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W. B. Badwell.

*DOMESTIC PLUMBING
AND
WATER SERVICE*

WILLIAM WHITE

F.S.A & F.R.I.B.A.



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DOMESTIC PLUMBING

AND

WATER SERVICE

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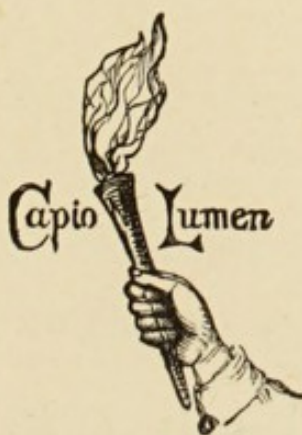
DOMESTIC PLUMBING AND WATER SERVICE

BY
WILLIAM WHITE

FELLOW OF THE SOCIETY OF ANTIQUARIES
AND
FELLOW OF THE ROYAL INSTITUTE OF BRITISH ARCHITECTS

Science's simplest forces,
In Nature's true courses,
With Invention's resources,
Point the highway to Health

(New Adage)



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PREFACE.

IN commending these pages to the favourable notice of my brother Architects, my Medical and other Scientific Friends, and the Public generally, I may obviously and reasonably be presumed to write with a certain amount of bias, from having a personal interest, as an Inventor, in several patented Sanitary Appliances.¹

Nevertheless I may be allowed to express my conscientious conviction that the fullest inquiry into the questions here discussed, and the fullest information afforded to the general public as to practical

¹ The appliances specially referred to are those made by Messrs. Frank Peirce & Co., Shrewsbury Sanitary Works, 1 and 2 Little York Place, Baker Street Station; viz. the Shrewsbury Valveless Closet (with valveless Water-Waste-Preventer and Regulator); the Shrewsbury Wasteless Lavatory; the Shrewsbury Automatic Ball-Valve, and other waterway taps; and certain Domestic fittings.

details in such matters, will be for the common benefit of all.

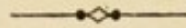
I venture further to indulge a well-grounded hope that the principles upon which these practical details are here treated will meet with careful and impartial consideration.

WILLIAM WHITE.

30a WIMPOLE STREET, W.

February 1880.

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DOMESTIC PLUMBING

AND

WATER SERVICE.

(1). EVERY careful Householder knows but too well the difficulties and dangers which beset his plumbing arrangements ; and his own want of practical information respecting them. They become to him a constant source of annoyance, anxiety, and expense. It may be considered a somewhat bold step to venture to suggest remedies for such a chronic state of vexation and trouble ; yet I purpose saying a few words, with especial reference to Sanitation, convenience, and economy respecting : (1.) The Water Service. (2.) The Water Closet. (3.) The Water Valve. (4.) The Drain Ventilator. And (5.) Remedies for Existing Evils.

I. THE WATER SERVICE.

(2). In cases where water has to be pumped up, or otherwise forced, or led to the top of the house, nothing need be said as to its storage,

except what will appear presently with reference to its preservation from contamination, and its economy by means of the special appliances to be described subsequently. In any case the saving of waste means the saving of expense, when the water has to be raised by manual labour. The case of public water service laid into the house is not so readily disposed of. A lively controversy has been carried on for some years past upon the merits of what is called the 'constant service' in the supply of water for domestic use in the Metropolis, and other large towns ; and this question, though considered by some to have been finally disposed of, is still under discussion.

(3). In Glasgow, the almost unlimited supply of Water from Loch Katrine, led with a direct and constant service to every house, makes the question of a little waste, more or less, of small moment to the inhabitants. Not many cities can look for such advantages ; and the whole question remains for serious consideration. For machinery, factory, and other purposes requiring a large supply, the mode of payment by meter, for all water used, has been adopted. This mode is scarcely available, even if desirable, for domestic use ; although it would put a practical, if not an effectual, check upon carelessness and wilful waste.

(4). Some of the 'Water-Waste-Preventers,' as I have been informed repeatedly, waste more water than they save. I have tried several in my own house, and have had to remove them again from the

uncertainty of their action. I have recently been told of a 'Waste-Preventer' which has been running away regularly for four or five months, since it was 'set right' by the plumber, it having been previously well nigh useless for two years, by 'sticking,' and thus 'saving' the water from properly supplying the closet at all. A simple contrivance for the prevention of this special source of waste, without recourse to meter, upon a wholly new principle, to be presently illustrated, will therefore be regarded with interest, by those who have already given attention to the question, as the commencement of a new era in Sanitary appliance. This contrivance must practically facilitate the adoption of the 'constant service' which, already extensively and increasingly used, will sooner or later prevail, except probably in the poorer districts where the difficulties of carrying it out would be very great, on the account of the enormous amount of supervision which would be required to guard against loss and waste.

(5). Whether the 'Constant Service' eventually fulfil all the anticipations of its advocates, or not, it will be accepted by those who are perhaps the best fitted to express an opinion, as a great advance in the right direction. The danger of the cistern getting foul by being exposed to impure air, or to a waste pipe connected with a foul drain, cannot be overrated. Even when free from this species of contamination, cistern storage is often open to serious objection. The inevitable neglect of its

presumed cleansing ; the absence of an available machinery for enforcing such cleansing ; and the repugnance of Water Companies not only to 'standing waste,' but also to the waste which this periodical cleansing implies, must be accepted as valid reasons for the constant service.

(6). Still the cistern cannot be entirely abolished in all cases, at any rate for the feed of the closet, even if avoided for culinary use. But, for the latter purpose, supposing the water supply liable to be charged, even in a small degree, with any deposit, the precipitation and interception of the sediment by the cistern, instead of being consumed as now in cooking and drinking, is a benefit which may perhaps be claimed on the other side. This benefit is very often, not to say commonly, lost by the 'draw off' for such purposes being inserted at an insufficient height from the bottom ; and by the ball-tap service being allowed to fall directly down into the cistern (making a great noise in so doing), thus stirring up afresh the whole of the sediment, every time the water is turned on, instead of the water being led by a piece of slate, or by other means, to fall against the side of the cistern.

(7). From the danger of blood poisoning through the use of lead and zinc for cisterns, these metals ought to be strictly prohibited, and cisterns supplying water for washing, cooking, and drinking should be made of slate, stone, or cement. An old lead or zinc cistern can be rendered innocuous by lining it with tile and cement. Zinc is said to

decompose even faster than lead. How far this is the case when used for the galvanising of iron, I am not informed. Lead is not decomposed by *running* water. Directly water becomes stagnant, whether in the pipe or in the cistern, the decomposition begins ; but it would not be possible always to allow it to be running to waste for such a reason as this. The connection between the water-main and the house being usually of *lead* (this material in fact being insisted on by the Representatives of some Water Companies) is a fair argument against 'constant service.' The water left in the pipes is stagnant all through the night, and gets charged with lead for morning use.

(8). Some of the Authorities (whether knowingly or not) are doing their best to make the 'constant service' unpopular, by allowing requirements (which are not properly within their legal powers) to be insisted on by their officers, whereby the Consumer is in danger of considerable damage being done to his house, before he can possibly be made aware of it. 'Waste Detectors' and 'warnings' may be necessary ; but surely not if their action involves, in case of anything going wrong, such an inconvenience as the necessary splashing of a whole room with water by the 'warning,' the flooding of it by a leaky 'detector,' the necessity of sending for the company's Inspector with a plumber—vainly perhaps on a Saturday afternoon—before another drop of water can be drawn for use. Let the warning or overflow be

visible or accessible to the servants of the Water Company ; let wilful waste, or neglect to remedy it, be fined in accordance with the powers which the companies already do or ought to possess, and with this let them be content.

(9). Estimated or supposed waste might be measured without difficulty, though not without expense. Probably the expense would not be greater than the present imperfect and objectionable contrivances for preventing the waste. In any case it must be admitted that the more the interests of the suppliers of water and the public to whom it is supplied become ONE, the better will it be for both parties, whether by prevention of waste, or by facilities for supply. There should be on the one hand, for the sake of the health and comfort of the whole community, as little restriction as possible upon the necessary use of water, and on the other hand every possible inducement, and every necessary provision, for the avoidance of waste.

(10). It will be almost needless to discuss the question of paying for water supplied for domestic purposes by meter, like gas. It would be more costly in operation than would be justified by the result, and it would be placing a restriction on the necessary use of water by those who most of all require every inducement to its free and proper use ; viz. the class of persons just above that whose water rate is paid by the landlord. It is to be hoped that, whatever views may be advocated by

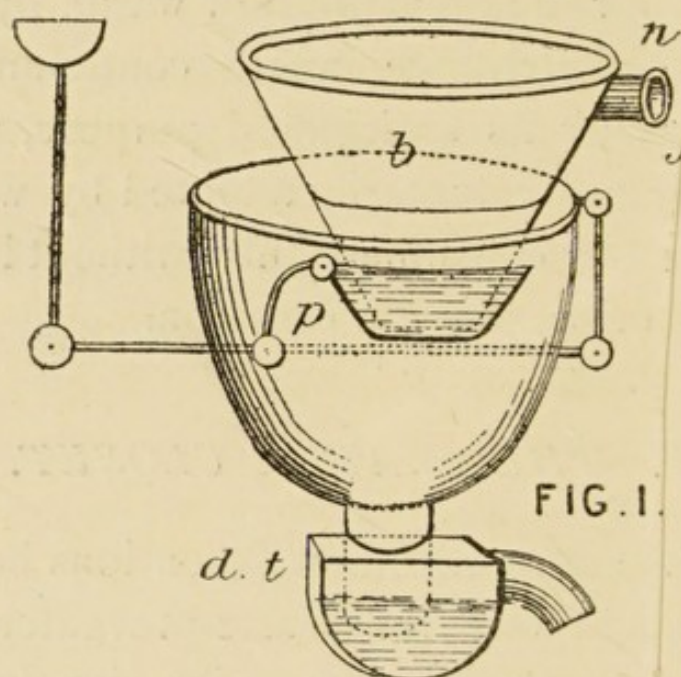
individuals, the whole question of water service will shortly be set at rest. The intention of the Government to take up the matter as one of public polity is a guarantee that it will receive full consideration in all its bearings, even if the result should prove not wholly successful in its working.

(11). My own design in introducing the subject, and going into it thus in detail, is to bring into notice the most available means yet discovered, as I conceive, for the prevention of waste, by a simple mechanical contrivance, which contrivance, when found to answer its anticipated purpose, will soon be generally and voluntarily adopted by water suppliers and water consumers alike, without legislative enactment, or illegitimate coercion.

II THE WATER CLOSET.

(12). The numerous new Inventions being constantly brought out for Waste-preventers, Regulators, and Water Closets, point conclusively to the great need generally felt for a more satisfactory solution of the problem than has as yet been put forth. It is not for me to say that the new appliance about to be described is beyond the reach of unfavourable criticism ; though I may myself entertain the belief that the work of the Household plumber will be materially affected, and indeed revolutionised, by it. In principle this appliance accords with that so strongly advocated by Mr. Teale (pl. vi.) in his book.

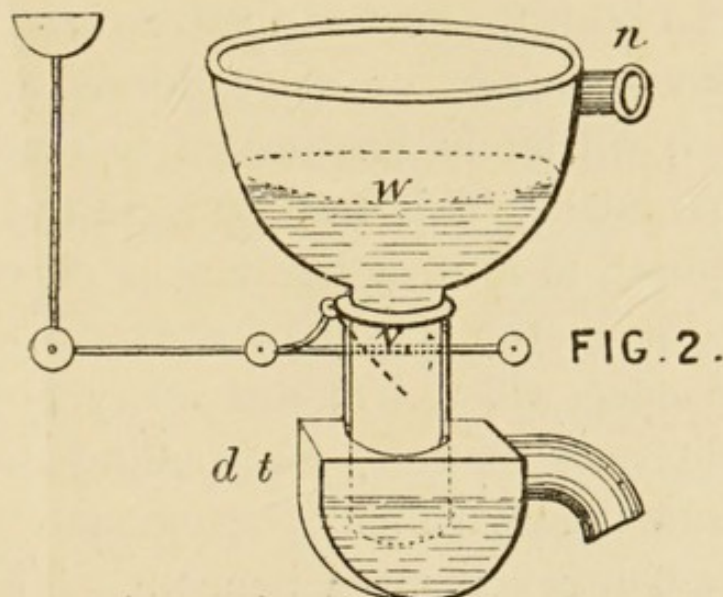
(13). Notwithstanding the many forms of apparatus, nearly all closets must still be classed under two heads. Under the first head are comprised those in which the water in the basin is retained by means of a pan, or a valve, or a plug, by the drawing of which the discharge is dropped into a receptacle or trap below, (*d t* Figs. 1 and 2). Under the second head are included those which contain merely a little water, commonly almost



invisible at the bottom of a very deep basin, the contents of which are *washed away directly*, or rather are assumed to be so, into the drain, by a flush of water let in from above (Figs 3 and 4). In the former, as will be seen further on, much is washed away that ought to be retained; and in the latter much is retained that ought to be washed away.

(14). Of the former sort, the 'common pan' (Fig. 1) has been, and I may say still is the most

universally popular. It is in reality the most objectionable. The pan or small dish (*p*) which holds the water at the bottom of the basin (*b*) is, on the pulling up of the handle, drawn down into a large iron 'container' (*c*) which contains not only the pan but an accumulation of corroded filth, and consequently a supply of foul air ready for dispersion into the house every time the closet is used. Truly this capacious receptacle is some-



times ventilated ; but no amount of ventilation will purify its contents or reach the root of the evil, even when this objectionable appendage is made of earthenware in lieu of iron.

(15). Of the same sort, and only a little removed from it in the scale of civilisation, is the 'Valve' closet (Fig. 2), which has been much used in houses of the better class. In this closet, when the handle is pulled up, a valve or flap (*v*) is let down into the D trap (*d t*) below, without the

intervening 'container,' the water being kept in the basin merely by the closeness of the fit of the valve against the bottom. With the slightest grit or corrosion, soapy slops, a hair, or a bit of paper, or even with the absence of a little ordinary knowledge or care, this valve gets foul and fails to close properly ; the water runs away, the basin is left in a state unfit for use, and emits the gases which still form in the pipe and trap, though to a smaller extent than in the 'pan container.'¹

(16). In both the pan and valve closet the trap (*d t*) below the pan or valve, forms a 'double trap,' which till lately has served to render these kinds so popular. This trap beneath the pan has been supposed to form a permanent check to the foul air, during the action of the pan or valve. But experience will tell almost every one who is sensitive in such matters, that pulling the handle releases into the apartment the emanations which are always being generated beneath. The trap of this sort of closet, whether the pan (Fig. 1.) or the valve (Fig. 2.), is an inviting receptacle for rags and refuse, old house flannels and scrubbing brushes, hair and waste paper, sponges, spent matches, candle ends, and other outpourings of the housemaid's pail.

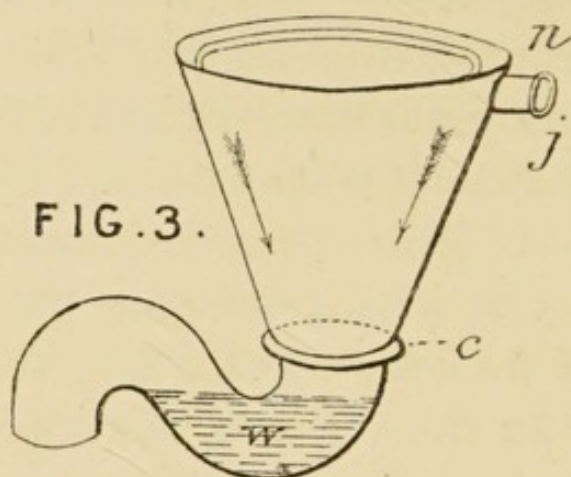
¹ Since writing the above one of the closet-valves in my own house was in this state for a considerable time ; and, by a strange and unfortunate coincidence, when the closet-valve readjusted itself the service-valve refused to close, the 'safe' did not carry off the water fast enough, and my floors and ceilings were flooded.

All these things are dropped through the pan out of sight into the trap below, from whence they are often carried into the drain itself. Sometimes, again, through negligent misuse of the closet without a proper service of water, in time of frost or of insufficient supply, the accumulations of several days may choke the trap, or the drain ; and in either case the result is disastrous.

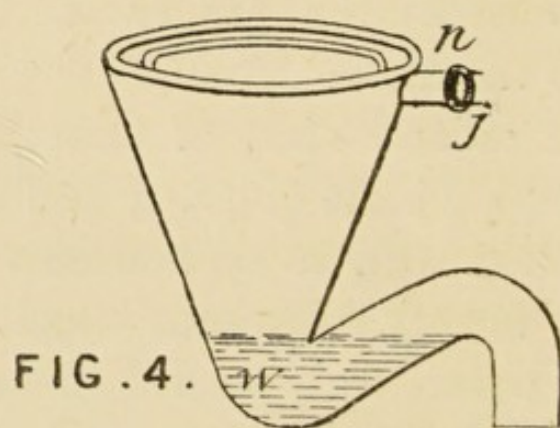
(17). In another popular closet the same operation of discharging the contents of the basin is effected by the drawing of a plug or valve which is out of sight ; the contents flow away into a trap below, whilst fresh water wells up from the same aperture into the basin, or is let in by a valve from above. This sort is equally open to the same objections, both as to the trap and as to the danger of the service leaking away, through an India Rubber washer, after a few months' use. Even when the trap has been abolished (as liable to choke with misuse) the danger has been merely transferred to the drain.

(18). The second class of closet, that of the hopper or flushing basin (Figs. 3 and 4), is simply a basin finished with a syphon-trap at bottom, without any further apparatus than that which admits the water to 'flush' or wash it out. Hitherto the form of the basin and the mode of flushing have been such as to render it almost impossible that it should be washed out by the inlet of water. It contains so little water that it never can be kept clean, and it is usually made

deep and narrow, in order that what ought to be washed away, but is not, may not be too visible. From their construction being so simple and

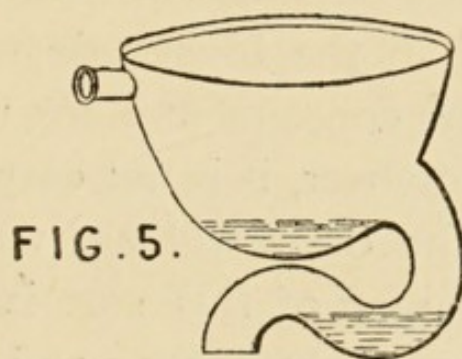


inexpensive they likewise have become popular for cottage and kitchen use ; as though it were of no great consequence that mechanics, cottagers, or servants should be exposed and accustomed to



uncleanly sights. In order to rinse the sides of the basin, which on account of its form must be constantly splashed or almost plastered with dirt,

various contrivances have been adopted such as 'flushing rims' and 'spreaders,' to lead the water round the surface of the basin, and thus take away all its force for flushing purposes, before it reaches the trap at the bottom. The force of the flush, again, is often neutralised by the syphon-trap below leading into a drain which also is trapped in its course, or at its outlet, and has no other opening or ventilator to prevent the accumulation of gas, and the consequent compression of air which takes place at every fresh flush. Not only does the flush thus lose its force, but the trap is rendered almost useless by becoming syphoned ; or by the compressed gas being forced out through it.



(19). There have been several inventions of late years for the purpose of obviating these defects, and some of them are great improvements upon the old form ; but others still retain the chief defect, in the carrying down of the discharge into another receptacle, or trap below (or at the side, as the case may be), only partially out of sight (Fig. 5), and without sufficient means, as it seems to me, of

ensuring the proper flushing of this receptacle, or trap, every time it is used. That which is really needed is the very simplest description of hopper or syphon basin, capable of ventilation beneath, and with such a flush of water as properly to clear the basin, not into any other receptacle, but directly into the drain itself. This, moreover, ought to be accomplished by means of a single simple action ; not by the continuous holding up, or pulling down, of a handle for an uncertain length of time ; which action is often neglected, especially by ignorant people.

(20). There is great danger, as has been observed, in the pan or valve closet being used without water. With the hopper or flushing basin, on the contrary, a few days' use without water is almost impossible, and in the highest degree improbable, on account of the consequent filling up of the basin. In this kind, moreover, it is not easy to wash down anything that the drain will not well carry away. The common failing of this sort is that they cannot be kept properly clean, and that floating remains are not effectually removed ; not merely from the want of proper inflow of water to flush them, but quite as much from their objectionable form. The great desideratum is a closet that shall not be liable to derangement, whether by wear, neglect, or abuse. A certain amount of reasonable attention in all sanitary matters, as in all mechanical appliances, must be, and ought to be, presupposed. Even the description of paper to be used

in the closet is a matter of some consequence. Those who regard their health will use a soft brown or whitey-brown paper. All descriptions of white, yellow, or other coloured paper, and all printed paper will be eschewed. Under certain conditions of health, contact with the ingredients used in printing ink, or with the vitriol, potass, lime and other chemicals used in the bleaching or colouring of common papers is injurious ; if it be not, as affirmed by some, a prevailing source of derangement and disease. And for the sake of the pipes and drains, all accumulations of hard or printed paper, when used, ought in any case to be immediately taken out and removed, if not easily washed down. With the common pan apparatus, a half sheet of the 'Times' might almost be washed down into the trap, out of sight, to the great danger of stoppage. But with the common flushing basin it would be difficult to wash such obstructions down without a force of water sufficiently great to carry everything with it. Hence it is desirable that none but a flushing closet should be used, and that its outlet should be, so far as is possible, such as not to allow of unsuitable things passing away.

III. THE WATER VALVE.

(21). The occasional accidental running away of water from the household cistern, to those especially whose supply is limited, has been for many years a constant course of vexation, incon-

venience and expense. At times I have lost my daily store of water, day after day, before discovering the cause, which has eventually proved to be due to the valve of one or other of the several w.c.'s getting occasionally (but not continuously) propped by the handle; or by the valve being improperly fitted, or some similar cause.

(22). For purposes requiring an excellent flush, with a strictly limited quantity of water, it is proposed to do away with this valve altogether, substituting for it something which is capable neither of leakage, nor yet of wilful or careless waste of water from being purposely propped or accidentally left open.

(23). The valve at present ordinarily used to serve the basin of the w.c. being one of the most fruitful sources of waste, its total abolition will prove one of the greatest boons in respect of Domestic Water Supply yet brought before the public. The cost of good valves at first, and in successive adjustment and repair; their inevitable liability to leakage, and other derangements; the difficulty of getting fullway valves of large capacity and keeping them in working order when obtained; their frequent damage from frost, obstruction, wear, or neglect, must render a satisfactory substitute for them a matter for general rejoicing.

(24). The new Apparatus of course, like all other Water Apparatus, may be disabled, though it is not liable to be deranged, by frost. But pipes, closets, and valves ought always to be securely pro-

tected against the effects of frost, and in ordinary circumstances and positions this may easily be done by casing and other means. Even a common brass French oil hand-lamp will keep out frost from a good-sized cistern, when protected from draughts of freezing air.

(25). A ball or floating valve-tap to feed the waste-preventer cistern, whether by constant or intermittent service, will still be required. In the working of these ball-valves, however, great and manifest improvements have now been made, by a further invention which will reduce to a minimum the chances of leakage and waste. This is effected by the adoption of an entirely new principle in their construction, the very opposite to that hitherto generally used; which principle ensures its immediate and automatic action in closing. The only force required to open the valve is applied below, or externally to the waterway. Under high pressure this force is very considerable, and is met by a simple method of single or compound lever as the case may be, its action being by way of direct counterpoise to the column of water within. It is without stuffing or packing of any sort, and quite free from all liability to stiffness or sticking. [See §§ 37, 38.]

(26). It is evident that in the adoption of such a ball-tap, combined with a valveless and waste-preventing regulator, incapable in its operation of leaking or of being left running, the most complete provision that can be devised against waste is obtained.

IV. THE DRAIN VENTILATOR.

(27). It is not my intention to say anything regarding drain ventilation, except as it may affect the proper working of the closet, and its freedom from smell. It is now generally agreed that—unless other ample means of ventilation are provided—provision ought in all cases to be made for continuing the soil pipe, of its full capacity, up to the roof of the house; and the mode of securing ventilation by means of a second pipe (as advocated by Mr. Masters in his paper at the Sanitary Institute) is to my mind the best of the various modes put forth by the numerous conflicting authorities. When drains are ventilated, the house drain ought in all cases to be disconnected from the sewer, by a trap at the lower part. I have myself used for this purpose a single ‘cleansing syphon’ and open grating, instead of two syphons with an opening between. But the upright nozzle of the cleansing syphon is liable to become clogged with floating matter, and then to require the cleansing process which ought to be unnecessary in a well-flushed drain.

(28). A complete system of disconnection and ventilation has been elaborately worked out by Mr. Woodhead, of Leeds, in a well illustrated pamphlet; which would be very effective, no doubt, though somewhat expensive. Still the advisability of having an open ventilator in the

ground, as the exit for a down current, is objected to by many sanitarians on the ground that the constant adhesion of fresh matter to the pipe is always creating emanations which, though to a great extent oxidised by the passage of air, must be more or less objectionable. But, besides this, the theory has been seriously questioned whether the current of air *will* always be downwards by reason of the larger column of air in the pipes nearest the house. From my own experience of draughts, and experiments made, I should very much doubt the possibility of ensuring a downward or yet an upward current under the circumstances, in all conditions of atmospheric influence. When the upperstratum of the atmosphere is moist and warm, the action would be just the reverse of that when it is fresh and keen. The plan of creating a current through the soil pipe at all has been objected to by others, on the ground that so long as decomposing matter is undisturbed and excluded from the air, its decomposition is checked; and, being stagnant, it will not come forth to pollute the atmosphere. These objectors will allow of the soil pipe being left open at the top, to prevent pressure upon the traps, but not of its having any admission of air which would disturb, or expel, or oxidise the foul gas within. It is in fact a sort of passive system of ventilation; and when the ever-recurring chilly change in the temperature of the early morning, or any unusual depression, takes place, the probability is that the compressed column of air will force the

traps, unless some special precaution against this shall have been provided. We know that in the early morning there is nearly always a strong draught of cold air forcing itself down the chimney flues into a house. And it is not likely that a slight trap would prevent the same action going on down a ventilating pipe, if it have no other outlet below. It may be, as urged by Dr. Willington, that, under such circumstances, the pipe will become entirely full of foul gas which will in many cases simply *overflow* to pollute the atmosphere of the surrounding dwellings. Dr. Willington's scientific theories and contrivances for the prevention of down draughts are indeed well worth attentive study in connection with this subject. On the other hand it is argued that a current of air through the pipe will oxidise the accretions in the trap, and on the inside of the pipe, sufficiently to render them innocuous. A professed Sanitarian has invented the means of ensuring a continuous upward draught in the pipe, by introducing small inlets for the fresh air at intervals, in spite of the acknowledged fact that, in order to ensure a draught, the pipe ought to have air-tight joints; and that the height of draught (which is the effective element) is reduced to that of the admission of air in the body of the pipe at any given height. The draught in a pipe might be so strong as to overcome the effects of such admission. But it is quite a novel idea to introduce them for the sake of creating an upward draught, which would probably be

almost stagnant, if not downward, under these conditions.

(29). The relative merits of passive and active ventilation can be decided only by patient investigation and careful experiment. It suffices for me at the present moment to maintain, that if the discharge from a w.c. be allowed to fall each time upon a 'buffer' of confined air at the bottom of the pipe, its force will be checked too much to allow of the flush doing its proper work ; for it is to a sudden and sufficient flush that we must look for efficient working. Only by these means can the soil pipes and drains be kept thoroughly cleaned and washed out. A small, gentle, and gradual dribble of water, such as a three-quarter or even an inch pipe affords, allows of sediment being deposited on its passage, which sediment gradually corrodes them. If the effect of an efficient flush be neutralised by such an impediment as confined air offers, the result is much the same, and the very force upon which we relied is proportionably sacrificed. [See also § 36].

V. REMEDIES FOR EXISTING EVILS.

(30). The principal remedy proposed is the adoption of the w.c. called the 'Shrewsbury Patent Closet,' which is constructed upon the principles set forth in previous sections of this paper. It is placed behind a casing at the back or side of the

closet. The contrivance consists in drawing, from the top of a small cistern *c* (Fig. 6) holding a regulated supply, enough water to form an efficient flush, through a properly formed hopper basin. This is effected merely by means of a movable flap or tray *t*, within the cistern, by the raising of which the requisite quantity is lifted out, whether bodily or by pressure against the sides, into a funnel *f*, and so discharged by a pipe *p* into the basin beneath,

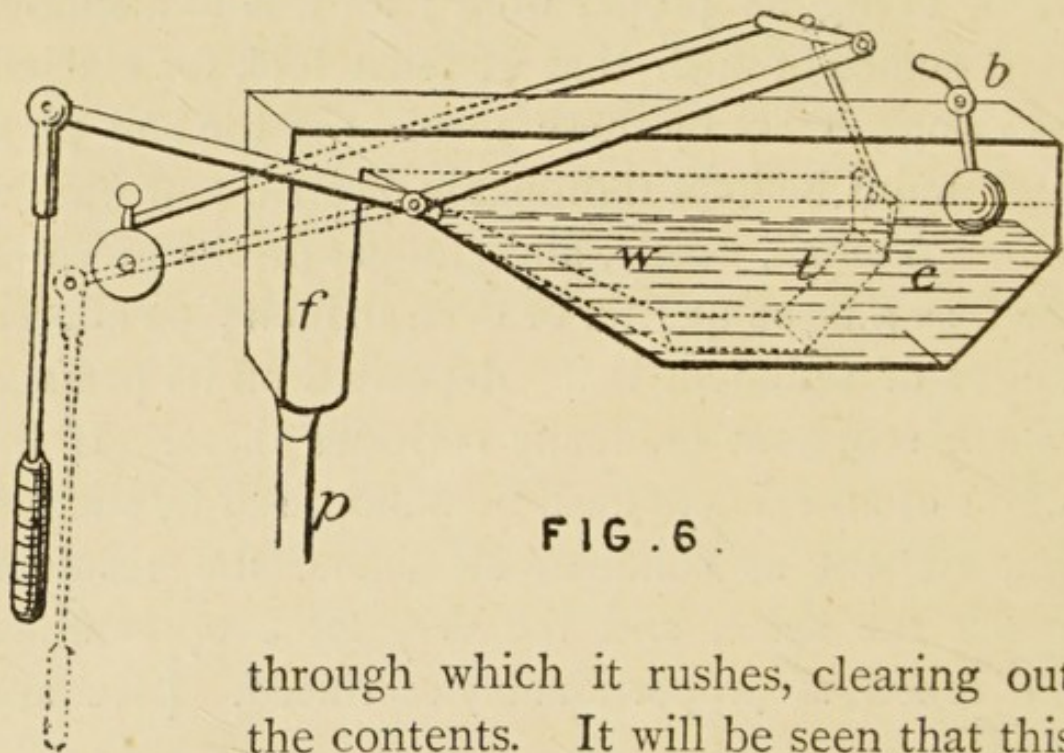
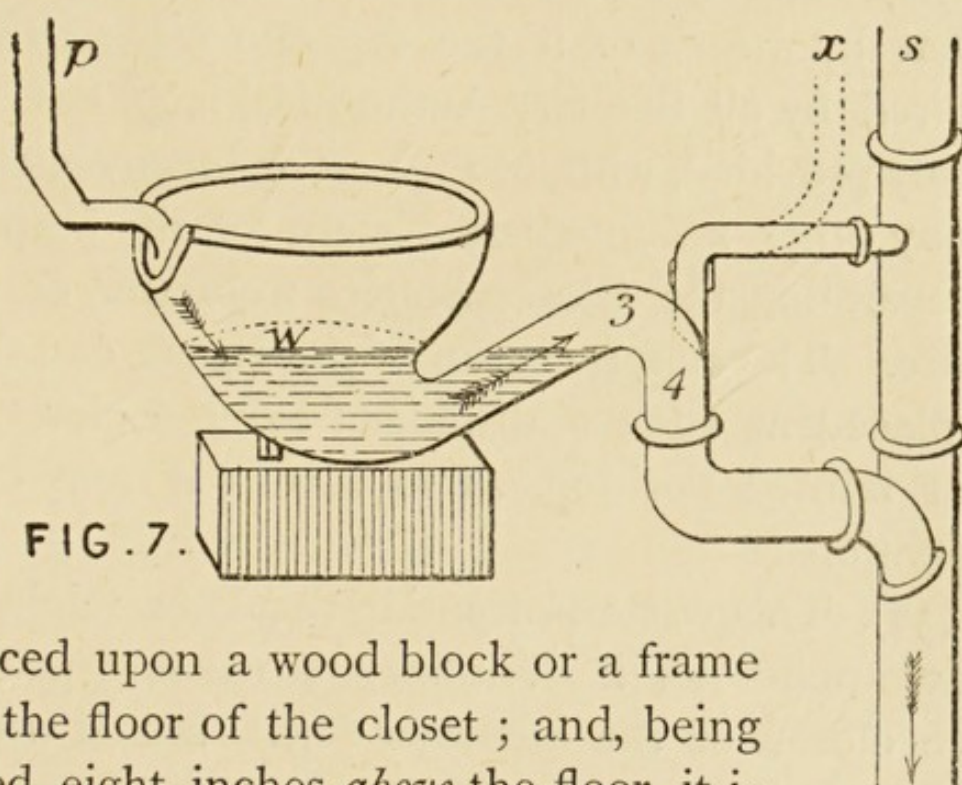


FIG. 6.

through which it rushes, clearing out the contents. It will be seen that this small cistern, having no opening except at the top, and being without any valve or other outlet for the water below, cannot be liable to leakage or other derangement. The hopper or flushing basin (Fig. 7) is of such form as to hold as much water (*w*) as an ordinary pan or valve closet, and thus is capable of being kept equally clean; whilst it is at the same time capable of being thoroughly flushed. It has provision for a circulating system of ventilation in the

trap which cuts off the soil pipe. The basin being of good form, and of Wedgwood, or other good ware, its use for the better class of houses will not be open to the objections which have hitherto entirely prevented the adoption of all descriptions of Hopper or Flushing Basins for anything but the cheapest and commonest purposes. The whole apparatus is complete in itself, the basin requiring only to be



placed upon a wood block or a frame on the floor of the closet ; and, being fixed eight inches *above* the floor, it is easily made good into the soil pipe.

The cistern is fixed on a bracket or shelf above, the only other requisite being a half-inch or three-quarter-inch supply of water, laid on ready for the attachment of a ball-valve at *b* (Fig. 6) to the apparatus cistern ; and some pipe for ventilation below the basin at *x* (Fig. 7), to prevent syphoning, and to create a current of air in the pipe. The apparatus cistern, described above, forms an effec-

tual regulator and water-waste-preventer, in one ; holding as it does the required quantity of water for each discharge. Seeing that the volume of water thus lifted out at one moment is from one to two gallons, the service pipe may be of any reasonable capacity, and a flush of two inches or more readily obtained. The quantity may be accurately regulated by the adjustment of the ball-valve.

(31). A further advantage of this arrangement is that by means of it the separate cistern (now required by all Sanitary Authorities) is *of necessity* already provided, without the cost or inconvenience of any other intermediate cistern for the purpose of separating the Closet Service from that of the House. The supply cistern of the House can thus be placed at such a distance from the closet, or other tainted position, as to secure it from contamination.

(32). This waste-preventing regulator might be made applicable, if desirable, to existing pan or valve closets of the common sort. But it would not be desirable. Those who care only for the prevention of waste might rest content with this. But those who would escape the evils of such pans or valves must have recourse to the special application of the regulator provided by means of the new flushing pan. The same may be said of the common hoppers or old flushing pans. It might be made applicable to these ; but according to their present usual construction, and for the reasons before given, only the benefit of *waste-preventing*

would be obtained. Their *nozzle* (*n*, Figs. 3 and 4) for the inlet service pipe would be far too small to allow of a sufficient quantity of water being admitted for proper flushing; in fact, in order to keep such basins clear, it is the common practice to throw down a pail of water occasionally. Cheap and common sorts of the Shrewsbury closet will necessarily be required in many cases, for cottages, and for servants' offices. In order to meet these requirements, arrangements have been made for their supply, of the proper form under the patent, for adaptation to the new waste-preventing flusher.

(33). In the hopper or flushing basin, to be used with the water-waste-preventing flusher just described, there is provision for rinsing the sides. The two-inch pipe *p* is brought down, through a notch or indentation (Fig. 7) over the edge of the basin without interception or interruption by any joint or other inequality, and the full force of the water is thus still given to the operation of flushing.

(34). It may be useful to make further notice here of the form of the hopper basin ordinarily in use, and to examine into the reason why the water does not properly flush it out. It will be seen that the water coming down the sides almost vertically into the pan (Figs. 3 and 4, § 18) its direction in rebound is almost vertical also. Its force is lost in eddy, after being spent in vain upon the surface, and hence it has no natural tendency to run in the

direction of the outlet, more than in any other. Besides this, the channel is rarely parallel, and its free flow is dissipated by breaks and irregularities (as at *c*, Fig. 3). The only way of meeting these objections is that which is provided by the new basin (Fig. 7), the water being made to fall with a rush from one side only, and then, by an obtuse inclination, to flow through an unbroken course over the syphon on the opposite side, as shown by the arrows in the diagram. With this basin, if a stoppage should occur through improper use, it can be readily reached from the basin itself (at the second arrow) without having to send for the plumber with his air-pump for forcing the trap. Supposing the water to be sufficient in volume and pressure, it will carry before it all that ought to be washed away. It may be observed also how much shallower is the basin than in the ordinary hopper, and how much greater the surface of water within it. The syphon trap and basin being commonly in two pieces (as in Fig. 3) instead of one (as in Fig. 4), the portion above and below the junction have no true continuation with each other, either in the inclination of their lines, or in the meeting of their surfaces. The continuity in the flow is entirely checked, or broken, by the conflicting courses.

(35). For the soil pipe itself, either stoneware or metal may be used. Till of late years lead was almost invariably employed. Its great advantage lies in its being ductile, continuous, and easily fixed,

with very few joints, which again are capable of being rendered for the time perfectly secure. Its great disadvantage is the certainty of its eventual corrosion and decay, which are especially rapid through the accumulation of sewer gas at its junction with the D trap, when unventilated. Iron again is liable, in the same manner, to corrosion and decay; but it is not liable to be eaten through by rats, or pierced by a nail or accidental blow. It is moreover the most available for continuation upwards as a ventilating pipe. It is the least objectionable in appearance, and it is the most easily fitted to old buildings. It is being largely introduced for soil pipes, and probably for these reasons, in Leeds; where sanitary measures claim and receive an unusual amount of attention. Glazed stoneware is unquestionably the cleanest and most durable for the purpose; and the making good to the outlet of an earthenware basin is more easily effected with this than with any other material. But where carried down externally to the wall, as in all cases a soil pipe ought to be, it is unsightly, unless it can be let into a cemented chase, cased in brickwork, or otherwise concealed. In no case should it be built up in a solid wall, or carried up as the wall is built, for the settlement of the work will inevitably fracture the joints. It ought moreover to be always accessible for examination, by the removal of its casing or otherwise, for sound and true work is no less necessary than proper arrangement. The neglect or ignorance of workmen who

are not sufficiently informed, or convinced, of the great necessity for their most careful attention to the hidden construction and details of such work has sometimes led to most disastrous and even fatal results.

(36). With the provision for ventilation shown (Fig. 7) circulation of air may be obtained by carrying the small pipe *x* to the top of the house, somewhat higher than the soil pipe *s*; which ought to be continued up, of its full capacity, well above all contiguity to opening windows, or other fresh air openings. But if the soil pipe be ventilated at its lower end, before being trapped into the main outfall or sewer, the smaller pipe may be carried merely into the soil pipe, a through current being thus obtained from the highest part of the syphon.

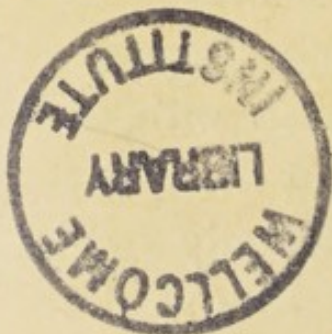
(37). It is necessary to add a few words, in conclusion, as to the best mode of supplying water for the service of this apparatus. Any ordinary ball-valve would be applicable; but the 'Shrewsbury Ball-Valve,' specially designed for it, requires only a small ball-float, and fits into the cistern without difficulty. Having only a ground-in metal seating, being free from india-rubber, or other compressible material, and closing automatically without force or friction, immediately upon its release by the ball-float, it is likely to be the most durable, as it is, in the foregoing respects, the most perfect yet produced. Indeed it 'wears sound' with use; and no amount of pressure, not even such as

would be required to burst the pipe itself, can force or injure it. It may indeed, like all others, be frozen up, but not otherwise 'set' or injured by frost. Nor is it affected by the expansion or contraction of the metal through heat or cold.

(38). The like may be said of the 'Shrewsbury Bib,' or draw-off, taps with the like automatic closing ; their general construction being similar. These taps are made to run only during the holding up of the handle. They may however be made, when required, to be left running like an ordinary tap. It is not always convenient to hold up the handle of a tap during the filling of a pail or other large vessel, great as is the security which this arrangement affords against neglect or accident. For the stop-cocks again in water mains, whether of the public streets or of private works, which are now so liable to wear and leakage, by the force and friction required in working them, and which, without constant use, are liable to get 'set,' they will be, no doubt, invaluable.

(39). The waste-preventing principle without a tap or valve is applied, equally, to the 'Shrewsbury' Lavatory Basin, which is made also without a plug, and without an overflow ; so that the water cannot be left either wilfully or accidentally running to waste. This is a tipping basin without the usual objectionable 'container' beneath, the sides of which get quickly corroded with sour soapsuds and dirt, and require the constant care of an attendant to keep them from becoming unpleasant.

(40). From the foregoing description the value of these improved appliances must be manifest, and, in this age of ever-increasing Sanitary Reform, every fresh practical Invention, if it shall prove to answer fully and effectually its proposed purpose, cannot fail to be hailed with universal satisfaction.



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