equal.

Difficult to get pipes and anemometers to work alike.

It would be an extremely difficult thing to fix a dozen pipes, with the upper and lower ends open to the atmosphere, with an anemometer in each pipe, and to find after an hour's trial that *all* the anemometers tallied. A current of air blowing across, or curling round the bottom ends (the inlets) of any of the pipes, would instantly remove the atmospheric pressure at such points, and cause a suspension of the anemometer, if not a reversal in its action. And this *down-fall*, or blow-down, of air, in such cases as just referred to, may occur in any number of the pipes, and for several times during the trial-testing, without taking place in the entire lot. Then there would be the further difficulty in getting such a number of anemometers to work and register *exactly* alike. With the greatest nicety in the make the fans may differ, though in the very smallest degree, yet just sufficient to allow the air to pass through a little easier, or to make one anemometer more sensitive than another. Apart from these objections it would no doubt be a great advantage to test all the cowls *simultaneously*, instead of two at a time, for the conditions of the atmosphere and wind would be equal over the whole number. But if the trial cowls are compared, as explained in the notes to each table, the reader will have no difficulty in coming to a conclusion on the relative value of the various cowls shown on Plate XXIII. Many other tests were made— both of longer and shorter durations—but as they chiefly support the results tabulated later on, the reader can want no more, not only to satisfy his mind as to the value of Cowls over Open Pipes, but also as to the relative value of the various cowls themselves. Other tests.

The results given in Table No. 4 are all in favour of the "Vacuum," but this table must not be taken by itself, for the other tables clearly show that *this* cowl is not so good as many of the others for inducing an *up-current;* in fact it is not so good as the Open Pipe, as shown by the results in Table No. 5.* But though this cowl is of no great value, as far as the writer is a judge, for inducing an up-current in soil-pipes, &c., it is the *best cowl* he has tested for *preventing* a *down-*

* Also see Tables Nos. 6, 7, and 8.

draught or *blow-down.* This is accounted for, perhaps, by the fact that the air-space is less to this cowl than to most of the others.

Tables 2, 3, 5 and clearly 8 prove that the *best* Cowls are better than Open Pipes.

Variations in up-currents.

To show not only the effect of the wind, but also of the atmosphere upon *up-currents* in ventilating-pipes (and, at the same time, the difficulty of testing cowls to get at their relative value), the Author's patent cowl, Fig. 119, was tested three times on the first day of this month—July, 1880. The cowl was placed on one of the pipes, as shown on Plate XXII. The first hour, between ten and eleven o'clock, the anemometer registered 11,789 feet (linear) as having passed through it; the second hour, during which a violent thunderstorm broke over London, 4,973 feet; and the third hour's trial, when the storm had blown over, 15,824 feet. Three more trials were made two days after this, with the same cowl on the same pipe, when the anemometer registered the first hour, 21,290 feet, the second hour, 20,659 feet, and the third hour, during which there was a heavy fall of rain, 6,474 feet.

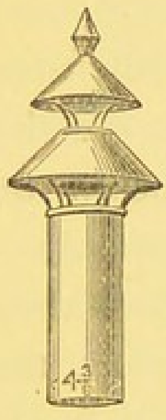


FIG. 119. —View of "Double-cap" Ventilator.

In testing the various cowls it was found that their *relative* value *varied* according to the different states of the atmosphere, *e.g.*, the Author's cowl shows greater *comparative* results (both in the testings given and not given) in foggy and heavy atmospheres, as well as when it is raining, and this is one of its special merits, as Open Pipes are found to work well enough, without any assistance, in clear and light atmospheres. Then, again, cowls, like people, are dependent upon their positions for any *income* of air they may get. Put them in *high* positions and they *draw* accordingly, but put them *under* the roof projections and their *draughts* will not *break* the atmospheric pressure upon any pipe, nor will the *currency* through them ever call for another mint, though it may call for another *coin* to lift them higher.

Cowls vary in their relative value in different weathers.

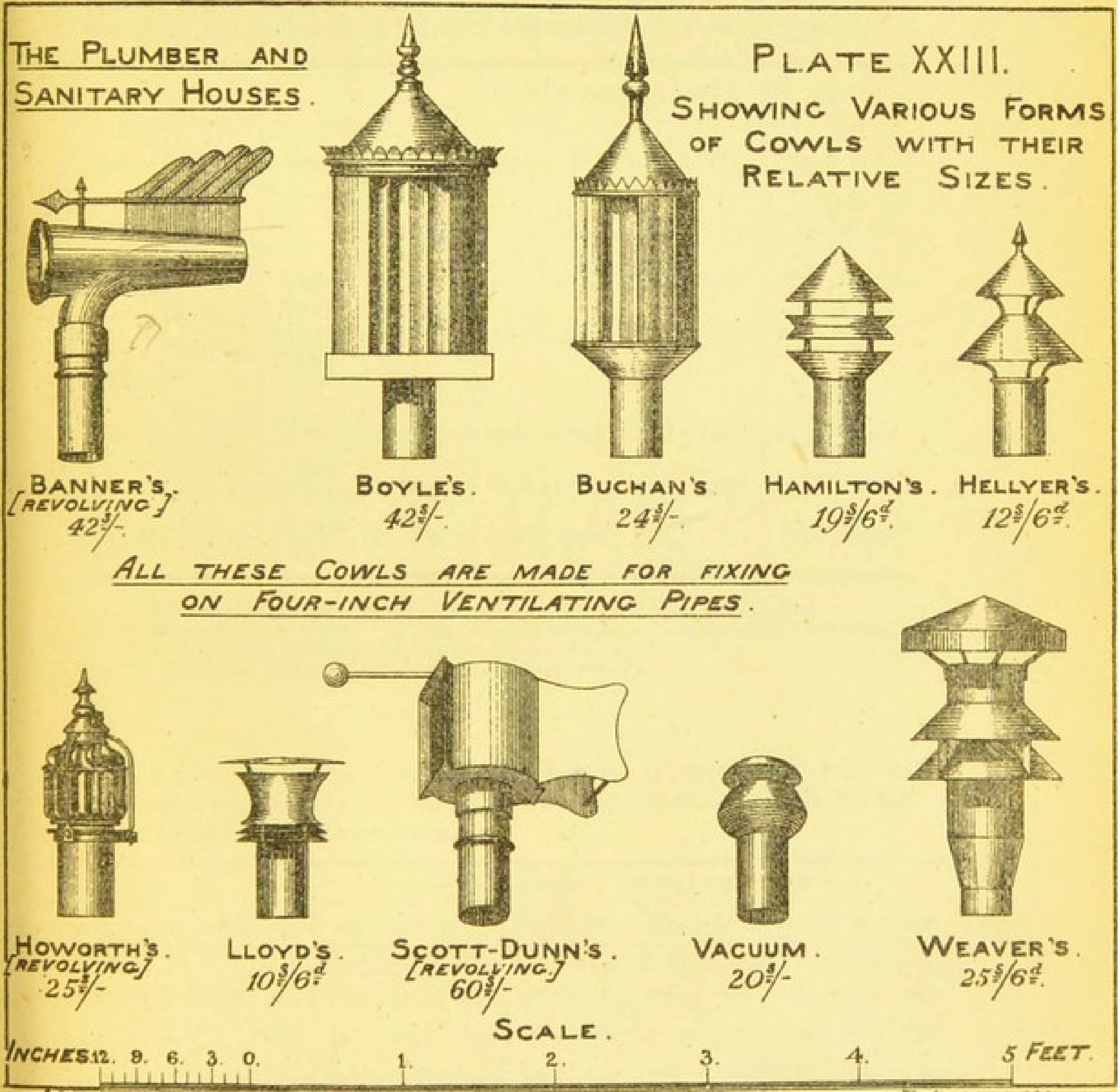
M. Papier's patent "Spiral Injector" is found to be so good a cowl that the writer is sorry not to have had one made for *soil-pipes* in time to have illustrated it with the other cowls on Plate XXIII. The trials made with it warrant its being put into the first rank of good cowls.

Taking all the tests into consideration, the palm of victory must be given to Mr. Buchan's; and the results given in the various tables warrant the Author in placing his own about second upon the list, but the reader can have no great difficulty in determining for himself the best cowls. In doing this he should, of course, keep one eye on the relative size of the various cowls, and the other on the prices—see Plate XXIII. showing same.

It only remains now to say that having selected the proper cowl be sure and "stick it up high," not only for the four winds of heaven to blow upon it, to get all you can out of it, but also to prevent any air coming out of it going into the house either through a window or chimney. A volume might be written on the *misplaced ends of ventilating pipes*, but as the writer is tired, and the reader getting weary, we will leave such *terminals* to tell their own tale and bring this to a terminus.

Abbreviations used in the following Tables.

Ba.	Banner's.	Hel.	Hellyer's.	Vac.	Vacuum.
Bo.	Boyle's.	Ho.	Howorth's.	W.	Weaver's.
Bu.	Buchan's.	Ll.	Lloyd's.	O.P.	Open Pipe.
Ham.	Hamilton's.	S.D.	Scott-Dunn's.	P.F.	Pipe F.
				P.G.	Pipe G.



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Whiteman & Bass, Photo-Litho. London.

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TABLE (NO. 1) SHOWING THE RESULT OF FIVE *ten-minutes* TESTS OF VARIOUS COWLS AND AN OPEN PIPE, TESTED ONE AT A TIME, ON ONE PIPE, AND WITH ONE ANEMOMETER, IN QUICK SUCCESSION.

Note.—This Table by itself is of no great value for determining the relative merits of the Cowls tried, as the Cowls not being tried simultaneously, the conditions of the wind and atmosphere were not equal.

				COWLS TESTED, WITH THE RESULT.					
Date.	Wind.	Atmos.	Temp.	Ba.	Bu.	Ham.	Ho.	Vac.	O.P.
1879.			Min. Max.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.
Dec. 29	W.	Light.	34·0-46·0	2637	2829	2931	2841	2752	3125
„ 31	W. and strong.	Thick and rain falling.	45·5-50·0	3144*	3802	3664	3597†	2690	3212
1880.									
Jan. 6	W. and light.	Cloudy.	30·0-35·0	1961	2693	2119	2391	1553	2224
„ 8	E.S.E.	Ditto and moist	29·0-32·0	1836	2289	1969	2252	1566	2205
„ 27	S.E.	Dense fog.	18·0-31·0	232‡	512§	477‖	¶	Nil.	109**

* Suspended 2 seconds. † Suspended 2 seconds, and 6 feet blow-down.
‡ Suspended $6\frac{3}{4}$ minutes. § Suspended $3\frac{1}{2}$ minutes. ‖ Suspended 3 minutes.
¶ Suspended $8\frac{3}{4}$ minutes, with 104 feet blow-down.
** Suspended 8 minutes, and blow-down for 20 seconds.

TABLE (NO. 2).—THE COWLS WERE TESTED IN THE SAME WAY AS EXPLAINED IN TABLE NO. 1, AND THE NOTE TO THAT TABLE ALSO APPLIES TO THIS ONE.

				COWLS TESTED, WITH THE RESULT.									
Date.	Wind.	Atmo.	Temp.	Ba.	Bo.	Bu.	Ham.	Hel.	Ho.	S.D.	Vac.	W.	O.P.
1880.			Max.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.	ft. up.
Feb. 11	N. W.	Light	40·0	1237	1144	1576	1187	1302	1041	1078	960	1281	1240
„ 12	W.	Rain falling	46·0	1407	1560	1531	1368	1902	1659	1575	1192	981	1590
„ 13	W.	Hazy	41·0	1462	1058	929	1332	1395	1065	1295	903	1549	993
„ 14	S.W.	„	43·0	2995	3497	3889	2684	3401	3487	3155	2912	3945	3550
„ 18	S.W.	„	49·0	1390	2348	3873	1069	2517	2872	2552	1784	2616	2577
—	—	—	—	8491	9607	11798	7640	10517	10124	9655	7751	10372	9950

The above Temperatures were taken by Stanley's instruments.

TABLE (No. 3), SHOWING THE RESULTS OF *Two One-hour* TESTS OF VARIOUS COWLS AGAINST OPEN PIPES, TESTED ON THE U-SHAPED PIPE ARRANGEMENT, AS EXPLAINED ON PAGE 284.

N.B.—Only the results of the individual trials, between the horizontal lines, must be compared, as the wind and atmosphere varying with each trial, the condition of the several trials would not be equal.

Date.	Wind.	Atmos.	Cowls against Open Pipes.		Result.			
					1st Hour.		2nd Hour.	
					Pipe F.	Pipe G.	Pipe F.	Pipe G.
1880. May 28	W.	Clear.	BANNER'S	*v.* OPEN PIPE, and *draws* in air through it on either Pipe.	Ba. ft. up. 1363	O. P. —	O. P. —	Ba. ft.up. 2222
" 4 } " 5 }	N.E.	Cloudy.	BOYLE'S	*v.* " " "	Bo. 539	—	—	Bo. 688
" 26	S.W.	Clear.	BUCHAN'S	*v.* " " "	Bu. 970	—	—	Bu. 283
April 29 } " 30 }	E.	Clear. Cloudy.	HELLYER'S	*v.* " " "	Hel. 5300	—	—	Hel. 1927
May 31	N.E.	Rainy.	LLOYD'S	*v.* " " "	Ll. 30	—	—	Ll. 3
" 11	S.E.	Clear.	SCOTT DUNN'S	*v.* " " "	S. D. 2765	—	—	S. D. 2543
" 27	S.W.	Clear.	VACUUM	*v.* " " "	Vac. 2007	—	—	Vac. 4528
" 19	N.W.	Clear.	WEAVER'S	*v.* " " "	W. 146	—	—	W. 478
June 8	S.W.	Rainy.	HAMILTON'S	*v.* OPEN PIPE, and *allows* air to be drawn in through it.	Ham —	O. P. 4504	O. P. 4790	Ham —
June 8	S.W.	Heavy rain.	HOWORTH'S	*v.* " " "	Ho. —	O. P. 2215	O. P. 2786	Ho. —

TABLE (No. 4) SHOWING THE RESULTS OF A SERIES OF *two one-hour* TESTS OF VARIOUS COWLS, TESTED TWO AT A TIME, ONE AGAINST THE OTHER, ON THE U-SHAPED PIPE, AS SHOWN ON PLATE XXII., AND EXPLAINED ON PAGE 284, ON THE "PULL, DEVIL! PULL BEGGAR!" PRINCIPLE.

Note.—To make this series of testing as fair as possible, the contesting Cowls worked one hour on each limb of the U-shaped Pipe, *i.e.*, the Cowl that worked the *first* hour on Pipe F, worked the *second* hour on Pipe G, and *vice versa*.

N.B.—Only the results of the Cowls *paired* against each other (between the horizontal lines) must be compared, as the conditions would not be equal in the whole series of trials, the wind and atmosphere being different in each trial.

Date.	Wind.	Atmos.	Cowls Tested.		Result. 1st Hour. Pipe F.	1st Hour. Pipe G.	2nd Hour. Pipe F.	2nd Hour. Pipe G.
1880. May 1	S.E.	Clear.	BANNER'S †	v. BOYLE'S.	Ba. Ft. up. 65	Bo. —	Bo. 39	Ba. Ft. up. —
„ 28	W.	„	„ *	v. HAMILTON'S.	3238	Ham. —	Ham. —	3704
„ 22	N.W.	Cloudy.	„ *	v. HOWORTH'S.	1038	Ho. —	Ho. —	1732
„ 21	„	Clear.	„ *	v. LLOYD'S.	820	Ll. —	Ll. —	293
„ 21	„	„	„ ‡	v. SCOTT-DUNN'S.	—	S.D. 100	S.D. 112	—
„ 22	W.	Cloudy.	„ ‡	v. VACUUM.	—	Vac. 958	Vac. 1708	—
„ 20	N.N.E.	Clear.	„ †	v. WEAVER'S.	5	W. 179	W. —	—
„ 3	S.E.	Cloudy.	BOYLE'S *	v. HOWORTH'S.	Bo. 102	Ho. —	Ho. —	Bo. 49
„ 3	N.E.	Hazy.	„ †	v. LLOYD'S.	2	Ll. —	Ll. —	Sus-pended
April 30	E.S.E.	Clear.	„ ‡	v. SCOTT-DUNN'S.	—	S.D. 1458	S.D. 775	—
May 4	N.E.	Cloudy.	„ ‡	v. VACUUM.	—	Vac. 2024	Vac. 2442	—
„ 1	S.E.	Clear.	„ ‡	v. WEAVER'S.	—	W. 124	W. 87	—

Date.	Wind.	Atmos.	Cowls Tested.		Result.			
					1st Hour.		2nd Hour.	
					Pipe F.	Pipe G.	Pipe F.	Pipe G.
May 24	W.	Cloudy and Moist.	Buchan's *	v. Banner's.	Bu. 556	Ba. —	Ba. —	Bu. 2193
,, 6	N.E.	Cloudy.	,, *	v. Boyle's..	1260	Bo. —	Bo. —	1208
,, 26	S.W.	Clear.	,, *	v. Hamilton's.	3680	Ham. —	Ham. —	4157
,, 25	W.	,,	,, *	v. Hellyer's.	799	Hel. —	Hel. —	487
,, 24	,,	Cloudy and Moist.	,, *	v. Howarth's.	1460	Ho. —	Ho. —	3792
,, 24	,,	Light.	,, *	v. Lloyd's.	7890	Ll. —	Ll. —	5115
,, 12	E.	Clear.	,, *	v. Scott-Dunn's.	1776	S.D. —	S.D. —	1574
,, 25	W.	,,	,, ‡	v. Vacuum.	—	Vac. 137	Vac. 1703	—
,, 14	N.E.	,,	,, *	v. Weaver's.	1110	W. —	W. —	257
April 28	,,	Cloudy.	Hellyer's *	v. Banner's.	Hel. 1310	Ba. —	Ba. —	Hel. 1337
,, 27	,,	Hazy.	,, *	v. Boyle's.	2043	Bo. —	Bo. —	2618
May 27	N.	Clear.	,, *	v. Hamilton's.	2143	Ham. —	Ham. —	3655
,, 27	N.W.	Rainy.	,, *	v. Howorth's.	801	Ho. —	Ho. —	1645
April 29	E.	Cloudy.	,, *	v. Lloyd's.	2727	Ll. —	Ll. —	2497
May 18	N.E.	Hazy.	,, †	v. Scott-Dunn's.	—	S.D. 24	S.D. —	103
April 27	E.N.E.	,,	,, *	v. Weaver's.	1300	W. —	W. —	1182
May 12	E.	Clear.	Scott-Dunn's *	v. Hamilton's.	S.D. 1078	Ham. —	Ham. —	S.D. 1447
,, 11	,,	Moist.	,, *	v. Howorth's.	534	Ho. —	Ho. —	638
,, 10	N.E.	Clear.	,, *	v. Lloyd's.	114	Ll. —	Ll. —	183

Date.	Wind.	Atmos.	Cowls Tested.		Result.			
					1st Hour.		2nd Hour.	
					Pipe F.	Pipe G.	Pipe F.	Pipe G.
May 7	N.E.	Clear.	SCOTT-DUNN'S *	*v.* WEAVER'S.	212	W. —	W. —	362
,, 11	S.E.	,,	,, ‡	*v.* VACUUM.	—	Vac. 536	Vac. 683	—
May 26	S.W.	,,	VACUUM *	*v.* HAMILTON'S.	Vac. 5914	Ham. —	Ham. —	Vac. 5407
,, 27	W.	,,	,, *	*v.* HELLYER'S.	462	Hel. —	Hel. —	2816
,, 26	S.W.	,,	,, *	*v.* HOWORTH'S.	1407	Ho. —	Ho. —	557
,, 27	,,	,,	,, *	*v.* LLOYD'S.	6314	Ll. —	Ll. —	7724
,, 14	N.E.	,,	,, *	*v.* WEAVER'S.	427	W. —	W. —	1735
May 28	N.W.	,,	WEAVER'S *	*v.* HAMILTON'S.	W. 3238	Ham. —	Ham. —	W. 1886
,, 13	E.	,,	,, †	*v.* HOWORTH'S.	638	Ho. 848	Ho. —	—
,, 15	N.E.	,,	,, *	*v.* LLOYD'S.	401	Ll. —	Ll. —	893

* *Draws* in air through the other Cowl on either Pipe.
† *Draws* in air through the other Cowl on *one* Pipe only.
‡ *Allows* the air to be drawn through it on either Pipe.

TABLE (No. 5) SHOWING THE RESULTS OF A SERIES OF *two one-hour** TESTS OF VARIOUS COWLS AGAINST OPEN PIPES, TESTED BY TWO PIPES AND TWO ANEMOMETERS SIMULTANEOUSLY.

N.B.—Notes 1, 2, 3, to Table No. 6, also apply to this Table.

Date.	Wind.	Atmos.	Cowls against Open Pipes.	One Hour on. Pipe F.	One Hour on. Pipe G.	Result. 2 Hours.	Difference.	In favour of.
1880. Mar. 12	E.S.E.	Misty.	Banner's .... Open Pipe ..	Ft. up. 12969 14528	Ft. up. 12440 = 11591 =	25409 26119	710	O.P.
,, 12	,,	,,	Boyle's ...... Open Pipe ..	17005 13425	15086 = 15168 =	32091 28593	3498	Bo.
,, 6	N.W.	Cloudy.	Buchan's .... Open Pipe ..	19603 16882	19088 = 16203 =	38691 33085	5606	Bu.
June 15 ,, 16	N. N.E.	Hazy & moist. Rainy.	Hamilton's.. Open Pipe ..	7994 5679	8249 = 9277 =	16243 14956	1287	Ham.
Mar. 11	E.	Misty.	Hellyer's .. Open Pipe ..	14353 14674	17694 = 14632 =	32047 29306	2741	Hel.
June 15	N.	Hazy & moist.	Howorth's .. Open Pipe ..	6876 10307	11906 = 8864 =	18782 19171	389	O.P.
April 15	E.	Moist.	Lloyd's...... Open Pipe ..	13488 12670	13533 = 12529 =	27021 25199	1822	Ll.
June 15	N.	Hazy & moist.	Scott-Dunn's Open Pipe ..	8490 7779	10032 = 9844 =	18522 17623	899	S. D.
,, 16	N.E.	Rainy.	"Vacuum" .. Open Pipe ..	5533 5341	6126 = 7233 =	11659 12574	915	O. P.
17	S.E.	Moist.	Weaver's.... Open Pipe ...	13136 11651	14636 = 11913 =	27772 23564	4208	W.

* See Table No. 8 for *ten-minute* tests.

TABLE (NO. 6) SHOWING THE RESULTS OF A SERIES OF DOUBLE HOUR-TESTS* OF VARIOUS COWLS, TESTED TWO AT A TIME WITH TWO ANEMOMETERS *SIMULTANEOUSLY*.

NOTE (1). The U-shaped connecting-pipe, shown on Plate XXII., C to D, was not used in this series of testing, but the two pipes, F and G, were kept independent of each other, and an anemometer (with 3-in. dia. air-way) was fitted into the bottom end of each of the two pipes.

(2). To make this series of testing as perfect as possible, the cowls, bracketed together, not only worked simultaneously, but they each worked one hour on the same pipe and the same anemometer, *i.e.*, the cowl that worked the first hour on pipe F worked the second hour on pipe G, and *vice versa*; thus making all the conditions equal.

(3). Only the results of the individual trials (between the horizontal lines bracketed together) must be compared with each other, as the conditions of the wind and atmosphere would vary in every trial.

Date.	Wind.	Atmos.	Cowls Tested.	One Hour on.	One Hour on.	Result.	Difference.	In favour of.
				P. F.	P. G.	2 Hours.		
1880.				Ft. up.	Ft. up.			
June 29	W.	Clear.	{ Banner's .... { Hamilton's..	15362 13998	11793 = 13833 =	27155 } 27831 }	676	Ham.
„ 29	W.	„	{ Banner's ... { Hellyer's ..	17371 19035	17324 = 19338 =	34695 } 38373 }	3678	Hel.
Mar. 13	N.E.	„	{ Banner's .... { Hellyer's ..	9837 11323	12264 = 13254 =	22101 } 24577 }	2476	Hel.
June 9	S.W.	Light, rainy.	{ Banner's .... { Howorth's ..	12709 13562	11149 = 8097 =	23858 } 21659 }	2199	Ba.
„ 26	N.E.	Hazy.	{ Banner's .... { Lloyd's.......	7707 5669	1085 = 3115 =	8792 } 8784 }	8	Ba.
June 9	S.W.	Rainy.	{ Banner's .... { Scott-Dunn's	4504 7029	5057 = 3451 =	9561 } 10480 }	919	S. D.
„ 9	N.W. } S.W. }	„	{ Banner's .... { Vacuum......	5948 3311	7921 = 10062 =	13869 } 13373 }	496	Ba.
„ 18	S.E. } fresh. }	Clear.	{ Banner's.... { Weaver's.....	18436 23685	23214 = 27488 =	41650 } 51173 }	9523	W.
July 12	W.	Light.	{ Boyle's...... { Banner's....	22381 19448	12058 = 7188 =	34439 } 26636 }	7803	Bo.

* See Table No. 7 for *ten-minute* tests.

Date.	Wind.	Atmos.	Cowls Tested.	One Hour on. P. F.	One Hour on. P. G.	Result 2 Hours.	Difference.	In favour of.
1880.				Ft. up.	Ft. up.			
July 12	W.	Light.	Boyle's...... Hamilton's	16246 11222	11985 = 11939 =	28231 23161	5070	Bo.
„ 9	S.W.	Clear.	Boyle's...... Howorth's ..	30101 27806	28289 = 28792 =	58390 56598	1792	Bo.
„ 12	W.	Light.	Boyle's...... Lloyd's......	14766 13211	15512 = 8877 =	30278 22088	7190	Bo.
„ 12	„	„	Boyle's...... Scott-Dunn's	21034 15268	11974 = 13038 =	33008 28306	4702	Bo.
„ 13	S.W.	Clear.	Boyle's...... Vacuum......	19214 17039	17592 = 11321 =	36806 28360	8446	Bo.
Mar. 3	N.W. very strong.	Cloudy.	Buchan's .. Banner's....	17840 12873	20498 = 13144 =	38338 26017	12321	Bu.
„ 3	N.W.	„	Buchan's .... Boyle's......	26567 20154	22763 = 17404 =	49330 37558	11772	Bu.
„ 5	„	„	Buchan's .... Hamilton's..	19413 12185	18078 = 12446 =	37491 24631	12860	Bu.
„ 8	E.N.E.	„	Buchan's .... Hellyer's ..	15467 10977	14103 = 14517 =	29570 25494	4076	Bu.
„ 4	N.W.	Clear.	Buchan's .... Howorth's ..	20481 18039	22105 = 15343 =	42586 33382	9204	Bu.
April 12	N.E.	Showery.	Buchan's .... Lloyd's	10686 9529	10582 = 7970 =	21268 17499	3769	Bu.
Mar. 6	N.W.	Cloudy.	Buchan's .... Scott-Dunn's	15760 13360	19786 = 12168 =	35546 25528	10018	Bu.
„ 4	„	Clear.	Buchan's .... Vacuum	17104 10337	16703 = 11510 =	33807 21847	11960	Bu.
„ 3	„	Cloudy.	Buchan's .... Weaver's....	21323 18695	20792 = 16661 =	42115 35356	6759	Bu.

Date.	Wind	Atmos.	Cowls Tested.	One Hour on. P. F.	One Hour on. P. G.	Result 2 Hours.	Difference.	In favour of
1880.				Ft. up.	Ft. up.			
Mar. 13	N.E.	Clear.	Hellyer's .. / Banner's .. .	11323 / 9837	13254 = / 12264 =	24577 / 22101	2476	Hel.
„ 16	E.	Hazy.	Hellyer's .. / Boyle's	11273 / 14139	13557 = / 9866 =	24830 / 24005	825	Hel.
July 31	„	Showery.	Hellyer's .. / Boyle's	9432 / 10799	9551 = / 6950 =	18983 / 17749	1234	Hel.
Mar. 10	N.W.	Foggy.	Hellyer's .. / Hamilton's..	1947 / 6755	9563 = / 3711 =	11510 / 10466	1044	Hel.
„ 15	E.	Hazy.	Hellyer's .. / Howorth's ..	11786 / 9223	12414 = / 14072 =	24200 / 23295	905	Hel.
April 12	N.E.	Showery.	Hellyer's .. / Lloyd's......	8189 / 7727	11440 = / 9796 =	19629 / 17523	2106	Hel.
Mar. 16	E.	Hazy.	Hellyer's .. / Scott-Dunn's	7862 / 6732	12918 = / 10063 =	20780 / 16795	3985	Hel.
„ 10	N.W.	Foggy.	Hellyer's .. / Vacuum	11174 / 11546	13059 = / 8027 =	24233 / 19573	4660	Hel.
„ 17	E.	Hazy.	Hellyer's .. / Weaver's	16933 / 19428	15906 = / 13461 =	32839 / 32889	50	W.
July 29	S.W.	Moist.	Hellyer's .. / Weaver's....	19874 / 17576	16151 = / 18363 =	36025 / 35939	86	Hel.
June 2	„	„	Lloyd's...... / Hamilton's..	14772 / 9851	10869 = / 16234 =	25641 / 26085	444	Ham.
April 14	„	Wet.	Lloyd's...... / Howorth's ..	3067 / 2445	4034 = / 2724 =	7101 / 5169	1932	Ll.
June 13	S.E.	Misty.	Lloyd's...... / Scott-Dunn's	7712 / 10456	10186 = / 8231 =	17898 / 18687	789	S. D.
„ 14	E.	Wet.	Lloyd's...... / Vacuum	4994 / 4100	4290 = / 4766 =	9284 / 8866	418	Ll.

Date.	Wind.	Atmos.	Cowls Tested.	One Hour on. P. F.	One Hour on. P. G.	Result 2 Hours.	Difference.	In favour of.
1880.				Ft. up.	Ft. up.			
April 13	S.E.	Misty.	Lloyd's…… Weaver's….	5017 6561	8389 = 9149 =	13406 15710	2304	W.
July 9	S.W.	Showery.	Weaver's…. Boyle's……	21676 19709	28564 = 31454 =	50240 51163	923	Bo.
„ 8	W.	Clear.	Weaver's…. Hamilton's	13147 10094	19007 = 11302 =	32154 21396	10758	W.
„ 8	„	Cloudy and Stormy.	Weaver's…. Howorth's ..	12600 8487	12875 = 14507 =	25475 22994	2481	W.
„ 8	„	Clear.	Weaver's…. Vacuum ….	20004 16349	31485 = 22226 =	51489 38575	12914	W.

Table (No. 7). Cowls Tested as in No. 6 Table, but for *ten minutes* each Trial, instead of *one hour*; and the Notes to that Table also apply to this.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Minutes. P. G.	Result Two Ten Min.	Difference.	In favour of.
1880.				Ft. up.	Ft. up.			
July 20	N.W.	Light.	Banner's…. Hamilton's..	611 1374	1361 = 674 =	1972 2048	76	Ham.
„ 20	„	„	Banner's…. Hellyer's ..	1356 1663	779 = 1028 =	2135 2691	556	Hel.
„ 20	„	„	Banner's…. Howorth's ..	2498 2423	1443 = 2096 =	3941 4519	578	How.
„ 20	„	„	Banner's…. Lloyd's……	2699 1885	2096 = 2767 =	4795 4652	143	Ban.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Minutes. P. G.	Result Two Ten Min.	Difference.	In favour of.
1880.				Ft. up.	Ft. up.			
July 20	N.W.	Light.	{ Banner's .... { Scott-Dunn's	1564 2041	2011 = 1334 =	3575 } 3375 }	200	Ban.
„ 20	„	„	{ Banner's .... { Vacuum	2059 1209	1972 = 2471 =	4031 } 3680 }	351	Ban.
„ 19	W.	„	{ Boyle's...... { Banner's	2281 2169	1878 = 1582 =	4159 } 3751 }	408	Bo.
„ 19	„	„	{ Boyle's...... { Buchan	2719 2829	2480 = 3346 =	5199 } 6175 }	976	Bu.
„ 19	„	„	{ Boyle's...... { Hamilton ..	1664 1632	3379 = 2248 =	5043 } 3880 }	1163	Bo.
„ 19	„	„	{ Boyle's...... { Hellyer's ..	3028 2419	2115 = 2889 =	5143 } 5308 }	165	Hel.
„ 19	„	„	{ Boyle's...... { Howorth's ..	2562 1985	2475 = 2953 =	5037 } 4938 }	99	Bo.
„ 19	„	„	{ Boyle's...... { Lloyd's......	2629 2301	2618 = 1245 =	5247 } 3546 }	1701	Bo.
„ 19	„	„	{ Boyle's...... { Scott-Dunn's	2199 1353	1087 = 1609 =	3286 } 2962 }	324	Bo.
„ 19	„	„	{ Boyle's...... { Vacuum......	1401 1615	3533 = 2321 =	4934 } 3936 }	998	Bo.
„ 19	„	„	{ Boyle's ..... { Weaver's....	3607 3181	3843 = 4151 =	7450 } 7332 }	118	Bo.
„ 20	N.W.	„	{ Buchan's .... { Banner's	2378 1909	1971 = 1029 =	4349 } 2938 }	1411	Bu.
„ 23	S.W.	„	{ Buchan's .... { Boyle's......	1830 1981	1627 = 955 =	3457 } 2936 }	521	Bu.
„ 23	„		{ Buchan's .... { Hamilton's..	2362 1880	1838 = 931 =	4200 } 2811 }	1389	Bu.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Minutes. P. G.	Result Two Ten Min.	Difference.	In favour of
1880.				Ft. up.	Ft. up.			
July 17	E.	Misty.	Buchan's .... Hellyer's ..	1207 1076	534 = 277 =	1741 1353	388	Bu.
" 23	S.W.	Light.	Buchan's .... Howorth's ..	2213 2046	1954 = 973 =	4167 3019	1148	Bu.
" 23	"	"	Buchan's .... Lloyd's......	3458 2154	2297 = 1746 =	5755 3900	1855	Bu.
" 23	"	"	Buchan's .... Papier's	3932 3355	3053 = 3133 =	6985 6488	497	Bu.
" 23	"	"	Buchan's .... Scott Dunn's	3425 2652	2870 = 1827 =	6295 4479	1816	Bu.
" 23	"	"	Buchan's .... Vacuum	2842 2493	2817 = 1395 =	5659 3888	1771	Bu.
" 21	"	"	Buchan's .... Weaver's....	2645 2290	1945 = 1612 =	4590 3902	688	Bu.
" 20	N.W.	"	Hellyer's .. Banner's	1663 1356	1028 = 779 =	2691 2135	556	Hel.
" 17	E.	Misty.	Hellyer's .. Boyle's......	1111 832	95 = 225 =	1206 1057	149	Hel.
" 17	"	"	Hellyer's .. Hamilton's. .	2478 2268	1633 = 1802 =	4111 4070	41	Hel.
" 17	"	"	Hellyer's .. Howorth's ..	2212 1994	1476 = 1346 =	3688 3340	348	Hel.
" 17	"	"	Hellyer's .. Lloyd's......	2290 2039	1499 = 1490 =	3789 3529	260	Hel.
" 17	"	"	Hellyer's .. Scott-Dunn's	2023 2086	1549 = 970 =	3572 3056	516	Hel.
" 17	"	"	Hellyer's . Vacuum	1937 1772	1189 = 1004 =	3126 2776	350	Hel.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Minutes. P. G.	Result Ten Min.	Difference.	In favour of.
				Ft. up.	Ft. up.			
1880. July 29	S.W.	Rainy.	{ Hellyer's .. { Weaver's....	3169 4241	3796 = 2684 =	6965 } 6925 }	40	Hel.
" 23	"	Light.	{ Papier's .... { Banner's	4190 3258	3469 = 2659 =	7659 } 5917 }	1742	Pa.
" 23	"	"	{ Papier's .... { Boyle's......	3184 3025	2687 = 2548 =	5871 } 5573 }	508	Pa.
" 23	"	"	{ Papier's .... { Hamilton's. .	3548 2446	2340 = 2022 =	5888 } 4468 }	1420	Pa.
" 24	W.	Moist.	{ Papier's .... { Hellyer's ..	2032 1829	1226 = 1325 =	3258 } 3154 }	104	Pa.
" 24	"	"	{ Papier's .... { Howorth's ..	2116 1264	606 = 989 =	2722 } 2253 }	469	Pa.
" 24	"	Rain falling.	{ Papier's .... { Lloyd's......	2137 781	551 = 685 =	2688 } 1466 }	1222	Pa.
" 24	"	"	{ Papier's .... { Scott-Dunn's	1892 1322	719 = 774 =	2611 } 2096 }	515	Pa.
" 24	"	Moist.	{ Papier's .... { Vacuum	1514 1808	1541 = 362 =	3055 } 2170 }	885	Pa.
" 24	"	"	{ Papier's .... { Weaver's....	2490 2400	1698 = 1660 =	4188 } 4060 }	128	Pa.
" 20	N.W.	Light.	{ Weaver's.... { Banner's	3031 2470	2491 = 1919 =	5522 } 4389 }	1133	W.
" 21	S.W.	"	{ Weaver's.... { Boyle's......	2152 2035	1209 = 1427 =	3361 } 3462 }	101	Bo.
" 21	"	"	{ Weaver's.... { Hamilton's..	2647 2211	1818 = 1687 =	4465 } 3898 }	567	W.
" 21	"	"	{ Weaver's.... { Howorth's ..	2224 1954	1424 = 1112 =	3648 } 3066 }	582	W.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Minutes. P. G.	Result Two Ten Min.	Difference.	In favour of.
				Ft. up.	Ft. up.			
1880. July 21	S.E.	Light.	Weaver's.... / Lloyd's......	2496 / 1883	1216 = / 1351 =	3712 / 3234	478	W.
,, 21	,,	,,	Weaver's.... / Scott-Dunn's	2192 / 2137	1862 = / 1054 =	4054 / 3191	863	W.
,, 21	S.W.	,,	Weaver's.... / Vacuum	3018 / 2196	2142 = / 1574 =	5160 / 3770	1390	W.

TABLE (NO. 8). COWLS AGAINST OPEN PIPES, TESTED AS IN TABLE NO. 3; BUT *ten minutes* INSTEAD OF *one hour*.

Date.	Wind.	Atmos.	Cowls Tested.	First Ten Min. P. F.	Second Ten Min. P. G.	Result Two Ten Min.	Difference.	In favour of.
1880.				Ft. up.	Ft. up.			
July 20	N.W.	Light.	{ Open Pipe .. { Banner's	2425 2794	2473 = 1594 =	4898 } 4388 }	510	O. P.
" 19	W.	"	{ Open Pipe .. { Boyle's	2867 2534	3120 = 3592 =	5987 } 6126 }	139	Bo.
" 23	S.W.	"	{ Open Pipe .. { Buchan's	3339 3481	2425 = 3124 =	5764 } 6605 }	841	Bu.
" 27	W.	"	{ Open Pipe .. { Hamilton's..	1419 1165	2121 = 1957 =	3540 } 3122 }	418	O. P.
" 20	N.W.	"	{ Open Pipe .. { Hellyer's ..	1277 1768	956 = 743 =	2233 } 2511 }	278	Hel.
" 27	W.	"	{ Open Pipe .. { Howorth's ..	2824 2659	2657 = 3347 =	5481 } 6006 }	525	How.
" 27	"	"	{ Open Pipe .. { Lloyd's......	2355 1000	1777 = 1826 =	4132 } 2826 }	1306	O. P.
" 24	"	Moist.	{ Open Pipe .. { Papier's	2867 2898	2128 = 2242 =	4995 } 5140 }	145	Pa.
" 27	"	Light.	{ Open Pipe .. { Scott-Dunn's	2262 1575	2237 = 2688 =	4499 } 4263 }	236	O. P.
" 27	"	"	{ Open Pipe .. { "Vacuum" ..	2478 1514	2541 = 2460 =	5019 } 3974 }	1045	O. P.
" 21	S.W.	"	{ Open Pipe .. { Weaver's	1769 2377	1545 = 978 =	3314 } 3355 }	41	W.

CHAPTER XXIV.

HAND-WORKERS (*continued from page* 141).

THE Author closes the Second Edition, as he did the First, with a word to hand-workers; and he would speak especially to those now in our employ, and to those who have gone forth from us during the last few years, who from their settled homes in various parts of the country now and then turn a friendly glance towards the "old plumbers' shop near the Strand."

The knowledge of sanitary work is spreading rapidly, and if you would keep abreast of your trade you must educate your eyes as well as your hands: for it is not enough in this Ventilating Age that you become skilled hand-workers, you must become intelligent head-workers as well: *i.e.*, you must add to your knowledge of joint-wiping, and trap and pipe fixing, the knowledge of sanitation in plumbing, the principle of *con*nection and *dis*connection, *how* to let fresh air into pipes and *where* to let it in, and how to keep vitiated air away from all *breathing places*, whether inside or outside the house—in short, you must become *sanitary plumbers*.

If the young plumbers—respectable sons of respectable plumbers—who leave us from time to time to settle down with their fathers, or for themselves, in other parts of the country, would only be determined to master the theoretical as well as the practical part of plumbing, we should hear very little about "levelling *downwards*" in sanitary plumbing, but there would be a good deal of work done in "levelling *upwards*." And then, purifying our houses from so many centres, by putting everything in a sanitary state, we should soon make our Island Home—"Home, sweet home."

You plumbers must maintain your *prestige*, for you are a respectable body; for do you not belong to a high profession? They call the clergy "members of the cloth." Well, are you not members of the "cloth," too? True, your cloth is not *broad* cloth, for it is hardly big enough to cover your nakedness; yet still you are members of the cloth, though it be only the *solder-cloth*. See, then, that you never disgrace your cloth by bad joint-wiping. Let every joint in the house be perfect, not only where it is in sight, but where it is out of sight—and *especially* in such places. The Author has often noticed in the old lead soil-pipes sent to his place from time to time joints only *half*-made—*i.e.*, the joint has never been *wiped* at all on the *back part* of the pipe;

the solder has simply been "splashed" on and rubbed about with the iron. Now such joints, though they may not show a water-leak, often allow soil-pipe-air to escape through them, as many a householder has found to his cost.

Though every competent plumber with us has his *mate*—for like the cuckoo he must have some-one to attend upon him—to feed him with solder, &c.—and there is a wise economy in this—the Author has no faith in unskilled labour; and, therefore, we have little or nothing at all to do with the old-fashioned plumber's labourer. The "mates" are *assistant* plumbers with us, and as they must have served their apprenticeship, or had several years' experience before they come with us, and as they come to us from all parts of the kingdom, our House is becoming a University for men to complete their education in plumbing. And, as an encouragement to the men who come to us to perfect their plumbing knowledge, and also to those who remain with us, the Author got out a Certificate of Merit last year, which he introduced at the annual Bean-feast, this year, held at the Crown Hotel, Broxbourne, on Saturday, July 10, 1880. As only about seventy or less than half the men in our employ, were then present to hear what was said, the Author repeats it here.

The form * on which the Certificate is written is elaborately got up, and nicely illuminated in many colours and gold; and though the plumber's tools are not in the *hands* of *mates*, they are well illustrated in shields held up by little figures in the margins.

In instituting this Certificate the Author said:—

"I have something to say to you on a subject of great interest to every plumber in this Firm, and which I hope will form a landmark in his history.

"Medals are struck, and hung upon the breast of the brave soldier or sailor who by *one* grand exploit or daring deed entitles himself to the distinguished notice of his country.

"And yet it is a beautiful thing to my mind, that hundreds of men are to be found, among all classes, who if they do not do one *great* deed, do their duty, not once or twice only, but day after day, week after week, and year after year; whether noticed or unnoticed, rewarded or unrewarded. They do it because they have a high and noble sense of what is right and true. We rejoice in having some such men in our employ.

* It was designed for the Author by Mr. Isaac Jones. The style is Italian Renaissance, with arabesque border, the shields containing tools used by the trade. On the corners are the four cardinal virtues as they would exhibit themselves in a good workman—Honesty being the outcome of Justice; Sobriety, Temperance; Perseverance, Fortitude; and Industry, Prudence. The four figures in the upper division of the design bear shields and labels with the Virtues; the centre figure bearing a label with a motto (taken from the Author's Address to Hand-workers, page 137 of this book) intended to inculcate them. The bottom panel bears the inscription; and in the centre of the bottom border is the Trade Mark of the Firm—The London Apprentice. The whole forming a testimonial to the character and ability of the workman whose name appears thereon, and is expressive of the altogether satisfactory manner in which he has served the Firm for a stated period.

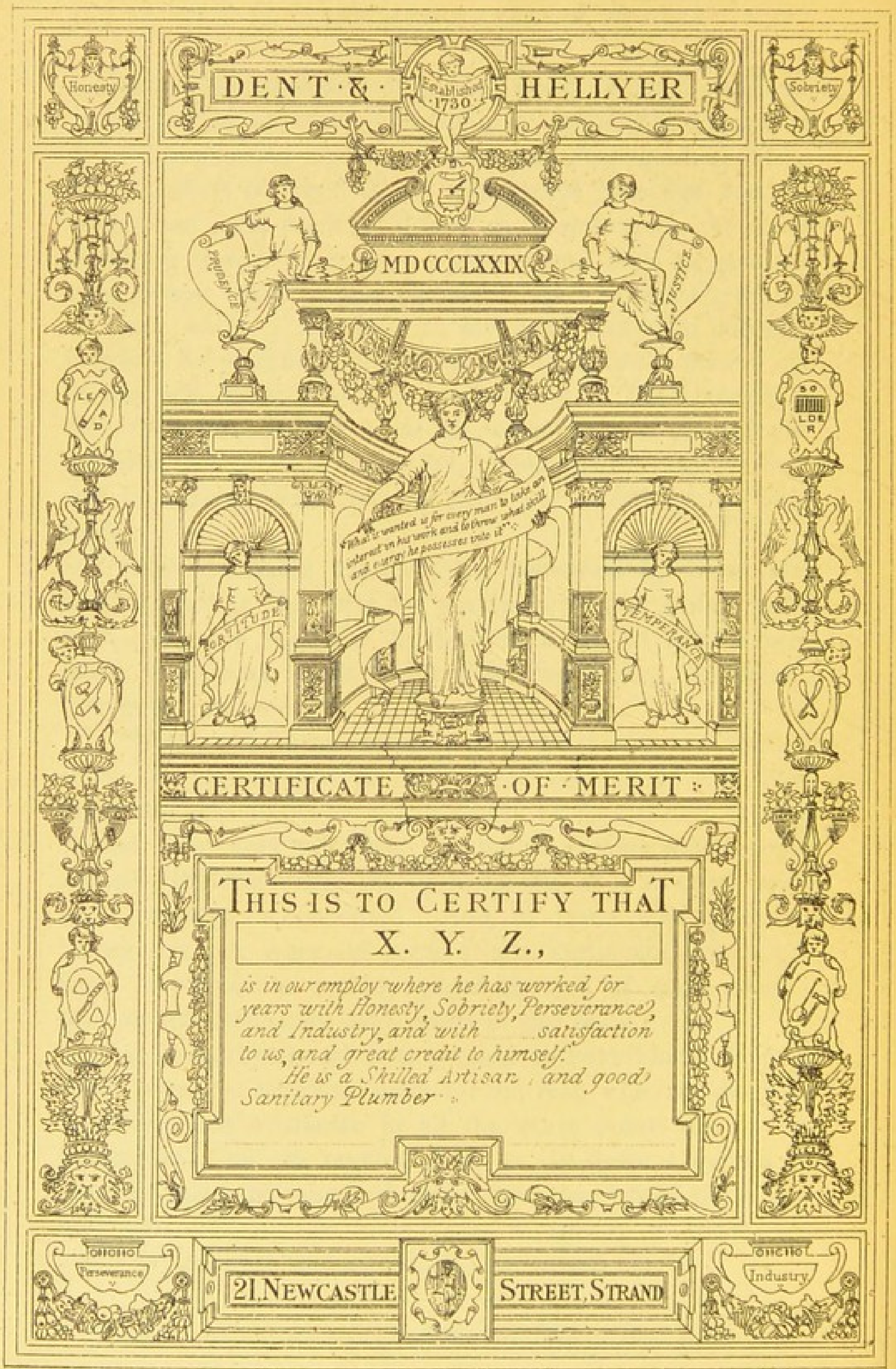
"It is customary, as many of you know, in our professional institutions, in our seats of learning, in our halls of science, to give distinguishing marks to men who distinguished themselves, and it occurred to my mind some time ago that the largest and most ancient House of Plumbers in the three kingdoms should have some mark—some token of goodwill—to bestow upon its leading men. And so this Certificate of Merit, which I now hold in my hand, has been specially prepared for presentation, from time to time, to the men in our employ who comply with its requisitions. The standard is high, for I want you all to become, what many of you are, the foremost men of your craft—first in honesty, first in sobriety, first in industry, and first in skill and knowledge of your trade.

"This certificate can only be possessed by those who have worked in the Firm for ten years, and as I want it to be a guarantee that the holders of it are all that it professes, you must *merit* it, for it is only kissing, you know, that goes by favour.

"There will be no difficulty in settling who are entitled to it, as far as *time* is concerned: our books will show that; nor will there be any difficulty as far as *skill* is concerned: your work will speak for itself; but there will be some difficulty in determining the fit recipients of it as far as *sanitary knowledge* is concerned. And to settle this question, before you can hope to receive this certificate, you must have carried out a sanitary plumbing job of some magnitude on the principles laid down in my book.

"It is in my thoughts at present to have block plans of some extensive buildings made for the men who are entitled to receive this certificate in all the other points except the sanitary one, and to require them to lay down a system of drainage upon the plans, showing how they would drain the buildings, and, at the same time, to specify in their own language how such drainage should be carried out."

After presenting at this meeting the first cer-



Whiteman & Bass, Photo-Litho, London.

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tificate to our General Foreman—one of the best sanitary plumbers in London—the names of about twenty men were read over, who, according to the Author's judgment, were there and then entitled to receive the certificate—which reads as follows :—

"This is to certify that X.Y.Z. is in our employ, where he has worked over ten years with Honesty, Sobriety, Perseverance, and Industry, and with much satisfaction to us, and great credit to himself. He is a Skilled Artisan and good Sanitary Plumber."

ADVERTISEMENT.

PRESS NOTICES OF THE FIRST *EDITION.*

"This is a practical treatise on the principles of internal plumbing work, with reference to the best means for excluding noxious gases from our houses. It treats of traps, soil-pipes, wastes, lavatories, baths, closets, ventilation, and so on. It is illustrated with numerous diagrams, and tastefully got up. . . . . We should be glad if every plumber in the kingdom would buy the book ; this would give a good sale to Mr. Hellyer, and a good lift to sanitary plumbing."—*The Builder*, Sept. 15th, 1877.

"We have read this book with a great deal of pleasure, because it contains evidence that the necessities of those who build houses and of those who live in them can be reconciled by any judicious and thoughtful man who is capable of investigating the great sanitary question from more points of view than one. We do not wish to convey the impression that we are completely in accord with Mr. Hellyer on all the matters which he discusses ; but we believe that a house fitted up by the plumber in the way he suggests will be found on the whole perfectly free from the poison of sewer gas, while no expedients are suggested which, beautiful in theory, utterly fail in practice. . . . . . The work is so easily obtained that it is quite unnecessary to consider it in detail. Its principal peculiarity is that it is written with unusual common sense. We can find throughout its pages no indication that the author is given to exaggerate anything. He attaches a rational value to every expedient that can be used for keeping out sewer gas, but he does not run wild about ventilation, or the pollution of water, or any other hobby. He suggests nothing that cannot be done in any house, and he admits that cheap houses require cheap fittings, which can, however, be rendered quite as effective as the more expensive sanitary appliances suitable to the mansion. . . . . . It would be superfluous to say more about a work the principal defect of which is that it advocates a style of work so excellent, and so far beyond the mental powers of the ordinary old-fashioned plumber, that some trouble will no doubt be incurred by those who insist on Mr. Hellyer's rules being put into practice. But there is nothing advocated, after all, that is not suitable to the requirements of ordinary life in cities. TO ALL ABOUT TO BUILD A HOUSE WE

WOULD SAY, BUY MR. HELLYER'S WORK, AND READ IT." — *The Engineer*, June 22nd.

"We have here a very sensible little volume containing numerous hints of value to all householders, and particularly to those whose sanitary arrangements are not all they ought to be. Many parts of the book are quaintly written, and altogether the author has managed to deal in a very readable way with the details of a subject which is not perhaps specially attractive. . . . . . Mr. Hellyer's remarks on traps generally are excellent, and so are those on the ventilation of soil-pipes, &c. Our author is, in fact, evidently well acquainted with the weak points of the sanitary fittings of our houses, and he directs attention to these weak points, and explains the details in which ordinary plumbers' work is but too often to be found wanting. Altogether the book is one we can decidedly recommend."—*Engineering*, Aug. 17th, 1877.

"In this book we have a manufacturer's views on sanitary apparatus. It is, however, an advantage to obtain the benefit of the experience of those who are best acquainted with the details of plumbing; and Mr. Hellyer is fair in dealing with the works of his rivals in trade. The book is clearly written, and is illustrated with some capital woodcuts."—*The Architect*, Oct. 27th, 1877.

"The author very clearly states the objects and methods of household plumbing details. . . . . . His every page exhibits practical knowledge, in a clear, simple style such as gives a charm to the driest details."—*The British Architect*, July 20th.

"With an elaborate binding and handsomely printed, and with illustrations that would do credit to many works of far greater pretensions. Though its appearance did not bespeak a plain treatise to practical men, we were agreeably disappointed on reading its contents. From cover to cover the book is full of hints, instruction, and information, and the work is well divided under different heads, and made still clearer by the marginal references used. Dedicated to designers and builders of houses. The importance of sanitary precautions and the convenience of various methods of fittings and drainage is discussed; the section on 'traps' with which the author commences his treatise is especially useful, and fully illustrated as it is by wood engravings and by lithography, the advantages of each appliance is made clear even to the unpractical mind. In the remarks on the 'D' trap we fully concur. 'How few,' says the author, 'understand the trade of plumber, practically and theoretically;' but both practical and theoretical men will be largely helped to a better knowledge of plumbing work through a perusal of this book."—*The Illustrated Carpenter and Builder*, Aug. 31st, 1877.

"This little volume of 144 octavo pages is a novelty in technical literature on account of its handsome typography. The type is large, the binding quaint and pretty, and there are numerous and finely-executed illustrations. In short, it is a book which would ornament any parlour centre-table, and on this account, as well as from the simplicity and clearness of its descriptions, it will attract many readers who are not interested in most sanitary publications. The author, who is a practical sanitary engineer, aims particularly to show not only the comfort and convenience of sanitary buildings, but also that it is possible to have them without the slightest fear of making them inlets for foul air or noxious gases. While many of the suggestions made are adapted for a comparatively mild climate, and would not therefore be suitable for many parts of the United States, yet any American plumber may gain benefit from reading this book. One of the most notable features of the work is that, like so many writers on household matters, he does not lay down rules and methods only adapted to persons of long purses, but he aims rather to suit a medium class. He gives several illustrations of neat and economical fittings for the smallest houses; and while he admits that cheap houses require cheap fittings, he insists that they can be rendered quite as effective as the more expensive appliances for the costliest mansion." — *The Plumber ana Sanitary Engineer*, New York, March, 1878.

"To aid us in the combat with sewer gas and miasma, we have called to our assistance the plumber with his array of bell-traps and sanitary appliances, and his imperfect knowledge has, in too many cases, afforded facility to the access into our houses of the deadly exhalations given off by the accumulations of filth in our sewers and drains. The ignorance of the ordinary householder on such points is only equalled by his indifference or his unwillingness to receive information. True it is that until very lately the professional experts, on whom he relied, have known very little more about the matter than their employer, and even now are but half enlightened; and, therefore, the multiplication of such books as the one before us is to be welcomed, especially when, as is the case in this instance, *the information is reliable, and given in a form likely to be of use*."—*Public Health*, June 15th.

"This book, of which we gave a short notice in our last issue, we heartily recommend for the scientific and practical way in which the important subject of house sanitation is treated. . . . . . We wish our space allowed us to quote more fully from Mr. Hellyer's most valuable remarks. His work should be in the hands of every plumber."—*The Plumber and Decorator*, April, 1879.

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