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PREVALENCE OF COMMUNICABLE DISEASES IN THE UNITED STATES

September 11–October 8, 1938

The accompanying table summarizes the prevalence of eight important communicable diseases, based on weekly telegraphic reports from State health departments, published each week in the PUBLIC HEALTH REPORTS under the section "Prevalence of disease." The table gives the number of cases of these diseases for the 4-week period ending October 8, the number reported for the corresponding period in 1937, and the median number for the years 1933–37.

DISEASES ABOVE MEDIAN PREVALENCE

Influenza.—The expected seasonal rise of influenza was apparent in all regions of the country. The number of cases (2,653) was about 35 percent above the number reported for the corresponding period in 1937, which figure also represents the median incidence for the years 1933–37. The South Atlantic and South Central areas seemed to be mostly responsible for the excess incidence; in the South Atlantic region the number of cases (1,219) was the highest reported in that region in recent years. The incidence was relatively low in the North Central and Pacific areas and about normal in the North Atlantic area.

Smallpox.—For the 4 weeks ending October 8 there were 157 cases of smallpox reported, as compared with 232, 123, and 109 for the corresponding period in 1937, 1936, and 1935, respectively. While the current incidence was only about 70 percent of the incidence in 1937, it was still high in relation to the 1933–37 average. Of the various geographic areas the East North Central, East South Central, Mountain, and Pacific reported more than the average number of cases, while in the West North Central, West South Central, and South Atlantic regions the incidence was slightly below the average. The North Atlantic regions remained free from the disease.

Measles.—The reported number of cases (3,033) of measles for the current period was only slightly below that for the corresponding period in 1937. For the country as a whole the incidence was about 30 percent in excess of the 1933–37 median incidence, and in each geographic area except the Middle Atlantic and West South Central the number of cases was considerably above the average incidence of recent years.

Number of reported cases of 8 communicable diseases in the United States during the 4-week period September 11–October 8, the number for the corresponding period in 1937, and the median number of cases reported for the corresponding period 1933–37 [1]

Division	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median	Current period	1937	5-year median
	Diphtheria			Influenza [2]			Measles [3]			Meningococcus meningitis		
United States [1]	3,309	2,849	3,566	2,653	1,955	1,955	3,033	3,081	2,306	113	212	212
New England	30	31	46	13	12	12	182	107	119	6	7	8
Middle Atlantic	154	200	292	59	65	55	389	1,083	523	28	48	44
East North Central	367	389	528	177	237	237	506	682	410	13	41	41
West North Central	228	160	304	117	123	148	397	189	158	10	22	17
South Atlantic	1,262	1,064	1,064	1,219	535	716	374	249	249	27	34	30
East South Central	616	485	709	265	163	156	121	195	104	18	25	25
West South Central	400	329	329	591	614	278	110	117	117	6	18	11
Mountain	106	98	75	136	101	65	274	319	98	4	7	6
Pacific	146	93	122	76	105	123	680	140	344	1	10	9
	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
United States [1]	244	2,615	1,271	6,621	7,431	8,107	157	232	123	1,737	2,211	2,604
New England	11	189	125	286	382	432	0	0	0	38	63	52
Middle Atlantic	56	458	458	851	1,125	1,276	0	0	0	207	322	322
East North Central	54	750	280	2,148	2,312	2,312	25	16	16	238	341	408
West North Central	32	550	87	854	1,098	831	28	60	34	115	210	205
South Atlantic	32	83	83	839	849	897	1	5	2	357	359	544
East South Central	25	57	57	558	442	611	9	7	2	217	233	433
West South Central	11	233	20	341	302	212	9	21	21	341	413	413
Mountain	9	124	53	223	425	302	38	47	17	132	180	180
Pacific	14	171	109	521	496	572	47	76	22	92	90	93

[1] 48 States. Nevada is excluded, and the District of Columbia is counted as a State in these reports.
[2] 44 States and New York City.
[3] 46 States. Mississippi and Georgia are excluded.

DISEASES BELOW MEDIAN PREVALENCE

Poliomyelitis.—The incidence of poliomyelitis (244 cases) was the lowest recorded for this period in the 10 years for which these data are available. As the summer rise of this disease usually reaches its peak during the month of September, it is now apparently safe to say that the year 1938 will be free from an epidemic of this disease. At this time in 1937 an epidemic that started in the South Central region and spread into the North Central and North Atlantic areas was in progress; in 1936 a minor epidemic was confined mostly to the East South Central area, while in 1935 Atlantic Seaboard States experienced a more serious epidemic. In 1932, the only nonepidemic year since 1929, there were 984 cases reported for the period corresponding to the current one.

Meningococcus meningitis.—The number of cases of meningococcus meningitis was also the lowest in the 10 years for which these data are available. For the current period, 113 cases were reported, as compared with 212, 237, and 240 for the corresponding period in 1937, 1936, and 1935, respectively. As the median figure (212) for the preceding 5 years falls in a year of rather high incidence, a comparison with the average (148 cases) for the years 1932, 1933, and 1934 greatly emphasizes the current low incidence of this disease.

Typhoid fever.—The incidence of typhoid fever was the lowest recorded for this period in recent years. The number of cases (1,737) was less than 80 percent of the number reported for the corresponding period in 1937, and only about 65 percent of the 1933–37 average incidence. In each region except the Pacific the number of cases was definitely below the seasonal expectancy.

Diphtheria.—The number of cases (3,309) of diphtheria was about 20 percent above that for the corresponding period in 1937 and about 50 percent above the 1936 figure, but it was low compared with the average incidence for the years 1933–37. The North Atlantic, North Central, and East South Central regions reported a relatively low incidence, while in the South Atlantic, West South Central, Mountain, and Pacific areas the incidence was slightly above the normal expectancy. The largest number of cases was reported from the South Atlantic, where the incidence during this period was the highest in 5 years.

Scarlet fever.—The number of cases of scarlet fever rose from approximately 3,300 during the 4 weeks ending September 10 to 6,621 for the 4 weeks ending October 8. The increase was about normal, however, for this season of the year. The incidence was about 10 percent below that of last year and 20 percent below the 1933–37 average incidence. The West South Central region reported more cases than might normally be expected, but in all other regions the situation was quite favorable.

MORTALITY, ALL CAUSES

The average mortality rate from all causes in large cities for the 4 weeks ending October 8, based on data received from the Bureau of the Census, was 10.2 per 1,000 inhabitants (annual basis). The rate for this period in 1937 was 10.4 and the average rate for the five preceding years was 9.8. While the current rate is slightly below that for last year, it is apparently a little above normal for this season of the year.

DISABLING SICKNESS AMONG MALE INDUSTRIAL EMPLOYEES DURING THE SECOND QUARTER AND THE FIRST HALF OF 1938[1]

By WILLIAM M. GAFAFER, *Senior Statistician* and ELIZABETH S. FRASIER, *Junior Statistician, United States Public Health Service*

First half.—All through the first six months of 1938 a favorable health record was indicated among industrial employees by reports from 26 industrial sick benefit organizations covering an average of 168,233 male employees. The frequency of sickness causing disability for more than one week was 28 percent lower in the first half of 1938 (76.8) than in the same half of 1937 (106.1) and 13 percent below the incidence rate for the corresponding periods of 1933–1937 (88.2). The frequency of nonindustrial injuries was approximately the same for the first six months of 1938 and the corresponding months of the two preceding periods under comparison.

For respiratory diseases as a group, the rate for 1938 (30.7), compared with the rates for 1937 (56.4) and 1933–37 (41.2), shows a decrease of 46 percent and 25 percent, respectively. The incidence of new cases of respiratory tuberculosis was slightly greater during the first half of 1938 than during the corresponding months of 1937 or of 1933–37. All of the other diseases included in the respiratory group show decreases in frequency during 1938 as compared with 1937.

Nonrespiratory diseases as a whole occurred at slightly lower rates in the first half of 1938 than in the same halves of 1933–37. The rate for 1938, however, was 7 percent below that for the first half of 1937.

Second quarter.—The favorable frequency rate of sickness among male industrial employees reported for the first quarter of 1938 continued through the second quarter of 1938. A comparison of the rates for the two quarters reveals only tuberculosis of the respiratory system and diseases of the stomach, except cancer, with higher rates in 1938; the remaining causes and cause groups showing rates of like or smaller magnitude. The rates for all sickness (64.8), respiratory diseases (22.1), and nonrespiratory diseases (42.7) are the lowest second-quarter rates since 1934 in which year the corresponding rates were, respectively, 63.2, 20.9, and 42.3

[1] From the Division of Industrial Hygiene, National Institute of Health, Washington, D. C. For the first quarter of 1938, see Pub. Health Rep., *53:* 1569–1570 (September 2, 1938).

TABLE 1.—*Frequency of disabling cases of sickness and nonindustrial injuries lasting 8 consecutive calendar days or longer among* MALE *employees in various industries, by cause; the second quarter of 1938 compared with the second quarter of 1937, and the first half of 1938 compared with the first halves of 1933–37, inclusive* [1]

Cause. (Numbers in parentheses are disease title numbers from the International List of the Causes of Death, 1929)	Annual number of cases per 1,000 males				
	Second quarter of—		First half of—		
	1938	1937	1938	1937	1933–37
Sickness and nonindustrial injuries [2]	75.1	88.6	87.5	116.8	98.6
Nonindustrial injuries (163–198)	10.3	11.3	10.7	10.7	10.4
Sickness [2]	64.8	77.3	76.8	106.1	88.2
Respiratory diseases	22.1	27.6	30.7	56.4	41.2
Influenza and grippe (11)	7.2	9.3	12.1	34.1	22.4
Bronchitis, acute and chronic (106)	3.1	3.9	4.7	5.7	4.5
Diseases of the pharynx and tonsils (115a)	4.8	6.2	5.1	6.1	5.4
Pneumonia, all forms (107–109)	1.9	2.7	2.5	3.5	3.0
Tuberculosis of the respiratory system (23)	1.1	.8	1.0	.8	.9
Other respiratory diseases (104, 105, 110–114)	4.0	4.7	5.3	6.2	5.0
Nonrespiratory diseases	42.7	49.7	46.1	49.7	47.0
Digestive diseases	13.1	13.9	13.3	13.7	13.2
Diseases of the stomach, except cancer (117, 118)	4.1	3.8	4.0	3.8	3.6
Diarrhea and enteritis (120)	.9	1.3	.8	1.1	1.1
Appendicitis (121)	4.1	4.7	4.2	4.6	4.0
Hernia (122a)	1.8	1.8	1.8	1.7	1.6
Other digestive diseases (115b, 116, 122b–129)	2.2	2.3	2.5	2.5	2.9
Nondigestive diseases	29.6	35.8	32.8	36.0	33.8
Diseases of the heart and arteries, and nephritis (90–99, 102, 130–132)	3.5	3.7	4.1	4.3	4.1
Other genitourinary diseases (133–138)	2.1	2.6	2.4	2.4	2.4
Neuralgia, neuritis, sciatica (87a)	1.8	2.0	2.3	2.3	2.3
Neurasthenia and the like (part of 87b)	1.0	1.4	1.0	1.1	1.0
Other diseases of the nervous system (78–85, part of 87b)	.9	1.2	1.2	1.0	1.3
Rheumatism, acute and chronic (56, 57)	3.9	4.6	4.2	4.5	4.9
Diseases of the organs of locomotion, except diseases of the joints (156b)	2.8	3.1	2.8	2.9	2.9
Diseases of the skin (151–153)	2.7	2.9	2.8	3.0	2.5
Infectious and parasitic diseases (1–10, 12–22, 24–33, 36–44)	2.4	3.9	2.6	3.9	3.3
Ill-defined and unknown causes (200)	1.5	3.4	2.0	3.5	2.4
All other diseases (45–55, 58–77, 88, 89, 100, 101, 103, 154–156a, 157, 162)	7.0	7.0	7.4	7.1	6.7
Average number of males covered in the record	164,215	188,038	168,233	182,124	151,399
Number of organizations	26	26	26	26	--------

[1] In 1938 and 1937 the same organizations are included; the rates for the first halves of the years 1933–37, however, are based on records from the same 26 organizations and some additional reporting organizations.
[2] Exclusive of disability from the venereal diseases and a few numerically unimportant causes of disability.

STUDIES OF SEWAGE PURIFICATION

VIII. Observations on the effect of variations in the initial numbers of bacteria and of the dispersion of sludge flocs on the course of oxidation of organic material by bacteria in pure culture [1]

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In earlier studies (*1*) of the fundamentals of the biochemical oxidation process, conducted with simple reproducible media and with pure cultures of bacteria, it was stated tentatively, among other conclusions, that:

1. Under natural conditions oxidation does not occur in the absence of living biological agents.
2. Oxidation takes place only as a result of the metabolic activity and proliferation of living bacteria, and is proportionate, though perhaps not directly, to the number of new cells produced.
3. The oxidation occurring during any time interval is proportional to the amount of food or organic material utilized by the bacteria.

This is the equivalent of saying that in a given set of such oxidations carried on under standardized conditions, the initial course of the oxidation observed will be governed by the number of effective units of living bacterial protoplasm present at the start of each series of observations.

Under standardized conditions (i. e., with a simple reproducible medium, a constant temperature, an adequate supply of oxygen, and a pure culture of bacteria) a definite, fixed amount of oxygen is required to oxidize the food material available to the bacterial species employed. Assuming a uniform generation time for the bacteria employed under the standardized conditions, it is reasonable to believe that the time required for this species of bacteria to oxidize all

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[1] Prepared for presentation before the joint meeting of the New England and New York Sewage Works Association at Hartford, Conn., Oct. 7, 1938.

The following are the preceding papers of the series:

I. Apparatus for the determination of dissolved oxygen in sludge-sewage mixtures. By Emery J. Theriault and Paul D. McNamee. Pub. Health Rep., 50: 480 (1935). Reprint No. 1680. (Originally printed in Sewage Works J., 6: 413 (1934).)

II. A zooglea-forming bacterium isolated from activated sludge. By C. T. Butterfield. Pub. Health Rep., 50: 671 (1935). Reprint No. 1686.

III. The clarification of sewage—A review. By Emery J. Theriault. Pub. Health Rep., 50: 1581 (1935). Reprint No. 1715. (Sewage Works J., 7: 377 (1935).)

IV. The use of chlorine for the correction of sludge bulking in the activated sludge process. By R. S. Smith and W. C. Purdy. Pub. Health Rep., 51: 617 (1936) Reprint No. 1746. (Sewage Works J., 8: 223 (1936).)

V. Oxidation of sewage by activated sludge. By P D. McNamee. Pub. Health Rep., 51: 1034 (1936). Reprint No. 1774. (Sewage Works J., 8: 562 (1936).)

VI. Biochemical oxidation by sludges developed by pure cultures of bacteria isolated from activated sludge By C. T. Butterfield, C. C. Ruchhoft, and P D. McNamee. Pub. Health Rep., 52: 387 (1937). Reprint No. 1812. (Sewage Works J., 9: 173 (1937).)

VII. Biochemical oxidation by activated sludge. By C C. Ruchhoft, P D. NcNamee, and C. T. Butterfield. Pub Health Rep., 53: 1690 (1938); Sewage Works J., 10: 661 (1938).

of the available food present (or to use up this fixed quantity of oxygen required) would vary with the number of individual units of bacteria present at the start of the test. That is, with large numbers of bacteria initially present the oxidation process should proceed much more rapidly than with a limited initial number, although the ultimate total oxygen requirement would be presumably the same in both instances.

Under such conditions, if the time intervals between determinations were too long, the results obtained would reveal the approach to the total oxygen requirement but would not reveal in any sense the course of oxidation followed in arriving at the observed point. Observations essential for the determination of the course of oxidation during this critical phase of the reaction would be missed and, moreover, due to the usual method of presenting results in the form of a cumulative curve, rather than by differences, any irregularities at the beginning of the curve would be concealed. Consequently any opportunity to observe the effect of an increased initial number of bacteria, should the condition exist, would be lost.

In the studies referred to (*1*) the time interval between determinations was 24 hours and the time required for the satisfaction of the total oxygen requirement varied from 24 to 72 hours. Consequently no conclusions can be drawn regarding the course of oxidation during the first 24-hour period. Experiments have been conducted with the initial concentrations of bacteria intentionally varied within wide limits by two different methods and with the time intervals between examinations so shortened that frequent determinations were made during the critical stage of the reaction. The procedure followed in setting up and conducting these experiments and the results obtained will be presented.

I. EFFECTS OF INITIAL BACTERIAL POPULATIONS ON GROWTH RATES AND RESULTANT OXIDATIONS

(A) *Initial population varied by multiple increases in the volume of the inoculum:*

Preparation.—Five 8-liter pyrex serum bottles, designated A, B, C, D, and E, each containing 0.09 g dextrose, 0.09 g peptone and 0.09 g dipotassium phosphate in 6 liters of formula "C" dilution water (*2*) were sterilized by autoclaving. After sterilization any loss in weight incurred was restored by the addition of sterile distilled water. Additional materials, such as B. O. D. bottles, pipettes, graduates, siphons, and the like, required for the set-up, appropriately protected from subsequent contamination by cotton filters, paper caps, etc., were sterilized in the same manner. All bottles were stored at 20° C., to check their sterility and to standardize their temperature. The culture of *Bact. aerogenes*, laboratory strain No. 72, to be used in the test was rejuvenated through a series of transfers and put on an agar slope for 40 hours' incubation at 20° C. prior to the start of the test.

Procedure.—The growth from the agar slope of *Bact. aerogenes* was washed off and placed in 100 ml of sterile dilution water. Ten ml of this bacterial suspension were put in bottle A and incubation at 20° C. was continued. (This 10 ml seeding produced in the 6 liters of bottle A a bacterial content of about 100,000 per ml.) After 40 hours storage at 20° C. (at the end of this period the growth of *Bact. aerogenes* was approaching its maximum), bottle A was removed from the incubator and after thorough mixing of its contents 4 liters were transferred by sterile siphon to a clean, sterile pyrex flask, marked "AX." The temperature of the flask AX (and contents) was raised to boiling and then held at 80° C. or higher for 20 minutes. It was then cooled to 18–20° C., and thoroughly agitated. This treatment was sufficient to kill all *Bact. aerogenes* and to destroy any known enzyme. After thorough mixing, additions to bottles B, C, D, and E from the contents of the original bottle A and flask AX, were made in order as follows:

Bottle	B	C	D	E
Ml from A	1	10	100	1,000
Ml from AX	999	990	900	0

This procedure provided conditions for the organic contents of the four bottles, B, C, D, and E, to be identical with the possible exception of a minor variation due to the partial loss of some of the volatile constituents from the portions of heated material added. Provision was also made for decimal increases between each bottle in the content of living units of bacterial protoplasm. That is, if bottle B had 1 bacteria per ml, C would have 10, D 100, and E 1,000 per ml. The additions from A and AX were made in order, and as soon as the increments to one bottle had been completed its contents were thoroughly mixed, aerated, and transferred through a sterile siphon to sterile B. O. D. bottles (300 ml ground glass stoppered, biochemical oxygen demand bottles). This was continued until the contents of all large bottles had been transferred to B. O. D. bottles. As each set was completed the time was noted and two bottles were examined for their bacterial and dissolved oxygen contents. The remainder of the bottles were stored at 20° C. Thereafter at frequent intervals, as indicated in the tables of results, bottles were removed from the incubator and examined.

Dissolved oxygen determinations were made by the standard Winkler method (*3*). Prior to the addition of the Winkler reagents the contents of the B. O. D. bottle or bottles to be tested were carefully but thoroughly mixed, without aeration, and 1 ml was withdrawn for bacteriological examination. Bacterial counts were made by plating on standard agar. To increase accuracy, dilutions were adjusted so that it was not necessary to measure volumes of less than 1 ml, and a sufficient number of plates at each dilution were poured to provide for three plates at the dilution selected for counting. The counts from these three plates were averaged for the reported result. The dilutions required to obtain plates with the number of colonies at the counting level could be judged very closely from the amount of oxygen utilized in the bottle under test. This amount of oxygen could be determined quickly and experience with this type of reaction permitted a close estimate of the probable numbers of bacteria present.

Results.—The observed oxygen requirements are presented in table 1 and are shown graphically in figure 1. The results for series B for the period from the sixteenth to the twenty-second hour (1 a. m. to 7 a. m. when observations were not made) were calculated from a curve based on the observed results for the series with the section of the curve for the fifteenth to the twenty-third hour interpolated in accordance with the trends indicated for similar periods in series C, D, and E. All other recorded results represent actual observations.

TABLE 1.—*Oxygen utilized by* Bact. aerogenes *during growth in pure culture in dilute medium at 20° C. when the initial bacterial content was varied. Results are expressed in mg of O_2 per liter*

[Series designation and number of bacteria per ml in each series at the start]

B. 3,200		C. 32,000		D. 320,000		E. 3,200,000	
Time (hours)	Mg O_2	Time (hours)	Mg O_2	Time (hours)	Mg O_2	Time (hours)	Mg O_2
2.0	0.00	0.5	0.00	0.25	0.00	0.25	0.00
4.5	.00	1.0	.00	.5	.00	.5	.00
6.0	.00	2.5	.00	1.0	.00	.75	.03
8.0	.00	4.0	.00	1.5	.00	1.0	.08
10.0	.10	6.0	.00	2.5	.00	1.5	.25
12.0	.11	8.0	.01	4.0	.00	2.0	.36
14.0	.34	10.0	.34	6.0	.18	2.5	.45
15.0	.49	11.0	.52	7.0	.54	4.0	1.49
[1] 16.0	[1] .90	12.0	.78	8.0	.93	5.0	1.93
[1] 18.0	[1] 1.95	13.0	1.41	9.0	1.42	6.0	2.34
[1] 20.0	[1] 2.70	14.0	1.92	10.0	2.00	7.0	2.71
[1] 22.0	[1] 3.26	23.0	3.88	11.0	2.14	10.0	3.50
23.0	3.45	27.0	4.22	12.0	2.43	12.0	3.66
27.0	3.99	--------	--------	13.0	2.68	14.0	3.74
--------	--------	--------	--------	14.0	2.99	23.0	4.54
--------	--------	--------	--------	23.0	4.11	--------	--------
30.0	4.26	30.0	4.56	30.0	4.60	30.0	4.93
48.0	5.45	48.0	5.64	48.0	5.65	48.0	6.28
96.0	6.34	96.0	6.37	96.0	6.50	96.0	6.45
120.0	6.50	120.0	6.68	120.0	6.80	120.0	6.59

[1] Results for these periods, covering the early morning hours, were estimated from a theoretical curve based on trends of results in C, D, and E and made with the data for series B of the tenth, eleventh, twelfth, fourteenth, fifteenth, and twenty-third, and subsequent hours employed to allocate the curve.

In figure 1 two sets of curves have been drawn. In 1A all observed points are included in determining the shape of the curves. In 1B all points obtained prior to the twenty-third hour have been omitted in establishing the trend of the curves. This is done to provide for a comparison between the results obtained by the usual procedure, when observations are not made until the end of 24 hours of storage, and by the procedure followed here. If the curves were based on the results for the forty-eighth, ninety-sixth, and one hundred and twentieth hours, which is done more frequently in routine practice, then the curves for B, C, D, and E would be practically identical, while as actually observed measurable oxygen utilization occurred in E at the end of the first hour, in D at the end of the sixth hour, in C at about the ninth hour, and in B not until the twelfth hour. However, at the end of 30 hours from the start of the experiment, when observed oxidation had been taking place in B, C, D, and E for 18,

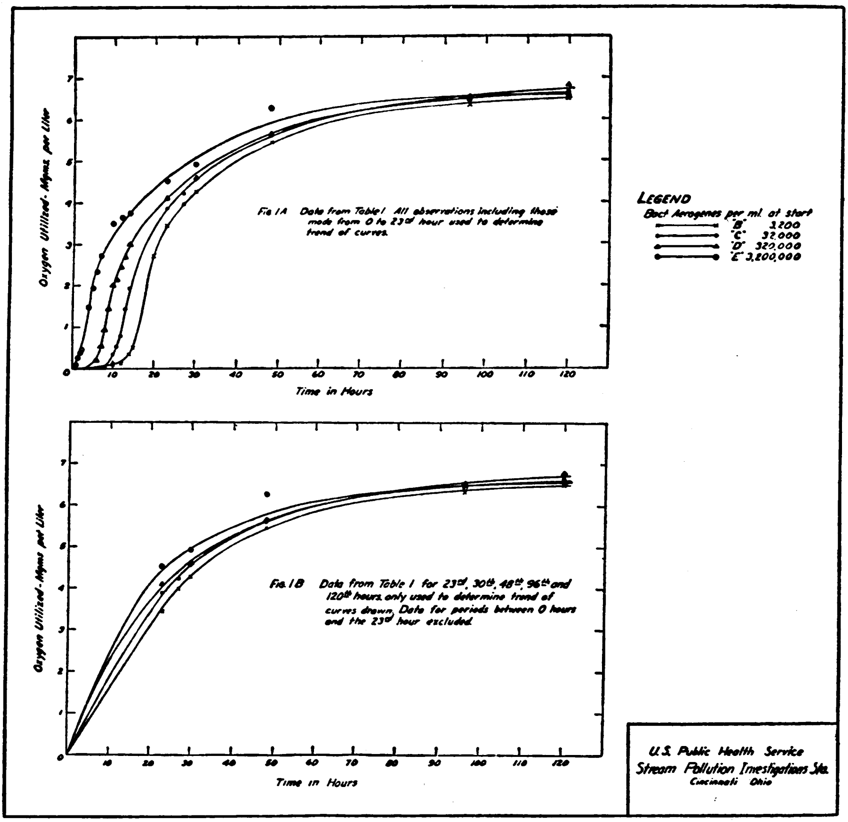

FIGURE 1.—Oxygen utilization by *Bact. aerogenes* at 20° C. with varying numbers of bacteria present at the start, when frequent determinations are made during the first 24 hours and when no determinations are made until the 23d hour.

21, 24, and 29 hours, respectively, the amounts of oxygen utilized in B, C, and D represented 86, 92, and 93 percent respectively of the amount utilized in E, while at the ninety-sixth and one hundred and twentieth hours the results for all bottles are well within the limit of error of such determinations, being namely 98, 99, and 101, and 99, 101, and 103 percent respectively, for these periods, of the amount of oxygen used in E.

Thus, from the results of these tests, if the 5-day biochemical oxygen demand were the only point of interest in the determination it would be immaterial whether the initial bacterial content was 3,000 or 3,000,000 per ml; the final result would be the same. However, if the amount of oxidation occurring during the first few hours of the test were desired, the initial density of the bacterial population would be of major importance, for in E, with the highest numbers of bacteria, at the end of 6 hours 41 percent of the 5-day oxygen requirement had been satisfied, in D, at the same period, with one-tenth as many bacteria at the start, oxidation had just started (2½ percent of the 5-day requirement), while in C and B a measurable loss of oxygen was not observed until from 3 to 6 hours later.

A more detailed presentation of the influence of the initial bacterial concentration on the course of oxidation during the early hours of storage (first 24 hours) is made in table 2 and figure 2. The data of table 2 were obtained by calculation from the results given in table 1, by deducting the amount of oxygen utilized at each period of observation from the amount of each following observation and expressing this difference in terms of hourly rates of oxidation for the interval involved. To illustrate, in series E the difference between the oxygen requirements for the 2.5 and 2.0 hour periods was 0.09 mg of oxygen per liter (0.45−0.36=0.09), and as the interval covered was 0.5 of an hour, the indicated hourly rate was 0.18 mg of oxygen per liter (2×0.09=0.18). Or in the same series the difference between the 4.0 hour and 2.5 hour requirement was 1.04 (1.49−0.45=1.04) mg of oxygen per liter and as the period covered was 1.5 hours the hourly rate for this interval was 0.69 (1.04÷1.5=0.69).

TABLE 2.—*Hourly rates of oxygen utilization by* Bact. aerogenes *growing in pure culture in dilute medium at 20° C. when the initial bacterial content was varied. Results expressed in mg of O_2 per liter*

[Series designation and number of bacteria per ml in each series at the start]

B. 3,200		C. 32,000		D. 320,000		E. 3,200,000	
Time [1] (hours)	O_2 used [1]	Time [1] (hours)	O_2 used [1]	Time [1] (hours)	O_2 used [1]	Time [1] (hours)	O_2 used [1]
2.0	0.00	0.5	0.00	0.25	0.00	0.25	0.00
4.5	.00	1.0	.00	0.5	.00	.5	.00
6.0	.00	2.5	.00	1.0	.00	.75	.12
8.0	.00	4.0	.00	1.5	.00	1.0	.20
10.0	.05	6.0	.00	2.5	.00	1.5	.34
12.0	.01	8.0	.01	4.0	.00	2.0	.22
14.0	.12	10.0	.16	6.0	.09	2.5	.18
15.0	.15	11.0	.18	7.0	.36	4.0	.69
[2] 16.0	[2] .41	12.0	.26	8.0	.39	5.0	.44
[2] 18.0	[2] .52	13.0	.63	9.0	.49	6.0	.41
[2] 20.0	[2] .38	14.0	.51	10.0	.58	7.0	.37
[2] 22.0	[2] .28	23.0	.22	11.0	.14	10.0	.26
23.0	.19	27.0	.08	12.0	.29	12.0	.08
27.0	.13			13.0	.25	14.0	.04
				14.0	.31	23.0	.09
				23.0	.12		
30.0	.09	30.0	.11	30.0	.07	30.0	.06
48.0	.07	48.0	.06	48.0	.06	48.0	.08−
96.0	.02	96.0	.01	96.0	.02	96.0	.00+3
120.0	.01	120.0	.01	120.0	.01	120.0	.00+5

[1] Results are expressed in terms of mg of O_2 per liter used per hour during the time period covered. The time period covered in each instance is the interval between the hour given for result recorded and the hour of the preceding examination.

[2] Results for these periods based on estimated results; see footnote to table 1.

Consideration of the data given in table 2 and illustrated in figure 2 discloses some interesting facts which are not readily discernible from table 1 and figure 1, where cumulative results rather than differences are considered. It is noted that, regardless of the number of bacteria present at the start of the test, the hourly rate of oxidation increased to a well-defined maximum and thereafter decreased rapidly until by the thirtieth hour a low rate prevailed in all four of the series. Thereafter this low rate continued to decrease very gradually to the end of the series of observations. However, when the time at which the maximum rate occurred is considered, it is observed that the numbers of bacteria present at the start exerted a very marked effect. For instance, in series E (initial bacterial content 3,200,000 per ml) the maximum rate was observed at or possibly just prior to the fourth hour; in series D, C, and B (with initial bacterial contents of 320,000

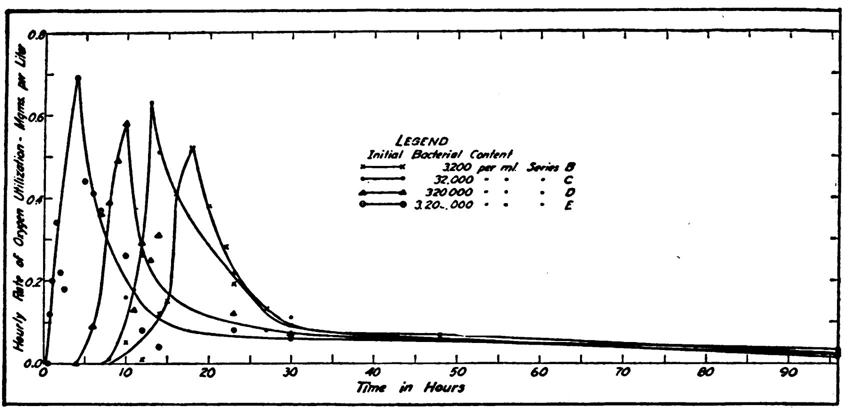

FIGURE 2.—Hourly rates of oxygen utilization by *Bact. aerogenes* at 20° C. when the numbers of bacteria present at the start were varied.

32,000 and 3,200 per ml, respectively) the maximum hourly rates were observed, respectively, at the tenth, the thirteenth (or possibly between the thirteenth and fourteenth), and the eighteenth hours of storage. Thus it is shown that, although the initial bacterial concentration had no effect on the final oxidation results obtained, it did have a very marked effect on the time of occurrence of the maximum rate of oxidation and, consequently, on the amount of oxygen required during the early hours of a test.

The results of the bacteriological examinations are presented in table 3 and figure 3. While it would be interesting to correlate oxygen requirements for given intervals of time with the number of bacteria present, or rather with the number of new cells produced during the same interval, this attempt cannot be made effectively with the available methods of bacterial enumeration. For in bacterial growth and multiplication the cell absorbs food material and, as it grows,

Table 3.—*Numbers of* **Bact. aerogenes** *developing in dilute medium at 20° C. when the initial numbers were varied within wide limits*

Storage time in hours	Series designation			
	B	C	D	E
0.0	3,200	32,000	320,000	3,200,000
0.25			306,000	2,340,000
0.5			300,000	
1.0			320,000	
1.5			200,000	
2.0	3,000			1,840,000
2.5		25,600	250,000	2,360,000
4.0		26,000	440,000	4,660,000
4.5	3,000			
5.0				6,940,000
6.0	7,000	50,000	600,000	5,760,000
7.0			1,360,000	9,900,000
8.0	20,600	216,000	1,960,000	
9.0			3,160,000	
10.0	100,000	600,000	4,740,000	13,600,000
11.0		1,150,000	8,060,000	
12.0	296,000	1,860,000	7,500,000	13,000,000
13.0		3,600,000	10,000,000	
14.0	704,000	4,540,000	12,000,000	17,800,000
15.0	1,460,000			
23.0	12,400,000	16,400,000	15,800,000	18,000,000
27.0	14,900,000	17,400,000		
30.0	17,100,000	16,400,000	16,800,000	21,600,600
48.0	20,800,000	18,100,000	20,200,000	16,400,000
96.0	17,700,000	18,300,000	15,400,000	19,600,000
120.0	18,400,000	18,600,000	18,200,000	18,200,000

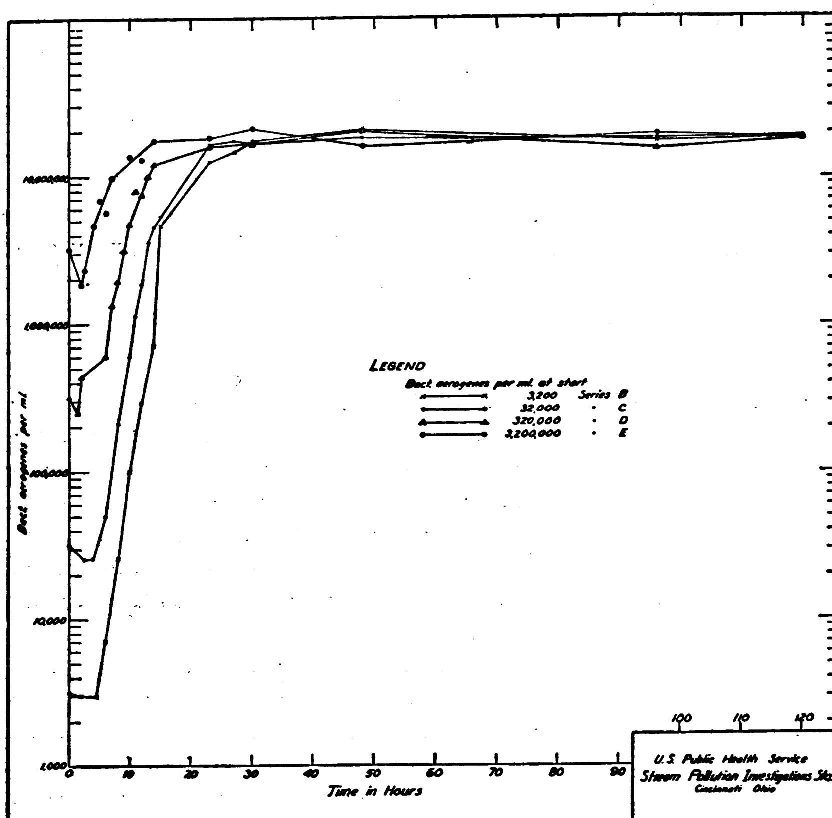

Figure 3.—Numbers of *Bact. aerogenes* developing at 20° C. in identical media when the numbers of bacteria present at the start were varied.

oxidizes part of this food and synthesizes part into increased cellular material. When the increase in cell volume is sufficient to activate cell division, a constriction appears about the middle of the cell and continues to increase until division is complete. Then two cells are present where there was only one before. Up until the time when this cell division is completed (regardless of the absorption or oxidation caused by cell growth) plate counts would indicate the presence of only one cell. Consequently the increase in bacterial numbers as indicated by plate counts would continuously lag behind the time of actual food utilization.

Thus in series D for the period from the eighth to the tenth hour, the indicated number of new cells per ml required to utilize 1.0 mg of oxygen per liter was 2,600,000, while for the succeeding 2-hour period 6,400,000 cells per ml apparently were required for the same utilization.

It is interesting to observe that for series C, during the period from the twelfth to the fourteenth hour, and series E, for the period of the second to the fourth hour (periods of activity similar to the eighth to the tenth hour in D), the indicated number of new cells required per ml to produce an oxygen requirement of 1.0 mg per liter was 2,350,000 and 2,500,000, respectively. This is in remarkable agreement with the indicated number of bacteria required in series D.

Certain trends indicated by the bacterial results also may be noted. First, a lag period was observed in all four series; in series B and C it prevailed for about 4 hours, while in D and E its duration was only 2 hours; thereafter active multiplication occurred in all series.

As the oxygen requirement per bacterial cell is exceedingly small (100,000 to 500,000 cells per ml are required to produce a measurable oxygen requirement of 0.1 mg per liter), it was to be expected that oxygen losses would be observed first in the series containing the largest numbers of bacteria at the start, and last in the series containing the fewest at the start. As a matter of fact the bacteria in B did not reach the number present at the start in C until about the eighth hour; those in C did not match the initial concentration in D until about the ninth hour; while the numbers in E at the start were equalled by those in D at about the eighth hour. Stated in another way, the bacteria in E had increased from 3,000,000 per ml to about 13,000,000 per ml in 10 hours, a four-fold increase at a level that required 3.5 mg of oxygen per liter, while in B during the same 10-hour interval, although a thirty-three-fold increase had occurred (3,000 to 100,000 bacteria per ml), the bacterial population had only just reached a concentration where measurable reductions, 0.1 mg of oxygen per liter, might be expected. However, after 23 to 30 hours of incubation and thereafter, the bacterial populations in all four series were practically identical. Thus it is noted again that if the 3- , or the 5-day bacterial populations were the only points of interest it would be immaterial whether the initial bacterial population was 3,000 or 3,000,000 per ml; the result would be the same. But if the population concentration during the first few hours, or the oxygen requirements for the same period, were the desired factors, then the initial population would be of major importance.

(B) *Initial population acting on substrate varied by the introduction of food increments.*—Experiments in which measured increments of food (organic material) were introduced after the resulting successive increases in bacterial numbers had occurred will now be considered. In general the same preparation and methods were followed in this series of experiments as described above. Certain deviations made in this series from the described routine are as follows: The bacterial food employed was composed of exactly the same constituents but their concentrations were reduced so that each liter of standard medium contained 0.01 gram dextrose, 0.01 gram peptone, and 0.01 gram phosphates. This reduction in concentration from 0.015 gram to 0.01 gram per liter was made because the cumulative effects of successive increments of food would increase the residual requirement for oxygen with consequent dangers of depletion. For these experiments the food was prepared in sterile concentrated solution of such a strength that 2 ml added to 1 liter of dilution water made up a standard medium of the given concentration. The food was prepared in this form to provide conditions for successive additions of exactly duplicate portions of food without any material alteration in the volume of the medium.

The *Bact. aerogenes* culture used for this series of experiments was laboratory strain No. 2. This strain has been in use in the laboratory for over 15 years and while it has retained all of its original biochemical characteristics it has changed apparently from an "S" to an "R" type. As an "R" type it exhibits a decided tendency to form small loose flocs or clumps which settle out (effect of removing part of bacterial population). This phenomenon was not exhibited by this strain originally, nor by laboratory culture No. 72 used in the preceding experiments. This tendency to floc places this organism, as far as clumping is concerned, in an intermediate position between laboratory strain No. 72 and zoogleal bacteria which form rather large and tenacious flocs. It was for this reason that culture No. 2 was used in this series of tests.

Procedure.—In this series five pyrex carboys, designated A, B, C, D, and E, containing identical kinds and amounts of dilution water, were prepared and sterilized by autoclaving. Subsequent to sterilization each carboy was placed at 20° C. for storage, sterility tests, and adjustment of temperature. The contents of each carboy were adjusted by weight, if made necessary by evaporation losses, to their original quantity by the addition of sterile distilled water. To each carboy were then added 2.0 ml of the concentrated medium per liter and also exactly the same amount of the same suspension of *Bact. aerogenes*. After thorough mixing and aeration, the contents of carboy A were immediately transferred by sterile siphon to sterile B. O. D. bottles. These bottles, together with carboys B, C, D, and E, were stored at 20° C. Frequent examinations for bacterial numbers, dissolved oxygen content, and for hydrogen ion concentration, were made on the contents of the bottles of series A.

At the 23-hour storage period carboys B, C, D, and E were refed with the concentrated medium at the rate of 2.0 ml per liter. After thorough mixing and aerating the contents of carboy B were transferred to sterile B. O. D. bottles. Storage at 20° C. was continued throughout. Frequent examinations, as with the A bottles, were made of the B bottles and the examinations of bottles from the A series were continued. (Thus the changes occurring in the A bottles after the twenty-third hour could be used as a control, or correction, for the changes observed in the B bottles so that the results from each series of bottles could be attributed to the effect of the presence of one increment of concentrated medium (i. e., concentrated medium 2 ml per liter).)

At the end of a further 23 hours of storage, namely 46 hours from the start of the test, carboys C, D, and E were fed again with concentrated medium at the rate of 2.0 ml per liter, the contents were thoroughly mixed and aerated, sterile B. O. D. bottles were filled from the contents of carboy C, and storage and examinations were continued.

After 4 more hours of storage (4 hours from the time the contents of carboy C had been put in B. O. D. bottles, i. e., 50 hours from the start of the test), carboys D and E were fed again at the same rate with the concentrated medium and sterile B. O. D. bottles were filled from the contents of carboy D after thorough mixing. After a further storage period of 21 hours (21 hours from the time the D bottles were filled and 71 hours from the start of the test) carboy E was given its final feeding at the same rate with the concentrated medium and its contents were transferred to sterile B. O. D. bottles. Storage and examinations were continued throughout as stated above. In addition 10 or more colonies were picked from the plates made for bacterial counts of the initial and final bottles of each series, and identified to check on the possible presence of any contamination.

Results.—No evidence was obtained at any time indicating that the bottles had become contaminated with other species of bacteria. The hydrogen ion concentration of the diluted medium remained at pH 7.1 throughout the period of examination. These data have been omitted from the tabulations.

The oxygen requirements for each series of this experiment are recorded in table 4 as observed, without correction, in terms of milligrams of oxygen used per liter of medium.

TABLE 4.—*Oxygen utilization by* Bact. aerogenes *growing in dilute medium in pure culture recorded as observed for series A, B, C, D, and E when refed with same amount of food at the 23d, 46th, 50th, and 71st hour of storage at 20° C.*

[These data are presented again in table 5, corrected for residual oxygen requirement of preceding food additions. Results are expressed in mg O_2 per liter]

Series A		Series B		Series C		Series D		Series E	
Time (hours)	Mg O_2	Time [1] (hours)	Mg O_2	Time [1] (hours)	Mg O_2	Time [1] (hours)	Mg O_2	Time [1] (hours)	Mg O_2
0.5	0.00	0.5	0.53	0.25	0.45	0.08	0.28	0.12	0.33
1.0	.05	1.0	.98	.5	.79	.25	.98	.25	0.96
1.5	.03	1.5	1.44	.75	1.10	.50	1.38	.5	1.56
2.0	.01	2.0	1.80	1.0	1.39	.75	1.83	.75	2.05
2.5	.03	2.5	2.25	1.5	1.97	1.0	2.33	1.0	2.44
3.0	.07	3.0	2.68	2.0	2.45	1.5	2.89	1.5	3.08
3.5	.07	3.5	2.94	2.5	2.80	2.0	3.38	2.0	3.41
4.5	.07	4.5	3.34	3.0	3.09	2.5	3.68	2.5	3.65
5.0	.13	5.0	3.49	3.5	3.27	3.0	3.86	3.0	3.97
5.5	.21	6.0	3.81	4.0	3.41	3.5	4.03	3.5	4.22
6.0	.24	7.0	4.14	5.0	3.79	4.0	4.36	4.5	4.79
6.5	.26	23.0	5.19	6.0	4.11	5.0	4.68	5.5	5.13
7.0	.38	26.0	5.27	7.0	4.36	21.0	8.08+	7.0	5.82
9.0	1.06	31.0	5.47	9.0	4.86			25.0	7.79+
10.0	1.50	48.0	5.74	25.0	5.63				
11.0	2.19			50.0	6.17				
12.0	2.84								
13.0	3.25								
13.5	3.43								
23.0	4.39								
30.0	4.74								
46.0	4.82								
54.0	4.98								
71.0	5.16								
96.0	5.01								
120.0	5.14								

[1] Hours from time of each addition of food. Data in subsequent tables for series A are set back 4.5 hours to allow for initial lag in growth.

To express the results on a comparable basis (i. e., in terms of the oxygen utilized for one increment of food in each series) it was necessary to correct the results of series B, C, D, and E for the residual oxygen requirement in each at the time the new increment of food had been added. Thus the B results were corrected by the amount of oxygen used in the A series during the period of examinations of B; the results from the C bottles were corrected by the amount of oxygen used in the B bottles during the interval that C bottles were being examined, and so on. In the case of the results from the series E bottles, this correction could not be made as the D bottles became depleted of oxygen at the time the examination of series E bottles was started. Consequently, the results for the E series are undoubtedly too high, the error probably ranging from at least 0.04 mg for the first 0.5-hour period to at least as much as 0.5 to 0.6 mg at the 7- to the 24-hour periods. The amount of these corrections for the intermediate intervals was determined by carefully plotting the results, for each two series concerned in each case, in large scale and selecting these corrections from the proper points on these curves. These corrected results are given in table 5 and are shown graphically in figure 4.

TABLE 5.—*Oxygen utilization results of table 4 corrected in the case of series B, C, and D for the residual oxygen requirement remaining from preceding food increments*

[Results are expressed in mg O_2 per liter and are plotted in figure 4]

Series A [1]		Series B		Series C		Series D		Series E [2]	
Time (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2
0.5	0.13	0.5	0.51	0.25	0.41	0.08	0.24	0.12	0.33
1.0	.21	1.0	.92	.5	.74	.25	.88	.25	.96
1.5	.24	1.5	1.36	.75	1.04	.50	1.18	.5	1.56
2.0	.26	2.0	1.68	1.0	1.32	.75	1.55	.75	2.05
2.5	.38	2.5	2.10	1.5	1.89	1.0	1.96	1.0	2.44
4.5	1.06	3.0	2.50	2.0	2.36	1.5	2.35	1.5	3.08
5.5	1.50	3.5	2.74	2.5	2.70	2.0	2.66	2.0	3.41
6.5	2.19	4.5	3.09	3.0	2.97	2.5	2.79	2.5	3.65
7.5	2.84	5.0	3.22	3.5	3.13	3.0	2.89	3.0	3.97
8.5	3.25	6.0	3.50	4.0	3.25	3.5	2.93	3.5	4.22
9.0	3.43	7.0	3.78	5.0	3.60	4.0	3.13	4.5	4.79
18.5	4.39	23.0	4.76	6.0	3.89	5.0	3.22	5.5	5.13
25.5	4.74	26.0	4.77	7.0	4.11	21.0	4.08	7.0	5.82
41.5	4.82	31.0	4.89	9.0	4.56	--------	--------	25.0	7.79+
49.5	4.98	48.0	4.98	25.0	5.08	--------	--------	--------	--------
66.5	5.16	--------	--------	50.0	5.52	--------	--------	--------	--------
91.5	5.01	--------	--------	--------	--------	--------	--------	--------	--------
115.5	5.14	--------	--------	--------	--------	--------	--------	--------	--------

[1] Data of series A set back 4.5 hours to allow for lag.
[2] In the case of E, corrections could not be applied as bottles for series D were depleted and data for the demand due to residual food could not be obtained. Consequently the results for E are undoubtedly too high.
[3] See footnote to table 4.

Hourly rates of oxygen utilization for series A, B, C, D, and E have been calculated from the results given in table 5. These calculated figures were obtained, as in the first experiment, by deducting the amount of oxygen utilized at each period of observation from the amount of each following observation and then expressing the difference in hourly amounts of oxidation for the time period ended by the last of the two observations under consideration. Essentially this consists in reporting the results in the form of the amount of oxygen used during each interval rather than in the form of accumulated amounts of oxygen utilized since the start of the test. This method of presentation permits a ready determination of the rates of oxidation from hour to hour when subjected to the varying conditions provided in this experiment. These hourly rate results are presented in table 6 and in figure 5.

An unavoidable error involved in this method of studying the effects of increased bacterial populations on resultant oxidations is noted in the total amounts of oxygen used in series B, C, D, and E. The rate of oxygen utilization apparently increases very rapidly with any increase in the number and activity of the bacterial cells present.

Thus the rate was much more rapid in B than it was in A, more rapid in C than in B, and so on. For instance, in filling the bottles of series D, the first bottle filled from the carboy was examined to determine its dissolved oxygen content. It contained 8.08 parts per million of

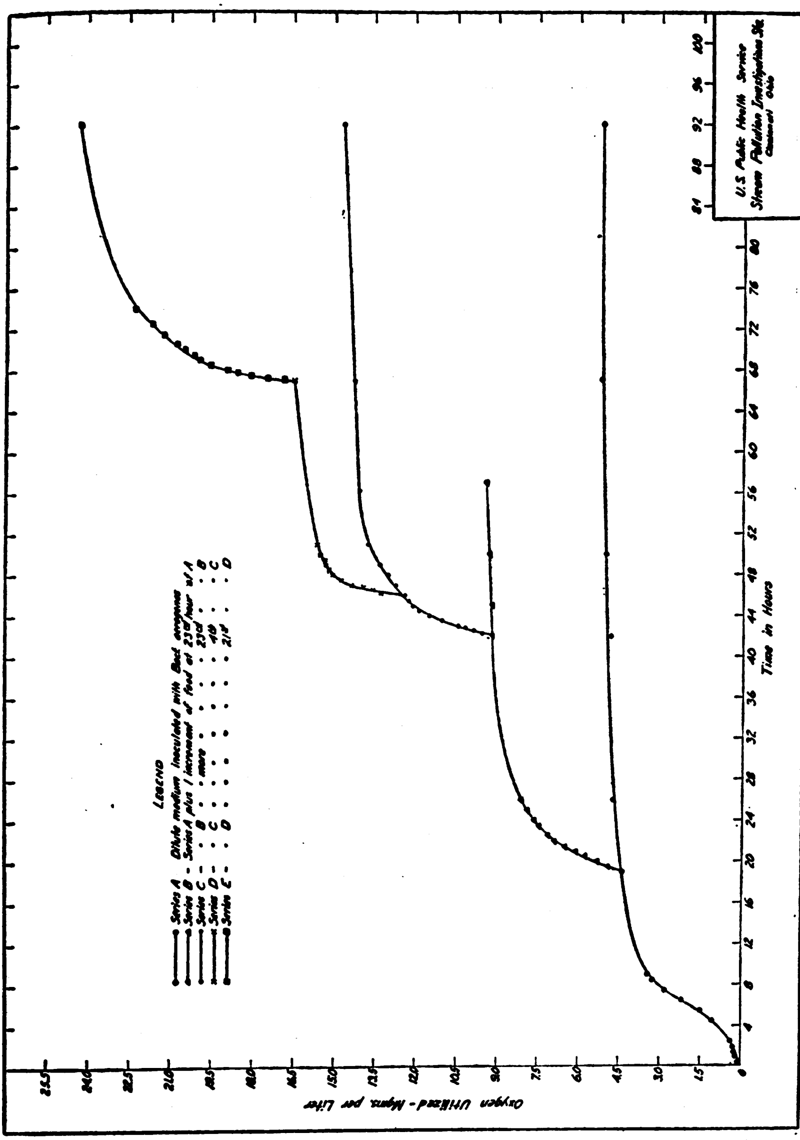

FIGURE 4.—Oxygen utilized by *Bact. aerogenes* at 20° C. when refed at various intervals with identical portions of the same medium. Data corrected for residual O_2 requirements of preceding food.

dissolved oxygen. The last bottle filled from this carboy (5 minutes were required to fill all of the bottles) when titrated showed a dissolved oxygen content of 7.80 p. p. m. Thus there is a very definite indication that at least 0.28 p. p. m. (8.08−7.80=0.28) of oxygen was used during this 5-minute interval. Similarly, in series E the first bottle filled contained 7.79 p. p. m., while the last one showed 7.46 p. p. m., an indicated loss of 0.33 p. p. m. In this instance 7 minutes were required to fill all the bottles.

TABLE 6.—*Hourly rate of oxygen utilization by* Bact. aerogenes *growing in dilute medium when refed at various intervals*

[Results, calculated from corrected data presented in table 5, are expressed in mg O_2 per liter per hour. These data are plotted in figure 5]

Series A [1]		Series B Refed at 23d hour		Series C Refed at 46th hour		Series D Refed at 50th hour		Series E [2] Refed at 71st hour	
Time (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2	Time [3] (hours)	Mg O_2
0.5	0.12	0.5	1.02	0.25	1.64	0.08+	2.88	0.12	2.83
1.0	.16	1.0	.82	.50	1.32	.25	3.20	.25	2.52
1.5	.06	1.5	.88	.75	1.20	.50	1.20	.5	2.40
2.0	.04	2.0	.64	1.0	1.12	.75	1.48	.75	1.96
2.5	.24	2.5	.84	1.5	1.14	1.0	1.64	1.0	1.56
4.5	.34	3.0	.80	2.0	.94	1.5	.78	1.5	1.28
5.5	.44	3.5	.48	2.5	.68	2.0	.62	2.0	.66
6.5	.69	4.5	.35	3.0	.54	2.5	.26	2.5	.48
7.5	.65	5.0	.26	3.5	.32	3.0	.20	3.0	.64
8.5	.41	6.0	.28	4.0	.24	3.5	.08	3.5	.50
9.0	.36	7.0	.28	5.0	.35	4.0	.40	4.5	.57
18.5	.10	23.0	.06	6.0	.29	5.0	.09	5.5	.34
25.5	.05	26.0	.00	7.0	.22	21.0	.05	7.0	.46
--------	--------	31.0	.02	9.0	.22	--------	--------	25.0	.11
--------	--------	--------	--------	25.0	.03	--------	--------	--------	------

[1] Data of series A set back 4.5 hours to allow for initial lag.
[2] Data of series E are not corrected for residual B. O. D.
[3] Hours from time of each addition of food.

When the concentrated medium was added to each carboy, just prior to putting up each series as in B, C, D, and E, at least 5 minutes were employed each time in getting this thoroughly mixed with the contents of each carboy prior to distribution in B. O. D. bottles. Thus, with the evidence presented in mind, it is reasonable to presume that considerable oxygen, probably at least 0.3 p. p. m., was used for the oxidation of the added food during this 5-minute interval of mixing. While this does indicate a failure to measure the total oxygen requirement it does not invalidate observations on the rate of oxidation and rather serves to emphasize the rapid rate of oxygen utilization under these conditions.

The bacteriological counts obtained from this experiment are presented in table 7 and in figure 6. These results have not been reduced to a comparable basis dependent on a single food increment for reasons which will be discussed. The procedure employed for obtaining the bacteriological data (plating on agar with three duplicate plates at each dilution) was not sufficiently accurate to yield satisfactory results for such a comparison. That is, it is known that the production of 1,000,000 bacterial cells may induce an oxygen requirement of about 1.0 mg. It is also known that the probable error of the bacterial counting method employed is, on the average, at least 10 percent for a single determination. Consequently when the number of bacteria present is in the range of 10,000,000 or more per ml, which was the case in series B, C, D, and E, an increase in the number of bacteria sufficient to create an oxygen requirement of at least 1.0 mg per liter

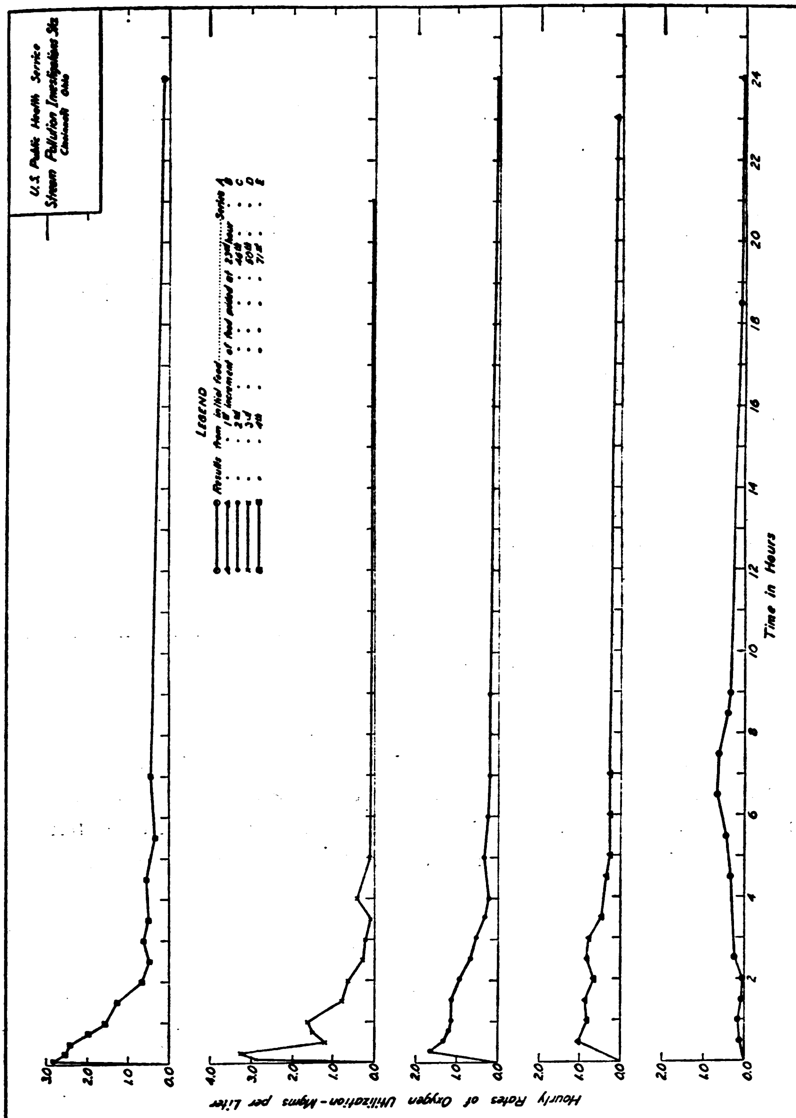

FIGURE 5.—Hourly rates of oxygen utilization by *Bact. aerogenes* at 20° C. when refed at various intervals. Results have been corrected in each case for residual O_2 requirements of preceding food increments.

might be concealed entirely by the probable error of the bacterial determination. This situation renders it difficult to make any definite comparisons between the numbers of bacteria present and the amount of oxidation produced. (Greater accuracy could be achieved by making 25 or more plates at each dilution but the limited personnel

available for this work does not permit such extensive plating and counting with the frequency of sampling required for this study.)

TABLE 7.—*Numbers of* Bact. aerogenes *developing in dilute medium when periodically enriched with fresh food*

Series A			Series B		Series C		Series D		Series E	
Hours from start	Hours as set back for lag [1]	Bacteria per ml	Hours [2]	Bacteria per ml	Hours [2]	Bacteria per ml	Hours [2]	Bacteria per ml	Hours [2]	Bacteria per ml
0.0	-------	505,000	0.0	19,400,000	0.0	20,200,000	0.0	24,700,000	0.0	40,000,000
.5	-------	530,000	.5	16,400,000	.25	22,000,000	.08	----------	.12	----------
1.0	-------	590,000	1.0	23,200,000	.5	18,600,000	.25	21,000,000	.25	41,700,000
1.5	-------	565,000	1.5	21,000,000	.75	22,000,000	.5	22,700,000	.5	27,400,000
2.0	-------	500,000	2.0	21,600,000	1.0	19,500,000	.75	28,700,000	.75	35,400,000
2.5	-------	550,000	2.5	22,800,000	1.5	23,400,000	1.0	26,000,000	1.0	39,700,000
3.0	-------	615,000	3.0	23,100,000	2.0	30,100,000	1.5	29,700,000	1.5	32,700,000
3.5	-------	640,000	3.5	23,000,000	2.5	27,500,000	2.0	27,300,000	2.0	41,700,000
4.5	0.0	610,000	4.5	24,000,000	3.0	24,900,000	2.5	29,000,000	2.5	43,400,000
5.0	.5	540,000	5.0	24,600,000	3.5	----------	3.0	48,700,000	3.0	37,300,000
5.5	1.0	480,000	6.0	24,200,000	4.0	27,900,000	3.5	37,000,000	3.5	----------
6.0	1.5	865,000	7.0	27,200,000	5.0	28,000,000	4.0	48,000,000	4.5	58,000,000
6.5	2.0	845,000	23.0	33,500,000	6.0	30,600,000	5.0	----------	5.5	51,000,000
7.0	2.5	1,100,000	26.0	29,400,000	7.0	35,300,000	21.0	48,300,000	7.0	----------
9.0	4.5	2,580,000	31.0	37,000,000	9.0	----------	-------	----------	25.0	43,300,000
10.0	5.5	2,980,000	48.0	30,000,000	25.0	36,000,000	-------	----------	-------	----------
11.0	6.5	4,180,000	-------	----------	50.0	58,400,000	-------	----------	-------	----------
12.0	7.5	6,640,000	-------	----------	-------	----------	-------	----------	-------	----------
13.0	8.5	8,780,000	-------	----------	-------	----------	-------	----------	-------	----------
13.5	9.0	----------	-------	----------	-------	----------	-------	----------	-------	----------
23.0	18.5	21,000,000	-------	----------	-------	----------	-------	----------	-------	----------
30.0	25.5	23,200,000	-------	----------	-------	----------	-------	----------	-------	----------
46.0	41.5	22,600,000	-------	----------	-------	----------	-------	----------	-------	----------
54.0	49.5	26,300,000	-------	----------	-------	----------	-------	----------	-------	----------
71.0	66.5	24,900,000	-------	----------	-------	----------	-------	----------	-------	----------
96.0	91.5	29,100,000	-------	----------	-------	----------	-------	----------	-------	----------
120.0	115.5	----------	-------	----------	-------	----------	-------	----------	-------	----------

[1] See tables 4 and 5.
[2] Hours from time of each addition of food.

However, in spite of the errors involved in this second series of experiments in the determination of both the total oxygen requirement and the bacterial counts, the results obtained indicate certain trends. These trends are significant and considered in connection with the results of the first series of experiments, which they definitely confirm, they are of much greater significance.

II. EFFECT OF DISPERSION OF BACTERIAL FLOCS ON THE COURSE OF OXIDATION

In studies which have been reported (*4*) (*5*) it has been suggested that activated sludge developed by pure cultures of zoogleal bacteria simulates natural activated sludge to a remarkable degree both in the production of a firm and tenacious floc and in the purification and oxidation accomplished by the sludge. In bringing about the oxidation reported, this pure culture sludge was kept continuously dispersed throughout the medium by the agitation of aeration. This sludge in a quiescent state settles quite rapidly. Consideration is now given to tests indicating the part that this dispersion of the flocs may play in the efficiency of the oxidation process.

Preparation.—A pure culture activated sludge (zoogleal culture, Z4, in standard synthetic sewage) was developed by the fill and draw

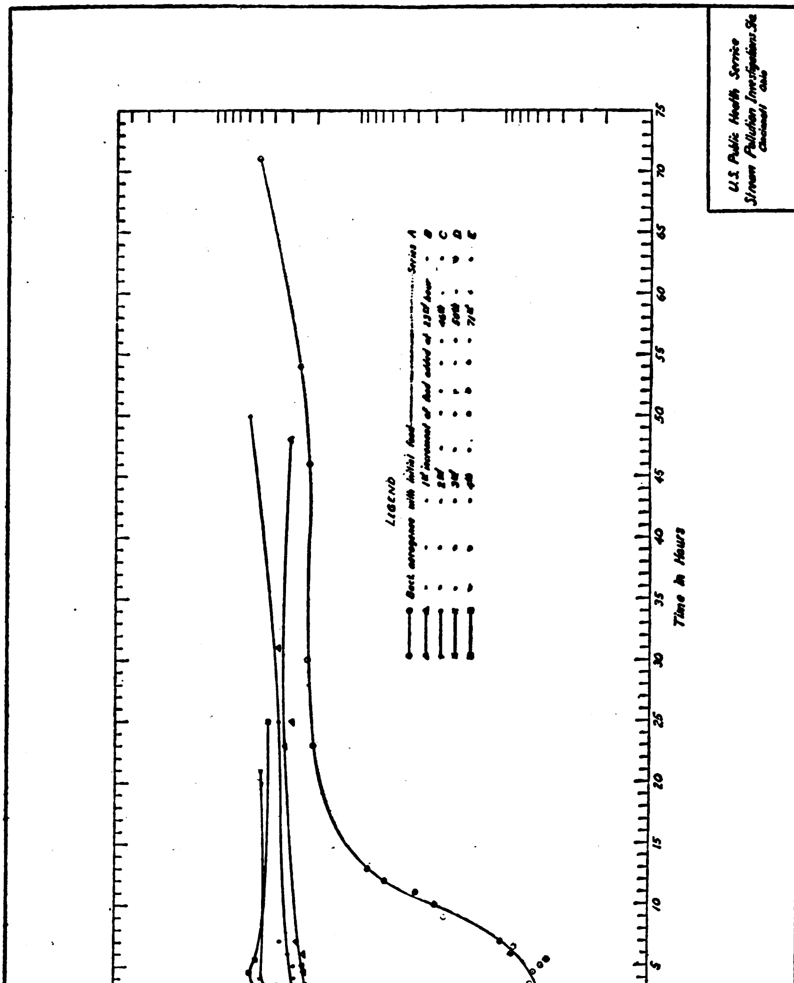

FIGURE 6.—Numbers of *Bact. aerogenes* developing at 20° C. when refed with identical portions of the same medium at various intervals. Results are plotted with time of addition of food as zero hour in each case.

method as described (*5*) for use in this test. When sludge had developed to the extent of 325 p. p. m. in terms of dry suspended matter, it was used. Sterile B. O. D. bottles, siphons, and the like were prepared as in the preceding experiments.

Procedure.—Standard biochemical oxygen demand determinations were made by the usual excess oxygen dilution method. As the observations were to be made over a 5-hour period only, dilute synthetic medium of 10-fold strength was employed. Twelve hundred ml of the pure culture activated sludge were centrifuged and the precipitate washed through three changes of dilution water by centrifuging down each time. The final precipitate was made up to 150 ml with sterile dilution water and 64 ml of this mixture were added to 6,400 ml of dilute synthetic medium (10-fold). After thorough mixing the contents were transferred carefully by sterile siphon to B. O. D. bottles. Gentle mixing was continued throughout the transfer period to insure a uniform distribution of the sludge. Two bottles were examined at once to determine their dissolved oxygen content. One-half of the remaining bottles were allowed to stand quiescent while the other half were inverted and twirled at 1-minute intervals until the time of test. While this amount of agitation probably did not equal the mixing obtained by the aeration method, it did keep the floc from settling out and maintained a fair degree of dispersion.

The floc in the quiescent bottles was, of course, thoroughly dispersed at the start of the examinations but after 30 minutes practically all of the floc in these bottles was in a thin layer at the bottom. However, not all of the bacteria present were held in this settled floc. As always happens when floc is treated in this manner a large number of the bacteria become detached from the flocs and are dispersed throughout the medium as individual cells or as very fine bits of floc.

Examinations for their dissolved oxygen contents were made on two bottles from each set (quiescent and agitated) at the 0.5, 1.5, 3.0, and 5.0 hour periods of storage. As the contents of the bottles were identical in each set any difference in the amount of dissolved oxygen utilized could be attributed to the effect of agitation produced in one set.

Results.—The differences between the amount of dissolved oxygen present at the start and the amounts present at the end of each examination interval, i. e., the average amount of oxygen used in each set for each time interval, are recorded in table 8. These results are also presented in figure 7. The oxygen requirement in the bottles with the sludge dispersed was approximately twice that observed in the quiescent bottles, indicating the marked effect of dispersion of the sludge on the rate of oxidation. With the sludge settled out any contact between available food and the bacteria in the settled floc would be dependent on the rate of diffusion of the food particles and of oxygen to the bottom layers, whereas with a dispersed floc greater opportunity for bacterial cell, oxygen, and food particle contact would

TABLE 8.—*Oxygen utilization by pure culture activated sludge when sludge is kept dispersed throughout and when it is allowed to settle to bottom of the container*

Condition of sludge	Oxygen used in mg per liter after following hours			
	0.5	1.5	3.0	5.0
Dispersed	0.73	2.09	5.19	[1] 7.74
Settled	.51	1.14	2.35	3.80

[1] This determination was made at the 4.25 hour as results indicated that these bottles might be entirely depleted of oxygen by the fifth hour.

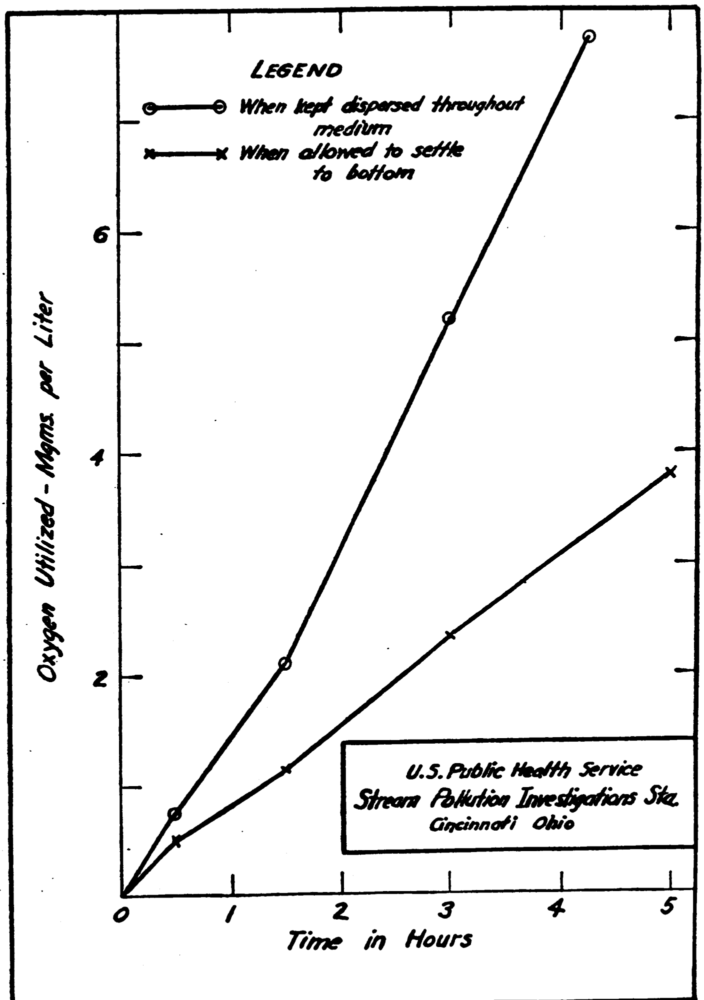

FIGURE 7.—Oxygen utilization by activated sludge when sludge is kept distributed throughout the medium and when it is allowed to settle to the bottom of container.

be provided. It is noted that the difference between the oxygen requirements for the two sets at the first 0.5 hour period is not nearly as great as for subsequent periods. This is probably due to the fact that the sludge was equally well dispersed in both series at the start. If the bacteria in the sludge flocs had not been slightly dispersed by the treatment given, the difference between the quiescent and agitated bottles would probably have been greater.

This experiment, as well as the preceding ones, has been repeated a number of times so that the trends indicated may be considered as fairly definitely established.

DISCUSSION OF RESULTS

It is interesting to note the application of the results of all three series of experiments to oxidation processes. When the initial bacterial population is limited to 500,000, or less, per ml (as is practically always the case in oxygen requirement determinations made by the excess oxygen dilution method), the incidence of measurable oxidation is slow, varying with the number of organisms present, and oxidation proceeds in an orderly fashion with the maximum hourly rate attained only after several hours of incubation. This is in keeping with the orderly progress of bacterial growth, under such conditions, until bacterial numbers are reached which require increased amounts of oxygen for their metabolic activity.

When the initial bacterial population is greater (3,000,000 to 10,000,000, or more, per ml), the incidence of measurable oxidation is very rapid, the maximum hourly rate of oxidation is attained very early in the life of the sample (from at once to 4 hours), and thereafter the hourly rate of oxidation decreases quite rapidly. This diminution in rate of oxidation, after the hourly peak rate has been reached, would be presumed to be caused by the decrease in the amount of oxidizable food available per bacterial unit (i. e., a situation is reached soon when this amount of food is no longer sufficient to stimulate growth and reproduction but is sufficient only to maintain life). The results presented at this time and those reported earlier (*1*) indicate that the amount of oxygen required for bacterial life processes under such limited nutritional conditions is very small indeed (less than 0.01 mg of oxygen per million bacteria per day).

With all initial bacterial concentrations tried, regardless of the time required for the incidence of measurable oxidation, and regardless of the time of occurrence of the maximum hourly rate of oxidation, the total oxygen requirement after a 24-hour or longer period was approximately the same in all cases with the same concentrations of food and the same bacterial species acting. It appears logical to assume that, if these final bacterial populations had been reduced below their limiting number, renewed growth with its consequent increase in oxidation would have ensued as was proven in a previous report (*1*). In fact, in biological processes such bacterial reductions or removals have been shown to be essential for the completion of both natural and artificial methods of purification.

While the bacterial maxima observed in the second series of experiments, using an aerogenes culture which tended to form flocs, were considerably greater than those obtained in the preceding experiment using a nonclumping strain of aerogenes, the increased bacterial numbers secured in this manner did not approach the huge concentrations of bacteria present in activated sludge. In pure culture activated sludge with a suspended solids content of about 1,000 p. p. m. (dry weight) the bacterial content is at least 10,000,000,000 [1] per ml. It is suggested, therefore, that this phenomenon of the initial acceleration of oxidation induced by increased initial numbers of bacteria is the explanation of the very greatly increased rates of oxidations reported for activated sludge (*5*) (*6*).

Because, in these experiments, when the initial numbers of bacteria were increased from a few thousands up to 10 millions per ml, the portion of the total oxygen requirement satisfied during the first few hours was very greatly increased, it would be reasonable to conclude that in an activated sludge with the concentration of bacteria present at the start of aeration raised to 10 billions or more per ml, a still larger proportion of the total oxygen requirement would be satisfied during the first few hours.

From a bacteriological viewpoint such deductions appear logical, for in the activated sludge method of sewage purification the continuance of the process, namely sustained growth and oxidation, is dependent on: (1) a continuous addition of sufficient, available bacterial food (by an inflow of suitable sewage of appropriate strength), (2) a continuous reduction of the excess bacterial population (by the removal of accumulated sludge in excess of required volumes), and (3) the withdrawal of by-products detrimental to bacterial growth (by the discharge of effluent).

CONCLUSIONS

The rate of oxidation of bacterial food during the early hours of incubation is dependent on the number of living units of bacteria present at the start; the greater the initial numbers the more extensive the initial oxidation.

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[1] This figure is based on an average of a number of determinations. The drastic methods required to disperse the cells contained in flocs, to make counting possible, probably kills or at least injures many of the included cells. Moreover, the flocs are undoubtedly not completely dispersed and the cultural methods employed may not have been suitable for the growth and demonstration of all of the effective organisms present, particularly so in the case of normal activated sludge. Consequently the figure given, 10 billion bacteria per ml, is considered a conservative estimate of the probable number of bacteria present in such concentrations of sludge.

The rate of oxidation is also influenced by the degree of dispersion of bacteria, or bacterial flocs, in the presence of a dispersed food; adequate dispersion is required to produce extensive oxidation.

A logical explanation, based on this influence of bacterial numbers and their dispersion on oxidation, is provided for the mechanism of the very rapid rate of oxidation obtained with pure culture activated sludges and of the same phenomenon as it occurs in the activated sludge process of sewage treatment.

REFERENCES

(*1*) Butterfield, C. T., Purdy, W. C., and Theriault, E. J.: Experimental studies of natural purification in polluted waters. IV. The influence of the plankton on the biochemical oxidation of organic matter. Pub. Health Rep., 46:393 (1931). (Reprint No. 1451.)
(*2*) Butterfield, C. T.: Experimental studies of natural purification in polluted waters. VII. The selection of a dilution water for bacteriological examinations. Pub. Health Rep., 48:681 (1933). (Reprint No. 1580.)
(*3*) Standard Methods for the Examination of Water and Sewage. 8th ed. American Public Health Association, New York, 1936. P. 150.
(*4*) Butterfield, C. T.: Studies of sewage purification. II. A zooglea-forming bacterium isolated from activated sludge. Pub. Health Rep., 50:671 (1935). (Reprint No. 1686.)
(*5*) Butterfield, C. T., Ruchhoft, C. C., and McNamee, P. D.: Studies of sewage purification. VI. Biochemical oxidation by sludges developed by pure cultures of bacteria isolated from activated sludge. Pub. Health Rep., 52:387 (1937). (Reprint No. 1812.) Sewage Works J., 9:173 (1937).
(*6*) Ruchhoft, C. C., McNamee, P. D., and Butterfield, C. T.: Studies of sewage purification. VII. Biochemical oxidation by activated sludge. Pub. Health Rep., 53: 1690 (1938); Sewage Works J., 10:661 (1938).

DEATHS DURING WEEK ENDED OCTOBER 8, 1938

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

	Week ended Oct. 8, 1938	Corresponding week, 1937
Data from 88 large cities of the United States:		
Total deaths	7,741	[1] 7,929
Average for 3 prior years	[1] 7,465	
Total deaths, first 40 weeks of year	324,718	349,032
Deaths under 1 year of age	521	[1] 465
Average for 3 prior years	[1] 507	
Deaths under 1 year of age, first 40 weeks of year	21,119	22,494
Data from industrial insurance companies:		
Policies in force	68,290,970	69,936,909
Number of death claims	11,480	11,764
Death claims per 1,000 policies in force, annual rate	8.8	8.8
Death claims per 1,000 policies, first 40 weeks of year, annual rate	9.3	9.9

[1] Data for 86 cities.

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.

In these and the following tables, a zero (0) indicates a positive report and has the same significance as any other figure, while leaders (------) represent no report, with the implication that cases or deaths may have occurred but were not reported to the State health officer.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 15, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median

Division and State	Diphtheria				Influenza				Measles			
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median
NEW ENG.												
Maine	6	1	0	1	6	1	------	------	24	4	12	8
New Hampshire	0	0	0	1	------	------	------	------	------	------	15	2
Vermont	0	0	6	1	------	------	------	------	14	1	5	------
Massachusetts	1	1	1	8	------	------	------	------	46	39	20	24
Rhode Island	0	0	1	1	------	------	------	------	------	------	2	3
Connecticut	6	2	7	3	21	7	------	1	36	12	2	6
MID. ATL.												
New York	7	18	21	25	[1]6	[1]8	[1]8	[1]8	27	68	141	54
New Jersey	12	10	9	12	20	17	8	7	11	9	62	15
Pennsylvania	18	35	30	43	------	------	------	------	34	66	341	48
E. NO. CEN.												
Ohio	23	30	65	65	------	------	22	26	7	9	222	35
Indiana	44	29	18	36	20	13	26	26	21	14	18	4
Illinois	30	46	35	44	4	6	1	6	9	13	59	13
Michigan [2,3]	11	10	33	18	------	------	2	2	39	36	26	21
Wisconsin	0	0	8	5	112	63	25	25	118	66	21	25
W. NO. CEN.												
Minnesota	10	5	11	11	8	4	1	------	155	79	2	8
Iowa	35	17	1	7	------	------	------	------	27	13	------	4
Missouri	42	32	43	57	26	20	39	39	20	15	57	14
North Dakota	44	6	1	2	37	5	1	------	598	81	------	2
South Dakota	15	2	0	0	------	------	------	------	83	11	------	1
Nebraska	19	5	3	3	4	1	------	------	15	4	4	3
Kansas	20	7	5	8	3	1	2	------	8	3	4	3

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 15, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Diphtheria				Influenza				Measles			
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median
SO. ATL.												
Delaware	0	0	2	0					40	2		1
Maryland [3]	12	4	7	9	22	7	10	6	78	25	3	3
Dist. of Col.	50	6	6	10			1		25	3	1	1
Virginia	200	104	61	72	204	106			21	11	20	15
West Virginia	53	19	35	68	25	9	10	14			25	11
North Carolina [3]	246	165	124	124	1	1	6	6	66	44	60	19
South Carolina [3]	67	24	24	23	584	210	114	132	6	2	6	4
Georgia [3]	91	54	48	32	74	44			5	3		
Florida [3]	31	10	19	11					3	1	7	1
E. SO. CEN.												
Kentucky	89	50	26	57	16	9	1	1	12	7	40	27
Tennessee	92	51	26	49	67	37	22	19	2	1	30	8
Alabama [3]	101	56	43	44	41	23	23	13	7	4	3	4
Mississippi [2]	54	21	14	20								
W. SO. CEN.												
Arkansas	81	32	38	20	25	10	20	9	56	22		1
Louisiana	46	19	23	22	12	5	10	3	17	7		1
Oklahoma	49	24	24	11	57	28	14	22	2	1	3	1
Texas [3]	49	58	58	58	45	53	210	90	13	15	18	6
MOUNTAIN												
Montana [3]	29	3	0	1	39	4	26	21	551	57	22	16
Idaho	0	0	4	1	53	5	8	3	254	24	7	2
Wyoming	0	0	0	1					22	1	3	1
Colorado	93	19	6	9	127	26			29	6	13	11
New Mexico	185	15	2	3					37	3	14	14
Arizona	114	9	5	2	342	27		6	51	4	2	2
Utah [2]	0	0	3	0	10	1	1		60	6	48	5
PACIFIC												
Washington	0	0	1	1			1		57	18	6	18
Oregon	15	3	0	0	41	8	13	15	25	5	4	7
California [3]	21	25	34	33	8	10	24	24	147	173	28	36
Total	41	1,027	931	1,099	38	769	649	595	41	988	1,376	723
41 weeks	20	20,334	18,650	24,698	60	50,717	278,058	144,016	767	766,491	247,694	345,932

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median
NEW ENG.												
Maine	0	0	1	0	0	0	8	3	43	7	8	15
New Hampshire	0	0	0	0	0	0	2	1	10	1	2	4
Vermont	0	0	0	0	0	0	0	0	95	7	0	6
Massachusetts	0	0	2	1	0	0	5	5	71	60	65	84
Rhode Island	0	0	0	0	0	0	1	0	38	5	9	9
Connecticut	0	0	1	1	6	2	7	2	60	20	23	23
MID. ATL.												
New York	1.6	4	8	7	2	5	20	20	49	121	139	179
New Jersey	1.2	1	0	0	5	4	10	10	58	48	35	45
Pennsylvania	1.5	3	3	2	0	0	7	7	90	176	165	174

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 15, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median
E. NO. CEN.												
Ohio	1.5	2	4	2	0.8	1	18	24	171	221	333	318
Indiana	0	0	2	2	0	0	3	3	141	94	122	101
Illinois	2	3	5	4	0.7	1	16	16	144	218	192	195
Michigan [2] [3]	4	4	2	1	3	3	13	18	252	233	260	148
Wisconsin	0	0	0	0	0	0	26	7	160	90	84	115
W. NO. CEN.												
Minnesota	0	0	0	0	2	1	20	9	104	53	46	59
Iowa	2	1	0	1	2	1	11	3	59	29	63	49
Missouri	1.3	1	1	1	0	0	10	3	124	95	153	95
North Dakota	0	0	0	0	0	0	0	0	170	23	26	26
South Dakota	0	0	0	0	0	0	0	2	83	11	14	14
Nebraska	0	0	0	0	0	0	5	1	23	6	9	16
Kansas	0	0	0	0	0	0	9	3	255	91	89	62
SO. ATL.												
Delaware	0	0	0	0	0	0	0	0	160	8	11	7
Maryland [3]	3	1	3	2	0	0	2	2	71	23	27	49
Dist. of Col	0	0	2	1	8	1	2	1	83	10	8	11
Virginia	0	0	5	1	1.9	1	2	1	87	45	35	59
West Virginia	6	2	2	1	0	0	1	1	176	63	84	84
North Carolina [3]	4	3	1	0	1.5	1	3	2	119	80	80	80
South Carolina [3]	2.8	1	1	0	0	0	0	0	0	0	10	9
Georgia [3]	0	0	3	0	1.7	1	2	2	54	32	29	29
Florida [3]	0	0	1	1	3	1	1	0	25	8	9	5
E. SO. CEN.												
Kentucky	7	4	1	1	1.8	1	1	4	127	71	55	84
Tennessee	5	3	3	3	0	0	3	3	94	52	38	56
Alabama [3]	1.8	1	2	1	1.8	1	2	1	45	25	15	17
Mississippi [3]	0	0	1	1	0	0	8	2	49	19	13	15
W. SO. CEN.												
Arkansas	5	2	0	0	8	3	3	0	64	25	15	9
Louisiana	2.4	1	0	1	0	0	1	1	44	18	8	11
Oklahoma	0	0	0	0	0	0	10	0	55	27	40	19
Texas [3]	1.7	2	1	1	0	0	21	2	43	51	53	29
MOUNTAIN												
Montana [3]	0	0	0	0	0	0	2	2	213	22	9	19
Idaho	0	0	0	0	0	0	0	0	180	17	19	16
Wyoming	0	0	1	0	22	1	0	0	44	2	5	6
Colorado	5	1	0	0	15	3	12	1	97	20	16	22
New Mexico	0	0	0	0	0	0	2	0	111	9	11	11
Arizona	0	0	0	0	0	0	2	0	13	1	5	8
Utah [3]	0	0	0	0	0	0	3	0	80	8	38	11
PACIFIC												
Washington	0	0	0	0	3	1	4	4	88	28	30	33
Oregon	10	2	0	0	0	0	3	2	228	45	25	26
California [3]	0	0	1	1	3	4	25	25	83	98	123	140
Total	1.7	42	57	49	1.5	37	306	263	98	2,416	2,668	2,967
41 weeks	2.4	2,405	4,605	4,605	1.4	1,444	8,433	6,294	146	148,754	177 590	177,590

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 15, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough	
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933–37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases
NEW ENG.										
Maine	0	0	0	0	0	0	9	4	195	32
New Hampshire	0	0	0	0	0	0	0	0	0	0
Vermont	0	0	0	0	0	0	0	0	626	46
Massachusetts	0	0	0	0	0	0	1	3	98	83
Rhode Island	0	0	0	0	0	0	0	0	207	27
Connecticut	0	0	0	0	6	2	0	1	123	41
MID. ATL.										
New York	0	0	0	0	3	8	22	19	136	338
New Jersey	0	0	0	0	5	4	3	7	195	162
Pennsylvania	0	0	0	0	13	26	27	36	96	188
E. NO. CEN.										
Ohio	0	0	2	0	5	7	22	23	97	125
Indiana	24	16	2	0	5	3	3	8	38	25
Illinois	1	1	4	1	10	15	24	24	252	380
Michigan [2, 3]	0	0	0	0	8	7	13	13	202	187
Wisconsin	0	0	1	4	2	1	1	1	422	237
W. NO. CEN.										
Minnesota	6	3	0	3	8	4	0	2	67	34
Iowa	4	2	3	1	12	6	10	10	27	13
Missouri	0	0	1	0	21	16	26	18	44	34
North Dakota	0	0	2	1	44	6	1	2	118	16
South Dakota	15	2	0	1	0	0	1	1	15	2
Nebraska	0	0	0	0	4	1	1	1	19	5
Kansas	0	0	1	0	11	4	4	6	53	19
SO. ATL.										
Delaware	0	0	0	0	20	1	1	3	100	5
Maryland [3]	0	0	0	0	47	15	4	16	65	21
Dist. of Col	0	0	0	0	42	5	1	2	133	16
Virginia	0	0	0	0	19	10	13	16	15	8
West Virginia	0	0	0	0	34	12	9	25	39	14
North Carolina [3]	0	0	1	0	51	18	6	11	134	90
South Carolina [3]	0	0	0	0	22	8	11	12	120	43
Georgia [3]	0	0	0	0	14	8	11	15	17	10
Florida [3]	0	0	0	0	12	4	3	1	34	11
E. SO. CEN.										
Kentucky	0	0	1	0	27	15	20	29	34	19
Tennessee	0	0	12	0	9	5	24	24	38	21
Alabama [3]	2	1	8	0	7	4	5	11	31	17
Mississippi [3]	0	0	9	0	13	5	5	6	--------	--------
W. SO. CEN.										
Arkansas	0	0	0	0	56	22	11	6	25	10
Louisiana	0	0	0	0	20	8	7	13	22	9
Oklahoma	2	1	0	0	16	8	27	12	4	2
Texas [3]	2	2	0	0	32	38	41	25	27	32
MOUNTAIN										
Montana [3]	39	4	13	0	29	3	12	5	126	13
Idaho	11	1	5	0	32	3	4	2	53	5
Wyoming	0	0	0	0	0	0	1	0	44	2
Colorado	5	1	0	0	49	10	3	9	141	29
New Mexico	0	0	0	0	12	1	14	12	86	7
Arizona	51	4	1	0	51	4	3	3	127	10
Utah [3]	0	0	0	0	0	0	0	1	90	9

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended Oct. 15, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough	
	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933-37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases	Oct. 16, 1937, cases	1933-37 median	Oct. 15, 1938, rate	Oct. 15, 1938, cases
PACIFIC										
Washington	3	1	6	5	31	10	2	4	75	24
Oregon	10	2	8	1	5	1	0	2	46	9
California [3]	1	1	2	0	11	13	9	11	103	122
Total	2	42	82	48	14	341	415	471	105	2,552
41 weeks	13	13,009	8,456	5,565	12	11,965	12,636	14,509	170	169,724

[1] New York City only.
[2] Period ended earlier than Saturday.
[3] Typhus fever, week ended October 15, 1938, 65 cases as follows: Michigan, 1; North Carolina, 1; South Carolina, 10; Georgia, 31; Florida, 3; Alabama, 10; Texas, 8; California, 1.

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	Meningitis, meningococcus	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid and paratyphoid fever
August 1938										
Puerto Rico	0	38	8	3,560	7	1	1	0	0	146
September 1938										
Alabama	9	155	76	1,213	59	32	15	61	3	65
District of Columbia	0	36	3		8	1	9	27	0	25
Indiana	4	39	38	47	10		1	143	14	42
Iowa	3	47	18	4	16		9	89	11	19
New Jersey	2	24	33	1	43		8	87	0	22
New York	13	51		12	253		27	323	0	130
North Carolina	3	438	7	82	116	26	4	211	1	56
Ohio	1	77	25	10	43		8	397	4	83
Vermont	0	7			3		1	23	0	0

Summary of monthly reports from States—Continued

August 1938

Puerto Rico:	Cases
Chickenpox	12
Dysentery	9
Filariasis	2
Hookworm disease	138
Leprosy	1
Mumps	2
Ophthalmia neonatorum	2
Puerperal septicemia	10
Tetanus	5
Tetanus, infantile	1
Vincent's infection	2
Whooping cough	88

September 1938

	Cases
Anthrax:	
New York	1
Chickenpox:	
Alabama	6
District of Columbia	6
Indiana	12
Iowa	16
New Jersey	120
New York	207
North Carolina	25
Ohio	118
Vermont	14
Diarrhea and enteritis:	
Ohio (under 2 years)	128
Dysentery:	
Alabama (amoebic)	1
Iowa (bacillary)	1
New Jersey (bacillary)	3
New York (amoebic)	3
New York (bacillary)	211
North Carolina (bacillary)	5
Ohio (bacillary)	20

September 1938—Contd.

	Cases
Encephalitis:	
Alabama	3
Indiana	2
Iowa	10
New Jersey	1
New York	10
Ohio	1
German measles:	
New Jersey	25
New York	32
North Carolina	4
Ohio	11
Lead poisoning:	
Ohio	3
Mumps:	
Alabama	13
Indiana	13
Iowa	24
New Jersey	108
Ohio	100
Vermont	27
Ophthalmia neonatorum:	
New Jersey	4
New York [1]	4
North Carolina	3
Ohio	79
Rabies in animals:	
Alabama	40
Indiana	30
Iowa	2
New Jersey	50
New York [1]	5
Rabies in man:	
New Jersey	1
Rocky Mountain spotted fever:	
Indiana	1
New York	2
North Carolina	3

September 1938—Contd.

	Cases
Septic sore throat:	
Iowa	1
New Jersey	13
New York	56
North Carolina	13
Ohio	35
Tetanus:	
Alabama	6
New Jersey	3
New York	3
Trachoma:	
New Jersey	1
Trichinosis:	
New York	1
Typhus fever:	
Alabama	42
North Carolina	4
Undulant fever:	
Alabama	8
District of Columbia	2
Indiana	3
Iowa	7
New Jersey	4
New York	43
North Carolina	1
Ohio	10
Vermont	5
Vincent's infection:	
New York [1]	49
North Carolina	2
Whooping cough:	
Alabama	77
District of Columbia	42
Indiana	35
Iowa	75
New Jersey	958
New York	2,282
North Carolina	739
Ohio	551
Vermont	100

[1] Exclusive of New York City.

CASES OF VENEREAL DISEASES REPORTED FOR AUGUST 1938

These reports are published monthly for the information of health officers in order to furnish current data as to the prevalence of the venereal diseases. The figures are taken from reports received from State and city health officers. They are preliminary and are therefore subject to correction. It is hoped that the publication of these reports will stimulate more complete reporting of these diseases.

Reports from States

	Syphilis		Gonorrhea	
	Cases reported during month	Monthly case rates per 10,000 population	Cases reported during month	Monthly case rates per 10,000 population
Alabama	1,944	6.72	278	0.96
Arizona	142	3.45	127	3.08
Arkansas	1,125	5.49	327	1.60
California	2,316	3.76	1,652	2.68
Colorado	158	1.48	74	.69
Connecticut	196	1.13	148	.85
Delaware	310	11.88	72	2.76
District of Columbia	269	4.29	211	3.37
Florida [1]	586	3.51	89	.53
Georgia	2,278	7.38	426	1.38
Idaho	21	.43	21	.43
Illinois	2,460	3.12	1,249	1.59
Indiana	292	.84	136	.39
Iowa	235	.92	195	.76
Kansas	173	.93	65	.35
Kentucky	885	3.03	354	1.21
Louisiana	1,400	6.57	126	.59
Maine	55	.64	65	.76
Maryland	1,125	6.70	390	2.32
Massachusetts	422	.95	433	.98
Michigan	1,096	2.27	661	1.37

See footnotes at end of table.

Reports from States—Continued

	Syphilis		Gonorrhea	
	Cases reported during month	Monthly case rates per 10,000 population	Cases reported during month	Monthly case rates per 10,000 population
Minnesota	252	.95	195	.74
Mississippi	2,429	12.01	2,699	13.31
Missouri	948	2.38	208	.52
Montana [1]	45	.83	35	.65
Nebraska	41	.30	64	.47
Nevada [2]				
New Hampshire [2]				
New Jersey	736	1.69	263	.61
New Mexico	104	2.46	31	.73
New York	6,407	4.94	2,135	1.65
North Carolina	3,979	11.39	569	1.63
North Dakota	26	.37	49	.69
Ohio	1,514	2.25	404	.60
Oklahoma [1]	340	1.33	272	1.07
Oregon [2]				
Pennsylvania	1,306	1.28	220	.22
Rhode Island	114	1.67	51	.75
South Carolina [2]				
South Dakota	25	.36	28	.40
Tennessee	1,132	3.91	440	1.52
Texas	1,723	2.79	473	.77
Utah	18	.35	37	.71
Vermont	22	.57	16	.42
Virginia	1,100	4.07	362	1.34
Washington	251	1.51	292	1.76
West Virginia [1]	393	2.11	95	.51
Wisconsin	87	.30	117	.40
Wyoming [1]	1	.04	1	.04
Total	40,481	3.22	16,155	1.28

Reports from cities of 200,000 population or over

	Syphilis: Cases reported during month	Syphilis: Monthly case rates per 10,000 population	Gonorrhea: Cases reported during month	Gonorrhea: Monthly case rates per 10,000 population
Akron, O.[3]				
Atlanta, Ga	302	10.06	97	3.23
Baltimore, Md	712	8.52	280	3.35
Birmingham, Ala	474	16.10	83	2.82
Boston, Mass	163	2.05	135	1.70
Buffalo, N. Y	130	2.16	53	.88
Chicago, Ill	1,715	4.68	852	2.32
Cincinnati, O	268	5.67	80	1.69
Cleveland, O	244	2.58	119	1.26
Columbus, O	130	4.15	28	.89
Dallas, Tex	273	8.98	110	3.62
Dayton, O	89	4.01	1	.05
Denver, Colo.[3]				
Detroit, Mich	488	2.69	258	1.42
Houston, Tex.[3]				
Indianapolis, Ind	34	.88	43	1.12
Jersey City, N. J	17	.52	8	.25
Kansas City, Mo	60	1.39	2	.05
Los Angeles, Calif	646	4.25	319	2.10
Louisville, Ky	329	9.71	89	2.63
Memphis, Tenn	335	11.47	60	2.05
Milwaukee, Wis.[3]				
Minneapolis, Minn	79	1.58	45	.90
Newark, N. J	233	5.13	166	3.65
New Orleans, La.[3]				
New York, N. Y	5,074	6.77	1,513	2.02
Oakland, Calif	69	2.20	67	2.14
Omaha, Nebr	13	.58	14	.63
Philadelphia, Pa	531	2.65		
Pittsburgh, Pa	324	4.60	26	.37
Portland, Ore	127	3.96	83	2.59
Providence, R. I	73	2.81	30	1.16
Rochester, N. Y	29	.85	42	1.23
St. Louis, Mo	401	4.76	85	1.01
St. Paul, Minn	36	1.25	28	.97
San Antonio, Tex	134	5.12	71	2.71
San Francisco, Calif	222	3.22	200	2.90
Seattle, Wash	112	2.89	140	3.62
Syracuse, N. Y	56	2.48	11	.49
Toledo, Ohio [2]				
Washington, D. C.[4]	269	4.29	211	3.37

[1] Incomplete.
[2] No report for current month.
[3] Not reporting.
[4] Reported by Social Hygiene Clinic.

WEEKLY REPORTS FROM CITIES

City reports for week ended Oct. 8, 1938

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

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								
Data for 90 cities:											
5-year average	195	89	23	143	387	628	4	344	74	868	--------
Current week [1]	166	69	24	226	345	502	4	328	42	1,139	--------
Maine:											
Portland	0	--------	0	0	3	1	0	0	0	0	24
New Hampshire:											
Concord	0	--------	0	0	0	0	0	0	0	0	5
Manchester	0	--------	0	0	0	0	0	0	0	0	13
Nashua	0	--------	0	0	0	0	0	0	0	0	5
Vermont:											
Barre	0	--------	0	0	0	2	0	0	0	0	2
Burlington	0	--------	0	0	0	0	0	0	0	0	7
Rutland	0	--------	0	0	0	0	0	0	0	0	1
Massachusetts:											
Boston	0	--------	0	3	8	17	0	4	0	35	224
Fall River	1	--------	0	0	1	2	0	2	0	0	27
Springfield	0	--------	0	1	2	0	0	1	0	2	41
Worcester	0	--------	0	1	5	6	0	2	0	20	53
Rhode Island:											
Pawtucket	0	--------	0	0	0	0	0	0	0	0	16
Providence	0	--------	0	0	3	3	0	1	0	23	59
Connecticut:											
Bridgeport	0	--------	0	0	1	1	0	1	0	1	30
Hartford	0	--------	0	1	2	2	0	1	0	3	45
New Haven	0	--------	0	3	3	1	0	2	0	17	39
New York:											
Buffalo	0	--------	0	0	3	2	0	9	0	20	124
New York	7	9	1	6	70	25	0	72	6	168	1,377
Rochester	0	--------	0	1	1	2	0	1	0	2	51
Syracuse	0	--------	0	0	2	2	0	1	0	9	42
New Jersey:											
Camden	2	--------	0	0	2	1	0	0	0	3	23
Newark	0	2	0	2	1	4	0	2	0	40	60
Trenton	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
Pennsylvania:											
Philadelphia	3	--------	2	5	20	23	0	11	0	53	428
Pittsburgh	1	2	1	1	11	22	0	7	0	8	154
Reading	3	--------	0	1	1	1	0	2	0	1	29
Scranton	0	--------	--------	0	--------	3	0	--------	1	2	--------
Ohio:											
Cincinnati	7	--------	0	0	2	7	0	9	1	9	127
Cleveland	0	7	1	4	6	14	0	11	0	46	200
Columbus	2	--------	0	0	1	7	0	3	0	2	68
Toledo	0	2	1	0	2	4	0	3	0	1	70
Indiana:											
Anderson	0	--------	0	1	4	4	0	0	0	0	7
Fort Wayne	0	--------	0	0	4	3	0	0	0	0	22
Indianapolis	9	--------	1	0	6	14	3	5	1	5	104
Muncie	0	--------	0	0	1	8	0	1	0	0	12
South Bend	0	--------	0	0	3	4	0	1	0	0	20
Terre Haute	7	--------	0	0	0	2	0	0	0	0	29
Illinois:											
Alton	0	--------	0	0	1	5	0	1	0	0	8
Chicago	11	8	0	9	25	66	0	42	5	263	623
Elgin	0	--------	0	0	0	0	0	0	0	1	8
Moline	0	--------	0	0	2	0	0	0	0	1	12
Springfield	0	--------	0	0	2	1	0	0	0	5	14
Michigan:											
Detroit	13	--------	0	3	9	47	0	11	1	81	248
Flint	0	--------	0	2	7	12	0	0	0	0	30
Grand Rapids	0	--------	0	1	3	12	0	0	0	1	29
Wisconsin:											
Kenosha	0	--------	0	1	0	1	0	0	0	3	9
Madison	0	--------	0	0	0	1	0	0	0	4	18
Milwaukee	0	1	1	0	6	25	0	3	0	137	116
Racine	0	--------	0	1	0	3	0	1	0	13	10
Superior	0	--------	0	0	0	2	0	0	0	3	11

[1] Figures for Trenton, N. J., and Tacoma, Wash., estimated; reports not received.

City reports for week ended Oct. 8, 1938—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								
Minnesota:											
Duluth	0	--------	1	0	1	1	0	0	0	8	14
Minneapolis	1	--------	2	4	6	11	0	1	0	16	97
St. Paul	0	--------	0	3	7	6	0	2	0	4	60
Iowa:											
Cedar Rapids	0	--------	--------	0	--------	2	0	--------	0	4	--------
Davenport	3	--------	--------	0	--------	1	1	--------	0	0	--------
Des Moines	0	--------	0	0	0	5	0	0	0	0	34
Sioux City	0	--------	--------	2	--------	4	0	--------	0	3	--------
Waterloo	11	--------	--------	0	--------	4	0	--------	2	2	--------
Missouri:											
Kansas City	3	--------	1	2	4	6	0	3	0	1	103
St. Joseph	0	--------	0	0	3	0	0	0	0	0	18
St. Louis	4	--------	0	2	1	14	0	5	8	6	193
North Dakota:											
Fargo	0	--------	1	57	0	3	0	0	0	2	9
Grand Forks	0	--------	--------	0	--------	0	0	--------	0	0	--------
Minot	1	--------	0	0	0	0	0	0	0	3	4
South Dakota:											
Aberdeen	0	--------	--------	0	--------	4	0	--------	0	0	--------
Sioux Falls	0	--------	0	0	0	0	0	0	0	0	10
Nebraska:											
Omaha	0	--------	2	0	7	2	0	0	0	2	54
Kansas:											
Lawrence	0	2	0	0	1	1	0	0	0	0	10
Topeka	0	--------	0	0	2	8	0	0	0	0	22
Wichita	0	--------	0	0	2	7	0	0	0	0	24
Delaware:											
Wilmington	1	--------	0	0	0	4	0	0	0	0	26
Maryland:											
Baltimore	2	1	1	14	10	6	0	12	3	22	204
Cumberland	0	--------	0	0	0	0	0	0	0	0	4
Frederick	0	--------	0	0	0	0	0	0	0	0	2
Dist. of Columbia:											
Washington	7	--------	0	4	10	7	0	4	3	5	132
Virginia:											
Lynchburg	11	--------	0	0	0	0	0	0	0	5	9
Norfolk	1	--------	0	0	4	2	0	0	0	0	18
Richmond	3	--------	1	1	2	3	0	2	0	2	51
Roanoke	2	--------	0	0	0	2	0	1	0	0	10
West Virginia:											
Charleston	1	1	0	0	1	1	0	0	0	0	34
Huntington	1	--------	--------	0	--------	3	0	--------	0	0	--------
Wheeling	0	--------	0	0	0	1	0	1	0	1	16
North Carolina:											
Gastonia	2	--------	--------	0	--------	0	0	--------	0	0	--------
Raleigh	2	--------	0	0	0	0	0	4	0	0	16
Wilmington	4	--------	0	0	2	1	0	0	0	0	11
Winston-Salem	4	--------	0	0	1	2	0	1	0	0	20
South Carolina:											
Charleston	0	3	0	0	1	0	0	2	1	0	12
Florence	2	--------	0	0	1	0	0	0	0	0	7
Greenville	0	--------	0	0	0	0	0	0	0	0	5
Georgia:											
Atlanta	10	24	1	0	3	6	0	7	0	1	72
Brunswick	0	--------	0	0	0	0	0	0	0	0	5
Savannah	1	2	2	0	1	0	0	2	1	0	40
Florida:											
Miami	0	1	0	0	0	0	0	0	0	0	21
Tampa	1	--------	0	0	0	1	0	2	0	0	18
Kentucky:											
Ashland	4	--------	0	0	0	0	0	0	0	0	6
Covington	2	--------	0	1	1	2	0	0	0	0	17
Lexington	1	--------	0	0	0	0	0	0	0	0	21
Louisville	0	2	1	1	2	9	0	2	0	5	72
Tennessee:											
Knoxville	2	--------	1	6	1	2	0	0	0	0	82
Memphis	2	--------	2	0	2	4	0	0	0	2	64
Nashville	0	1	1	0	2	0	0	2	1	4	58
Alabama:											
Birmingham	2	2	1	1	5	2	0	4	0	2	68
Mobile	1	1	0	0	1	3	0	1	1	0	18
Montgomery	0	--------	--------	1	--------	2	0	--------	1	0	--------

City reports for week ended Oct. 8, 1938—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								
Arkansas:											
Fort Smith	1	4	------	0	------	2	0	------	0	0	------
Little Rock	0	------	------	0	------	1	0	------	0	0	------
Louisiana:											
Lake Charles	0	------	0	0	0	0	0	0	0	0	1
New Orleans	4	------	0	0	13	3	0	8	4	17	160
Shreveport	0	------	0	0	8	5	0	5	0	0	57
Oklahoma:											
Oklahoma City	1	4	0	0	0	3	0	2	0	0	46
Tulsa	0	------	------	0	------	3	0	------	0	2	------
Texas:											
Dallas	1	------	0	0	2	1	0	2	0	3	56
Galveston	0	------	0	0	0	2	0	0	1	0	6
Houston	9	------	0	0	1	1	0	4	0	0	63
San Antonio	1	------	0	0	2	0	0	6	0	0	53
Montana:											
Billings	0	------	0	0	0	0	0	0	0	0	7
Great Falls	0	------	0	1	0	0	0	0	0	1	5
Helena	0	------	0	0	0	0	0	0	0	0	2
Missoula	0	------	0	0	0	1	0	0	0	0	4
Idaho:											
Boise	0	------	0	0	0	0	0	0	0	0	6
Colorado:											
Colorado Springs	0	------	0	0	1	2	0	0	0	1	14
Denver	6	------	0	3	4	10	0	3	0	8	57
Pueblo	0	------	0	0	5	0	0	4	1	2	14
New Mexico:											
Albuquerque	0	------	0	0	1	2	0	3	1	0	13
Utah:											
Salt Lake City	0	------	1	3	1	3	0	0	0	5	24
Washington:											
Seattle	0	------	0	0	2	6	0	5	0	2	71
Spokane	0	------	0	1	0	0	0	0	3	0	22
Tacoma	------	------	------	------	------	------	------	------	------	------	------
Oregon:											
Portland	0	------	0	2	3	13	1	1	0	0	75
Salem	0	2	------	0	------	7	0	------	0	0	------
California:											
Los Angeles	16	5	0	6	11	27	0	22	0	18	306
Sacramento	1	------	0	3	5	1	0	4	0	0	35
San Francisco	0	------	0	75	3	2	1	4	0	22	127

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Connecticut:				**Kansas:**			
New Haven	1	0	0	Topeka	0	0	1
New York:				**Maryland:**			
New York	2	1	1	Baltimore	1	0	0
Pennsylvania:				**District of Columbia:**			
Scranton	1	0	0	Washington	0	0	1
Ohio:				**Louisiana:**			
Cleveland	0	0	1	Shreveport	0	1	0
Illinois:				**Texas:**			
Chicago	2	2	0	Houston	1	0	0
Michigan:				**Colorado:**			
Detroit	1	0	2	Denver	0	0	1
Minnesota:							
St. Paul	0	0	1				

Encephalitis, epidemic or lethargic.—Cases: Wichita, 1; Great Falls, 1.

Pellagra.—Cases: Philadelphia, 2; Washington, 1; Lynchburg, 1; Charleston, S. C., 1; Atlanta, 5; Savannah, 1.

Typhus fever.—Cases: Charleston, S. C., 7; Savannah, 2; Birmingham, 1; New Orleans, 1; Dallas, 1.

FOREIGN AND INSULAR

GERMANY

Vital statistics—First quarter 1938.—Following are vital statistics for Germany for the first quarter of 1938.

Number of marriages	125,796
Number of live births	363,227
Live births per 1,000 population (exclusive of Austria)	20.0
Number of stillbirths	9,286
Total deaths (including Austria)	233,521
Deaths per 1,000 population (excluding Austria)	12.2
Deaths under 1 year of age	22,176
Deaths under 1 year of age per 100 live births	6.2

SWEDEN

Notifiable diseases—August 1938.—During the month of August 1938, cases of certain notifiable diseases were reported in Sweden as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	5	Poliomyelitis	[1] 268
Diphtheria	11	Scarlet fever	1,124
Dysentery	8	Syphilis	31
Epidemic encephalitis	6	Typhoid fever	13
Gonorrhea	1,336	Undulant fever	10
Paratyphoid fever	137	Weil's disease	5

[1] Includes 70 cases nonparalytic at time of notification.

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

From medical officers of the Public Health Service, American consuls, International Office of Public Health, Pan American Sanitary Bureau, health section of the League of Nations, and other sources. The reports contained in the following table must not be considered as complete or final as regards either the list of countries included or the figures for the particular countries for which reports are given.

CHOLERA

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	May 29–June 25, 1938	Week ended— July 1938: 2	July 9	July 16	July 23	July 30	August 1938: 6	Aug. 13	Aug. 20	Aug. 27	September 1938: 3	Sept. 10	Sept. 17	Sept. 24
Afghanistan [1]																		
China:																		
Canton	C				2	2	2	2	5	5	2	2	3	6	5	5	7	4
	D						3	1		1			2		3			
Foochow	C														11	8		
	D														13	2		
Hankow	C			2	24	35	29	33	47	69	70	43	25	24	31			
Hong Kong	C			2	22	25	43	60	48	26	30	39	38	21	19	12	17	20
	D			1	7	14	32	53	33	26	17	17	20		6	10	15	11
Kwangtung Province	C					6,267			4,259	769	289			2,292	1,408	936	526	
	D					1,858			539	327	74			622	381	255	116	
Macao	C				49	76	273	121	63	24	29	62	50	41	56	26	31	
	D					148	145	89		17	21	42	37	27	26		15	
Mukden	C										P							
Shanghai	C			20	482	301	225	901	505	121	1,265	1,066	959	586	421	245	209	113
Swatow	C		1	17	710	300	150	56	8	4	8	5	7	7	5	13	17	
Tientsin	C								2	7	6	13	8	1	5			
Tsingtao	C											P						
Chosen (Korea)	C															1	35	11
	D																20	7
Dutch East Indies: Macassar	C		[2] 1															
India	C	12,561	22,930	33,698	47,910	7,071	8,953	10,725	10,366	11,399	14,215	12,316	15,548					
	D	5,818	10,939	18,724	23,687	3,474	3,910	4,643	4,995	5,261	6,561	5,371	7,604					
Allahabad	C	4	8	12	5	7	2	2	1	6	3	1	1					
Assam	C	298	938	667	1,194	169	141	85	71	64	98	38	47	53		380	187	104
	D	138	469	340	575	93	80	55	36	32	25	18	29	34		196	67	45
Bassein	C	1	4	3	4													
Bengal Presidency	C							439	489	358	301			427		1,205	1,464	
	D							209	205	173	142			220		567	726	
Bombay Presidency	C	14	52	22	154		155	123	250	239	287	620	604	612	394			
	D	9	38	9	81		67	59	71	80	113	192	226	218	174			
Bombay	C			[3] 1	1						3							

Calcutta	C	574	634	436	343	41	40	32	15	16	24	12	20	14	23		25	22
Cawnpore	C		1	15	88	3	22	66	67	44	49	21	24	8	15		3	1
	D		1	6	33	2	2	16	19	10	10	9	11	4	5			
Central Provinces and Berar	C	213	4,039	5,640	6,878	1,034	1,959	2,825	3,648	4,961	6,078	5,342	9,264	7,314	8,884		5,295	
Chittagong	C	1	5	2	1	[3] 1	1					3						
Delhi	C		29	74	64	3	1	7	3					1				
Howrah	C		344	137	127			19	78	59	52							
Jodhpur	C			3														
Madras Presidency	C	705	1,575	802	1,169	604	850	763	710	686	622	486	397	393				
	D	376	730	352	475	222	324	335	300	320	281	210	192	167				
Madras	C	3	9	1	2		1		1	1	1	1				1		1
	D	2	4															
Northwest Frontier Province	C		1	284	555	149	86	72	73	39	70	42	93	243	27		2	53
Orissa Province	C	102	169	425	332	57	45	78	29	24	25	12	11	4		3		3
Gopalpur	C				5													
Punjab	C		1,090	2,319	673	112	149	84	134	63	11	43	29	5	8		1	
Rangoon	C	1		1	1													1
Sind State	C		2	57	242	16	61	91	32	21	23	17	6	15	1			
Larkana	C		[4] 1															
India (French):																		
Chandernagor Territory	C	9	27		11				4	4								
Karikal Province	C	8																
Pondichery Province	C	35	6		2													
Yanaon	C					1	1											
India (Portuguese): Noroli	C	7																
Indochina (French):																		
Annam Province	C	13	451	615	698	117	86	137	293	290	151	161	53	75	34	1		
Tonkin Province	C	55	1,043	1,659	1,383	177	107	63	62	42		15	8		7			
Haiphong	C		1															
Hanoi	C	17	175	193	82	3	11	12	6	2		1	3					
Japan:																		
Fukuoka Prefecture—Wakamatsu	C									2								
Hiroshima Prefecture—Fukuyama.[5]																		
Okayama Prefecture	C								5	3								
	D								4									

[1] Cholera reported present early in June in South Afghanistan, Afghanistan.
[2] El Tor strain.
[3] Imported.
[4] Suspected.
[5] For the week ended October 1, 1938, 3 cases of cholera with 2 deaths were reported in Fukuyama, Hiroshima Prefecture, Japan.

On vessels:
- S. S. *Karoa* at Rangoon from Calcutta — 1 case — Mar. 21, 1938
- S. S. *Tsushima Maru* at Calcutta from Japan — 1 case — Apr. 16, 1938
- S. S. *Mandasor* at Calcutta — 1 case — Apr. 18, 1938
- S. S. *Tak Sang* at Hong Kong from Shanghai and Swatow — 1 case — June 5, 1938

On vessels—Continued.
- S. S. *Kikukawa Maru* at Fukuoka from Shanghai — 57 cases — July 28, 1938
- S. S. *Mau Sang* at Hong Kong from Sandakan — 1 case — July 18, 1938
- S. S. *Kweiyang* at Bangkok from Swatow and Hong Kong — 1 case — Aug. 5, 1938
- S. S. *Ethiopia* at Madras — 1 case — Sept. 5, 1938

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

PLAGUE [1]

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	May 29–June 25, 1938	Week ended— July 1938: 2	9	16	23	30	August 1938: 6	13	20	27	September 1938: 3	10	17	24
Argentina. (See table below.)																		
Belgian Congo	C	4	4	3	2	1	1	-	1	-	-	3	-	-	-	1	-	-
Bolivia (see also table below):																		
Chuquisaca Department	C	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Santa Cruz Department	C	[2] 1	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Tarija Department	C	-	-	-	96	-	-	-	-	-	-	-	-	-	-	-	-	-
Brazil. (See table below.)																		
British East Africa:																		
Kenya	C	1	4	10	-	-	5	2	2	-	1	3	-	-	-	-	-	-
Uganda	C	14	7	17	19	9	15	13	10	12	13	8	9	15	19	9	-	-
	D	14	7	16	17	11	15	13	10	12	13	8	9	14	20	9	-	-
Ceylon:																		
Colombo	C	1	1	4	1	-	-	-	-	-	-	1	-	-	-	-	-	-
	D	-	-	5	1	-	-	-	-	-	-	1	-	-	-	-	-	-
Plague-infected rats		5	2	4	1	-	-	-	-	1	-	-	1	1	-	-	-	-
China: [3]																		
Dutch East Indies:																		
Java and Madura	C	238	204	130	135	28	32	25	-	-	-	-	-	-	-	-	-	-
	D	235	205	128	135	28	32	25	-	-	-	-	-	-	-	-	-	-
Pasoeroean (vicinity of)	C	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ecuador:																		
Chimborazo Province—Chimbo	C	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Guayaquil	C	5	11	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-
	D	4	8	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plague-infected rats		2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Egypt: Asyut Province	C	-	[2] 1	7	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Hawaii Territory: Plague-infected rats:																		
Hawaii Island—Hamakua District:																		
Kukaiau		-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Paauhau Sector		3	6	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Pohakea Sector		-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

India	C	3,883	2,294	218	68	64	83	71	126	144	261							
	D	2,026	1,164	224	32	29	44	33	81	88	113							
Allahabad	C	1	1															
Bassein	C	1	1	4	2	1	2			1		1	1			2		
Bombay Presidency	C	47	58	6	11		3	7	10	7	12	7	9	21	27			
	D	28	30	2	9		1	5	4	4	7	5	4	11	13			
Central Provinces and Berar	C	1,306	821	42	1						8	11	55	52	109		68	116
Cochin	C													1				
	D													1				
Plague-infected rats												2			2	1	3	4
Madras Presidency	C	69	70	24	51	31	45	56	49	50	66	52	62	47				
	D	36	26	15	24	9	15	20	20	20	27	24	28	18				
Mandalay	C	121																
	D	115																
Punjab	C	1																
Rangoon	C	4	1		1	2		1					1				2	
	D	2	1		1	2		1					1				2	
Plague-infected rats		1																
Madagascar. (See table below.)																		
Niger Territory. (See table below.)																		
Peru. (See table below.)																		
Senegal: M'Bour subdivision	C				1													
Tunisia: Tunis: Plague-infected rats		1				2												
Union of South Africa (see also table below)	C	7	[4] 4	21	8	[4] 3				1						[4] 1		
Cape Province—Port Elizabeth	C		8		2	2	1							2				
	D		11					1										
United States.[5]																		
On vessel:																		
S. S. *Ville de Tamatave* at Beirut	C		1															

[1] Including plague in the United States and its possessions.

[2] Pneumonic.

[3] According to information dated Aug. 12, 1938, 23 deaths from plague occurred in Kirin Province, China, up to Aug. 10, 1938, and 16 deaths from plague occurred in South Hin-An Province from July 28 to Aug. 8. Information dated Aug. 25, 1938, states that 17 cases of plague had occurred in South Hsingan Province and that 10 cases of plague with 10 deaths were reported in Northern Kirin Province between July 29 and Aug. 10.

[4] For 2 weeks.

[5] Last reported human case, Aug. 30, 1937, Fresno County, Calif. Intensive plague work is being conducted in the western States and detailed reports of plague-infection found in animals and insect hosts are published currently in the PUBLIC HEALTH REPORTS. The following summarizes recent reports for 1938: *California.*—Ground squirrels, April, May, June, July, Aug. 4, 8; insects, April, May, June, July, Aug. 4, 8, 15, 18; *Idaho.*—Ground squirrels, May, June; insects, May, June, July; *Montana.*—Ground squirrels, June; insects, May, June; *Nevada.*—Insects, April; *New Mexico.*—Prairie dogs, August, Sept. 1; insects, August, Sept. 1; *Oregon.*—Ground squirrels, April, May; insects, April, May; *Utah.*—Ground squirrels, June; insects, May, July; *Washington.*—Ground squirrels, March, April; insects, March, April; *Wyoming.*—Ground squirrels, June, July; insects, June, July Aug. 2, 3, 10, 11.

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

PLAGUE—Continued

[C indicates cases; D, deaths; P, present]

Place		March 1938	April 1938	May 1938	June 1938	July 1938	August 1938
Argentina: Salta Province	C				4		1
Bolivia (see also table above)	C					6	
Brazil:[6]							
Ceara State	C	2	6	1			
	D	1	3				
Parahyba State	C	3					
	D	1					
Pernambuco State.[6]							
Madagascar (central region)	C	57	29	16	5	22	
	D	55	26	13	5	20	
Niger Territory	C	26					
Peru	C	7	3	1		1	4
Libertad Department	C	2	2				1
Lima Department	C	5	1	1		1	3
Union of South Africa:							
Cape Province	C	6	12	19			
Orange Free State	C	1	2	7	5		

[6] Information dated Apr. 19, 1938, states that since Mar. 25, 1938, 4 deaths from bubonic plague have been reported in Novo Exu District, Pernambuco State, Brazil.

SMALLPOX

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	May 29–June 25, 1938	Week ended— July 1938					August 1938				September 1938			
						2	9	16	23	30	6	13	20	27	3	10	17	24
Algeria:																		
Algiers Department	C		1	1	1													
Constantine Department	C			1	1								1					
Southern Territories	C		1															
Angola. (See table below.)																		
Belgian Congo. (See table below.)																		
Bolivia. (See table below.)																		
Brazil: Porto Alegre	D			2														
British East Africa: Tanganyika	C		205		84	70		24		64	54		1	39	29	1		
Canada:																		
Alberta	C	[1] 8	9		12			[1] 1										
British Columbia	C			1														

Manitoba	C				16	[1] 10												
Nova Scotia—Halifax	C	3																
Ontario	C										9							
Saskatchewan	C					[1] 11										[1] 1		
China:																		
Canton	C	98	46	1														
Dairen	C	1	2	1	2													
Hankow	C	1	16	15	24	6												
Hong Kong	C	766	514	90	25	1	1	1	2									
	D	639	590	93	19			1	2									
Macao	C		8	1														
Shanghai	C	9	12	13	8	1			6		7				2		2	
Swatow	C		[2] 1	2														
Tientsin	C				1													
Chosen (Korea). (See table below.)																		
Colombia: (See also table below.)																		
Barranquilla	D		1															
Cartagena	D				1	1												
Dahomey	C			119														
Dutch East Indies: Batavia	C			4													[2] 1	
Ecuador: Guayaquil	C		1															
Egypt:																		
Alexandria	C			1														
Port Said	C	6	9															
Eritrea	C	14	1	1														
Great Britain: England and Wales—																		
Kent County—Gravesend	C	8		2	1													
Lancaster County	C								2		3							
Leighton Buzzard	C	2																
Port of London	C	1																
Greece. (See table below.)																		
Guatemala. (See table below.)																		
Honduras: Tela	C			2														
India	C	12,752	16,692	12,001	5,716	962	1,124	920	858	698	671	545	478					
	D	2,991	3,575	3,265	1,621	264	349	223	218	188	160	148	97					
Allahabad	C		2															
Assam	C	147	224	193	163	15	25	18	15	14	26	6	7	10			5	2
Bassein	C		1	3					1									
Bengal Presidency	C							162	123	104	104			62		37	35	
	D							56	51	25	36			23		13	16	
Bombay Presidency	C	3,412	3,569	1,720	826		151	236	151	146	106	90	100	105	44			
	D	735	620	337	170		22	47	21	29	18	20	15	24	7			
Bombay	C	874	508	159	57	5	7	11	6	8	7	1	4	3	1		2	3
	D	491	300	108	38	6	5	7	4	6	6		3	2	1		1	1
Calcutta	C	848	768	336	165	22	16	14	16	18	9	6	8	8	12		5	5
	D	565	574	273	142	9	15	9	12	9	8	5	5	5	8		4	1
Cawnpore	C	13	31	10	2													
Central Provinces and Berar	C	249	507	340	260	37	43	32	25	7	11	5	11	1	6		8	1
Chittagong	C	4	1	1														
Delhi	C	11	26	32						1					1			

[1] For 2 weeks.
[2] Imported.

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

SMALLPOX—Continued

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	May 29–June 25, 1938	Week ended— July 1938					August 1938				September 1938			
						2	9	16	23	30	6	13	20	27	3	10	17	24
India—Continued																		
Howrah	C		61	23	50			9	6	9	17							
Jodhpur	C			1	1													1
Karachi	C	17	21	5	4						1							
Madras Presidency	C	765	699	390	228	99	97	114	126	103	179	122	101	109				
	D	125	208	75	44	21	17	18	26	31	26	20	21	31				
Madras	C	249	241	138	126	37	47	33	35	33	46	34	30	22	34		15	28
Negapatam	C	8	11	3														
Northwest Frontier Province	C	155	86	235	82	28	22	5	21	19	15	9	17	34	4		1	9
Orissa Province	C	1,291	936	704	487	102	90	59	106	85	89	65	54	50		24	27	25
Punjab	C	836	553	213	4	7	17	2	10	5	1	6		9	6		1	2
Rangoon	C	77	23	12	21				2		1			3		1	1	2
Sind State	C	522	844	491	300	62	29	25	48	3	14	54	24	20	8		13	18
Vizagapatam	C	2	2															
India (French):																		
Chandernagor Territory	C	2	2	4	2													
Karikal Province	C	1																
Indochina (French) (see also table below):																		
Tonkin Province	C	675	905	332	156		26	19	11	32		10	20	15	7	22	4	13
Haiphong	C	45	30	3	1													
Hanoi	C	16	46	6	4													
Saigon-Cholon	C	1	2	2			2		3			1	1	1	1		2	1
Tourane	C			1														
Iran	C	2	2									1						
Iraq	C		11															1
Baghdad	C			1														
Basra Province	C	1																
Ivory Coast. (See table below.)																		
Japan:																		
Kobe	C				1													
Nara Prefecture	C				1													
Saga Prefecture	C		1															

Mexico (see also table below):																		
Chihuahua	C	1																
Durango	D	2	1															
Mexico, D. F	C	2	6	11	8		3	3	1					1				
Monterrey	C		2	2	5								3					
Saltillo	D				1													
San Luis Potosi	D			2	1													
Torreon	C																	
	D																	
Morocco. (See table below.)																		
Nigeria	C	1, 224	253	405	130				102		115							
Lagos	C	3	4	1	2				1	1				1	2	8		
Niger Territory. (See table below.)																		
Northern Rhodesia	C							9		13			6		6			
Nyasaland	C												1		2			
Portugal (see also table below):																		
Lisbon	C	12	1	5	6	1			4	2		4		1		3	2	
Oporto	C														1			
Senegal. (See table below.)																		
Siam	C	84	3	1	1													33
Sierra Leone	C	5	23	6	1	1												
Southern Rhodesia	C	7	28	39	70		163	84	549	187	10	225	133	35	28	28	7	
Straits Settlements: Singapore	C		1															
Sudan (Anglo-Egyptian)	C	58	59	19	8			1			1		3			1		1
Tunisia: Tunis	C				3													
Union of South Africa. (See table below.)																		
Uruguay. (See table below.)																		
Venezuela. (See table below.)																		

On vessels:		
S. S. *Yuen Sang* at Singapore from Hong Kong	1 case	Feb. 28, 1938
S. S. *Cathay* at London	1 case	Mar. 4, 1938
S. S. *City of Auckland* at Halifax from Calcutta	1 case	Mar. 5, 1938
S. S. *Kaisar-I-Hind* at Yokohama from Hong Kong	3 cases	Mar. 6-7, 1938
S. S. *Van Heutsz* at Singapore from Amoy, Swatow, and Hong Kong	1 case	Mar. 9, 1938
S. S. *Hai Hing* at Singapore from Amoy, Swatow, and Hoihow	1 case	Mar. 9, 1938
S. S. *Netuka Maru* at Moji from Dairen	1 case	Mar. 11, 1938
S. S. *Norviken* at Singapore from Hong Kong and Swatow	1 case	Mar. 13, 1938
S. S. *Kum Sang* at Singapore from Kobe, Amoy, and Hong Kong	1 case	Mar. 16, 1938
S. S. *Haruna Maru* at Kobe from Hong Kong	1 case	Mar. 16, 1938
S. S. *Hinsang* at Sandakan from Hong Kong	2 cases	Mar. 22–24, 1938
S. S. *Kiturin Maru* at Moji from Dairen	1 case	Mar. 31, 1938
S. S. *Sirdhana* at Singapore from Kobe, Amoy, and Hong Kong	1 case	Apr. 1, 1938
S. S. *Prosper* at Singapore from Hong Kong and Swatow	2 cases	Apr. 3, 1938
On vessels—Continued.		
S. S. *Straithaird* at Fremantle	2 cases	Apr. 7, 1938
S. S. *Shirala* at Singapore from Japan	1 case	Apr. 14, 1938
S. S. *Hosang* at Singapore from Hong Kong	3 cases	Apr. 15, 1938
S. S. *Cremer* at Singapore from Amoy, Swatow, and Hong Kong	1 case	Apr. 19, 1938
S. S. *Jean Laborde* at Singapore from Kobe, Shanghai, Hong Kong, and Saigon	1 case	Apr. 21, 1938
S. S. *Sandviken* at Singapore from Hong Kong	1 case	Apr. 29, 1938
S. S. *Hinsang* at Sandakan from Hong Kong	1 case	May 18, 1938
S. S. *Forth Bank* at Niigata from Vancouver	1 case	May 28, 1938
S. S. *Ellenga* at Rangoon from Calcutta	1 case	July 19, 1938
S. S. *Planter* at Aden	1 case	Aug. 2, 1938
S. S. *Pronto* at Tangku-Taku from Hong Kong	1 case	Aug. 8, 1938
S. S. *Defender* at Aden	1 case	Aug. 19, 1938
S. S. *Katori Maru* at Kobe from London, Singapore, Hong Kong, and Shanghai	3 cases	Aug. 20, 1938
S. S. *Conte Biancamano* at Suez from Shanghai, Colombo, Bombay, and Massowah	1 case	Sept. 10, 1938

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

SMALLPOX—Continued

[C indicates cases; D, deaths; P, present]

Place		March 1938	April 1938	May 1938	June 1938	July 1938	August 1938
Angola	C		86	13			
Belgian Congo	C		252	251		262	
Bolivia:							
Cochabamba Department	C		1	5	4	2	
La Paz Department	C	9	12	6	5	5	
Oruro Department	C		1	1			
Potosi Department	C	2	4	1	4	2	
Santa Cruz Department	C		1	1	1	5	
Tarija Department	C	1		1			
Chosen (Korea)	C		5	8		4	
Colombia	C	[3] 194			[3] 226	124	
Greece: Salonika	C	7		2			
Guatemala	C		1	3	4		1
Indochina (French) (see also table above)	C	1,258	1,237	511		137	
	D	237	161	90		32	
Ivory Coast	C	23	33				10
Mexico (see also table above):							
Aguascalientes State—Aguascalientes	C		12	1			
Campeche State	C		2				
Chiapas State	C	1					
Chihuahua State	C	1					
Ciudad Juarez	C			4			

Place		March 1938	April 1938	May 1938	June 1938	July 1938	August 1938
Mexico—Continued.							
Coahuila State—Piedras Negras	C			1			
Guerrero State	C		1				
Hidalgo State	C	1	7				
Mexico State	C		1				
Mexico, D. F.	C	6	5	19			
Michoacan State	C		4	5			
Nuevo Leon State—Monterrey	C		2	4			
Puebla State	C	1					
Queretaro State	C	6	3				
San Luis Potosi State	C	1	1	1			
Tamaulipas State	C	4					
Morocco	C		4		3	4	1
Niger Territory	C	53	51				
Portugal (see also table above)	C			46	41		40
	D			3	2		4
Senegal	C	103	116				
Union of South Africa: Transvaal	C		110		72		33
Uruguay—Montevideo	C				2		
Venezuela	D			8	5	2	3

[3] For 3 months.

TYPHUS FEVER

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	Week ended— June 1938 4	June 11	June 18	June 25	July 1938 2	July 9	July 16	July 23	July 30	August 1938 6	Aug. 13	Aug. 20	Aug. 27	September 1938 3	Sept. 10	Sept. 17
Algeria:																				
Algiers Department	C	77	43	34	27	16	6	4	1	5	3	4		2	3			1		1
Algiers	C	3	3	7				4												
Constantine Department	C	142	163	179	59	23	53	37	16	1	8	6	11	4	1	11	4	9	2	5
Bone	C			1		1		25			1		2	1		1	2			
Constantine	C	33	25	94		5				1	1		3		1					1
Philippeville	C			1										1		4	2	2	1	1
Oran Department	C	7	34	17	10	2		6	3	3		3			1		11		1	
Southern Territory	C	13	6	1																
Australia: Adelaide	C									1										
Basutoland	C																			
Bolivia. (See table below.)																				
British East Africa: Kenya	C		5	10													3	1	1	
Bulgaria	C		2							4										
Chile	C	42	51	26	7	4	10	2	4	5	6	18	10	5						
Concepcion	C	9	16	2		1				1		1	1							
Coquimbo Province	C									3	1		4	1						
Malleco Province	C	6	2	2	2															
Nuble Province	C	8	2	10	2	1	5	2	1		3	2	4	3						
Santiago Province	C	30	17	2			1				1	3		1						
Tarapaca Province	C											10								
Valdivia Province	C								1											
Valparaiso	C	3	2	2	2	1	3		2		1						1			1
China (see also table below):																				
Dairen	C		2	1	1	2		3		1										
Hankow	C		1	2																
Hong Kong	C			[1] 1																
Shanghai	C	26	236	254	103	65		46		35	27							5		
Tientsin	C	1	1	1																
Chosen. (Korea) (See table below.)																				
Colombia: Barranquilla	D								1											
Czechoslovakia. (See table below.)																				
Dutch East Indies: Sumatra. (See table below.)																				

[1] Imported.

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

TYPHUS FEVER—Continued

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	Week ended— June 1938: 4	11	18	25	July 1938: 2	9	16	23	30	August 1938: 6	13	20	27	September 1938: 3	10	17
Egypt:																				
Alexandria	C	11	9	14	2	2	1		1	1		1			1					1
Aswan Province	C	16	16	24		2	2													
Asyut Province	C		1	12		1			2								2	1	1	
Beheira Province	C	33	78	91		30	15		2			8					6	7	3	
Cairo	C	13	20	14	11	3	5	5	2	1	2	1	2		1		1			1
Dakahliya Province	C	27	14	10		2	8		16			13								
Gharbiya Province	C	5	43	26		3	20		4								6	3	3	
Girga Province	C			4								5					1	3	1	
Giza Province	C								15			7					1			
Kalyubiya Province	C								7								1			
Minufiya Province	C	4	57	49		9	24		14			13								
Minya Province	C	11	4	4													1			
Port Said	C			2																
Qena Province	C	25	109	32		1														
Sharkiya Province	C	12	1	9		5	3		5			2								
Provinces	C	262	626	687	146	86	85	97	65	42	42	70	26	21	24	32	18	14	9	2
Greece. (See table below.)																				
Guatemala. (See table below.)																				
Hawaii Territory: Honolulu	C	1		3	1	1			1	2							3	1	1	
Hungary	C		1						1											
Iraq	C		1														1			
Latvia. (See table below.)																				
Libya: Garian	C														1					
Lithuania. (See table below.)																				
Mexico (see also table below):																				
Mexico, D. F.	C	18	40	5	2	2	2	1			4	4	7			1		4		
Torreon	D														1		1			
Morocco (see also table below)	C	1,316	1,011	684	169	170	166	71	66	56	39	36	29	22	16	9	8	4	3	4
Casablanca	C	213	91	113	9	3	15	7	7	5	1	6	4	1	3	1		1		
Palestine:																				
Haifa	C			1	1	2												1		
Jaffa	C	3	2	4	1			1			1	1		3	1				3	

Panama Canal Zone. (See table below.)																				
Poland	C	689	652	424	97	67	44	59	64	67	33	31	20	18	10	13	17	12	5	12
	D	38	30	15	3	4	2	3	5	4										
Portugal. (See table below.)																				
Rumania. (See table below.)																				
Sierra Leone: Freetown	C				1															
Straits Settlements: Singapore	C		1				1		1					1						
Trans-Jordan	C	3	4																	
Tunisia:																				
Tunis	C	7	12	13	3	6	6		6	1	2	2		2	1					
Provinces	C	261	217	255	93	103	77	76	55	54	52	47	37	12	26	26	22	18	20	18
Turkey. (See table below.)																				
Union of South Africa. (See table below.)																				
Yugoslavia	C	106	108	68	8	39	10	3		5	13	2	14	5	2	3	1	1		
On vessel:																				
S. S. *Empress of Japan* at Yokohama	C		1																	

Place		March 1938	April 1938	May 1938	June 1938	July 1938	August 1938
Bolivia:							
Cochabamba Department	C			4		1	
La Paz Department	C	5	12	17	8	5	
La Paz	C					2	
Oruro Department	C	3	3	8	6	2	
Potosi Department	C	8	5		4	3	
China: Manchuria—Harbin	C	5	4	9		1	
Chosen (Korea)	C		87	55		22	
Czechoslovakia	C	2	12	1			
Dutch East Indies: Sumatra	C						
Greece	C	6				5	
Guatemala	C	1	40	2	11	108	20
Latvia	C	3				1	
Lithuania	C	49	20	25	3	3	
Mexico (see also table above):							
Aguascalientes State	C		2	3			
Coahuila State	C						
Guanajuato State	C		4	3			
Hidalgo State	C	6	2				
Jalisco State	C	1					
Lower California	D		1				
Mexico State	C	6		7			

Place		March 1938	April 1938	May 1938	June 1938	July 1938	August 1938
Mexico—Continued							
Mexico D. F.	C	26	32	5			
Mexico City	D						
Oaxaca State	C		1				
Puebla State	C	6					
Queretaro State	C	5	2				
San Luis Potosi State	C	5	2	2			
Tlaxcala State	D	1					
Zacatecas State	C		4				
Morocco (see also table above)	C	1,545	1,474	1,264			
Panama Canal Zone	C		1				
Portugal	C					3	
Rumania	C	533	257	222	35	10	
Turkey	C	48	73	38			
Istanbul	C	1	3	3	6	4	
Union of South Africa:							
Cape Province	C	49	36	4	37	98	62
Port Elizabeth	C	3	1				
Natal	C		1			1	
Orange Free State	C	2	6	2	2	10	
Transvaal	C	4	7	3			1

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

YELLOW FEVER

[C indicates cases; D, deaths; P, present]

Place		Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	May 1–28, 1938	Week ended— June 1938: 4	11	18	25	July 1938: 2	9	16	23	30	August 1938: 6	13	20	27	September 1938: 3	10	17	24	Oct. 1, 1938
Belgian Congo:																						
Saratumba	C	[1]1																				
Zongo	C	[1]4																				
	D	1																				
Brazil:[3]																						
Amazonas State	D			1									1									
Federal District	D	1																				
Minas Geraes State	D	55	5	8	1		1	1														
Rio de Janeiro State	D	37	8	8																		
Santa Catherina State	D	9	16																			
Sao Paulo State	D	2	2																			
Colombia:																						
Cundinamarca Department	D	1		2	2			1	1				1	1			1					
Santander Department	D		2																			
Dahomey: Allada	C									1												
French Equatorial Africa: Gabon—Koula Moutou	C								[1]1													
Gold Coast[3]	C		[1]1	[1]2				3		1			2					1			2	
	D		[1]1										1					1				
Keta	C		[1]1	1																		
Ivory Coast:																						
Agboville	C	[1]1																				
Bognoa	C									[1]1												
Dedougou.[4]																						
Grand Bassam	C	2																				
Korhogo.[4]																						
Spao Plantations (near Bingerville)	C	2																				
Nigeria	C			2										1			[1]2	1				1
	D													1								1

Senegal: Diourbel	D		1																			
Sierra Leone: Kailahun	C			[1] 1																		
Sudan (French):																						
Kouy	C																				[1] 1	
Segou Circle—Kokry	C							1														
Tougan.[5]																						

[1] Suspected.
[2] See also reports of yellow fever in Brazil in preceding issues of the PUBLIC HEALTH REPORTS.
[3] During the week ended Oct. 8, 1938, 1 fatal case of yellow fever was reported in Gold Coast.
[4] During the week ended Oct. 8, 1938, 1 fatal case of yellow fever was reported in Dedougou, and 1 case in Korhogo stated to be from Tiassale, Ivory Coast.
[5] During the week ended Oct. 15, 1938, 3 cases of yellow fever were reported in Tougan, French Sudan.

X