TABLE 4—ESTIMATED COST OF TREATMENT OF BOULEVARD SEWAGE—DOLLARS PER MILLION GALLONS

	Miles Acid Process.	Imhoff Tanks and Chlorination.	Fine Screening and Chlorination.
Tanks and Buildings (interest and depreciation)	$ 2.47	$ 4.44	$ 4.60
Acid treatment	10.74		
Drying sludge	2.04		
Degreasing sludge	1.91		
Redrying tankage	.17		
Superintendence	2.65	1.15	1.15
Labor on tanks and screens	1.00	1.50	2.05
Disposal of sludge or screenings		1.00	.50
Chlorination		4.05	4.05
Gross cost	20.98	12.14	12.35
Revenue	10.66		
Net cost	10.32	12.14	12.35

Winslow and Mohlman's paper is an eminently fair report of the results of a thorough investigation. They have given this new proposition just the treatment it should receive, namely, an unbiased discussion to bring out all important points, both favorable and unfavorable. In so doing they have made two criticisms, both of which are unfavorable and call for comment and explanation. F. W. Mohlman* states that the effluent, containing as it does bisulphites and free dioxide, has the power of deoxygenating several volumes of diluting water, and apprehends that a zone of deoxygenated water will be formed about the point of discharge of the acid effluent. Although not so stated, the implication is that such a zone might cause a nuisance or be injurious to fish life. Otherwise there would be no need for considering it a danger. The question raised is whether or not effects would be produced which would call for the aëration of the effluent. Mohlman's laboratory experiments show the effect upon the dissolved oxygen and sulphur dioxide contents of diluting the Miles process effluent with varying volumes of New Haven harbor water. The results are given in the following table:—

TABLE 5—MIXTURE OF HARBOR WATER AND MILES EFFLUENT

	Effluent.	Harbor Water.	1 Eff. to 2 Water.	1 Eff. to 4 Water.	1 Eff. to 9 Water.	1 Eff. to 19 Water.
Dissolved oxygen	0.8	12.0	1.0	5.0	8.8	11.0
Sulphur dioxide	118	0	8	0	0	0

This table shows that in a dilution of 2 of harbor water to 1 of effluent, the oxygen is reduced from 12 parts to 1 part per million, and the sulphur dioxide from 118 to 8 parts. At a dilution of 4 to 1, the oxygen is decreased five times, and the sulphur dioxide has disappeared. At a dilution of 9 to 1, the oxygen is 73%, and at a dilution of 19 to 1, 92% restored.

Polluted waters produce nuisances when they putrefy and give off tne products of the decomposition of organic

TABLE 6—CONTINUOUS AERATION OF MILES EFFLUENT

Date.	Sulphur Dioxide, Influent.	P.P.M. Effluent.	Reduction, Per Cent.	Air per Gal. Cu. Ft.
March 6, 1918	99.1	44.9	54	0.10
March 7, 1918	70.4	14.4	79	0.10
March 8, 1918	72.3	14.4	80	0.11
March 9, 1918	69.1	5.2	92	0.10
March 10, 1918	81.3	46.4	43	0.10
March 11, 1918	80.9	36.1	55	0.06
March 31, 1918	53.8	10.2	81	0.10
April 1, 1918	108.5	37.4	65	0.10
April 2, 1918	90.9	26.5	71	0.10
April 3, 1918	71.0	19.8	72	0.10
April 4, 1918	92.2	4.5	95	0.10
Average	78.1	23.6	70	0.097

*F. W. Mohlman. Miles Acid Process May Require Aeration of Effluent. "Engineering-News Record," 81, 285, August 1, 1918.

matter containing sulphur. They putrefy if the oxygen is exhausted before the organic matter is oxidized. In other words, the bacteria will oxidize the organic matter to the limit of the oxygen, and if any organic matter remains, the bacteria of putrefaction will attack it and produce the well-known conditions.

The Miles acid effluent does not represent the same conditions as those which exist in a deoxygenated, polluted water, because, in the case of the effluent, the deoxygenation has been produced chemically, not biologically, and the organic matter present has been practically sterilized. Furthermore, the settleable solids which might form sludge banks near the point of discharge have been largely removed. Before a nuisance can occur, bacteria must be introduced and be given a chance to multiply. Meanwhile dispersion and dilution are doing their work, and reaëration is taking place. Then there exists the condition of a warm, practically sterile effluent, free from sludge-forming suspended matter, being discharged into a considerable body of water, to the surface of which it will tend to rise and spread in a thin layer, thereby becoming subject to the reaërating effect of the wind, currents, passing craft, etc.*

Removal of Sulphur Dioxide

Mohlman showed that the sulphur dioxide may be removed by aëration before dilution with harbor water, and after aëration the effluent will not deoxygenate large volumes of diluting water. The average results of various aëration experiments using compressed air admitted through a "Filtros" plate into a shallow aërating tank providing a detention period of thirty-one minutes are as follows:—

From the results of these experiments, Mohlman concludes that 70% of the free sulphur dioxide may be removed by blowing the effluent in a shallow tank with 97,000 cu. ft. of free air per million gallons of sewage. This degree of aëration is about one twentieth of the 2 cu. ft. per gallon commonly used in connection with the activated sludge process.

Oesten, also G. C. and M. C. Whipple, and others, have shown that the aëration of water, which is in this case the interchange of oxygen and sulphur dioxide, may be accomplished more economically by the use of riffles, sprays or cascades, than by aëration with compressed air. The latter method is rarely if ever used in water-works practice. In the case of the Miles effluent we believe that a sufficient degree of reaëration could be secured by discharging the effluent over a series of riffles, or, if that plan were impracticable, by pumping the effluent through a suitable aërator, in the latter case at a cost of less than $1.00 per million gallons.

Fish life could hardly be affected, for the only place where fish could get into any considerable depth of deoxygenated water would be close to the outlet. Elsewhere they would not be affected unless they swam on the surface, which fish would not do ordinarily.

Recovery of Grease

Pearse's statement in connection with experiments at Chicago†—namely, that the acid effluent has a lower oxygen requirement than ordinary tank effluent—is evidence that, while the effluent contains no oxygen, less is required for the oxidation of the remaining organic matter than in the case of settled sewage.

It is therefore our opinion that under ordinary conditions of discharge into rivers or harbors, the dispersion, dilution and reaëration of the acid effluent would be much more rapid than the development of putrefaction and consequent nuisance; and in rare cases where aëration might be necessary it could be accomplished at a cost which would not militate against the usefulness of the process.

The second point,—namely the presence of unsaponifiable matter in the recovered grease has already been referred to above, and it is one of great importance, as it makes necessary the distillation of the grease.

The value of the grease from the Boulevard sewage is estimated at 8.5c. per lb. to the producer. This is the

*Mohlman, loc. cit.
†Report on Industrial Wastes, loc. cit.