The Sanitary Plumbing of a Modern House

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The Sanitary Plumbing of a Modern House.

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I - Introduction.

Good housekeeping 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 helpermate 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 if it is hard to collect and keep it pure; it lacks aleration and has a flat insipid taste owing to the absence of mineral matter. 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 sulfur 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 eased by the water and have good cabs. 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 salt. 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

Upland surface
- Stored rain water

Suspicions:
- Surface water from cultivated land
- River water with sewage contamination
- Shallow well water

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—constant and intermittent. 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 vacuum
are less liable to occur. Fancier 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 ex-
cept that it is heavy and it is hard
to avoid leakage through the joints. There
must be made of cement. Wood is
sometimes used but sooner or later decays
and organic contamination results.
Galvanized iron is probably most practic-
able 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,
ever in a dark corner, and neither
should be 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 as 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 wall. 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.

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 and the other...
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.

Hence plumbing demands the following requisites: 1st, receptacles for collecting waste or experts. These must be adequate for the purpose, small, non-corrosive, self-cleaning, well flushed, accessible, and as constructed
as to dispose of their contents easily.
and, separate vertical pipes for sewage
proper for rain water. These are to be
upright, direct, non-corrosive, water and
gas tight, well flushed and ventilated.
5th., 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 fix-
tures by traps on the fixtures. All pipes
must be exposed to view. Simplicity
is the keynote to all plumbing.
The house drain is the hori-
tal main pipe receiving all waste water
and sewage from the vertical pipes (oil
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 build-
ing must be securely fastened to the foundaion 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 moveable 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 can
not 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 hop
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 roof's 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 nearer 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 main 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 when 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-foot 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 L and lead caulked 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 seamless lead or iron for there is danger of corrosion. Brown lead pipes are good.

The main waste pipe is the pipe receiving waste water from any fixtures except the water closet. General 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 coulee 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 caves 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 caulked 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 wider 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, opening caps, etc., to facilitate cleaning. Traps are named according to their use, gully, graywater, sediment, intercepting, etc. to their shape;
D, P, S, N, bell, bottle, jet, globe, etc., and to the inventors, Buchan, Cotman, Dodd, Antill, Rentz, Kelly, 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 cleaned 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. Siphon 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, in 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 jet projects 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 trap 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. McCulland'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 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 ofless 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 give to a highly polished marble. Enamelled 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 silt 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 fouling 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 working around with a cloth to thus giving the joint a bulbous form. If the lead branch waste pipe joins an iron waste or soil pipe a brass ferrule must be used because lead cannot be soldered to iron. The brass ferrule is soldered to the lead pipe by a wiped joint and to the iron pipe by an ordinary lead casted joint. Putty, cement, and slip joints should not be tolerated on any pipe. The "Anti-P" 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 ob-
tain very good fixtures at a reasonable cost. A great deal has been written re-
garding stationary bowls. Undoubtedly they are unsanitary and undesirable
in a sleeping room but they are appro-
priate for bath rooms provided they are
left open at the base and thereby easily
accessible. Porcelain or marble are suit-
able 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 inlets 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 waterclosets. But almost
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 full closets are only fair and more satisfactory if they have a long chamber for the plug. All of this kind must be fitted 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. Value 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 closets— the long and the short. The long are hard to keep clean. The short are good if a large supply of water is possible. 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, but because it is liable to contamination
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 shot. Now 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 side should be cast in one piece, no woodwork is allowable to enclose the sink. It should be supported on nickel legs and entirely open under neath. 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 grate to keep waste out of the sink should lie just 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 dysentery.

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. 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. Smoke is sometimes forced into the pipes, the ends plugged up, and the appearance of smoke noted if it escapes.

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 acetic acid in rain water and hang it in the room. If sewer gas is present it 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 remark 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 competent. Plumbing is not so difficult but that the average person may understand the fundamental principles. The best fixtures may have been provided, the best pipes and other materials obtained and yet an ignorant or careless worker may as well throw 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 lifetime. 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 homemakers we are benefiting our country. Thus we see the great value of a properly constructed sewage system.