### R E P O·R T

OF THE

# CITY CIVIL ENGINEER,

ON THE SUBJECT OF

### SEWERAGE,

## DEER CREEK VALLEY.

PUBLISHED BY ORDER OF THE CITY COUNCIL.

CINCINNATI, MAY, 1851.

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# REPORT.

#### To the Honorable the City Council of Cincinnati.

MR. PRESIDENT AND GENTLEMEN :

By resolution of your honorable body, I am instructed to lay before you my opinions in regard to the Sewerage of Deer Creek Valley, and the best mode of improving the same; keeping in view the general good, and the best interests of this great and growing city.

This is a matter fraught with interest to the citizens of Cincinnati, and it seems to me that the time has now come when the Council, in its corporate capacity, ought to act, and that promptly and energetically, in this matter of Sewerage.

It is well known to every one in the least conversant with the system of Sewerage adopted hitherto in this city, (if system it may be called,) that no general mode or plan of arrangement has been either conceived or carried out, such as will not only be generally conducive to the health of the citizens, by endeavoring to get rid of the deleterious effects of the effluvia arising from our gutters and well-holes, but for the actual and proper drainage of the different levels; so as most effectually to carry off the water from our streets by the simplest, the best and the cheapest known method.

With the permission of your honorable body, I will therefore, first, very briefly, treat on the best and most proper mode of con-

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structing Sewers in the city of Cincinnati, taken in connection with the geological strata, where the said Sewers are necessary; and secondly, by a general view of the topography of the city; shew where and in what direction the different portions of the same ought to be drained.

In the first place, then, where the curve is flat or easy, which should in no case be less than a radius of thirty feet, and where the ground is soft or spongy, I consider the *circular* or barrel Sewer the most approved plan, with a foundation such as is shewn in the annexed figure.— This plan presents the largest



amount of surface on that portion of the structure where the least resistance is afforded; and, where there is considerable fall, it may be generally considered the best for our city. There are, however, cases where it might be considered impolitic, or even impracticable to build a Sewer of this description. I would therefore, in such cases, recommend either of the following plans as good, although differing considerably in their form, appearance, capacity, and expense of construction.



The next is the Oviform: This is shaped like an egg, and built with the smaller end down—the sides of this Sewer form curves of very large radii; and where the ground is firm and solid, it is undoubtedly the best plan for Sewers, as the contained body of water is contracted, and the velocity increased; and also, as the bottom

surface is reduced, there will be less liability to the deposit of sediment in the Sewer.

Another, and a very good plain, has often been used and adopted to advantage, as herein shewn in the annexed plate. This plan is good where there is a sufficiency of depth to admit of its being built; but generally it is more expensive of construction, and also more liable to be affected by outward pressure, or in other words, the sides of the Sewer have less force of resistance than the last plan.

As regards the laying out, or the curvature of Sewers, this matter is

seldom attended to so closely as the importance of the subject The passage of water, or the time occupied by said demands. passage, may be considerably increased or diminished by the radius of the curve; for instance, the proportions will be, (supposing equal falls and equal quantity,) the time to run water on a straight line 90 sec. On a true curve exceeding thirty feet radius - 100 sec. At right angles - 140 sec. It will thus be seen that bad curves contribute, and that in no small degree, to diminish the capacity of a Sewer; and so long as we have curves of Sewers, such as is shewn at the intersection of Court street and the Deer Creek road, for instance; so long will the city shew bad policy in computing the capacity of its Sewers from the amount of water, ascertained by measurement, thrown into them.

Another error which the city authorities of Cincinnati have fallen into, is the nature of the materials used in the construction of Sewers. I should, perhaps, have mentioned this before to your honorable body; but seeing the custom was fully established in building stone Sewers, before I had the honor to hold office, I cared not to interfere; I am, however, decidedly in favor of *brick* as a better material for Sewers, than the soft, rough, lime,



or other calcareous stone we have here. I conceive that good, hard burnt brick, sound and well made, and properly laid, in well compounded mortar, of about one part of good, strong and newly burned Yellow Springs lime, and two parts of clean, sharp sand, with workmanship of the best description, will give a Sewer far preferable to any stone around this city. Let the bricks at the upper or outer edge be laid closely adjoining each other, well bonded, and form an even curvature on the inside and well grouted, and no stone Sewer, hitherto built in Cincinnati, will equal it. If Roman Cement be used, it should be in the proportion of about one-half Cement and one-half clean, sharp, river sand; such as can be obtained in Mill creek, near the Spring Grove Cemetery.

There are many other forms of Sewers I might mention, but the above I consider the best and the most important to be treated on here. In some cities of Europe, and also in this country, where every house is drained into the common Sewers, a great variety of drains are made use of for carrying off the water and the contents of privy vaults, &c., but as they are not contemplated to be used in this city, (for the present at least,) I need not now enter into an analysis of them. I will only say that I consider a good system of Sewerage of this description, one of the greatest blessings this, or any other city can enjoy; and where a fall can be obtained for carrying off the accumulated filth of a great city, no consideration, pecuniary or otherwise, should prevent its being adopted; as the foul fluid matters are thus put out of sight-all gaseous exhaltations prevented, and one of the most effective causes of sickness and pestilence removed. Water running in our gutters, where the fall is slight, often becomes stagnant, and whatever filth may be thrown into the streets by families, (which the regulations of no city can absolutely prevent, and which your subscriber has had ocular and sometimes feeling demonstrations of, in the alley at the side of his office,) soon becomes putrid and injurious to health and life.

If a general system of common Sewerage were adopted, the benefits to our city would be incalculable. Common Sewerage has been objected to on account of the stench arising from traps and other openings; but I can see no difficulty whatever, in effectually preventing any such nuisances by a judicious adoption of the many improvements lately made, some of which I will treat of hereafter.

Let the common Sewers be laid sufficiently low, that all empty lots may be drained by them—let the water, accumulating in the gutters, be let into the Sewer at short distances, and particularly at each intersection; you will thereby get rid of these (at present necessary) deep gutters across the intersections; the side gutters also, by a reduced volume of water being carried along them, might be very materially reduced in depth, thus giving a much higher road bed, and assisting to keep more firmly the curbs in their places, and making also more secure the side-walks, giving altogether a finer appearance to our streets.

As however, I presume, there is no intention on the part of your honors to change materially the mode of Sewerage, at present adopted. I beg to return to the second part of my report, viz: a general view of the topography of the city, and endeavor to show where, according to the present system of drainage, the the superabundant waters might be carried off.

Were it possible to place ourselves in any portion or locality of the city, where we could have a complete view of its general outline, we would find, that the whole area lying east of Vine street, from Sixth street extending northwardly to the ridge, beyond the new Corporation line; thence eastwardly by said ridge to Walnut Hills; thence south by the Observatory to Lock street; thence by Lock, Symmes, Pike, Fourth, Broadway, Fifth, Sycamore and Sixth streets, to the place of beginning, embracing an area of no less than twenty-two millions three hundred thousand square feet; comprises a greater area, or in other words, an area requiring a greater capacity for Sewerage, by nearly onehalf, than the present Deer Creek Sewer is capable of passing or venting.

Allow me next to turn your attention to what is generally termed the Green Street Sewer. The capacity of this Sewer, not exceeding an area of about fifty feet, would present some difficulties in carrying the water westward; I could not therefore, recommend to your honorable body, the accumulation of water at the intersection of Pleasant and Green streets; for, from a careful examination, made by myself, I find that the area, drained by the Sewers under the canal, or in other words, by the Green street and northern Sewers, is equal to about eighteen millions of square feet.

Before proceeding further with my remarks, the question naturally arises, whether the city, in its corporate capacity, has the right or power to divert the waters, or *runs* from their original directions; and also can it be proved, whether waters accumulating at a certain point have been augmented by the improvements adopted by the city, and whether the same runs are old and natural ravines.

To proceed, the area drained by the Linn and Liberty street Sewers, and ravine crossing Dudley, Freeman and other streets, and from thence through the Garrard estate to Mill Creek, is equal, as before stated, to nearly eighteen millions of square feet. From the above facts I deduce the following, to wit: that the area drained and carried into Deer Creek, is entirely too great for the capacity of that Sewer, while the area drained westward might be considerably increased by the areas exhibited of the two Sewers north of Liberty street. It is evident, therefore, to me, that you must adopt one of the following plans:

First. Make arrangements by Sewerage, or otherwise, for carrying off all the water west of Main street, and north of Liberty street; westward to the Green street and northern Sewers, thus easing the Abigail street Sewer, and consequently the Deer Creek Sewer of the large stream of water that is conveyed to it from the hills west of Walnut street produced; then construct another Sewer from Court street down Main street to the Ohio river, of sufficient capacity to admit of the contents of lateral drains at some future day. By this means you divert the waters of Court street Sewer, and thus give abundance of scope for the capricious play of the bloody and stinking waters of Deer Creek. Second. Either pull down the old Sewer in Deer Creek Valley, and re-build it of a dimension not less than of an area equal to about 200 square feet, or,

**Third.** Build another along side of the old one; this latter plan is objectionable in many respects; you have to get the right of way for your new Sewer; you have to go to a very great expense in excavation and refilling, as the valley is now in several places some eighteen or twenty feet above the top of the Sewer, and you have also to "foot the bill" for damages on private property, by breaking up the old Sewer where houses are built directly above it.

Fourth. Commence another Sewer sufficiently far north, in Deer Creek Valley, as will be sufficient to receive the waters of the side hills; say commence at the ravine near the intersection of the Deer Creek and Montgomery roads; running thence southward along the eastern slope of the hills, until it strike the north end of east Sixth street; thence along said street and the hill side, wherever a good grade can be obtained, to Lock street; thence southward by Lock street, &c., to the Ohio river; this mode of disposing of the water east of Deer Creek, would effectually get rid of the difficulties at present existing in the old Sewer.

In regard to the improvement of the valley, I would recommend and say, that the improvement of Deer Creek, and the interests of not only the property holders, but the public at large, would be more beneficially subserved by commencing the grade of the Deer Creek road at the present level of the said road and the Montgomery road, where the same intersect each other, and descending southward at such grade as shall effectually carry off the waters accumulating in the gutters, until it reach Court street, at about one hundred feet east of Broadway; this would give a grade of one degree. Such a grade as this, the city ought to adopt, if it intend to improve Deer Creek Valley. This grade will be about fifty-five feet above the present grade at "Schooley's Pork House," or at the intersection of east Eighth, State street and the present Deer Creek road. One word in reference to east Eighth street; if Clark Williams, Esq., had shewn his usual sagacity in saving a few feet of his ground on said street, before it reached Hopper, Wood and Miles' subdivision, there would have been no such difficulty as *now* exists in connecting that street with the Deer Creek road.

A Sewer would thus have to be constructed along the entire valley of about eight feet in diameter, or at least running northward to within two or three hundred feet of the junction of the Lebanon and Montgomery turnpikes. This Sewer will cost about \$3 00 per foot lineal, or about \$12,000 00 for the whole Sewer; of this expense I presume, from the location of the road, the property holders would have to pay about four-fifths, so that only about \$2,400 00 would be taxed on the grand levy for the improvement of the entire valley. I consider this Sewer of a sufficient capacity, no matter which of the plans herein described you may adopt; as it appears to me, there should be a general direction in proportioning the parts as well as the whole Sewer-And where the fall is considerable, and the velocity consequently increased, the Sewers may be built something in the shape of an inverted telescope, growing less as they advance, instead of greater; or, to illustrate more fully, that the united waters of Deer Creek proper, and the Abigail street Sewer, might be conducted into one, (not the present one however,) whose sectional area is not equal to either of them. In the course of a few years by opening quarries on the side hills, and letting them out to quarrymen, the refuse or soil would be hauled into the valley, for the consideration of selling the stone; and even, were the city to be put to a very considerable expense, either in damages or cost of construction, I should consider it a profitable investment, as the enhanced value of the property for taxation will be thereby largely increased.

Fifth. If neither of these plans suit your honorable body, try the system of common Sewerage, and let a special rate be levied on the property improved, and where not improved, put that rate on the grand levy. Let the large, or principal Sewers be constructed at the expense of the city; say, for instance, one running south under each street—I conceive the expense will not exceed \$2 00 per lineal foot, for a good circular brick Sewer, about two and a half or three feet in diameter. The property holders benefitted by common Sewers, might be assessed on each street, in the following manner: apportion this private charge, or special rate, if you please to term it, by a kind of compound consideration of the value of the house and lot in the assessor's book, and number of entries of the owners thereof, where the same may be built upon and improved; where it is not so improved, let the city take to itself the cost, so as to relieve the actual occupants, with the certainty of being able to indemnify itself in process of time by future entries.

Let the common Sewer be laid as low as possible, and then if any individual should see proper to build his cellar below the level of the Sewer, let him take the consequences, or otherwise re-build the city Sewer, (if too high,) between his own property and the river.

I mentioned in my report, that common Sewers of two and a half or three feet in diameter, were sufficiently large for all the purposes of drainage; this, however, is too small to admit of a full grown man to clean them out, should such become necessary. To overcome this difficulty, I would propose to construct cesspools at certain distances to be regulated by the fall. These cesspools should be of a regular form, and connected with the Sewer by an outlet on the surface, so guarded by stone curbs. and an oak or stone covering, that no danger whatever, negdlabe apprehended, wherever it might be located. Let the bottom of these cesspools be lower, by some three or four feet, than the bottom of the Sewer, and of sufficient capacity to receive all the filth or sediment likely to accumlate during a whole winter season; after which, let the top be opened, the cesspools cleaned out, the covering replaced, and thus you have your Sewer cleaned out without the expense of a single dollar, other than the wages of your workmen.

In treating of cesspools, it might perhaps be well and proper to explain a little more fully their utility. They are intended to receive the filth of the Sewer from the different dwelling houses; which filth, thus becomes a deposit at the bottom of the cesspool. By opening the covering or platform in the street, immediately above it, this deposit can be removed at pleasure; and thus the necessity of ever breaking up the highway is obviated; without this, the streets would be continually interrupted by digging up for the purpose of cleaning the drains which might become choked, thereby greatly increasing the expense in replacing the pavement, and the frequent repairs of the streets rendered necessary by breaking the arch of the pavement, and occasioning their becoming loose, an evil to be avoided by all means if possible—an illustration of which we all have on those streets, broken by the Gas and Water companies, no matter how well they may have been repaired or repaved; the street, particularly, if paved with bolder stone, is utterly ruined by it. This plan, however, is only necessary where the fall is very slight, and would scarcely be considered necessary in any portion of our city.

To treat more fully on the subject of Sewerage in Cincinnati, than I have endeavored to do in this report, would take any Engineer a long, long time, even years, to state particularly where the water of each gutter ought to run, and how far, before it enters a Sewer. The streets of this city are so strangely located, and the grades so mixed up with each other, that no one can possibly fathom them, or keep any idea of them in his mind's eventyhile writing, so as to be able to report positively on the hest grades. Allow me to say, however, that the grade of Deer Creek, in my opinion, can not be carried too high; that it ought to be sufficiently elevated to admit of a good grade for a street, from east Sixth street westward, at right angles across the valley to Hunt street, a thoroughfare which you are all well aware is much needed, particularly since East Sixth street has been shut up.-Had I the whole municipal power in my hands, I should open up a street from Accommodation street, from a point some ten or twelve feet north of the north line of Hopper, Wood and Miles' subdivision, where the same strikes the Deer Creek road, to the Lebanon road, and let the proprietors, holding property on East Eighth street, take the consequences of their stubbornness. I

would then construct a small branch Sewer, if necessary, to carry off the water accumulating in the gutters of Eighth street, south of said Hopper, Wood and Miles' subdivision, into the main Sewer in Deer Creek, if needs be at valuation.

Should the proposed grade of the Deer Creek road, as I before recommended, be elevated above the grade as now established of Dublin street, the difficulty might be easily overcome, by running a small branch Sewer, from the intersection of Dublin and Court streets produced, to Deer Creek; the expense, if any, will be comparatively small.

This proposed elevation of the street, at the Hepworth and and Hunt property, would also benefit the grade of the street proposed by Conkling and others, as an extension of Pendleton street, from Hunt street to Eighth Street, or at least from Hunt street to Deer Creek.

I had not intended in this report, to enter into any lengthened detail of the various systems and plans of the best construction of well-holes, &c., but as it has been already carried to a greater length than I originally intended, it may not be amiss to add a little more in reference to this important matter.

I, therefore, lay before you one or two plans invented by your subscriber, together with a plan of one which has long been in use; in various cities of this country.

I would here state to your honors, that I spent several years in London and vicinity, as an Engineer, and that I was slightly acquainted with the general topography and the drainage of that city; I have examined closely the several latest modes of constructing well holes, but many of them appearing to me unsatis-



factory, I have laid before you the following sketches, which will shew at a glance, the improvements intended, to prevent the spread of the effluvia from well-holes or other openings. Plan A. shews a cross section of the Sewer and well-hole; in this case, the stench is prevented by the adoption of what I would term the hanging valve; this plan shews the whole intention of the improvement sought: A is the plate or cover of the wellhole, B the gutter, C the dripstone, D the metal hanging plate, E the hinges, F the Sewer.

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You serve that in this case a good deal depends upon the weight of the plate, its angle of inclination, and the weight and velocity of the body of water brought to bear upon; it may be so constructed, that a gallon of water will open it, or it may, on



the other hand, be so made that the gutter would be ready to overflow before the valve would open to receive the water; these calculations, however, are not necessary either in, or accompanying this report, but if either of the plans I suggest should be adopted, I am ready to enter into them at the proper time.

The next plan, B, I woud beg to call your attention to, and which is also my own, is the chain or suspension valve. A description of this is scarcely necessary, after taking a look at the annexed. figure; in the plate A covering the well-hole, is fixed an iron sheaveblock B, over which runs a chain connected with the valve plate C, at the end of this chain



is attached a weight E, more than sufficient to keep the plate C in a horizontal position; this plate being air tight, cannot, of course, be opened until a sufficient amount of water fall into the well-hole to overcome the preponderating weight of E, and then will open only in exact proportion to the amount of water, the volume of which will exactly fill the opening, be the same more or less.

In common Sewerage I would remark, that the great importance of having every drain that enters a dwelling house secured by an air trap may be conceived, from the fact that the focial or foul air emitted from the common Sewer must necessarily be very considerable, how much, I am not at present able to say, but it is certainly sufficient to injure the health of those constantly exposed to its effects. Fig. 1.

I, therefore, lay before you, two kinds of traps, suitable for domestic use, the action of which needs little or no explanation; that represented in figure 1, which is commonly used in Sewers in London, is made of metal, and is used



in sinks; the apparatus being fitted into the stone so as to be flush with its upper surface. The grating to which the inverted cup that acts, as a different valve is attached, may be screwed out when necessary, in order to cleanse the trap. The water, after passing under the edge of the dipping valve, and rising to the top of the vertical pipe, runs off through it to the drain, as shewn in the annexed plate.

The second plan, figure 2, is copied from an English work on mechanics. This trap is adapted for insertion in kitchen floors, it may be made of brick cemented together, or of metal at the pleasure of the owner, in either case it would occupy but a comparatively small space.



Sewers in general, from their peculiar situation and usc, are more difficult to examine and repair than any other structures of brick or stone, while a defect may be productive of very serious injury before it attracts notice; it is especially desirable that they should be constructed in the most perfect and durable manner; while the necessity for providing for the passage of water from existing branches, and from such as may be constructed at a future time, requires great care in adjusting the dimensions, grades, and levels.

I have thus endeavored to lay before you, as directed, my views generally, on the improvement of the Deer Creek Valley, and the Sewerage of the city, and before concluding, it may not be amiss, as it would affect the system of Sewerage, to say a few words in reference to the location of the Ohio canal, within the limits of the city. It is of no consequence now, by whom or by what authority, the present canal level, as it runs through our city, from the Corporation line to Broadway, was first established, but this I know, that it injures, in no slight degree, the interests of Cincinnati, and if not too late, it ought, by legislative enactment, or otherwise to be changed. What I complain of, is, that the surface of the canal is altogether too high for the general level of the ground on each side of it, through almost the whole city, lying between the above mentioned points.

I would ask your honorable body, whether it would not have been much better to have constructed a lower level by building the Lock now at the intersection of Court street and Broadway, somewhere near or beyond the Brighton House, thereby reducing the height of the canal throughout the whole of that space, and thus getting rid of the difficulties of steep grades on the streets crossing the canal, necessarily made so by the high level; we would thus have north and south Canal streets on a level, nearly, with Sycamore, Main, Walnut, Vine, Race, Elm and Plum streets, and what is of more importance still, we would then be enabled to reduce the very steep grades of Twelfth, Everett, Liberty, Findlay and Mohawk Bridge approaches; just picture to yourselves the advantages derived, to say nothing of its beauty, by crossing at each street without changing the grade and having the canal spanned at each crossing, by a handsome stone structure, instead of the miserable ten degree grades, and wooden bridges now in existence.

I am well aware that the change of the location, or rather, of the formation of a canal, is attended with considerable difficulty, and all the talent of the Engineer is called forth to overcome it, but although they may at first sight appear almost insurmountable, patience coupled with perseverence, and a careful investigation of the case will generally overcome all obstacles.

As I before stated, I had another object in view when speaking of the present level of the canal, and it was this, supposing your honorable body were at any future time to adopt any system of Sewerage requiring Sewers under the canal, the lowering of the same, while it would slightly increase the expense in Sewers running south, would on the other hand, be of immense benefit to the great northern and western drainage of the city, for even at the present time, there are portions of our streets where it is with the greatest difficulty imaginable we can get any fall at all, to the present Sewers under the canal. I need not remind your honors, that drainage is among the most important operations of the Engineer; the health, the cleanliness, and general salubrity of the atmosphere of a great city like this, will always depend in a great measure upon the manner its superfluous waters may be best conducted from the gutters of our streets and the surface generally.

Hoping the above remarks may be of some service.

The Tree Stars St.

I am, Gentlemen,

Very respectfully, &c., JAMES STEWART, City Civil Engineer.