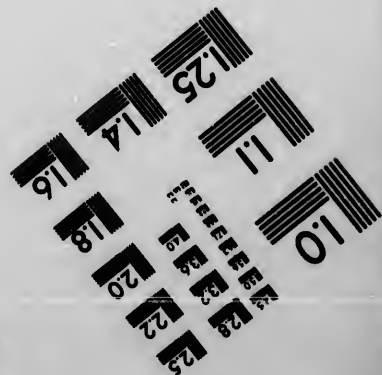
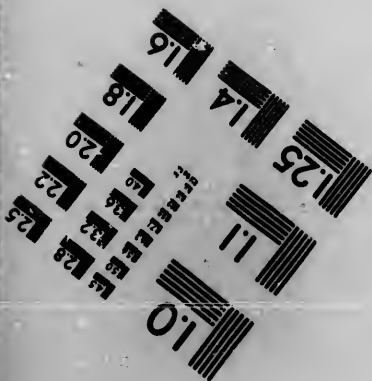
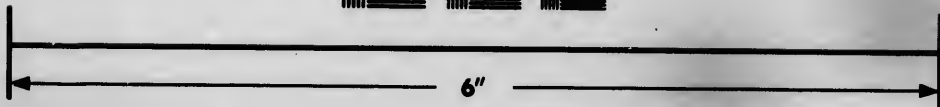
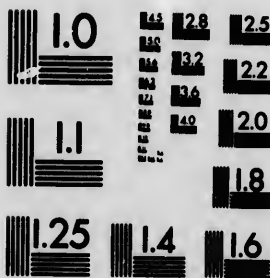


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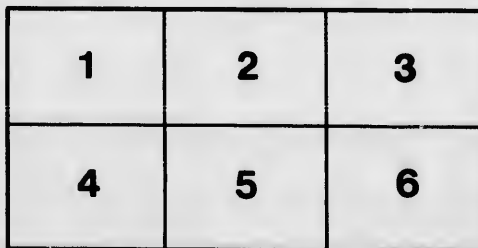
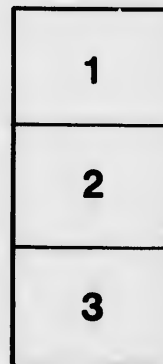
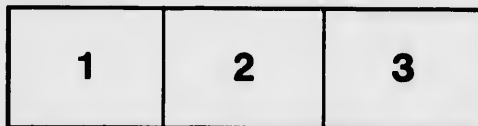
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15

THE
REMOVAL OF SEWAGE
AND THE
DRAINAGE OF DWELLINGS,

WITH PRACTICAL HINTS ON THE PROPER SITUATION AND CARE OF
DOMESTIC PLUMBING APPARATUS.

*Second Edition, Revised and Corrected, with an Additional Chapter
on Smells.*

BY J. W. HUGHES,

PLUMBER, ETC., MONTREAL.



MONTREAL :

"WITNESS" PRINTING HOUSE, 33, 35 AND 37 ST. BONAVENTURE STREET.

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PREFACE.

The following quotation from an eminent author is my apology for intruding myself upon the public :—

“It is the duty of every man to endeavor that something may be added, by his industry, to the hereditary aggregate of knowledge and happiness.”

The favor and enquiry arising from the publication of the first edition of this little work was such as to encourage me to again appear before the public with a second edition, in which I have endeavored to correct some errors of the first, and to give my readers the benefit of my more mature experience. I make no pretensions to originality, but only seek to lay before the general public, in a simple manner, a few facts that have always been well known to the learned, and initiated in the matters of which I write. I am largely indebted to the columns of the “Metal Worker,” and “Plumber and Sanitary Engineer,” as well as to their talented editors personally, Messrs. Wingate and J. C. Bayles, for much of my information, the latter having given considerable personal attention to the publication of the first edition. To G. W. Weaver, J. C. Radford, James Lowe, and other practical and scientific workers in the cause of sanitary reform in our city, I am likewise under obligation for many favors and much useful information.

J. W. HUGHES.

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THE REMOVAL OF SEWAGE AND THE DRAINAGE OF DWELLINGS.

CHAPTER I.

Soil Pipes and Drains.

It is not my intention in the following pages to advocate any particular theory as to the disposal of sewage nor to ride any favorite hobby, but rather to lay before that portion of the public who may desire to extend a little practical sympathy toward the cause of sanitary reform a few hints that will enable them to do so with some measure of success.

Having for a number of years devoted a considerable amount of time to the study of sanitary matters, more particularly in regard to the sanitary improvement of private dwellings, as well as having had a large experience in carrying out the practical details of the various plans and theories that have from time to time been laid before the public, I have been much surprised at the amount of ignorance that exists as regards the simple little details of a practical nature that should be thoroughly understood by every householder, or at least by all those having any claim to education and intelligence. I have found that many people who thoroughly understood the natural laws by which the various gases and fluids with which they had to deal were controlled, were almost entirely ignorant of the practical rules necessary to be observed in the carrying out of their theories in order to insure success, and so were at the mercy of any ignorant person they might employ to carry out what might be a most excellent plan of sanitary improvement; and the beneficial results that otherwise might have been obtained have on this account been entirely lost.

It is with a view to help such persons that I have been prompted to write this pamphlet; and should I by my efforts assist in making one house in our city more healthy than it formerly was, I shall consider myself amply repaid.

It is not my intention to confine my remarks to the question of sewage and drainage alone, but I shall also make some observations on that portion of the plumbing apparatus of our dwellings more immediately connected with the subject. I allude to the waste and soil pipes of our houses, which are, after all, only continuations of the public sewers and private drains into our private sanctuaries; and any person who has the slightest interest in the sanitary condition of his dwelling should bear the latter assertion constantly in mind.

The following facts should never be lost sight of by persons who are about to lay drains: 1st, they should be of the very best material; 2nd, they should be properly laid or put down; 3rd, they should be thoroughly ventilated; 4th, never lay a drain under your basement floors if there is any possible means of avoiding it; 5th, except in exceptional cases, do not put a trap or cesspool in a private drain.

Regarding my first head, which relates to material, I would recommend iron pipe with well-leaded and caulked joints. At the time of writing the first edition of this little work I was not fully convinced of the durability and other qualities of iron pipe, to warrant my recommending it as a substitute for the tile drain pipe used in this city. Since that time I have fully convinced myself that a heavy grade of iron pipe is a superior material for use inside buildings, and now unhesitatingly recommend its taking the first place for inside drainage. For this purpose pipe of not less than 13 lbs. per foot for 4", 17 lbs. per foot for 5", and 20 lbs. for 6". It should be well tarred outside and in, or better still, enamelled inside and all precautions as to grade, tight joints, &c., be carefully attended to in laying it. Next in quality comes sound glazed earthen pipes (tile). When either of the forementioned materials are not to be obtained, stone set in cement, or hard-burnt bricks of a proper shape, may be used; when either of the latter materials are used, the drains made with them must be well and smoothly cemented inside—but never, under any circumstances, use wood. In selecting drain pipes to carry off sewage matter, two errors are to be avoided: 1st. Do not select a drain that is too small, or it will soon become obstructed by the solid matter that is intended to pass through it. 2nd. Do not select one that is too large, or it will never be properly flushed. A 6-inch drain is as large as can be properly flushed by the waste water from an ordinary dwelling, and the laying of a larger one is only putting in an effective apparatus for the manufacture and storage of sewer gas.

Where no plumbing apparatus is used but a sink or bath, a 4-inch drain laid with sufficient fall is ample. It is my opinion that drains made of a triangular shape instead of round would be best, as such a shaped drain laid with the point of the triangle down would be effectively flushed with a very small quantity of water, and the solid



matter would be less liable to accumulate in it. However, this is not likely to occur to any great extent in round drains, provided they are laid of a size proportionate to the quantity of water that can be used to flush them.

The second point is the proper method of putting in or laying the drain.

The first and all-important fact to be ascertained is the level or position of the main sewer or other receptacle into which it is proposed to connect the sewer about to be laid. Neglect of this has had more to do with badly-drained houses and the consequent ills that result therefrom than any other cause I know of. I think I may safely say that there are hundreds of houses in this city where, owing to neglect in not first obtaining the proper level of the main sewer, it has been necessary to dip down in order to get the drain to enter the building below the level of the basement floor; and in consequence of so doing that portion of the drain immediately under the house has always contained more or less sewage matter. Under such circumstances, unless the drain is perfect in itself, and the joints have been extra well cemented, this sewage filters out and thoroughly impregnates the soil under the dwelling that is so imperfectly drained.

Where it is found that the main sewer is too high to allow of a proper fall to it from the extremity of the house drain, I would most emphatically say, alter the whole of the internal arrangements, or even pull down and rebuild the house, but above all things have the drain right. *All else in the house is as nothing compared to its healthfulness, since on our health depends, in a great measure, our success in life as well as our happiness in this world, and perhaps in the world to come.*

After having ascertained the level of our main sewer, and provided the necessary materials, all of the best, not forgetting the skilled labor necessary to its proper use, the reader will perhaps think we are all ready to begin operations; but, stay a moment. Do not put in a foot of sewer pipe unless you are sure it will remain where you place it; in other words, your drain must be laid on a proper foundation, else all your labor will be in vain. Where the soil through which your drain is to run is firm and solid no special preparation will be required. Eminent authorities have recommended the laying of drain pipes that pass over loose sand or shifting soils, or on any poor foundation, in a box, the box to be filled with Portland cement, completely imbedding the pipes therein. When this plan is adopted hand-holes should be left in the pipes at suitable intervals, to allow of examination and afford access for removing any material that may accumulate therein. In some cases a plank of some comparatively imperishable wood laid under the drain is all that is necessary, but in other cases a foundation of concrete or other suitable material to meet the requirements of the case must be provided, otherwise the drain will sink down and defective drainage will be the result.

After the foundation is prepared and the levels have been found to be correct, the laying of the pipes may proceed. If you have laid a

plank or other foundation, with a proper incline to main sewer, nothing will require to be done but to lay your pipes on it. If iron sewer pipes are being used the joints should be well caulked with oakum, and $1\frac{1}{2}$ " of soft lead be run in on top of it, and the lead, when cold, should be well caulked. If tile pipes, a little oakum must first be driven in, and the joint be then well filled with cement, leaving sufficient cement on the outside of the socket or collar of the pipe to make a solid and durable joint. Where oakum is not first put into the joint great care must be taken to remove any cement that may have got into the inside of the pipe. Portland cement is very good for this purpose. It may be used in the proportion of one of cement to two of river sand. Each length of pipe as it is put in should be tested with the level, to prevent any twist in the pipe from causing a disturbance in the fall. This is best done by means of a straight-edge, long enough to rest on three of the pipe-collars at the same time. The straight-edge may be so made as to indicate the correctness of the work, when the spirit-level bead rests quite in the centre of the instrument, the proper fall being allowed for on the straight-edge. This is the most certain plan, and is better than levelling one length at a time. But whatever plan is adopted let it be certain, and the grade not dependent on any guess-work or sleight-of-hand for its success. In taking levels always give the greatest amount of incline possible, although it is well, in cases where there is ample fall, to allow for a foot of earth to cover the pipes. Yet, on no account should any sacrifice be made in the incline or fall of the drain for the sake of reaping the questionable advantage of having a few inches of earth over it.

As to what might be the least amount of fall per yard, allowable in laying a drain that will work, I am not prepared to say—good authorities say not less than 3" every 10 feet—but no error will be made in giving all the fall you can. On the other hand, a drain will work well provided it is laid with the slightest possible incline—no water can remain in it, and, if regularly flushed, the water will carry off any small quantity of solid matter that may have begun to accumulate; but a drain laid with a very slight incline is liable, on the slightest derangement, by settlement or upheaval, to have the incline turned the wrong way for a portion of its length, and thus the foundation is laid for all the evils that follow and result from a choked drain.

In laying drains under basement floors, as is the custom in our city, I believe a great mistake is made; but as custom becomes habit, and habit is second nature, it is very hard to prevent its being done, and in many cases all one can do is to see that the least amount of harm is done by this system, by having the mechanical operations well done. One weak spot in the present system of house drainage is the junction between the soil and waste pipes of the house and the drain. These joints are usually well made with cement; but as the soil pipes are firmly secured to the walls of the building, while the drain is laid on the earth, it will plainly be seen that the slightest settlement of the walls carry the soil pipes with them, while the drain,

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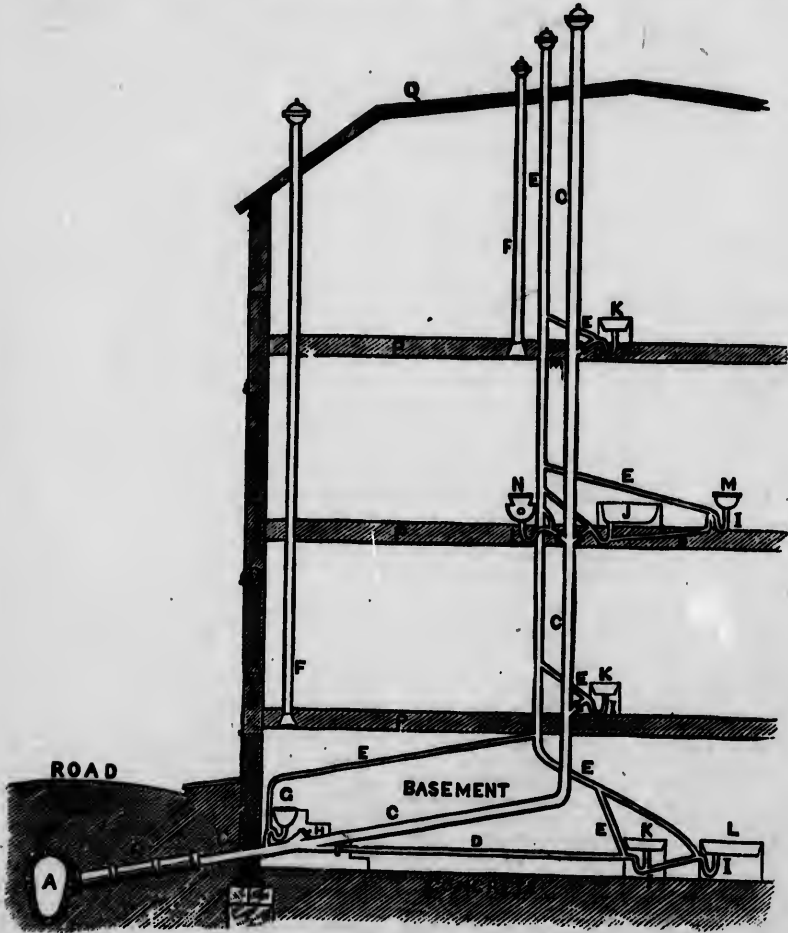
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if well laid, is prevented from sinking. A crack in the joint at the junction of soil pipe and drain is sure to occur, and on this account all such apparatus should be made above the floor and left easily accessible. On the other hand, if the drain is laid on a poor foundation, it will sink and leave the soil pipe, either mishap being serious and to be most carefully guarded against.

do this in a satisfactory manner requires greater skill and attention than have yet been called for. A perfect sewer with imperfect plumbing apparatus connected therewith is even worse than an imperfect sewer with perfect plumbing work, because, as already mentioned, the waste and soil pipes are but a continuation of the drain into the interior of the house. Starting



HOUSE DRAINAGE.

A, main sewer; B, private sewer; C, C, C, soil pipe; D, waste from kitchen sink; E, E, E, ventilation from traps; F, F, ventilation from ceilings; G, basement W. C. (water close.); H, hand hole for cleaning drain; I, I, I, traps under sinks, &c.; J, bath; K, K, K, sinks; L, wash tubs; M, basin; N, W. C.; O, wall; F, floors; Q, roof.

Having laid the sewer from the street sewer from the drain pipe above the floor of basement, to the junction of the soil and waste pipes of the soil pipe (never less than 4 inches, and preferably of iron) should be carried in the most direct manner possible up through the roof (see

sketch) above any fire walls or chimneys that might interfere with the free discharge of sewer gas. It should be fitted on the top with a cap of such construction as will prevent the wind blowing down it. The joints of the soil pipe must be made perfectly water and air-tight, and I may here remark that they usually are so. From this pipe on its way to the roof branches must be left in suitable positions to receive the different fixtures that are to be used. It is at these points that the traps require to be placed. There are various kinds of traps in use, any of which are effective in their working, provided always that they contain a sufficient quantity of water to prevent the escape of sewer gas through them. The quantity of water does not require to be large, as the gases will not force their way through even a small quantity of water when it can freely escape by means of the open pipe going through the roof. But when traps of improved construction are to be had, use them.

Baths, basins, sinks, &c., should have traps placed immediately under them, and when it is necessary to connect waste pipes leading from any fixture into other traps the connection should always be made low down in the trap with which they connect, so that the ends of the pipes may be sealed by the water contained in the trap with which they connect.

Besides the trap under each basin, bath, &c., an air-pipe must be fitted immediately outside all traps (between trap and drain). This pipe should be the full size of the waste or soil pipe it is intended to ventilate, and, when possible, it should be carried up through the roof or conducted into a ventilator pipe, in connection with some of the other fixtures. When a single ventilator-pipe is used to ventilate a number of traps care must be taken to have it of a size suitable for the work it has to do, and carry it up through the roof, so that any foul odors formed in the branches leading to the different apparatus may have free escape and not force its way into the rooms in which the apparatus is fitted.

The fitting of such air pipes will add to the cost of the plumbing apparatus; but I think they will cost much less than a single case of typhoid or other disease that may be caused by the escape of foul air into our dwellings.

These air pipes are sometimes connected with a chimney, but it is a mistake to so fit them. In our climate, for months every year, the chimneys, excepting that from the kitchen, are not used, and during such periods they are liable at times to a down draft, and consequently the foul air from the pipes connected with them would be blown into the house. Even the kitchen chimneys of houses that are left tenantless are liable to this drawback, and on this account it is much the safest plan to carry all ventilation pipes up through the roof.

The carrying of soil pipes and air pipes up through roofs serves another purpose of great importance, besides giving free escape for foul gases. They prevent the syphoning of the traps, as the plumbers call it; that is, they prevent the emptying of the traps by air pressure after a vacuum has been formed in the soil pipes by the sudden emptying of a large quantity of water into them.

I will now endeavor to explain the way in which traps are emptied of their water seal, as I was a short time ago made aware that one of our people to whom we look for advice in sanitary matters was quite ignorant of its cause and cure. I cannot better illustrate the matter than by alluding to the working of the common lift pump. The pump is used, as generally understood, to raise water, while in reality it does nothing of the kind. What the pump really does is to exhaust the air from the pipe leading into the water to which it is attached; then the pressure of the atmosphere (about 14 lbs. to the inch), pressing on the water into which the pipe from the pump leads, forces the water into the vacuum produced by the pump, and up into the pump chamber, from which it is discharged through the action of suitably arranged valves, worked by the pump handle and rod. Now if you substitute for your pump barrel a length of soil pipe, and for the plunger or piston of the pump you substitute a body of water suddenly thrown into it, which, on its way down, forces the air out of the pipe in front of it, leaving a vacuum behind it, it will be plain that the atmospheric pressure exerts itself on the water contained in the trap, and empties it of a greater or less quantity of water, just in proportion as it takes a greater or less quantity of air to restore the balance which was disturbed by the water thrown down the soil pipe. In fact the arrangement is a perfect pump—or, more correctly speaking, a syphon—of which the long leg is the soil pipe and the starter usually the housemaid. But, whatever we may call it, the principle is the same, and it is sure to work every time. It acts according to well understood natural laws, and nature makes no mistakes or omissions. Now, just as a hole in the pump pipe or syphon prevents its efficient working (and a very small hole will do), so will a hole in the soil pipe answer the same purpose, and this is best provided by the ventilator pipes before alluded to, as the air rushes in by means of these openings to restore the balance that has been disturbed, and so prevents the air coming in through the traps and the consequent emptying of them.

The facts just laid down regarding the benefits of ventilating soil pipes have always been well understood and acted upon by all intelligent plumbers, but it required the advocacy of some prominent man to convince the public that this system of doing work was absolutely necessary, and not a job of the plumber's to swell the bill.

I now come to my fourth head or principle laid down, namely, never to run a drain under the basement floors of a dwelling if it can possibly be avoided; and there is not the least difficulty in the matter, especially in the erection of new dwellings. It should, in my opinion, be compulsory on all proprietors to so arrange the sewage system of their houses as to avoid long stretches of drain pipes under the floors. The following is the system I would recommend:—

The drain pipe from the street should be brought into the house above the basement floors instead of below, as at present. The waste pipes of the house should run toward the drain pipe on the walls or ceilings, but always above the floor, so as to be easily seen and

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repaired when necessary. The various pipes should not be boxed up, as is at present the custom. It frequently takes much longer to get at the pipes than it does to repair them. Where it is necessary that they be enclosed it should be with boards secured with buttons, or hinged, so that the occupant of a dwelling could in a few moments make an examination of the various pipes. Where the soil and drain pipes connect just inside the wall of the house, it should be done in such a manner that by unscrewing a plug or cap (see sketch on page 3) access may be had to the drain for the insertion of a rod for cleaning-out purposes. I am aware the foregoing plan of work is not new, but where it has been carried out it was not so much in consequence of the advantages of the plan—it was rather the result of accident than design. The advantages of the foregoing plan are, first, an ample fall for the pipes can always be had; second, the junction of waste pipes and drain, always a weak point, is above the floor and easy of access; third, should a chokeage occur in drain or pipes they are easy of access, and it will not require the presence of several workmen in the house for a lengthened period of time, with the consequent trouble and expense, in order to find out a trifling defect; fourth, a leakage of either sewer gas or water will reveal itself more readily and its position be more easily ascertained; fifth, should it be necessary to open the drain it can be done outside the house; sixth, there will be less liability of derangement of pipes, as the waste pipes are made of a more durable material than the tile drains; that is, a material so constructed and put in that they are less liable to get out of order than the ordinary drain pipes, and they are usually fitted by skilled workmen, while the drains are generally laid by labor of a poor class.

I now come to my fifth head, which is, never to put a trap in the private drain if it can be avoided. My reason for laying down this rule is not because a trap so placed is a bad thing in itself, as that its being so placed is liable to cause evil effects that are less liable to occur if a trap is not put in. One of the principal evils likely to be caused by the presence of a trap is the choking of the drain and obstruction of ventilation, the trap being so constructed that it catches and retains all matter that is of a greater gravity than water, and consequently it is only a question of time when the trap will be filled up and the drain choked thereby. Where it is necessary that a trap be put in, it should always be placed where it can be seen and be easily cleaned, and there should always be provided an instrument for cleaning it. The cover of the trap should be made to fit so that no foul gases can escape, and on the cover should be in large, plain letters, in metal or other durable material, the words, "Trap, clean twice a year," as many persons in whose houses traps are placed are quite ignorant of the fact, and when aware of their existence do not know that they require any special attention. During the two years that have elapsed since I penned the foregoing remarks on traps, having, of course, special reference to the plan and prac-

tics generally pursued in this city, I have given the question close study and observation, and have no reason at present to change my views on the subject. I make this explanation, as I am aware traps are recommended by eminent authorities in our midst, as well as by sanitarians in foreign parts. If our system of laying private drains were changed, and the traps fitted in them in such a manner that their chokeage should be immediately made known, by the various fixtures ceasing to work, as is the case when a chokeage occurs in any of the traps situated under sinks, basins, &c., they might not be so objectionable; but as long as our drains are buried under the floors, out of sight and inaccessible, I say most emphatically, and after large experience and careful consideration, we are better without them.

I understand it is in contemplation to pass a by-law compelling the introduction of traps in all private drains. Should such a law be passed, the traps should be placed outside the houses, preferably on the street, and they should be in charge of the city authorities, whose duty it should be to keep them clean, and, at the same time a law should be made forbidding the burying of tile drains in the ground under floors, as is the universal custom at present. Should this be done, and the soil and waste pipes be kept above the floors as I recommend, one of my greatest objections to traps would be removed, but the important question of ventilating the private sewer would still remain, as the plan adopted in cities situate in milder climates is not suitable here. Given honest materials properly fitted, and the chances of injury from the omitting of traps in private drains is very small.

CHAPTER II.

Drainage.

By drainage I mean the carrying away of the water that accumulates in the earth, and where such accumulations are large, such as in swamps or low-lying lands, we invariably find disease prevails to a greater or less extent. In fact there are a number of complaints that are peculiar to such localities. That these complaints are caused by the accumulation of water is proved by the fact that removing such surplus water renders the localities, previously unhealthy, salubrious and fit to live in.

Now, in our city there are certain low-lying districts that were originally swamps or marshes, and notwithstanding that these localities have in many cases been effectually drained in the usual acceptance of the term (that is, they have had sewers put in), they are notoriously the unhealthy districts of our city, as the statistics of our health association will prove. Now, what is the reason of this? These localities have the usual allowance of sewers, yet they are more unhealthy than other districts a little removed from them. Is it not that the provision for draining the soil is not adequate? And although the original swamps are not to be seen, having been built over, still they actually exist, no provision having been made for their eradication, and consequently the parties so unfortunate as to be living over them have their vitality lowered

by the unhealthy emanations therefrom, and so fall easy victims to any prevailing disease, besides been subject to the class of complaints peculiar to such localities.

Our present system of drain inspection, while filling a want, has a tendency to aggravate the state of affairs just alluded to, as drains or sewers, as now laid, are as tight as a bottle; in fact, they must be so from end to end, or else they will not be passed. Now, while this is quite right and proper so far as that portion of the drain or sewer in the house is concerned, I think it is a mistake as regards at least a portion of the sewer, from the line of the outside of the dwelling to the main sewer. Here some provision should be made for the free escape of the water from the surface of the earth. I have frequently seen house drains laid without cement, the parties laying them giving as a reason for not cementing the joints that the locality was swampy and they wished the surface water to escape by the open joints; and I think the evil likely to result from the open joints of a drain under such circumstances would be in a measure neutralized by the good derived from draining the soil, although I by no means advocate the adoption of such a plan. But I would suggest that all sewers laid in the houses and for one or two lengths outside the dwelling be tightly cemented, as is at present the rule. After that I think it would be as well to leave the bottoms of the joints open and fill in round them with gravel or broken stones. That would prevent the earth being washed into the sewer, but would at the same time allow the free escape of surface water. I have heard that there is some provision made in the main sewers for the removal of the water from the soil, but I have no personal knowledge of the arrangement. There should certainly be some plan adopted, especially in our low-lying localities, that would allow for the free and rapid escape of the water from the earth. The best plan, and one that has been adopted with the best results in other cities, is to fit a separate system of subsoil drainage in all localities where the necessity is indicated. Over 14 miles of these drains have been laid in New York with the best results.

There are various systems of subsoil drainage, some of which might perhaps be made a portion of our sewer system for use in localities where such drainage is required; but this is a subject I am not in a position to write definitely upon, my intention being only to point out one defect in our more recent system of laying house sewers, and to suggest one cheap and practical remedy for it that could be adopted and carried out in all parts of the city without adding to the present cost of such work. Something of the kind is absolutely necessary in all localities, especially as the custom of building houses with basements more or less below the surface is becoming more general every day, and no matter how dry the locality may be naturally, in the time of heavy rains, or during the rapid thaws peculiar to climates like ours, such basements will be damp and unhealthy unless something is done to provide a means for the rapid escape of surface water.

CHAPTER III.

Position of Sanitary Apparatus.

As the position of the various sanitary apparatus in connection with dwellings has a great deal to do with their effectiveness, I will endeavor to lay down a few general principles that may aid persons about to build or put in improved sanitary appliances to place them in such a manner that good working is secured and the least annoyance from smell or derangement of the mechanical parts is avoided.

The next great requisite besides good workmanship and materials is light, and therefore all water-closets and similar apparatus should be so placed that the fullest benefit from that greatest of all sanitary agents, the sun, is obtained. Closets and bath rooms should always be so situated that they can be provided with windows opening directly into the outer air, thus securing a proper amount of air and light, without which it is impossible to maintain them in a proper state of sanitary effectiveness. I never knew a water-closet that was imperfectly lighted to give perfect satisfaction.

The practice of locating water-closets in the interior of a dwelling, like a cupboard, is altogether wrong. Where it is impossible to obtain the necessary amount of room convenient to the outer walls, the following plan, adopted by some of our leading architects, gives excellent results: The bath-room and closets are placed on the top flat, and are lit by means of a skylight, which is so arranged that the sash may be easily opened so that ventilation at all seasons of the year will be effected. This plan is applicable to most dwellings, the only exceptions being very high buildings, and in those there is not usually that want of space that would prevent a suitable room being provided convenient to the outer walls. In houses intended for the use of small families it is best to have the water-closet, bath, &c., in one room. Where a large number of persons occupy the same building it is necessary that they be separate, and that access be had to them by separate doors.

Where it is impossible to adopt any but what I call the "cupboard plan," the apparatus should be so located that it may be well illuminated by borrowed light and ample ventilation be provided for from the ceiling. The ventilator should be so arranged as to be flush with the ceiling, and the pipe from the bell mouth-piece let into the ceiling should be carried up through the roof. (See sketch.)

Another important matter to be looked to in locating sanitary apparatus is security from frost. In our climate the extreme cold always produces a plentiful harvest to the plumber, and while he gets some small profit thereby, he never fails to get a large amount of polite and sarcastic abuse, as it is the prevailing opinion that the plumber is in league with the elements to draw money out of people's pockets, while in reality the blame rests in many cases with those who are responsible for locating the various apparatus in such positions that in a climate like ours it would require little short of a miracle to pre-

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vent the frost from injuring the work. This is the first great cause of trouble from frost, and in most cases the plumber has no say in the question, but must obey the mandates of those employed to look after such matters. The reasoning of the latter persons may be, with exceptions, well expressed by the following: "It is a pity to waste that nice room by using it for a bath room and closet. Here is a corner that will do well enough, and you can put that room to a more useful purpose." I ask what more useful purpose is there than to aid in keeping the health of the family. But I am digressing. I hope, however, to have pointed out one preventable cause of frozen pipes.

Never run pipes on an outside wall if it is at all possible to avoid it. If unavoidable, run them on a board blocked out from the wall, put

easily accessible. Where the pipes need to pass upward to the upper stories, a box should be put round them, beginning in the earth below frost and carried up to the story above the cold of basement. This box should be at least 2 inches larger than the pipes, which are so supported that they do not come directly into contact with its sides. Outside this box another should be placed with 4 inches of space between it and the inside box. This space must be filled with some non-conductor, but the inside box must contain nothing but the pipes and confined air. I have known pipes placed in very exposed positions completely protected from frost by this method.

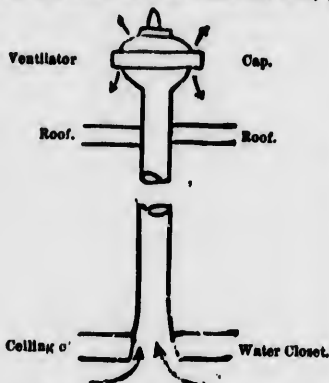
To run pipes so that they may be emptied by shutting off a suitably arranged stop-cock is a very effective plan, provided it is attended to; but the very fact of its requiring constant attention makes it an undesirable plan for general use. Besides, there are in all dwellings pipes that are so situated as to render their drainage a matter of some difficulty. It is much the best plan, where it is at all possible, to so place the different pipes and apparatus that no special attention is required in order to keep them in effective working order.

It is desirable to place the different plumbing apparatus in such situations that a disarrangement of them may not seriously damage the more important household decoration. A water-closet or bath placed directly over a handsomely decorated parlor ceiling is certain sooner or later to cause a great amount of annoyance, as the most perfect work cannot last forever, and outside of ordinary wear and tear, which can in some measure be guarded against by the skillful mechanic, there is the carelessness of the occupants of the building to contend against, which is quite beyond the control of the plumber's skill, and is more frequently the cause of trouble than would generally be supposed.

Carelessness in the use or abuse of the bath tub and its fixtures is a fruitful source of trouble and expense. The large faucets and small overflow pipes make the overflow of a bath tub a serious matter. Careless servants, careless people, and children ignorant of the damage caused by overflowing are fruitful sources of inundation and damage. Such accidents, however, are liable to happen in almost any family, and those who place their apparatus where the playful freaks of childhood, the carelessness of servants, or their own forgetfulness causes the greatest possible amount of damage, have only themselves to thank.

Kitchen sinks should always be placed where there is plenty of light, and should not be made of wood, but of iron or slate, as the wood absorbs the water, and is sure to be the cause of more or less unpleasant odor. The space under sinks should not be boxed or cupboarded in. The sink should be supported on legs, leaving the space under it easily seen and so likely to be kept clean. The pipe under the sink may be boxed to such a height as will secure it from injury.

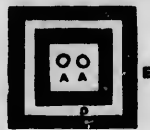
Wash-tubs should invariably be of porcelain, slate or marble, not wood, as in most houses these articles are only used one day in the week, and



(BILING VENTILATOR NECESSARY IN ALL CLOSETS.

boxes between the floor ceiling, and fill them with some non-conductor. This cuts off the drafts that are generally found under floors, as the box containing the pipes acts as a chimney and causes the prevailing drafts to set in the direction of the pipes they contain. The boxing and packing between floors should always be done. The boxes covering pipes should be so made that they can be easily opened. Then, in extremely cold weather, they can be opened to allow the heat of the house to get at the pipes. Another method is to have the boxing pierced with holes at the top and bottom so that heat may circulate freely. These openings may be covered with ornamental gratings.

Water Pipes placed in cold basements should be buried so deep that frost cannot reach them,



A A, pipes in confined air space; B, inner box; D, non-conductor; E, outer box.

this being the only certain plan. The stopcocks should be inclosed and covered so as to be

during the remaining six days the moisture contained in the wood causes a very unpleasant odor. The same remarks regarding boxing space under sinks also apply to wash-tubs. It is an excellent plan to lay the floor immediately under sinks, wash-tubs, &c., with cement. A portion of the walls under and around them may also be made of cement or slate, with advantage, as they are not so liable to absorb moisture as the ordinary plaster or wood, and can be kept clean with very little trouble, or, better still, with glazed tiles, now plentiful and cheap in this market.

All water-closets, bath rooms, laundries, sculleries, &c., should have well-painted walls and ceilings, or, better still, be tiled, so that they can be frequently washed. Urinals should have a large ventilator immediately over them, and coming down as close as may be convenient to allow of one standing under them. They should be set on slate, marble or cement walls, and the flooring immediately under them should be of similar material. They require particular attention as regards cleanliness, and on this account I think the law in this city, compelling the fitting of a self-closing cock on them under a penalty of \$15 per annum—for a penalty it really is—is offering a premium for the encouragement of an offensive apparatus, and is certainly not economy from a sanitary point of view, although a saving of water is effected. I also am of opinion that the taxing by special rate of water-closets is on a par with the above-mentioned system of doing business. For, let a closet be ever so bad, it is not nearly so terrible a nuisance as the outside privy; for while the water-closet may cause inconvenience and injury to one or two families, the outside privy is carrying death and destruction to a whole neighborhood, and for this there is hardly any remedy, especially if the sewer is connected with the pit by an open drain, as is frequently the case, while the water-closet, with all its defects, may, with proper care and attention, be kept in a comparative state of effectiveness, and becomes a convenience that is far in advance of the outside privy in a rigorous climate such as ours. A citizen who has expended time and money, and has fitted his dwelling with all that science and mechanical skill can suggest or devise, may have all his efforts completely neutralized by his next-door neighbor erecting one of these abominable privies, or perhaps a whole row of them under his bed-room windows. Of course, a remedy may be provided to a certain extent by the common law against nuisances. But the action of law is proverbially slow, and a legal process cannot restore lost health, or wife or child slowly poisoned. The rich can, in a measure, avoid this trouble by fleeing from the city during the hot weather, and only returning when nature has provided a remedy; but to the poor man and his family there is no such means of escape; he must stay and suffer. I write at this length on the subject, as it has been my misfortune to reside in localities in this city where these abominable pest pits abound, and I know whereof I speak; and my only regret is that I have not an inspired pen to do full justice to a subject that is of far greater importance

than any political scheme for advancing the welfare of our young nation.

The wash basin, when properly fitted in a bedroom, with its accompanying hot, cold and waste water pipes, is a most convenient apparatus. But unless one is prepared to spend the money necessary to secure a first-class job in every respect, wash-basins are better omitted from the bedrooms, since any derangement in the waste pipes from them exposes the occupant of the room to the foul emanations from the sewer during a time when sleep locks up the faculties upon which we depend to detect foul odors and dangers of a more visible kind. A wash-basin should always be well trapped, and the waste pipe leading from it ventilated as described in a former chapter. This should never be omitted, and the ventilator should be fully as large as, if not larger than, the waste pipe to basin and carried direct to the outer air. The space under wash-basins, owing to their position, must, as a general rule, be enclosed, but this should be done in such a manner as will allow the connections, &c., under the basin to be examined without trouble.

Some general directions are necessary as to the care of plumbing apparatus such as are to be found in most dwellings. My first advice is that the different fixtures should be regularly inspected by the head of the household, or some responsible person, and at the first appearance of any derangement advice should be had; by this means expense and annoyance will be saved.

Great care should be taken to insure cleanliness and to ascertain that the different fixtures are in perfect working order. Proper attention should be paid to the flushing of the drains. This is best done by filling the various baths, basins, sinks, &c., and letting the water from them run off at the same time. While the water is running the handle of the closet or closets should be drawn up and let down at least six times. This, in the case of the pan-closet at least, will insure the emptying of the trap under it; merely letting the water run by fastening up the handle is not nearly so good a plan. If a pailful or two of water is thrown suddenly into the closet while waste water from the rest of the apparatus is running, it will be of great benefit, as the object is to fill the house drain as nearly as possible with water, in order that any deposit therein may be carried away into the main sewer.

The traps under the various apparatus should be emptied from time to time by taking out the screw provided for that purpose.

When the common pan closet is used the trunk or ironwork should be thoroughly cleaned by being burnt twice per year and the iron fresh coated with tar by having the closet taken apart and the accumulation of filth that always gathers thereon burnt off and the ironwork retarred or varnished. Neglect of this is the great cause of smell from the closets when the handle is drawn, the foul odor that arises at such times being generally caused by the accumulation of filth in the container or trunk. When the pan closet is used (which should be as seldom as possible, as it is one of the worst articles for the purpose ever contrived) the trunk should

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be so ventilated that a circulation of fresh air may be continually taking place through it. This may be accomplished by fitting 2 pipes to it, one from the top and one from the bottom of the trunk. A 1" or $\frac{3}{4}$ " pipe will be large enough. These pipes must be run above the roof, the one from the top of the trunk being left higher than the one from the bottom. For dwellings some of the more improved closets should be used. Where the expenses would prevent the adoption of one of these, I would prefer to fit a hopper closet, properly ventilated, as being far less liable to be the cause of foul odors than the pan closet. A ventilator from the trunk of the closet will in a measure prevent this, but the great preventive is to keep the apparatus clean.

In cold weather care should be taken, immediately after lighting the fire in the cooking ranges, to see that the water contained in the pipes attached to them is not frozen. This can easily be ascertained by feeling the pipes close to the range. If they are both of the same temperature and hot water cannot be drawn from the nearest tap, the fire should be drawn at once; otherwise steam will be generated and an explosion may occur. When the water in the pipes in connection with the range is circulating freely, one pipe will always be found hotter than the other, and immediately after kindling the fire the difference in temperature is considerable.

In case of a sudden burst in the water pipes the best thing to be done is to stop the water at the stop-cock, which should always be conveniently placed and left easy of access. The position of this stop-cock should always be ascertained on moving into a strange house. The next thing is to have it repaired in an efficient manner.

When water suddenly makes its appearance in any part of the house, try to ascertain where it comes from with some accuracy before sending for a plumber, and, when possible, send an intelligent message, that the man who is sent may have an idea of the nature of the trouble and the necessary tools and material required to remedy the defect.

It is an every-day occurrence to send out men to repair a water pipe when the trouble may be caused by a defect in the roof or cistern, the overflowing of a bath, basin or sink, or the result of carelessly spilt water, a fact which the interested one carefully keeps concealed, only to be revealed to the plumber in strict confidence after a rigid cross-examination. Try and trace the leak to its source, as water may show itself in the basement that has come from the upper stories. By a little attention to these matters your plumber's bills will be much smaller, as a great deal of time is generally wasted because the facts of the case have been improperly stated when ordering repairs. People should understand that it is a physical impossibility for a man and his helper to carry all that might possibly be needed to do work; yet most persons leave orders simply to repair a water pipe. Last, but not least, I would say employ the best men to be had. Depend upon it, this is the cheapest plan in the end. Having secured a good man,

be guided to some extent by his advice, for, depend upon it, he knows more about the matter than you do. I write this, as I know many people give orders to workmen as to how they want a job done, and are then very apt to grumble if the results are not what they expected, and say, if told it was done to their order, that the workman should not have done it if not right; but, on the other hand, they would report the man for impertinence if he refused to do as ordered.

* CHAPTER IV.

Protection of Pipes from Cold.

As the greatest enemy to plumbing work in all cold climates is frost, I have thought it advisable to devote a chapter especially to the best means of avoiding damage from this cause; and here the old adage applies with more than its usual force and significance—"An ounce of prevention is worth tons of cure."

In order to make my subject as plain and easily understood as possible, I will divide it into the following four parts or heads:—

- 1st. The preventive measures as regards position or situation.
- 2nd. Protection.
- 3rd. Mechanical action.
- 4th. Emptying the pipes.

The merits of the different methods rank in the order I have enumerated them. The position of the plumbing apparatus is most important for various reasons, some of which I have attempted to make plain in the earlier chapters of this paper, nothing being more urgent, after the sanitary aspect of the case has been disposed of, than the proper protection of the pipes from damage caused by cold. Having this object in view, all very exposed quarters of a building should be avoided as dangerous places for plumbing apparatus, and on no account should pipes be placed in immediate contact with outside walls. Where it is impossible to avoid attaching pipes to such walls, certain precautions preventing immediate contact must be taken, they alone proving effectual safeguards against damage to pipes from cold. In many cases where the running of soil pipes on such walls is unavoidable, the water pipes, which are far more likely to give trouble, can be run in another direction, and in such positions that they will not be exposed to cold. There are in all dwellings certain apartments that should be avoided, as they are not proper situations for plumbing apparatus; for instance, coal and meat cellars, lumber rooms, &c., because, there being no necessity for keeping such places warm, any pipes that pass through them are very apt to be a source of trouble.

After having laid our plans to the best of our ability in this northern climate, certain protective measures are still to be taken before our plumbing work is safe from damage by frost. This brings me to my second head, referring to pro-

* Chapter IV was written at special request of Mr. Bayles, Editor of *The Metal Worker*, after the foregoing chapters were printed, which accounts for some slight repetitions in it; but as the subject is a most important one I concluded not to strike them out.—J. W. H.

tection of pipes, especially such as are fitted in an exposed position; and I would here remark that it is always best, before taking steps to protect old work, to see if the pipes that are giving trouble cannot be removed to a more secure position, as it will in all probability pay best in the end to do so. This will be granted when it is considered that the best means of

between this board and the wall, the object being to have a space in rear of board and between it and the wall containing confined air. In some cases it will not be necessary to fit these pieces, as the sides of the boxing covering the pipes can be made to answer the purpose; but the great object in all cases is to get a space containing confined air between the pipes to be

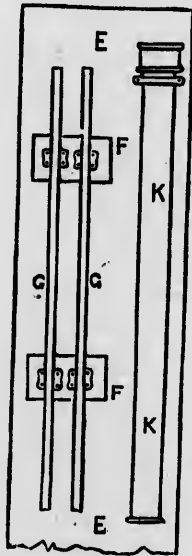


Fig. 1.

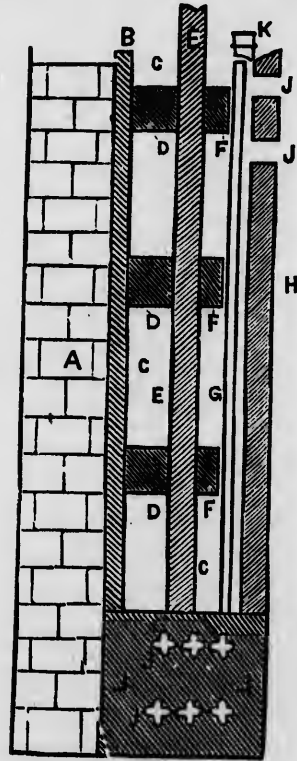


Fig. 2.

A, outside wall; B, plaster; C C C, air space; D D D, blocks attached to the wall to carry the board E; F F F, blocks attached to the board E, to which the water pipe G is fastened; H, ordinary boxing; L, side of boxing carried to the wall and forming, with the board E, the air spaces C C C; J J J, openings in the top and bottom of boxing to allow circulation of air; K, soil pipe fastened to the board E.

protection are liable to disarrangement from many causes, chief of which are the depredations of rats and the carelessness of workmen who may have had to remove materials in order to make repairs. Pipes that are situated on outside walls may be kept from immediate contact by the following method:—Have the wall thoroughly plastered, then fasten at intervals on the wall blocks at least 2 inches thick, and nail on these blocks a 1½-inch well-seasoned board. The latter should be wide enough to leave an inch or so of margin between the pipes placed on it and its edges. Pieces are then fitted

protected and the cold atmosphere. In nine cases out of ten the cause of damage to water-pipes from cold has been draft. Where there is great danger it will be better to nail other blocks on the face of the 1½-inch board at suitable intervals, and to these blocks the water-pipes may be fastened, but the soil-pipe will be quite safe on the board. The pipes in ordinary situations inside a dwelling may then be boxed in the usual way, openings being left in the bottom and top of boxing to allow the heat of the house to circulate through it. These openings may be covered with ornamental iron

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the object of board and confined air. Try to fit these covering the purpose; but get a space pipes to be

gratings. Such openings should be left in boxes containing plumbing work, to allow the circulation of air in all cases where they are not filled with packing of any kind and are situated in the inhabited and warm portions of the house.

The foregoing sketches (Figs. 1 and 2) will, I hope, more fully explain what I have attempted to describe:—

Where pipes run from story to story great care must be taken to secure space between the under side of the floors and the upper side of the plaster, that is, the space formed by the beams between floor and ceiling, so as to cut off any drafts. This should be carefully attended to in all buildings, and may be done either by fitting a section of well-made boxing that will extend below the plaster of the ceiling and above the floor before the plaster is put on. If it is not convenient to do this, boards may be nailed between the floor and plaster, and the space so

strips of hair felt over pipes that gave occasional trouble was all that was required. This is especially the case where pipes are frozen by draughts caused by the temporary opening of a door or window or some similar cause. Where pipes have to pass through cold cellars, it is far the best plan to bury them below frost when the nature of the ground will admit, or to do so does not interfere with their proper working. This plan is adopted in this city with great success. Where pipes so buried leave the ground in order to reach the stories above, the following method of protecting them will be found effective:— Make a box of 1-inch or 1½-inch stuff, large enough to contain the pipes to be protected, leaving a space of at least 2 inches all around them. This box must be long enough to reach from the ground below frost and up into the flat above that is warmed. Secure the pipes in the centre of this box by means of blocks, as

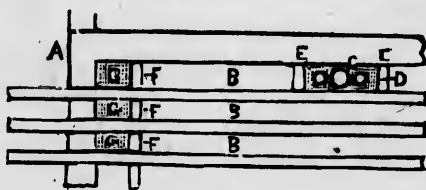


Fig. 3.

A A, walls; B B B, beams; C, enclosed space around water pipes filled with non-conductor; D, pipes; E, boards between plaster and floor to form space C; F F F, the same to form space against cold from the gallery; G G G, space similar to C, filled with non-conductor.

inclosed be filled with charcoal, cork cuttings, dry sawdust, or any other suitable non-conductor that will pack tight enough to effectually cut off drafts. Where there are galleries supported by beams that pass through the walls, cold air must be carefully prevented from coming in through the space left by the shrinkage of beams, to secure protection to the pipes and to have warm floors. At any rate no effort should be spared to prevent such cold air from coming into contact with any pipes that may be situated between floor and ceiling, or near door and window frames, especially in stone or brick houses. I know of no other method of keeping cold from coming in around door or window frames let into brick or stone than to carefully caulk the space between the wood and stone with oakum, and then to point with oil cement. I have frequently traced the cause of frozen water pipes to a defective door, window frame, or to gallery beams that were situated yards away from the pipes affected, but the cold from which had been drawn toward the pipes, the boxing in which pipes were enclosed acting as a chimney to draw the cold air in the direction where it was certain to do most harm, no effort having been made to cut it off from contact with the pipes. (For the method of protection see Fig. 3).

Pipes secured to ceilings of cold rooms or cellars must be protected on principles similar to those already laid down; the great secret of success, if I may so call it, being to have the pipes isolated in a space containing confined air. In many instances I have found that tacking

before described. Another box must be made of same length as the first one, but large enough to enclose it, leaving a space of from 6 to 18 inches, according to the nature of the situation. This space must be filled with some dry non-conductor. I have known pipes so protected to give no trouble for several winters, although exposed to an outside temperature. (See Figs. 4 and 5.)

I hope enough has been written to make the general principles to be observed in protecting pipes from frost understood, which is all that can be done in this article, the limits of which prevent my giving instructions suitable for each particular case that might arise.

My third head refers to mechanical means of preventing water from freezing, or, in other words, of keeping the water in motion. This may be done in cisterns, vats and similar vessels by means of mechanical contrivances, but it would hardly pay to do so. It is generally accomplished by letting the water run continually from some of the faucets in the house—a most effective but wrong method of procedure, as it is very wasteful, and in all well-regulated communities would subject the parties so doing to fines and penalties for infractions of the laws. Where, however, a house is supplied from a private lake, spring, or any such source, there is no objection to its employment, the only danger being that a very slow stream trickling through the waste pipes is likely to cause those useful articles to gradually fill with ice, a flooded house being apt to result therefrom.

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My fourth head refers to emptying the pipes of the water contained in them. If a house is very carefully piped with this object in view, and good grades given to all pipes leading to the faucets fitted for emptying them, this may be done; but as this method requires constant

remarks as to the best means of preventing them from freezing, which they frequently do in unoccupied buildings (I never knew it to occur in an occupied dwelling) when the proper precautions have not been taken to prevent it. I will endeavor to explain the way in which these

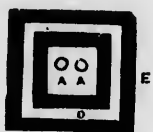


Fig. 4.

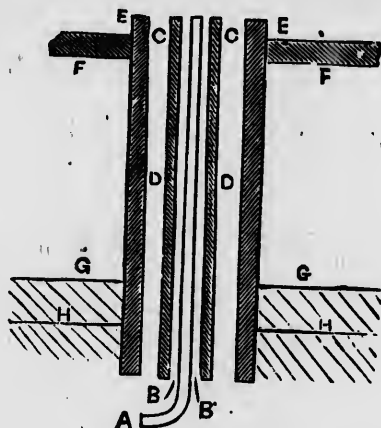


Fig. 5.

A A, pipes; B, space in inside box; D, space between outside and inside boxes filled with non-conductor; C C, outside box; F F, floor of upper stories; G G, ground line; H H, frost line, or line of greatest depth to which frost will penetrate.

watching and attendance, and to forget only once would render a large outlay fruitless and result in perhaps great damage, I cannot recommend it for general adoption for dwellings. In stores, stables and outbuildings, by adopting the hydrant principle, it is very effective, and is accomplished by having the stop and waste faucets buried below frost underground, and a rod extending therefrom that has to be turned every time it is desired to draw water. This can be so arranged as to permit of water being drawn from a faucet in the usual way during the summer, while in the fall the ordinary faucet must be left fully open and the handle removed to prevent its being shut, and the water turned on and off only by means of the rod or key attached to the stop and waste faucet. It must be borne in mind that in shutting off water with the intention of emptying pipes, it is necessary to open the various faucets throughout the building to admit the air, or the water will not run off. It is also a good plan to blow forcibly into some of them. All unoccupied houses should have the pipes they contain carefully emptied in the fall. This should only be done by a plumber, or some one who thoroughly understands what is required, as there are various cisterns, traps, water-backs, &c., that it is not possible to empty by simply opening the ordinary faucets.

As the system of pitching roofs to the centre and running the down spouts or leaders through the building in connection with the plumbing work is becoming somewhat extensively adopted, it may not be out of place to make a few

pipes generally become frozen. After a spell of very severe weather there is apt to be a sudden rise of temperature, and it will be readily understood that the temperature of the air in a building that is carefully shut up will not rise at the same rate as the outside air during a sudden change. Thus, it is quite possible that while it is warm and rain is falling outside, the air in the building may still be several degrees below the freezing point. Now, as the water begins to fall on the roof and trickle down the leader pipe it begins to freeze to the sides, and it does not take long to fill the leader pipe with ice. Then the usual bursting takes place or the roof is filled to flooding, and damage to the building is sure to result. Those having charge of unoccupied buildings that are fitted with inside leader pipes should always open doors and windows on any sudden rise of temperature, after a cold snap, in order to equalize the temperature of the building with that of the outer air, although this means must not be depended upon as a sure preventive from damage. The first great requisite for safety is to have the down pipe drop perfectly straight from roof to drain. (The latter must be untrapped in every case,) as any bends in such pipes, especially near the roof, are certain to cause trouble, because snow, &c., falling into the pipe, is arrested at such bends, and will soon cause a general chokeage. Even running water is partially arrested by a bend, and ice will speedily begin to form. The next important point is the size of the pipe; it should never be less than 4-inch, and I have had trouble with that size, but with 5 or 6 inch, straight through-

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out, you can depend upon having no trouble, as the warmth from any ordinary system of town sewage is quite sufficient to keep pipes of these sizes free from ice in the coldest weather. It is better that houses fitted with the centre pitch roofs should have the space between the ceilings of upper flats and the roof ventilated; in fact, it should be done in all buildings that are in climates subject to severe cold and heavy falls of

weather; water in which salt has been mixed to the point of saturation also has its freezing point considerably lowered.

CHAPTER V.

Smells.

That the nose or smelling organ was intended by the Creator for more than an ornamental purpose, no intelligent person will deny, neither can it be denied that no attention is paid to the education and training of our smelling faculties. It is true that in time most persons become familiar with certain odors, pleasant and unpleasant, but the number of persons who can intelligently distinguish and understand the many lessons conveyed to the mind by the sense of smell, is small. An unpleasant and unusual odor in a house is, by 99 out of 100 persons, immediately attributed to sewer gas, as that is the fashionable stink, at present, in our city, and nearly all unpleasant odors in our dwellings are immediately set down to this cause; but experience warrants me in stating there are many other causes of foul odors in our dwellings, a few of which I will enumerate, hoping by so doing that some of my readers will by this means be enabled to trace out and remedy existing causes. Ranking second as a cause of foul odors, I may place illuminating gas. Now, while both these gases, sewer and illuminating gas, are largely to blame for foul odors in our dwellings, yet there are many other causes which, to use a paradoxical expression, may be easily perceived by an educated nose. In further explanation of my subject, I will name a few that I am familiar with. Third on the list is that foul abomination, that should be immediately banished from every well-regulated household, the swill barrel or bucket. One of these pests carefully concealed under the enclosed sink is a fruitful cause of foul odors, especially during the heated term, and it is astonishing to find with what care it is put out of sight into the yard or outhouse when the servants become aware that an examination of the premises is to be made for cause of a complaint of foul odors. I have frequently, on suspicion of the swill bucket being the cause of complaint, had to make frequent and unexpected visits before catching the offender. Now there is hardly any substance thrown into the swill pail but what can and ought to be burnt in the cooking range or stove, and I know from actual observation in many families that it can be done with little or no inconvenience. Fourth, in my list I place odors from vermin, especially rats and mice, filth from these pests under floors and between walls (the accumulations of years) is more frequently the cause of foul odors, especially in old houses, than is generally suspected. When it is ascertained that a house is being poisoned from this source, it is first necessary to rat-proof the building and exterminate or drive out the cause, then the filth must be removed by having floors and baseboards removed, and thoroughly cleaning and disinfecting the spaces. Sometimes it is more convenient and inexpensive to remove the

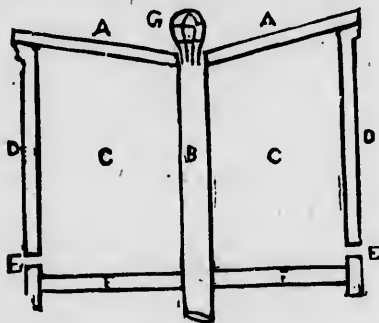


Fig. 6.

A A, roof; B, down-pipe or leader; C C, space between roof and ceiling; D D, walls of building; E E, openings left in the wall to allow circulation of air between roof and ceiling; F F, ceiling, usually having G inches of dry sawdust placed on it to prevent escape of heat from house; G, wire grating to keep dirt out of leader pipe.

snow, as it equalizes the temperature of the roof and prevents the heat from the house melting the under portion of the snow, which is usually frozen again during the night. This goes on until there is frequently from 6 inches to 1 foot of ice on the top, especially in the vicinity of the down-spouts. Then in case of a sudden thaw the ice prevents the free escape of water, and a flooded and leaky roof with all its annoyances is the result. The accompanying sketch will, I think, make my meaning plain.

This plan will also prevent the roof from sweating, as it is called.

In conclusion, I would say that a great deal depends upon taking the proper preventive measures in time against damage from frost. If cellars and similar places were properly secured early in the fall, so that the natural heat of the place would be retained, there would be hardly any trouble; but generally it is only after damage has been done that people find out open doors and broken windows, and as the frost has then got fast hold, any amount of packing and fixing is of little avail unless fires are lit and the place is warmed. While the temperature is above the freezing point pack and secure, and there is a chance of success. During extreme weather spare bedrooms, pantries and similar places should be put into communication with the rest of the house, in order that they may be warmed. It is also well to open the doors of wash stands and the boxing of pipes, &c., for the same reason. Four or five gallons of glycerine to 10 gallons of water will prevent water from freezing solid in ordinary cold

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plaster than the wood-work. I have found freshly slacked lime a very useful agent for cleansing the foul places infested with vermin. Closing the rooms or cupboards tightly and slacking a quantity of lime in them has a very sweetening effect, and, where possible, a plentiful supply of lime wash should be used. Sulphur may be burnt, or any method suggested by experience and convenience can be adopted, providing the work is effectually done. About the easiest way to get rid of rats, after care has been taken to prevent their entrance, is to starve them out, leave no loose food or a crumb of anything they can feed upon within their reach, and they will not care to stay about the place. Fifth, I place dirty kitchen sinks, wash-tubs and water-closets; they are very liable, with but slight neglect, to be a prolific source of foul smells, especially when they are so constructed that the surrounding wood work becomes saturated with filthy moisture. For this reason wooden wash-tubs boxed in sinks, and similar arrangements, should be carefully avoided; slate, marble, tile, cement, stone, brick, are all substitutes for wood that can be utilized in most cases. Last, but not least, many houses are foul smelling because not kept clean, and these cases are about the most difficult for a sanitarian to take in hand, as it requires a good deal of nerve and moral courage to enable one to face the lady of the house, and tell her it is stinking because not kept clean. Yet dirty store-rooms, neglected pot-holes, unwashed wood-work,

walls covered with several layers of paper, uncleaned carpets, filthy refrigerators, and what the thrifty house-wife would sum up under the head of "dirt," is very frequently the cause of foul smelling and unhealthy dwellings. Houses are frequently pervaded with foul odors arising from external causes, that is, causes not existing within the four walls; privy pits, stables, dirty yards and lanes, untrapped yard or street gratings, rotten planking in yards or sidewalks, and similar causes exist, and are sometimes very difficult to remove or remedy, as they sometimes exist owing to the carelessness and apathy of the neighbors. The occupants of terraced houses are frequently troubled with foul smells having their origin in the adjoining houses, which make their way from house to house by means of cracks in walls, openings around beams, rat holes, and, in many cases, through the walls themselves. I have had many such cases to deal with. In conclusion I will give the following recipe, in which I have great faith. It was written by a physician in answer to a patient's request for a good disinfectant to use during the warm weather:—

"R—Brush, 1; pail, 1; shovel, 1; wheelbarrow, 1; broom, 1; cloth, 1; soap, *ad lib.* *agua pura quantum suf.* (plenty clean water), add a sufficient quantity of brains and muscle to cause the whole to be vigorously worked, and use in large quantities until complete relief is afforded."

J. W. H.



