In determining these rates it is understood that the total revenue is to be made up of that for domestic and industria! uses and for fire hydrants. The total amount received annually may be determined from the factors mentioned above, but the proper charge for individual service must always be determined by a very thorough study of local conditions by an expert.

In considering the matter of charges for fire hydrants and for other services directly of benefit to the community at large, it is now coming to be understood that the value of all such general services should be properly determined and charged for in all plants whether municipally or privately owned. In the case of a municipal plant, the charges for fire or hydrant and other public services should be met by a general tax levy in an amount equal to the value of the services rendered and the fund so received placed to the credit of the water department. The present more or less general policy of basing the charge for public service as well as poor compensation for the general public services rendered, and may place an unwarranted expense on the domestic consumers.

In the adjustment of rates for domestic service municipal officials may save much trouble for themselves and, perhaps, for the consumers by advocating and working for the installation of meters, which afford the only equitable basis for selling water.

The water served to a community must be of good quality. If it is thought desirable to correct a fallacious estimate of the cost of furnishing filtered water, as it is frequently stated that filtration of a public water supply necessitates rates at least 25 per cent. greater than would be required without filtration. The average cost of installation and operation of works, with and without purification, for a city of 30,000 population is shown.

## Representative Waterworks Data for City of 30,000 Population.

	Without	With Purification.
Total cost of investment	. \$600,000	\$675,000
Interest at 5 per cent	. 30,000	33,750
Replacement at 2 per cent Probable cost of operation an	. 12,000 d	13,500
maintenance	. 35,000	41,000
Total annual revenue required.	. \$77,000	\$88,000

These figures show that the total annual revenue must be approximately 15 per cent. greater with filtered water than without. It should be noted, however, that the operating costs are less than one-half the total annual cost and it is well known that a plant may supply water at less cost per million gallons up to its full capacity than is possible at less than full capacity. Consequently, a waterworks should aim to get all the business possible, and it is believed that a filter plant will always bring in more revenue than it will cost. In fact, experience shows that the filter plant frequently is the only salvation for the waterworks, because you cannot make people buy poor water at any price.

As evidence of this fact the following figures refer to the waterworks situation at Niles, Ohio, a city which last year constructed a filter plant, under the direction of the writer: Ownership, municipal; population served, 8,000; estimated value of works, \$125,000; investment per capita, \$15.63; miles of mains, 21; number of hydrants, 125; source of supply, Mahoning River, unfiltered; quality of water, very poor; lift of pumps, 200 ft.; number of consumers, 900; consumers per mile of main, 43; total annual income, \$8,758; total annual expenses, \$14,942, including interest, depreciation, operation and maintenace. In the above statement it is of interest to note that the waterworks were not self-sustaining although the rates charged for service compare fairly well with those charged in the neighboring communities. Attention is called to the low number of consumers per mile of main, namely 43, or about one-half of what might reasonably be expected were the supply of good quality. It is believed that the installation of the filter plant, although increasing the annual cost, will result in placing the works on a sound financial standing, due to increased business.

As compared with the above, the following data relate to the waterworks at Warren, Ohio, where there is in use one of the oldest mechanical filter plants in the United States: Ownership, private; population served, 10,000; estimated value of works, \$268,000; investment per capita, \$26.80; miles of mains, 31; number of hydrants, 161; source of supply, Mahoning River, filtered; quality of water, excellent; lift of pumps, 150 ft.; number of consumers, 2,300; consumers per mile of main, 74; total annual income, \$38,783; total annual expenses, \$34,466, including interest, depreciation, operation and maintenance; rates charged for service, 6-room house, \$6, 1 bath and 1 basin, \$2.75, 1 closet, \$2.50, total annual, \$11.25; sprinkling 50 ft. and street, \$5.00.

In comparing the situations at the two plants, it is of interest to note that the Warren water supply has been maintained of excellent quality for many years, and that consequently the water is in general use, resulting in an excellent financial standing for the plant. It should be added, however, that the annual income at Warren contains a hydrant rental of \$6,675 and that no hydrant rental is credited to the plant at Niles. As previously stated, however, there is a growing appreciation of the fact that all water departments, whether private or municipal, should be credited with and funds placed to their account for all public services rendered. Even on this basis, the conditions at Niles clearly warranted and required the installation of the purification plant even from a purely business standpoint, and not considering the health of the consumers.

## EXPERIMENTS WITH KEROSENE FUEL.

An investigation of kerosene fuel is being conducted by the Engineering Experimental Station at the Pennsylvania State College under the direction of Prof. J. A. Moyer, of the mechanical engineering department. With the increase in the price of gasoline has come the demand for some cheaper fuel that will give as good results. Kerosene would meet the demands if a satisfactory carburetor can be designed, and it is with a view of determining the merits and defects of various types of carburetors that the investigation is being carried on. The price of gasoline has nearly doubled in this country in the past year, while in England the price has risen to 50 cents a gallon for "motor spirit." Many of the writers in the trade journals in England advocate the use of a mixture of gasoline and kerosene, but point out that without an efficient carburetor no such mixture may be used. Professor Moyer, who has made numerous experiments on smoke washing and electrostatic treatment of smoke, has already installed at the college a motor built to utilize the energy from either of the two fuels mentioned which is suitable for use on farms and country estates. Experiments will also be made on various mixtures, and a carburetor valve will be designed to shift the fuel supply automatically from a small gasoline tank, used only for starting, to the main kerosene tank. These experiments should be of interest to manufacturers and users of gasoline motors throughout the country.