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EXPERIMENTAL STUDIES OF NATURAL PURIFICATION IN POLLUTED WATERS

VIII. DISSOLVED OXYGEN IN THE PRESENCE OF ORGANIC MATTER, HYPOCHLORITES, AND SULPHITE WASTES[1]

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In general, it appears well established that the Rideal and Stewart method (14), or permanganate modification of Winkler's well-known procedure, for the determination of dissolved oxygen is of value in dealing with waters containing appreciable quantities of nitrites or of ferrous salts. Likewise, a preliminary treatment with permanganate may be desirable in dealing with such forms of organic matter as are commonly present in freshly aerated sewage at ordinary dilutions or in certain varieties of industrial wastes. However, as shown elsewhere (15), the permanganate modification is of doubtful value in dealing with stale sewage. More recently this widely used modification has been shown to fail when applied to samples containing large amounts of either dextrose or peptone. Certain points of interest in connection with this study will be presented in this paper, and a readily applicable procedure will be developed for the determination of dissolved oxygen in the presence of relatively large amounts of organic matter.

There is another type of interference with the Winkler method for which, on closer study, the permanganate treatment has been found to be of little, if any, value—that is, the interference encountered when dissolved oxygen is determined in the presence of sulphite wastes. Notable amounts of organic matter, as much as 10 percent by weight, are present in these wastes together with sulphur compounds. A reasonably effective procedure, based on a preliminary treatment with hypochlorites, will be proposed for the determination of dissolved oxygen in the presence of such wastes.

Finally, attention will be given to the determination of dissolved oxygen in chlorinated samples. The findings in this direction have a direct bearing on studies of chlorination as an adjunct to sewage treatment.

[1] Presented before the Division of Water, Sewage, and Sanitation at the eighty-first meeting of the American Chemical Society, Indianapolis, Ind., Mar. 30 to Apr. 3, 1931, and printed in Industrial & Engineering Chemistry, Analytical Edition, vol. 4, p. 59, Jan. 15, 1932.

INTERFERENCE BY ORGANIC MATTER (GLUCOSE)

Experiments to test the extent of interference with the Winkler method by various forms of organic matter were undertaken, primarily in connection with oxygen-demand studies in which a synthetic mixture containing glucose and peptone was being used. For the purposes of the present discussion these substances may also be regarded as typical of numerous forms of organic matter commonly found in waters polluted by sewage and industrial wastes.

The effect of varying amounts of glucose on the indicated oxygen content of samples containing known amounts of dissolved oxygen is shown in table 1. The experimental solutions were obtained by adding suitable volumes of stock solutions of glucose well below the surface of bottles completely filled with distilled water of known oxygen content. As the concentration of glucose in these stock solutions was relatively high, no correction was applied for the dilution of the dissolved oxygen. The stoppers were then replaced and the mixture was made uniform by inverting the bottles several times. The usual Winkler reagents (2 ml each of manganous sulphate and alkaline-iodide solutions) were then added and the bottles were inverted several times to distribute the precipitate. After the precipitate had settled, the bottles were again inverted several times, and when the upper part of the liquid was clear, 2 ml of concentrated sulphuric acid were added. The test was then completed by titrating a volume of iodine solution equivalent to 200 ml of the original sample.

In another series of bottles to which corresponding amounts of glucose had been added, the tests were started by a preliminary treatment with permanganate, using 0.7 ml of concentrated sulphuric acid and enough 0.2 N potassium permanganate to produce a reddish coloration which was permanent for 5 minutes. The excess of permanganate was then removed by the addition of minimum amounts of oxalate solution. When decolorization was complete, the regular Winkler reagents (1 ml of manganous sulphate solution and 3 ml of alkaline-iodide solution) were added and, after a 5-minute period of contact, the test was completed in the usual manner.

TABLE 1.—*Magnitude of interference due to glucose*

[A, unmodified Winkler procedure; B, permanganate modification]

	GLUCOSE, P.P.M.												
Procedure	0	10	20	40	80	120	160	200	400	600	1,000	2,000	5,000
	INDICATED DISSOLVED OXYGEN CONTENT												
A	8.63	8.55	8.50	8.45	8.41	8.31	8.27	8.20	7.92	7.70	------	------	------
B	8.64	8.57	8.55	8.55	8.43	8.45	8.42	8.30	8.20	8.00	7.90	7.64	7.18

TABLE 1.—*Magnitude of interference due to glucose*—Continued

APPARENT LOSS OF DISSOLVED OXYGEN

A	0.00	0.08	0.13	0.18	0.22	0.32	0.36	0.43	0.71	0.93	------	------	------
B	0.00	.07	.09	.09	.21	.19	.22	.34	.44	.64	0.74	1.00	1.46

As shown in table 1, the apparent loss of dissolved oxygen is progressively greater with increasing amounts of glucose, irrespective of the procedure used. With the unmodified, or regular, Winkler procedure, the loss of dissolved oxygen reaches 0.93 p.p.m. in the presence of 600 p.p.m. of glucose. Somewhat better results are obtainable with the permanganate modification, although it is clear that this procedure is only partly effective in counteracting the interference.

SOURCE OF INTERFERENCE

Numerous attempts were made to locate the source of the interference. Thus, on the theory that the apparent loss of dissolved oxygen is due to absorption of iodine prior to the titration, the experiment was tried of adding varying amounts of acid for the final acidification. The regular Winkler procedure was used throughout. The results presented in table 2 indicate that the amount of acid used is of little consequence. The behavior of glucose in this respect differs from that of the oxalates (15). These results also indicate that the period of standing after the final acidification and before titration is apparently not a factor.

TABLE 2.—*Effect of increased acidity on interference due to glucose*

Glucose	Sulfuric acid (conc.)	Time of standing after final acidification	Indicated oxygen content	Apparent loss[1]
P.p.m.	*Ml.*	*Min.*	*P.p.m.*	*P.p.m.*
0	1	15	8.56	0.04
0	2	16	8.63	−.03
0	3	17	8.61	−.01
0	4	18	8.60	.00
200	1	5	8.06	.54
200	2	6	8.24	.36
200	3	7	8.21	.39
200	4	8	8.19	.41
200	1	23	8.24	.36
200	2	24	8.27	.33
200	3	25	8.14	.46
200	4	26	8.21	.39

[1] Assuming that the correct oxygen content was 8.60 p.p.m.

In table 3 results are presented which indicate that the apparent loss of dissolved oxygen from samples containing glucose does not depend on the amount of dissolved oxygen present. The dissolved oxygen in these experiments was varied by applying suction to partly filled carboys. Within the range of values found in natural waters, the apparent loss when the concentration of dissolved oxygen was relatively high was much the same as when water of low oxygen content was used.

TABLE 3.—*Effect of variations in dissolved oxygen content on interference due to glucose*

Concentration of dissolved oxygen	Glucose, P.p.m.		
	0	40	200
INDICATED OXYGEN CONTENT			
High	7.80	7.72	7.46
Medium	6.72	6.57	6.06
Low	2.79	2.69	2.43
APPARENT LOSS			
High	0.00	0.08	0.34
Medium	.00	.15	.66
Low	.00	.10	.36

These preliminary experiments have indicated that interference by glucose probably occurs during the period of alkalinization. Further experiments were therefore made to determine the influence of variations in pH value on the rate of oxidation of glucose. Consideration was also given to the effect of variations in pH value on the rate of absorption of dissolved oxygen by manganous hydroxide.

TABLE 4.—*Results with calcium hydroxide as alkalinizing agent*

Glucose	Indicated oxygen content	Apparent loss of oxygen	Glucose	Indicated oxygen content	Apparent loss of oxygen
P.p.m.	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*
0	7.73	0.00	120	7.60	0.13
10	7.67	.06	160	7.57	.16
20	7.69	.04	200	7.55	.18
40	7.73	.00	400	7.43	.30
80	7.70	.03	600	7.23	.50

In the experiments summarized in table 4 a suspension of calcium hydroxide was used as an alkalinizing agent instead of the customary alkaline-iodide mixture. In this manner the pH value of the alkalinized sample was reduced from the usual figure of 13 or over when the sodium hydroxide-potassium iodide mixture is used to a value of about pH 12. Acidification in the presence of the calcium hydroxide suspension was accomplished with hydrochloric acid, and a solution of potassium iodide was added as a separate reagent.

In comparison with results given in previous tables, it appears that the substitution of calcium hydroxide for sodium (or potassium) hydroxide does lead to somewhat better results when large amounts of glucose are present. The advantage, however, is not marked, and for the results given in table 4 it was secured only by extending the period of alkalinization to fully 8 minutes. With shorter periods of contact, the results obtained were decidedly too low, even in the blanks, indicating that the rate of absorption of dissolved oxygen is greatly affected by any lowering of the pH value. As the decomposition of glucose proceeds at a measurable rate at pH 12, it must be concluded that any beneficial effect of working at this relatively low pH value is counteracted by the prolonged exposure required for the complete absorption of the dissolved oxygen.

TABLE 5.—*Rate of absorption of dissolved oxygen by manganous hydroxide*

PERIOD OF CONTACT WITH $Mn(OH)_2$				
8 min.	1 min.	30 sec.	20 sec.	15 sec.
OBSERVED OXYGEN CONTENT[1]				
P.p.m.	*P.p.m.*	*P.p.m.*	*P.p.m.*	*P.p.m.*
8.15	8.17	8.17	8.15	8.18
8.12	8.15	8.15	8.18	8.17
8.16	8.18	8.18	8.17	8.15
APPARENT LOSS OF OXYGEN[2]				
0.02	0.00	0.00	0.02	−0.01
.05	.02	.02	−.01	0.00
.01	−.01	−.01	0.00	.02

[1] Triplicate determinations.
[2] Basis of average value of 8.17.

RATE OF ABSORPTION OF DISSOLVED OXYGEN

On the basis of these and other experiments it appeared desirable to determine more closely the minimum time required for the complete absorption of dissolved oxygen by manganous hydroxide. In these experiments the medium was ordinary distilled water without addition of glucose. The usual Winkler reagents were used, and the tests were started by the addition of 2 ml of manganous sulphate solution followed by 2 ml of alkaline-iodide reagent. The bottles were then stoppered and the precipitate was agitated, either continuously or at frequent intervals, so that the manganous hydroxide at all times was uniformly distributed throughout the bottle. To secure exact periods of contact, the sulphuric acid required for the final acidification was added before the precipitate had settled and a slight correction, the same in each case, was applied for the loss of the precipitate. Under these conditions the reaction is practically complete in 15 seconds at ordinary temperatures (table 5) when intimate contact between the dissolved oxygen and the manganous hydroxide is maintained through the solution. Up to 8 minutes the exact duration of the period of alkalinization did not appear to be of consequence. It will be noted, however, that organic matter was absent in these experiments.

The technique in these experiments differed from that employed by Theriault (15) in similar experiments where the precipitate was allowed to settle completely each time before repeating the shaking. As the precipitate settles very readily, the actual period of contact with the upper portion of the liquid is uncertain when this procedure is followed, and complete absorption can only be obtained by repeating the shaking.

IMPROVED TECHNIQUE FOR DISSOLVED-OXYGEN TESTS

Attempts were next made to reduce interference due to glucose by diminishing the period of contact with the alkaline-iodide to the minimum consistent with the complete absorption of dissolved oxygen. The effectiveness of this procedure in comparison with tests conducted over periods of alkalinization of 2, 4, and 8 minutes is shown by the results presented in table 6.

TABLE 6.—*Effect of varying periods of alkalinization on interference due to glucose*

Period of alkalinization	Glucose, p.p.m.										
	0	40	60	100	160	200	400	600	1,000	2,000	5,000
	APPARENT LOSS OF DISSOLVED OXYGEN [1]										
8 minutes	0	0.10	0.14	0.14	0.14	0.30	0.58	0.74	1.02	1.52	2.45
4 minutes	0	.04	.07	.04	.15	.18	.34	.54	.62	.86	1.52
2 minutes	0	.00	.07	.04	.08	.06	.14	.24	.40	.51	.92
25 seconds	0	.00	.02	.00	.00	.02	.05	.10	.13	.20	.36
15 seconds	0	.00	.00	.10	.02	.09	.05	.10	.13	.24	.26

[1] Results with 1,000 p.p.m. of glucose or over are averages of triplicate determinations.

When the period of alkalinization was 8 minutes the precipitate was first uniformly distributed throughout the bottle and then allowed to settle completely before mixing for a second time. After a third mixing followed by complete subsidence of the precipitate, the sample was acidified and the liberated iodine was titrated with 0.025 M thiosulphate. A similar procedure was employed when the period of alkalinization was 2 and 4 minutes, except that precipitates were allowed to settle only once and twice, respectively. The precipitate was continuously agitated when the shorter periods of 15 and 25 seconds were used, and the acid was added before the precipitate had settled appreciably. The preliminary treatment with permanganate was not used.

The results presented in table 6 indicate that, in the presence of glucose and presumably other forms of organic matter, huge errors may be introduced in the Winkler method if the period of alkalinization is prolonged beyond the time strictly necessary for the absorption of the dissolved oxygen. Under the given conditions it seems fair to conclude that reasonably accurate results for dissolved oxygen can be obtained even in the presence of 5,000 p.p.m. of glucose, provided that the period of alkalinization does not exceed 15 to 25 seconds. It would appear, therefore, that the absorption of dissolved oxygen by manganous hydroxide proceeds at a much faster rate than that of the interfering reaction due to the decomposition of glucose at high pH values. The apparent loss of dissolved oxygen when the period of alkalinization is unduly prolonged may be ascribed to the reduction of the manganic hydroxide by the decomposition products of the glucose.

TABLE 7.—*Magnitude of interference due to peptone*

[A, permanganate modification; B, regular Winkler procedure; C, abbreviated technique, 25 seconds' contact; D, abbreviated technique, 15 seconds' contact]

Procedure	Peptone, p.p.m.									
	0	20	40	80	120	160	200	400	600	1,000
	APPARENT LOSS OF OXYGEN									
A	0	0.20	0.27	0.44	0.57	0.94	1.41	--------	2.12	2.85
B	0	.10	.05	.11	.15	.19	.32	0.62	.74	1.43
C [1]	0	.02	0	.03	.07	.12	.11	.22	.34	.40
D	0	0	.01	.03	.04	.10	.08	.21	.23	.40

[1] Average values in triplicate determinations. Other results are representative series of single observations.

It is to be noted that the rate of absorption of dissolved oxygen by manganous hydroxide depends not only on the pH value at which the reaction occurs but also on the amount of manganous hydroxide present in suspension. It can readily be shown that the period of alkalinization should be approximately doubled when 1 ml each of the Winkler reagents is used instead of 2-ml portions as in the above experiments. A longer period of contact with manganous hydroxide must also be allowed when phosphates, carbonates, and other buffering materials are present in large amounts. Clark (5) recommends a period of alkalinization of at least 10 minutes when dissolved oxygen is determined in samples of sea water. With river waters and with ordinary domestic sewage, a period of contact of 20 to 25 seconds appears to be sufficient when 2-ml portions of the Winkler reagents are added to 300-ml samples.

INTERFERENCE BY PEPTONE

As shown in table 7, the simple expedient of abbreviating the period of alkalinization is also effective in reducing interference due to peptone. Using the regular Winkler procedure (2 ml each of the reagents) and allowing the precipitate to settle twice, the apparent loss of dissolved oxygen was 0.74 p.p.m. when 600 p.p.m. of peptone (Difco) were present. The period of alkalinization in this experiment was about 3 minutes. Using the modified technique (25 seconds' contact), this loss was reduced to 0.34 p.p.m. The corresponding loss with the permanganate modification was 2.12 p.p.m. With large amounts of peptone, the proposed technique is not so effective as with corresponding amounts of glucose. The improvement over the usual procedures is nevertheless marked.

As pointed out by Cooper, Cooper, and Heward (6) in work with peptone solutions, and as further shown by Theriault (15) for stale sewage, the results obtained with the permanganate modification are progressively lower as the period of contact with the permanganate solution is increased, the indication being that dissolved oxygen may be absorbed by peptone and by stale sewage even in the presence of permanganate. In the experiments presented in table 7, this "immediate" demand effect was partly obviated by aerating the stock peptone solution prior to the test. Huge losses may be observed with freshly prepared peptone solutions and with stale sewage irrespective of the procedure used. For the purposes of oxygen-demand tests, the dissolved-oxygen content calculated from the known value for the dilution water may be more nearly correct than the value found by direct analysis. The error in question disappears when the samples are incubated under aerobic conditions for 24 hours or longer.

Apart from its usefulness in work with dilute solutions of dextrose or of peptone, the procedure of reducing the period of alkalinization to a minimum has been found very effective in dealing with concentrated sewage mixtures and sludge liquors. The extension of this technique to such other forms of organic matter as may be encountered in various industrial wastes calls for special study of the individual waste. In dealing with sulphite wastes, for example, this modified or abbreviated technique appears very effective in repressing the deleterious effect of the organic matters present. It is of no value, however, in obviating interference due to the inorganic constituents (sulphites, polythionates, etc.) of such wastes.

INTERFERENCE BY SULPHITE WASTES

A critical study of methods for the determination of dissolved oxygen in the presence of sulphite wastes was undertaken in this laboratory in April 1930 at the request of the State Department of

Health of Maine, in preparation for a cooperative study of stream conditions. A report covering this survey has been published by a committee of paper manufacturers (Joseph A. Warren, chairman, Cumberland Mills, Maine) and the State health department (C. F. Kendall, commissioner, and E. W. Campbell, sanitary engineer) with the collaboration of C. L. Walker, Cornell University, and C. M. Baker, representing the American Pulp and Paper Association. Various modifications of the Winkler method were applied to samples of digester wastes furnished through the courtesy of representative paper manufacturers. The results obtained are of interest in the elucidation of the mechanism of the interference. For this reason they will be briefly discussed before presenting the new modification which finally proved to be reasonably effective.

RIDEAL-STEWART MODIFICATION (PERMANGANATE)

Warrick (State Department of Health of Wisconsin; private communication) had previously indicated that the permanganate or Rideal-Stewart modification of the Winkler method is of doubtful value in counteracting interference due to sulphite wastes. Haase (8) has claimed that the permanganate treatment is useless with these wastes, and in a later publication (9) he has proposed an empirically calibrated electrochemical procedure for the determination of dissolved oxygen in the presence of sulphites.

Bach (2) has confirmed the findings of Haase in regard to the deficiencies of the permanganate procedure and has shown that sodium sulphite may be present in amounts up to 1,000 p.p.m. when the Miller (ferrous ammonium tartrate and safranin) procedure is used, provided that alcohol, at the rate of 10 ml of 95 percent ethyl alcohol per liter, is added as a preliminary treatment.

There is ample evidence in the literature (10) that the oxidation of sulphites by permanganates and also by bromates does not proceed to completion. It appears probable that dithionic acid is formed along with sulphate, so that only 90 to 95 percent of the total sulphite is actually oxidized to sulphate. It is not surprising, therefore, that the Rideal-Stewart (permanganate) modification should prove inadequate in the presence of relatively large amounts of sulphite wastes.

Experiments with the permanganate modification indicate that, in water containing 8 or 9 p.p.m. of dissolved oxygen, the results obtained after adding 1 volume of digester waste to 1,000 volumes of water may be 3 or 4 p.p.m. too low. The total absence of dissolved oxygen may be indicated at dilutions of 1 to 300. As shown by direct observations on the rate of absorption of dissolved oxygen by sulphite wastes, this loss is only apparent. It is not difficult, for instance, to produce a laboratory condition where fish are swimming freely in a water apparently devoid of dissolved oxygen on the basis of the permanganate modification.

ALSTERBERG MODIFICATION (BROMINE)

The Alsterberg (1) modification, based on a preliminary treatment with bromine with subsequent removal of the excess of reagent by salicylic acid, gave somewhat better results than the permanganate treatment. At best, however, the errors were still too great to make this modification of any value for the purpose at hand. The period of contact with the bromine was only 2 minutes in these experiments. A 24-hour period of contact, as recommended by Alsterberg, is impractical with sulphite wastes.

NOLL MODIFICATION (IODINE)

The preliminary oxidation of interfering substances has been accomplished by Noll (13) through the use of iodide in the presence of manganic salts. A solution of iodine is recommended by Lunge (11) and by Winkler (18) when organic matter is present. It is now well known that the oxidation of sulphites by iodine proceeds to completion with the formation of sulphates. This modification, therefore, appeared promising in dealing with sulphite wastes.

In applying the iodine modification a solution of potassium biniodate was first added to 300-ml sample bottles filled with distilled water to which graded amounts of a freshly prepared stock solution of sodium sulphite had also been added. Iodine was then released by acidification in the presence of an iodide. After standing for a few minutes, 0.2 ml of starch solution was added to serve as an indicator and the excess of iodine was removed by the addition of thiosulphate solution, thereby forming tetrathionates. Dissolved oxygen was then determined by the regular Winkler procedure, starting with the addition of 2-ml portions of manganous sulphate and of alkaline-iodide solutions. Starch solution, in the amount added, does not interfere with the Winkler method.

It was noted that the brown precipitate of manganic hydroxide which first forms became rapidly lighter in color on standing. The results for dissolved oxygen were decidedly low, the error increasing somewhat in proportion to the amount of thiosulphate used in the preliminary treatment. Chapin (4) has clearly shown that "tetrathionates are notably sensitive to even low concentrations of hydroxyl ions, although only slightly affected by sodium bicarbonate." The decomposition leads to the formation of sulphites and thiosulphates by which the manganic hydroxide can be reduced to the manganous condition (12). With particular reference to the determination of arsenic, but with equal application to the present problem, Chapin (4) recommends that "as a discharging agent for iodine * * * it seems safer to abandon the use of thiosulphate altogether, and to substitute therefor a dilute solution of sodium sulphite."

Avoiding the use of thiosulphate for the removal of iodine, the preliminary oxidation of sulphites was next accomplished by the cautious addition of an iodine solution to an end point, again using starch as an inside indicator. In other experiments a definite excess of iodine was added and the decolorization was accomplished with a dilute solution of sodium sulphite. Accurate results were obtained in either case with sulphites present to the extent of 2.0 to 12.0 ml of 0.025 M sodium sulphite in 300 ml of distilled water. The loss of dissolved oxygen from dilute sulphite solutions was negligibly small over the short period of standing required in these experiments. In time, however, a gradual deoxygenation is readily shown.

The observation that the use of thiosulphates for the removal of iodine prior to the addition of the Winkler reagents is unsound has an obvious bearing on studies of the chlorination or superchlorination of sewage, industrial wastes, and grossly polluted waters. The usual procedure has been to discharge the excess of chlorine by the addition of an iodide. The liberated iodine is then removed with thiosulphate. The dechlorinated sample may then be used for dissolved-oxygen or oxygen-demand tests. In cases where an excess of iodine is necessarily present it is obviously advisable to substitute sulphites for thiosulphates in the removal of free iodine, thereby forming stable sulphates instead of the readily decomposable tetrathionates.

Although a preliminary treatment with iodine is very efficacious in obviating interference due to sulphites, this procedure was found to be of little value in dealing with sulphite wastes. The indications are that sulphites, as such, are of minor significance in these waste liquors. Other modifications of the Winkler method were therefore examined.

MANGANOUS CARBONATE MODIFICATION

Winkler (18) has proposed an ingenious modification of his original procedure for dissolved oxygen for use in the presence of nitrites and organic matter. The test is conducted in the usual manner up to the removal of dissolved oxygen by the formation of manganous hydroxide, except that the alkalinizing solution need not contain any iodide. The excess of manganous hydroxide is then converted to carbonate by leading in carbon dioxide or by the addition of solid sodium acid carbonate (3). As the carbonate does not absorb oxygen from air, interfering substances are then removed by filtration and the test is completed on the precipitate itself.

In blank experiments using sodium acid carbonate it was found that high results were obtained when the hydrogen-ion concentration corresponded to pH 10 or thereabouts. The best results were obtained by adjustment of solution in the range of pH 7 to 8 with phosphoric acid. At still lower pH values, low results were obtained owing to the loss of precipitate by resolution.

In work with pure sulphite solutions low results were invariably obtained, irrespective of pH adjustments. As already shown, this loss is due to the reduction of the manganic hydroxide by the sulphite, so that the subsequent filtration is purposeless.

Applied to sulphite wastes, the method gave somewhat better results than previously described procedures. At best, however, the errors were still much too great to warrant the extension of this modification to the paper-mill wastes.

MANGANIC CHLORIDE MODIFICATION

The reduction of the manganic hydroxide formed in the course of the dissolved-oxygen test suggests the possibility of counteracting this interference by a preliminary treatment with manganic salts, as originally proposed by Winkler (17). A precipitate of manganous hydroxide was accordingly oxidized by air, and, after acidification, the resulting suspension was used as an oxidizing agent. The excess of manganic salt was reduced by adding potassium iodide, and the liberated iodine was in turn removed with sodium sulphite. The results obtained in this double treatment with manganic salts and iodine were unsatisfactory and the procedure was abandoned.

ACID HYPOCHLORITE MODIFICATION

Winkler (19) has proposed a fourth modification of his original procedure for the determination of dissolved oxygen, based on a preliminary treatment of samples containing readily oxidizable substances with calcium hypochlorite in acid solution. The excess of reagent is removed with potassium thiocyanate and a correction is applied by running a blank.

This method and a later revision (20) proved impractical in work with sulphite wastes owing to the difficulty of obtaining accurate values for the blanks. The results obtained were nevertheless encouraging.

ALKALINE-HYPOCHLORITE MODIFICATION

On the basis of the foregoing experiments and in accord with the work of Foerster et al. (7) on the equilibrium between sulphurous acid and its salts in aqueous solution, the conclusion seems warranted that the interference of sulphite wastes with the Winkler method is only partly due to sulphites as such. As shown by direct titration with iodine solutions, the amount of sulphite present in these wastes is relatively small. The iodine-consuming capacity of these wastes may be increased thirtyfold, however, upon treatment with hydroxides.

It is probably due to the readily decomposable polythionates and to similar organic sulphur compounds that interference due to sulphite wastes is to be ascribed. Under the highly alkaline conditions of the Winkler procedure it is to be expected that these sulphur compounds would break down to form sulphites and thiosulphates. It is obvious that interference would then occur either by reduction of manganic hydroxide or by removal of iodine, as in the final step of the Winkler process.

A preliminary treatment of the sulphite wastes with alkalies, followed by a treatment with iodine in acid solution, does not remedy the situation, as the oxidation of the thiosulphates and trithionates only proceeds to the formation of tetrathionates which are later broken down during the subsequent period of alkalinization.

Now it is known that the oxidation of thiosulphates and the higher polythionates does proceed to completion under the action of chlorine. The method finally adopted, therefore, for the determination of dissolved oxygen in the presence of sulphite wastes consists in a preliminary treatment of the sample with a highly alkaline solution of a hypochlorite. As these conditions are also favorable to the reaction of dissolved oxygen with organic matter and with inorganic sulphur compounds, this preliminary treatment must necessarily be brief. The subsequent treatment calls for the removal of the undecomposed hypochlorite. This is accomplished by acidifying the sample in the presence of an iodide, which is in turn removed with a dilute solution of sodium sulphite. Dissolved oxygen may then be determined in a solution supposedly freed from sulphites, thiosulphates, and the polythionates, although notable amounts of relatively stable forms of organic matter are still present. The technique developed in the first part of this paper for use in the presence of such forms of organic matter as glucose also appears to be reasonably effective in dealing with the organic components of sulphite wastes.

The reader is referred to Supplement No. 90 to the PUBLIC HEALTH REPORTS (16) for detailed instructions regarding the performance of the dissolved-oxygen test in the presence of various interfering substances. For sulphite wastes the recommended procedure is substantially as follows:

1. Add enough alkaline-hypochlorite reagent (1 M sodium hypochlorite in 0.1 M sodium hydroxide) to oxidize the sample, avoiding a great excess.

With river water polluted with sulphite wastes, 0.2 ml of the alkaline-hypo chlorite reagent may be added as a trial amount. In oxygen-demand work, add 1 ml of alkaline-hypochlorite reagent for each milliliter of digester waste present in the bottle under examination.

The alkaline-hypochlorite reagent may be prepared by passing chlorine gas through 2.1 M sodium hydroxide, with cooling, until a 1-ml test portion of the chlorinated solution requires about 20 ml of 0.10 M thiosulphate for the neutralization of the iodine released upon acidification in the presence of an iodide. This reagent should give more than a fleeting color with phenolphthalein.

2. Mix well by inverting rapidly a few times. The duration of this treatment should not greatly exceed 20 seconds.

3. Acidify the sample by adding 1 ml of dilute sulphuric acid (10 percent solution) and add 1 ml of 1 M potassium (or sodium) iodide to release iodine. Shake.

4. Neutralize the liberated iodine with 0.1 or 0.025 M sodium sulphite, using 0.2 ml of starch solution as an inside indicator. If the end point is greatly overstepped, it may be restored with 0.1-ml portions of 0.1 or 0.025 M potassium biniodate or iodate.

The reaction between sulphites and iodine to form sulphates is complete, under the given conditions, only in very dilute solution. Relatively low results will be obtained when more than 3 ml of 0.05 M (0.1 N) sulphite are required for the neutralization of the iodine. On the other hand, if only 0.1 ml or thereabouts of 0.05 M sulphite is required, it may be assumed that an insufficient amount of alkaline-hypochlorite has been used.

5. Add 1 ml of the usual manganous sulphate solution and 1.3 ml of alkaline-iodine solution. A slight excess (0.3 ml) of the alkaline-iodine solution is used in order to neutralize the acid added during the preliminary treatment. The period of contact with the manganous hydroxide should not exceed 40 to 50 seconds.

6. The titration should not be delayed, as a measurable loss of iodine occurs on standing.

Comparative results with the permanganate modification (A), with the unmodified Winkler procedure (B), and with the alkaline-hypochlorite modification (C) are given in table 8. Satisfactory results are obtained by all three procedures when the concentration of digester waste does not exceed 1 part in 30,000 of water. The results with the permanganate modification are decidedly low at dilutions of 1 to 10,000, and the complete absence of dissolved oxygen may be indicated by this procedure at dilutions of 1 to 300.

On the whole, the unmodified, or regular Winkler, method gives better results with sulphite wastes than the permanganate modification. Huge errors, nevertheless, are introduced at dilutions of 1 to 3000 or less.

The alkaline-hypochlorite modification gives reasonably accurate results even in the presence of 1 part of digester waste in 300 parts of sample, corresponding to the situation which might be encountered at sampling points in the immediate vicinity of a paper mill. At dilutions of 1 to 150, however, this method also shows signs of failure.

TABLE 8.—*Magnitude of interference due to sulphite wastes*

[A, permanganate modification; B, regular Winkler procedure; C, alkaline-hypochlorite modification]

Method	Dilution of digester waste, p.p.m.												
	1 to 300,000	1 to 150,000	1 to 60,000	1 to 30,000	1 to 15,000	1 to 10,000	1 to 6,000	1 to 3,000	1 to 1,500	1 to 1,000	1 to 600	1 to 300	1 to 150
	Apparent loss of oxygen [1]												
A	−0.06	0.00	−0.06	0.12	0.34	0.45	0.77	1.68	2.78	3.58	5.67	[2] 8.27	------
B	.03	.07	.10	.15	.02	.30	.24	.54	1.17	1.74	2.63	4.59	7.22
C	0.00	.05	.02	0.00	.04	.07	.06	−.06	.10	.16	.20	.30	1.10

[1] Average values in triplicate determinations.
[2] Corresponding to the total absence of dissolved oxygen.

It will be noted that the values given in table 8 refer to the apparent loss of dissolved oxygen and not to the dissolved-oxygen content. The actual dissolved-oxygen content in all cases was in the neighborhood of 8.5 p.p.m. prior to the addition of digester waste. The possibility exists that, under rigid conditions of test, these apparent losses with different procedures might serve as an index to the amount of waste present in a sample of river water. A less cumbersome and more sensitive test might be devised on the basis of the increase in iodine-consuming capacity of a sample following a treatment with hydroxides.

LITERATURE CITED

(1) Alsterberg, G.: Biochem. Z., **170**, 30–75 (1927).
(2) Bach, H.: Gesundh.-Ing., **54**, 39–41 (1931).
(3) Bruhns, G.: Chem.-Ztg., **39**, 845–8 (1915).
(4) Chapin, R. M.: J. Am. Chem. Soc., **38**, 625–6 (1916).
(5) Clark, H. W.: 15th Annual Rept. of Dept. of Health of Mass., p. 56 (1929).
(6) Cooper, A. E., Cooper, E. A., and Heward, J. A.: Biochem. J., **13**, 349–53 (1919).
(7) Foerster, F., et al.: Z. anorg. Chem., **128**, 245–342 (1923).
(8) Haase, L. W.: Gesundh.-Ing., **52**, 846 (1929).
(9) Haase, L. W.: Ibid., **53**, 289 (1930).
(10) Hendrixson, W. S.: J. Am. Chem. Soc., **47**, 1319–25, 2156–9 (1925).
(11) Lunge, G.: Technical Methods of Chemical Analysis, vol. I, pp. 776 et seq. Gurney and Jackson, 1908.
(12) Meyer, J., and Schramm, W.: Z. anorg. allgem. Chem., **132**, 226–38 (1923).
(13) Noll, H.: Z. angew. Chem., **18**, 1767 (1905).
(14) Rideal, S., and Stewart, C. G.: Analyst, **34**, 141–8 (1909).
(15) Theriault, E. J.: Pub. Health Bull., **151**, 18–29 (1925).
(16) Theriault, E. J.: Pub. Health Repts., Suppl. **90** (1931).
(17) Winkler, L. W.: Ber., **21**, 2843–54b (1888).
(18) Winkler, L. W.: Z. anal. Chem., **53**, 665–72 (1914).
(19) Winkler, L. W.: Z. Nahr. Genussm., **29**, 121–8 (1915).
(20) Winkler, L. W.: Z. angew. Chem., **29** (I), 44–5 (1916).

COURT DECISION RELATING TO PUBLIC HEALTH

Certified copy of birth certificate held admissible in evidence.—(Missouri Supreme Court, Division No. 2; *State* v. *Worden*, 56 S.W. (2d) 595; decided Dec. 14, 1932.) In a criminal case the State introduced in evidence a certified copy of the birth certificate of the prosecuting witness. By section 9052, Revised Statutes 1929, a certificate of birth was required to be filed by the attending physician, and, by section 9060, a certified copy of a certificate was admissible in evidence. On appeal, the introduction of the certified copy was assigned as error, the complaint being that the portion of the law providing for certified copies as evidence was contrary to the State constitution in that the title of the act had no reference to the issuance of certified copies. In holding the certified copy admissible, the supreme court said:

Since original certificates of that character [birth certificates] are required by the statute, section 9058, R.S. 1929 (Mo. St. Ann., sec. 9058), to be permanently kept, such a certificate becomes an official record which is always admissible in evidence. A copy of a public paper required to be filed, certified by the officer intrusted with its custody, is admissible in evidence if the original is admissible. [Cases cited.] A certified copy was admissible without the authority of section 9060 (Mo. St. Ann., sec. 9060).

DEATHS DURING WEEK ENDED OCTOBER 21, 1933

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Oct. 21, 1933	Corresponding week 1932
Data from 85 large cities of the United States:		
Total deaths	7,647	7,348
Deaths per 1,000 population, annual basis	10.7	10.5
Deaths under 1 year of age	531	561
Deaths under 1 year of age per 1,000 estimated live births (81 cities)	46	47
Deaths per 1,000 population, annual basis, first 42 weeks of year	10.8	11.1
Data from industrial insurance companies:		
Policies in force	67,550,341	70,173,439
Number of death claims	13,202	12,741
Death claims per 1,000 policies in force, annual rate	10.2	9.5
Death claims per 1,000 policies, first 42 weeks of year, annual rate	9.8	9.6

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

CURRENT WEEKLY STATE REPORTS

These reports are preliminary, and the figures are subject to change when later returns are received by the State health officers

Reports for Weeks Ended October 28, 1933, and October 29, 1932

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 28, 1933, and Oct. 29, 1932

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932
New England States:								
Maine	2	1	18		1		0	0
New Hampshire					1		0	0
Vermont	1				2	1	0	0
Massachusetts	19	34		2	68	40	0	0
Rhode Island	1	7				1	0	0
Connecticut		5	3	2	5	10	1	2
Middle Atlantic States:								
New York	45	25	[1] 15	[1] 14	170	96	1	6
New Jersey	20	26	9	12	16	93	0	2
Pennsylvania	88	118			8	193	4	2
East North Central States:								
Ohio [2]	124	122	83	94	14	101	0	1
Indiana	66	101	49	55	11	10	0	5
Illinois	41	112	13	17	19	30	4	7
Michigan	22	26	3	5	11	104	1	3
Wisconsin	13	13	34	26	51	123	0	1
West North Central States:								
Minnesota	11	21	1	3	11	102	0	1
Iowa [2]	25	25			2	3	1	2
Missouri	109	92	1	2	3	8	1	1
North Dakota	11	1			1	67	0	0
South Dakota	5	1			20		0	0
Nebraska	6	40			3	5	0	0
Kansas	21	26		3	7	8	0	1
South Atlantic States:								
Delaware	2	4				1	0	0
Maryland [2]	29	22	6	2	3	3	1	2
District of Columbia	12	2	1	1	2		0	0
Virginia [2]	141	61			6	58	0	0
West Virginia	121	69	36	7	6	10	2	1
North Caroline [2] [4]	195	106	15	7	75	60	1	1
South Carolina [2]	40	34	270	393	26	1	0	0
Georgia [2]	67	56			30	1	1	0
Florida [2]	9	18	3	4	2	1	0	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 28, 1933, and Oct. 29, 1932—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932
East South Central States:								
Kentucky	140	82	38	36	------	44	0	1
Tennessee	73	95	78	25	73	1	2	1
Alabama [3]	95	94	79	28	9	2	1	1
Mississippi [3]	36	51	------	------	------	------	0	0
West South Central States:								
Arkansas	52	23	24	37	18	4	0	0
Louisiana	47	29	5	17	1	4	1	2
Oklahoma [5]	79	86	38	25	10	1	0	0
Texas [2]	275	185	104	46	10	------	0	0
Mountain States:								
Montana	2	------	4	14	------	85	0	1
Idaho	------	8	------	------	------	1	0	0
Wyoming	------	------	------	1	1	1	0	0
Colorado	11	6	------	------	3	1	0	0
New Mexico	12	10	------	27	15	------	0	0
Arizona	3	4	3	40	------	1	0	0
Utah [3]	------	------	------	------	51	2	1	1
Pacific States:								
Washington	6	------	------	------	12	5	1	0
Oregon [4]	2	------	25	36	23	23	0	0
California	50	59	18	214	193	40	2	4
Total	2,129	1,900	976	1,195	993	1,345	26	49

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932
New England States:								
Maine	4	3	4	27	0	0	9	2
New Hampshire	1	0	16	26	0	0	2	0
Vermont	2	0	6	11	0	0	1	0
Massachusetts	2	1	121	181	0	0	6	14
Rhode Island	1	0	7	20	0	0	1	0
Connecticut	1	2	39	26	0	0	1	0
Middle Atlantic States:								
New York	29	7	244	238	0	1	13	22
New Jersey	5	8	84	119	0	0	9	7
Pennsylvania	10	32	348	402	0	0	31	55
East North Central States:								
Ohio [2]	21	1	397	436	9	19	19	26
Indiana	1	1	172	117	2	1	15	6
Illinois	5	6	278	284	0	4	12	19
Michigan	4	1	217	218	0	0	22	6
Wisconsin	1	3	98	59	18	1	2	1
West North Central States:								
Minnesota	11	3	38	51	4	0	3	9
Iowa [2]	1	0	70	47	0	2	2	2
Missouri	1	1	124	87	5	0	5	20
North Dakota	4	0	19	2	0	0	2	0
South Dakota	1	0	13	30	0	0	3	2
Nebraska	3	4	34	61	1	3	4	1
Kansas	2	1	119	93	0	1	5	7
South Atlantic States:								
Delaware	0	1	5	7	0	0	1	1
Maryland [3]	2	0	86	79	0	0	14	30
District of Columbia	0	1	9	17	0	0	2	1
Virginia [2]	2	3	143	96	0	0	28	20
West Virginia	5	0	160	77	0	0	32	25
North Carolina [2] [4]	1	1	171	111	0	0	15	17
South Carolina [2]	0	0	28	9	0	1	13	22
Georgia [2]	0	1	33	45	0	0	11	21
Florida [2]	0	0	6	7	0	0	1	0

See footnotes at end of table.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended Oct. 28, 1933, and Oct. 29, 1932—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932	Week ended Oct. 28, 1933	Week ended Oct. 29, 1932
East South Central States:								
Kentucky	0	3	144	88	1	1	39	43
Tennessee	2	4	161	90	2	0	30	24
Alabama [2]	1	1	55	56	0	0	16	5
Mississippi [3]	0	0	31	45	0	0	9	4
West South Central States:								
Arkansas	0	3	33	17	0	0	11	9
Louisiana	0	0	24	18	1	1	27	6
Oklahoma [5]	0	2	26	50	1	0	27	28
Texas [2]	1	2	94	80	4	1	54	23
Mountain States:								
Montana	0	0	5	16	0	0	2	2
Idaho	0	1	4	3	2	2	0	3
Wyoming	0	0	5	18	0	0	0	0
Colorado	0	1	34	33	5	1	9	3
New Mexico	0	0	26	14	1	0	33	17
Arizona	0	0	12	15	0	0	3	4
Utah [3]	0	0	1	--------	0	0	0	1
Pacific States:								
Washington	3	1	37	27	1	5	2	5
Oregon [4]	1	1	38	12	3	2	4	3
California	5	4	171	115	10	5	13	7
Total	133	104	3,990	3,680	70	51	563	523

[1] New York City only.
[2] Typhus fever, week ended Oct. 28, 1933, 55 cases, as follows: Ohio, 9; Virginia, 2; North Carolina, 2; South Carolina, 1; Georgia, 17; Florida, 2; Alabama, 17; Texas, 5.
[3] Week ended earlier than Saturday.
[4] Rocky Mountain spotted fever, week ended Oct. 28, 1933, 2 cases, as follows: North Carolina, 1; Oregon, 1.
[5] Exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of cases reported monthly by States is published weekly and covers only those States from which reports are received during the current week.

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
September 1933										
Alabama	3	326	84	1,320	53	99	6	187	1	98
California	8	116	95	6	322	2	17	408	29	46
Kansas	1	40	8	3	27	--------	12	251	2	38
Mississippi	--------	116	627	18,339	164	469	2	58	2	52
Oklahoma [1]	5	234	92	423	41	13	12	66	3	192
Oregon	1	20	51	9	--------	--------	7	48	4	24
Texas	6	498	562	2,557	--------	47	7	177	--------	298
Virginia	7	300	277	58	53	9	10	320	0	142
Washington	2	20	20	--------	112	--------	27	59	11	25

[1] Exclusive of Oklahoma City and Tulsa.

September 1933

	Cases
Actinomycosis:	
California	2
Anthrax:	
Kansas	1
Virginia	1
Botulism:	
California	1
Chicken pox:	
Alabama	3
California	347
Kansas	34
Mississippi	111
Oklahoma [1]	4
Oregon	26
Virginia	20
Washington	127
Diarrhea and dysentery:	
Virginia	335
Dysentery:	
California (amebic)	7
California (bacillary)	24
Mississippi (amebic)	44
Oklahoma [1]	90
Oregon	2
Food poisoning:	
California	42
German measles:	
California	32
Kansas	3
Washington	15
Hookworm disease:	
Mississippi	873
Impetigo contagiosa:	
Kansas	17
Oklahoma [1]	2
Oregon	115
Washington	1
Leprosy:	
California	1
Lethargic encephalitis:	
Alabama	5
California	6
Kansas	75
Mississippi	1
Oklahoma [1]	13

September 1933—Continued

	Cases
Lethargic encephalitis—Continued.	
Oregon	2
Texas	25
Virginia	6
Washington	6
Mumps:	
Alabama	23
California	549
Kansas	57
Mississippi	39
Oklahoma [1]	11
Oregon	8
Virginia	13
Washington	60
Ophthalmia neonatorum:	
California	1
Oklahoma [1]	1
Virginia	3
Paratyphoid fever:	
California	3
Kansas	3
Oregon	3
Texas	10
Virginia	7
Washington	1
Puerperal septicemia:	
Mississippi	22
Washington	2
Rabies in animals:	
California	56
Mississippi	3
Washington	6
Relapsing fever:	
California	2
Rocky Mountain spotted fever:	
California	1
Virginia	2
Scabies:	
Kansas	18
Oklahoma [1]	4
Oregon	65
Washington	11

September 1933—Continued

	Cases
Septic sore throat:	
California	4
Kansas	4
Oklahoma [1]	42
Oregon	1
Virginia	9
Tetanus:	
California	5
Kansas	3
Oklahoma [1]	2
Trachoma:	
California	20
Kansas	1
Mississippi	14
Oklahoma [1]	8
Trench mouth:	
Oklahoma [1]	2
Oregon	6
Trichinosis:	
California	4
Tularaemia:	
Virginia	3
Typhus fever:	
Alabama	143
Undulant fever:	
California	12
Kansas	8
Oklahoma [1]	4
Oregon	6
Virginia	6
Washington	1
Vincent's angina:	
Kansas	6
Oregon	10
Whooping cough:	
Alabama	92
California	816
Kansas	183
Mississippi	534
Oklahoma [1]	34
Oregon	33
Virginia	143
Washington	79

LETHARGIC ENCEPHALITIS, ST. LOUIS, MO.

From July 1 to November 3, 1933, 561 cases of lethargic encephalitis were reported in the city of St. Louis, Mo., with 124 deaths. In the county of St. Louis during this period there were 501 cases of lethargic encephalitis with 89 deaths.

WEEKLY REPORTS FROM CITIES

City reports for week ended Oct. 21, 1933

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Maine:											
Portland	0		0	0	1	0	0	0	0	8	28
New Hampshire:											
Concord	0		0	0	0	0	0	0	0	0	8
Manchester	0		0	0	0	0	0	1	0	0	16
Nashua	0		0	0	0	17	0	0	1	0	1
Vermont:											
Barre	0		0	0	0	0	0	0	0	0	4
Burlington	0		0	0	0	1	0	0	0	0	4
Massachusetts:											
Boston	5		1	19	20	36	0	7	1	38	188
Fall River	0		0	0	1	1	0	1	0	1	26
Springfield	0		0	1	0	1	0	1	0	10	33
Worcester	0		0	23	3	0	0	1	0	18	43
Rhode Island:											
Pawtucket	0		0	0	0	1	0	0	0	0	16
Providence	0		0	0	2	8	0	1	0	36	42

[1] Exclusive of Oklahoma City and Tulsa.

City reports for week ended Oct. 21, 1933—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Connecticut:											
Bridgeport	0	2	2	1	3	8	0	1	0	0	40
Hartford	0		0	0	2	2	0	0	0	0	36
New Haven	0	2	0	0	2	2	0	0	0	4	42
New York:											
Buffalo	3		0	3	20	15	0	4	0	27	124
New York	37	10	3	12	129	62	0	75	18	129	1,362
Rochester	0		1	0	3	0	0	2	0	7	59
Syracuse	0		0	0	1	0	0	0	0	13	37
New Jersey:											
Camden	1		0	0	0	5	0	1	0	0	24
Newark	0	3	0	2	6	10	0	8	0	36	100
Trenton	0	2	0	0	1	7	0	3	0	2	40
Pennsylvania:											
Philadelphia	4	1	0	15	23	42	0	17	1	38	448
Pittsburgh	8	3	1	1	21	12	0	6	1	10	149
Reading	0		0	1	1	0	0	1	0	11	23
Ohio:											
Cincinnati	11		0	1	12	22	0	5	0	7	128
Cleveland	19	35	0	0	11	43	0	13	2	27	182
Columbus	1	1	1	0	3	18	0	4	1	2	82
Toledo	3		0	0	5	16	0	1	0	3	76
Indiana:											
Fort Wayne	4		0	0	5	1	0	0	0	0	28
Indianapolis	0		0	0	5	9	0	5	1	3	
South Bend	0		0	0	0	11	0	1	0	1	17
Terre Haute	0		0	0	1	0	0	2	0	0	15
Illinois:											
Chicago	0	2	1	5	30	84	0	33	0	45	709
Springfield	0		0	0	2	3	0	0	0	0	25
Michigan:											
Detroit	13	3	2	5	11	46	0	18	1	85	188
Flint	3		0	0	1	21	0	4	0	4	24
Grand Rapids	0		0	0	1	7	0	0	0	0	18
Wisconsin:											
Kenosha	0		0	0	0	1	0	0	0	5	9
Madison	0			0		1	0		0	23	27
Milwaukee	3		0	5	5	7	0	4	1	61	94
Racine	0		0	0	0	7	0	0	0	4	7
Superior	0		0	0	0	2	0	0	0	2	7
Minnesota:											
Duluth	0		0	0	5	4	0	1	1	0	24
Minneapolis	7		0	1	3	11	0	1	0	14	111
St. Paul	0		0	0	3	9	0	0	0	4	55
Iowa:											
Des Moines	5			0		13	0		0	0	32
Sioux City	2			1		0	0		0	2	
Waterloo	1			0		0	0		0	0	
Missouri:											
Kansas City	1		0	1	7	10	0	4	5	2	82
St. Joseph	2		0	0	1	3	0	0	0	0	21
St. Louis	17		1	2	2	16	0	10	0	9	174
North Dakota:											
Fargo	0		0	0	0	0	0	0	0	0	0
Grand Forks	0		0	0	0	0	0	0	0	0	0
South Dakota:											
Aberdeen	0		0	1	0	0	0	0	2	0	0
Nebraska:											
Omaha	4		0	1	5	6	0	2	0	6	47
Kansas:											
Topeka	0		0	0	0	2	0	0	0	2	15
Wichita	1		0	0	1	13	0	3	0	1	28
Delaware:											
Wilmington	1		0	1	4	0	0	0	1	0	48
Maryland:											
Baltimore	7	5	1	0	20	22	0	11	4	23	199
Cumberland	1		0	0	0	9	0	1	0	2	11
Frederick	0		0	0	0	3	0	0	0	0	3
District of Col.:											
Washington	8	1	1	1	5	10	0	14	5	3	139
Virginia:											
Lynchburg	7		0	0	0	3	0	1	0	7	5
Richmond	9		2	0	4	4	0	1	0	0	46
Roanoke	4		0	1	1	7	0	0	0	0	17
West Virginia:											

[1] Imported cases.

City reports for week ended Oct. 21, 1933—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Virginia—Contd.											
Charleston	2	------	0	0	1	1	0	0	[1] 6	0	9
Huntington	3	------	0	0	0	18	0	0	0	0	0
Wheeling	0	------	0	0	2	3	0	0	2	0	11
North Carolina:											
Raleigh	3	------	0	0	0	12	0	1	0	0	18
Wilmington	2	------	0	0	1	4	0	1	0	0	12
Winston-Salem	16	------	0	0	2	10	0	0	0	0	14
South Carolina:											
Charleston	0	12	0	0	3	1	0	1	0	0	28
Columbia	0	------	0	0	2	0	0	0	0	0	11
Greenville	1	------	0	0	0	1	0	1	0	2	12
Georgia:											
Atlanta	14	11	0	0	5	7	0	2	0	3	80
Brunswick	0	------	0	1	0	0	0	0	0	0	4
Savannah	1	10	0	0	1	2	0	1	1	0	28
Florida:											
Miami	2	1	0	1	0	0	0	0	2	1	15
Tampa	2	3	3	0	0	0	0	1	0	0	29
Kentucky:											
Ashland	6	------	0	0	0	6	0	0	2	0	--------
Lexington	5	1	0	0	2	6	0	1	0	0	16
Louisville	37	3	0	0	4	18	0	4	1	2	66
Tennessee:											
Memphis	5	------	1	0	5	15	0	6	4	1	86
Nashville	8	------	0	0	5	11	0	1	1	0	67
Alabama:											
Birmingham	5	4	2	0	3	13	0	2	0	0	71
Mobile	3	------	0	0	0	0	0	1	0	3	25
Montgomery	4	------	--------	0	-------	5	0	-------	0	0	--------
Arkansas:											
Fort Smith	1	------	--------	0	-------	1	0	-------	0	0	--------
Little Rock	[2] 1	------	0	4	2	1	0	1	0	0	4
Louisiana:											
New Orleans	12	2	3	2	15	9	0	13	4	0	140
Shreveport	10	------	0	0	2	1	0	1	1	0	18
Texas:											
Dallas	20	------	0	0	1	5	0	4	0	0	57
Fort Worth	4	------	0	0	6	6	0	0	1	0	34
Galveston	0	------	0	0	1	0	0	0	0	0	11
Houston	18	------	0	2	6	3	0	3	0	0	67
San Antonio	2	------	0	0	0	1	0	8	0	0	57
Montana:											
Billings	0	------	0	0	0	0	0	0	0	1	5
Great Falls	0	------	0	1	0	0	0	1	0	0	11
Helena	0	------	0	0	0	0	0	0	0	0	0
Missoula	0	------	0	0	0	3	0	0	0	0	3
Idaho:											
Boise	0	------	0	0	0	0	0	1	0	0	8
Colorado:											
Denver	1	16	0	3	4	10	3	5	2	28	71
Pueblo	0	------	0	0	1	0	0	1	2	2	10
New Mexico:											
Albuquerque	0	------	0	0	0	2	0	4	3	0	8
Utah:											
Salt Lake City	3	------	0	11	2	3	0	0	0	6	26
Nevada:											
Reno	0	------	0	0	0	0	0	0	0	0	2
Washington:											
Seattle	1	------	--------	0	-------	3	0	-------	0	14	--------
Spokane	0	1	1	6	3	0	0	1	0	3	30
Tacoma	0	------	0	0	2	1	0	1	0	1	26
Oregon:											
Portland	0	------	1	0	4	21	4	1	0	0	83
Salem	0	1	0	0	0	0	0	0	0	0	0
California:											
Los Angeles	27	21	0	5	16	35	0	17	0	30	285
Sacramento	2	------	0	1	1	6	0	4	4	4	30
San Francisco	3	------	0	2	4	3	0	8	2	7	157

[2] Nonresident.

City reports for week ended Oct. 21, 1933—Continued

State and city	Meningococcus meningitis		Polio-myelitis cases
	Cases	Deaths	
Maine:			
Portland	0	0	1
Massachusetts:			
Boston	0	0	2
Worcester	0	0	1
New York:			
New York	1	0	6
Syracuse	0	0	2
New Jersey:			
Newark	0	0	1
Trenton	1	0	0
Pennsylvania:			
Philadelphia	0	1	0
Pittsburgh	0	0	1
Ohio:			
Cincinnati	0	0	1
Cleveland	0	0	4
Toledo	0	0	1
Indiana:			
Indianapolis	3	0	0
Illinois:			
Chicago	4	1	1
Michigan:			
Detroit	0	0	2
Minnesota:			
Duluth	0	0	3
Minneapolis	0	0	6
St. Paul	0	0	1
Iowa:			
Des Moines	0	0	1
Missouri:			
St. Joseph	0	0	1
St. Louis	0	0	1
Georgia:			
Atlanta	0	0	1
Louisiana:			
New Orleans	1	0	0
Colorado:			
Denver	0	1	0
Utah:			
Salt Lake City	0	0	1
Washington:			
Seattle	1		3
California:			
Los Angeles	0	0	1
San Francisco	0	0	1

Lethargic encephalitis.—Cases: New York, 3; Philadelphia, 1; Springfield, Ill., 1; Kansas City, Mo., 4; St. Louis, 14; Louisville, 3; Nashville, 1; Fort Worth, Tex., 1; San Antonio, 2; Portland, Oreg., 1; Sacramento, 1.

Pellagra.—Cases: Philadelphia, 1; Lynchburg, Va., 3; Charleston, S.C., 2; Dallas, Tex., 2.

Typhus fever.—Cases: Savannah, 1; Tampa, 2; Galveston, Tex., 1. Deaths: Galveston, 1.

FOREIGN AND INSULAR

CANADA

Quebec Province—Communicable diseases—Two weeks ended October 21, 1933.—The Bureau of Health of the Province of Quebec, Canada, reports cases of certain communicable diseases for the 2 weeks ended October 21, 1933, as follows:

Disease	Cases	Diseases	Cases
Cerebrospinal meningitis	1	Ophthalmia neonatorum	1
Chicken pox	133	Poliomyelitis	9
Diphtheria	49	Scarlet fever	160
Erysipelas	5	Tuberculosis	95
German measles	3	Typhoid fever	147
Influenza	1	Whooping cough	183
Measles	59		

CZECHOSLOVAKIA

Communicable diseases—August 1933.—During the month of August 1933 certain communicable diseases were reported in Czechoslovakia as follows:

Disease	Cases	Deaths	Diseases	Cases	Deaths
Anthrax	17		Paratyphoid fever	38	2
Cerebrospinal meningitis	5	1	Poliomyelitis	18	2
Chicken pox	34		Puerperal fever	38	18
Diphtheria	1,636	97	Scarlet fever	1,192	19
Dysentery	14		Trachoma	131	
Influenza	26	1	Typhoid fever	654	35
Malaria	232		Typhus fever	1	

PUERTO RICO

Notifiable diseases—Four weeks ended October 7, 1933.—During the 4 weeks ended October 7, 1933, cases of certain notifiable diseases were reported in the municipalities of Puerto Rico, as follows:

Disease	Cases	Disease	Cases
Chicken pox	20	Pellagra	3
Diphtheria	48	Pink eye	1
Dysentery	176	Ringworm	11
Erysipelas	2	Syphilis	12
Filariasis	40	Tetanus	2
Influenza	47	Tetanus (infantile)	6
Malaria	3,856	Trachoma	16
Measles	83	Tuberculosis	476
Meningeal tuberculosis	1	Tuberculosis (intestinal)	1
Mumps	64	Typhoid fever	35
Ophthalmia neonatorum	6	Whooping cough	123
Paratyphoid fever	1		

NOTE.—The above figures are a continuation of the table on p. 1205 of the Public Health Reports of Sept. 29, 1933, and not of the table on p. 1275.

CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

(NOTE.—A table giving current information of the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS for Oct. 27, 1933, pp. 1328–1339. A similar cumulative table will appear in the PUBLIC HEALTH REPORTS to be issued Nov. 24, 1933, and thereafter, at least for the time being, in the issue published on the last Friday of each month.)

Cholera

Philippine Islands.—During the week ended October 28, 1933, cholera was reported in the Philippine Islands as follows: Antique Province, Dao, 8 cases, 10 deaths; Bohol Province, Clarin, 2 cases, 2 deaths, Inabanga, 7 cases, 8 deaths, Jetafe, 41 cases, 19 deaths, Tubigon, 2 cases, 2 deaths; Cebu Province, Cebu City, 6 cases, 2 deaths, Talisay, 1 case, 1 death, Toledo, 3 cases, 1 death; Iloilo Province, Lawigan, 1 case, 1 death, San Joaquin, 11 cases, 10 deaths. From October 1 to 8, 1933, cholera was reported in Samar Province as follows: Gandara, 2 cases, Santa Margarita, 5 cases, 4 deaths, and Tarangnan, 4 cases, 4 deaths.

Typhus Fever

Irish Free State—Kerry county—Dingle.—During the week ended October 14, 1933, 4 cases of typhus fever were reported in Dingle, Kerry County, Irish Free State.

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