THE DISPOSAL OF CITY CLEANINGS.

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Civilized man is the only animal which willingly lives in its own filth, while claiming to be the only animal intelligent enough to know the consequences.

The brutes are generally cleanly; and human savages, being wanderers, have the advantage over civilized man that they can easily run away from habitats which have become unendurable.

The civilized man deliberately and knowingly sits down and dwells amid the accumulating offal, trash and excreta of generations.

On the site of old Troy three successive cities have been built on as many layers of made soil. The Roman forum, lately uncovered, has been lying for centuries under fifteen feet of material, mostly decomposed deposits of a cattle market.

Millions of our species have gone into premature graves by the way of black death, plague, Asiatic cholera, typhoid fever, diphtheria and other filth diseases, and to-day in our modern cities and towns thousands are going the same way.

The economic efficiency of vast numbers is reduced by an incalculable amount, and the expense of maintaining invalids is another vast increment of loss.

The mediæval way of accounting for all this death and loss was to attribute them to the Divine vengeance, punishing men for sin. And this was merely a theological expression of a fact not now disputable, that disease and premature death are inevitable consequences of filthy living.

Fortunately sunshine, fresh and unlimited air, and rain water are friendly and protective. Fortunately, also, men are so scattered over the surface of the planet that these protective agencies, co-operating with the natural disinfecting qualities of soil, can dissipate and disarm the diabolical forces of disease.

But this scattering of population is less thorough than it was a few generations ago. City life is always fascinating. Co-operation in comforts and pleasures is easy in towns. Men are gregarious, and enjoy keenly the nervous sympathy and stimulus of crowds.

There is no longer any recollection, there is no actual tradition of great city plagues. That last survival of the feudal institution, the country gentleman, has moved into town. The roadside smith, tailor, weaver, shoemaker and their fellow artisans have been swallowed up by the great factories which environ our town and cities.

It seems useless to lament this inevitable tendency.

The first census of the United States in 1790 showed three and three-tenths per cent of the people to be in the cities. In 1830 that percentage had doubled, in 1850 quadrupled; and in 1880 our cities held twenty-two and one-half per cent of the population.

In England sixty per cent of the people were in 1881, in cities. Our own country will soon see one-half of its population collected in cities.

The most vexatious problems of politics, economics and morals of the age are city problems. Democracy has failed in many of our large cities and the people are calling wildly on State legislatures for protection. In this very town (Minneapolis) citizens have been publicly asked to contribute to the suppo.t of a soldiery, liable to be useful in putting down the "dangerous classes."

Passing without mention a large group of city problems I come at once to the sanitary problem. As life and health are more precious than all other things, the sanitary interests of cities outweigh all other interests. And still I think it can be shown that in the long run the economic interests of a city are best subserved by effective sanitation at almost any cost. If citizens mean to live and live well they must provide for these fundamental things:

1. A well drained and uncontaminated terrain for their city.
2. An abundant supply of pure water.
3. The uninterrupted access of fresh air to all passages and enclosures.
4. The removal and ~~purification~~ destruction of filth and rubbish of every kind.

If cities were built ideally according to plans and specifications, these fundamental things would be attended to first of all. As a matter of fact they are tardily undertaken when the increase of disease and death frightens the powers that be, into action. And it rarely happens in this land of local administration, that any orderly plan is made or followed.

It is of one of these four fundamental things, the removal of city rubbish and filth, that I am, by the kind invitation of your president, permitted to speak at this time. If the subject should prove uninteresting I throw the responsibility on his broad shoulders, well able to bear it.

Next to the people who create the filth of the cities, the market gardeners, fruit farmers and dairymen who environ modern cities, are most interested in its proper disposal. In an ideal state of cultivation every particle of decomposed animal and vegetable matter goes back to the soil whence it came. The waste and offal which are now filling and polluting our streams, lakes and bays and destroying their fish, will some day cover places now desolate with blooming gardens and fruit-laden orchards.

It seems to me that without delay a goodly portion of the city filth should be put to its proper use of fertilization in the neighborhood of cities. I should be glad if this paper would set a single person to work on this problem. I hope it may set more than one to thinking.

Some account of various plans for disposing of city offal may prove interesting and furnish suggestions for further efforts.

The matter to be disposed of is conveniently separated into four parts:

1. Solid matter, not excreta, including sweepings, ashes, garbage and litter.
2. Excreta, i. e. fæces and urine.
3. Foul waste, including house slops, and the waste of factories of many kinds.
4. Surface water.

Let us eliminate the first and last elements.

Of the first, solid matter, not excreta, the only thing to do is to collect and cart it off to some suitable place. As to its ultimate disposition I will speak farther on.

Of the last constituent, surface water, it needs only to be said, that it must be allowed to run off in drains, closed or open. Of late years there has been a very lively debate between advocates of two systems for disposing of surface water. One party clamors for a so-called "separate system" of drains, independent of the sewers. The other party prefer to turn all rain water into the ordinary sewers, enlarging their capacity accordingly. The "separate system" has obtained considerable acceptance in London.

For our purpose we need to remark that any attempt to utilize water-carried sewage is immensely increased in difficulty if it is di-

luted with surface water. It is, I think, probable that the separate system may come into extensive use on this account, but there are those who question this.

There remain for further consideration the other two constituents:

Excreta and

Foul water.

Before the introduction into England toward the close of the sixteenth century of the ancient Asiatic water closet, it was the custom to remove excreta in wheeled boxes or tubs, and allow foul water to run off in open drains. The formation of sewers was an afterthought. The great Cloacæ of the Romans, the huge original conduit of Paris, the first sewers of London, were constructed to drain off superfluous ground waters, those in particular of certain streams and swamps.

When the slop waters of a city became voluminous and their discharge in open drains intolerable it was a simple device to put them out of sight by turning them into the great underground drains. A rapid extension of lateral and tributary sewers was a natural consequence. The introduction of water supply systems into modern cities has brought the water closet into extensive use, and along with it the so-called "water-carriage system" of removing excreta. This consists in simply turning all faecal matter at once into the common sewer to float off to the point of discharge. The water-carriage system is so cheap, convenient and effective that it is not likely to be supplanted in our time.

There is but one competing system, the so-called (from its inventor) Liernur system in the city of Amsterdam, Holland. That city cannot discharge its sewage into the sea because it lies too low in the water. By means of powerful air pumps, operated by steam power, the sewage is sucked through iron pipes to a central receiver. There the water is expressed, the solid residuum dried and converted into a valuable manure. The system is reported to be effective, very favorable to good sanitation, but not economically cheap.

Modern sewage is composed, then, of excreta and foul water, with or without rain water. A previous generation thought to have disposed of sewage by turning it into underground drains and shutting it out of sight. All it had accomplished was the partial removal of a nuisance from door yards and kitchens to the mouth of the sewer. I say partial, for the sewer itself now became the nest and brooding place of deadly gases, which no Yankee ingenuity in traps and seals has ever completely shut out of houses. The royal blood of England was poisoned almost to death but a few years since by sewer gas, emptied into a palace through the most scientific appliances.

And the question is before us this hour: How shall we dispose of our sewage so that it shall not dispose of us?

English experience here furnishes the most valuable suggestions. The immense increase of manufacturing establishments, such as woolen mills, paper mills, dyeing and printing works, bleacheries, gas works, etc., so polluted the rivers of England that parliament intervened in the famous Rivers Pollution act, of 1867. The operation of this act led to numerous experiments for purifying sewage.

Besides this there was, as there had been for centuries, the sewage problem of London. In former times the slops of London went into the Thames as that stream flowed through the town. Then the outlets of the sewers were carried down stream, and then still further down. A half million tons of solid matter turned into that river yearly have threatened to ruin navigation, have destroyed the fisheries and created a nuisance beyond the power of words to describe.

Without going into details, we may group the English experiments under three heads. Of course I do not count the ancient no-system of simply letting sewage flow where gravitation and tide would let it flow.

1. SIMPLE SUBSIDENCE.

This plan is that of emptying the liquid sewage into large tanks or vats, in which the solid matter settles and the liquid overflow passes into the nearest stream or tidewater.

Such is the condition of some English rivers that this effluent water, although loaded with deadly organic poison, is actually purer than the stream into which it may issue. This was the case at Leeds where a costlier plan of sewage disposal was abandoned because it turned out the waste water cleaner than the river.

Under this system the solid matter called the "sludge," is carted or barged off to some place of deposit on land or water. This plan may serve well as a temporary one for small cities.

2. IRRIGATION.

As the word indicates, this system disposes of sewage by discharging it by means of suitable piping over areas of agricultural lands, being itself purified while enriching the soil. The plan is not new.

The town of Bunzlow, in Germany, has had a sewage farm in operation for three hundred years.

The Craigentinny meadows, near Edinburgh, of four hundred acres, have received a good share of the sewage of that city for a hundred years, and that to great profit.

A number of English towns, among them Croydon, Cheltenham and Blackburn have adopted the irrigation system.

The city of Berlin, built on a sandy plain, has of late years introduced this plan on a great scale. Still later Paris has begun disposing of a portion of her sewage on land lying west of the Seine.

A drawback to this plan is that lands do not always need irrigation, while sewage flows incessantly. If no other remedy is devised the surplus must flow off by some waterway. The experience of Berlin and other North German cities shows that the cold of northern winters does not preclude the discharge of sewage upon land.

In mild climates and in the warm season anywhere, a modified form of the irrigation system promises to serve as a useful adjunct for disposing of sewage when not needed for irrigating. This modification consists in flowing the sewage off the fields on to small areas of land thoroughly underdrained to a depth of six feet or more. The soil to the depth of the drainage becomes a great filterbed, holding solid and suspended matter, leaving the filtered water to escape by the drains.

By alternating the flow between several plats, and thus leaving them to the operation of sun and air at intervals, it has been found practicable to discharge the sewage of 1,000 people on each acre of porous soil. Irrigation—"broad irrigation" as we may now call it—requires an acre to each 100 people. The Royal Commission of England in 1882–84 recommended the "intermittent filtration plan" for London.

3. PRECIPITATION,

There are many contrivances under this head all having for their object the acceleration of subsidence of suspended matters. When quantities become large, subsidence is slow, and decomposition sets in. To quicken subsidence various chemical substances are mingled with the sewage in the settling tanks. Lime in the shape of milk of lime at the rate of one ton of lime to one million gallons of sewage has come into commonest use. Other chemicals employed are tar and chloride of magnesium or of lime, sulphate of alumina, protosulphate of iron, and a mixture of clay (alumina), blood and carbon. The system employing alumina, blood and carbon is called for shortness the A, B, C process.

After precipitation by whatever process, the effluent water still holding organic matter in solution may be variously disposed of. It may be discharged into the sea or a stream. It may be used for irrigation or filtered through soil. The city of Birmingham, of 600,000 people, precipitates by the milk of lime process, and irrigates 1,200 acres of land with the waste water.

The disposal of the sludge still remains. It is of little value for manure, and has a gelatinous consistency which makes it very difficult to handle. On the seaboard it can be puumped into barges and carried out to sea. I meet nowhere with any satisfactory suggestions for handling the sewage sludge of inland cities. It can be made into bricks and has been made into a cement, but not at a cost to warrant such manufacture.

An experiment at Aylesbury, a town of 29,000 people about forty miles northwest of London, offers a probable solution of the problem for small cities. The A, B, C process of precipitation is used. The sludge is dried, ground with some sulphate of magnesia and sold under the name of native guano at $17.50 a ton. The material as it issues from the filter press resembles oil cake, and is quite inoffensive. Ten hundred weight of it doubles a crop. It is reported to be better than stable manure or Peruvian guano.

The difficulty of applying the Aylesbury plan to London and other great cities, is that the immense proportion of inert mineral matter in the sludge reduces its value for manure out of all proportion to cost of handling.

To lessen this difficulty a combination of the systems of simple subsidence and chemical precipitation has been proposed by a Maj. Gen. Scott, of England, who appears to be acknowledged as an expert in sanitary matters.

This plan proposes to flow the liquid sewage from the mains first into great settling tanks, where the mineral matters in suspension are to be allowed to subside. It is calculated that two-thirds of the solid matter, nearly all mineral, will settle. Naturally some organic matter will be carried down.* From these settling tanks the sewage water, bearing little but organic matter and that in solution, is to flow into a second set of tanks, when some defecating process, such as the lime process of precipitation, is to be applied to it. This is expected to yield a sludge so rich in organic matter that the manufacture of a fertilizer will be profitable. It is further proposed to enrich this organic sludge with superphosphates. The sludge of the settling tanks must be removed by barges or wagons, and may serve for filling low lands; if not, it must go out to sea. The effluent water, nearly pure, may be discharged as may be found convenient.

4. MECHANICAL FILTRATION.

This system, nowhere in operation except in an experimental way, is interesting because it is a Yankee invention, and because I believe it to point towards a simplification of the sewage problem.

Not many years ago a Mr. Hyatt, of Newark, N. J., invented an apparatus for filtering on a great scale water for house use and manufacturing purposes. An example was shown in the Minneapolis Industrial Exposition of 1886. This apparatus forces the water, treated with a solution of alum, through a filter bed of pulverized coke and clean sand. The novel feature is that of cleaning the filter bed by simply reversing the current for a very short time, once in say twenty-four hours. There can be no doubt of the efficiency of the Hyatt apparatus, on a moderate scale, for cleansing waters. A thousand towns and cities are already using it.

The claim is now made that this apparatus will filter liquid sewage effectually, and deliver the water purer than most unfiltered drinking water. As an instance: An experimental apparatus set up in Chicago has, it is alleged, delivered water purer than that of Lake Michigan, as furnished by the city water works. Mr. Hyatt has lately made a proposition to the city of Paris to filter its sewage, guaranteeing to discharge the water perfectly pure into the Seine.*

* San. Era, Dec. 15, 1887.

The advocates of mechanical filtration are not bound more than other people to dispose of sludge, but Mr. Conant, editor of the *Sanitary Era*, a journal published to advertise the Hyatt filter, advocates with great earnestness a plan for purifying sludge with dry earth. His idea is simply to mix a sufficient quantity of dry earth with sludge to deodorize it, and to repeat the process until the mixture becomes a fertilizer equal in value to Peruvian guano. I do not learn that any machines or appliances have been devised for working this plan. It seems to me to be one of great promise, but the cost may postpone its introduction for a long time.

We have briefly described the systems of sewage disposition worthy of serious consideration.

They are, to recapitulate:

1. Simple subsidence.
2. Irrigation, with or without intermittent filtration.
3. Chemical precipitation of the whole sewage, or of a residuum after subsidence of suspended mineral matter.
4. Mechanical filtration.

At the risk of unduly trespassing on the time of this meeting, I propose to devote the remainder of this paper to an answer to this inquiry: What, in view of past experience and present knowledge, may be reasonably undertaken by an inland city, such as Minneapolis in the way of cleaning?

Two things we presume: First, that the cleanings of a city are not to be dumped into rivers, lakes, or other waters, or deposited on lands where they will be a nuisance. The spectacle of a city of the size and pretentions of Minneapolis or Saint Paul, emptying into the Mississippi river thousands upon thousands of tons of solid and liquid filth and offal yearly is one to make angels weep and men blaspheme. Men who will hold the offices of mayor, alderman, or health officer, and not make it their first duty to lift their voices for some kind of civilized scavenging and sewerage are fit representatives of a people who are content to sit in the midst of their filth and pray the good Lord not to scourge them with tuberculosis, typhoid and diphtheria.

Exasperating as official inactivity may be, the mournful, humiliating part of the business is, that we, the people, are so blind, so ignorant, and so intent on living that we forget to live.

The first duty of a city is to clean itself, and dearly does any city neglect this duty.

Another thing to be presumed is, that the cost of thorough cleaning is a secondary consideration. A better statement would be that a thorough cleaning at any cost will pay; pay in the influx of population to a healthier city, pay in increase of values, pay in a lessened death rate, and a cleaner bill of health.

A third thing to be most heartily desired is the co-operation of a large body of intelligent cultivators to utilize the best at least of the fertilizing material now filling up and polluting the noble river which belongs to us simply to use and not to abuse. Upon these assumptions let us attack the practical question first proposed.

For clearness, let us recur to the classification of city filth already named. Four sorts:

1. Solids not excreta.
2. Excreta.
3. Foul water.
4. Rain water.

The first class, solids, consisting of street sweepings, dust, ashes, stable litter, garbage and rubbish should be collected systematically under compulsory regulations and removed.

House ashes, dust and garbage should be kept under cover till emptied in the public carts. Stable litter, if not removed by proprietors within reasonable time, should be carted off by the public scavenger and the expense charged upon the property.

Street sweepings are already removed by a public agency.

All of this service should be managed as a department of the city government, just as much as the water supply. It should be compulsory, and should be effective enough to keep all streets and alleys, all grounds and areas absolutely free from accumulations of filth. No syndicate or corporation should be allowed to levy a tax upon the people under the guise of a franchise.

The removal of this class of cleanings must be followed by assortment and ultimate disposition, In the first place, none must go into the river and none on to lands to be a nuisance.

Street sweepings, dust and ashes may go to filling low grounds until they shall be in demand for fertilizing.

Stable litter, garbage and rubbish may be "cremated," in whole or in part. The burning of this material is now rendered perfectly feasible by ingenious furnaces with two fire boxes. Cremation is no new device. The Gehenna of ancient Jerusalem was the perennial fire on which the offal of that holy city was consumed.

The second class, excreta, solid and liquid, is that whose prompt and innoxious removal is of first importance. There is no help for it but that excreta must go into the sewers, until the present fashion changes and better means of removal are organized. And better means might easily be organized. The power of common dry earth to thoroughly defecate night soil has been placed by experiment beyond all question. The day will come when all this material, purified by dry earth, will command a price, which will amply pay for more than the cost of removal. The city of Lynn, Mass., got a clean profit of $2,176.25 from the composting of night soil in 1886. (San. Era, April, 1887). Minneapolis and Saint Paul waste $50,000 worth apiece of good fertilizer each year.

As to the third class, foul water, i. e. house slops, and the liquid waste of manufactories; these go to the sewers—of course. In time, some manufactories may be required to purify their waste before emptying it into the sewers. This [redacted] frequently required in England.

As to surface water, the sewage question would be most simplified if rain water could be conducted away in separate pipes. But that seems almost impracticable in a climate like ours where pipes must be so deeply buried at so great cost. Until the time shall come when under every principal street there shall be an ample subway in which shall be accommodated all pipes for rain water, sewage, gas, condensed air, steam, and all electric wires, surface water, not escaping by the gutters and open mains, must flow into the sewers.

There remains now, the disposal of the sewage; consisting of rain water, foul water and excreta. Here there is room, not for indifference and uncertainty, but for caution and experiment. The plan must be adapted to the climate, and the topography of the city and its environs.

While experimenting with other plans it is perfectly feasible to adopt that of simple subsidence, letting effluent water, impure of course, flow into the river, and carting the sludge to a sufficient distance.

It remains to be determined by experiment whether sewage farming and intermittent filtration through soil, can be depended on where the snow lies for four months, or can be profitably practiced where the lands lie much above the outlets of the sewers. A sandy or porous soil at least, is almost a necessity to these methods.

The cities of Providence, R. I., and Worcester, Mass., after a long and careful study by their engineers of European and and American experiments, have resolved to introduce a chemical precipitation system. The Worcester plant is to cost $300,000, and the annual expense of operating is placed at $22,000.

In my judgment, there should be no delay on the part of our city authorities in observing the results of these New England experiments, and also of those in progress in Chicago and elsewhere, in mechanical filtration.

The ultimate disposal of sludge presents great difficulties, especially during our long and severe winters. It seems probable that some plan of drying will have to be adopted. What one, can only be decided after careful experimentation on the spot.

The plans to be tried would seem to be these:

1. Drying the whole sludge by means of filter presses, centrifugals, blowers and perhaps artificial heat.

2. Drying the whole sludge after mixture with dry earth.

3. Drying only the organic stuff caught in precipitation tanks after the subsidence of mineral matters in settling tanks. In cold weather it might be found necessary to dry this earthy sludge in order to handle it.

As to the value of our sewage sludge for fertilizing, that, too, must await the decision of experiment. Should the dry earth process of defecation be adopted, the stuff can be used over and over until it shall reach any desired degree of richness, and the sale of it would help to pay expenses. If demanded by cultivators, it could be enriched by superphosphates or other chemical manures. It is at this point that the co-operation of enterprising gardeners and fruit growers will be found indispensable.

Let me briefly recapitulate:

An inland city, like Minneapolis, has four kinds of filth to remove and dispose of:

1. Solid matter not excreta, such as sweepings, ashes, dirt, garbage, rubbish, and stable litter.

These must be collected, assorted and carted to convenient centres. Garbage and rubbish and stable litter should be burned, except such stuff as may be taken for manure. Other solids should be in demand for fertilizing and filling low grounds.

2. Rain water, to go off by open gutters and into the common sewers.

3. Excreta.

4. Foul water.

These two to the sewers.

Our four classes reduce then to two:

1. Solid matter, to be cared for above ground.

2. Fluid matter, to go into the sewers below ground.

The fluid sewage must be purified and deodorized, and the water turned off pure enough to enter any decent river. The solid residue must be handled in such of the ways indicated above as experiment shall show to be most efficient and economical.

Meantime we are in Minneapolis lavishing hundreds of thousands of dollars upon a system of sewers planned to empty the liquid filth of a great city into the Mississippi river. It may be we cannot stop where we are, but from this instant our engineering talent should be devoted to such a modification of plans as may render the sewers we are now laying of some use in a system of the future, designed to discharge its contents at some convenient point for purification.

The city will not be allowed to discharge its filth into the Mississippi river indefinitely. Mighty as that stream is, it is not big enough to dilute and deodorize the sewage of a hundred towns and cities seated on its banks and tributaries. The national government will soon be invoked to preserve this great waterway from pollution, or if not, the riparian cities of our own State will soon be knocking at the doors of its capital for protection against the stinks and offal of the dual cities.

It is none too soon to attend to the problem of caring for own filth. We may now handle it at leisure and with composure. If we neglect it, we may be forced suddenly to adopt hasty plans, and expend millions, only to find those plans unsuitable.