end of a twenty-two-inch drum four feet long. The opposite end of this drum was flush, and into it the pipe nipple six inches long was screwed, and on the end of which the valves were screwed, so that the pressure came on the underside of the valve. Each valve was left open at the outlet end, and no nipple or pipe was screwed in the discharging end. The water was delivered by the valve directly into a catchall which returned the water into a tumbling bay, from which it flowed through combing boards into the fore bay and so to the weirs. Two sizes of weirs were used six inches by eight inches, and eight inches by twenty one and one half inches.

The above was the procedure in testing valves when passing the largest quantities of water. With the medium sized valves the water was allowed to discharge into a 3,000-gallon cistern, where its quantity was measured directly by volume. With the smallest sizes, the water flowed into one or the other of two collecting barrels and weighed directly on platform scales. A pressure-gauge connected to the twenty-two-inch drum measured the pressure of the water, while a second pressure-gauge, connected by a nipple screwed into the pipe-nipple which connected the drum with the valve, gave readings of what is entitled the "pressure at the valve." The quarter-inch pipe-nipple from the pressure-gauge was screwed into the other one sufficiently far so that its end was filed off flush and smoothly with the interior wall of the nipple through which the water flowed. Readings were taken of the pressures and height of water in the cisterns and on all the weirs once per minute. Most of the runs were of twenty minutes duration and were timed by a stop-watch which had been calibrated at the observatory. In order to convert pounds of water to gallons or to cubic feet, the specific gravity of the water used was accurately determined and found to be 1.00074 (231 cubic inches were taken to be a gallon). The weirs, cisterns, scales and pressure-gauges had all been accurately calibrated and calibration curves drawn to a large scale from which corrected readings were taken.

The following results and conclusions were drawn:

The amounts of water passed under given conditions by the gate and angle valves which were tested were approximately double and one and one-half times respectively the amounts of water passed by the globe valves of exactly the same nominal size under the same conditions.

By the efficiency of the valve is meant the ratio of the number of gallons of water per minute that it actually discharged to the number of gallons which theoretically flow through a frictionless pipe of an area equal to the actual area of standard black pipe and at the velocity due to the head. For fourteen of the valves tested there was apparently one pressure at which there is a maximum efficiency of flow of water; for ten of the valves the efficiency seems to be constant at all pressures; while, with five of the valves tested, the efficiency decreased as the pressure increased. With valves of certain makes the efficiency of the different sizes vary greatly. For example, while the ½-inch and 1-inch gate valves of a certain make have an efficiency of 71.9 per cent. and 72.2 per cent. respectively, the efficiency of the ¾-inch valve of the same make is only 58.9 per cent. By a comparison of the weights of the valve with the current market price of them, it would seem that the amount of water passed by a valve of a given size is approximately directly proportional to its cost. In other words, that, if you pay 45 cents for a ¾-inch valve and 90 cents for a ¾-inch valve of a different make or type, the amounts of water passed by these two valves will be approximately in the proportion of 45 : 90, or as 1 : 2. We are of the opinion that the relative efficiency of valves may be determined by the relative drops in pressure from the standpipe to the valve. In other words, that, of two valves discharging water from a standpipe at eighty pounds pressure, the one having the greater efficiency will have the least pressure at the valve. This is, therefore, suggested as a rough test by which to determine the relative efficiency of valves.

A few experiments were made with one of the valves at six different pressures with a nipple four diameters long in the outlet of the valve, and from which it was concluded that nipples of this length caused an increased loss of about two per cent.

From the above it will be seen to be advisable to use a gate valve when the full capacity of the valve is always desired and a globe valve should only be used in a water line when excessive throttling of the quantity or pressure is immaterial. A three-fourth gate valve will pass more water than will any of the one-inch globe valves tested, while a one gate valve of a certain make will actually pass more water than will a certain one and one-half inch globe valve at the same pressures. As the pressure is a direct measurement of the h.p. exerted in pumping water, it will be readily seen that when it takes upwards of 200 pounds pressure to get 100 gallons per minute through a one-half gate valve or three-quarter globe valve, and that from seventy to ninety pounds pressure is required to get the same amount of water through three-quarter gate valves, and from fifty to eighty pounds pressure to get that amount of water through one-inch globe valves and only from ten to twenty pounds pressure to get that amount of water through one and one-half gate valves, it would seem that, in the best practice, water valves at least one size larger than the nominal size of the wrought iron pipe should always be used. There is apparently much chance for the manufacturers of small valves to improve the water discharging capacity of their valves and at but a slight increase in first cost to the purchaser. In the opinion of the writer, this subject should come home to the members of this association, and these facts, it is thought, may be of some slight value when complaints are made by householders that they are unable to draw water fast enough, and for the very good reason that not only the pipes in their houses are too small, but that valves are used whose chief duty, it would seem, was to throttle the discharge; and, furthermore, that an increase in pressure of from forty to eighty pounds at the pumping station may be required, in order to force the desired amount of water through the small valves and faucets which may be found in many dwelling houses and other buildings of cheap construction.

To deduce from these data conclusions as to the relative expenses of using small valves and those of adequate size is almost impossible, and, except in some definite case, would be valueless. If one wanted a bucket of water with which to quench an incipient conflagration, the value of a valve which would give the desired amount of water in the least time would be inestimable. Generally speaking, this investigation would show that by the use of gate valves of the proper size, pressures one-quarter to one-half of those that would be needed with smaller valves would be sufficient. This may not hold true and exact with the large valves of city water works, but it doubtless does hold true with the smaller pumping plants and hydraulic elevator service of office buildings and the like. In any particular plant, knowing the cost of steam delivered at the pump, some approximate estimate can be made as to the cost of using small valves and large steam cylinders and high steam pressures as compared with valves of more generous discharge and small steam cylinders and lower steam pressures.

It is reported that T. H. Wiggins, C.E., has tendered his resignation as town engineer of Cornwall, Ont.