TENTH

ANNUAL ADDRESS.

SEWERS:

ANCIENT AND MODERN,

WITH APPENDIX AND ILLUSTRATIONS.

"HOBBIES,"

AND SOME WHICH WE HAVE RIDDEN IN 1886.

AUBURN, N.Y.

1887.
SEWERS: ANCIENT AND MODERN;

WITH AN APPENDIX,

Compiled from Official Sources of the Sewerage System of the City of Auburn, N. Y.

A Paper Read Before the Cayuga County Historical Society, December 14, 1856.

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INTRODUCTORY.

The subject of our paper this evening will be Drainage and Sewerage, ancient and modern. How the work was done; how it is done; how it should be done.

To some of our hearers this evening we fear the subject will be dry and uninteresting, yet it is one of great importance and should not be ignored. The character of the drainage and sewerage of our residences and their surroundings, determine the standard of the individual and public health. The more perfect and thorough this work, the purer will be the soil, the water, and the air; the higher the standard of public health, and the lower the death rate. We have succeeded a people, whose lives were passed in a primitive manner, on this beautiful domain.
SEWERS: ANCIENT AND MODERN.

"Lo, the poor Indian," erected his wigwam on our river banks, and here children engaged in healthful play; young men and maidens, in youthful pastimes, and old men met in council. Their wants were few and their ambitions limited. "Fire water," and the enervating habits of a modern civilization, had not then been introduced. The pure air of Heaven surrounded him; pure water from Owasco's stream, or adjacent springs, quenched his thirst, and simple food satisfied his hunger. Here he lived, in the enjoyment of a vigorous animal life. "Malaria" to him was unknown, and death when not ushered in by accident, or the tomahawk of an enemy, came by the slow approaches of old age, to transport him to the happy hunting grounds where, "His faithful dog shall bear him company."

AN in his primitive state paid little attention to his sanitary surroundings. His animal instincts prompted him to make his resting place when not engaged in a search for food, in a dry and sheltered situation; and experience would soon teach him that such places, were conducive to his physical comfort. If carried back in imagination to pre-historic times, we may see him, intellectually, but little above the beasts of the field, his animal nature preponderating. In such a state he would only be stimulated to activity, by the demands of hunger, and the necessity of guarding against the attacks of the enemies that surrounded him. Experience in time taught him, that the struggles of life would be relieved by association with other men, for mutual protection and defense. This bringing together of numbers of the human family, in clans or tribes, necessitated the selection of favor-

ble locations, for their home life. These selections were made, with due regard to their proximity to water and food, freedom from moisture, and the advantages of good natural drainage. The shelter in those primitive days was of the rudest kind, affording good ventilation and ready removal to a different locality, when the necessities of the occupants made it necessary. That the Aborigines of this country practiced this, is clearly shown by an examination of the sites of their villages, many of which can still be identified. In the primitive state, the difficulty of procuring necessary food prevented the gathering together in one place, for any length of time, of large numbers of the human family. In the progress of human developments, families became associated together in larger numbers; and with the increase of numbers, other, and unseen dangers surrounded and assailed them.

The alarming inroads of disease and death, at times struck terror to the stoutest hearts. In their ignorance, they attributed their sufferings to the anger of some unseen and undefined being whom they had offended. One stage farther in development, and unusual attacks of disease and death were charged to an overruling Providence, or the visitation of God. In progress of time, some minds more advanced than others, recognized the great law of cause and effect, and began to enquire the cause of the unusual visitations of disease and death. Investigation, closely connected certain conditions and surroundings with disease and death of a certain character, or type; and conviction in the minds of the few, led to the efforts on their part to remove the cause; with the cause removed, they found disease disappeared. In time there became established in the minds of many, the fact, that great unchangeable laws governed the inanimate material, as well as the animate physical world. All these laws existed long before they became established facts in the minds of any portion of the human family. From the records of the human race, as found in Genesis, we learn that prior to the flood, the wickedness of the world had become so great, that the flood was necessary for its purification. The inhabitants of the world at that time, had so far infringed on the laws governing their physical and moral life, that natural selection could not accomplish the work of regeneration, and selection by an overruling power was necessary for the proper development of the human race.

To Noah the promise was made, that seed time and harvest should thereafter continue to the end of time; and the bow of promise spanned the Heavens, as a reminder that the promise would be fulfilled.

Noah and his sons went forth from the Ark to people the earth. In those early days they led a pastoral life, living in tents, and changing their locality as the wants of their increasing herds, or the changes of the season demanded. Their simple out door life, and limited numbers gathered under a patriarchal government, was conducive to health and longevity.

The first large gathering of people after the flood, was on the plains of Shinar, where the abortive attempt was made to reach the heavens, by the erection of a tower which, from the confusion of tongues that followed, and the dispersion of its builders, has come down in history as the tower of Babel. The first recorded sanitary direction given to any people is found in Deuteronomy, xxiii chapter, 11th, 12th and 13th verses, in which washing for cleanliness is commanded, and a place to be set apart outside of the camp, and a puddle ordered used on their weapons for sanitary purposes.

Pure water was early recognized, as essential to the health and comfort of the human family. Hunger can be longer endured without serious injury, than thirst; and without an abundant supply of water where large numbers of people are congregated together, good sanitary conditions cannot be long maintained, and it has been truthfully said that “Cleanliness is indeed next to godliness.”
In the city of Jerusalem, 726 years before the birth of Christ, in the reign of the good king Hezekiah, will be found recorded in the 2d of Kings, 20th chapter, and 20th verse, that he caused “a pool to be made, and a conduit, and brought water into the city.”

Recent excavations made on the site of Solomon’s Temple, establishes the fact, that a thorough system of drainage and sewerage, was provided for the temple, and its surroundings. The general canal system of Egypt, executed under Ramesis the first, and his successors, served extensive drainage and sewerage purposes. The canals of Assyria and Babylon, fed by the Tigris and Euphrates, probably served the same purpose. The ancient Romans at an early period of their history adopted a regular system of drainage and sewerage. The trunk sewer of Rome, called the Cloaca Maxima, constructed of hewn stone, fifteen feet wide, and thirty feet high, was originated by Tarquin the elder, one hundred and fifty years after the foundation of the city. Agrippa sailed through it in a boat, Nero the tyrant caused his victims to be thrown into it; and it yet remains a part of the sewerage system of Rome. An elaborate system of sewerage has been discovered in connection with the Colosseum.

The ancients not only fully comprehended the necessity of drainage and sewerage, but as fully appreciated the advantages of an abundant water supply, for cleanliness and health, and availed themselves of its advantages as a means of removal by water carriage of the filth from their dwellings. On this continent evidences exist of its ancient inhabitants having some knowledge of drainage, if not of sewerage. In the works of the mound builders of this country, are found evidences of conduits, aqueducts, and reservoirs, showing that such a system was in existence at an early day in this country.

The date of these works cannot be determined, as they antedate any history extant, and were evidently constructed by an extinct race, superior in intelligence and constructive skill, to the Indian race, found here, at its earliest discovery by the whites.

Drainage, as well as sewerage, should receive due consideration. While drainage is important, sewerage is indispensable in a sanitary point of view. The question of drainage received attention in England, as early as 1436, when the possibility of relieving “the fens bordering on the river Ouse was agitated.” Nearly two hundred years after this the Earl of Bedford attempted to reclaim this tract by an embankment, but failed after an expenditure of half a million; but his son fifteen years afterwards by an expenditure of one and one-half millions, cut two drainage channels more than twenty miles in length, of navigable capacity, through this tract. In England at an early day the system of underdraining was practiced with advantage on wet lands; stone being first used and afterwards, earthen, or clay tiles. Holland has an extensive system of drainage, which has been in practice for centuries. Within the last half century, the system of under drains for the improvement of moist, or wet lands has been introduced, and quite extensively practiced in this country.

Central, and western New York, in its early settlement, with a virgin soil, penetrated by the roots and fibers of a heavy growth of timber, recently removed; produced abundant crops.

As the roots and fibers decayed, they enriched the soil, and left channels which served to relieve the soil, to a considerable extent, of its excess of moisture. Continued cultivation closed these channels; and land once light and friable, became heavy and sodden, cropping unprofitable, and drainage had to be resorted to, or cultivation abandoned. Stone, here as in England was first used, but drain tiles and pipes were introduced and extensively used for that purpose. Their invention, and first use for the purpose, is believed to be due to the Romans.

In England, sewer commissioners were appointed in the
reign of Henry VII; but their powers were limited to surface drainage, and rear walls, the sewerage being left to the local commissioners.

The drainage of London was provided for by legislative enactments, commencing in 1225, and the whole was revised by Sir Thomas More, in the celebrated bill of sewers, passed in 1581.

The use of sewers in London, up to the present century, was limited to the water that runs in the gutters, and the liquid refuse from the houses. In the reign of George III, an act was passed prohibiting the discharge of other matter into them under a penalty. The houses were provided with cess-pools, the accumulations of which were occasionally removed by the night carts.

The introduction of an abundant supply of water into the city, and the invention of water-closets, led to a new use of the sewers; and to results, not contemplated in their original construction.

The refuse matter of the cess-pools, instead of being transported into the country, to enrich the soil, was turned into the sewers, and discharged into the river Thames, at the nearest point. These sewers proved insufficient for the work, and reconstruction on a larger scale became necessary, and a regular system was adopted; bringing the sewers down to the river on each side, for a distance of six miles: their total length in 1855, exceeded 2,000 miles. and at that date, London was regarded as the best sewered city in the world.

Notwithstanding the magnitude of the work, serious difficulties existed by reason of the low points of discharge of the sewers into the river, made necessary to obtain sufficient fall. The result was, that their outlets remained closed for a large portion, of every twenty-four hours by the rising tides, forcing back into the houses noxious gases. Another difficulty arose from the large accumulation of filth along the banks of the river, caused by the obstructed flow of the sewers. This accumulation, at low tides, in warm weather, filled the atmosphere with offensive odors and gases.

To remedy this difficulty, it was decided, in 1858, to adopt some means to abate the nuisance. An effort was made to do so, by discharging into the sewers, during warm weather, immense quantities of lime, and chloride of lime, for the purification and disinfection of the same. During the summer of 1859, 110 tons of lime, and 12 tons of chloride of lime, were daily thrown in, at a weekly cost of £1,500, and £20,000 was expended during the season in flushing the sewers. This method proving unsatisfactory, to remedy the difficulty, three large parallel intercepting sewers, seven miles long were constructed, on each side of the river, at different levels, crossing the old sewers at right angles, so as to intercept and carry off their contents. These intercepting sewers, cost £4,250,000, or $21,280,000, and it is estimated that the total cost of these immense works, will not fall short of £30,000,000, or $150,000,000.

The importance of the sewer system of London, and its magnitude will be apparent, when it is stated, that her sewers discharge into the river Thames, 144 tons of refuse per minute, an amount equal to 18,126,400 tons per year. This would require for its removal if transported by rail road, in cars carrying standard loads of ten tons each, 264 cars per hour, or 6,336 per day, or 316 trains of 20 cars each, daily; and allowing 525 feet for each train, 81 miles of railroad track would be required, to stand upon.

London, to-day, is undoubtedly the best sewered city in the world, and this is conclusively proven, by a comparison of its annual death rate with other cities of less population. With a population of 4,058,928, for the month of July last, it was equal to 17.9 per 1,000 annually. The city of Liverpool with 579,724 inhabitants, had a death rate of 23.9. New York city
with a population of 1,489,000 for the same time had a death rate of 34.35,—a marked difference.

In the "Revue d'Hygiène," for October, Dr. Bertillon, in giving the comparative healthfulness of different cities for 1885, states that the death, by typhoid fever in every 100,000 inhabitants in London was 17, and in New York 26; and the death from diphtheria for the same number of inhabitants in London was 22, in New York 94.

The drainage and sewerage of Paris, another important European city, has been greatly improved in the last half century, and at the present time, is second only to that of London. Napoleon the First, ordered the repair and extension of the system during his reign, and the extension and improvement has continued until the present time. The main sewers are of sufficient capacity to receive gas and water mains, and in some of them, rails are laid on which cars are run, and in others boats are used for cleaning the same, and they are accessible to visitors by the same means. In connection with these sewers, a system of gutter flushing is in practice, making the streets of Paris models of cleanliness. The improved system of sewerage and drainage, has proved so beneficial to the public that the annual death rate, which was 36 per thousand in Louis the XVI time, has been reduced to 22, and Paris, today, is the healthiest city on the continent.

The construction of sewers in this country until a recent date has been without any well defined system, and has been the result of a pressing necessity. The cess-pool, and vault, or no vault system prevailed for a long time, and still continues to exist to the detriment of health in many places. The cess-pool and vault systems are usually but holes in the ground, sometimes lined with wood, and the more rapidly their contents disappear, the more valuable they are thought to be. Small, irregular water courses, walled up with loose stones, and covered over in time were made to serve as sewers; and what were once harmless rivulets, became elongated cess-pools of the most dangerous character.* In many instances, they were connected with cellars by drains without traps, furnishing ready avenues for the entrance of noxious gases to the cellars and living rooms above.

In the earlier constructed sewers, it was thought necessary to have them serve the purpose of drainage as well as sewerage, and no attempt was made to construct them as water-tight conduits. With the introduction of pipes, they were laid without cement in their joints, thus making long cess-pools of what should have been water-tight conduits†.

The danger of cess-pools and badly constructed sewers, (which are much worse as their influence is far reaching), cannot be estimated. The accumulation of refuse matter, within and around or in the vicinity of human habitation is always attended with danger. If permitted to accumulate for a sufficient length of time, it will tell upon the health and vitality of the occupant. Gases will be generated, and bad air, under the popular name of "malaria," will be held responsible for ills that often make life burdensome. In locations unfavorable from lack of good natural drainage, the difficulty is increased and the danger intensified. With a dense population located on ground saturated with water and an accumulation of filth, having no outlet except by the slow process of evaporation, an undue amount of sickness may be expected to prevail. In soils saturated with filth, during the winter when the surface is closed by frost and ice, the danger from noxious gases is increased, as the easiest avenue for their escape is through the cellars of residences to the rooms above. This danger is increased in buildings warmed by furnaces in the cellar, even if the supply of air for the rooms above is taken from the outer air. If the air is all taken from the cellar the danger is increased. The danger is not entirely due to noxious emanations, but from the use of water for drinking, taken from wells sunk in such soil.

* See Plate 8.  † See Plates 4, 5 and 10.
Artificial drains, it is understood, will in most soils, draw water horizontally, ten times their depth vertically. This is true in soil and sub-soil, free from underground water channels; when these exist, wells may, and undoubtedly do draw their supply from long distances. Water will find its level, and sheets of water and rivulets exist at varying distances below the surface of the earth. These mainly derive their supply from rainfalls, and have a more or less rapid movement according to the character of the soil and sub-soil, and the strata of rock on which they rest. Wells supplied from such sources are liable to become contaminated, especially in localities honeycombed with vaults and cess-pools, and what is worse, badly constructed sewers. It is claimed that water passing through the earth is filtered and purified. It should not be forgotten that the earth acts more as a sieve, to remove the impurities that it holds in suspension, and that poisons in solution remain in the water after filtration. Cleanness is not a proof of purity. A glass of water clear as crystal, may contain poison enough to kill a whole family, not alone by the slow process of disease, but immediately and surely.*

The peculiar sparkle and flavor of the water from some wells so highly prized as a beverage, may be due to deleterious gases and poisonous adulterations from some cess-pool near by, or more distant.

Danger always attends the use of water taken from wells in cities. Though active disease and death may not follow from the use of sewer and cess-pool contaminated water, the standard of health and vitality may be so lowered that life may to a certain degree be felt to be a burden. Many ills are charged now to malaria, which were in former times charged to an imaginary being whom the sufferers believed they had offended. The sympathies of kind hearted neighbors are often extended to sufferers from sickness, with a feeling that a hard fate attends them, when a better understanding of the cause would enable them to discover some connection between cess-pools on their own, or their neighbor's property, or an imperfect sewer. A careful analysis made of the water of a well, at one time of the year, will not prove what its condition may be at another. Its character may be entirely changed by a drought or an excess of rain-fall. It is safe to assume that wells in the more densely populated parts of cities are always in danger of contamination, and that it is unsafe to draw from such, your daily supply of water.* Remember that pure water cannot be obtained with certainty from wells sunk amongst cess-pools, no more than pure air can be expected in houses connected with sewers and cess-pools, without proper traps.

Cowper sung "God made the country, and man made the town;" and Cowley, "God the first gardens made, and the first city Cain." The first city was built in the "Land of Nod," a name suggestive of "malarial influences" or "bad air." The sixth commandment found recorded in "Holy writ" is, "Thou shalt not kill." How many deaths in cities are due to bad drainage and sewerage, can never be determined. The indictment and conviction of bad sewers and cess-pools, for murder and manslaughter, (or more properly, women and children slaughter, as they are the greatest sufferers), would be of advantage, if execution could speedily follow, and their removal take place. The slaughter of the innocents would decrease in a marked degree. For every person dying, it is estimated twenty fall sick; and Playfair estimates it at twenty-eight. Municipal authorities are not blameless in this; and it is not a good defense to say, "Where ignorance is bliss 'tis folly to be wise," or believe as another has said:

"From ignorance our comfort flows,
The only wretched are the wise."

The Pollution of streams and bodies of water adjacent to large cities, must to a certain degree always take place; as the nat-

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* See Plate 7.
ural rain fall, or so much of it as is not disposed of by evaporation, sooner or later finds its way to some river or body of water. It has been found that running streams furnish the best available means for the disposal of liquid filth, and refuse of cities. Water carriage, when available, has been found to be the cheapest, as well as the least objectionable means of disposing of the large quantities of filth that would otherwise accumulate, to the detriment of public health. With the introduction of an abundant supply of water in cities, the necessity for sewers increases. Ancient Rome, in all her glory, with her public baths, is said to have had a supply of 300 gallons per head, daily. This was no doubt an extravagant expenditure. The daily consumption in New York, for each person, is 25 gallons; in Albany 75, and Buffalo 63. The Water Works Company of this city, is delivering to our citizens at the present time, 2,500,000 gallons; equal to 96 gallons for each of 26,000 persons, the estimated population of the city.

This water mixed with the refuse of manufactories and dwellings, finds its way into the Owasco river again, as sewerage, and cannot fall much short of three and a quarter million of gallons: this is equivalent to nearly one car load per minute, or 54 cars hourly, and 1,296 daily, or 65 trains of 20 cars, carrying 20,000 pounds each, daily. This is diluted by the average daily flow from the Owasco lake, of 60,000,000 gallons, a dilution equal to 2,458 gallons to each inhabitant. A large portion of the impurities carried by rivers, are sooner or later deposited, at a greater or less distance, from the point where received. It is estimated that the Mississippi river deposits annually in the Gulf of Mexico, no less than 400,000,000 tons of mud.

This city is favorably located for drainage and sewerage. The Owasco river, the outlet of Owasco lake, a body of water unexcelled for purity, flows centrally through the city. At times its flow is rapid, and at all seasons its current is sufficient to bring a continuous fresh supply. The extreme dilution of the sewage of the city after reaching the river, renders it comparatively innocuous. It can have but little, if any, influence on the atmosphere, and the only danger lies in the exposure by low water, of the filth deposited along its banks, for too long a time, in the heat of summer. The removal of the Prison dam has been advocated by some; but this, it is believed, can only be done with safety when the city, or its citizens, are prepared to wall up the channel of the stream, and fill in the adjacent banks without delay.

With the ground water held at a uniform height, there is less danger from the exhalation of noxious gases, than where considerable changes in height takes place. The ground everywhere contains more or less air. In porous soil, the proportion is estimated at one-third cubic foot of air to each cubic foot of earth.

In ground filled with water the air is expelled. As the water falls, the air takes its place, and as it rises again, the air is again expelled.

If the ground is filled with animal and vegetable filth, noxious gases or bad air is expelled. Thus the earth goes through a process of breathing. These noxious exhalations from the body of diseased mother earth, are comparatively harmless, if largely diffused through the atmosphere. If instead, it escapes into a confined space, like a cellar, it may prove a slow, or more active poison. It has been pointed out by Professor Pettenkoffer, that in districts where the rivers are held up by weirs or dams, at a uniform level, the conditions are favorable to health.

In an examination of the records of “Vital Statistics,” going back to January, 1880, and including this year, to the present time, it is found that the whole number of deaths, in the swamp district, included on both sides of Dill street, State street, Academy, to Dill and Market
street, embracing 30 acres in the heart of the city, was 25. Of these seven (7) were over 60 years of age; over 40, and less than 60, four (4); over 20, and less than 40, six (6); over 10, and less than 20, one (1); over 5, and less than 10, one (1); over 1, and less than 5, two (2); less than 1 four (4). The causes of death were as follows: Old age 2; pneumonia 2; heart disease 2; cancer 1; consumption 3; Bright's disease 1; apoplexy 1; inflammation of the bowels 1; chronic bronchitis 1; debility 1; inflammation of the bladder 1; peritonitis 1; congestion of the brain 1; convulsions 1; entero colitis 1; cerebral spinal meningitis 2. The last two cases were children, one of whom died in Market and the other in State street.

Water contaminated with sewage, is not a safe every day beverage; and some of our citizens evidently fear that Owasco lake water cannot be drank with safety, at least, so long as they can obtain something they like better. The erection of public hydrants in localities in this city where wells are now generally in use, would be a public benefit, as with their erection, the use of wells could be prohibited. Under the system now in practice, for the disposal of the refuse of cities, other questions besides contamination, must eventually receive consideration.*

A steady drain upon the country is going on, and its fertility and productiveness is being reduced, and in time with the increase of population will be seriously felt. The time is not far distant when young men and old, will not, as now, be able to follow the advice of the venerable sage Greeley, and "Go west." The fertility of this country, and the facilities for transportation are such, that our cities can draw their supplies of food from long distances; and from large tracts of country; but it is safe to assume, that with the rapid growth of cities at the present day, the time is being hastened when the stream of wealth that now flows into the sea, will be directed to the land. The stream of fertilizers, that London is daily pouring into the Thames; if it could be as easily, and cheaply, spread over the Emerald Isle, would so increase its productiveness, that immigration would cease, and many of her sons and daughters return to their "Fatherland."

Intercepting sewers parallel to the river, have been recommended; the necessity for them will arise when our city has quadrupled in population, or the time come when river pollution shall be forbidden and enforced by law, or the value of sewage as a fertilizer better appreciated.

The apparent turpitude, and discoloration of the water, is not a certain indication of increased pollution. Manufactories discharge dye-stuffs and refuse into sewers and streams, giving the fluid an appearance of pollution that does not exist. There is but little sewage discharged into the Owasco river, above Lizette street bridge.

It receives, on the east side at the bridge, the sewage from a considerable territory lying south of East Genesee street, and west of Seward avenue. On the west side below Lizette street bridge the Elizabeth street sewer has its outlet. At the Genesee street bridge, the East Genesee street and Second ward sewers discharge.

At the North street bridge, the Franklin street sewer discharges, and below the bridge on the south side the Dill street sewer discharges. On the north side below the bridge two sewers discharge. At the State street bridge, on the north side, the Cross, Wall and State street sewers discharge, and below the Prison dam, the sewers from State, Clark, Genesee and Hubert streets discharge.

On the opposite side, through the Prison wall, the prison sewer has its outlet. Below Barber's factory on the south side, the Washington, Jefferson and Clark street sewers discharge. On the north side, Washington, Barber and West Water streets discharge.

On the south side near Division street bridge another dis-
charges, which serves for Orchard street below Jefferson. On the north side below Aurelius avenue bridge the Van Anden street sewer discharges. There are several small sewers, on both sides of the stream that discharge into it, but they serve for a very limited territory. East of the highest point on Franklin street, sewers from it and Cayuga street discharge into an open brook. A territory lying east of Seward avenue; Morris street, Beach avenue and Grant avenue, discharges its surface water into this brook, and its sewers must find an outlet by the same route; and another tract lying in the north and west part of the city, drains north and west to reach the outlet.

On the south and south-west, another portion of its territory, finds an outlet in the same direction.

In the several portions of the city last described, the surface drainage reaches the Owasco river outside of the city limits.

This city, from its near proximity to several lakes receives annually a considerable rain fall. During the summer, showers are frequent, and often copious, and materially aid in flushing its sewers. The topography of this city is such, that the river receives the surface drainage, of a large portion of it, within its limits. A lime-stone ledge underlies the city, and in places forms the bed of the stream. This bed of rock is seammed and fissured, and in places where it is exposed, small rivulets flow into these fissures and disappear. This mass of rock underlying the city forms a floor, (except where fissures exist), impervious to water. On this floor a sheet of water rests, and is slowly moving towards a lower level. The character of the soil and sub-soil covering this rock is variable, embracing sand, gravel, quick sand, swamp muck, and boulder clay. In these have been constructed vaults and cess-pools, which have been long in existence, as the receptacles of the solid, and fluid refuse of the inhabitants, and will it is feared be too long continued.

Our citizens generally take pride in their homes, and adorn and beautify them. Neatness and order mark their residences, and their surroundings; their lawns and shrubbery are kept neatly cut and trimmed, and their walks in good repair, and daily swept.

Fata! sickness has not invaded their homes; but it may have their neighbors. A beautiful and neatly kept lawn, may conceal a cess-pool that feeds a neighbor’s well, and has sown the seeds of disease and death, in his household. The well from which you draw your daily supply of water, may be in near proximity to your cess-pool, and escape the foul current your neighbor’s well receives.

Sewer construction in this city was begun, and has been carried forward without any very definite plan, beyond meeting the immediate and pressing wants of the time, and the locality where constructed.

The oldest existing sewers, (more properly elongated cesspools), were originally concealed water courses; made so by the owners of the property, walling them up from time to time, as the several owners desired to hide a blemish, and improve their property. The walls were laid with stones without mortar or cement, and with but little attention to grade, and with no purpose in view, except to provide a covered conduit, of sufficient size, to carry the rain fall received in the basin it drained.*

In a few localities in the city, open drains that serve for sewer purposes still exist; and people reside in close proximity to them apparently without a thought of danger. Not long since, some members of the Board of Health were requested to visit such a locality, and when there, met a resident, a native of the Emerald Isle, who evidently did not believe in sewers, and was unwilling that the salubrity and healthfulness of his locality, should be called in question, as he declared, with considerable earnestness: “By gosh, I have lived here more than twenty years, and there ain’t a healthier place in the whole city: I never paid a shilling to the doctors.” In this case the drain was made

* See Plate 1.
in the earth without protecting walls, and the supply of water was insufficient, to carry off its filthy deposits.*

The early records of the village show that some sewers were constructed of wood: the corporation timber, by direction of the village board, being applied to that purpose. A step in advance was made, when sewers were constructed of stone, laid in mortar, on a board or plank foundation. The next advance was the substitution of water lime cement, for quicklime mortar. It has been charged, that contractors sometimes used common clay, as a substitute for mortar; at least sewers have been so poorly constructed, that parties assessed for the same, refused to pay, the city failed to collect, and considerable amounts remain to this day uncollected. Sewers constructed of stone square in form, with flat bottom, if constructed in the best manner, are objectionable, as the flow of their fluid contents is much impeded, and they will at all times retain a large amount of filth and cannot be as perfectly flushed.† Brick sewers came next in order, made circular in form; then followed cement pipes, and lastly vitrified, or glazed clay pipes. There has been a gradual improvement in the construction, and material used, but there is still further advances required.

Many of the sewers heretofore constructed, fail in their workmanship. Brick sewers have been constructed with single walls, or rings of brick, circular in form. The objection to these is the difficulty, almost impossibility, of making the joints between the bricks tight enough to hold their fluid contents. All brick sewers should be built with double courses of bricks, and are only preferable, when exceeding a certain size.‡ In pipe, as well as brick sewers, leaky joints have been too much the rule. Until within a few years, it was thought to be an important requisite of sewers, that they should have open joints, to admit the ground water, so as to serve also the purpose of soil drainage.§ The joints of the pipes were left without cement, that the water might get in, without a thought of whether their contents would get out, or if out, what would be the effect; in fact many of our sewers are so many elongated cess-pools.

But few of the sewers have been laid deep enough, to serve for present use, or to admit of future improvement. They have not been properly ventilated, or been provided with proper openings and connections for the street water; and house connections have been left to the ignorance or caprice of any person who desired to make, or have them made; the Common Council granting permission to excavate in the streets for that purpose, and leaving the work without supervision. As a result the work is often badly done, and the streets generally left in bad condition.

The question of ventilation is an important one, and should not be overlooked. The wide diffusion of noxious gases through the atmosphere, deprive them of their deleteriousness. The mixing of "sewer gas" with a large volume of pure atmospheric air, hastens by oxidation the destruction of the noxious germs, with which the gas may be charged.*

The attendants upon patients in fever wards in hospitals, are free from danger, if proper ventilation is kept up; and when they suffer, it is conclusive evidence that the ventilation is bad. A physician of this city, who was a surgeon on active duty in the field during the war, has stated a case that occurred under his observation, where a field hospital, immediately after battle, was located in a grove; patients suffering from amputations, and serious wounds, were doing badly, and an unusual mortality set in; a removal of these patients from the grove to a high open field, exposed to the rays of the summer sun, with an unobstructed circulation of air, and improvement immediately followed, and within three days all unfavorable symptoms disappeared.

The sanitary rule of "Hippocrates," the "father of medicine" was "pure air, pure water, pure soil;" where these con-

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* See Plate 19.
† See Plate 3.
‡ See Plate 20 and 21.
§ See Plate 4, 5 and 15.
ditions exist, but little more can be expected. The best disinfectants for ordinary family use, are "pure air," and "sunlight;" and always, remember that faded carpets, are better than faded cheeks; and where the sunlight cannot come, the doctor must.

The earliest public movement for sewer construction, was made at an annual meeting held at the Court House, in the village of Auburn, May 4th, 1835, and was expressed in the following words: "On motion,

"Resolved, that the trustees be authorized to dig and form a subterranean drain; commencing near the Court House, on the south side of Genesee street, at such place as the said Trustees may deem proper to commence at, and run thence to the Owaseo creek, either at or near Patty's store, or else running to the intersection of North and South streets, and thence turn and run north to the Owaseo creek near the old market, as the said Trustees may direct; and that the said drain be dug sufficiently deep to drain the cellars to the buildings on the south side of Genesee street, and that the same be made sufficiently large so that the same may be cleaned by men passing through it underground, and that in raising the necessary tax for the purpose of making the said drain, the Trustees be directed to assess the same as far as may be practicable, upon such persons, where property will be benefitted by the construction of said sewer." Though this sewer was authorized at this early day, eighteen years elapsed before its final construction. In those days, as now, many people failed to appreciate their advantages, and were ready with remonstrances.

The records of Auburn, as a village, show that some of the earlier sewers were constructed of wood; although water courses were walled up, or partially walled up at an earlier day, as such are known still to exist, and are used for sewer purposes, though nothing in the village records indicates when or by whom constructed.

The first sewer constructed by the direction of the village authorities, was in 1839, and was from the Presbyterian Church, and was probably, from the church edifice to the creek. The cost of this sewer cannot be determined, as F. J. Clute, the builder of it, was for that, and removing the village pound, ordered paid $33.00.

In September, 1839, complaint was made about Mr. Richardson's drain on South street, and "on motion he was required to remove the same within ten days." What kind of a drain this was; why it was objectionable, or how, or where it was to be removed to, does not appear from the records. August 2d, 1841, the street committee were ordered to examine Green street, and ordered the notice for the construction of a sewer, "beginning at the north-east corner where it intersects Clark street, running thence along the east side of Water street: to be constructed of stone, two feet wide, and three feet high, well covered with flat stones." October 29th, the cost of this sewer was reported to be $500.00, and this sum was ordered "assessed on the property benefitted by the construction of said sewer." John Hepburn, George Casey, William Woods, Thomas Munroe, and Thomas Hunt, were appointed commissioners to assess the same. "July 4th, 1845, a sewer of oak and beach timber was ordered constructed on the south side of Clark street, of such dimensions as the street committee small deem advisable." This sewer was constructed, though the cost does not appear, but the report of the Assessors was confirmed, and the property on said street assessed for the purpose, ordered sold, unless the assessments were paid within three days. This would appear at the present day, like a summary proceeding. Evidently the village fathers believed in prompt payment. "October 4th, 1847, a sewer was ordered constructed on the south side of Genesee street, from the termination of a sewer near Joseph T. Pitney's to the Owaseo creek; to be built of stone, one foot square in the clear," and November 15th, 1847,
$90.00 was ordered "assessed on property benefited by the construction of said sewer." The sewer with which this connected, was probably a private sewer on the south side of Genesee street, which had its opening near Dr. Pitney's residence. April 6th, 1848, the "Loveliest village" became a city, and began to put on "City airs." On the 9th day of May, the "City Fathers" aired their wisdom, by the passage of an ordinance forbidding, under a penalty of five dollars, any person "putting any straw, shavings, wood, tan bark, stones, ashes, rubbish, or any filthy substance in the sewers of the city." Our "city forefathers," evidently started out with the determination to make the sewers models of cleanliness. If the ordinance could be enforced, there would have been no trouble from sewer gas. In 1848, a sewer was constructed in Chapel street, in front of the property of the Auburn and Syracuse Railroad Company, at a cost of $48.00. Two sewers were ordered constructed in July, 1850. One of them from "Consider Carter's, on State street, easterly through the lower ground between Genesee street and Dill street, to a lane in the rear of the Methodist church, and thence across Water street, to the creek; the other from Seymour street, south along Cross street to Wall street, and thence along Wall street, to the sewer passing under the Prison wall. Each was "to be of stone, on plank foundations, one and one half feet wide, and one foot high in the clear." Loren Patchen built the Cross street sewer, at a cost of $275.55; and the cost of the other was $393.07; who built this does not appear. At the same meeting, $121.87 was ordered assessed on property benefited by a sewer on Water street; this probably was a continuation of the Green street sewer. At the same time $149.69 was ordered paid to Daniel Goodrich, for a sewer constructed by him on the west side of Hulbert street. In May, 1853, the "Committee reported in favor of constructing a sewer from the court house along the south side of Gene-

esee street, to the Owasco outlet, to be constructed of stone, on a stone bottom, with flag stone covering, to be four feet by two feet in the clear." June 20th, 1853, a contract was entered into with Daniel C. Goodrich, for the sum of $2,800.00. September 12th, following, the committee reported the cost of the same to be $3,423.21, and that amount was ordered assessed on the property benefited. July 25th, 1853, a resolution rescinding the order of the Council for the construction of a sewer in Academy street, was introduced, and was very wisely held to be out of order, as the sewer was already completed, and the cost of the same was reported to be $81.77. November 12th, 1853, a suit was reported commenced against the city by Miller & Tibbals, on account of the construction of the Genesee street sewer; how it terminated the records do not show.

Time will not admit of a further detailed statement, of the sewers constructed. To this time, it is estimated that there is within the city limits 26 miles of sewers; seven of which were constructed by private parties.

The number built by the order of the village and city is 60; of these, 36 were constructed prior to 1881, at a cost of $30,219.84; and since then to the present time, the number constructed is 24, and the cost $62,292.31, making the total cost $92,421.65. The private sewers are estimated at $10,000.00, making the whole cost of sewers to date $102,421.65. In this connection an examination of the records of "Vital statistics" of the city, will be of interest.

In 1882, the whole number of deaths in the city was 495; on the basis of a population of 26,000, this is an annual death-rate equal to 19.64-100 per 1,000 inhabitants. In 1883, the whole number of deaths was 389, equal to 15.35-100 per 1,000. In 1884, it was 359, equal to 14.96-100 per 1,000; and in 1885, it was 357, equal to 13.73-100 per 1,000. This is a reduction of 88 per cent. in the death-rate, between 1880 and 1886.
This reduction, from whatever cause, is very remarkable. On the basis of the death-rate in 1862, the duration of life would be 52 52-100 years, and for 1885, 72 88-100 years.

This reduction in the death-rate in the same ratio cannot be expected to indefinitely continue, as the duration of human life half a century hence would be 326 68-100 years; and the days and years of the oldest patriarch Methuselah, would be again reached, perhaps exceeded. We can, it is believed, give to the increase in sewerage facilities, a portion of the credit; and another portion to the increased use of Owaseo’s water; another portion to the sanitary work of the Board of Health; and a portion of this very marked improvement must be set down to favorable conditions, not at present understood. It will no doubt be some time before this city reaches that degree of healthfulness claimed for some of the earlier western cities, where it was asserted, nobody died, and they found it necessary to “shoot a citizen to start a cemetery.”

The largest and most expensive work, was the Second ward sewer, nearly one mile in length, costing $23,932.91. This sewer was proposed as early as 1870, and a survey and estimate of the cost of the same made; and this was repeated from time to time, different surveys being made, until 1881, when an act of the Legislature, providing for its construction was passed, the right of way secured, and the work undertaken.

Unavoidable delay in commencing the work, made it impossible to complete it before winter set in, and the work was continued, and completed in 1882. Robert Tate was the inspector, appointed at the commencement of the work, and gave good satisfaction to the tax-payers on the line of the sewer. The election of a new board of Aldermen in the spring following, had changed the political complexion of a majority of the council; and on the afternoon of July 12th, 1882, a call for a special meeting of the council that evening, signed by five Aldermen, was served on the other Aldermen, and the Mayor.

Some one surmised the object of the meeting, and in a brief time, the names of the largest portion of the tax-payers along the route of the sewer was obtained to a remonstrance against the removal of Mr. Tate, and asking his continuance in the position. This was handed to the Mayor a few moments before the organization of the meeting, and he placed it in his pocket to wait events. A few minutes after the organization of the meeting, a resolution preceded by a preamble in the form of a

WHEREAS, said sewer is not “being built in strict conformity to the specifications, etc.,” and ending with declaring the office of Inspector of the Second ward sewer vacant. This was followed by the presentation, and reading of the remonstrance of the tax-payers interested; when the mover wisely concluded that it was best to, and did withdraw the resolution, and it was never renewed; and Mr. Tate continued inspector to the completion of the work.

This case is given as an illustration of the pernicious tendencies of politics in the construction of works of a public character.

In the construction of sewers, everything depends on the character of the work; and the importance of selecting a competent man for the position of Superintendent, or inspector, should not be lost sight of.

The question will now be asked, what is the best system of sewerage and drainage for cities? This question would receive from different persons, claiming to be experts on the subject, different answers; and the response from their hearers might well be, “When doctors disagree, who shall decide?” Without claiming to be an authority on the subject, you will permit us to give our views on the question, after briefly describing the principal systems now advocated and practiced. There is very generally in use in our cities what is known as the combined system. This name has been applied to it somewhat recently,
to distinguish it from the separate, sometimes called the "waring system." There is also in use to some extent, what is called the "mixed system," or one which embraces to a certain extent, both of the preceding systems. The combined system is that in which the rain fall, the sewage proper, and the street washings, are received into, and flows in the same pipes and conduits. The separate system, provides conduits, for the sewage proper only; and either provides separate conduits for the rain fall, and gutter flushings, or permits the same to flow off in the gutters at the side of the streets. The mixed system, embraces both of those described, the lateral sewers being of the separate system, and the main or trunk sewers of the combined system.

Under this system, the rain fall is carried in the street gutters, to the streets where the larger, or trunk sewers are located.

The objection to the combined system, is, that they must be constructed of large size, at increased expense, and of sufficient capacity to carry the greatest amount of rain fall that can take place at any time of the year; whilst at other seasons of the year, their capacity is largely in excess of their requirements, and are liable, from an accumulation of filth in them, to generate noxious gases, which will endanger the public health. Such sewers are difficult and expensive to flush, and only receive it when a heavy rain fall occurs. The objections to the separate system, are that it is only adapted to a city, the streets of which are densely built up.

That to attempt to build sewers, under the separate system, in sparsely built cities, or in sparsely built portions of cities, would involve an expense for flushing that would be in excess of its advantages. It is believed that it can only be applied with success in crowded cities, with paved streets. If a separate conduit is also laid in the streets for receiving and carrying off the rain fall and street flushings, the expense will exceed that of the combined system.

Memphis has made trial of the separate system with a good degree of success, but difficulties have arisen, either from deficiency in size, or the increased demands made upon the pipes, in some localities. It is a question whether any sewer system can be devised that will be equal to the requirements of the service, at all times, and under all conditions.

A sewer adjusted to the requirements of the day time, would be largely in excess of the requirements of the night.

The Water Works Company of this city, at the present time, is delivering hourly, from 6 o'clock A.M. to 10 o'clock P.M. twenty per cent more water than it delivers between the hours of 10 P.M. and 6 A.M., and under any system, sewers of smaller size would answer for the night, than would be required for day sewers.

Flushing tanks working automatically, may be provided, with an abundant supply of water, and still it remains a question whether they have any advantages, even in densely populated districts over the combined system. In all cities, there is more or less accumulation of filth on the streets, and with the separate system, this filth to a certain extent, must either find an outlet by way of the street gutters, or a separate conduit for that purpose, and with every storm this must be swept into the conduits, or along the gutters. In a time of drought, (which seldom occurs in this locality) flushing, by means of the fire hydrants, for which provision is made in the contract with the Water Company, should be resorted to.

Believing that the combined system is well adapted to our city, we will now briefly describe what we believe to be the best way to apply it, or "how it should be done."

First of all, the proper material should be selected and properly applied. For all sewers under two (2) feet in diameter, pipe tile should be used. Pipe of cement, if properly made, of first quality materials, is to be preferred. Such pipe increase in strength by time and use, and the sections can be so united as to give, what is of importance, a smooth internal
surface, of uniform diameter. The next is glazed, or vitrified clay pipe, made in sections of uniform diameter, internally and externally, with separate short sections, or rings, of the same material, for securing the abutting ends of the sections. This kind of pipe, if properly laid, will give uniform smooth internal conduit.\textsuperscript{*}

The next best, is the pipe with an enlarged socket end, for making connections. These are the most difficult to unite, so as to produce a smooth, uniform channel. Pipe of all kinds should be provided with branches for connecting lateral sewers. Branches should not be united at right angles, but at a less angle, or in the form of a Y. Bends should be used, where lateral sewers are laid at right angles to their mains.\textsuperscript{†}

For sewers over two (2) feet in diameter, brick is the cheapest and the best; hard burnt brick only being used, and laid with good cement. The walls should always be laid double, and with joints properly broken. Single brick sewers cannot be relied upon, as leakage of their contents is liable to take place from imperfect joints. The best form of brick sewers is the combination of two semi-circles, of different diameters, united by sections of an ellipse, forming what is generally known as an egg shaped. Sewers of this form must be laid a little deeper than the round ones of the same capacity, but the advantage of a more rapid flow of their contents when partly filled, will more than compensate for the small increased cost.

The connection of all branches with mains, should, as far as possible, be made above the base line of the arch. Work of this character should not only be thoroughly done, but no inferior material should be used, at any price.

In the construction of sewers in cities, the future as well as the present should be considered. Whilst the cost may be slightly increased, it will be cheaper than to enlarge from time to time, to meet the requirements of increased population on the same or adjacent territory. A carefully considered plan should be adopted, embracing the whole city, or so much thereof as is embraced in one entire water shed. Main or trunk sewers should be first constructed, and be large enough, and deep enough, to carry the accumulations of all the branches afterwards required. The branches should be laid deep enough to give thorough drainage and sewerage to all buildings erected, or that may thereafter be erected, and to admit of the deepening of shallow cellars, in houses already erected, and made so from necessity, by reason of lack of proper drainage when constructed.

The excavations should be made to conform to the outer contour of the sewer, whether constructed of brick or pipe, and should be laid in conformity to the grade given by the engineer. If of brick, the walls should be laid with double courses, in good cement, and at the spring of the arch, the brick should be laid as headers, to give increased strength. Ventilating flues should be laid up to the street grade, one every 150 feet, and capped with an iron frame and grating.\textsuperscript{*}

These ventilating flues should, as they approach the surface, be enlarged so as to give the covering grate an area of opening at least equal to the area of the flue. At every point where the line of the sewer is changed in direction, manholes should be constructed and capped with a ventilating cover. This should be done without reference to the location of the street gulleys, or basins for receiving the street water. These ventilating flues, rising from the crown of the sewer, will permit the gas to escape freely, and by its rapid diffusion through the atmosphere become comparatively harmless, as well as inoffensive. The branches for receiving basins or gulleys, should be connected with the sewer at a low level, so as to avoid the escape of gas through them, that its entire volume may be discharged through the more direct channel of the ventilating flues.

The receiving basins should, as far as possible, be located at

\textsuperscript{*} See Plates 12, 14, 19 and 20.
\textsuperscript{†} See Plates 9, 10 and 14.
\textsuperscript{*} See Plates 19 and 21.
the corners of intersecting streets, and should be placed inside of the curb-stone. They should have sand traps, or basins, of sufficient size and depth below their outflow, to contain at least twenty-seven cubic feet. Without receiving basins, the heavier material washed by heavy rains, from unpaved streets, will find a lodgment in the sewer, and retard the flow of liquid filth, and produce an excess of noxious gases. The inlet for the water should be through a hole in the curb stone, protected by an iron grate or bar. The basin should have a flag stone covering, with a hole large enough for a man to enter, secured by a removable iron cover. The silt collected in these basins, should be removed often enough to prevent their overflow, and discharge of silt into the sewer.

All necessary house branches, (including vacant lots), should be constructed with the street sewer, extended to the curb-stone, and a durable mark set to indicate the points where they terminate. They should be connected with their street mains at a point above the center or spring of the arch, Y's and bends being used in making the connection; and in pipe sewers, less than one foot in diameter, the connection can be made on top.* The survey and map, made by the engineer, should distinctly show not only the route of the sewer, but the exact location of the house branches. Soft spots in the bottom of trenches should be replaced by hard material; and where quick sand is met with, wood inverts should be used. In laying pipe sewers, if the sections have socket ends, or when using straight sections with ring couplings, the excavations should be enlarged at the points where the ends unite, so as to give the sections of the pipe a firm bearing between the sockets or ring couplings, or there will be danger of breakage or displacement by the weight of the earth above, forcing the pipes out of alignment.† The connecting joints should be cemented with the best hydraulic cement, and care should be taken to have the internal channel in line. This can only be done in pipes having socketed ends, by coating the lower half of the socket end with cement, before inserting the end of the following pipe, and adjusting the same internally by a straight edge, of at least the length of three sections of the pipe. When properly adjusted, the upper portion of the pipe can be thoroughly cemented. Before another is added, the joint on the inside should be filled with cement, and brought to a line with the internal surface of the pipe.

This can readily be done by a wooden float, shaped to a section of the inner circle of the pipe. This will produce a smooth channel, for the flow of its fluid contents. In filling the excavation, the earth should be thoroughly tamped as fast as put in, to a point one foot above the crown of the arch. No sewer should be constructed, except under the superintendence and inspection of a competent person, who should insist that the specifications (which should be clear and explicit on all points), be carried out to the letter.

Politics should be ignored in the appointment of a sewer inspector: competency should be the requirement. If street repairs and improvements are improperly or imperfectly done, the defect can be seen by all with open eyes, who walk or ride; but defects in sewers once concealed, mischief unsuspected may follow.

The question of sub-soil, or deep drainage, as well as sewerage, is one that should demand our attention, and in cities should be considered therewith.* With sewers properly constructed, so that no escape of their contents can take place, (except at their points of discharge); it is evident that some provision must be made, for relieving the soil of an excess of earth water in many localities.

It is of importance to keep the sewerage, and deep drainage separate, as far as practicable. This can best be done, by laying lines of common drain tile on each side of the lateral sewers, and extending branches to, and around to the outside of the

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* See Plates 13 and 14.
† See Plates 2 and 3.
* See Plates 20 and 21.
foundation walls of the buildings, and placing a few inches of clean gravel on the tile, before returning the earth.* This will except in rare cases, protect cellars from objectionable dampness. If from springs in the cellar bottom, or the building occupying the entire lot, it becomes necessary to extend the drain tile within the walls, it should be provided with a trap, located within the walls, so that it can at all times be easily inspected. If the flow of water from the cellar is not at all times sufficient to keep the trap full, it will be advisable to provide for the discharge of a portion of the roof water through it. In cellars with good cement floors, drain tile can be extended within, and around inside of the foundation walls, with but little danger from the escape of noxious gases; provided the drainage system is not united with the sewer system; except at considerable distance from the dwelling. As an additional precaution the drain tile may be ventilated in the same manner as the sewer and soil pipe, as hereafter described. Having provided good sewerage and drainage, outside of our dwellings, unless the fixtures and plumbing inside are also good, the work has been worse than useless, as an avenue for disease, and perhaps death to enter, has been provided. It is the poisonous germs contained in the accompanying vapor, (and which may not have an offensive smell), that gives to "sewer gas" its deleterious properties. Gases that would be harmless, diffused through the atmosphere outside of your dwellings, become deadly poison when introduced into the confined space of dwellings, and especially sleeping rooms.†

In connection with the question under consideration, permit us to relate our personal experience. In the early part of January 1808, three members of our family were stricken down with typhoid fever. The attending physician, Dr. Hall, expressed in a decided manner, the opinion, that the sickness was due to the unsanitary condition of the premises occupied, and that the drainage, sewerage, or plumbing, must be defective.

A carpenter was called in, a portion of the floor in the hall of basement removed; and in the earth below, rat holes were found, which on removal of the earth, were found to communicate with an imperfectly constructed sewer, permitting the free escape of gas, which found its way to the rooms above through cracks in the floor and openings in the partition walls. A basement heater that took its supply of air from the hall, sent the gas through its hot air flues, direct to the living and sleeping rooms above, to poison the occupants. This house was one of a block of five, and this sewer served for all the houses. The house was occupied on a lease, at a moderate rental, having more than two years to run. The landlord declined to do more than patch up the sewer, but did not object to its being done at his tenants' expense. It was so done.

The old sewer was entirely removed, and a cement pipe sewer, with joints well cemented, laid in its place. By the side of this was laid drain tile, extending to the street sewer in the manner we have heretofore described. In a residence of eight years afterwards, no difficulty from that source was experienced, and we can see no reason why, that sewer should be found any different now except that the pipe would be found harder and stronger than when laid twenty years ago. There is always danger however, from the breakage or displacement of cement or vitrified pipes used for sewer purposes, and to ensure safety iron only should be used inside of the basements, or cellars of buildings.*

Poor fixtures, material, and workmanship, will be dear at any price.

First-class material only should be used, and first class workmen employed, as on the perfection of the work the safety of the occupants depend. The pipes and fixtures should be so located, and arranged, as to be easily accessible for inspection. It is much better to have the pipes and fixtures exposed to view, at all times, than have them concealed in partition walls.

* See Plates 5 and 6.
† See Plate 6.
or under floors, where they can only be reached by employing the carpenter and mason.

All soil pipes should extend above the roof, and to prevent syphonage, all traps, large and small, should be ventilated by a separate pipe of sufficient size, extended above the roof. Soil pipes should not only extend above the roof, but should be continued down, and outside of the foundation walls of the building, and terminate in a running trap.* This pipe should have united with it, inside of the trap, a vertical pipe of the same size as the soil pipe, which should extend above the surface of the ground, and have its open end protected by a hood or cowl.† This serves for the admission of fresh air, to produce an upward current in the soil pipe. Such portions of the soil pipe as are placed underground, should receive a thick coating of Portland cement, which will effectually protect the outside from oxidation. In laying the soil pipe, angles should be avoided, by the use of curves and bends. Chimney ventilation is in some cases resorted to. This is carried out by continuing a branch from the soil pipe up through, and above the top of a chimney flue.‡

Oakum and lead should be used in making the joints, which should be thoroughly caulked. When the work is completed the same should be thoroughly tested. This can best be done by plugging all the openings below the roof, and filling the pipe with water, or by pouring a small quantity of oil of peppermint into the pipe, followed by two or three pailsful of hot water, and closing the opening in the pipe, when any defect in the pipe, or its joints, will be detected by odor of the peppermint.

Examine closely the closets offered you, before selecting one. Do not be captivated by a name, or you may be afterwards forcibly reminded of the couplet, "What's in a name? that which we call a rose, by any other name would smell as sweet."§ All other conditions being equal, closets with separate flushing tanks are to be preferred; as with such an arrangement, danger from contamination of the water in the supply pipe, by diminished pressure in the street mains, is avoided. Select basins having large discharge and overflow orifices, and you will escape damage to ceilings by overflowing basins.

Trap baths and basins, independent of each other.* Avoid carrying water pipes up, or along outside walls, unless you desire the services of a plumber with every recurrence of zero weather. Place lead sinks under all closets, basins and bath tubs, and extend a pipe from the same to the basement or cellar, with its open end exposed, that leakage may be detected. Have stop-cocks with handles, put on the supply pipes, so that the water can be shut off at any moment, without going to the cellar, hunting for a wrench, or sending for a plumber. If your work is to be done by contract, have your specifications as full and perfect in every detail, as they can be made; be prepared to pay a fair price for good work, and do not accept poor work or material at any price. If in the progress of the work changes are suggested, be satisfied that the change is an improvement before you adopt it. Remember that pipe, wrenches, a man, a boy helper, and five dollars per day, will not always ensure good work. Inspect the work as it progresses; see that all the pipes, large and small, are properly supported, and all joints water and gas tight. Do not suffer any portion of the work to be concealed from view until it is carefully and thoroughly examined. If you doubt your ability to decide the question, call in some one who has had more experience. In conclusion, permit us to say, if you are satisfied from your own experience, and the reported experience of others, that the drainage, sewerage and plumbing of this city are not what they should be, and that the health of yourself, your family, and the health of your neighbors, "the public," will be benefitted by improving the same, unite with them in an earnest effort to make it what it should be.

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* See Plate 14.
† See Plate 17.
‡ See Plate 18.
§ See Plate 6.

* See Plate 16.