

the test of meters which were used by the private company preceding municipal management disclosed under-registration varying between 10% and 50%, with an average of 20% for the entire system. It was also found that in several cases where the bills were not high in spite of very small leakage that the meters did not register leakage as small as 30 gallons per day.

#### Complaint Bureau

The efficient complaint bureau, and the education of the water consumers, are important both for the satisfaction of the water-taker who tends to regard the meter with suspicion and for the peace of mind of the water department executive who realizes that it does not pay to antagonize citizens. The systematic handling of complaints is infinitely more satisfactory than adverse arbitrary decisions, or spineless methods of leniency caused by fear of political pressure or favoritism. Every high bill can and ought to be explained. The problem is really one of education. In Oak Park the campaign was begun by utilizing the backs of the water bills for admonitions to the consumer referring to the waste of water. This was supplemented by letters to each complainant with follow-ups in order to test the reduction in consumption after the repair of leaks. The meter readers report all suspicious sounds of running water, although not attempting to trace the cause to save time, and the rest is handled in the office by the complaint clerk. If the consumption is abnormal, a special call is made by a complaint inspector before the waste is brought to the attention of the consumer. It was noted that if notices were sent to the consumer before the investigation, he often repaired the fault and then insisted there must be a mistake or that the meter was incorrect, because there could be no leaks. Hence the adoption of a policy of locating serious trouble before reporting it.

No one in Oak Park has ever been obliged to stint in the use of water in order to receive reasonable bills. In fact the leaks consumed 3 to 10 times more water than the consumers themselves can actually use for all purposes. Our investigators proved that, in every case of that kind, there were toilets leaking at the rate of  $\frac{1}{8}$  to  $\frac{1}{2}$  gallon per minute. Sometimes the waste was so small that the watching of the meter did not readily indicate the quantity. Sound is really the best indicator of leaks. This is explained to the consumer who thereafter manages to use all the water he needs, although keeping down the bills. Often a warm meter advocate is thus obtained. It is always a good policy to give the consumer the benefit of the doubt and let it be known that the department is glad to correct errors. In many cases diplomatic cross examinations will uncover sources of waste which the consumers do not realize. It is dangerous to try to prove that the complainant is wrong until you can show him where. Rectify errors promptly. Service is the important element in popularizing the use of meters.

Aside from the waste through fixtures, high bills are caused by leaks in toilets, broken underground pipes in basements, defective toilet valves or ball-cocks, dripping faucets, thermostats, water motors, pumps operated by water power, defective stop-and-waste cocks, leaking valves, breaks in pipes under cement floors and between walls, water used for cooling food, water wasted to obtain a cool drink or to procure hot water from defective heaters, children leaving faucets open, lawn sprinkling with hose without nozzles, the flushings of water-closets uselessly after use for purposes for which they are not designed such as garbage receptacle, leakage through tanks in attics and by allowing water to run continuously in order to prevent freezing or into wash tubs or lavatories for washing purposes instead of filling the bowls or tubs before using.

#### Domestic Waste Detector

For cases where the department was unable to determine the cause of high bills owing to the fact that there was no leaking and that the consumer was sure he was not wasting water, a recording detector was designed, which when substituted for the meter gives a graphic record of the consumption for 24 hours or a week. This device consists of a piece of brass pipe  $\frac{1}{2}$  in. or  $\frac{3}{4}$  in. in diameter

and 7 ins. long, into which are inserted two brass tubes  $\frac{1}{16}$  in. in diameter, one pointed upstream and the other perpendicular to the axis of the pipe. For convenience these orifices or pitot tubes are soldered into  $\frac{1}{8}$  in. brass nipples. Two needle valves and strong rubber tubing complete the meter. A special type of recorder with a rapidly revolving chart so that drafts lasting only one-half minute could be detected, was constructed, which indicated at what time and how long faucets were left open for baths, for washing dishes or clothes, or for lawn sprinkling; how often toilets were flushed, together with a record of all leakage of  $1\frac{1}{2}$  gallons a minute or more. In fact, it was found easy to determine at what time the consumers arose and retired and whether they got up during the night or not.

#### First Apparatus Was Limited

The pipe, in reality a brass meter nipple into which are soldered permanently two pitot tubes, is inserted in the house service either in place of the meter or connected in tandem with it. In all, only two tubes were necessary for the range of consumption which exists between a four-room bungalow and 24-apartment building. In the first experiments the pitot tubes were connected to a mercury U-tube, by means of which rates ranging from less than  $\frac{1}{2}$  gallon per minute to 30 gallons per minute were measured by using the  $\frac{1}{2}$  in. and  $\frac{3}{4}$  in. nipples. A camera provided with a revolving sheet of bromide paper, 3 ins. wide, was designed and adjusted so that the lens magnified the deflections through a slot about eight-thousandths of an inch wide. A pocket flashlight supplied the illumination, through a condenser, and the power was furnished by a single-cell storage battery constructed for the purpose. The only drawback to the device was that the high deflections were beyond the range of the slot, although small leakage was detected which the disc meter failed to record.

#### Will Detect All Flows

The next step, after fruitless attempts to alter the quantitative measuring device of the displacement so that it would register in gallons per minute, was to design a recorder which could take care of all flows. This new recorder will detect rates as low as  $1\frac{1}{2}$  gallons per minute, and there is no limit to the maximum recording capacity if larger meter tubes with lower centre velocities are used. The diaphragm is constructed of  $\frac{1}{8}$  in. mechanical rubber, and it is surprising to note the power transmitted through the stuffing box. The recovery after a short draft is rapid, even at maximum velocities. The recorder is not extremely accurate but frequent rating by means of the regular meter-testing outfit indicates that it is amply dependable. It has been used successfully in connection with a 2-in. Venturi meter, in making waste surveys by means of the hydrant and hose method, and gives much assistance in determining the varying consumption in the district tested, so that the leakage can be ascertained.

Plumbers invariably mislead the consumer by failing to appreciate small leaks and by discrediting the meter. But Oak Park water-takers are rapidly becoming educated in spite of this. After being shown repeatedly the waste which plumbers failed to locate, and seeing the effect of the stoppage of leaks which, according to the plumbers, could not amount to more than 10 gallons a month—they refuse to be sidetracked.

#### High Bills Caused by Leakage

Regarding rebates on high bills which were caused by leakage, we find that to reduce these indiscriminately is to defeat the purpose of the meters. As stated before, reliance should be placed upon educating the consumer rather than in the practice of allowing reductions in order to avoid adverse criticism or to satisfy some influential citizen. Water-takers easily fall into the habit of depending upon leniency if such is known to be a possible way out of their difficulties. The average consumer can bring the plea of first offense and a promise to be careful in the future. The way it works out though is this: If a rebate is allowed in one case, the tendency of the authorities will be known throughout the community in a short time, and it will be