these companies are usually competent to give reliable advice, their main business is the selling of equipment. Because of this fact and because the usual small water company or municipality is weak financially, the filter plant is designed to fit the available money, and the company offering the equipment for the least sum is generally given the contract, regardless of the quality of the material to be furnished. As a result of this practice, plants that are poorly designed, lacking in the necessary equipment for efficiency, or even wholly ill-adapted to the situation, are commonly met with. A few cases of this kind which have come under the observation of the writer will be noted. Probably the worst example was at a plant supplying about a million gallons per day. The supply was originally obtained from artesian wells, but on account of the high iron content of the water, a new supply was obtained from an artificial lake. This water was highly colored by its passage through cedar swamps. From the lake the water flowed by gravity to the coagulation basin. This was a rectangular wooden tank of such size that normally less than twenty minutes were allowed for coagulation and sedimentation. During periods of high consumption the time was considerably decreased. The basin was set at such an elevation that at times of low water in the lake it was impossible to obtain the normal supply except by by-passing some raw water. From the coagulation basin the water flowed by gravity to 4 rapid sand filters of the gravity, circular wooden tank type, without loss of head-gauges or rate-controllers. The agitating rakes were intended to be driven by a water motor, but the necessary power was lacking. The beds were, therefore, not agitated during washing. From the filters the water passed to a suction well which had been used in connection with the former well supply, and which provided less than 30 minutes' storage. Two solution tanks had been provided and connected with a small displacement pump driven from the line shaft to which the main water pumps were attached. The small solution pump was intended to force a solution of sulphate of alumina into the raw water just before it entered the coagulation basin. At the time of the writer's first visit to this plant the chemical pump was out of order and no chemical was being added. It was afterward learned that this was its chronic condition. Tests of the raw water showed it to be slightly acid owing probably to humic acid from the cedar swamps. Consequently the addition of sulphate of alumina would be an absolute loss as far as results are concerned. Analyses of the raw and filtered water showed no material difference, and the filtered water had at times a color as high as two hundred.

While the foregoing may seem to be an extreme case, conditions almost as bad were found in several instances. Two other plants were discovered treating acid water with sulphate of alumina only, rate-controllers and loss of head-gauges were almost unknown, and the methods of regulating the amount of chemical applied were very crude. Few calibrated orifice boxes were found in use. Two gravity, rapid sand plants, treating waters high in organic matter and often turbid, had no coagulation basins, so that they required too frequent washing with corresponding reductions in bacterial efficiency as well as increased costs of operation. Another large plant, using the pressure type of filter, was treating a turbid water with very little time for coagulation. The effluent was frequently turbid, and at times contained aluminum hydrate.

One plant of the slow sand type had less than a foot of filtering sand, and had a clear-water well holding about a half hour's supply. As a result of this combination, the rate of filtration fluctuated exactly as the demand, and purification was practically nil.

At one rapid sand plant the clear-water basin was so small that it was necessary to wash with raw water. Another plant had no arrangement for filtering to waste, so that whenever it was necessary to get at the strainer system the dirty water in the bed was drained into the clear-water well.

On the matter of operation, conditions were found to be as bad, if not worse. As has been said, the man in charge of a small water purification plant has usually little or no idea of the nature of the process. He operates the plant by "rule of thumb" methods in an endeavor to produce a good-looking water. Although efficient results depend so largely upon the use of the correct quantity of coagulant, the greatest ignorance was shown of this matter. At several plants the engineer stated that he put in a certain number of buckets of alum per day. He did not know how many pounds were used, and made no attempt to add it in the same proportion at all times. A few engineers said that they increased the dose "some" when the water was turbid, but did not know how much. In only a few plants was any attempt made to regulate the dosage by the aid of alkalinity and turbidity tests. As a matter of fact, few of the men in charge could be depended upon to make the necessary alkalinity tests. At only two plants, treating less than twenty million gallons per day, were laboratories maintained, and at these plants the tests, both chemical and bacteriological, were made under the direction of non-resident chemists. The engineers who made the tests were unable to interpret them or apply them in the operation of the plants. At one modern municipal plant, absolutely no records were kept. The chief engineer could neither read nor write, and could see no use in records of any kind, not excepting pumpage records. The president of the board of water commissioners in charge of the plant stated that the only reason he could see for filtering water was to remove turbidity, notwithstanding the fact that the sewage of over a hundred thousand people was discharged in the river, from which the supply was taken, about seventeen miles above the intake.

At one plant visited, it was found that through the laziness of the engineer the filters were not being washed enough, the deficiency of water due to clogging being made up by by-passing raw water. At another plant, the beds were washed too often, resulting in a low bacterial efficiency and a high cost of operation. Oven ten per cent. of all water filtered was being used for wash water.

It is not believed that such cases are confined to New Jersey. Reports of investigations in Ohio, Pennsylvania, New York, and Illinois show very similar conditions. Much as they are to be deplored, the fact remains that they do exist, and that a discussion of possible remedies is in order.

The most feasible remedy for poor design is a statute requiring the submission of plans for proposed plants or changes in existing plants to the state board of health, or some other state authority, for approval before construction can legally be carried out. Such a regulation is in effect in a number of states at the present time. Coupled with the appointment of a properly qualified engineer to pass upon all plans, it will satisfactorily care for new works. State supervision for existing plants will, if carried out, do much to remedy the more serious imperfections of construction and operation. This supervision cannot, however, be thorough enough to furnish definite information for the efficient operation of the