SEWER MAINTENANCE*

By GRANT M. OLEWILER

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Q. 1. What is the nature and extent of the sewer system of Lower Merion Township?

A. 1. The sanitary sewer system of Lower Merion Township consists of 119.89 miles of sewers serving a territory of about 12 square miles. This represents about 50 per cent of the area of the Township, but the system serves about 90 per cent of the population, which was 35,000 at the time of the 1930 census, and is now estimated at 40,000. Pipe is of vitrified clay or cast iron, with joints of cement or lead. Except for the intercepting sewers, the pipe is 8 in. inside diameter. Intercepting sewers vary from 10 to 24 in. There are slightly over 3,100 manholes in the system.

Q. 2. What is the nature of the maintenance work on the sewer system?

A. 2. Maintenance of the sewer system consists of: (1) flushing the entire system, progressively, once a year; (2) cleaning of sewers found to be flowing in a sluggish manner, or subject to root growth, by dragging; (3) setting manhole tops to new grades established by road construction or regrading of private property; (4) cleaning screen chambers and collecting wells at the sewage pumping stations; (5) replacing handles in manhole lids; (6) repairing and replacing buckets placed under ventilating lids to catch sand and road stone, which would otherwise enter the sewer in times of storm; (7) re-distributing ventilating lids to provide better ventilation for the system as well as to overcome complaints of odors; (8) placing asphaltic or asbestos gaskets under lids which have become noisy; (9) building channels where the old ones have become eroded or were not constructed properly; (10) removing stoppages and investigating reports of stoppages; (11) building new manholes where it is found that the interval between manholes is too great for proper maintenance; and (12) making general repairs or replacing pipe in places where the sewer has been broken by external forces.

Q. 3. How is flushing accomplished and why is it necessary?

A. 3. Flushing of the sewer system is accomplished by discharging the contents of a 625 gallon steel tank, mounted on a truck, directly into manholes through a six inch vertical gate valve. The water discharges so rapidly that it entirely fills the outlet pipe and provides a strong flow of water which will thoroughly

clean an 8 in. pipe of grease or other light sediment for a distance of from 500 to 800 feet, depending upon the grade of the pipe. As a minimum grade of .005 has been established and enforced for 8 in. pipe in this Township, and very few of the branch sewers have a depth of flow of more than 1 1/2 in., the purpose of flushing is to remove a film which grows from the sides of the pipe, and other light sediment, rather than to clean the pipe of sand or stones, because they are taken out by dragging.

Q. 4. *What experience have you had in obtaining water for flushing, and what is the present cost of water?*

A. 4. Water for flushing was formerly purchased from a private water company, at a cost of 40 cents per thousand gallons, plus a standby charge of $85 per year for each point where a 2 in. water service was run to a manhole, to provide a place from which water could be obtained. Use of fire plugs, except at a high rate of charge, is prohibited. As the cost of water seemed out of reason, a gasoline-driven self priming pump with 2 in. suction hose was purchased at a cost of $195, placed on the truck, and connected with the tank. Water was then pumped from creeks in the various localities. This provided more places for obtaining water than were available from the five Water Company plugs, and cost less than half of former charges, even for the first year, when the cost of the pump was included. Since that time, the cost of the water, consisting of cost of gasoline, oil and grease, repairs and depreciation of pump, and new suction hose has been about $65 per year.

Q. 5. *What is the organization of the flushing crew?*

A. 5. The flushing crew is made up of one truck driver, one foreman, who has worked upon the system for about fifteen years and is thoroughly familiar with it, and one laborer to help open manhole lids, and observe flows.

Q. 6. *What plan is followed in this work?*

A. 6. Each watershed is taken separately. The branch line entering the trunk sewer nearest to the outlet is flushed first by emptying water into the dead end manhole, or such other manholes as the length of the line requires. The branch next higher is then flushed, and so on until the entire watershed has been covered. All manholes in the path of the flow from any point of discharge are first opened to inspect the condition of the channel, or any backing of sewage into the manhole, before water is emptied into the higher manhole. Experience has taught that this is essential because many sticks, stones and other materials that might lodge in the pipe have been found during this preliminary inspection, and were removed before the flow of water carried them on. The only exception to this procedure is in the case of the larger trunk sewers, where the distance between branches is so great that the truck would be held up
to await the arrival of the other men. These lines are patrolled upon completion of the flushing in each watershed. While the inspection is being made, the truck driver has gone to the nearest creek, filled the tank with water, and returned to the next manhole indicated by the foreman. This operation is then repeated until the system is flushed. Separate loads of water are not discharged into trunk sewers above 12 in. diameter, as the amount of water held in the tank and discharged through a 6 in. valve would not increase the depth of flow and velocity sufficiently to justify the operation, especially since the flows in the larger sewers have sufficient velocity to carry most of the material which gets into them, and also have the benefit of all the loads of water dumped into the branch sewers.

The original method of flushing was to begin at the highest point, and work down the sewer system. This was discarded in favor of working up the system, because of the two-fold washing effect where branches intercepted. While this choice may be with the Superintendent of Maintenance, the major requirement is to adopt a system, and follow it. Daily records are kept, showing the areas covered.

Q. 7. What is the total cost of the work, and how does this compare with costs in the past?

A. 7. The cost of flushing the system in 1936, was $693.00, itemized as follows:

Wages of Men, 34 1/2 Days .................. $400.20
Supervision by Superintendent .................. 81.75
Cost of Truck, Insurance, Depreciation, Gasoline, and Oil ...... 176.53
Cost of Pumping, Repairs, Supplies and Depreciation on Pump ...... 64.91

This is equivalent to a cost of $5.89 per mile of sewer, and compares with $6.88 in 1935, $12.08 in 1932, and $18.95 in 1922, before pumping our own water.

Q. 8. How is the inspection made, during flushing, of value for other work?

A. 8. As flushing progresses, notes are made of sections of sewer where the water will not run off properly; manholes where the channels are in bad shape, or manholes which have been covered by grading. Any missing manhole lid handles, and those about to break, are replaced by new ones.

Q. 9. How do you care for the flow while channels, found to be defective when inspected while flushing, are being rebuilt?

A. 9. Upon completion of flushing, those channels which were found to need attention are reconstructed. In cases where the flow of sewage is small, sewage is kept away from the work by inserting expanding rubber plugs in the pipes entering the manhole until the new channel is formed, and then passing the flow over light sheet iron forms or over other material, until the cement-concrete has had a chance to harden. In cases where the normal flow is heavy; as in intercepting lines, it has been
found necessary to do this work between midnight and eight o’clock A.M., when the flow is only a small fraction of daytime volume.

Q. 10. What work is done next?
A. 10. Manhole tops covered, or exposed by grading operations, are then raised or lowered to conform to the new grades.

Q. 11. Who raises or lowers the manhole tops when roads are being regraded and reconstructed, and what has been your experience with this work?
A. 11. In order to insure the proper placing of manhole tops, the Sewer Department insists that all raising or lowering be done by our repair force. This procedure was established when inspection in connection with flashing showed that, when the work was done by road contractors, no care was taken in raising or lowering manhole tops, and the lids were raised on rough stone, or anything else that happened to be handy. As this material was not properly bound with cement, it was soon dislodged by traffic and fell into the sewer, not only providing causes for stoppages, but also causing the top to settle, with the result that the new roadway would have to be cut to raise the manhole top. In cases where the road was lowered, the new top of brickwork would come through the crown of the manhole, where the diameter was considerably larger than the inside of the manhole frame, with the result that the frame would only have a small bearing on brickwork, and that would be on the overhanging portion of the brick; some lids were found to have been suspended on reinforcing irons. Under construction by our own force, changes in height of more than several courses of brick make necessary tearing out of the crown, and rebuilding of the manhole wall. All changes are made with the use of brick masonry.

Q. 12. What method have you adopted to exclude road material from the sewer while roads are being reconstructed?
A. 12. When a road surface is to be reconstructed, the bottoms of the manholes are covered with boards to keep out as much debris as possible. This is necessary, because the first thing which happens is that the power shovel lifts the manhole top, together with other road surface, and into the manhole goes about half a yard of road surface, stone and dirt. If someone is there to enforce it, an attempt is made to clean out the manhole, but if it were not for the false bottom, a considerable quantity would go down the pipe. The frame is then replaced over the hole, not fastened, and as each of the line of trucks passes by, it is given a nudge, and more dirt goes to the bottom. When the road is ready to be sub-graded, the manholes are rebuilt to bring the top to the grade elevation, but again, unless a close watch is kept, trucks or graders will knock it off. The final danger is passed if you are successful in having the base course
rolled without moving the lid, where a two-course road is con-
structed, or get the concrete finishing machine past the man-
hole without moving the lid, or in some cases, where the in-
spector insists on finishing the road with the manhole lids
removed, in keeping the concrete from entering the manhole.
Upon completion of the paving, the false bottoms must be re-
moved, together with as much of the debris as possible. The
sewer line is then cleaned by dragging to insure a clean sewer,
and to avoid telephone calls in the middle of the night, on
Sunday or holidays, as it seems that a sewer can not become
stopped, or rather reported, during working hours.

In one instance, before the present program was arranged,
a stone 9½ in. wide, 3 in. thick, and 12 in. long had entered a
10 in. diameter sewer, and had moved down the line for a dis-
tance of 150 ft. before it lodged in such a position that it could
not be moved by rodding the sewers. Needless to say, the pipe
was uncovered and a section removed, in order to clear the line.

Q. 13. I notice that you refer to cleaning screen chambers and collect-
ing wells at the sewage pumping stations. Will you tell us
about this?

A. 13. The collecting well at each of the sewage pumping stations is
provided with a screen and grit chamber to remove rags, large
objects, and the grit or sand which would otherwise score the
pump shafts and erode the impellers and pump casing. Rags
and other material caught on the bar screen are removed by
hand by the station engineer, and buried upon the property,
and the sand pits are cleaned by the sewer repair force when
they show evidence of filling. This is generally done twice a
year. At the same time, the walls of the large collecting wells
are scraped to remove grease. Material removed is buried on
the station grounds, except at the Ardmore Pumping Station,
where there is no land available, because of the closely built
neighborhood, and it is therefore hauled to the Mill Creek
Pumping Station, and buried in the large meadow adjoining
this station.

Q. 14. What type frame and cover is used, and what has been your
experience with covers?

A. 14. Manhole frames and covers are of cast iron. The frame is 7 in.
high, and has a 24 in. diameter tapered opening in which the
cover seats. The original type had a seat 1½ in. deep with a
corresponding thickness of the cover around the outer edge,
while the center of the cover was reinforced by ribs, which made
a thickness of 2⅛ in. in the center of the cover. Following the
practice of the City of Philadelphia, a frame with a seat 3 in.
depth, and a cover with a corresponding thickness around the
outer edge, but without material change in the location and size
of reinforcing ribs, was later substituted for the lighter top on
all new work. This frame and cover weigh around 350 pounds.
Argument for the heavier lid was that the lighter cover would jump off, and break under the increased speed and weight of loads carried by the present day trucks. This does not seem to be justified by my experience in maintenance work, for the past fourteen years, as the only time that I had definite knowledge of a cover coming off was when one heavy type lid disappeared entirely, presumably being stolen. Several reports that lids were off were investigated immediately, but the lids were always in place when visited, while only three or four had cracked, and in each case, the road was found to have a rut, or hole, a short distance in front of the cover, so that the lid was subjected to an unusually severe impact, and it is doubtful if the heavier lid would have stood the strain. In the same period, one of the heavier lids cracked and had to be replaced.

Q. 15. Do you favor the use of handles for manhole covers?
A. 15. From the viewpoint of maintenance of the system, it is essential that the lids be provided with some means of lifting them in order to inspect and work on the sewer. Our experience is that two handles of ½ in. diameter iron, used in conjunction with an opening large enough to insert the end of a pick, cast into the outer edge of the cover, are very helpful, especially when the opening between the frame and cover has become filled with road asphalt or when the fit is tight. In some cases, the lids become so tight, that it is necessary to use the hoist on the truck to provide enough force to remove the lid, and I have seen places where the frame would lift the road surface before the cover would come off. Needless to say, in these cases steps are taken to make a looser fit before the cover is again replaced. In all cases of tight lids a generous use of a hammer seems to be of value. While this item may seem unworthy of much thought by the designing engineer, it is of extreme importance to the maintenance force and once a system is started, and the manhole covers set in road paving, it is an expensive proposition to replace the work.

Q. 16. What is meant by “ventilating covers”—are they necessary?
A. 16. Although any opening in the cover may admit water in time of storm, it has been found necessary to provide ventilation for the system, especially since the use of a main house trap located near the property line of the road, does not allow free ventilation through each house line. This ventilation is provided by placing eight 1 in. diameter openings in “Ventilating Covers.” These covers are placed at dead ends of the system and roughly at each third manhole, although none is placed if the manhole is in a gutter, is so located that considerable storm water would flow over the cover, or if the manhole is located near a house, or in such other location that odors would become a nuisance to property owners. As additions are made to the sewer system, it becomes necessary to relocate the ventilating manholes.
Q. 17. Does not a considerable quantity of road grit or sand enter the sewer when ventilating covers are used?
A. 17. All frames are provided with pockets to support the legs of a bucket, which hangs under the ventilating cover, and catches any sand or road stones which would otherwise enter the sewer. The bucket also becomes a receptacle for sticks, pieces of wire and even umbrella ribs, which are pushed through the openings. These items, if allowed to enter small diameter sewers, would be a potential source of stoppage. Notations of buckets which require new hangers or other repairs are made while flushing and repairs are made when the other work will permit. This is generally done when the weather, because of cold or storm, will not permit outside work.

Q. 18. What have you done about the noisy manhole lid problem, and cases where lids have a tendency to roam?
A. 18. Until about a year ago, noisy manhole were made quiet by placing a layer of sand, mixed with road asphalt, on the seat of the frame and then placing the cover on this cushion. At present a prepared asbestos gasket, reinforced with brass wire and covered with an adhesive surface, is being tried with good results. In a few instances, manhole lids along the trunk sewers near creeks were found to have been removed, and rolled into the water. The lids were replaced but at later dates were again found to be removed. In order to prevent further removals, asphaltic compound, purchased for making joints in terra cotta pipe, was poured in the space between the frame and the cover. Since that time, the manhole lids were not disturbed, and it is even difficult for our own men who were accustomed to opening tight covers, to remove these lids. After that, the asphalt was only applied to three or four points around the cover, but was sufficiently strong to prevent removal of the lid by persons without tools.

Q. 18a. What has been your experience with manhole steps?
A. 18a. Manhole steps installed when the original sewers were constructed in 1904 were “U” shaped, and were staggered. In all later construction this type was abandoned in favor of bars placed to form a ladder, because of the tendency to slip from the step, especially when they became coated with the slimy deposit which forms in manholes. Prior to 1927, steps were built of galvanized iron pipe, but when some of these began to rust, the Township adopted a policy to purchase solid wrought iron, heavily galvanized bar steps, and to require that all contractors purchase these items from the Township so that the Township now retains control of the quality of the bars. The same policy was adopted for manhole frames and covers, and cast iron “Y” saddles used in making connections to sewers when no “Y” branch is available.
Q. 19. What is your experience with the location and nature of stoppages?

A. 19. Reports of stoppage in the sewer are investigated immediately and with few exceptions are found to be in the lateral or house connection which must be maintained by the property owner. The owner is then notified. When a stoppage in the main sewer is found, one man and rods are obtained from the sewer repair force, and the sewer is rodded. In a majority of cases, where sewage has backed into the manhole without evidence of a stoppage and overflow of a trap vent at a point lower than the manhole, it has been found to be a good policy to obtain a pipe or long pole, and be sure that there is no obstruction at the mouth of the outlet pipe, as most of our trouble has been located at this point. In one instance, a stick had lodged across the pipe, and the accumulation of rags, paper, etc., had sealed the outlet so that a head of 9 ft. was created. On several other occasions, someone had placed quantities of stones from nearby creek beds in the manhole, and thus shut off the outlet. While the general cause of stoppage is the entry and growth of tree roots in the sewer, other obstructions found were a large soup bone, a beer bottle, three croquet balls tightly wedged together, and not infrequently, roots torn loose from house connections by plumbers and allowed to go down the line in such volume that when they entered the main sewer they piled up, and shut off the flow. At one time, someone had removed a manhole cover and deposited in the manhole a small cartload of tin cans, ranging in size from a sardine can to a “Keebler” saltine can. By the time it was discovered the cans were strung out for about 900 ft. in a 10 in. diameter pipe and for several hundred feet in the 15 in. outfall line. The cans which had not entered the sewer were removed, and the entire line was dragged to the pumping station screen.

Q. 20. Is it ever necessary to build new manholes on the older sewers?

A. 20. When other work will permit, new manholes are constructed at points where the interval between manholes is too great to properly care for the sewer.

Q. 21. What are classed as general repairs, and who makes them?

A. 21. General repairs, including replacement of pipe found to be crushed, are also made by the three men comprising the sewer repair crew. Crushed pipes have been found to have been caused by backfilling of large stones directly upon the pipe, washing out of the base by a water pipe leak with a consequent settlement of the pipe and ditch, and settlement of a culvert wall.

Q. 22. Do you ever have trouble with the force mains?

A. 22. Occasional leaks develop in the lead joints on the pressure main from the pumping stations, generally because the joint is not caulked sufficiently hard to withstand the pressure, or, as in
the case of the original line laid in 1904, the pipe was not centered in the bell and straight pipe was used to turn bends. In two instances, cracked pipe developed. The pipes are uncovered and the joints recalked, using cold lead in places where extra room develops in the joint. Where the pipe has become cracked, and a length or more must be removed, the Philadelphia Suburban Water Company has always come to the assistance of the Township, and loaned us their equipment, and men who are thoroughly familiar with the work. As might be expected, the leaky joints appear in the places most difficult of access, and generally on the bottom of the pipe—inspectors please note. At one time, a leak appeared on a creek bottom and, although the water could have been by-passed by the use of a flume, it would have required considerable time to construct the dam and flume. To save this time, the joint was caulked by a man who had to be completely submerged while working and had to come up for air at frequent intervals.

Q. 23. What has been done toward cleaning the sewer system?
A. 23. During 1928 the Township purchased a “Champion” sewer cleaning outfit, consisting of rods, buckets, cables and windlass, and hired men to operate it in cleaning the entire sanitary sewer system. Prior to that time, a truck and men were hired from a local contractor to flush the sewer system, clean the basins, and open stoppages whenever they occurred, but the Township did not have a full time force of its own. The first task was to locate and bring to grade the manholes which had been covered. It is estimated that in the first two years of operation of the sewer repair force, 700 manholes were uncovered and brought to grade. Because of the demands of the other work, it took five years to complete cleaning of all the sewers.

Q. 24. What is the method used to clean sewers?
A. 24. The method used is to push wooden, iron jointed rods between the manholes, fasten a cable to the end of the rods, and draw it to the next manhole by removing the rods. A bucket with jaws mounted on a swivel is then fastened to the cable, and drawn back and forth between the manholes, scraping any material in the pipe to a manhole, from which it is removed, until the bucket no longer brings out sediment. The operation is then repeated in the section next lower, until a trunk line is reached. All branches were carried down first, and then the trunk was cleaned. Since the system was cleaned, dragging has been confined to those sections which at the time of flushing are observed to flow poorly, and to streets where road construction has recently been completed. The wisdom of dragging these bad spots is reflected by the marked decrease in the number of serious stoppages, which before the sewers were cleaned seemed to be continuously occurring, and which now have de-
creased to the extent that a report of a stoppage is investigated before it is taken as a fact.

Q. 25. Have efforts been made to reduce infiltration of ground water?
A. 25. Some work has been done in efforts to locate and decrease infiltration of ground water, but the time that could be devoted to this work has been very limited. It is hoped that much more can be done in the next few years.

Q. 26. What would you consider as maintenance of pumping stations?
A. 26. Briefly, maintenance of the pumping stations consists of care of the buildings, pumps and grounds.

Q. 27. What is done toward keeping the buildings and grounds attractive?
A. 27. The buildings are kept painted and cleaned while care is taken to have the grass, shrubbery, and flowers always kept in such a condition that the plants are the subject of favorable comment by the citizens. At two of the four stations, the grounds have been turned into parks for the public, and if the large number of persons who used them on Memorial Day is any indication of the coming use this summer, space will be at a premium.

Q. 28. How can a small amount of inspection and work, keep pumps from losing their efficiency?
A. 28. Volumes pumped by each unit are checked at frequent intervals, and the impellers and casings inspected for wear. Decreased pumping due to wear may be overcome to a large extent by setting the impeller on the shaft so that the space between the edge of the impeller, and the casing is reduced to a bare clearance.

Q. 29. What about packing and oil?
A. 29. Packing to be used to stop sewage from leaking out around the shaft is a matter of personal thought, and since I have not found two of our men who can agree on which kind is best, I will only mention the matter in passing. A sufficient supply of oil is important but, again, the particular brand which is best will be left to the opinion of the user, with the remark that although several standard makes have been tried, no one seemed superior.

Q. 30. What is the chief source of trouble in operating the pumps?
A. 30. Actual operation of the pump usually resolves itself into a battle between the operator and the rags or other solids which will stop the pump, especially when small size pumps with close impeller blades are in use. Of course, life is often interesting, as when thunder storms send flashes of electricity hopping from switchboards to radiators; when in the middle of the night a check valve refuses to close, with the result that the pump will not operate until the valve is taken apart and freed of rags, sticks or other material which has held it open; or when something stops the pump, and blows the fuses. It is then that one is thankful for duplicate units.
Q. 31. Who supervises the construction of lateral connections to the sewer?

A. 31. Until several years ago, the inspection of the sewer connection between the building and the fence line or property line of the road was made by the plumbing inspector working for the Board of Health, while the part of the line between the fence line and the main sewer was built by contract by the Township, and inspected by the Sewer Department. This arrangement was then changed so that now the Sewer Department inspects the entire connection from the sanitary sewer to a point ten feet from the walls of the building, which point is the end of the cast iron soil pipe laid by the plumber.

Q. 32. Why was the change made?

A. 32. This change was made so that the entire line could be checked for grade by a level instrument, and so that better location records could be kept, in addition to bringing the control of ground water infiltration into the connections, within the department which was most vitally interested in keeping this to a minimum. In addition to the change of jurisdiction, arrangements were made to refuse a plumber a plumbing plan until the connection was laid to the building.

Q. 33. Were any good results accomplished?

A. 33. Detailed location sketches are now made and placed on file. Plumbers are learning that the centering of the spigot end of the pipe within the bell is essential if they desire to lay the line with a hand level. Houses are no longer being connected where the fall from the building to the end of the lateral was extremely small and sometimes a negative quantity, because the plumbing inspector did not have equipment to check the total fall and had to depend on a level placed on each pipe. Builders are learning that they must place the building sufficiently high to have the necessary fall, and since the connection must be made before the house has progressed very far, they can no longer avail themselves of the plea that the work in the house has been completed and to make changes would involve tremendous expense, thus bringing sympathetic pressure to bear to have poor connections accepted. Use of cast iron pipe in wet places has been insisted upon, with a consequent reduction in the amount of infiltration.

Q. 34. All sewers have a gradient, and therefore sewage must flow to the outlet, so why bother with all the many items of maintenance work which have been mentioned, especially since it all means an outlay of money for something which is under the ground, and therefore unseen, and unheeded by the majority of citizens?

A. 34. It is indeed true that as long as sewers function properly, they are unseen and unheeded, but as soon as they fail to carry off the wastes from the buildings, they become very evident to those persons who are affected, and loud and vigorous protests...
are voiced into the ears of those who control the government. After receiving several indignant telephone calls in the middle of the night, most elected representatives of the people are quite willing to make it their business to see that at least sewers in their districts are cared for properly. It is then that the neglect of maintenance is most evident. An unskilled working force must be organized, tools must be obtained, buried manholes and lines without recorded locations must be found before relief work may be started, and in the meanwhile, the insistent demand for action becomes more loud, and even insulting. Finally, when the stoppage has been located and removed, there is still the question of liability for damages to property, and the ever present fear of spread of contagious diseases, together with the expense of cleaning the mess which has resulted. Is it not far better to keep a few men who become familiar with the location of the lines, and skilled in the use of the tools, who can work on the sections known to be in need of cleaning, and thus reduce the chance of stoppage to a point where a stoppage is an accident, rather than to face the demands of citizens who believed that the funds which they pay as taxes entitle them to protection from these troubles. The big job is to make the citizens sewer conscious, and they will be ready to support the work if they can be shown the need. This is one of the real reasons for the adoption of a sewer rental which will not only provide sufficient funds, but will bring to the attention of the citizens the manner in which their payments are returned to them as benefits.

**Discussion**

**Chairman Freeburn:** I think Mr. Olewiler has pretty well covered the subject, but if there are any questions we will hear from a few people very briefly.

**Prof. O'Donnell:** Do you have in your plumbing requirements the main drain trap?

**Mr. Olewiler:** Yes.

**Prof. O'Donnell:** That is still a part of your Board of Health requirements?

**Mr. Olewiler:** Yes.

**Chairman Freeburn:** Anybody else have anything to say? Of course nobody has any trouble with the sewer system!

**Mr. A. F. Stone (Reading, Pa.):** You mentioned in connection with the maintenance at the pumping station, that so far as the efficiency of the pumps is concerned, you move the impeller and the impeller shaft up to the impeller head to have the clearance between the impeller hub and the impeller head at a minimum. There are certain limitations as to how far you can move the impeller towards the impeller head, and after you have gone to the limit what do you do?

**Mr. Olewiler:** Buy a new one.
Mr. Stone: The reason I asked that question, is that we have been repairing our pumps by putting a bronze ring on the impeller hub and a steel ring in the impeller head. We have a capacity of 11,000,000 gallons per day at Reading and we find that it works satisfactorily.

Mr. Olewiler: We have found that the cost of the impeller is not too high. Of course you are limited to one type of impeller. There is an open and closed type, and you can only do that on the open type.

Mr. Stone: We have the open type impeller and it costs us around $60 per pump. So far as getting a new impeller is concerned, you would have to get a new casing. The cost of the installation of the brass and steel rings is about $60 per pump.