The Sanitary Plumbing of a Modern House

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I- Introduction.

Good house-keeping is always difficult. With every modern convenience at her command the housewife will still find many calls upon her time and strength. If she be wise she will take advantage of everything that will lighten the labor for her. There is no doubt but that a good sewage system saves an immense amount of time and labor. It carries away all the waste products from the house and relieves the housekeeper of this drudgery.

Such a system is economical in dollars and cents. When the overburdened worker in the house breaks down and doctor's bills are due the "head of the house" realizes that he might have been saved this expense by easing the labors of his helpmate and thus preventing the breakdown, by the inauguration

of a good system of sewage disposal. It saves a great amount of wear and tear on clothing, especially shoes, thus reducing the family shoe bill. It is economical again in making doctors' bills unnecessary by preventing sickness. It is a sanitary arrangement in every respect. It carries away filth, that would cause disease, with speed, it prevents soil contamination and thereby drinking water. Foul gases are kept from entering the house as would come if the waste material was left to lie and decay about the yard. There is grave danger to health from sewer gas and this subject is discussed fully in the succeeding pages.

II- Discussion.

One of the first things to be considered in planning for plumbing a house is the source from which the water is to come. It is usually customary for the water to be stored either in a tank or reservoir and either of these should be kept scrupulously clean. The original source of the water is of most importance. There are three principal sources of drinking water; viz.; rain, surface, and sub-surface water. Rain water is good only it is hard to collect and keep it pure; it lacks aeration and has a flat, insipid taste owing to the absence of mineral matters. If it is to be used for drinking purposes it must be filtered and properly stored. Surface water is pure and good to drink if obtained from unpopulated districts. It is merely rain water stored in natural reservoirs, lakes, ponds, and rivers. Its purity depends upon the nature of the soil, amount of refuse matter near, and proximity of sewage systems. As a general rule water from surface

wells must be regarded with suspicion because of the danger of pollution. Subsurface water is found in some springs and in deep wells. Springs are of two classes; the surface springs and deep springs. The quality of water depends upon the temperature, source, and physical characteristics of the soil through which it passes. Iron, salt, and sulphur springs are common. Spring water is usually cool, pure, and wholesome. Wells may be divided into shallow or deep. Shallow wells may be dangerous for they are formed by water percolating through the soil and it often carries impurities with it. Sparkling and clear water may be full of bacteria; may have no taste or odor and yet be dangerous. Shallow wells ought to be cased to the water and have good curbs. Deep wells are generally reliable because the water must pass through so much soil it is pure by the time it reaches the well. The water might be objectionable because of its hardness or for its excess of salts. The distinction between deep and shallow wells is not the depth of the well for a

deep well may tap the surface water and a shallow well may sometimes tap the sub-surface water. But the difference lies in the depth to which the water of either descends, before being tapped.

Water is classified thus:

- Wholesome.
  - Springs
  - Deep wells
  - } Very palatable
  - Upland surface.
  - Stored rain water
  - } Fairly palatable
- Suspicious
  - Surface water from cultivated land
  - River water with sewage contamination
  - Shallow well water.
  - } Palatable.

The first care in selecting pipes for bringing water into the house should be the material. Lead pipes are not satisfactory because lead is very soluble in certain waters and lead poisoning is so often the result. Iron pipes rust out, porcelain

pipes are not strong enough and are liable to crack. Glass lined pipes are manufactured and answer the purpose well. The best material available is galvanized iron. This is made of iron coated with zinc or tin. Zinc while it lasts acts more perfectly than tin. When the tin is once broken the iron oxidizes more rapidly than if the tin was not present. By the use of zinc, its durability is combined with the strength of iron. Also, they are not liable to rust. The only objection to galvanized iron is that the zinc is worn away very slowly and the presence of zinc in the drinking water may cause constipation.

The supply pipe that enters the house need not be more than one-half inch in diameter. Especially is this true when the water enters directly from the main supply station. It may be larger if it leads to a special storage tank in the house. Sometimes in case of fire a large supply pipe is convenient.

There are two means of distribution - <u>constant</u> and <u>intermittent</u>. In the first method the taps deliver the water direct from the service pipe without a cistern. In the latter a cistern is necessary. Cisterns are frequently necessary when the force of water is not

great enough to reach high buildings or buildings upon high ground. The first plan, when possible, is best because the cistern is liable to contamination, the stored water supply is liable to be exhausted in case of fire, and vacuums are less liable to occur. Faucets and ends of pipes are generally made of brass or nickel. The brass is harder to keep looking nice.

The cistern for the storage of the water supply in the house in the intermittent system should be made of galvanized iron or slate. Slate is best except that it is heavy and it is hard to avoid leakage through the joints. These must be made of cement. Wood is sometimes used but sooner or later decays, and organic contamination results. Galvanized iron is probably most practicable as it is easily jointed, does not rust, and wears off very slowly. Storage tanks should be large enough to hold all the water that can possibly be needed in the house during the day. This amount will make fires less dangerous because there will then be a large water supply on hand. A cistern must be easily accessible, never in a dark corner, and neither should the direct rays of the sun be

allowed to fall upon it. It should be covered and ventilated and never connected with the supply pipe of a water closet. If the cistern is connected with drain, soil-pipe, etc., it acts as a ventilator for them and so contaminates the water supply. The overflow pipe should be cut short off on the outside of the house. This should be covered with a hinged flap. The service pipe entering the cistern or the house directly should not be on the outside of the wall nor on the inside of an outside wall unless properly encased from the cold. It should be on the cross walls. If it must come on the outside wall it must be correctly encased and wrapped with asbestos. A board one inch thick should be put between the casing and the wall.

2/. There are two methods of carrying the sewage or waste of a house to a sewer. They are the water carriage and the dry. In this discussion only the water carriage method will be described as it is the cleanest, most rapid, most convenient, and cheapest method of sewage disposal. The water carriage method comprises two systems: the combined and the separate. In the separate system two groups of pipes are used, one for the sewage proper

uncontaminated water. The combined system uses but one set of pipes for the disposal of rain water, waste, and sewage. The advantages of a separate system are, as follows:

Sewers may be small in diameter - e.g. six inches; there is a constant and efficient flow and hence flushing of sewage; sewage is richer in fertilizing matter; sewers never overflow; no decomposition takes place in the sewers; and it needs no special means of ventilation. The disadvantages of the separate system are:

The extra cost of two systems, the sewers used for the sewage proper need some system for periodically flushing them which, in the combined system, is done by the rain, small sewers cannot be cleaned or gotten at as the larger ones. Both systems, however, give satisfaction.

House plumbing demands the following requisites: 1st, receptacles for collecting waste or excreta. These must be adequate for the purpose, small, non-corrosive, self-cleansing, well-flushed, accessible, and so constructed

as to dispose of their contents easily. 2nd., separate vertical pipes for sewage proper and for rain water. These are to be upright, direct, non-corrosive, water and gas tight, well flushed and ventilated. 3rd., short, direct, clean, well-flushed, gas-tight branch pipes to connect receptacles with vertical pipes. 4th., disconnection of the house sewer from the house pipe by the main trap on the house drain and disconnection from the house of all fixtures by traps on the fixtures. All pipes must be exposed to view. Simplicity is the Key-note to all plumbing.

The house-drain is the horizontal main pipe receiving all waste water and sewage from the vertical pipes (soil pipes) and conducting them outside of the foundation walls where it joins the house sewer, or, rather, after the house drain reaches from two to five feet from the walls it is called the house sewer. Extra heavy cast iron is the best material to use and the size depends upon the work to be done. If too large, will not be self-cleansing. A three-inch pipe is large enough for a small house; a four-inch pipe is obligatory in most cities and a five- or six-inch pipe is

desirable for very large buildings. The house drain when within the building must be securely fastened to the foundation wall above the cellar floor. Unless fixtures in the cellar drain into this, the house drain should be hung on the cellar walls or ceiling. If the fixtures do drain into it from the cellar the drain must be laid in a trench, cut in uniform grade, walled with bricks laid in cement, and provided with movable covers. It should rest on a hydraulic cement base four inches thick. The fall depends upon its size. A fall is needed to increase the velocity of the flow and make it self-flushing and cleansing. Rates of fall are:

Four inch pipe - one foot in forty feet.
Five inch pipe - one foot in fifty feet.
Six inch pipe - one foot in sixty feet.

A house drain should not open into a cesspool unless it cannot be avoided and then the cesspool must be well ventilated and separated from the drain by a trap. If a house drain empties into a sewer of the combined system there must be a trap before its junction to prevent sewer air from returning and there must

also be an opening for fresh air between this trap and the foot of the soil pipe. This will provide for a current of air through the drain and soil pipes to the exit in the roof. If a house drain empties into a separate sewer system there need be no trap between the house drain and sewer. The fresh air inlet is still necessary, however. Every ventilating pipe must extend two feet above the roofs highest peak or the highest chimney. They must be full size, far from air shafts or windows. The fresh air inlet should be at least four inches in diameter and enter the house drain on the house side of the main trap. It must not be nedrer than fifteen feet from a window or door or near a cold air furnace box. The house drain passes through the cellar wall and a proper opening must be provided for it to prevent damage from settling. Junction of the vertical soil, waste, or rain leader pipes must not be made with the horizontal house drain by right angled joints but rather, by a curved elbow fitting or by Y branches and by forty-five degree bends. Near all bends traps and connections of other pipes with the house drain suitable hand holes should be provided. These hand holes

should be tightly covered with brass screw ferrules, screwed in and fitted with red lead. No steam exhaust should be connected with the house drain until passing into a condensing tank. The disconnection of the house pipes from the street sewer is accomplished by a trap on the house drain near the front wall inside the house or just outside the foundation wall. A siphon or running trap is best for this.

The soil pipe receives waste from the water closets and carries it to the house drain. It is located almost entirely within the house. It would be better outside were it not for the danger of freezing. The pipe is usually cast or wrought iron. It should be four inches in diameter and as nearly straight as possible. It should be prolonged into the drain and have a flange attached to it which rests on the floor of the socket. The joint should be of cement. It must extend unobstructed from the house drain to several feet above the roof, ending where winds and currents from high walls and chimneys will not interfere with its free ventilation. The vertical pipe should never be within the wall of a house but it is best in a three-feet square shaft adjacent to the fixtures. Fixtures should be as near

the soil pipe as possible to avoid having the branch pipes long. Joints are ¼ and lead calked always. The traps on the branch soil pipes should not be far from the fixture as two traps on the same line of branch soil pipe will cause the air between the traps to be closed in forming a cushion that will prevent the ready flow of contents. The pipe should have a fall of at least one-fourth inch to the foot. All fixtures in the house should be as near the soil pipe as possible so no stretches of foul waste pipe will be below floors. All connections with the soil pipe should be at an acute angle to avoid interfering with the free ventilation. Soil pipes should never be of seamed lead or iron for there is danger of corrosion. Drawn lead pipes are good.

The main waste pipe is the pipe receiving waste water from any fixtures except the water closet. Generally remarks on the soil pipe apply equally here also.

Branch soil and waste pipes are the short pipes between the fixtures in the house and the main soil and waste pipes. Every such pipe, eight feet or more long, or if two or more water closets are connected to it, must extend to the roof or be connected with the soil

pipe above the highest connection with the fixtures. This is to prevent any closed ends where foul air may collect. The pipes must be so secure that no jar or settling of the building can destroy their continuity.

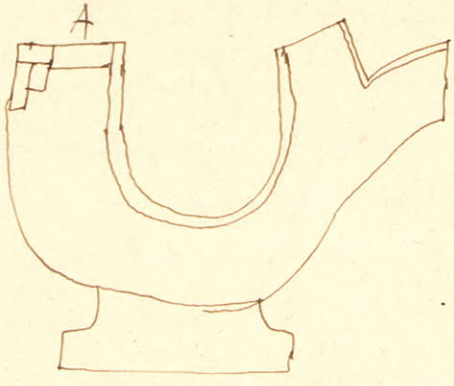
Vent pipes are the special pipes to which the traps or fixtures are connected and serve to ventilate the air in the pipes and prevent siphonage. Cast iron is the best material for these. The size depends on the number of traps with which they are connected but usually a two or three inch pipe answers the purpose. The joint of the branch vent must be at the crown of the trap and of the branch vent to the main vent above the trap to prevent friction of air. Vent pipes should not be perfectly vertical, for if they are, condensation of air will occur. The pipe is to extend above the roof several feet and no return bends or cowls should be tolerated on top of the vent pipe. Sometimes the vent pipe instead of running to the roof, is connected with the soil pipe several feet above the fixtures. All bends must be avoided. It should not go around the eaves but through it and should be capped with large mesh netting.

The rain leader is the pipe receiving rain and storm water from the roof of the house. It usually

empties into the house drain though it may empty into the street sewer or gutter. If it is in the house it must be of cast iron with lead calked joints. If outside it may be of sheet metal or galvanized iron with soldered joints. When near a window it should be trapped near the base and the trap should be deep enough to prevent evaporation or freezing.

Traps are bends in pipes so constructed as to hold a certain volume of water called the water seal. This seal serves as a barrier to prevent air and gases from the sewer, entering the house. The simpler the trap the more satisfaction it gives provided the water seal is deep enough. Many mechanical appliances may become clogged and not fit tight. The value of a trap depends upon: 1st the depth of the water seal, 2nd, the strength and permanency of the seal, 3rd, the diameter and uniformity of the trap 4th its simplicity, 5th its accessibility 6th its self cleaning character. The depth of the trap should be about three inches for water closets, and two inches for sinks. They must be larger in diameter than the pipe to which they are attached and be provided with a clean-out screw, openings, caps, etc., to facilitate cleaning. Traps are named according to their use, gully, grease, sediment, intercepting, etc; to their shape;

D, P, S, N, bell, bottle, pot, globe, etc.; and to the inventors, Buchan, Cottam, Dodd, Antill, Renk, Hellyer, Croydon. The S trap is as simple as any and is recommended for sink waste pipes. This trap is of uniform diameter, has no projections to catch dirt, and is thoroughly cleansed by each fair flow of water through it. The siphon trap is best for all water closet pipes. It has two openings besides the inlet and outlet. One is at A. which



is carried up to the surface of the ground and screened and the other is beyond the seal. Gully traps are used to cut off waste pipes of the house from the drain. But it must always be outside the house. Bell traps must be condemned. A trap may be bad in principle and construction, badly situated and connected, inaccessible, foul, easily obstructed, or unsealed. Traps may lose their seals in several ways. 1st. Evaporation as when a fixture is not used for a long time. To prevent this flush frequently or, if the fixture is not to be used, pour oil into the pipe to prevent the water evaporating. 2nd - Momentum. A sudden flow of water

from the fixture by its force may empty all the water in the trap and thus leave it unsealed. To prevent this the trap must be of proper size – not less than the waste pipe of the fixture, the seal must be deep, the trap in a perfectly straight position, and care be taken to empty it slowly. 3rd. Capillary attraction. If a piece of paper, cotton, thread, hair, etc., remains in the trap and a part project into the lumen of the pipe, a part of the water will be withdrawn by capillary attraction, and may unseal the trap. To prevent this, the traps should be of uniform diameter without nooks and corners, not too large in size, and should be well flushed. 4th Siphonage. A large volume of water completely filling and descending a vertical pipe must in its course create powerful suction and may by the force of its suction and vacuum, aspirate all the contents of the smaller waste pipes and the traps connected with the same vertical pipe. To prevent siphonage mechanical means are sometimes applied to assist the water seal. They are liable to get out of order. McClellan's anti-siphon works well as it permits free ingress of air to the trap but no air can get out from the soil pipe. The best way is to avoid creating a vacuum by extending the vertical

pipes over the roof and by connecting the traps with the open vent, the air in which will prevent the formation of a vacuum and consequent siphonage of the traps. Each trap at its upper portion or crown is connected with a branch pipe running up to and joining the soil pipe above the entrance of the waste pipe from the highest fixture. This also serves to ventilate the traps and pipes connected with them. If a trap is properly constructed, the soil pipe of proper size and height, and if the fixtures are as near the soil pipe as possible there is little danger of siphonage.

Although the shape, principle and general construction of the various house fixtures is important, they are of less importance than the connections, joints, and general plan of the pipes. Each fixture must be separately trapped and as near the fixture as possible. They must be exposed to the air — have a circulation of air all about them. Never close them in as this makes access to the traps almost impossible. Under each fixture there should be a drip safe to catch any leakage or overflow of water. Pipes from the drip safe are not to be connected with the waste or soil pipe but should lead to the open air.

The bath tub comprises

or zinc to a highly polished marble. Enameled iron and porcelain are also found. The size varies but there are two principal sizes - the half length and the full six foot tub. The former is used for sitz or foot baths, the latter for a regular full-length bath. It is necessary that the bath room should be located on an outer wall of the house where fresh air and sunshine may freely enter. The tub is to be placed where the branch waste pipe may easily join the main waste pipe without a long stretch of pipe where foulness may collect. The tub is not to be covered or enclosed. Lead pipes are generally used for the branch waste pipe because they can be easily bent and shaped. They are from one-half to two inches in diameter usually. All connections between lead pipes must be of "wiped" solder joints. This is made by pouring the solder on the ends of the two united pipes, working the solder about the joint, shaping into an oval lump and wiping around with a cloth thus giving the joint a bulbous form. If the lead branch waste pipe joins an iron waste or soil pipe a brass ferule must be used because lead cannot be soldered to iron. The brass ferule is soldered to the lead pipe by a wiped joint and to the iron pipe by an ordinary lead calked joint. Putty, cement and slip joints should not be tolerated on any pipe. The "Anti D" is the best trap

to use on a bath tub branch waste pipe.

With the lavatory as with the bath tub one may secure unlimited elegance in the fittings or he may obtain very good fixtures at a reasonable cost. A great deal has been written regarding stationary bowls. Undoubtedly they are unsanitary and undesirable in a sleeping room but they are appropriate for bath rooms provided they are left open at the base and thereby easily accessible. Porcelain or marble are suitable materials for a lavatory. An overflow outlet should be provided in the top of the basin and the pipe connected with the branch waste pipe after being trapped on the inlet side of the trap of the same fixture. It is liable to become clogged if not watched. As regards pipes for the lavatory the same conditions apply here as for the bath tub pipes.

The water closet is the most important fixture in the house. It must be in a separate apartment, well lighted and ventilated. In all fixtures the form is of very great importance. Especially is this true of water closets. But also one must remember that a good form is not the only requisite. The very

best form may prove useless with poor connections and no ventilation. In selecting a closet remember that of value closets only the best quality and therefore the most expensive give satisfaction. That plug closets are only fair and none satisfactory if they have a long chamber for the plug. All of this kind must be fixed with a siphon-trap. Avoid a closet with too long a basin. Do not have a wash out closet. If one of this class is to be used get a wash down. The pan closet has been condemned because it has too many mechanical contrivances and is liable to get out of order. Valve and plunger closets are an improvement but are still rather too mechanical. Hopper closets are of iron and earthenware. The latter are better. There are two classes - the long and the short. The long are hard to keep clean; the short are good if a large supply of water is possible. Of all forms the wash down closets are probably the best. A closet that allows water to fall over every part at once, completely flushing and carrying away waste, is the ideal. The best material is earthenware.

The flushing cistern must be constructed at least four feet above the closet. It is never permissible to flush immediately from the source of water

Therefore a second cistern, holding enough water to permit an abundant flow of water into the closet (say from three to five gallons) is necessary. The service pipe should be one and one-fourth inches in diameter and this is too small unless the tank is more than five feet above the closet. This pipe is connected to the basin with a rubber cap. The cistern has a plug and handle so by pulling the handle the plug is lifted and the water flows out. The siphon cistern is good. It should be lined with lead to prevent rusting.

Pipes are made of cast iron of two or three inches in diameter. The branch waste pipe, connecting the closet to the main waste pipe, should be short. Near the trap should be a ventilating pipe either running to the roof or connected with the soil pipe above the highest entrance of a fixture. This also prevents siphonage. The siphon trap is best to use on all closets. One must be sure that the joints are absolutely air and gas tight.

The sink should be located in the house where it will be most convenient, where it is light, where sunlight can reach it, if possible. They are usually made of cast iron, painted, enameled or galvanized. Also of wrought

iron, earthenware, porcelain, and slate. Although the first cost is greater the slate sinks give the greatest satisfaction and require the least care. If possible the back and sides should be cast in one piece. No woodwork is allowable to enclose the sink. It should be supported on nickel legs and entirely open underneath. Sinks must be trapped inside the house with a siphon trap. It should slope toward the outlet and there meet a funnel shaped waste pipe. A grating to keep waste out of the sink should be put over this opening. An overflow pipe is convenient. It should be connected with the siphon trap below. A screw cap ought to be provided at the base of the trap for convenience in cleaning.

The necessity of having absolutely tight pipes cannot be too firmly impressed upon the mind for by leakage of gases or water comes all the trouble of a sewage system. There is great danger in breathing sewer gas. It takes the place in the lungs of the oxygen and suffocation occurs in a short time. The dangers from sewer gas are:

1st - The offensive odors give headache and nausea.

2nd - The organic matter decomposes and gives off gases and other products of decomposition.

3rd - It may contain pathological bacteria as of typhoid fever, cholera, and dysentary.
4th - It may contaminate the soil, ground-water, and air.

Sewer gas is only ordinary air contaminated with various products of organic decomposition. It is a mixture of gases the principal products being carbonic acid gas, marsh gas, compounds of hydrogen and carbon, carbonate and sulphate of ammonia, sulphuretted hydrogen, carbonic oxide, volatile fetid matter, organic putrefactive matter, and pathogenic and other bacteria. There are several ways of testing pipes to determine if there is any leakage. 1st To test pipes in new plumbing have the house drain plugged; fill the pipes with water to a certain noted level and leave one-half hour. If no leak or sweat appears at the joints - and if the level of the water has not fallen, the pipes are water tight.
2nd Smoke is sometimes forced into the pipes, the ends plugged up, and the appearance of smoke noted if it escapes.
3rd Oil of peppermint is put into the pipes. If any defect exists in any part of the house the scent will be found there.
4th To detect sewer gas in a room saturate a piece of paper with acetate of lead in rain water and hang it in the room. If sewer gas is present the paper will be blackened.

Conclusion:

Captain Miles Standish was wise when he said, "If you would have a thing well done, do it yourself." Yet he did not follow his own sage remarks in his courtship of the maiden Priscilla. People today are very like him. Especially is this true when technical work is to be done. An expert is employed and we take it for granted that they understand their own business. And so they should. But if we wish our work well done and are unable to do it ourselves we should at least examine and oversee the skill of the expert and know that he is competant. Plumbing is not so difficult but that the average person may understand the foundation principles. The best fixtures may have been provided, the best pipes and other materials obtained and yet an ignorant or careless worker may so put them together that the system will prove a complete failure and an insufferable nuisance.

It is economy to purchase the best fixtures. The first cost is necessarily greater but with proper care this class will last a life time. With the cheaper material, there is always the danger of leaky drains or of something out of repair.

Our homes form our nation. There can be no home in the true sense without a happy, healthy housewife for its guide. When, therefore, we provide for the maintenance of the health of our housekeepers we are benefiting our country. Thus we see the great value of a properly constructed sewage system.