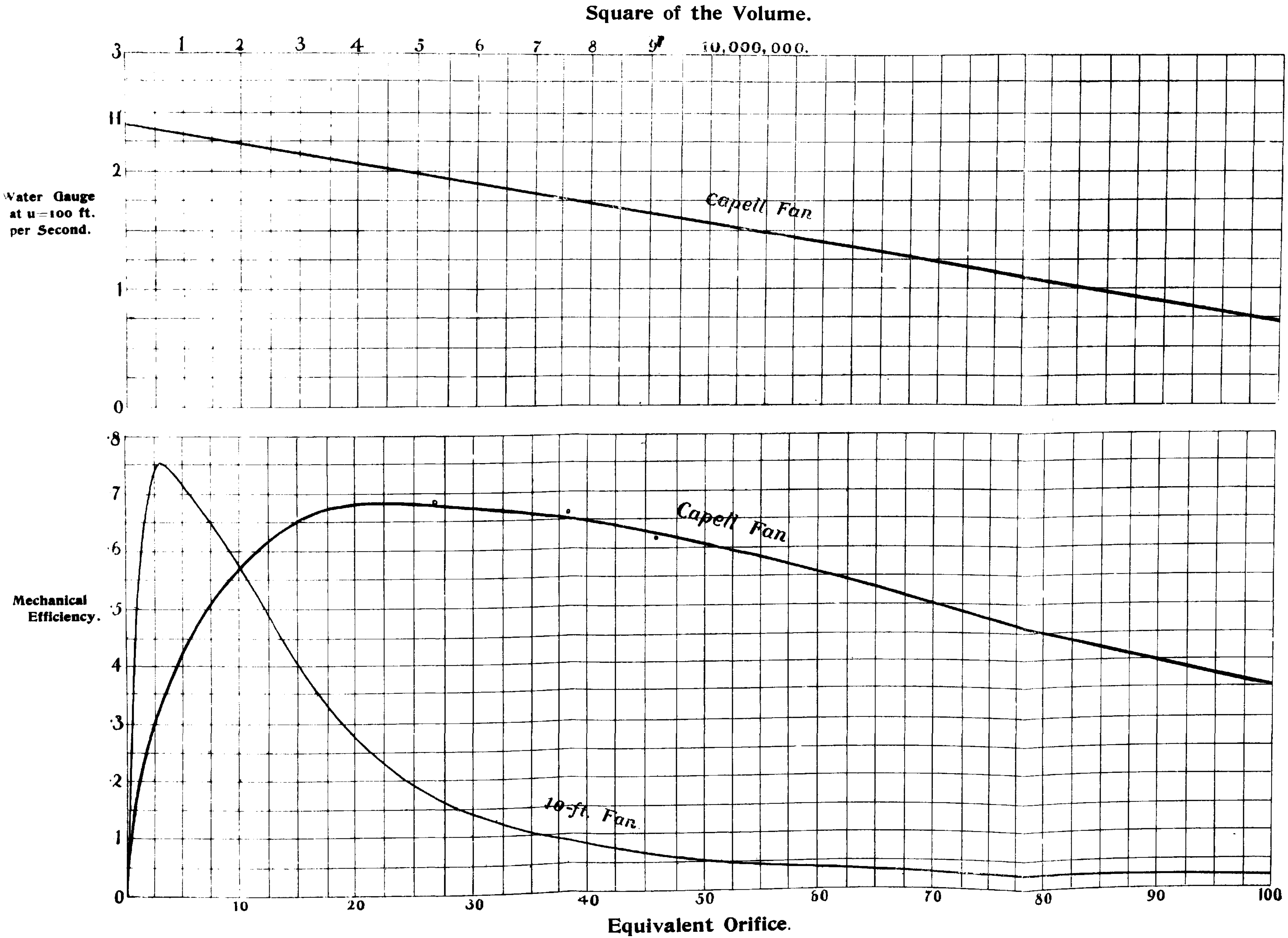
SEWERAGE, DRAINAGE AND WATER SUPPLY.

BY PROF. F. W. SPERR.

The principal objects of sewerage are to keep our houses, outbuildings and streets clean, carry off storm water, and drain the ground on which we live. The sewers must be made tight so as not to contaminate the soil; and smooth on the inside so as not to accumulate decaying matter and breed disease. The drainage could be accomplished with a system of tight sewers, by laying underdrains with proper outlets. Underdrains are often necessary in the construction of sewers to keep the trench free from water. A thing that we now hear of frequently where there are springs and valuable supplies of water is that these are drained off through leaky sewers. If the sewers were made tight and the sub-soil drainage managed with a view of preserving the water supplies, the system would be very nearly perfect. There is a method of sub-drainage practiced in this city, for which little good can be said, I refer to the method of laying a few courses of the outer ring of a brick sewer, in the bottom of the invert, without mortar. This weakens the sewer and gives but inefficient drainage. There seems to be some trouble experienced in this city, with the bursting of sewers. And I know of one large sewer which probably wilt never burst, but simply fall apart. This is the Indianola sewer across the State University flats. This sewer has been recently built, and already has a crack exteuding along the top for about 1000 feet. The sewer appears buckling on the shoulders iu places. Of course it has only two rings at the bottom to break open. The outer ring at the bottom is laid without cement. The crown of the arch has dropped dowu about three inches perhaps, and the ring has been shoved out about an inch each way at the spring line. Now, almost any yielding material will give that much without any force upon it at all, except its own weight. It perhaps was not tamped very hard when the back filling was put in and that will allow it to spread somewhat. In some places the excavation I believe commenced below the spring line of the sewer. The sewer is built almost on top of the ground, then the


Square of the Volume.
1 2 3 4 5 6 7 8 9 10,000,000.
Water Gauge at u=100 ft. per Second.
Capell Fan
Mechanical Efficiency.
Capell Fan
10-ft. Fan
10 20 30 40 50 60 70 80 90 100
Equivalent Orifice.

back filling put in. If the break is at the spring line, the opening will be greater at the bottom and at the top; and the contraction beaween the top and bottom will be abont six inches and a thrust to right and left of about the same. There would be an elongation traversely of about six inches. That would necessitate a thrust at the spring line of about three iuches. Probably however there is not so much thrust at the spring line. I wish to emphasize this point, because it is usually supposed that sewers break in at the top because they are not well rammed at the spring line. That is not necessarily the case. A very little giving at the spring line will allow the upper segments to come in. Then the break is at some place higher up than the spring line.

When this sewer was constructed, it was built across a flat plane west of Neil Avenue on the University grounds. The bottom of the sewer is considesably below the bottom of the springs. As soon as the excavation reached the gravel, the water all dropped out of the springs. It began to drain the springs a little when it entered the boulders and quicksand.

But, when they reached the gravel, the bottom literally dropped out of the springs and great consternation seized all parties concerned except the contraotor. He was only in a hurry to get through and get the work in, thinking that if he succeeded in doing so, everything would be all right and nothing could be done, as is generally the case. He was attempting to lay brick in the water about a foot and a half in depth in his trench and he was throwing in brick and cement in the water and trying to hold the brick together until they could get the three rings in and then build along up. He was stopped however by the city engineer, and then various schemes were suggested by which the leakage of the water from the springs might be prevented. They tried putting rings around the sewer, consisting of an extra course of brick, thinking that by putting these rings around a pipe laid in perfectly loose gravel, it would prevent the water from going through the gravel. A lot of good cement was also wasted in ramming it into the gravel. Little excavations would be made and cement rammed in to keep the water from coming in, and a year afterwards, when they were attempting to repair the bad work, they still thought they could prevent the water from running around a plug in the loose gravel. It seems impossible for them to understand the condition of things, and much time some money was of course wasted there in the attempt to accomplish the impossible. Then again, going on eastward, other clay deposits and gravel deposits were discovered and in some places the whole trench was gravel. After the construction was stopped at a point about opposite the springs, I was asked to undertake the construction from there to High Street. Although a very defective piece of work was already in, I undertook to build the sewer from there to High Street, according to the specifications which were intended to secure a tight sewer. It was with some difficulty that I succeeded in accomplishing the object. The bricklayers were in the habit of doing their work in a slovenly manner, and had to be watched every minute of the time, I looked after the bricklayers myself and employed assistants to watch the cement box and the sorting of the bricks. After the section was completed to High Street, it was proposed to take up and reconstruct the defective work referred to, so as to make the water take its old course through the springs. The Board of Public Works of the City of Columbus ordered the City Engineer to take it up and reconstruct it last February. About the 1st of the following October he commenced the work and proposed to take out and replace the two inner rings up to the spring line, thinking that it would make the sewer tight and that the water supply at that place would not be destroyed by the sewer. I contended that it would probably prove a failure, but the attempt was made. The two inner rings were taken out nearly to the spring line. The outer brick, where they were found in loose, were also taken up and replaced for a distance of about 65 feet. When that had been done, the water rose in the springs and commenced to flow over in the lower one. It has not flowed over in the upper one. Beyond the 65 feet repaired, there were also a large number of leaks which had been rammed full of toe, rags, etc., which are now rotting out, as they were not even tarred. The spring is again subsiding. Of course the water is going into the sewer. There are about 25 cubic feet of water a minute running into the bottom of that sewer in ordinary times.

It was also contended that the water would find its way along the pipe of the sewer, and that to prevent this, it would be necessary to construct a bulkhead of greater or less size to keep the water from running along the pipe of the sewer. But where a sewer or any other pipe is laid in a well-formed bottom of clay, and the brick are laid in, cemented against the clay, no water will follow that sewer.

Sewers with open joints have been recommended to drain the subsoil. There is then at least something to be said for the ordinary sewer that leaks. It provides drainage, but an intercepting sewer, like ours, which laid along the river front and below the level of low water in the river, ought not to leak. Observations were made December 22nd, 1892. Along the line of this sewer there had been a deficiency in rainfall for four months. For about three months the deficiency was about 50 per cent. and almost as large in December. There had not been any rain for some time before these observations were made. At the northermost point, near North Columbus, there was a little water in the bottom of the sewer, but no current. At Northwood avenue, about 800 feet south of there, a little more water and a slight current. At Frambes avenue, just north of the University grounds, a little more water and a little current. On the University grounds, where the Indianola sewer crosses the intercepting sewer, the flow was about 26½ cubic feet per minute. At Sixth avenue, 7,900 feet from the first point, the flow had increased to 39½ cubic ft.

[A MEMBER: That is below the springs, is it not?

PROF. SPERR: This is the intercepting sewer. It has no connection with the springs. The sewer which destroys the spring is the Indianola sewer, which is a trunk sewer, a storm water sewer, coming across from the east and draining quite an area of country and running across the University grounds.] At Fourth avenue, a thousand feet further south, the flow had increased to 40½ cubic feet per minute. At Buttles avenue, 11900 feet from the first point, the flow was 59 cubic feet per minute. I should have said that the water at Fourth avenue in the river was a foot and a half higher than the water in the sewer. At Buttles avenue the water in the river was 2.4 higher than the water in the sewer. At Hayden's rolling mill, just north of the railroad crossing, the flow had increased to 62 feet per minute. That is a distance of 13900 feet from the first point of observation. At Dublin avenue, 17300 feet from the first point, the flow had increased to 70.3 cubic feet per minute. Here I went down into the manhole the same as at other points above and I went through the sewer to the next manhole and about 100 feet beyond it. I don't know the exact distance, but it is perhaps seven or eight hundred feet. I marked it provisionally 18200 feet from the first point. The flow had increased in that distance of about eight or nine hundred feet, to 84¾ cubic feet per minute. Back of the Neil House I went down another manhole, and followed through the sewer to State street. The water was running in quite freely. Here water in the river was about four and a half feet above the water in the sewer. Then below that the Peters Run sewer comes in and empties its sewerage into the intercepting sewer. Altogether there was a flow of about 320.4 cubic feet per minute. The sewer goes under the canal, so that by the time it reaches the river it is considerably below the river. It rises in a large manhole, and flows over into the river. The calculated leakage flow at the river will be about 236 cubic feet per minute, and if this has to be pumped, it will cost over $1,000 per year to pump it 25 feet high for fuel alone, and this is considerably below the average dry weather leakage. It will take more extended observations to show just what the average dry weather leakage will be. The flow at the mouth of the Indianola sewer at this time was about 25½ cubic feet per minute.

THE CHAIR: Gentlemen, you have heard the paper. Now, is there any discussion on it? Does any member of the Institute want to discuss the paper?

SECRETARY HASELTINE: I would like to ask Prof. Sperr if that portion of the sewer through the University grounds in which the water supply of the springs has been cut off, was laid in sewer pipe of equal size, would it not withstand the water and allow the springs to flow uninterrupted?

PROF. SPERR: It is the experience of engineers that a pipe over 18 inches — in fact, over 16 inches in diameter, is not safe, and that vitrified pipe cannot be made so that they will be safe. There is no good reason why a brick sewer can not be made absolutely water-tight and safe.

From the springs to High street the Indianola sewer is tight. Now, if one section can be built tight, why cannot all sections be built tight? All it needs is honest construction and honest supervision.

A MEMBER: In this flow of water in this chart that you have given us, is not a portion of that sewerage coming from tiling:

PROF. SPERR: No sir. There are no sewers emptying into that intercepting sewer until the Peters Run sewer comes in. Between Capital alley and State street, the water was not coming in much above the spring line at the time I was through there, and it showed plainly that when the water was high enough in the river it did come in all around the top. With the ordinary flow in the river, the pressure from the bottom would be greater and increase the flow from the holes through which it flows now and find addititional holes through which to leak. I believe this sewer might have been built so as not to leak, because I saw some sections which are well built, the joints are good and the centers perfect; but a little beyond, t e work would be of the slipshod order. Now I cannot see why they could not do good work right along.

SECRETARY HASELTINE: They had no surface water to contend with at the university.

PROF. SPERR: Yes sir, they had the whole river to contend with.

SECRETARY HASELTINE: All the time?

PROF. SPERR: Yes sir, all the time. But why should it prevent their building the sewer in a proper manner part of the way and not all the way? It can be built in a perfect manner and the water be kept out of the trench. It is never necessary in a case of this kind to have water in the trench. It can be taken care of and should be taken care of.

A MEMBER: Professor, did I understand you to say that the sewer at the University grounds was draining the springs there?

PROF. SPERR: Yes sir.

A MEMBER: How did you get that stopped?

PROF. SPERR: The springs flow out at a level near the top level of the sewer. There is about five and a half or six feet of head to force the water into the bottom of the sewer. It required some head of course to force the water through the openings before the repairs were made. When two of the rings were taken up and relaid, it made the leakage enough less that it requires a head equal to the top of the springs to force the water through the holes which still exist. And if the work had been perfectly done, there would be no leaks for the water to go through, and the water would have to run out through its natural channels the same as before the sewer was built; and the springs would flow much stronger.

SECRETARY HASELTINE: If the building of the city continues in the vicinity of the Ohio State University, will it not be the case that in a few years the ground will become so filled with impurities as to render that water unwholesome and destroy its use for domestic purposes?

PROF. SPERR: Therein lies the criminality of our method of sewering. It unnecessarily destroys our water supplies. All the sewers in our houses that carry foul matter should be absolutely tight and convey their matter to the intercepting sewer, and from there on to the point of disposal. We should have no foul matter from houses going into the soil, but have it carried off in perfectly tight sewers. If that were done, it would be a long time, if ever, before this stratum of gravel would become contaminated.

SECRETARY HASELTINE: Then you advocate dispensing with cesspools entirely.

PROF. SPERR: I certainly do.

SECRETARY HASELTINE: Well, that is not the case in North Columbus, is it?

PROF. SPERR: No sir, it is not. With our present system everything will be contaminated. And in the east end, if the source of the water supply ever is built upon, where the water for Columbus is to come from will be a more serious question.

SECRETARY HASELTINE: Well, I understand that our water supply at present comes from a large gravel bed pierced with large wells in the vicinity of Alum Creek. Am I right about that?

PROF. SPERR: I believe so.

SECRETARY HASELTINE: Well now, if that is the case and they are getting such a strong flow of water, and if in that vicinity a portion of the city is built, in which cesspools are constructed, percolating through the soil, will not that water become contaminated and unfit for use in the city?

PROF. SPERR: It most certainly will, and, if any epidemic break out, we shall all still have to drink the water.

A MEMBER: Professor, do I understand that they had some difficulties in putting this intercepting sewer through in parts of it, on account of so much water to contend with? Did they ever build that part of it?

PROF. SPERR: It is now all completed.

A MEMBER: What kind of material did they use for the underground part of it?

PROF. SPERR: Brick. It is a brick sewer throughout. It was generally open trench work with very little tunneling necessary.

THE CHAIR: Well, it seems that this paper has been better understood by the discussion than by the reading of it and that is the glory of our Institute. When we can't do something one way we will do it the other. Now is there any more discussion on this paper.

SECRETARY HASELTINE: I move a vote of thanks be tendered Prof. Sperr for his paper.

The motion being seconded was unanimously adopted.

THE CHAIR: Now we will get a paper from ex-District Mine Inspector William B. Rennie, of New Philadelphia. The Subject is, "Miners' Sunshine and its Uses."

MR. RENNIE. I am not prepared at present to read my paper.

THE CHAIR: Well, we will call upon Exdistrict Mine Inspector James W. Haughee, of Nelsonville, Ohio, on the subject, "A Standard Grade of Powder Necessary for Mines."