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THE ACTION OF CURRENTS OF VERY HIGH FREQUENCY UPON TISSUE CELLS

A. UPON A TRANSPLANTABLE MOUSE SARCOMA.

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INTRODUCTION

In a previous paper [1] were reported some of the effects of an electrostatic field, forming part of a tuned circuit excited by electrical oscillations of very high frequency (135,000,000 to 8,300,000 cycles per second), upon small laboratory animals (mice). The oscillations were generated by a three-element tube oscillator of special design.

It was observed in the course of these studies that these currents, applied through the action of the field just mentioned, were capable of injuring tissues, and, moreover, that their action bore some relation to the frequency employed, oscillations of the highest and lowest frequencies studied having much less effect than those of intermediate frequencies.

Since frequency seemed an important factor in the action of these oscillations, the thought occurred that, under suitable conditions, oscillations at certain frequencies might prove more injurious to some tissue cells than to others; in other words, there might be a differential action upon tissue cells with respect to frequency.

Evidently the tissue cells of transplantable tumors should be excellent experimental objects for this purpose. Here we have groups of cells distinguished from the adjacent tissue cells by their size and their active proliferation, not only contributing nothing to vital functions, but being highly detrimental to their host. Retardation of their growth or their eventual recession through the action, under suitable conditions both as to frequency and method of application, of electromagnetic radiation might well develop interesting data with respect to such possible differential action.

[1] Schereschewsky, J. W.: The Physiological Effects of Currents of Very High Frequency (135,000,000 to 8,300,000 Cycles per Second). Pub. Health Repts., vol. 41, No. 37 (Sept. 10, 1926), pp. 1939-1963.

This paper is a preliminary report on this phase of the subject and describes attempts which have met with a certain amount of success to influence adversely the growth of a transplantable mouse sarcoma of great virulence, and also, with H. B. Andervont as collaborator, that of the well-known Rous fowl sarcoma.

The mouse tumor selected for these experiments was the strain of mouse sarcoma known as the Crocker Research Laboratory's No. 180, which was kindly furnished to the writer by Dr. F. C. Wood, director of the Crocker Laboratory for Cancer Research, for which grateful acknowledgment is hereby made.

Grateful acknowledgment is also made to Dr. M. J. Rosenau, professor of preventive medicine and hygiene of the Harvard Medical School, for permitting the use of the laboratory facilities in his department for these studies, and to Asst. Prof. Lloyd D. Felton for bacteriological work in connection with the tumors used.

This mouse sarcoma is reputed to be one of the most virulent of the known strains of laboratory tumor. Implantations yield 95 to 96 per cent of takes, and spontaneous recessions seldom occur. From information obtained on a visit to the Crocker Laboratory, in 10,000 implantations of the tumor 96 per cent were successful, while spontaneous recessions were observed in but 2 per cent of the instances.

Though the tumor is now in its twenty-third generation since it was received by the writer, no case of spontaneous recession has been observed in at least 230 control mice, the tumor causing the death of the animals in from four to six weeks from the date of implantation.

APPARATUS AND METHODS

In subjecting the tumors to the action of the very high-frequency currents, the following apparatus and methods were employed:

Generation of high-frequency currents.—For generating currents of very high frequency use was made of a three-element tube oscillator having a range of 150,000,000 to 60,000,000 cycles per second. The circuit used is one described by Huxford [2] and is excellently adapted to the efficient and stable generation of oscillations in this range of frequencies. The oscillator used in these experiments is fully described and illustrated as oscillator No. 2 in the writer's paper to which reference has already been given.

For the convenience of the reader Figure 1 shows the circuit network and Plate 1 the general appearance of the oscillator with the accompanying auxiliary circuit for applying the high-frequency currents to the tissues to be treated.

Determination of frequency.—For determining the frequency at which the oscillator was operating, the Lecher parallel wire system

[2] Huxford, W. S.: Standing Waves on Parallel Wires. Physical Review, Corning, N. Y., 2d series, vol. 25 (1925), pp. 686–695.

described in my previous paper (to which the reader is referred) was employed. This system permits the determination of the wave length, and hence the frequency, with an accuracy of perhaps one-half of 1 per cent or less.

Utilization of oscillator output.—In studying the effects of currents of very high frequency on the growth of tumors it is obviously inexpedient to make use of any conductive arrangement, as the

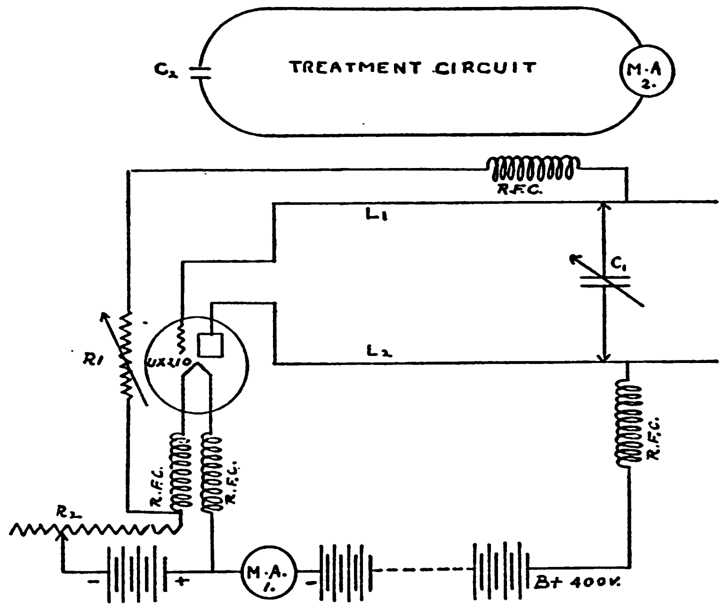


FIG. 1.—Circuit diagram of high frequency oscillator (range 150,000,000 to 60,000,000 cycles)
L_1=Grid inductance
L_2=Plate inductance
C_1=Tuning condenser
C_2=Treatment electrodes
R_1=Grid-biasing resistance (10,000 to 200,000 ohms)
R_2=Filament rheostat
R. F. C.=Radio-frequency choke coils

constants of the oscillating system would, at these very high frequencies, be thereby seriously disturbed.

Therefore, the effect of these high-frequency oscillations on tumor cells was studied by means of an auxiliary tuned circuit which was inductively coupled to the oscillator. As shown by the accompanying diagram (Figure 2, and Plate I, A), this circuit consisted of an inductance and a capacity, the inductance consisting of a single-turn wire loop, having a Weston thermomilliammeter inserted at its mid-point to read the current, and the capacity of a pair of treatment electrodes, presently to be described, which were connected through flexible leads and suitable binding posts to the inductance.

Treatment electrodes.—As in the experiments reported in the previous paper, it was the effect upon the growth of tumors of an intense electrostatic field which was investigated in the present studies. The tumors were subjected to the action of such field by including them between pairs of insulated copper plates which, through their connection by means of flexible leads, formed part of the auxiliary tuned circuit previously mentioned which was coupled inductively to the oscillator.

These electrodes, of several convenient sizes (19 by 15 millimeters, 15 by 14 millimeters, and 12 by 12 millimeters) were cut out of 30-gauge copper sheet, the corners being slightly rounded. They were also bent on a slight arc of a circle, so that when applied to either side of a tumor they would tend to lift the tumor mass away from the underlying tissues, thus concentrating the influence of the electro-

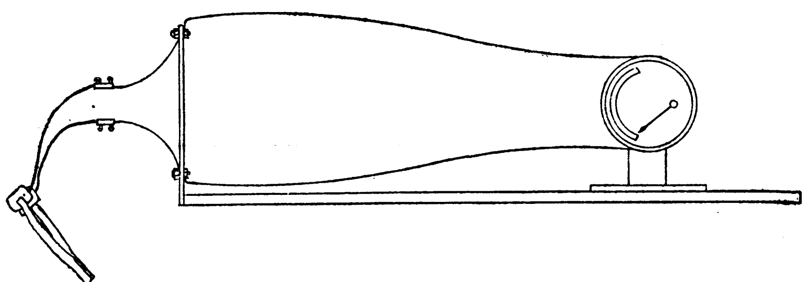
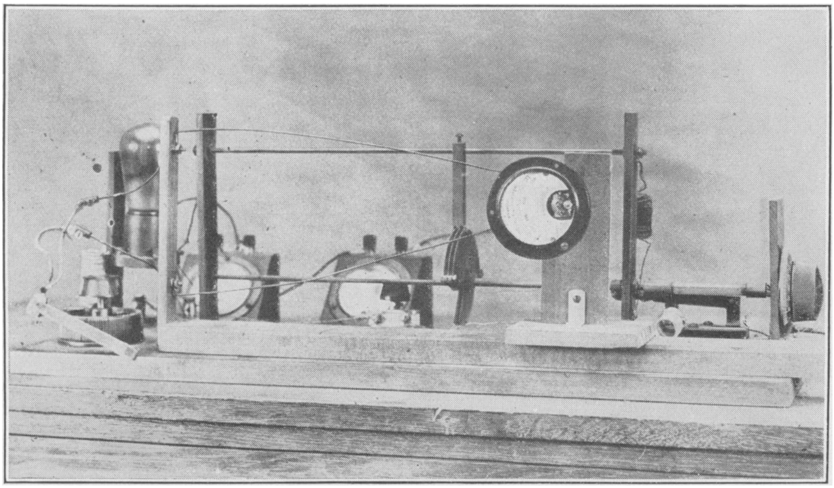


FIG. 2.—Diagram of auxiliary treatment circuit

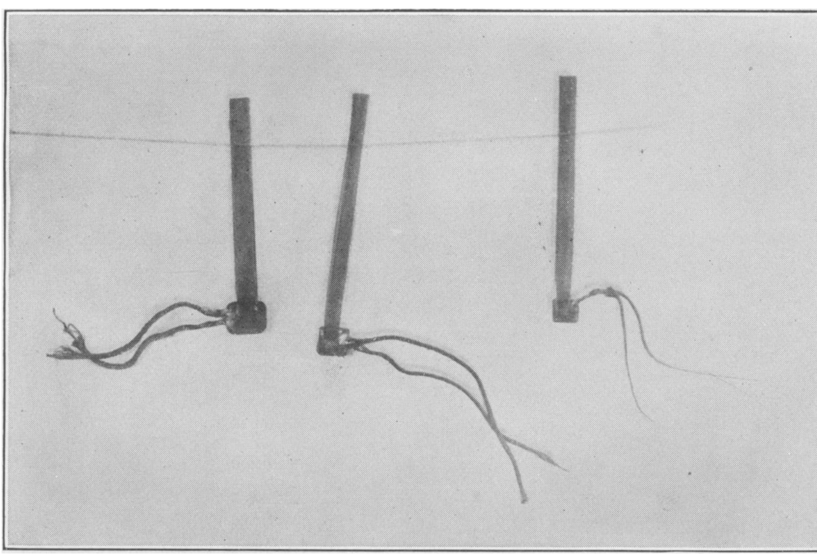
static field between the plates upon the tumor, while at the same time diminishing it upon the adjacent tissues.

In order properly to apply the treatment electrodes to the tumors, the electrodes were mounted by means of cellulose lacquer to a tissue forcepslike arrangement, made of two strips of stout celluloid about 11.5 centimeters long, 0.8 centimeters wide, and 1.5 millimeters thick. These strips were glued together at the end opposite the plates by a dab of the lacquer, and the remainder of the strips was given a suitable curve by bending them while heated. The appearance of the treatment electrodes is shown in the photograph. (Pl. I, B.)

Insulation of electrodes.—Since the studies were concerned with the effects of an electrostatic field, and since the electrodes with the intervening tissues formed the capacity which, taken in conjunction with the inductance formed by their flexible leads and the rest of the wire in the auxiliary coupled circuit, caused this circuit to be tuned to the frequency generated by the oscillator, it was deemed necessary to avoid all metallic conduction effects upon the tissues subjected to treatment by carefully insulating the surfaces of the treatment electrodes.



A. High frequency oscillator (range 150,000,000 to 60,000,000 cycles per second), with auxiliary treatment circuit placed in inductive relation to oscillator



B. Treatment electrodes of various sizes

As the studies proceeded the impression was strengthened that the nature and quality of the insulation covering the electrodes played an important part in the results, defective or broken-down insulation resulting in undesirable effects, such as little or no current in the auxiliary circuit, pain, sparking, local heating, burning of tissues, and the like.

After some experimenting the following insulating lacquer was found to be satisfactory:

Cellulose acetate (Eastman Kodak Co.'s No. 1097)	grams	11
Acetone, Merck's C. P	cubic centimeters	100

In the preparation of this lacquer, care should be taken to avoid the presence of moisture. Before mixing, the cellulose acetate was dried by keeping it in the incubator room (which was very dry) for several days, or in a desiccator. The use of Merck's C. P. acetone was also found desirable, as the commercial variety appears to contain a small amount of moisture, resulting in milkiness of the lacquer.

Before applying the lacquer, the surface of the electrodes was burnished with fine steel wool and then freed from grease by dipping in ether. This is necessary in order to secure good adhesion. Each electrode was given three coats of the lacquer by dipping and allowing the surplus to drain off, each coat being first allowed to dry thoroughly. When properly applied, the insulating lacquer is glassy and transparent. Air bubbles are to be avoided, as they form weak points in the insulation which are prone to break down.

The insulation appears to deteriorate with use, so it was scraped off and the electrodes were recoated whenever the clear glasslike appearance was lost or the insulation became loosened along the edges.

Tuning of auxiliary treatment circuit.—In order that any considerable oscillating current should flow through the auxiliary circuit when placed in inductive relation to the oscillator, from well-known physical considerations it is, of course, necessary that the auxiliary circuit should be approximately in resonance with the frequency at which the oscillator is operating. This is readily accomplished by a "cut and try" method by varying the length of the wire forming the inductance of the auxiliary circuit until the current indicated by the thermomilliammeter inserted in the auxiliary circuit is a maximum for a given oscillator output and degree of coupling.

Since practically all the studies were carried out at uniform frequencies of 68,000,000 to 66,000,000 cycles per second, once the length of the wires had been satisfactorily determined, it was not necessary to change the adjustment throughout the experiments. In this particular instance it was found that a total length of wire of 52 centimeters (including the flexible lead to the electrode) from each binding post of the meter, with a maximum spacing of 15 centimeters, taken in conjunction with the capacity furnished by the plates of the treatment electrode, formed a circuit roughly in resonance with the frequencies mentioned above.

Using a UX 210 tube having a rating of 7.5 watts with a plate voltage of 400 and a filament current of 1.25 amperes, currents of over 500 milliamperes were readily obtainable in the auxiliary circuit. Using a more powerful tube especially adapted to short-wave transmission, such as the UX 852, with suitable plate voltage, no doubt currents of 5 or more amperes could as readily be obtained. Since the currents applied in these experiments scarcely ever exceeded 350 milliamperes, the output obtained with the UX 210 proved entirely satisfactory.

Frequencies employed.—As mentioned before, with but few exceptions, this series of experiments was conducted at frequencies, rather arbitrarily chosen, of between 68,000,000 and 66,000,000 cycles per second. In the writer's previous paper mention is made of an interesting hypothesis suggested by Prof. G. W. Pierce, of Harvard University, director of the Cruft High Tension Laboratory, that tissue cells placed in an electrostatic field and subjected to the displacement currents caused by the rapid alternations in polarity of the field may undergo some mode of electromechanical vibration which might well have definite effects upon the cell. Professor Pierce also supplied the writer with a simplified formula based on Lamb's [3] mathematical investigation of mechanical oscillations in solid elastic spheres by which the diameter of the smallest sphere capable of vibrating in some mode at a particular frequency may readily be calculated, if we assume that sound vibrations travel through tissue cells with approximately the same speed as through water.[4] Now the diameter of the tumor cells of the mouse sarcoma used in these studies varies from 12 to 15 microns. According to the formula, solid elastic spheres of such diameters should be capable of mechanical vibrations at frequencies ranging from 80,000,000 to 64,000,000 cycles per second. Lacking the means of orientation, frequencies within this range were therefore taken as a point of departure, and since these frequencies were found capable of exerting pronounced effects upon the cells of the tumor in question, experiments were continued at these frequencies until it was believed that sufficient data had been collected to justify their publication in a preliminary way.

Method of treating tumor-bearing mice.—For the sake of convenience in handling, tumors were uniformly implanted on the right anterior surface of the belly at a locality which, in human beings, would cor-

[3] Lamb, H.: On the Vibrations of an Elastic Sphere. Proc. London Math. Soc., Series 1, 1882, vol. 13, p. 189.

[4] For a more extended treatment of this hypothesis the reader is referred to the writer's original paper.

respond to McBurney's point. Tumors in this situation were found to grow with great rapidity, often reaching a diameter of from 4–6 millimeters in 3 days and 10–12 millimeters in 6 or 7 days.

To subject the tumor to the action of the high-frequency currents, the mouse was held in the left hand by pinching a fold of skin on the back of the neck between the thumb and forefinger while at the same time holding the tail by pressure of the middle and ring fingers against the ball of the thumb. The oscillator having been turned on and the auxiliary circuit placed in its proper inductive relation to the oscillator, the tumor was gently pinched between the insulated plates of the treatment electrodes, the current indicated by the meter in the auxiliary circuit being kept constant at the selected value by varying the filament rheostat as required.

Controls.—Ten mice out of every lot of implantations were set aside as controls, so that the course of the tumor treated could be compared with that in control mice. The dates of death of the controls were recorded as they occurred. No case of spontaneous recession of a tumor was seen in any of the controls, some 230 in number.

Effects upon the growth of tumors.—Soon after the beginning of the experiments the fact was noted that treatment in the manner described had a pronounced immediate effect upon the tumor. The mass seemed to become much smaller and softer, and a small tumor 4 or 5 millimeters in diameter, might, just after treatment, barely be palpable. There was usually some local reaction within 24 hours in the shape of edema of the treated area. In favorable cases, after the edema had subsided, the remains of the tumor were represented by a mass, which grew smaller and smaller until it eventually disappeared. There was usually, too, some superficial necrosis of the skin overlying the tumor, resulting in the shedding of the hair and the formation of a small eschar which came away in 10 days to 2 weeks, leaving the skin pink and healthy beneath it. The extent to which the overlying skin was affected appears very largely to be determined by the strength of the current used and the number of treatments required to cause recession of the tumor. In cases where one treatment was sufficient and the current was kept at a relatively low value (300 milliamperes or less), the skin disturbance was slight. In all cases, however, there seemed to be some shedding of the hair, so that the treated area could be detected two or three months after the absorption of the tumor.

When properly applied—i. e., with well-insulated electrodes and current not too high—the treatment appears to cause no pain. The mice remain passive, or struggling is no greater than is observed in mice forcibly restrained for similar periods of time. If, however, the insulation has become defective, or breaks down, pain is apparently great, as shown by squealing and struggling of the mouse. Defects in the insulation may cause severe local heating of the tissues, followed by necrosis in them, a result to be avoided by careful attention to the state of the insulation on the electrodes before their application.

Recovery naturally depends on the death of the tumor cells. This tumor appears to have such vitality that the impression was gained that if but a few viable cells were left behind, recrudescence of the tumor was bound to occur. The presence of renewed activity on the part of the tumor was, as a rule, readily detected by the increase in size and a firm elasticity in the feel, characteristic of rapidly multiplying tumor cells. Almost without exception recrudescence of the tumor, if it occurred, was manifest within a short time after treatment, as a rule within 10 days. Among the mice listed as recovered no case of recrudescence or recurrence of the tumor was observed taking place after the death of the last control mouse. For this reason, if mice survived the last control mouse tumor free and in good health, they could be regarded as recovered for practical purposes.

In Table 1 are summarized the following data in regard to 100 mice in which, as a result of treatment, the tumor receded completely and the mouse was tumor free and in good health at the date of death of the last control: Laboratory number of mouse; date of inoculation; date of first treatment; size of the tumor, in millimeters; number of treatments; frequency employed; current used, measured in milliamperes; date on which recession of the tumor was complete and the skin had returned to normal condition; date of death of the last control mouse; remarks.

TABLE 1.—*Summarized data with regard to 100 mice which, as a result of treatment, were tumor-free at date of death of last control*

Mouse laboratory No.	Date inoculated	Date of first treatment	Size of tumor in millimeters	Number of treatments	Total duration of treatment	Frequency in megacycles	Current, in milliamperes	Date of complete recession of tumor	Date of death of last control	Remarks
					Min. sec.					
12	Sept. 26, 1927	Oct. 5, 1927	10 by 8	3	8 30	68-66	330	Oct. 29, 1927	Oct. 30, 1927	Tumor-free and in good health, Mar. 10, 1927.
13	do	do	11 by 10	3	9	68-66	300	do	do	Do.
14	do	do	9 by 8	5	14	68-66	330-300	Nov. 2, 1927	do	Do.
17	do	do	10 by 10	5	14	68-66	300	Nov. 7, 1927	do	Died Dec. 21, 1927, from intestinal infection. No trace of tumor at autopsy.
70	Oct. 21, 1927	Oct. 27, 1927	6 by 5	3	9	68-66	330-300	Nov. 22, 1927	Dec. 1, 1927	Good health till Jan. 15, 1928, when killed in fight with companion. No trace of tumor at autopsy.
71	do	do	12 by 9	2	5	68-66	380-350	Nov. 10, 1927	do	Do.
72	do	do	7 by 7	1	3	68-66	330	Nov. 11, 1927	do	Good health till Jan. 18, 1927, when died of wounds received in fight. No trace of tumor at autopsy.
88	do	do	9 by 6	2	4	68-66	350-300	do	do	Good health till Mar. 2, 1928, when died from intestinal infection. No trace of tumor at autopsy.
89	do	do	2 tumors each, 9 by 6.	3	8 30	68-66	330-300	Nov. 15, 1927	do	Good health till Feb. 22, 1928, when died of diarrhea. No trace of tumor at autopsy.
95	Oct. 26, 1927	Oct. 31, 1927	10 by 7	2	5 30	68-66	400-300	Nov. 22, 1927	Dec. 7, 1927	Tumor-free and in good health Mar. 10, 1927.
127	Nov. 7, 1927	Nov. 14, 1927	10 by 9	1	3	68-66	330	Nov. 29, 1927	Jan. 5, 1928	Do.
128	do	do	10 by 8	4	9 30	68-66	300-200	Jan. 6, 1928	do	Do.
129	do	do	9 by 9	1	2	68-66	300	Dec. 1, 1927	do	Do.
130	do	do	10 by 10	1	3	68-66	300	Nov. 28, 1927	do	Do.
133	do	do	12 by 10	1	3	68-66	300	Dec. 28, 1927	do	Killed in fight with companion Jan. 21, 1928. No trace of tumor at autopsy.
137	do	do	do	1	3 30	68-66	300	Nov. 29, 1927	do	Tumor-free and in good health Mar. 10, 1928.
138	do	do	9 by 9	3	7	68-66	300	Dec. 7, 1927	do	Do.
142	do	do	12 by 10	2	5	68-66	300-250	Dec. 27, 1927	do	Do.
143	do	do	13 by 9	3	6 30	68-66	300	Nov. 29, 1927	do	Do.
144	do	do	13 by 8	1	3	68-66	320-300	Nov. 26, 1927	do	Do.
145	do	Nov. 23, 1927	14 by 11	1	4	68-66	200	Dec. 7, 1927	do	Do.
146	do	Nov. 14, 1927	11 by 9	1	3 30	68-66	330	Dec. 1, 1927	do	Killed in fight with companion Feb. 22, 1928. No trace of tumor at autopsy.
191	Dec. 22, 1927	Dec. 30, 1927	10 by 8	3	9 30	68-66	300	Jan. 24, 1928	Feb. 5, 1928	Tumor-free, in good health, Mar. 10, 1928.
192	do	do	11 by 8	4	10 10	68-66	300-250	Jan. 30, 1928	do	Do.
199	do	do	2 tumors, 9 by 7 and 10 by 10.	4	11 30	68-66	300-250	Jan. 27, 1928	do	Do.
200	do	do	10 by 9	2	6	68-66	300	Jan. 16, 1928	do	Do.
205	do	Jan. 3, 1928	14 by 10	4	11 30	68-66	300-250	Jan. 24, 1928	do	Do.
206	do	do	2 tumors, each 10 by 10.	6	18	68-66	300-250	Feb. 2, 1928	do	Do.
207	do	do	12 by 10	5	15	68-66	300	Jan. 27, 1928	do	Do.
208	do	do	10 by 8	3	9	68-66	300-250	Feb. 8, 1928	do	Do.
209	do	do	14 by 10	5	16	68-66	300-250	Jan. 30, 1928	do	Do.

TABLE 1.—*Summarized data with regard to 100 mice which, as a result of treatment, were tumor-free at date of death of last control*—Continued

Mouse laboratory No.	Date inoculated	Date of first treatment	Size of tumor in millimeters	Number of treatments	Total duration of treatment (*Min. sec.*)	Frequency in megacycles	Current, in milliamperes	Date of complete recession of tumor	Date of death of last control	Remarks
210	Dec. 22, 1927	Dec. 30, 1927	14 by 9	8	21	68-66	300-250	Jan. 30, 1927	Feb. 5, 1928	Tumor-free, in good health, Mar. 10, 1928.
214½	do	Dec. 28, 1927	9 by 8	5	11 45	68-66	300-250	Jan. 24, 1928	do	Do.
223	Dec. 28, 1927	Jan. 15, 1928	2 tumors, 6 by 6 and 9 by 9.	3	8	68-66	300	Jan. 27, 1928	(1)	Do.
238	Jan. 6, 1928	Jan. 16, 1928	2 tumors, 10 by 6, and 5 by 5.	2	5	68-66	250	Feb. 2, 1928	Feb. 21, 1928	Do.
239	do	Jan. 10, 1928	2 tumors, each 4 by 4.	2	5	68-66	250	Jan. 24, 1928	do	Do.
240	do	do	4 by 4	3	8 15	68-66	280-250	Feb. 6, 1928	do	Do.
241	do	do	do	3	8 30	68-66	300-250	Jan. 27, 1928	do	Do.
242	do	do	3 by 3	3	8	68-66	300-250	Jan. 30, 1928	do	Do.
243	do	Jan. 16, 1928	2 tumors, 10 by 8 and 5 by 5.	2	5	68-66	300-250	Feb. 6, 1928	do	Do.
244	do	do	2 tumors, 4 by 4 and 5 by 5.	2	5	68-66	300-250	Jan. 27, 1928	do	Do.
245	do	Jan. 10, 1928	4 by 4	2	6	68-66	300-250	Feb. 2, 1928	do	Do.
252	do	Jan. 11, 1928	do	3	8 30	68-66	280-250	Feb. 6, 1928	do	Do.
261	do	Jan. 13, 1928	2 tumors, 8 by 8 and 5 by 5.	2	6	68-66	300-250	Feb. 8, 1928	do	Do.
262	do	do	6 by 6	2	5 30	68-66	300-250	Feb. 2, 1928	do	Do.
263	do	do	2 tumors, 5 by 5 and 6 by 6.	3	8 30	68-66	300-250	Jan. 27, 1928	do	Do.
264	do	do	5 by 6	1	3	68-66	290	Feb. 2, 1928	do	Do.
265	do	do	8 by 8	2	6	68-66	300-250	Jan. 30, 1928	do	Do.
266	do	do	do	2	5	68-66	300-250	Jan. 24, 1928	do	Do.
272	do	Jan. 17, 1928	10 by 10	2	6	68-66	300-200	Jan. 26, 1928	do	Do.
275	Jan. 14, 1928	Jan. 21, 1928	2 tumors, each 4 by 4.	4	12	68-66	300	Jan. 30, 1928	do	Do.
276	do	Jan. 19, 1928	5 by 10	2	5	68-66	300	Feb. 2, 1928	do	Do.
277	do	do	2 tumors, 5 by 5 and 6 by 6.	3	9	68-66	300-280	Feb. 6, 1928	do	Do.
278	do	do	4 by 4	1	3	68-66	300	do	do	Do.
279	do	do	5 by 5	1	3	68-66	300	Jan. 30, 1928	do	Do.
280	do	do	do	2	6	68-66	300-250	Feb. 2, 1928	do	Do.
313	Jan. 18, 1928	Jan. 23, 1928	2 tumors, 5 by 5 and 4 by 4.	2	6	68-66	300-250	Feb. 11, 1928	do	Do.
314	do	do	5 by 5	1	3	68-66	300-250	Feb. 13, 1928	do	Do.
322	do	do	2 tumors, each 5 by 5.	2	6	68-66	300	Feb. 8, 1928	do	Do.

323	do	do	11 by 8	2	6		68-66	300-250	Feb. 10, 1928	do	Do.
343	Jan. 25, 1928	Jan. 28, 1928	5 by 5	2	6		68-66	300-250	do	Mar. 6, 1928	Do.
344	do	do	6 by 6	3	9		68-66	300-250	Mar. 7, 1928	do	Do.
345	do	do	4 by 4	2	3		68-66	300-280	Feb. 17, 1928	do	Do.
346	do	do	2 tumors, 7 by 7 and 5 by 5.	3	8	30	68-66	300-250	do	do	Do.
347	do	do	2 tumors, 5 by 5 and 3 by 3.	3	9		68-66	300-250	do	do	Do.
348	do	do	7 by 7	2	6		68-66	300-250	Feb. 10, 1928	do	Do.
349	do	do	6 by 6	2	6		68-66	300-250	Feb. 15, 1928	do	Do.
350	do	Jan. 31, 1928	10 by 5	3	7		68-66	300-250	Mar. 7, 1928	do	Do.
351	do	do	10 by 10	2	6		68-66	300-250	Feb. 15, 1928	do	Do.
353	do	do	2 tumors, each 7 by 7.	2	6		68-66	290	Feb. 25, 1928	do	Do.
354	do	do	6 by 6	1	3		68-66	250	Feb. 17, 1928	do	Do.
355	do	do	5 by 5	1	3		68-66	300-250	Feb. 8, 1928	do	Do.
357	do	Jan. 28, 1928	6 by 6	2	6		68-66	300-250	Feb. 17, 1928	do	Do.
358	do	do	9 by 8	2	6		18-66	300-250	Feb. 13, 1928	do	Do.
359	do	do	6 by 6	3	8	30	68-66	300-250	do	do	Do.
360	do	do	5 by 5	5	13	45	68-66	300-250	Feb. 25, 1928	do	Do.
361	do	do	10 by 6	1	3		68-66	300-250	Feb. 13, 1928	do	Do.
362	do	do	2 tumors,[2] 6 by 6 and 11 by 11	5	16		68-66	300-250	Mar. 7, 1928	do	Do.
363	do	do	5 by 5	3	9		68-66	300-250	Feb. 17, 1928	do	Do.
364	do	do	do	2	5	30	68-66	300-250	Feb. 15, 1928	do	Do.
366	do	Jan. 31, 1928	7 by 6	1	3		68-66	300-250	Feb. 13, 1928	do	Do.
367	do	do	6 by 6	1	3		68-66	300-250	Feb. 10, 1928	do	Do.
368	do	do	do	1	3		68-66	300	Feb. 13, 1928	do	Do.
369	do	do	8 by 8	2	5	30	68-66	300-250	do	do	Do.
370	do	do	10 by 6	1	3		68-66	300	Feb. 25, 1928	do	Do.
371	do	do	2 tumors, 6 by 6 and 5 by 5.	[3] 2	6		68-66	300-250	Feb. 13, 1928	do	Do.
372	do	do	7 by 7	2	6		68-66	300-250	Feb. 25, 1928	do	Do.
380	Feb. 1, 1928	Feb. 7, 1928	2 tumors, 6 by 6 and 5 by 5.	[3] 2	6		68-66	300	Feb. 21, 1928	Mar. 5, 1928	Do.
381	do	do	7 by 7	2	6		68-66	300-250	Feb. 27, 1928	do	Do.
382	do	do	6 by 5	1	3		68-66	300	Feb. 20, 1928	do	Do.
383	do	do	2 tumors, 7 by 7 and 4 by 4.	[3] 2	6		68-66	300-260	Feb. 18, 1928	do	Do.
384	do	do	7 by 7	2	6		68-66	300-250	Mar. 21, 1928	do	Do.
385	do	do	9 by 7	2	6	45	68-66	300-250	Mar. 6, 1928	do	Do.
386	do	do	7 by 6	1	3		68-66	300-280	Feb. 27, 1928	do	Do.
388	do	do	2 tumors, 8 by 8 and 6 by 6.	2	6		68-66	250	Feb. 23, 1928	do	Do.
389	do	do	15 by 8	2	6		68-66	290	Feb. 18, 1928	do	Do.
391	do	do	9 by 6	1	3		68-66	300-250	Feb. 21, 1928	do	Do.
392	do	do	2 tumors, 4 by 4 and 5 by 5.	[3] 2	6		68-66	290	Feb. 23, 1928	do	Do.
394	do	do	7 by 6	2	5	30	68-66	300-290	Feb. 21, 1928	do	Do.
403	do	do	9 by 9	2	6		68-66	300-250	Mar. 8, 1928	do	Do.

[1] Record lost.

[2] Secondary tumor developing later.

[3] 1 to each.

DISCUSSION

The table sets forth the principal data with respect to 100 mice, formerly bearers of the mouse sarcoma worked with, which survived their controls tumor-free and apparently in good health.

These mice were the survivors of 403 mice which were treated and observed. Consequently the percentage of recovery was practically 25 per cent, the remaining 303 mice dying from various causes before the death of the last control mice. Certainly, these results fall far short of the ideal of 100 per cent of recoveries. However, these figures include all the mice experimented with from the very beginning, except those under treatment at the time of the present writing. As will be seen by the large gaps in the sequence of numbers of the recovered mice, results were very poor at first, but improved later on. Attention is invited to the series commencing with mouse No. 343 and ending with mouse No. 372. The only mice dying in this series were mice Nos. 352, 356, and 365, which died from some intercurrent affection after the tumor had receded. This gives 27 survivors out of a series of 30 mice, or 90 per cent of recoveries.

One feature worth noting is the fact that of the 403 mice treated, only 22, or about 5.5 per cent, actually died of tumor, the remainder dying from other causes.

One circumstance which led to considerable unavoidable mortality among the mice is the association of this tumor, as is often the case, with a diphtheroid bacillus, which of itself is pathogenic for mice. This organism, a Gram positive pleomorphic diplococcus, was frequently encountered in the heart blood of mice which, after making good progress toward recovery from the tumor, began to sicken and lose weight, eventually dying in three weeks or so after treatment had been started, often after the tumor had apparently receded completely.

Asst. Prof. L. D. Felton kindly isolated this organism for me from a tumor and showed not only that it might be very pathogenic for mice, but also that it had the property of causing local necrosis of tissue. Again, a number of mice were lost from intercurrent intestinal disorders so common in laboratories. Due to lack of any previous experience, the treatment, too, was responsible for the loss of a number of mice in that the dosage was too high or the treatments were unnecessarily repeated. In a delicate creature such as a mouse the treatment in itself is quite capable of causing death if the dosage is too high, and a number of mice were lost in this way, especially in the earlier days, the mice dying within 24 or 48 hours after the treatment was applied.

Even now, since histologica work has been begun on the mode of action of these high-frequency currents, the writer is of the belief that the current values as set forth in the table are still too high, and had these been reduced to values in the neighborhood of 240 to 200 milliamperes, the results might have been materially better

Mode of action of the high-frequency currents.—At present not much positive information can be given as to the mode of action of these high-frequency currents upon the tumor cells, although histological studies, later to be reported, are now in progress which, it is hoped, will throw light on the question. The action of the electrostatic field in which the tumors are placed for treatment does not seem to be the same as that in medical diathermy with the conventional high-frequency apparatus. With low-current values (not in excess of 300 milliamperes) and the time of exposure not exceeding three or four minutes, there does not appear to be any significant heating of the tissues. If the tissues are felt immediately upon the end of treatment, the local rise in temperature of the parts is often not perceptible or is slight. Yet the diminution in size and the softening of the tumor affected immediately by the treatment is striking and often remarkable.

It is evident that a potent destructive influence is exerted upon the tumor cells which brings about their death in a large number of instances and, in favorable cases, results in the complete absorption of the cell remains.

From a preliminary study of sections made of the tumor removed immediately and 24 hours after exposure in situ for a space of three and one-half minutes at a frequency of 68,000,000 cycles per second and at current values of 300, 250, and 200 milliamperes, the impression was strong that the tumor cells, and especially their nuclei, bore the brunt of the attack, the surrounding areolar tissue being much less affected. Fragmentation of the nucleus, disappearance of cell outlines, and pyknotic nuclei of the tumor cells were some of the effects noted.

Some of these sections were kindly examined for the writer by Dr. S. B. Wolbach, professor of pathological anatomy at the Harvard Medical School. Doctor Wolbach's personal communication to the writer reads, in part, as follows:

> In general, the immediate effects of the agency you have applied to the tumor is necrosis to the tumor cells and accompanying vascular and connective tissue structures. The general picture produced is that of so-called coagulation necrosis and the most familiar corresponding picture that I know of is in completely infarcted tissues.
>
> A very striking phenomenon, however, as brought out in the slides, is the extraordinarily rapid disappearance of the necrotic tumor. I am quite unfamiliar with anything corresponding to it. In the few microscopic preparations submitted one gets the impression that there has been very rapid solution, possibly solution by autolysis (?) of the cells including the nuclei.

UPON A TRANSPLANTABLE FOWL SARCOMA

By J. W. Schereschewsky, *Surgeon, United States Public Health Service, Associate in Preventive Medicine and Hygiene, Harvard Medical School;* and H. B. Andervont, D. Sc., *Instructor in Epidemiology, Harvard School of Public Health*

Some diffidence would be felt in publishing results based on the small number of observations contained in this series were it not for the fact that, when taken in conjunction with the much greater body of material reported upon in the first section of this paper, the meagerness of the observations takes on a meaning which otherwise it would not possess.

At the time when the mouse experiments were going forward one of us (H. B. A.) was propagating, for other purposes, a strain of the Rous fowl sarcoma. The material from which this strain was started in this laboratory was derived from dried powdered tumor obtained from the Rockefeller Institute for Medical Research.

The Rous fowl sarcoma is notable because it may be propagated by injection of the cell and bacteria-free filtrate of the tumor, on account of its rapidity of growth, its tendency to extensive metastasis, its virulence, and its extreme ease of inoculation. Skin tumors are readily implanted, merely by slightly scarifying the skin and rubbing thereon a bit of fresh tumor tissue.

The following experiments were performed with tumors implanted variously in the skin, comb, and wattles of chickens. The technique and methods of subjecting these tumors to the action of the high-frequency currents were the same as those used in the experiments reported in the preceding paper.

EXPERIMENT NO. 1

White Leghorn rooster No. 226.—This fowl was inoculated November 19, 1927, with Rous fowl sarcoma, in the posterior portion of the comb.

First treatment was given November 28, 1927, when tumor in comb was about 8 millimeters in diameter.

Duration of treatment, 3 minutes at a frequency of 66,000,000 cycles and a current of 350 to 300 milliamperes.

Treatment was repeated November 29, 1927. During the second treatment the treated portion of comb became cyanotic, dried up, and 14 days later dropped off, together with the tumor. Evidently in this case the treatment was unnecessarily severe, not only destroying the tumor but the adjacent comb tissues.

On January 13, 1928, this fowl was reinoculated with tumor on the skin of the right breast. Six days later it had several well-developed skin tumors in two areas of the scarifications, each collection forming an area about 8 by 10 millimeters.

On January 19, 1928, each area was treated for 3 minutes at a frequency of 68,000,000 cycles and a current of 300 milliamperes. Immediately after treatment the tumors were much less prominent and felt soft. Superficial necrosis of the skin over the treated area became evident 3 days later, leading to scab formation. This dropped off in 10 days, leaving the skin smooth and free from tumor on February 6, 1928. This fowl is in excellent condition and tumor free at the date of writing, March 16, 1928.

EXPERIMENT NO. 2

White Leghorn rooster No. 228.—This fowl was inoculated both in the comb and on the skin of right breast on November 19, 1927, and was noted as sick and anemic at the time of inoculation.

First treatment was on November 28, 1927, when it had a tumor mass in the comb 8 millimeters or so in diameter.

This tumor was given 3 treatments of 3 minutes each at a frequency of 66,000,000 cycles and current of 300 milliamperes on November 28, 29, and December 1, 1927, with the result that on December 6, 1927, it had completely receded. The tumor implanted in the right breast had grown slowly, so that the first treatment was not given it until December 5, 1927, when it was about 5 millimeters in diameter. The frequency was 68,000,000 cycles, the duration 3 minutes, and the current 215 milliamperes. This tumor began to recede at once, but a fresh tumor developing near by was given 3 treatments of 2 minutes each on December 8, 12, and 14, after which it, too, became inactive.

The fowl's general condition, however, characterized by grave anemia, became progressively worse, so that it died on December 26, 1927.

At the autopsy no trace of tumor nor metastasis was found.

EXPERIMENT NO. 3

Full-grown Plymouth Rock rooster No. 230.—Inoculated November 19, 1927, on the left breast.

On December 1, 1927, 3 skin tumors each 4 millimeters in diameter were each given 1½ minutes' treatment at a frequency of 68,000,000 cycles and a current of 230 milliamperes. The tumors remained quiescent until December 13, 1927, when they showed signs of renewed activity. Treatments were repeated on December 14, 24, and 31, 1927, and on January 7, 1928. On January 11, 1928, a scab 10 by 10 millimeters came away, leaving a raw, healthy area which quickly cicatrized, the fowl remaining in excellent condition until February 17, 1928.

Second inoculation.—On February 17, 1928, the fowl was reinoculated with tumor in the right breast. By February 24, 1928, a small tumor 3 millimeters in diameter had developed, which grew slowly until February 28, 1928, when it received a 3-minute treatment at a frequency of 68,000,000 cycles and a current of 220 to 200 milliamperes. This halted the growth and caused the recession of the tumor mass, which had entirely disappeared by March 6, 1928.

Third inoculation.—The fowl was inoculated for the third time on the left breast March 1, 1928. By March 10, 1928, it had developed a small tumor mass on the left breast 6 millimeters long by 4 millimeters wide. This was given a treatment on that day of 3½ minutes at a frequency of 68,000,000 cycles and a current of 250 to 200 milliamperes.

At the time of writing, March 16, 1928, there are no signs of tumor activity in the treated area. It is possible that, in this case, the fowl has gained a certain degree of immunity from the first inoculation, making the second and third crop more susceptible to the treatment.

EXPERIMENT NO. 4

Full-grown Plymouth Rock fowl No. 231.—Inoculated November 19, 1927, in the skin of the right breast.

First treatment on December 3, 1927, when 2 skin tumors, each 4 by 4 millimeters, had developed. These each were given 1½ minutes' treatment at

68,000,000 cycles and a current of 250 milliamperes, with little immediate effect. Treastment was repeated next day with a duration of 2 minutes and a current of 250 milliamperes.

This case proved obstinate and intractable new suspicious massed were observed from time to time, so that treatments were repeated on December 8, 10, 13, 14, 17, 19, 24, 27, and 29, 1927, and January 3, 1928, with a total duration of 47 minutes and current values of 280 to 220 milliamperes.

As a result of these numerous treatments a large scab was formed which, when it became detached on December 27, 1927, left a triangular raw area 23 by 15 millimeters. By December 29, 1927, this raw area had shrunk to 13.5 by 8 millimeters and was completely cicatrized by January 7, 1928. At the time of writing the scar can be detected only with difficulty.

Second inoculation.—The fowl was inoculated in the skin of the left breast on February 16, 1928. This resulted in the development on February 21, 1928, of a small tumor mass measuring 6 by 4 millimeters and consisting of several coalescent tumors. On that date treatment of 3 minutes' duration at 68,000,000 cycles and current of 250 to 220 milliamperes was given. This single treatment caused the complete recession of the tumor mass on March 6, 1928.

Third inoculation.—The fowl was inoculated for the third time on the skin of the right breast on March 1, 1928, and on March 10, 1928, the first treatment to the tumor forming a small mass 6 by 4 millimeters was given, lasting 3 minutes at the same frequency and current of 220 to 210 milliamperes. At the time of writing, these tumors are apparently receding.

EXPERIMENT NO. 5

Half-grown White Rock fowl No. 246.—Date of inoculation January 13, 1928, in right breast.

Date of first treatment January 23, 1928, when it had three tumors each 3 millimeters in diameter in a row along line of inoculation. Treatment lasted 3 minutes at a frequency of 68,000,000 cycles and a current of 250 milliamperes. As there was little immediate effect, 2 minutes' additional treatment under the same conditions was given.

There was some local edema the next day, followed by slight skin necrosis. Recession of the tumors went on continuously and was complete by February 6, 1928. This chicken is tumor-free and in good health at the present time (March 17, 1928).

EXPERIMENT NO. 6

Half-grown White Rock fowl No. 247.—Inoculated January 13, 1928, in skin of right breast. Date of first and only treatment was January 23, 1928, when there were two tumors each 3 millimeters in diameter along line of inoculation. Each tumor received a treatment, 3 minutes to one and 2 minutes to the other, at a frequency of 68,000,000 cycles and a current of 250 milliamperes. There was practically no local reaction, and the tumors receded till recovery was complete on January 27, 1928.

Second inoculation.—On March 1, 1928, the chicken which had remained tumor-free and in good health was reinoculated in the skin of the same breast. By March 9, 1928, there was a new skin tumor 4 millimeters in diameter. This was treated for 3½ minutes at the same frequency with a current of 250 to 210 milliamperes. The outcome from this treatment is still under observation, but the tumor is inactive and apparently receding.

EXPERIMENT NO. 7

Half-grown White Rock fowl No. 249.—Inoculated January 13, 1928, in the skin of the right breast.

First treatment on January 23, 1928, when it had a row of tumors 23 millimeters long and 3 to 4 millimeters wide along the inoculation scratch. This tumor formation was treated in two sections, with a duration of 3 minutes to each section, at the usual frequency and a current of 300 to 250 milliamperes. There was no further tumor activity and but trifling local reaction. Recession set in almost at once and was complete by February 4, 1928.

Second inoculation.—On March 1, 1928, this chicken received a second inoculation in the skin of the same breast. By March 10, 1928, it had developed a fresh skin tumor 7 by 6 millimeters. This was treated, on that date, for 4 minutes, at a frequency of 68,000,000 cycles and a current of 270 to 220 milliamperes, the immediate effect being great softening and diminution of the tumor. There was practically no local reaction, and at the present time of writing recession is practically complete.

From the foregoing it appears that seven chickens, of which two were Plymouth Rocks, a breed known to be especially susceptible to this tumor, were inoculated a total of fifteen times with the Rous fowl sarcoma, and in each case it was possible to induce, by the treatment which has been described, a complete recession of the tumor. So much for the bright side of the shield. On the darker side are an equal number of chickens, 1 inoculated in the comb, 1 in the wattle, and 5 in the skin of the breast, in which only retardation of the tumor growth was produced, the fowls ultimately dying from extensive tumor growth.

In at least four of these chickens the basic error was too great severity of the initial treatment. This provoked an excessive local reaction with swelling and edema which masked the multiplication of the tumor cells in the adjacent areas until the tumor had obtained such a start that treatment was ineffective.

Excluding, as being too recent, the last inoculation of fowls numbered 230, 231, 247, and 249, it appears that, out of a total of 18 inoculations there were 11 recessions and 7 deaths from tumor, or 61 per cent of recessions.

It seems, with the experience gained in the experiments both with mice and chickens, that it should be possible to better this figure. Moreover, it is also possible, in the case of the Rous fowl sarcoma, that the frequency chosen for the treatments, either the same or virtually the same as that for the mouse sarcomas, might not be the frequency at which the best results would be secured with the Rous fowl sarcoma. This is obviously a point for further investigation, in view of the considerable variation in size of the cells of this sarcoma.

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CONCLUSION AND GENERAL COMMENT

From the data presented in both sections of this paper the conclusion seems justified that by exposing transplantable tumors of two strains (mouse sarcoma C. R. 180 and the Rous fowl sarcoma) to the action of an intense electrostatic field excited by high-frequency oscillations of 68,000,000 to 66,000,000 cycles per second, it is possible in a sufficient number of instances to be significant, to produce complete recession of the tumor and consequent recovery of the tumor-bearing animal.

The method, in its present state of development, has obvious limitations in that it is confined to the treatment of subcutaneous growths which can readily be included between the plates of the treatment electrodes. Within these limitations, however, the action of the electrostatic field proved highly inimical to tumor growth and development, only 22, or 5.5 per cent, of 400 mice experimented with actually dying of tumor. With mice the problem was not so much the destruction of the tumor as to preserve the mouse free from intercurrent infections until complete recession and solid recovery had taken place.

The impression was derived that mice which had undergone treatment were, for a time at least, more susceptible than normal mice to certain bacterial infections, which brought about many more deaths than did the tumors. The treatment, too, when a certain dosage was exceeded, was able of itself to cause death. Also the lack of experience as to correct dosage, proper insulation of electrodes, and similar factors was responsible for a considerable mortality which in future experiments it should be possible to avoid.

Since stable and efficient apparatus for generating these high-frequency currents has been available to the laboratorian only for about four years or so, the action of these currents on living tissues has been but little investigated. Certainly, no previous data of practical value as to physiological action were available for guidance in the experiments here reported.

Even now we are evidently only on the threshold of the possibilities for investigation. Much remains for study, particularly with respect to the changes wrought in living cells by the application, in this particular way, of these currents. Studies along these lines are now under way and will be made the subject of future report.

The hypothesis that the frequency at which these currents are produced may have the specific quality of attacking certain cells more than others is interesting and worthy of future experimentation. Observations already collected suggest that this may be the case. The first paper published on the action of those currents, to which reference has been given, shows plainly that their action at all frequencies is not the same but that pronounced differences exist.

In a small series of experiments a much higher frequency (135,000,000 cycles per second) than the one usually employed proved to be without particular effect on the tumor cells of the mouse sarcoma, while a preliminary study of sections of treated tumors removed immediately after exposure shows that normal tissue cells surrounding the tumor seem to be less attacked by the high-frequency currents than the tumor cells themselves.

So far as the possible therapeutic application of this method and these currents to human disease is concerned, a considerable period of observation and investigation is required before one would be justified in making such attempts, although one may hope that the results of animal experimentation foreshadow, albeit though dimly at present, results which may well be of practical utility.

Finally, it may be said that the results herewith reported distinctly encourage further investigation and study. The hope is expressed, too, that others will investigate this field with its many seeming possibilities and thereby increase the likelihood of recording observations which may be susceptible of practical application.

EFFECT OF CERTAIN TRADE WASTES ON SLUDGE DIGESTION[1]

By WILLEM RUDOLFS, *Chief, Department of Sewage Disposal, New Jersey Agricultural Experiment Station, New Brunswick, N. J.*

Little direct and reliable information concerning the influence of trade wastes upon sludge digestion is available. A thorough study of the subject will no doubt yield important results. Preliminary studies were conducted during 1927 in our laboratory, the results of which are worthy of reporting.

Fresh solids were collected in the usual manner by hanging pails in the different compartments of an Imhoff tank. The contents of the pails were mixed and brought to the laboratory. Forty-eight hours elapsed between the time of hanging the pails and that of making the initial analyses. The ripe sludge used had been kept for some time previously in the laboratory after having been drawn from the tank. The anlyses of the fresh solids and ripe sludge were as follows:

Material	Solids		pH	Alkalinity, p. p. m.	Acidity, p. p. m.
	Per cent	Per cent of ash in			
Fresh solids	5.56	22.3	5.3	600	154
Ripe sludge	6.52	48.2	7.5	2,100	44

[1] Paper No. 59, Department of Sewage Disposal, New Jersey Agricultural Experiment Station, New Brunswick, N. J.

The fresh solids were mixed with ripe sludge in proportions of 1 : 1 on a dry solids basis, or of 1:1.28 on the basis of volatile matter. To the mixtures were added different wastes, mainly of an inorganic nature. The additions of waste material made it imperative that all mixtures be diluted with distilled water. In those cases in which laundry waste, dye waste, and H_2SO_4 were added, the amount of distilled water for diluting was smaller in proportion. On the basis of diluted mixtures the following amounts of the different materials were added per liter:

No.	Waste
1	Nothing.[1]
2	Laundry, 10 per cent by volume.
3	Sulphur-black dye, 5 per cent by volume.
4	Sulphuric acid, 500 p. p. m.
5	Sulphuric acid, 1,000 p. p. m.
6	Sodium hydroxide, 500 p. p. m.
7	Sodium hydroxide, 1,000 p. p. m.
8	H_2SO_4, 500 p. p. m. and NaOH, 500 p. p. m.
9	$FeSO_4$, 3 gm.

[1] See analyses and description.

The laundry waste was secured from a commercial laundry and contained 500 p. p. m. chlorides, 640 p. p. m. NaOH, 81,000 p. p. m. total alkalinity.

The sulphur-black dye was liquid from a vat in which stockings had been dyed. No wash water was included and the liquid corresponded, therefore, to the material in a concentrated form received at a sewage plant. The amount added (10 per cent on the basis of fresh solids) is probably higher than is ordinarily received. The material was collected at High Point, N. C. For convenience and for the general interest the following calculations are made for that city.[2]

According to the secretary of the Chamber of Commerce at High Point, the population of the city is 30,000. Part of the city is not sewered and Mr. Weir felt that the figure should be in the vicinity of 25,000. The average flow at the outfall was about 2,250,000 gallons per day. This includes about 160,000 gallons of industrial waste from the hosiery mills. The materials used in the sulphur-black dye process are listed below with the total amounts used in all the 12 hosiery mills. These figures cover the chemicals added to the dye vats, but do not show the actual amount which goes to the sewer, because much of the dye material is obviously retained in the hosiery stock. However, the relative amounts of these various constituents in the waste as discharged are probably the same as in the fresh dye.

[2] I am indebted to Mr. Weir, assistant engineer, North Carolina State Board of Health, and to Mr. W. C. Olsen, consulting engineer, Raleigh, N. C., for some of the basic figures given here.

Material	Pounds per day
Sulphur-black dye	550
Sodium chloride	550
Sodium sulphide	550
Sodium carbonate	175

In addition to the sodium chloride shown in the tabulation, about 300 pounds are used in the various other dye processes. This must be added to the 550 pounds for a total. However, since only black-sulphur dye waste with the relative proportions of the ingredients was used in the experiment, the latter 300 pounds of sodium chloride must be left out here. As nearly as could be determined analytically (highly colored liquor) the amounts of chemicals in the waste used in the experiment were as follows:

	Per cent
Total solids	5. 38
Dye	1. 2
Sodium chloride	2. 0
Sodium sulphide and sulphates	1. 6
Sodium carbonate	0. 6

The amount of dye was determined by absorption with washed-neutral-decolorizing carbon (Nuchar from the Ind. Chemical Co., New York).

About 7 per cent of the total sewage flow consisted of dye waste. On a basis of dry solids (assuming that the average amount of dry solids per capita daily is 70 grams, the amount of fresh solids received at the plant would be 1,750 kilograms. The dye waste together with the wash water has a volume of 160,000 gallons daily making a total of 405 kilograms dry additional waste, or 18.8 per cent of the total. The waste increase would require, therefore, a disposal plant with a capacity for 29,700, or, roughly 30,000, people if no detrimental effect was experienced from the waste. The amount of waste used in our experiments was three times as much as is received at High Point. The results included here are given because they show the possible effect on digestion with larger quantities.

RESULTS

The initial analyses of the mixtures in this series (No. 404) are given in Table 1.

TABLE 1.—*Initial analyses of mixtures*

No.	Mixture	Solids		pH
		Per cent	Per cent of ash in	
1	Ripe sludge, fresh solids	3. 01	35. 2	6. 8
2	Ripe sludge, fresh solids, laundry waste	3. 02	35. 3	6. 8
3	Ripe sludge, fresh solids, dye waste	3. 02	35. 5	7. 0
4	Ripe sludge, fresh solids, H_2SO_4 (500 p. p. m.)	3. 05	35. 2	5. 6
5	Ripe sludge, fresh solids, H_2SO_4 (1,000 p. p. m.)	3. 10	35. 5	5. 2
6	Ripe sludge, fresh solids, NaOH (500 p. p. m.)	3. 05	35. 4	7. 8
7	Ripe sludge, fresh solids, NaOH (1,000 p. p. m.)	3. 10	35. 6	8. 4
8	Ripe sludge, fresh solids, H_2SO_4, NaOH (1,000 p. p. m.)	3. 10	35. 7	6. 7
9	Ripe sludge, fresh solids, $FeSO_4$	3. 14	35. 7	6. 5

The progress of digestion of the different mixtures was markedly different. In every case where H_2SO_4 was added, strong H_2S odors emanated from the mixtures. This was also the case with the mixture to which dye was added. Condensed notes on the odor, gas, appearance of liquid and sludge, and scum formation, after 20 and 30 days, are given in Table 2.

TABLE 2.—*Notes on consistency and odor of mixtures*

No.	After 20 days				
	Solids, top	Liquid	Odor	Sludge color	Gas
	Per cent				
1	0	Opaque	Musty	Grayish green	Much.
2	0	Yellow	do	do	Do.
3	0	Dense gray	do	do	Some.
4	50	Very dense	H_2S	Black	Much.
5	50	Black	do	Gray	Little.
6	0	Opaque	None	Gray, black	Much.
7	0	Yellow	do	do	Do.
8	0	Opaque	Ripe	Black	Do.
9	0	Clear	do	do	Do.

No.	After 30 days				
	Solids, top	Liquid	Odor	Sludge	Drain ability
	Per cent				
1	0	Clear	Ripe	Black	Very good.
2	0	Opaque	Tarry	do	Do.
3	0	Dense	H_2S	Intense black	Fairly good.
4	20	Very dense	Strong H_2S	do	Poor.
5	15	do	Putre active H_2S	Gray	Some.
6	0	Clear	Ripe	Black	Good.
7	0	Opaque	Tarry	do	Very good.
8	0	Clear	H_2S	do	Do.
9	0	Very clear	Ripe	do	Do.

After 60 days, Nos. 3, 4, 5, and 8 still had strong H_2S odors, but decomposition of organic matter progressed very slowly. The H_2S odor was still perceptible in No. 3, and very strong in No. 5 after 100 days of incubation. Apparently, practically all the sulphuric acid was eventually changed partly to H_2S and partly to sulphur, which was precipitated out against the walls of the bottle, causing a thin yellow coating. Finally, this precipitated sulphur disappeared again, probably being oxidized to sulphates and combining with alkaline products formed in the course of decomposition of organic materials. The whole question, which deals with the sulphur cycle, is under further investigation at the time of this writing.

Part of the chemical results obtained are presented in Table 3, and the percentage solids reduction and ash increase, together with relative values for solids reduction, are given in Table 4. Table 4 shows that the addition of laundry waste had a slight effect on the digestion activities. The sulphur-black dye waste was particularly detrimental, which effect was no doubt caused by some of the inorganic salts. Comparatively small quantities of H_2SO_4 did not seem to affect the digestion process at the beginning, and appeared actually to stimulate it after an incubation period of 60 days; larger quantities of H_2SO_4 appeared to be detrimental even after 60 days. A mixture of NaOH and H_2SO_4 seemed to be detrimental at the beginning, but this was reversed later. Small quantities of NaOH appeared to retard the digestion slightly, and larger quantities more. The particular quantity of iron sulphate added in the case recorded here was slightly detrimental at the beginning.

TABLE 3.—*Chemical determinations of mixtures*

No.	After 30 days				After 60 days				After 100 days	
	pH	Alkalinity	Solids	Ash in solids	pH	Alkalinity	Solids	Ash in solids	Solids	Ash in solids
		P. p. m.	*Per cent*	*Per cent*		*P. p. m.*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	7.6	1,240	2.11	47.1	7.4	870	2.05	47.6		
2	7.4	1,430	2.24	47.6	7.5	1,215	2.22	49.7		
3	7.5	1,425	2.64	48.1	7.9	1,365	2.44	47.9	2.29	50.2
4	7.2	1,020	2.19	44.6	7.7	960	1.92	45.2		
5	6.3	450	2.49	39.4	7.2	695	2.44	52.1	1.94	53.2
6	7.5	1,545	2.32	48.2	7.3	825	2.12	46.8		
7	7.7	1,860	2.43	45.9	8.0	1,200	2.30	50.5	2.20	52.6
8	7.6	1,320	2.43	49.7	7.9	900	2.05	44.0		
9	7.5	1,335	2.30	47.1	7.5	720	2.30	50.5	2.17	50.2

TABLE 4.—*Percentage solids reduction and ash increase, and relative solids reduction*

No.	30 days		60 days		100 days		Relative reduction	
	Solids	Ash in solids	Solids	Ash in solids	Solids	Ash in solids	30 days	60 days
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*		
1	29.9	33.8	31.8	35.2			100	100
2	26.4	34.0	26.4	40.7			90	90
3	13.2	36.6	19.2	34.9	31.4	42.6	43	63
4	28.8	25.6	33.7	28.4			97	113
5	20.7	10.7	21.3	46.7	37.4	49.8	70	70
6	24.7	35.8	30.4	32.2			83	100
7	22.6	28.5	25.8	41.9	29.0	52.6	77	87
8	22.6	39.2	33.9	41.7			77	113
9	26.8	31.9	30.0	41.2	30.8	40.6	90	100
Ripe sludge	9.5	6.9	9.8	12.5				

The effect of sulphur-black dye waste on sludge digestion was further studied in a somewhat different way. It was assumed that a city of 25,000 people would produce about 3,860 pounds of dry fresh solids daily. Assuming a removal of suspended solids of 60 per cent by settling, a plant would have to take care of 2,320 pounds of dry fresh solids daily. It was also assumed that out of 1,825 pounds dye waste used, 50 per cent would reach the sewer (900 pounds) and remain in contact with the solids for six hours before the fresh solids would be settled out.

The following experiments were then performed. To mixtures of ripe sludge and fresh solids in the ratio of 1:1 on a dry basis were added different amounts of dye waste. The amount of dye waste was calculated to be approximately on the basis assumed above.

The following amounts were added on the basis of dry fresh solids:

No.	Fresh solids	Dye waste	No.	Fresh solids	Dye waste
	Gram	*Gram*		*Gram*	*Gram*
1	25	0	3	25	0.5
2	25	1.0	4	25	.25

The ripe sludge fresh solids used for the mixtures analyzed as follows:

Material	Solids		Volatile matter, per cent
	Per cent	Per cent of ash in	
Ripe sludge	6.90	45.1	3.80
Fresh solids	5.17	20.5	4.13

The mixtures with the different quantities of dye waste added were diluted with distilled water, shaken, and left standing for six hours, and thereafter two-thirds of the supernatant liquid was

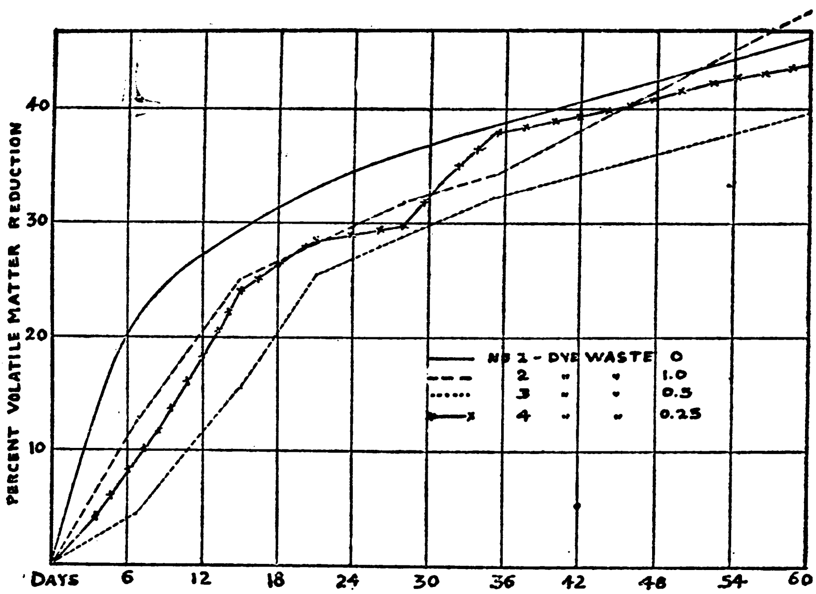

FIG. 1.—Effects of different amounts of dye waste on the percentage volatile matter reduction

siphoned off. The mixtures were then incubated at 70° F. and analyzed at intervals. The results after 35 and 60 days are given in Table 5. It can be seen that, under this procedure, the effect of the dye waste was considerably less than it was in the experiment with larger quantities reported above. Within a week the mixtures with the dye waste produced strong H_2S odors. In 14 days this odor had disappeared from the mixture with the smallest amount of dye waste, but it took more than 5 weeks before this odor disappeared from the mixture to which the largest quantity of dye waste was added. That the dye waste had a retarding effect is clearly shown in Figure 1, where the volatile matter reduction is plotted for the entire digestion time.

TABLE 5.—*Effect of dye waste on volatile matter reduction and ash increase*

No.	Beginning			35 days			60 days			Volatile matter reduction		Ash increase	
	pH	Solids	Ash in solids	pH	Solids	Ash in solids	pH	Solids	Ash in solids	35 days	60 days	35 days	60 days
		Per cent	*Per cent*		*Per cent*	*Per cent*		*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
1	6.7	3.45	35.4	7.6	2.58	46.7	7.3	2.56	47.0	38.5	46.2	31.8	32.8
2	7.7	3.98	37.5	7.6	3.11	47.3	7.6	2.62	49.3	34.1	48.2	26.2	31.5
3	7.2	3.37	39.0	7.4	2.68	47.5	7.8	2.50	49.6	32.0	38.8	21.8	26.9
4	7.0	3.36	38.0	7.6	2.37	45.9	7.7	2.48	47.1	38.4	43.8	20.8	23.9

SUMMARY

Preliminary studies on the effect of certain trade wastes upon the rate of sludge digestion show that with seeded material—

1. Laundry waste is somewhat detrimental to digestion activities.
2. Sulphur-black dye waste is particularly detrimental when left in contact with the sludge. It is detrimental to a much lesser extent in the digestion of fresh solids when the dye waste is partly removed with some of the supernatant liquid.
3. Comparatively small quantities of H_2SO_4 did not seem to affect digestion processes markedly during the first stages of digestion, and appeared to stimulate them somewhat after a prolonged period of incubation. Larger quantities appeared to retard.
4. Small quantities of NaOH retarded activities slightly and larger quantities more.
5. A mixture of NaOH and H_2SO_4 seemed to be detrimental at the beginning, but this was reversed later.
6. Certain proportions of iron sulphate have little effect on digestion.

PUBLIC HEALTH INSTITUTE AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

The second Public Health Institute for health officers and other public health workers will be held at the Massachusetts Institute of Technology, Cambridge, Mass., from July 2 to 24, 1928.

This institute aims to provide for the health officers and other persons interested in health work, and opportunity to study public-health procedures and to examine modern public-health practices under the direction of experts in their respective fields.

Practitioners of medicine frequently spend a few weeks in observation and study at great clinical centers with advantage. In this Institute of Public Health it is hoped to provide an equally valuable type of experience for health officers, public-health nurses, and other persons actively engaged or interested in public-health activities. Its main purpose is intensive instruction in the essential principles and the presentation of the best methods of modern practice in some of the important aspects of public-health work.

It is desired that application for this course be made before June 15, 1928.

Further information may be had by addressing Prof. S. C. Prescott, Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

COURT DECISION RELATING TO PUBLIC HEALTH

Supreme Court Interprets and Upholds Constitutionality of the Harrison Antinarcotic Act

Provision of antinarcotic act making sale, etc., of narcotic drugs unlawful except in pursuance of written order on official form construed and held constitutional.—(United States Supreme Court; Nigro *v.* United States; decided April 9, 1928.) The United States Circuit Court of Appeals for the Eighth Circuit submitted for the consideration of the United States Supreme Court four questions concerning the validity and proper construction of the Harrison Antinarcotic Act of December 17, 1914 (38 Stat. 785), as amended by the revenue act of 1918 (40 Stat. 1130). Questions I and II which were submitted read as follows:

> *Question I.*—Is the provision which is contained in the first sentence of section 2 of the act limited in its application to those persons who by section 1 are required to register and pay the tax?
>
> *Question II.*—If a broader construction is given to said provision, is the provision as so construed constitutional?

The first sentence of section 2 of the antinarcotic act provided:

> That it shall be unlawful for any person to sell, barter, exchange, or give away any of the aforesaid drugs except in pursuance of a written order of the person to whom such article is sold, bartered, exchanged, or given, on a form to be issued in blank for that purpose by the Commissioner of Internal Revenue.

The Supreme Court answered the first question in the negative and the second question in the affirmative, making it unnecessary to answer the third and fourth questions. Following are extracts from the court's opinion:

In interpreting the act, we must assume that it is a taxing measure, for otherwise it would be no law at all. If it is a mere act for the purpose of regulating and restraining the purchase of the opiate and other drugs, it is beyond the power of Congress and must be regarded as invalid, just as the child labor act of Congress was held to be, in *Bailey, Collector*, v. *Drexel Furniture Company*, 259 U. S. 20. Everything in the construction of section 2 must be regarded as directed toward the collection of the taxes imposed in section 1 and the prevention of evasion by persons subject to the tax. If the words can not be read as reasonably serving such a purpose, section 2 can not be supported.

The importation, preparation, and sale of the opiate or other like drugs and their transportation and concealment in small packages are exceedingly easy and make the levy and collection of a tax thereon correspondingly difficult. More than this, use of the drug for other than medicinal purposes leads to addiction and causes the addicts to resort to so much cunning, deceit, and concealment in the procurement and custody of the drug and to be willing to pay such high prices for it that, to be efficient, a law for taxing it needs to make thorough provision for preventing and discovering evasion of the tax—as by requiring that sales, purchases, and other transactions in the drug be so conducted and evidenced that any dealing in it where the tax has not been paid may be detected and punished and that opportunity for successful evasion may be lessened as far as may be possible.

The literal meaning of "any person," in the first line of the first sentence of section 2, includes all persons within the jurisdiction. The word "persons" is given expressly the meaning of a partnership, association, or corporation, as well as that of a natural person. Why should it not be given its ordinary comprehensive significance? The argument to the contrary in favor of limiting it to exclude all but those who are required to register and pay the tax is that it would be superfluous to include persons selling opium who are not registered, because they are denounced as criminals by the first section for selling without registration. That is no reason why they may not be included under a second reasonable restriction enforceable by punishment. Of course such a restriction should be fairly adapted to obstruct the successful accomplishment of the main crime or furnish means of detecting the guilty person, and not be a fruitless, useless inhibition only resulting in what is in effect a duplication of punishment for substantially the same crime, as in the case of *United States* v. *Katz*, 271 U. S. 354, 362

It would seem to be admissible and wise in a law seeking to impose taxes for the sale of an elusive subject to require conformity to a prescribed method of sale and delivery calculated to disclose or make more difficult any escape from the tax. If this may be done, any departure from the steps enjoined may be punished, and added penalties may be fixed for successive omissions, but all for the one ultimate purpose of making it difficult to sell opium or other narcotics without registering or paying the tax.

The reasonableness of such requirements is well illustrated in the many limitations which were imposed upon the ancient freedom in the making and sale of distilled spirits to the end that the collection of the heavy tax on the subject matter might be successfully secured in spite of the temptation to avoid the tax. The provision of section 2 making it an offense to sell unless the purchaser gives a particular official form of order to the seller was enacted with a like object. The sale without such an order thus carries its illegality on its face. Its absence dispenses with the necessity of sending to examine the list of those registered to learn whether the seller is engaged in a legal sale. The requirement that the official forms can only be bought and obtained by one entitled to buy, whose name shall be stamped on the order form, and that after the sale the order form shall be recorded, effects a kind of registration of lawful purchasers, in addition to one of lawful sellers, and keeps selling and buying on a plane where evasion of the tax will be difficult.

There are persons who may lawfully have access to or even custody of the drugs without registration. Thus included among such persons are the employees of those who have registered and paid the tax. If they were to attempt to sell such drugs the necessity for an order form from the would-be purchaser would embarrass the illegal sale, for the participants would hesitate to make a record of the transaction. Thus the operation of section 2 in preventing an individual not a registered dealer or physician from acquiring the drug other than by an order form or a prescription is directly related to tax enforcement, because such drugs are not necessarily consumed by the purchaser but may be peddled or sold illegally. These order-form provisions constitute a needed check on illegal sales and they are distinctly helpful in the detection of an attempted dealing in, or selling of, the drug free from the tax.

Section 2 of the act is the same as it was when originally passed in 1914. The construction put upon it before the amendment of section 1, by the revenue act of 1918, must be the same now as before. Under section 1 in the original act, the only provision to keep track of purchasers was the order form provision of section 2, as it is now. Without it, unless it applied to those not required to register or pay the tax, there was no restriction upon such persons whether illegal sellers or illegal purchasers in the disposition and spread of the drug, except the simple punishment for unregistered sellers in the first section, and there was entire immunity from order requirements of the purchasers from illegal sales. We can not suppose that, considering the general language of section 2, any such result was intended by Congress.

By the amendment of section 1, much higher occupation taxes were imposed and they vary in amount for producers and manufacturers and for wholesale and retail dealers and for physicians. More than that, an excise tax of one cent per ounce of the drug is imposed and payment thereof is to be evidenced by stamps attached to the bottle or box containing the drug, and the sale of the drug from anything but a stamped bottle or container is punishable. The provision for order forms is thus useful under the amended section, and there is therefore still reason for holding the provisions of section 2 to apply to all persons so as to be helpful in promoting detection of evasion from the added tax imposed under the new section 1. The two tax provisions of that section would be much less effective if a purchaser of drugs from an unregistered dealer is not required to furnish an order form. The purchaser may be himself one who should register, but has not done so, or he may be dealing in and selling the drug on which the stamp tax has not been paid and it is just as important that sales by an unregistered dealer should be punished unless made on a prescribed form as that sales by registered dealers should be subject to penalty.

* * * * * * *

Section 2 of the antinarcotic act introduces into the act the feature of the required and stamped order form to accompany each sale. It is to bear the name of the purchaser, and is addressed to the seller, with other data. Recorded as the law requires it to be, it constitutes a registry of purchasers, as distinguished from that of sellers. Congress intended not only to punish sales without registration under the first section, but also to punish them without order forms from the purchaser to the seller as a means of making it difficult for the unregistered seller to carry through his unlawful sales to those who could not get order forms. Thus an illegal unregistered seller might wish to clothe his actual unregistered sales with order forms that would give the transaction a specious appearance of legality. To punish him for this misuse of an order form is not to punish him for not recording his own crime. It is to punish him for an added crime—that of deceiving others into the belief that the sale is a lawful sale There is no incongruity in increasing the criminal liability of the nonregistered seller who fails to use an order form in his sales, or who misuses it. Both the registered and the nonregistered seller are, under our construction of the section, punished for not using the order forms as the statute requires, or for misusing them. The order form is not a mere record of a past transaction—it is a certificate of legality of the transaction being carried on, or else it is a means of discovering the illegality and is useful for the latter purpose. * * *

We are of opinion, therefore, that the provision which is contained in the first sentence of section 2 of the act is not limited in its application to those persons who by section 1 are required to register and pay the tax. We answer the first question in the negative.

This brings us to the second question, which is "* * * is the provision as so construed, constitutional?" It was held to be constitutional in *United States* v. *Doremus*, 249 U. S. 86, 94. * * *

Four members of the Court dissented in the *Doremus case*, because of opinion that the court below had correctly held the act of Congress, in so far as it embraced the matters complained of, to be beyond its constitutional power and that the statute, in section 2, was a mere pretext as a tax measure and was in fact an attempt by Congress to exercise the police power reserved to the States and to regulate and restrict the sale and distribution of dangerous and noxious narcotic drugs. Since that time, this court has held that Congress by merely calling an act a taxing act can not make it a legitimate exercise of taxing power under section 8 of Article I of the Federal Constitution, if in fact the words of the act show clearly its real purpose is otherwise. *Child Labor Tax Case*, 259 U. S. 20, 38. By the revenue act of 1918, the antinarcotic act was amended so as to increase the taxes under section 1, making an occupation tax for a producer of narcotic drugs $24 a year, for a wholesale dealer $12, for a retail dealer, $6, and for a physician administering the narcotic, $3. The amendment also imposes an excise tax of one cent an ounce on the sale of the drug. Thus the income from the tax for the Government becomes substantial. Under the narcotic act, as now amended, the tax amounts to about one million dollars a year, and since the amendment in 1919 it has benefited the Treasury to the extent of nearly nine million dollars. If there was doubt as to the character of this act as an alleged subterfuge, it has been removed by the change whereby what was a nominal tax before was made a substantial one. It is certainly a taxing act now as we held in the *Alston case*.

It may be true that the provisions of the act forbidding all but registered dealers to obtain the order forms has the incidental effect of making it more difficult for the drug to reach those who have a normal and legitimate use for it, by requirement of purchase through order forms or by physician's prescription. But this effect, due to the machinery of the act, should not render the order form provisions void as an infringement on State police power where these provisions are genuinely calculated to sustain the revenue features. The section 2 was once sustained by this court some nine years ago with more formidable reason against it than now exists under the amended statute. Its provisions have been enforced for those years. Whatever doubts may have existed respecting the order form provisions of the act have been removed by the amendment made in 1919.

* * * * * * *

In this case the qualification of the right of a resident of a State to buy and consume opium or other narcotic without restraint by the Federal Government is subject to the power of Congress to lay a tax by way of excise on its sale. Congress does not exceed its power if the object is laying a tax and the interference with lawful purchasers and users of the drug is reasonably adapted to securing the payment of the tax. Nor does it render such qualification or interference with the original State right an invasion of it because it may incidentally discourage some in the harmful use of the thing taxed. *License Tax Cases*, 5 Wall. 462; *Nicol* v. *Ames*, 173 U. S. 509, 524; *Knowlton* v. *Moore*, 178 U. S. 41, 60, 61; *In re Kollock*, 165 U. S. 526, 536.

This leads to an answer to the second question in the affirmative, and makes it unnecessary for us to answer the remaining third and fourth questions.

PUBLIC HEALTH ENGINEERING ABSTRACTS

Irrigation with Sewage Effluent. W. A. Riney. Proceedings Tenth Texas Water Works Short School, January, 1928. (Abstract by Jane H. Rider.)

Abilene, Tex., has successfully disposed of its sewage for 25 years by allowing farmers, under contract, to use the effluent from the septic tanks for broad irrigation. The 400 acres of farm land available are sufficient to dispose of the 2 acre-feet per day effluent without creating a nuisance. Farms irrigated with the effluent are much more productive than adjoining land which is not irrigated. The State hospital at Abilene also successfully irrigates its farm with the effluent from its septic tank.

Climatological data obtained from the United States Weather Bureau at Abilene are given, together with a classification of the soils of Taylor County made by the United States Bureau of Soils.

The essential requirements for successfully disposing of sewage effluent by broad irrigation are (1) an ample acreage of well-drained soil in an isolated location; (2) intelligent cultivation of crops; (3) provision for storing the effluent when the land can not be irrigated.

Pont Burn Joint Sewage Disposal Works, Leadgate Co., Durham. Anon. *The Surveyor*, vol. 72, No. 1875, December 30, 1927, pp. 635–636. (Abstract by H. W. Streeter.)

The sewage disposal works, which were opened November 3, 1927, are joint between the urban district of Leadgate and the rural district of Lanchester. They were designed to treat 130,000 gallons per day, d. w. f., with allowance for 20 gallons per person daily. They consist of 2 detritus tanks, 4 sedimentation tanks, dosing chamber, storm-water tank, 3 percolating filters, and 2 humus tanks. All units except the humus tanks are placed adjoining one another. Filters are circular and dry walled, with air-lock sprinklers 73 feet in diameter. Total cost of the works was £9,600, or about $48,000.

Sludge Drying and Disposal. F. E. Daniels. Proceedings of First Conference of Sewage Works Operators, Pennsylvania State College, July 13–14, 1926. Tech. Bulletin No. 1, pp. 46–48. (Abstract by J. B. Harrington.)

In this article sludge drying and disposal is described briefly. Sludge should be well rotted before draining to enable it to give up water readily and reduce odors. The percentage of water contained in various volumes of sludge is given in a table. Bad weather is often a handicap to successful sludge drying even with properly designed and constructed beds.

Three requisites for a well designed sludge bed are (1) sufficient underdrains; (2) a deep bed of properly graded material; (3) a clean surface of fine material.

Operation of Milwaukee Sewage Treatment Plant. Robert Cramer and John Arthur Wilson. *Public Works*, vol. 59, No. 1, January, 1928, pp. 20–23. (Abstract by R. J. Faust.)

This article outlines the treatment equipment available, the operating results, operating difficulties, operating cost, and future improvements at the Milwaukee activated sewage treatment plant.

The purification, judged by removal of suspended solids, bacteria count, or oxygen demand, is practically perfect. Operating difficulties arose from some inadequate equipment, lack of skill in operation, and an inadequate operating force. Organization of operating force, cost of repairs, and coal have added greatly to the past operating cost. Studies with experimental treatment plants prove that the city's sewage can be treated at three times the rate in gallons per cubic foot of air, as compared with the main plant, and have produced a sludge that can be successfully filtered, giving rise to the hope that a considerable saving can be accomplished in the future.

Odor Nuisances at Sewage Works—The Use of Chlorine. L. H. Enslow. *The Surveyor*, vol. 73, No. 1880, February 3, 1928, pp. 183–184. (Abstract by H. W. Streeter.)

Emanating from sewers and sewage plants are several different odors. Hydrogen sulphide has been shown to be the most serious of the odor-producing gases and is also destructive to masonry structures.

In odor control, prevention rather than destruction is a chief objective. The introduction of chlorine at a point where sewage is fresh is important, though frequently the sewage becomes stale before a major portion of it can be collected for treatment.

Where odor production exists, the following conditions seemingly must occur simultaneously: (1) Presence of sulphates, (2) hydrogen sulphide-producing bacteria, (3) temperature sufficiently high to promote rapid growth of sulphide-splitting organisms, and (4) period of time necessary for producing hydrogen sulphide. Elimination of but one of these factors will result in securing effective control of hydrogen-sulphide generation. Odor destruction consists primarily in splitting up the hydrogen sulphide in sewage.

Another factor in odor control is the effect of the course of the sewage, whereby an intimate mixture may be caused between fresh sewage and liquid heavily laden with hydrogen sulphide. Saving in chlorine consumption may be effected by changes in flow chambers to prevent disturbance of the lower 5 feet of liquid in the chamber. Chlorine application to the influent will effect complete odor elimination at moderate expense. On the whole, odor control is much more readily effected at separate sludge digestion plants.

In conclusion, examples are given of chlorination for odor control at Neodesha and Independence, Kans.

Developments in Sewage Treatment. G. G. Nasmith. *The Surveyor*, vol. 73, No. 1880, February 3, 1928, pp. 179–180. (Abstract by H. W. Streeter.)

This article is a review of progress in sewage treatment during the year 1927, under the headings: Activated sludge process, colloiders, fine screens, removal of oil, sludge digestion and treatment, storm-water tanks, sewage chlorination, sewage-treatment mechanisms, and pollution of water supplies.

The author notes that although no great discoveries were made during the year, a steady accumulation of new knowledge and confirmation of earlier observations have taken place, together with the establishment of numerous chemical, physical, and biological facts. He notes especially the results of chlorination of raw sewage in respect to prevention of Imhoff tank foaming and of excessive film formation on trickling filters, and the improvements in sludge digestion effected by pH adjustment, by daily addition of small amounts (not over 2 per cent) of fresh solids and by temperature adjustment to an optimum of 80° F.

The difficulties involved in the operation of the activated sludge method and the means of overcoming them are discussed in detail; likewise those entailed in the digestion of sludge. The increasing attention being devoted to stream pollution and to the creation of river boards is emphasized.

Spent Gas Liquor in Relation to Sewage Disposal. H. Ross Hooper, *The Surveyor*, vol. 73, No. 1879, January 27, 1928, pp. 111–112. (Abstract by H. W. Streeter.)

Spent gas liquor is dangerous to fish life and cattle and detrimental to small streams, as its oxygen-absorbing qualities prevent and retard self-purification. The difficulties of dealing with gas liquor have become more acute because of (*a*) the increased manufacture of gas for domestic uses; (*b*) the introduction of vertical retorts with use of steam, thereby increasing the volume of gas liquors; and (*c*) the adoption of the activated sludge method of sewage disposal. With vertical retorts, 76 gallons of spent liquor are produced per ton of coal, whereas with horizontal retorts 50 gallons are produced. The efficiency of the activated sludge process is likely to be affected by the presence of unduly high amounts of spent gas liquor in the sewage treated. Because of its high oxygen-absorption power the admixture of the spent liquor with crude sewage requires greater aerobic activity in the treatment of such mixtures, usually necessitating an increased purifying area.

It is possible, by several measures named, to diminish the amount of gas liquor produced; likewise to purify the liquor before its discharge into sewers. In the latter connection it is noted that if the volume of spent gas liquor does not exceed 1 per cent of the volume of domestic sewage and is introduced into the sewers in a small steady flow, the mixture can be purified without difficulty. Experiments made on treatment of the spent liquor have indicated that when diluted until the 4-hour oxygen absorption value is 4,000 p. p. m., the liquor itself is amenable to biological filtration, which, at a rate of 15 gallons per cubic yard per day of 8 hours, reduced the oxygen absorbed by 90 per cent, and a second filtration at a rate of 12 gallons per cubic yard produced an effluent absorbing less than 20 p. p. m. of dissolved oxygen.

In conclusion, it is stated that the discharge of spent gas liquors into sewers should be, as far as possible, uniform and proportionate to the flow of domestic sewage. The construction of equalizing tanks for this purpose offers no engineering difficulties.

Gas from the (Berlin) Sewage Settling Plant at Wassmansdorf. F. Langbein. Gas. u. Wasserfach 70, 1109–18 (1927); cf. C. A. 21, 4000. Abstract by R. W. R. in *Chemical Abstracts*, vol. 22, No. 3, February 10, 1928, pp. 472–473.

"Sewage from the Neukoln and Shonberg areas of Berlin are clarified by settling tanks of the Ems or Imhoff type so that the effluent can be used for irrigation without 'baking' the soil. The Ems wells or basins are of the 'two-story' type, the settling basin comprising the upper part and the fermentation chamber the lower part. The separated slime slides through slits in the settling chamber into the fermentation chamber. About six months are required to 'work in' a fermentation chamber so that it is odorless and the cellulose fermentation is well established and capable of taking care of regulated amounts of fresh slime. At this time the gas produced by the fermentation consists of 70–80 per cent CH_4, with the balance largely CO_2. The resultant slime (after fermentation) is black, easily handled, smells slightly like rubber, and may be dried on suitable beds. It contains much humus and may be used agriculturally. Three hundred and fifty thousand cubic feet of sewage per day are treated in this way and fermenting capacity must be provided for three months. The slime is almost completely settled out in 45–50 minutes. The gas produced will average about 200,000 cubic feet per day, although 50 per cent greater may be produced in hot weather and 30 per cent less in cold weather. Part of the gas will be purified and used to run pumping engines and the rest will be sold to Neukoln or used to generate electricity."

Sacramento to Go Afar for Water. Anon. *Water Works Engineering*, vol. 81, No. 2, January 18, 1928, pp. 79–80 and 93. (Abstract by Frank Raab.)

At present the city of Sacramento, Calif., is taking its water supply from the Sacramento River. which is filtered and chlorinated. At times when the water in the river is very low, it is so highly charged with organic matter that it is "undesirable as a public water supply." Likewise "during such low water stages the rise of the tide reverses the flow of the river and occasionally carries a portion of the sewage from the outlet of the city sewers back to and into the water works intake." Silver Creek has been proposed as a new supply. This creek has its source in the mountains at an elevation of more than 5,000 feet. The project would require the building of several dams at an estimated cost of about $29,000,000. It is estimated that completion of the project will yield from 160,000,000 to 190,000,000 gallons daily which would supply a city of about 1,000,000 population. The water would have to be carried over a distance of 60 miles. The article gives estimates of the cost of construction of the entire project as well as a part of it which is all that is deemed necessary at first. The article also suggests the feasibility of a hydroelectric project. It is planned that the present filter plant be retained as a stand-by plant.

Five Years' Operation of a Rapid Sand Filtration Plant. Melville C. Whipple and Harold C. Chandler. *The American City*, vol. 38, No. 2, February, 1928, pp. 119–120. (Abstract by W. L. Havens.)

In order to prevent corrosion of the Cambridge, Mass., water system, a policy has been followed of furnishing water as nearly like the untreated supply as possible in mineral constituents and no worse in its tendency to dissolve metals. This treatment has consisted of the addition of from 50 to 150 pounds per million gallons of soda ash when alum alone is used as the precipitant, and from 35 to 65 pounds when using both alum and sodium aluminate. Odors and growths in the fresh pond reservoir have been controlled by the dosage of copper sulphate in amounts equal to 2 pounds per million gallons. The *B. coli* index per 100 c. c. averaged, during 1926–27, 10.0, 0.6, 0.1, and 0 for the raw, coagulated, filtered, and effluent samples, respectively. The total purification costs, exclusive of fixed charges, have amounted to about $11.50 per million gallons during the past three years.

Sand Filter Plant, Launceston, Tasmania. G. D. Balsille. *The Commonwealth Engineer*, 15, 95–8 (1927). Abstract by Edward Bartow in *Chemical Abstracts*, vol. 22, No. 3, February 10, 1928, p. 471.

"The water is taken from St. Patrick's River and passed through a mortar-lined channel in which green algæ grow. The algæ are sometimes present in sufficient quantity to decrease the flow of water through the channel. It has been noted that these algæ grow at alkalinities below 17 parts per million, and disappear at alkalinities above 18. Caddis worms, larvæ of a fly of the dragon family, feed on and destroy the algæ. Fresh soda is used to raise the alkalinity when it is too low for efficient treatment on the sand filters. Color is the index to show practical operation and it has been reduced 90 per cent throughout the year."

The Biological Effect of Colored Glass Windows in Waterworks. R. Kilkwitz. Gas u. Wasserfach 70, 1118 (1927). Abstract by R. W. Ryan in *Chemical Abstracts*, vol. 22, No. 3, February 10, 1928, p. 471.

"The use of colored glass windows, especially green, results in a marked decrease in the formation of algæ and mosses on wooden parts and walls."

A Comparison of the Temperature and Bacterial Count of Milk and Foam During Certain Stages of the Pasteurization Process. H. A. Whittaker and R. W. Archibald, U. S. Department of Agriculture, Tech. Bulletin No. 18, September, 1927. 11 pages. (Abstract by C. T. Butterfield.)

This article includes a complete description of the apparatus and methods employed, including the construction, placement, and operation of the thermocouples. Studies were made under conditions of normal operation at plants using the batch method of Pasteurization.

Bacterial count of foam was higher in every instance than that of the milk. During Pasteurization the bacterial count of milk decreased, while in 66.7 per cent of the tests the count in the foam increased. Bacterial count of foam varied greatly at different points in vats. Depth of foam did not affect bacterial reduction. If vats are tightly closed, bacterial content of foam is reduced.

The temperature of the air above the foam and of the foam itself was in every instance lower than that of the milk. The amount of foam varied in area from small patches to the entire surface of the vat and in depth from one-half to 4 inches. In no case was the foam raised to a satisfactory Pasteurizing temperature.

Controle Technique d'une Installation Municipale de Stérilisation d'Eau par l'Ozone. (Control of a Municipal Plant for Purification of Water by Ozone.) J. Salmon and P. Quarre. *Bulletin of Hygiene*, vol. 2, No. 12, December, 1927, pp. 978–979. (Abstract by C. R. Cox.)

A description of the water disinfecting plant of the city of Boulogne consisting of an ozonizer and the circulating system for ozonized air and the sterilizer or disinfecting unit. The ozonizer consists of a series of glass cylinders, a coaxial aluminum rod which serves as one electrode, and the aluminum inclosing case which serves as the other electrode. A single phase, 50-cycle, alternating current transformed to 8,000 to 10,000 volts is applied to the electrodes. Air, dried by calcium chloride, is forced through the cylinders in which the silent electrical discharge occurs, generating the ozone. This ozonized air is forced through a sterilizer, consisting of a vertical tower of reinforced concrete divided at intervals by horizontal partitions of perforated celluloid to insure intimate contact between the water and the ozonized air, both of which enter at the base of the tower. The effluent from the sterilizer is tested periodically with starch iodide for free ozone and in the manner used for determining the residual chlorine in water. Bacteriological data are given indicating that the number of *B. coli* per liter was reduced from 1,000 to 0 and the gelatin count was reduced from 714 to 6 per c. c. The plant, with a capacity of 10,000 gallons per hour, consumes 0.65 k. w. hours of current to operate the ozonizer, consisting of two units of 3 cylinders each, and an additional 1.1 k. w. hour to operate the air compressor.

The Lethal Effect of Various Chemicals on Cyclops and Daphnia. B. A. Adams. *Water Works Engineering* 29, 361–4 (1927). Abstract by J. A. Kennedy in *Chemical Abstracts*, vol. 22, No. 3, February 10, 1928, p. 473.

"All sterilizing agents used in water treatment are lethal to *Cyclops* and *Daphnia* in the water of the Nile. Cl and hypochlorite mixed with $(NH_4)2SO_4$ is the most lethal and is effective in concentration of 1 in 1,000,000. Cl or hypochlorite alone is effective with a concentration of 1 in 500,000. $KMnO_4$, chloramine-T, and acridine are effective in concentrations of 1 in 200,000. Phenol and cresols are lethal in concentrations of 1 in 100,000. $CuSO_4$ has some effect, but formalin has no effect in a concentration of 1 in 100,000. Lime in excess or not quite in excess is very effective."

DEATHS DURING WEEK ENDED APRIL 7, 1928

Summary of information received by telegraph from industrial insurance companies for the week ended April 7, 1928, and corresponding week of 1927. (From the Weekly Health Index, April 11, 1928, issued by the Bureau of the Census, Department of Commerce)

	Week ended Apr. 7, 1928	Corresponding week, 1927
Policies in force	70, 570, 508	67, 271, 091
Number of death claims	12, 812	13, 077
Death claims per 1,000 policies in force, annual rate	9. 5	10. 1

Deaths from all causes in certain large cities of the United States during the week ended April 7, 1928, infant mortality, annual death rate, and comparison with corresponding week of 1927. (From the Weekly Health Index, April 11, 1928, issued by the Bureau of the Census, Department of Commerce)

City	Week ended Apr. 7, 1928		Annual death rate per 1,000, corresponding week, 1927	Deaths under 1 year		Infant mortality rate, week ended Apr. 7, 1928 [2]
	Total deaths	Death rate [1]		Week ended Apr. 7, 1928	Corresponding week, 1927	
Total (68 cities)	8, 732	15. 0	13. 7	975	871	80
Akron	37			7	5	76
Albany [3]	42	18. 2	16. 6	8	4	164
Atlanta	62	12. 8	15. 1	3	8	
White	37		10. 1	2	3	
Colored	25	(4)	26. 8	1	5	
Baltimore [3]	254	16. 0	15. 5	38	28	121
White	176		13. 3	28	20	112
Colored	78	(4)	28. 6	10	8	157
Birmingham	80	18. 8	17. 5	10	13	86
White	30		12. 6	3	4	41
Colored	50	(4)	25. 2	7	9	158
Boston	269	17. 6	16. 6	45	30	124
Bridgeport	40			3	4	55
Buffalo	160	15. 1	13. 7	17	17	73
Cambridge	44	18. 3	13. 5	3	2	53
Camden	56	21. 6	11. 8	8	3	128
Canton	18	8. 1	10. 1	1	3	24
Chicago [3]	957	15. 9	12. 3	94	87	81
Cincinnati	171	21. 6	16. 6	14	14	85
Cleveland	241	12. 5	10. 9	15	23	41
Columbus	93	16. 5	14. 9	8	2	75
Dallas	60	14. 4	13. 8	9	8	
White	50		13. 9	6	8	
Colored	10	(4)	13. 3	3	0	
Dayton	48	13. 6	15. 6	3	2	50
Denver	92	16. 4	17. 5	8	8	
Des Moines	34	11. 7	12. 6	3	4	50
Detroit	375	14. 2	10. 9	79	50	122
Duluth	25	11. 2	11. 4	2	0	47
El Paso	50	22. 2	17. 0	8	9	
Erie	22			3	3	62
Fall River [3]	26	10. 1	11. 4	4	4	69
Flint	23	8. 1	10. 6	2	10	26
Fort Worth	39	12. 1	14. 0	3	3	
White	35		11. 6	2	1	
Colored	4	(4)	31. 9	1	2	
Grand Rapids	28	8. 9	11. 6	6	6	90
Houston	68			9	5	
White	50			8	4	
Colored	18	(4)		1	1	
Indianapolis	121	16. 6	15. 2	8	11	61
White	100		14. 6	7	8	61
Colored	21	(4)	19. 8	1	3	61
Jersey City	83	13. 4	11. 5	8	12	60
Kansas City, Kans	27	11. 9	15. 1	0	4	0
White	22		13. 0	0	3	0
Colored	5	(4)	24. 6	0	1	0
Kansas City, Mo	113	15. 1	15. 8	6	10	42

(See footnotes at end of table.)

Deaths from all causes in certain large cities of the United States during the week ended April 7, 1928, infant mortality, annual death rate, and comparison with corresponding week of 1927. (From the Weekly Health Index, April 11, 1928, issued by the Bureau of the Census, Department of Commerce)—Continued

City	Week ended Apr. 7, 1928		Annual death rate per 1,000, corresponding week, 1927	Deaths under 1 year		Infant mortality rate, week ended Apr. 7, 1928
	Total deaths	Death rate		Week ended Apr. 7, 1928	Corresponding week, 1927	
Knoxville	32	15.9	19.9	5	5	109
White	25		18.0	4	5	97
Colored	7	(4)	34.2	1	0	213
Los Angeles	277			17	16	49
Louisville	110	17.5	15.5	11	3	92
White	90		14.4	10	3	95
Colored	20	(4)	21.3	1	0	69
Lowell	27	12.8	15.6	1	5	21
Lynn	16	7.9	10.9	1	4	25
Memphis	70	19.2	19.5	2	4	23
White	35		16.3	1	2	19
Colored	35	(4)	25.5	1	2	31
Milwaukee	131	12.6	9.7	22	18	98
Minneapolis	103	11.8	12.5	12	9	72
Nashville	64	24.1	18.2	7	6	110
White	40		14.8	2	3	43
Colored	24	(4)	26.8	5	3	300
New Bedford	30	13.1	10.9	4	3	87
New Haven	42	11.7	14.4	9	3	127
New Orleans	156	19.0	18.8	13	26	63
White	90		13.3	6	13	44
Colored	66	(4)	34.5	7	13	102
New York	1,862	16.2	14.2	216	175	87
Bronx Borough	230	12.6	11.8	15	19	45
Brooklyn Borough	618	14.0	12.4	90	68	90
Manhattan Borough	766	22.9	19.2	81	73	96
Queens Borough	200	12.2	9.9	21	13	85
Richmond Borough	48	16.7	17.1	9	2	162
Newark, N. J	116	12.8	12.7	20	11	103
Oklahoma City	30			3	4	
Omaha	54	12.7	19.3	7	10	81
Paterson	33	11.9	9.4	5	2	87
Philadelphia	591	15.0	14.7	53	53	71
Pittsburgh	210	16.3	15.7	25	28	82
Portland, Oreg	75			8	5	86
Providence	88	16.1	12.6	7	6	61
Richmond	50	13.4	15.2	6	7	78
White	32		12.6	4	4	81
Colored	18	(4)	21.6	2	3	73
Rochester	85	13.5	13.0	9	6	73
St. Louis	232	14.3	14.2	22	9	74
St. Paul	65	13.5	12.7	3	6	29
Salt Lake City [3]	25	9.5	13.4	3	2	49
San Antonio	70	16.8	15.5	16	8	
San Diego	37	16.2	14.5	0	2	0
San Francisco	144	12.9	14.7	5	5	31
Schenectady	23	12.9	11.7	3	3	94
Seattle	73	10.0	10.3	3	1	31
Somerville	26	13.2	9.2	6	4	207
Spokane	29	13.9	12.4	3	0	77
Springfield, Mass	30	10.5	11.0	4	6	63
Syracuse	58	15.2	13.2	6	6	73
Toledo	88	14.7	13.7	7	4	67
Trenton	39	14.7	14.1	6	7	102
Utica	31	15.6	15.1	2	2	45
Washington, D. C	137	13.0	12.4	15	16	86
White	83		9.8	11	10	91
Colored	54	(4)	19.9	4	6	74
Waterbury	21			0	3	0
Wilmington, Del	28	11.4	6.6	5	3	132
Worcester	74	19.6	16.0	8	7	97
Yonkers	27	11.6	11.4	3	5	68
Youngstown	35	10.5	10.2	7	11	93

[1] Annual rate per 1,000 population.
[2] Deaths under 1 year per 1,000 births. Cities left blank are not in the registration area for births.
[3] Deaths for week ended Friday, Apr. 6, 1928.
[4] In the cities for which deaths are shown by color, the colored population in 1920 constituted the following percentages of the total population: Atlanta, 31; Baltimore, 15; Birmingham, 39; Dallas, 15; Fort Worth, 14; Houston, 25; Indianapolis, 11; Kansas City, Kans., 14; Knoxville, 15; Louisville, 17; Memphis, 38; Nashville, 30; New Orleans, 26; Richmond, 32; and Washington, D. C., 25.

PREVALENCE OF DISEASE

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

UNITED STATES

CURRENT WEEKLY STATE REPORTS

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

Reports for Weeks Ended April 16, 1927, and April 14, 1928

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended April 16, 1927, and April 14, 1928

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928
New England States:								
Maine	4	7	68	1	113	42	0	0
New Hampshire	-------	1	-------	-------	-------	-------	-------	0
Vermont	-------	1	-------	-------	117	40	0	0
Massachusetts	97	90	16	25	368	1,573	2	2
Rhode Island	1	15	-------	-------	-------	236	0	0
Connecticut	21	23	6	13	77	369	1	0
Middle Atlantic States:								
New York	495	363	[1] 43	[1] 117	793	2,723	9	37
New Jersey	113	113	21	23	78	1,582	1	3
Pennsylvania	168	169	-------	-------	854	1,885	2	9
East North Central States:								
Ohio	-------	142	-------	84	-------	1,034	-------	6
Indiana	31	21	27	18	260	435	0	0
Illinois	108	103	27	219	1,991	164	3	11
Michigan	93	49	-------	16	194	1,472	0	0
Wisconsin	29	22	52	412	833	101	6	9
West North Central States:								
Minnesota	21	17	6	44	176	93	2	4
Iowa	25	9	-------	-------	462	31	1	1
Missouri	37	27	5	52	231	89	2	4
North Dakota	10	5	-------	44	109	15	1	1
South Dakota	6	5	10	16	254	45	1	3
Nebraska	5	6	16	63	301	30	0	1
Kansas	9	2	4	7	1,147	78	2	2
South Atlantic States:								
Delaware	-------	-------	-------	-------	19	27	0	0
Maryland [2]	40	31	55	26	37	1,074	0	0
District of Columbia	30	-------	2	-------	3	-------	0	-------
Virginia	-------	-------	-------	-------	-------	-------	-------	-------
West Virginia	17	15	47	13	151	228	0	0
North Carolina	23	22	-------	-------	920	1,959	0	0
South Carolina	13	17	1,776	657	177	553	0	0
Georgia	12	11	180	106	145	134	3	0
Florida	33	16	5	40	192	81	1	0
East South Central States:								
Kentucky	-------	-------	-------	21	-------	321	-------	0
Tennessee	10	6	195	199	92	250	2	1
Alabama	22	15	-------	286	197	408	0	1
Mississippi	5	-------	-------	-------	-------	-------	-------	-------

[1] New York City only.
[2] Week ended Friday.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended April 16, 1927, and April 14, 1928—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928
West South Central States:								
Arkansas	2	2	42	256	208	426	0	1
Louisiana	27	32	7	35	100	116	1	0
Oklahoma [3]	18	29	159	437	336	349	1	3
Texas	39	28	35	141	387	267	1	2
Mountain States:								
Montana	6	16			54	6	4	1
Idaho	4				74	9	2	3
Wyoming				1	83	21	0	3
Colorado	8	13	1	2	177	86	0	2
New Mexico	3	1			122	107	0	0
Arizona	4	14	3		153	34	0	2
Utah [2]	7	3		3	66	4	0	1
Pacific States:								
Washington	14	11		1	431	183	5	1
Oregon	13	14	53	34	217	68	1	2
California	101	78	18	52	2,474	118	6	2

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928
New England States:								
Maine	0	0	17	22	0	0	2	0
New Hampshire		0		7		0		0
Vermont	0	0	8	1	0	0	0	1
Massachusetts	1	0	494	294	0	0	7	4
Rhode Island	1	0	18	28	0	0	1	0
Connecticut	0	0	85	57	0	0	1	3
Middle Atlantic States:								
New York	2	1	1,156	724	7	3	13	15
New Jersey	1	0	306	285	0	3	4	3
Pennsylvania	0	1	654	578	0	2	17	6
East North Central States:								
Ohio		4		206		34		8
Indiana	0	0	193	111	232	138	5	1
Illinois	1	1	288	236	30	23	8	5
Michigan	0	0	256	237	19	45	6	6
Wisconsin	1	3	183	183	7	7	4	2
West North Central States:								
Minnesota	0	1	175	145	4	2	4	2
Iowa	0	0	38	51	21	57	1	1
Missouri	1	0	96	71	36	57	3	1
North Dakota	1	2	64	70	3	4	2	3
South Dakota	0	0	63	36	1	4	1	4
Nebraska	0	0	56	145	33	38	1	1
Kansas	0	0	105	159	9	60	2	2
South Atlantic States:								
Delaware	0	0	12	3	0	1	0	0
Maryland [2]	0	0	73	78	0	0	9	12
District of Columbia	0		12		0		0	
Virginia	0				15			
West Virginia	0	0	53	48	40	54	4	6
North Carolina	0	0	14	24	33	58	1	3
South Carolina	1	0	10	7	18	12	3	11
Georgia	0	0	8	12	41	0	14	3
Florida	0	1	24	21	50	6	22	9
East South Central States:								
Kentucky		0		44		17		9
Tennessee	0	0	30	18	8	12	5	4
Alabama	0	2	9	8	51	11	21	6
Mississippi	0		5		7		12	
West South Central States:								
Arkansas	0	0	2	12	2	13	2	2
Louisiana	0	0	6	7	3	20	17	12
Oklahoma [3]	0	1	70	79	28	186	47	6
Texas	0	0	10	65	75	24	12	5

[2] Week ended Friday. [3] Exclusive of Tulsa.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended April 16, 1927, and April 14, 1928—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928	Week ended Apr. 16, 1927	Week ended Apr. 14, 1928
Mountain States:								
Montana	0	0	63	21	12	25	1	0
Idaho	0	0	13	6	0	5	1	5
Wyoming	0	0	16	28	8	3	0	0
Colorado	0	0	143	94	10	9	1	1
New Mexico	0	1	16	33	1	3	0	0
Arizona	1	0	50	5	4	43	1	0
Utah [2]	0	0	32	4	3	15	0	0
Pacific States:								
Washington	1	0	64	27	33	36	10	5
Oregon	0	0	12	6	15	47	4	2
California	1	5	183	114	28	28	9	4

[2] Week ended Friday.

SUMMARY OF MONTHLY REPORTS FROM STATES

The following summary of monthly State reports is published weekly and covers only those States from which reports are received during the current week:

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
January, 1928										
Colorado	25	82	3		353		8	594	102	10
February, 1928										
Colorado	21	70	15		240		1	509	60	4
District of Columbia	0	134	9		249		0	193	0	1
March, 1928										
Arizona	21	29	3		109		1	89	132	8
Connecticut	4	108	199		1,574		2	453	4	3
Nebraska	5	52	257		137		4	582	255	1
North Dakota	12	22	12		15		1	309	6	10
Vermont	0	3			325			60	0	1

January, 1928

	Cases
Colorado:	
Botulism (December)	3
Chicken pox	474
German measles	16
Impetigo contagiosa	5
Mumps	248
Scabies	4
Trachoma	2
Whooping cough	82

February, 1928

	Cases
Chicken pox:	
Colorado	227
District of Columbia	97
German measles:	
Colorado	6
Impetigo contagiosa:	
Colorado	14
Mumps:	
Colorado	59
Paratyphoid fever:	
Colorado	1

February, 1928—Continued

	Cases
Puerperal fever:	
Colorado	1
Scabies:	
Colorado	7
Septic sore throat:	
Colorado	2
Trachoma:	
Colorado	1
Whooping cough:	
Colorado	99
District of Columbia	34

March, 1928

	Cases
Chicken pox:	
Arizona	58
Connecticut	417
Nebraska	330
North Dakota	66
Vermont	170

March, 1928—Continued

	Cases
Conjunctivitis:	
Connecticut	2
Dysentery (bacillary):	
Connecticut	1
German measles:	
Connecticut	11
North Dakota	4
Impetigo contagiosa:	
North Dakota	5
Lead poisoning:	
Connecticut	1
Lethargic encephalitis:	
Connecticut	2
North Dakota	7
Mumps:	
Arizona	56
Connecticut	1,269
Nebraska	437
North Dakota	94
Vermont	448

March, 1928—Continued

	Cases
Paratyphoid fever:	
Arizona	1
Rabies (in animals):	
Connecticut	1
Septic sore throat:	
Connecticut	5
Nebraska	17
Vermont	14
Tetanus:	
Connecticut	1
Trachoma:	
Arizona	21
Trichinosis:	
Connecticut	4
Vincent's angina:	
North Dakota	1
Whooping cough:	
Arizona	23
Connecticut	572
Nebraska	59
North Dakota	46
Vermont	141

Number of Cases of Certain Communicable Diseases Reported for the Month of January, 1928, by State Health Officers

State	Chicken pox	Diphtheria	Measles	Mumps	Scarlet fever	Smallpox	Tuberculosis	Typhoid fever	Whooping cough
Maine	161	13	248	80	141	0	34	11	74
New Hampshire		1			83	0		0	
Vermont	256	5	74	198	54	0	13	1	64
Massachusetts	1,320	485	5,518	1,311	1,508	3	473	28	1,271
Rhode Island	48	95	37	60	214	0	33	5	19
Connecticut	582	177	606	390	496	125	144	5	516
New York	2,507	1,835	4.607	2,286	2,857	44	1,719	92	2,125
New Jersey	1,006	761	1,051		987	4	440	27	723
Pennsylvania	3,339	1,123	3,963	2,932	2,348	0	630	80	1,144
Ohio	1,746	705	2,163	1,375	1,452	98	441	54	702
Indiana	236	188	318	74	466	471	140	17	66
Illinois	1,753	761	234	1,171	1,515	121	984	57	1,101
Michigan	770	375	1,550	1,092	1,125	169	404	22	596
Wisconsin	1,175	149	276	828	772	130	128	8	293
Minnesota	412	153	28		707	11	180	18	55
Iowa	224	85	284	168	368	350	21	11	42
Missouri	279	197	252	635	401	215	205	15	208
North Dakota	73	23	45	19	140	14	[1] 3	5	18
South Dakota	70	9	138	97	294	67	5	1	39
Nebraska	274	49	37	125	322	161	16	6	47
Kansas	893	100	110	207	775	470	131	5	431
Delaware	46	10	64	41	16	0	[1] 4	0	15
Maryland	712	131	1,358	118	285	2	218	27	133
District of Columbia	137	140	38		153	0	86	2	43
Virginia	628	194	1,755		231	34	[1] 57	37	469
West Virginia	241	75	345		243	88	33	26	141
North Carolina	775	270	13,760		282	501		9	544
South Carolina	248	135	4,075	8	67	76	161	31	244
Georgia	115	56	513	85	70	32	63	30	31
Florida	172	67	29	19	45	19	61	30	6
Kentucky [2]									
Tennessee	208	91	2,994	114	95	98	149	37	135
Alabama	180	163	806	156	73	24	195	43	97
Mississippi	802	101	5,174	1,100	143	132	290	50	1,401
Arkansas	291	63	1,097	249	129	65	[1] 38	30	80
Louisiana	47	104	406	31	51	68	[1] 132	33	24
Oklahoma [3]	141	155	464	73	160	512	53	38	22
Texas [2]									
Montana	76	25	6	3	141	135	32	3	31
Idaho	169	2	10	103	126	80	[1] 8	3	6
Wyoming	63	5	19	9	136	30		1	76
Colorado	474	82	353	248	594	102	133	10	82
New Mexico [2]									
Arizona	51	60	64	17	24	9	94	7	24
Utah [2]									
Nevada [4]									
Washington	374	70	217	326	299	228	98	13	41
Oregon	298	48	168	80	88	193	47	13	20
California	1,996	581	367	623	845	169	758	35	516

[1] Pulmonary.
[2] Reports received weekly.
[3] Exclusive of Oklahoma City and Tulsa.
[4] Reports received annually.

Case Rates per 1,000 Population (Annual Basis) for the Month of January, 1928

State	Chicken pox	Diphtheria	Measles	Mumps	Scarlet fever	Smallpox	Tuberculosis	Typhoid fever	Whooping cough
Maine	2.39	0.19	3.68	1.19	2.09	0.00	0.50	0.16	1.10
New Hampshire		.03			2.15				
Vermont	8.58	.17	2.48	6.63	1.81	.00	.44	.03	2.14
Massachusetts	3.63	1.33	15.19	3.61	4.15	.01	1.30	.08	3.50
Rhode Island	.79	1.57	.61	.99	3.53	.00	.54	.08	.31
Connecticut	4.12	1.25	4.29	2.76	3.51	.89	1.02	.04	3.65
New York	2.56	1.88	4.71	2.34	2.92	.04	1.76	.09	2.17
New Jersey	3.11	2.35	3.25		3.05	.01	1.36	.08	2.23
Pennsylvania	4.00	1.35	4.75	3.51	2.81	.00	.75	.10	1.37
Ohio	3.02	1.22	3.74	2.38	2.51	.17	.76	.09	1.21
Indiana	.88	.70	1.18	.28	1.73	1.75	.52	.06	.25
Illinois	2.80	1.21	.37	1.87	2.42	.19	1.57	.09	1.76
Michigan	1.98	.96	3.99	2.81	2.89	.43	1.04	.06	1.53
Wisconsin	4.70	.60	1.10	3.31	3.09	.52	.51	.03	1.17
Minnesota	1.79	.66	.12		3.07	.05	.78	.08	.24
Iowa	1.09	.41	1.38	.82	1.79	1.75	.10	.05	.20
Missouri	.93	.66	.84	2.13	1.34	.72	.69	.05	.70
North Dakota	1.34	.42	.83	.35	2.58	.26	[1] .06	.09	.33
South Dakota	1.17	.15	2.31	1.63	4.93	1.12	.08	.02	.65
Nebraska	2.30	.41	.31	1.05	2.70	1.35	.13	.05	.39
Kansas	5.75	.64	.71	1.33	4.99	3.02	.84	.03	2.77
Delaware	2.23	.48	3.10	1.98	.77	.00	[1] .19	.00	.73
Maryland	5.20	.96	9.92	.86	2.08	.01	1.59	.20	.97
District of Columbia	2.93	2.99	.81		3.27	.00	1.84	.04	.92
Virginia	2.88	.89	8.05		1.29	.16	[1] .26	.17	2.15
West Virginia	1.65	.51	2.36		1.66	.60	.23	.18	.97
North Carolina	3.11	1.09	55.30		1.13	2.01		.04	2.19
South Carolina	1.57	.86	25.81	.05	.42	.48	1.02	.20	1.55
Georgia	.42	.21	1.89	.31	.26	.12	.23	.11	.11
Florida	1.44	.56	.24	.16	.38	.16	.51	.25	.05
Kentucky [2]									
Tennessee	.98	.43	14.13	.54	.45	.46	.70	.17	.64
Alabama	.83	.75	3.70	.72	.33	.11	.89	.20	.45
Mississippi	5.29	.67	34.12	7.25	.94	.87	1.91	.33	9.24
Arkansas	1.77	.38	6.66	1.51	.78	.39	[1] .23	.18	.49
Louisiana	.28	.63	2.46	.19	.31	.41	[1] .80	.20	.15
Oklahoma [3]	.78	.85	2.55	.40	.88	2.82	.29	.21	.12
Texas [2]									
Montana	1.63	.54	.13	.06	3.03	2.90	.69	.06	.67
Idaho	2.36	.04	.22	2.23	2.72	1.73	[1] .17	.06	.13
Wyoming	3.01	.24	.91	.43	6.50	1.43		.05	3.63
Colorado	5.13	.89	3.82	2.69	6.43	1.10	1.44	.11	.89
New Mexico [2]									
Arizona	1.27	1.49	1.59	.42	.60	.22	2.34	.17	.60
Utah [2]									
Nevada [4]									
Washington	2.78	.52	1.84	2.43	2.22	1.70	.73	.10	.30
Oregon	3.90	.63	2.20	1.05	1.15	2.53	.62	.17	.26
California	5.17	1.51	.95	1.61	2.19	.28	1.96	.09	1.34

[1] Pulmonary.
[2] Reports received weekly.
[3] Exclusive of Oklahoma City and Tulsa.
[4] Reports received annually.

Number of Cases of Certain Communicable Diseases Reported for the Month of February, 1928, by State Health Officers

State	Chicken pox	Diphtheria	Measles	Mumps	Scarlet fever	Smallpox	Tuberculosis	Typhoid fever	Whooping cough
Maine	119	20	169	141	122	0	20	8	132
New Hampshire	-------	8	-------	-------	88	0	-------	0	-------
Vermont	193	3	104	144	59	0	[1] 10	1	79
Massachusetts	1,092	496	7,174	1,325	1,400	0	508	15	1,079
Rhode Island	44	67	176	143	264	0	28	5	28
Connecticut	404	138	1,267	541	378	16	160	7	642
New York	2,372	1,714	6,824	3,004	3,330	42	1,519	68	2,019
New Jersey	896	595	2,415	-------	1,197	1	418	13	631
Pennsylvania	3,121	1,001	5,363	4,257	2,557	1	761	50	1,361
Ohio	1,500	587	3,715	1,843	1,512	122	623	30	726
Indiana	273	141	533	215	577	471	112	11	82
Illinois	1,745	706	489	1,380	1,459	206	1,111	45	1,239
Michigan	719	301	2,586	1,775	1,297	139	538	31	666
Wisconsin	920	142	329	914	803	109	177	11	386
Minnesota	416	123	42	-------	708	12	282	9	101
Iowa	310	66	193	218	416	295	25	9	40
Missouri	293	228	565	820	468	190	191	11	268
North Dakota	55	26	26	50	257	16	8	6	14
South Dakota [2]	-------	-------	-------	-------	-------	-------	-------	-------	-------
Nebraska	343	61	16	275	391	132	14	7	75
Kansas	702	77	181	420	813	302	133	3	365
Delaware	24	6	37	41	18	0	[1] 9	1	21
Maryland	565	164	2,921	133	293	1	190	15	192
District of Columbia	97	134	249	-------	193	0	84	1	34
Virginia	737	122	3,905	-------	293	20	[1] 143	27	544
West Virginia	186	86	423	-------	226	251	61	44	74
North Carolina	693	183	17,433	-------	177	498	-------	12	679
South Carolina	247	315	5,276	9	40	33	151	26	308
Georgia	21	44	758	81	86	20	72	29	57
Florida	317	58	66	49	53	19	38	20	38
Kentucky [3]	-------	-------	-------	-------	-------	-------	-------	-------	-------
Tennessee	135	76	2,298	425	152	115	198	31	80
Alabama	167	119	1,033	92	49	23	308	39	69
Mississippi	885	75	6,382	1,322	95	134	300	47	1,563
Arkansas	171	45	2,396	232	147	31	50	22	101
Louisiana	38	86	874	19	44	99	116	43	30
Oklahoma [4]	174	114	721	73	260	589	72	43	42
Texas	-------	-------	-------	-------	-------	-------	-------	-------	-------
Montana	72	46	9	8	97	78	30	0	12
Idaho	58	5	-------	151	52	36	[1] 4	1	10
Wyoming	26	7	173	17	100	16	1	1	37
Colorado	227	70	240	59	509	60	131	4	99
New Mexico [3]	-------	-------	-------	-------	-------	-------	-------	-------	-------
Arizona	82	42	40	44	25	101	72	2	19
Utah [3]	-------	-------	-------	-------	-------	-------	-------	-------	-------
Nevada [5]	-------	-------	-------	-------	-------	-------	-------	-------	-------
Washington	420	60	1,219	349	278	265	192	11	69
Oregon	258	46	267	88	114	184	58	11	21
California	2,876	641	864	1,329	1,109	191	1,007	50	738

[1] Pulmonary.
[2] Reports not received at time of going to press.
[3] Reports received weekly.
[4] Exclusive of Oklahoma City and Tulsa.
[5] Reports received annually.

Case Rates per 1,000 Population (Annual Basis) for the Month of February, 1928

State	Chicken pox	Diphtheria	Measles	Mumps	Scarlet fever	Smallpox	Tuberculosis	Typhoid fever	Whooping cough
Maine	1.89	0.32	2.68	2.24	1.94	0.00	0.32	0.13	2.10
New Hampshire	.00	.22			2.44	.00		.00	
Vermont	6.91	.11	3.72	5.16	2.11	.00	[1] .36	.04	2.83
Massachusetts	3.21	1.46	21.11	3.90	4.12	.00	1.49	.04	3.17
Rhode Island	.78	1.18	3.10	2.52	4.65	.00	.49	.09	.49
Connecticut	3.06	1.04	9.59	4.10	2.86	.12	1.21	.05	4.86
New York	2.59	1.87	7.46	3.28	3.64	.05	1.66	.07	2.21
New Jersey	2.96	1.97	7.98		3.95	.00	1.38	.04	2.08
Pennsylvania	4.00	1.28	6.87	5.45	3.28	.00	.97	.06	1.74
Ohio	2.77	1.09	6.87	3.41	2.80	.23	1.15	.06	1.34
Indiana	1.08	.56	2.12	.85	2.29	1.87	.45	.04	.33
Illinois	2.98	1.20	.83	2.35	2.49	.35	1.90	.08	2.11
Michigan	1.98	.83	7.11	4.88	3.57	.38	1.48	.09	1.83
Wisconsin	3.93	.61	1.41	3.91	3.43	.47	.76	.05	1.65
Minnesota	1.93	.57	.19		3.28	.06	1.31	.04	.47
Iowa	1.61	.34	1.00	1.13	2.16	1.53	.13	.05	.21
Missouri	1.05	.82	2.02	2.94	1.68	.68	.68	.04	.96
North Dakota	1.08	.51	.51	.93	5.06	.31	.16	.12	.28
South Dakota [2]									
Nebraska	3.07	.55	.14	2.47	3.50	1.18	.13	.06	.67
Kansas	4.83	.53	1.24	2.89	5.59	2.08	.91	.02	2.51
Delaware	1.24	.31	1.91	2.12	.93	.00	[1] .47	.05	1.09
Maryland	4.41	1.28	22.81	1.04	2.29	.01	1.48	.12	1.50
District of Columbia	2.22	3.06	5.69		4.41	.00	1.92	.02	.78
Virginia	3.61	.60	19.14		1.44	.10	[1] .70	.13	2.67
West Virginia	1.36	.63	3.10		1.65	1.84	.45	.32	.54
North Carolina	2.98	.79	74.89		.76	2.14		.05	2.92
South Carolina	1.67	2.13	35.72	.06	.27	.22	1.02	.18	2.09
Georgia	.08	.17	2.99	.32	.34	.08	.28	.11	.22
Florida	2.84	.52	.59	.44	.47	.17	.34	.18	.34
Kentucky [3]									
Tennessee	.68	.38	11.59	2.14	.77	.58	1.00	.16	.40
Alabama	.82	.58	5.07	.45	.24	.11	1.51	.19	.34
Mississippi	6.24	.53	44.98	9.32	.67	.94	2.11	.33	11.62
Arkansas	1.11	.29	15.55	1.51	.95	.20	.32	.14	.66
Louisiana	.25	.56	5.66	.12	.28	.64	.75	.28	.19
Oklahoma [4]	1.02	.67	4.24	.43	1.53	3.46	.42	.25	.25
Texas									
Montana	1.66	1.06	.21	.18	2.23	1.79	.69	.00	.28
Idaho	1.34	.12		3.49	1.20	.83	[1] .09	.02	.23
Wyoming	1.33	.36	8.84	.87	5.11	.82	.05	.05	1.89
Colorado	2.63	.81	2.78	.68	5.89	.69	1.52	.05	1.15
New Mexico [3]									
Arizona	2.18	1.12	1.07	1.17	.67	2.69	1.92	.05	.51
Utah [3]									
Nevada [5]									
Washington	3.34	.48	9.69	2.78	2.21	2.11	1.53	.09	.55
Oregon	3.61	.64	3.74	1.23	1.60	2.57	.81	.15	.29
California	7.97	1.78	2.39	3.68	3.07	.53	2.79	.14	2.04

[1] Pulmonary.
[2] Reports not received at time of going to press.
[3] Reports received weekly.
[4] Exclusive of Oklahoma City and Tulsa.
[5] Reports received annually.

GENERAL CURRENT SUMMARY AND WEEKLY REPORTS FROM CITIES

The 99 cities reporting cases used in the following table are situated in all parts of the country and have an estimated aggregate population of more than 31,500,000. The estimated population of the 93 cities reporting deaths is more than 30,800,000. The estimated expectancy is based on the experience of the last nine years, excluding epidemics.

Weeks ended March 31, 1928, and April 2, 1927

	1928	1927	Estimated expectancy		1928	1927	Estimated expectancy
Cases reported				*Cases reported*—Contd.			
Diphtheria:				Typhoid fever:			
43 States	1,554	1,824	--------	43 States	170	227	-------
99 cities	840	1,130	900	99 cities	33	47	37
Measles:				*Deaths reported*			
41 States	18,788	16,191	--------				
99 cities	8,378	4,807	--------	Influenza and pneumonia:			
Poliomyelitis:				93 cities	1,476	1,077	-------
43 States	28	14	--------	Smallpox:			
Scarlet fever:				93 cities	0	0	-------
42 States	4,887	6,143	--------				
99 cities	1,831	2,611	1,367				
Smallpox:							
43 States	1,205	1,064	--------				
99 cities	150	143	120				

City reports for week ended March 31, 1928

The "estimated expectancy" given for diphtheria, poliomyelitis, scarlet fever, smallpox, and typhoid fever is the result of an attempt to ascertain from previous occurrence the number of cases of the disease under consideration that may be expected to occur during a certain week in the absence of epidemics. It is based on reports to the Public Health Service during the past nine years. It is in most instances the median number of cases reported in the corresponding weeks of the preceding years. When the reports nclude several epidemics or when for other reasons the median is unsatisfactory, the epidemic periods are excluded and the estimated expectancy is the mean number of cases reported for the week during non-epidemic years.

If the reports have not been received for the full nine years, data are used for as many years as possible but no year earlier than 1919 is included. In obtaining the estimated expectancy, the figures are smoothed when necessary to avoid abrupt deviations from the usual trend. For some of the diseases given in the table the available data were not sufficient to make it practicable to compute the estimated expectancy.

Division, State, and city	Population July 1, 1926, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
NEW ENGLAND									
Maine:									
Portland	76,400	3	0	1	0	0	0	17	1
New Hampshire:									
Concord	[1] 22,546	0	0	0	0	0	0	0	2
Vermont:									
Barre	[1] 10,008	0	0	0	0	0	0	0	0
Massachusetts:									
Boston	787,000	31	42	23	6	2	472	11	43
Fall River	131,000	0	3	1	1	1	1	0	2
Springfield	145,000	8	3	0	0	0	0	33	2
Worcester	193,000	20	4	3	0	0	50	48	12
Rhode Island:									
Pawtucket	71,000	3	1	1	0	0	8	17	0
Providence	275,000	11	8	10	0	0	165	11	12
Connecticut:									
Bridgeport	(2)	3	6	5	3	0	0	0	4
Hartford	164,000	0	7	4	2	2	21	7	7
New Haven	182,000	14	3	0	0	0	159	79	13

[1] Estimated, July 1, 1925.

[2] No estimate made.

City reports for week ended March 31, 1928—Continued

Division, State, and city	Population, July 1, 1926, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
MIDDLE ATLANTIC									
New York:									
Buffalo	544,000	11	10	19	5	0	198	49	24
New York	5,924,000	225	240	258	67	31	1,476	54	330
Rochester	321,000	7	11	3	2	0	36	31	7
Syracuse	185,000	40	5	0	-------	0	120	9	2
New Jersey:									
Camden	131,000	1	6	3	1	1	93	0	8
Newark	459,000	22	12	19	19	0	439	25	19
Trenton	134,000	1	4	4	3	1	11	0	6
Pennsylvania:									
Philadelphia	2,008,000	63	71	52	4	20	527	92	96
Pittsburgh	637,000	30	18	10	-------	6	152	94	48
Reading	114,000	8	2	3	-------	1	8	2	2
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	411,000	6	8	12	0	3	122	0	29
Cleveland	960,000	53	27	43	35	4	34	141	27
Columbus	285,000	6	4	2	1	1	33	9	6
Toledo	295,000	36	4	5	0	0	286	13	3
Indiana:									
Fort Wayne	99,900	2	2	4	0	0	2	0	4
Indianapolis	367,000	15	6	5	0	0	60	160	36
South Bend	81,700	0	1	0	0	0	1	0	4
Terre Haute	71,900	5	1	0	0	2	0	0	3
Illinois:									
Chicago	3,048,000	104	75	105	95	14	27	49	130
Springfield	64,700	7	1	0	4	4	0	13	5
Michigan:									
Detroit	1,290,000	62	53	36	7	5	1,182	59	56
Flint	136,000	11	4	2	0	0	50	138	1
Grand Rapids	156,000	6	2	0	1	2	42	22	1
Wisconsin:									
Kenosha	52,700	37	1	0	0	0	2	0	3
Milwaukee	517,000	70	16	10	2	2	8	42	10
Racine	69,400	5	2	4	0	0	0	6	1
Superior	[1] 39,671	1	1	0	0	0	0	0	0
WEST NORTH CENTRAL									
Minnesota:									
Duluth	113,000	3	0	0	0	0	0	6	1
Minneapolis	434,000	61	14	12	0	1	108	214	11
St. Paul	248,000	20	12	0	0	0	2	63	4
Iowa:									
Davenport	[1] 52,469	3	0	0	0	-------	1	0	-------
Des Moines	146,000	0	2	1	0	-------	0	0	-------
Sioux City	78,000	2	1	0	0	-------	6	40	-------
Waterloo	36,900	5	0	0	0	-------	0	6	-------
Missouri:									
Kansas City	375,000	40	6	4	0	5	32	143	18
St. Joseph	78,400	3	1	0	0	0	0	4	4
St. Louis	830,000	22	38	23	2	1	233	11	-------
North Dakota:									
Fargo	[1] 26,403	-------	0	-------	-------	-------	-------	-------	-------
Grand Forks	[1] 14,811	1	0	1	0	-------	0	0	-------
South Dakota:									
Aberdeen	[1] 15,036	18	0	0	0	-------	0	0	-------
Sioux Falls	[1] 30,127	0	0	0	0	-------	0	0	-------
Nebraska:									
Omaha	216,000	14	2	4	0	0	2	0	13
Kansas:									
Topeka	56,500	37	1	0	5	2	1	6	6
Wichita	92,500	17	2	0	0	0	0	0	7

[1] Estimated, July 1, 1925.

City reports for week ended March 31, 1928—Continued

Division, State, and city	Population, July 1, 1926, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
SOUTH ATLANTIC									
Delaware:									
Wilmington	124,000	2	2	3	0	0	5	0	2
Maryland:									
Baltimore	808,000	93	28	19	18	3	847	19	44
Cumberland	[1] 33,741	2	1	0	0	0	4	0	3
Frederick	[1] 12,035	1	0	0	0	0	3	0	0
District of Columbia:									
Washington	528,000	26	12	22	1	1	229	0	15
Virginia:									
Lynchburg	30,500	0	0	1	0	0	30	0	3
Norfolk	174,000	18	1	2	0	0	84	0	6
Richmond	189,000	11	2	3	0	1	201	2	7
Roanoke	61,900	0	0	7	0	1	25	2	3
West Virginia:									
Charleston	50,700	0	1	0	0	1	0	1	1
Wheeling	[1] 56,208	6	1	0	0	0	1	0	2
North Carolina:									
Raleigh	[1] 30,371	2	0	2	0	0	93	0	2
Wilmington	37,700	2	0	2	0	2	5	0	8
Winston-Salem	71,800	9	0	1	0	0	45	17	3
South Carolina:									
Charleston	74,100	1	0	0	18	1	3	0	7
Columbia	41,800	12	0	0	0	0	14	26	3
Greenville	[1] 27,311	0	0	0	0	0	1	3	0
Georgia:									
Atlanta	([2])	12	2	6	17	1	32	16	12
Brunswick	[1] 16,809	3	0	0	0	0	28	6	1
Savannah	94,900	5	1	0	16	1	6	0	7
Florida:									
Miami	[1] 69,754	26	5	1	0	0	2	14	2
St. Petersburg	[1] 26,847		0			0			0
Tampa	102,000	9	1	1	0	0	1	0	2
EAST SOUTH CENTRAL									
Kentucky:									
Covington	58,500	1	0	0	0	1	10	0	4
Louisville	311,000	3	3	7	9	0	147	6	34
Tennessee:									
Memphis	177,000	13	4	7	0	5	39	14	4
Nashville	137,000	8	0	1	0	2	25	5	8
Alabama:									
Birmingham	211,000	16	2	1	21	3	112	5	3
Mobile	66,800	0	1	1	1	4	2	0	2
Montgomery	47,000	12	0	0	1		5	1	
WEST SOUTH CENTRAL									
Arkansas:									
Fort Smith	[1] 31,643	2	0	0	0		0	0	
Little Rock	75,900	1	1	0	1	0	27	0	8
Louisiana:									
New Orleans	419,000	9	7	10	10	3	4	0	12
Shreveport	59,500	3	0	0	0	0	84	1	5
Oklahoma:									
Oklahoma City	([2])	0	1	4	25	0	27	4	7
Texas:									
Dallas	203,000	19	4	6	12	10	13	0	8
Fort Worth	159,000	25	2	3	3	3	7	3	12
Galveston	49,100	2	0	1	0	0	5	0	1
Houston	[1] 164,954	1	2	5	0	1	53	1	15
San Antonio	205,000	2	1	5	0	7	23	0	10
MOUNTAIN									
Montana:									
Billings	[1] 17,971	1	0	2	0	0	0	0	0
Great Falls	[1] 29,883	10	0	0	0	0	0	0	2
Helena	[1] 12,037	0	0	0	0	0	0	0	0
Missoula	[1] 12,668	0	0	0	0	0	0	0	0
Idaho:									
Boise	[1] 23,042	1	0	0	0	0	1	0	0

[1] Estimated, July 1, 1925. [2] No estimate made.

City reports for week ended March 31, 1928—Continued

Division, State, and city	Population, July 1, 1926, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
MOUNTAIN—continued									
Colorado:									
Denver	285,000	8	9	10	-------	6	68	139	4
Pueblo	43,900	9	1	0	0	0	11	0	1
New Mexico:									
Albuquerque	[1] 21,000	1	0	0	0	0	19	0	3
Utah:									
Salt Lake City	133,000	18	3	1	0	0	5	0	5
Nevada:									
Reno	[1] 12,655	0	0	0	0	0	0	0	0
PACIFIC									
Washington:									
Seattle	(2)	19	5	1	0	-------	135	7	-------
Spokane	109,000	8	2	0	0	-------	1	0	-------
Tacoma	106,000	-------	1	-------	-------	-------	-------	-------	-------
Oregon:									
Portland	[1] 282,383	25	7	0	0	0	13	2	5
California:									
Los Angeles	(2)	129	44	17	16	2	18	60	20
Sacramento	73,400	14	1	0	0	0	10	3	2
San Francisco	567,000	73	21	11	4	2	40	68	8

Division, State, and city	Scarlet fever		Smallpox			Tuberculosis, deaths reported	Typhoid fever			Whooping cough, cases reported	Deaths, all causes
	Cases, estimated expectancy	Cases reported	Cases, estimated expectancy	Cases reported	Deaths reported		Cases, estimated expectancy	Cases reported	Deaths reported		
NEW ENGLAND											
Maine:											
Portland	4	1	0	0	0	2	0	0	0	5	35
New Hampshire:											
Concord	1	0	0	0	0	0	0	0	0	0	7
Vermont:											
Barre	0	0	0	0	0	1	0	0	0	0	3
Massachusetts:											
Boston	77	78	0	0	0	15	1	1	0	63	268
Fall River	4	15	0	0	0	1	1	1	0	1	22
Springfield	5	20	0	0	0	1	0	0	0	4	39
Worcester	11	9	0	0	0	2	0	0	0	13	77
Rhode Island:											
Pawtucket	2	1	0	0	0	0	0	0	0	2	26
Providence	9	40	0	0	0	4	0	0	0	2	78
Connecticut:											
Bridgeport	12	2	0	0	0	0	0	0	0	4	40
Hartford	6	7	0	0	0	2	1	0	0	5	41
New Haven	11	3	0	0	0	2	1	0	0	11	50
MIDDLE ATLANTIC											
New York:											
Buffalo	24	59	0	0	0	12	0	0	1	23	145
New York	287	508	1	1	0	134	8	8	0	151	1,770
Rochester	16	6	0	0	0	1	0	0	0	9	68
Syracuse	13	10	0	0	0	3	0	0	0	24	45
New Jersey:											
Camden	6	6	1	0	0	0	0	0	0	1	44
Newark	32	51	0	0	0	6	0	0	0	30	124
Trenton	5	3	0	0	0	4	0	0	0	0	43
Pennsylvania:											
Philadelphia	90	120	0	0	0	38	3	1	0	67	640
Pittsburgh	30	32	1	0	0	9	1	0	0	32	-------
Reading	4	21	0	0	0	0	0	0	0	1	22

[1] Estimated, July 1, 1925.
[2] No estimate made.

City reports for week ended March 31, 1928—Continued

Division, State, and city	Scarlet fever		Smallpox			Tuberculosis, deaths reported	Typhoid fever			Whooping cough, cases reported	Deaths, all causes
	Cases, estimated expectancy	Cases reported	Cases, estimated expectancy	Cases reported	Deaths reported		Cases, estimated expectancy	Cases reported	Deaths reported		
EAST NORTH CENTRAL											
Ohio:											
Cincinnati	19	20	1	2	0	14	0	0	0	5	166
Cleveland	40	25	1	0	0	15	1	0	0	47	220
Columbus	12	9	2	0	0	12	0	0	0	0	106
Toledo	15	7	3	0	0	0	0	0	0	5	58
Indiana:											
Fort Wayne	6	12	3	0	0	0	0	0	0	0	25
Indianapolis	9	15	9	11	0	4	0	1	0	2	102
South Bend	4	1	1	0	0	0	0	0	0	2	15
Terre Haute	3	1	1	5	0	1	0	0	0	0	24
Illinois:											
Chicago	126	135	2	3	0	56	2	2	0	102	915
Springfield	2	16	0	8	0	0	0	0	0	1	35
Michigan:											
Detroit	95	102	2	2	0	27	1	0	0	71	384
Flint	7	11	1	2	0	1	0	0	0	8	24
Grand Rapids	9	5	0	0	0	0	0	0	0	4	34
Wisconsin:											
Kenosha	3	1	1	4	0	1	0	0	0	8	14
Milwaukee	27	45	2	0	0	11	0	0	0	14	125
Racine	4	3	0	0	0	0	0	0	0	5	8
Superior	3	6	1	0	0	0	0	0	0	0	5
WEST NORTH CENTRAL											
Minnesota:											
Duluth	9	11	0	0	0	3	0	0	0	5	24
Minneapolis	51	31	5	1	0	3	0	0	0	12	88
St. Paul	33	10	5	0	0	4	0	0	0	19	58
Iowa:											
Davenport	3	2	4	1	------	------	0	0	------	0	------
Des Moines	6	11	2	17	------	------	0	0	------	0	------
Sioux City	2	0	2	0	------	------	0	0	------	1	------
Waterloo	2	10	0	1	------	------	0	0	------	4	------
Missouri:											
Kansas City	12	29	3	4	0	5	1	1	0	14	142
St. Joseph	3	2	0	4	0	1	0	0	0	0	38
St. Louis	37	20	4	4	0	18	1	0	0	19	254
North Dakota:											
Fargo	2	------	0	------	------	------	0	------	------	------	------
Grand Forks	0	4	0	0	------	------	0	0	------	0	------
South Dakota:											
Aberdeen	3	1	0	0	------	------	0	0	------	0	------
Sioux Falls	1	2	0	0	------	------	0	0	------	0	5
Nebraska:											
Omaha	3	4	8	5	0	2	1	0	0	0	76
Kansas:											
Topeka	3	7	1	8	0	0	0	0	0	7	29
Wichita	3	5	1	6	0	2	0	0	0	4	29
SOUTH ATLANTIC											
Delaware:											
Wilmington	5	0	0	0	0	1	1	0	0	0	30
Maryland:											
Baltimore	38	27	1	0	0	20	2	2	1	35	291
Cumberland	1	1	0	0	0	2	0	0	0	0	18
Frederick	0	0	0	0	0	0	0	0	0	0	2
District of Col.:											
Washington	24	60	1	1	0	16	1	1	0	12	137
Virginia:											
Lynchburg	0	0	0	0	0	2	0	1	0	12	16
Norfolk	1	6	0	0	0	4	0	0	0	1	------
Richmond	2	4	0	0	0	1	0	2	0	3	54
Roanoke	1	0	1	0	0	1	0	0	0	0	23
West Virginia:											
Charleston	1	5	0	0	0	2	0	0	0	1	15
Wheeling	2	2	0	0	0	0	1	0	0	0	18
North Carolina:											
Raleigh	1	0	0	2	0	0	0	0	0	3	15
Wilmington	0	2	0	1	0	0	0	0	0	2	17
Winston-Salem	0	1	5	0	0	0	0	0	0	0	11

City reports for week ended March 31, 1928—Continued

Division, State, and city	Scarlet fever		Smallpox			Tuberculosis, deaths reported	Typhoid fever			Whooping cough, cases reported	Deaths, all causes
	Cases, estimated expectancy	Cases reported	Cases, estimated expectancy	Cases reported	Deaths reported		Cases, estimated expectancy	Cases reported	Deaths reported		
SOUTH ATLANTIC—continued											
South Carolina:											
Charleston	0	0	1	0	0	4	0	0	1	1	40
Columbia	0	0	0	0	0	0	0	2	0	2	13
Greenville	0	0	1	0	0	1	0	0	0	2	6
Georgia:											
Atlanta	4	11	6	1	0	10	0	0	0	2	92
Brunswick	0	0	0	0	0	0	0	0	0	0	11
Savannah	0	2	0	34	0	0	1	1	1	0	35
Florida:											
Miami	2	1	0	0	0	2	0	1	0	0	25
St. Petersburg	1		0		0	0	0		0		14
Tampa	0	5	1	0	0	1	1	3	0	0	24
EAST SOUTH CENTRAL											
Kentucky:											
Covington	1	2	0	1	0	3	0	0	0	0	31
Louisville	6	30	1	1	0	12	2	0	0	0	135
Tennessee:											
Memphis	5	6	4	2	0	9	0	0	0	1	79
Nashville	2	0	0	0	0	5	0	0	0	5	53
Alabama:											
Birmingham	2	0	8	1	0	5	1	1	0	3	67
Mobile	0	3	1	1	0	1	0	1	0	0	26
Montgomery	0	0	1	0			0	0		0	
WEST SOUTH CENTRAL											
Arkansas:											
Fort Smith	0	0	0	0			0	0		0	
Little Rock	1	3	1	0	0	2	0	0	0	0	
Louisiana:											
New Orleans	6	7	1	0	0	24	2	2	0	6	179
Shreveport	0	1	1	0	0	2	0	0	0	3	33
Oklahoma:											
Oklahoma City	2	6	3	20	0	3	0	0	0	0	38
Texas:											
Dallas	2	21	4	7	0	3	0	1	0	2	66
Fort Worth	1	2	2	9	0	1	0	2	0	0	44
Galveston	0	2	0	0	0	0	0	0	0	0	12
Houston	2	1	1	2	0	6	0	0	0	0	70
San Antonio	1	1	0	0	0	15	0	0	0	0	86
MOUNTAIN											
Montana:											
Billings	1	0	0	0	0	0	0	0	0	2	7
Great Falls	1	0	1	2	0	0	0	0	0	6	9
Helena	0	0	0	0	0	0	0	0	0	0	2
Missoula	1	0	0	0	0	0	0	0	0	3	5
Idaho:											
Boise	1	0	1	0	0	0	0	0	0	3	11
Colorado:											
Denver	13	17	2	0	0	10	0	0	0	24	92
Pueblo	2	4	0	0	0	0	0	0	0	2	8
New Mexico:											
Albuquerque	0	0	0	0	0	4	0	0	0	0	15
Utah:											
Salt Lake City	2	0	1	13	0	6	0	0	0	4	45
Nevada:											
Reno	1	0	0	1	0	0	0	0	0	0	4
PACIFIC											
Washington:											
Seattle	9	9	3	1			0	0		1	
Spokane	7	11	5	6			0	0		0	
Tacoma	2		4				1				
Oregon:											
Portland	7	1	7	43	0	1	1	0	0	0	
California:											
Los Angeles	28	28	5	0	0	26	1	1	1	21	250
Sacramento	1	3	0	2	0	3	0	0	0	1	27
San Francisco	16	28	3	0	0	11	1	0	1	21	166

City reports for week ended March 31, 1928—Continued

Division, State, and city	Meningococcus meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
NEW ENGLAND									
Massachusetts:									
Boston [1]	0	0	0	1	0	0	0	0	-------
MIDDLE ATLANTIC									
New York:									
New York	13	14	0	3	0	0	0	2	1
Pennsylvania:									
Philadelphia	1	1	2	2	0	0	0	0	0
Pittsburgh	2	2	0	0	0	0	0	1	1
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	0	0	0	0	0	0	0	0	1
Cleveland	0	0	0	0	0	1	0	2	0
Columbus	0	0	1	1	0	0	0	0	0
Illinois:									
Chicago	8	5	1	0	0	0	1	0	0
Michigan:									
Detroit	3	3	0	0	0	0	0	0	0
Wisconsin:									
Milwaukee	2	3	0	0	0	0	0	0	0
Superior	2	0	0	0	0	0	0	0	0
WEST NORTH CENTRAL									
Minnesota:									
Minneapolis	1	0	0	0	0	0	0	0	0
Iowa:									
Davenport	0	0	0	1	0	0	0	0	0
Missouri:									
Kansas City	6	3	0	0	1	1	0	1	0
St. Louis	5	2	0	0	0	0	0	0	0
SOUTH ATLANTIC [2]									
Maryland:									
Baltimore	1	1	0	0	0	0	0	0	0
District of Columbia:									
Washington	0	0	0	0	0	0	0	1	0
Georgia:									
Atlanta	1	1	0	0	0	1	0	0	0
Savannah [2]	0	0	0	0	1	0	0	0	0
Florida:									
St. Petersburg	0	1	0	0	0	1	0	0	0
EAST SOUTH CENTRAL									
Tennessee:									
Memphis	2	0	0	0	0	0	0	0	0
Nashville	0	0	1	0	0	0	0	1	0
Alabama:									
Birmingham	0	1	0	0	0	0	0	0	0
WEST SOUTH CENTRAL									
Arkansas:									
Little Rock	0	0	0	0	0	1	0	0	0
Louisiana:									
New Orleans	1	0	0	0	3	1	0	0	0
Shreveport	0	0	0	0	0	2	0	0	0
Oklahoma:									
Oklahoma City	2	0	0	1	0	0	0	0	0
Texas:									
Dallas [2]	0	0	0	0	2	0	0	0	0

[1] Rabies (human): 1 case and 1 death at Boston, Mass.
[2] Dengue: 1 case at Charleston, S. C., 1 case at Savannah, Ga., and 1 case at Dallas, Tex.

City reports for week ended March 31, 1928—Continued

Division, State, and city	Cerebrospinal meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
MOUNTAIN									
Colorado:									
Denver	5	7	0	0	0	0	0	0	0
Pueblo	1	0	0	0	0	0	0	0	0
Utah:									
Salt Lake City	0	1	0	0	0	0	0	0	0
Nevada:									
Reno	0	1	0	0	0	0	0	0	0
PACIFIC									
Washington:									
Seattle	1		0		0		0	0	
Spokane	1		0		0		0	0	
Oregon:									
Portland	1	0	1	0	0	0	0	0	0
California:									
Los Angeles	2	1	0	0	0	0	0	0	0
Sacramento	1	0	0	0	0	1	0	0	0

The following table gives the rates per 100,000 population for 101 cities for the five-week period ended March 31, 1928, compared with those for a like period ended April 2, 1927. The population figures used in computing the rates are approximate estimates as of July 1, 1927 and 1928, respectively, authoritative figures for many of the cities not being available. The 101 cities reporting cases had estimated aggregate populations of approximately 31,050,000 in 1927 and 31,657,000 in 1928. The 95 cities reporting deaths had nearly 30,370,000 estimated population in 1927 and nearly 30,961,000 in 1928. The number of cities included in each group and the estimated aggregate populations are shown in a separate table below.

Summary of weekly reports from cities, February 26 to March 31, 1928—Annual rates per 100,000 population compared with rates for the corresponding period of 1927 [1]

DIPHTHERIA CASE RATES

	Week ended—									
	Mar. 5, 1927	Mar. 3, 1928	Mar. 12, 1927	Mar. 10, 1928	Mar. 19, 1927	Mar. 17, 1928	Mar. 26, 1927	Mar. 24, 1928	Apr. 2, 1927	Mar. 31, 1928
101 cities	182	172	183	172	176	158	178	158	190	[2] 139
New England	163	140	128	145	137	136	130	124	137	110
Middle Atlantic	223	233	230	214	240	212	226	222	263	181
East North Central	176	164	165	171	157	135	178	148	159	146
West North Central	115	113	133	131	127	115	121	132	158	[3] 85
South Atlantic	195	130	155	124	141	139	146	112	157	121
East South Central	81	90	112	85	30	105	41	60	61	85
West South Central	149	92	190	168	161	136	174	116	178	108
Mountain	233	186	197	97	126	106	81	80	108	115
Pacific	133	141	198	171	165	125	193	105	170	[4] 78

[1] The figures given in this table are rates per 100,000 population, annual basis, and not the number of cases reported. Populations used are estimated as of July 1, 1927 and 1928, respectively.
[2] Fargo, N. Dak., and Tacoma, Wash., not included.
[3] Fargo, N. Dak., not included.
[4] Tacoma, Wash., not included.

Summary of weekly reports from cities, February 26 to March 31, 1928—Annual rates per 100,000 population compared with rates for the corresponding period of 1927—Continued

MEASLES CASE RATES

	Week ended—									
	Mar. 5, 1927	Mar. 3, 1928	Mar. 12, 1927	Mar. 10, 1928	Mar. 19, 1927	Mar. 17, 1928	Mar. 26, 1927	Mar. 24, 1928	Apr. 2, 1927	Mar. 31, 1928
101 cities	880	1,126	952	1,131	929	1,349	943	1,326	837	[2] 1,390
New England	172	1,979	198	1,657	212	2,277	198	1,536	205	2,014
Middle Atlantic	67	1,000	80	970	93	1,213	114	1,393	127	1,491
East North Central	1,173	761	1,169	865	1,233	1,063	1,138	1,009	925	1,023
West North Central	952	341	1,241	489	1,560	590	1,514	725	1,821	[3] 756
South Atlantic	794	2,576	783	2,784	1,010	2,972	972	2,893	1,091	2,905
East South Central	538	1,541	314	1,307	441	1,855	436	1,426	284	1,696
West South Central	720	1,695	1,187	1,300	1,026	1,328	1,754	1,120	935	836
Mountain	8,132	142	9,091	283	5,397	345	5,074	504	3,443	752
Pacific	3,030	892	3,252	904	2,923	830	3,163	807	2,761	[4] 550

SCARLET FEVER CASE RATES

101 cities	418	295	446	303	431	300	423	309	440	[2] 304
New England	423	347	591	377	546	402	479	411	530	405
Middle Atlantic	532	345	583	358	572	352	580	374	612	398
East North Central	399	309	369	292	353	296	347	306	329	266
West North Central	443	261	471	290	426	271	400	292	467	[3] 254
South Atlantic	180	254	193	268	220	223	179	224	197	221
East South Central	218	214	279	259	208	160	162	234	172	204
West South Central	66	96	120	128	62	208	58	124	54	144
Mountain	1,076	257	1,112	195	1,336	248	1,130	177	1,210	186
Pacific	329	194	285	192	253	217	360	202	340	[4] 213

SMALLPOX CASE RATES

101 cities	21	17	30	22	31	21	30	25	28	[2] 25
New England	0	0	0	0	0	0	0	0	2	0
Middle Atlantic	0	0	0	0	0	0	0	0	0	0
East North Central	21	18	34	14	33	26	29	18	33	24
West North Central	53	62	53	92	49	64	69	125	30	[3] 65
South Atlantic	52	19	54	25	51	33	41	23	61	68
East South Central	122	0	81	20	132	20	106	25	122	30
West South Central	50	20	70	36	45	44	74	36	62	36
Mountain	0	53	0	115	90	53	18	62	9	142
Pacific	13	49	94	69	84	38	99	61	68	[4] 24

TYPHOID FEVER CASE RATES

101 cities	9	10	8	4	7	4	8	4	8	[2] 5
New England	2	0	12	2	5	7	5	9	12	5
Middle Atlantic	5	8	8	3	6	2	7	4	6	4
East North Central	6	7	1	4	4	3	4	3	1	2
West North Central	10	6	4	2	0	4	4	0	2	[3] 2
South Atlantic	23	12	11	9	11	11	13	11	18	21
East South Central	41	50	30	5	20	10	41	5	20	10
West South Central	8	32	17	4	12	12	29	8	25	12
Mountain	9	9	0	0	9	0	0	0	0	0
Pacific	8	8	10	3	18	5	10	5	24	[4] 3

[2] Fargo, N. Dak., and Tacoma, Wash., not included.
[3] Fargo, N. Dak., not included.
[4] Tacoma, Wash., not included.

Summary of weekly reports from cities, February 26 to March 31, 1928—Annual rates per 100,000 population compared with rates for the corresponding period of 1927—Continued

INFLUENZA DEATH RATES

	Week ended—									
	Mar. 5, 1927	Mar. 3, 1928	Mar. 12, 1927	Mar. 10, 1928	Mar. 19, 1927	Mar. 17, 1928	Mar. 26, 1927	Mar. 24, 1928	Apr. 2, 1927	Mar. 31, 1928
95 cities	25	24	27	22	31	25	27	32	22	[2] 29
New England	9	7	12	21	19	7	7	9	12	11
Middle Atlantic	24	16	25	19	31	26	26	22	21	29
East North Central	23	17	16	16	18	12	16	35	15	24
West North Central	17	10	14	12	21	16	14	16	4	[3] 19
South Atlantic	47	32	70	25	79	19	65	39	38	21
East South Central	21	84	80	42	90	84	96	89	106	78
West South Central	38	103	47	74	21	115	25	98	30	86
Mountain	54	88	54	62	18	80	27	133	27	53
Pacific	17	24	7	20	14	10	28	7	24	[4] 15

PNEUMONIA DEATH RATES

	Mar. 5, 1927	Mar. 3, 1928	Mar. 12, 1927	Mar. 10, 1928	Mar. 19, 1927	Mar. 17, 1928	Mar. 26, 1927	Mar. 24, 1928	Apr. 2, 1927	Mar. 31, 1928
95 cities	171	190	188	191	184	221	167	213	163	[2] 222
New England	202	193	188	205	172	239	156	182	156	225
Middle Atlantic	193	217	222	221	226	258	198	245	186	264
East North Central	132	148	157	156	142	194	141	211	147	207
West North Central	104	106	81	96	114	139	101	118	93	[3] 132
South Atlantic	229	217	272	214	262	214	218	240	225	230
East South Central	271	240	186	272	191	335	197	240	133	288
West South Central	183	263	161	254	195	263	136	275	161	242
Mountain	126	265	170	265	161	203	170	168	161	106
Pacific	121	155	148	122	93	125	110	101	128	[4] 109

[2] Fargo, N. Dak., and Tacoma, Wash., not included.
[3] Fargo, N. Dak., not included.
[4] Tacoma, Wash., not included.

Number of cities included in summary of weekly reports, and aggregate population of cities in each group, approximated as of July 1, 1927 and 1928, respectively

Group of cities	Number of cities reporting cases	Number of cities reporting deaths	Aggregate population of cities reporting cases		Aggregate population of cities reporting deaths	
			1927	1928	1927	1928
Total	101	95	31,050,300	31,657,000	30,369,500	30,960,700
New England	12	12	2,242,700	2,274,400	2,242,700	2,274,400
Middle Atlantic	10	10	10,594,700	10,732,400	10,594,700	10,732,400
East North Central	16	16	7,820,700	7,991,400	7,820,700	7,991,400
West North Central	12	10	2,634,500	2,683,500	2,518,500	2,565,400
South Atlantic	21	21	2,890,700	2,981,900	2,890,700	2,981,900
East South Central	7	6	1,028,300	1,048,300	980,700	1,000,100
West South Central	8	7	1,260,700	1,307,600	1,227,800	1,274,100
Mountain	9	9	581,600	591,100	581,600	591,100
Pacific	6	4	1,996,400	2,046,400	1,512,100	1,548,900

FOREIGN AND INSULAR

TYPHUS FEVER ON VESSEL

Steamship "Gaika"—At Durban, Union of South Africa, from Island of Mauritius.—Under date of March 9, 1928, the arrival of the steamship *Gaika* from Island of Mauritius, with a case of typhus fever on board, was reported from Durban, Natal, Union of South Africa. The *Gaika* left London December 22, 1927, for Mauritius, passed Las Palmas, Canary Islands, December 29, 1927, Cape Town January 18, arrived at Mauritius January 31, 1928, and sailed for London via Durban and ports February 8, 1928.

THE FAR EAST

Report for the week ended March 17, 1928.—The following report for the week ended March 17, 1928, was transmitted by the eastern bureau of the health section of the secretariat of the League of Nations, located at Singapore, to the headquarters at Geneva:

Plague, cholera, or smallpox was reported present in the following ports:

PLAGUE

Aden Protectorate.—Aden.
India.—Bassein, Bombay, Rangoon.
Ceylon.—Colombo.
Dutch East Indies.—Cheribon.

CHOLERA

India.—Bombay, Tuticorin, Rangoon.
Siam.—Bangkok.
French Indo-China.—Saigon.

SMALLPOX

Iraq.—Basrah.
India.—Bombay, Madras, Rangoon.
French India.—Pondicherry.
Straits Settlements.—Singapore.
French Indo-China.—Tourane.
Dutch East Indies.—Belawan-Deli, Banjermasin.
China.—Canton, Shanghai, Hong Kong.

Returns for the week ended March 17 were not received from the following ports:

India.—Calcutta.
Dutch East Indies.—Samarinda.
Kwantung.—Port Arthur, Dairen, towns of the South Manchurian railway zone.
Union of Socialist Soviet Republics.—Vladivostok.

AUSTRIA

Communicable diseases—January 1 to 28, 1928.—During the period January 1 to 28, 1928, communicable diseases were reported in Austria as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Cerebrospinal meningitis	6	1	Puerperal fever	18	12
Chicken pox	789		Scarlet fever	496	4
Diphtheria	665	13	Trachoma	52	
Dysentery	12		Typhoid fever	61	5
Paratyphoid fever	29	2	Typhus fever	[1] 1	

[1] Vienna.

CANADA

Provinces—Communicable diseases—Week ended March 24, 1928.—The Canadian Ministry of Health reports cases of certain communicable diseases from seven Provinces of Canada for the week ended March 24, 1928, as follows:

Disease	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	Total
Cerebrospinal meningitis			2	1				3
Influenza	15			12				27
Smallpox				35		7	20	62
Typhoid fever		10	8	2			4	24

Quebec Province—Communicable diseases—Week ended March 31, 1928.—The Bureau of Health of the Province of Quebec reports cases of certain communicable diseases for the week ended March 31, 1928, as follows:

Disease	Cases	Disease	Cases
Chicken pox	221	Scarlet fever	90
Diphtheria	52	Smallpox	35
German measles	19	Tuberculosis	54
Influenza	5	Typhoid fever	15
Measles	273	Whooping cough	20
Poliomyelitis	1		

CZECHOSLOVAKIA

Communicable diseases—February, 1928.—During the month of February, 1928, communicable diseases were reported in Czechoslovakia, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	5	1	Paratyphoid fever	4	1
Cerebrospinal meningitis	14	6	Puerperal fever	42	21
Diphtheria	870	73	Scarlet fever	1,315	29
Dysentery	8	1	Trachoma	198	
Malaria	3		Typhoid fever	452	44

DENMARK

Communicable diseases—January, 1928.—During the month of January, 1928, communicable diseases were reported in the Kingdom of Denmark, as follows:

Disease	Cases	Disease	Cases
Anthrax	1	Paratyphoid fever	3
Cerebrospinal meningitis	12	Puerperal fever	22
Chicken pox	99	Pneumonia	480
Diphtheria	681	Scabies	1,082
Erysipelas	281	Scarlet fever	304
Influenza	5,877	Tetanus	4
Lethargic encephalitis	11	Tuberculosis, pulmonary	270
Measles	6,883	Typhoid fever	8
Mumps	704	Whooping cough	1,469

Population of Denmark: 3,491,000.

DOMINICAN REPUBLIC

Leprosy.—A report dated March 5, 1928, states that there were at that time 56 leper patients in the National Leprosarium and that about 20 lepers were isolated in their homes in the Dominican Republic. The National Leprosarium is located about 17 kilometers from Santo Domingo. The population of the Dominican Republic is said to be about 1,000,000.

FRENCH SUDAN AND UPPER VOLTA

Smallpox—February 16–29, 1928.—During the two weeks ended February 29, 1928, smallpox was reported present in the French Sudan with 1 case and in the Upper Volta with 5 cases.

ITALY

Communicable diseases—January 2–15, 1928.—During the two weeks ended January 15, 1928, communicable diseases were reported in the Kingdom of Italy, as follows:

Disease	Jan. 2-8, 1928		Jan. 9-15, 1928	
	Cases	Communes affected	Cases	Communes affected
Anthrax	28	26	25	23
Cerebrospinal meningitis	7	7	19	15
Chicken pox	307	108	365	125
Diphtheria	435	264	480	272
Dysentery	5	3	2	2
Lethargic encephalitis	3	3	6	6
Measles	2,135	277	2,506	297
Poliomyelitis	10	9	9	9
Rabies			1	1
Scarlet fever	369	146	396	174
Smallpox	1	1	2	2
Typhoid fever	548	298	477	276

JAMAICA

Smallpox (alastrim)—February 26–March 24, 1928.—During the period February 26 to March 24, 1928, 11 cases of smallpox, reported as alastrim, were notified in the island of Jamaica, occurring in localities not included in the Kingston area.

Other communicable diseases.—During the same period, other communicable diseases were reported in the island as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Chicken pox	1	11	Puerperal fever		1
Dysentery	10	25	Tuberculosis	17	48
Erysipelas		2	Typhoid fever	20	63

Population: Kingston, 62,707; island, 926,000.

LATVIA

Communicable diseases—January, 1928.—During the month of January, 1928, communicable diseases were reported in the Republic of Latvia as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	4	Poliomyelitis	1
Diphtheria	42	Puerperal fever	4
Erysipelas	17	Scarlet fever	240
Influenza	36	Tetanus	1
Leprosy	6	Trachoma	22
Measles	239	Typhoid fever	60
Mumps	7	Whooping cough	46

Population: 1,950,000.

MADAGASCAR

Plague—January 1 to 15, 1928.—During the 15 days ended January 15, 1928, 199 cases of plague with 188 deaths, were reported in the island of Madagascar. The distribution of occurrence by Provinces was as follows: Ambositra—cases 54, deaths 54; Antisirabi—cases 43, deaths 43; Itasy—cases 13, deaths 13; Moramanga—cases 19, deaths 19; Tananarive—cases 70, deaths 59, including Tananarive Town with 5 cases, 4 deaths. The distribution by type was as follows: Bubonic, 123; pneumonic, 41; septicemic, 35.

MALTA

Communicable diseases—January-February, 1928.—Communicable diseases were reported in the island of Malta during the months of January and February, 1928, as follows:

Cases reported

Disease	January, 1928	February, 1928	Disease	January, 1928	February, 1928
Broncho-pneumonia	11	11	Pneumonia	4	5
Chicken pox	24	14	Puerperal fever		1
Diphtheria	11	4	Scarlet fever	4	6
Erysipelas	2	2	Trachoma	21	26
Influenza		1	Tuberculosis	17	15
Lethargic encephalitis	1		Typhoid fever	37	29
Malta (undulant) fever	38	39	Whooping cough	8	2
Measles	2				

Population (civil), estimated, 227,440.

MEXICO

State of Jalisco—Smallpox—April 5, 1928.—On April 5, 1928, an epidemic of smallpox was reported in eastern Jalisco, Mexico.

PERU

Arequipa—Mortality—February, 1928.—During the month of February, 1928, 73 deaths from all causes, including 12 deaths from gastroenteritis and 22 from tuberculosis, were reported at Arequipa, Peru.

SENEGAL

Plague—Smallpox—February 16-29, 1928.—During the two weeks ended February 29, 1928, 17 cases of plague with 13 deaths were reported in the interior of Senegal. During the same period smallpox was reported in the interior of Senegal, in the district of Dakar, and in Mauretania.

UNION OF SOUTH AFRICA

Plague—Orange Free State—Week ended February 25, 1928.—During the week ended February 25, 1928, a case of plague was reported in the Orange Free State, occurring on a farm.

Smallpox.—During the same period an outbreak of smallpox was reported in the Orange Free State.

Typhus fever.—During the same period typhus fever was reported in one district of the Cape Province and in two districts of the Orange Free State.

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

From medical officers of the Public Health Service, American consuls, health section of the League of Nations, and other sources. The reports contained in the following tables 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		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928		
							24	31	7	14	21	28	4	11	18	25	3	10	17
China:																			
Amoy	C	28	72	16															
	D	7	3																
Canton	C	31	36	14	12	1													
	D	16	25	14	11	1													
Foochow	C	P	P	P															
Hong Kong	C	P	1	P															
Shanghai (settlement and concession)—																			
Foreigners only	C	1	6	3															
Including natives	D	20	74	7															
Swatow	C	42	P	P	P														
	D		P	P	P														
Tientsin	C	P	15	2	P	1													
Dutch East Indies: Java—Batavia	C				28	3													
	D				18	3													
India	C	45,163	31,390	20,160	23,047	25,139	4,624	3,960	3,550	3,243	3,267	3,097	3,026	3,001					
	D	22,051	15,895	10,371	12,863	15,026	2,617	2,353	2,046	1,847	1,765	1,739	1,684	1,562					
Bassein	D												1			1	1		
Bombay	C	42	3		2							1							
	D	30	2		2													1	1
Calcutta	C	87	76	101	199	428	69	42	43	22	39	36	70	58		80	99		
	D	40	39	64	138	281	48	34	27	16	18	24	38	32	35	42	63	101	
Madras	C	547	59	14	13	1				1	1			1		3	11		
	D	278	48	8	7	2				1		3		1	2	2	7	7	
Madras Presidency	C	7,660	3,056	2,050	3,073	3,702	503	382	482	497	1,163	1,301	1,305						
	D	3,513	1,581	1,055	1,736	2,104	241	209	254	280	623	813	726						
Negapatam	C										4								
	D										4	1		1	2	2			
Rangoon	C	1	2	6	2	8	1	2		1	4		1	1	10		3		
	D	1	2	5	5	6	1	1		1			1	1	8	4	2	4	2
Tuticorin	C			1		8													
	D			1	37	14													1

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

CHOLERA—Continued

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

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927: 24	31	January, 1928: 7	14	21	28	February, 1928: 4	11	18	25	March, 1928: 3	10	17
India (French):																			
Chandernagor	C	1	1		6	10	6	3	4	1	1		5						
	D	1			6	10	4	2	2	1			1						
Karikal	C	18	1		1	1			6	2	9	7	8	8					
	D	12	1		1	1			4		5	4	5	5					
Pondicherry	C	12	15		1	25	4	1	2	4	2	3	2	5					
	D	11	15		1	21	6	1	2	3	2	3	2	3					
Indo-China: Saigon	C		1	1					2	1	1	1		2	1	5		8	27
	D								1					1	1	1		6	19
Iraq [1]																			
Philippine Islands: Manila	C	1																	
Siam	C	77	40	18	110	88	24	24	13	49	50	33	48	69	74	59			
	D	53	24	11	76	64	18	21	5	36	34	21	42	42	50	38			
Bangkok	C	2	3	5	4	3	2	3	7	9	11	28	28	34	23	17	12		8
	D	1	1	3	2	2	2	1	3	5	7	16	26	17	12	11	7		5
Straits Settlements: Singapore	C				7	5	3	15	3	2	2			1					
	D				5	4	1	4	5	2	1								
On vessel:																			
S. S. Adrastus: At Yokohama, Japan	C	1																	
	D	1																	
S. S. Tabaristan: At Basra, Iraq	C			1															

Place		July-September, 1927	October, 1927	November, 1927: 1–10	11–20	21–30	December, 1927: 1–10	11–20	21–31	January, 1928: 1–10	11–20	21–31	February, 1928: 1–10	11–20	21–29
Indo-China (French):															
Annam	C	3,179	226	13	75	38	16	2		79	95	93	23	36	14
Cambodia	C	251	180	56	1	28	21	12	39	30	9	15	38	22	51
Cochin-China	C	469	178	21	27	52	17	38	58	46	119	130	178	113	153
Laos	C	246	67	10											
Tonkin	C	1,297	1			1			2	1					
Kwangchow-wan	C	16													

[1] From July 19 to Dec. 26, 1927, 1,479 cases of cholera were reported in Iraq, with 1,063 deaths, as follows: Amarah Liwa, 261 cases, 205 deaths; Baghdad Liwa, 80 cases, 60 deaths Basra Liwa, 421 cases, 330 deaths; Diwaniah Liwa 122 cases, 72 deaths; Diyalah Liwa, 1 case, 1 death; Dulaim Liwa, 100 cases, 69 deaths; Hillah Liwa, 105 cases, 71 deaths; Kerbalah Liwa, 79 cases, 60 deaths; Kut Liwa, 66 cases, 44 deaths; Muntafiq Liwa, 244 cases, 151 deaths.

PLAGUE

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928				
							24	31	7	14	21	28	4	11	18	25	3	10	17	24	31
Algeria: Oran	C	4	1		2																
	D	3	1																		
Arabia: Aden	C									19	13	22	54	89	63	45	77	158	189		
	D									7	8	8	33	55	50	31	26	99	134		
Argentina:																					
Bahia Blanca district	C					3															
Buenos Aires	C													2							
Cordoba Province	C	2		P	P	10	1	1													
Entre Rios	C	5																			
Firmat	C					1															
Quilino	C					3															
Rosario	C					4	2	3				4			1						
Santiago Province	C														1						
Ucacha	C					1															
Azores: St. Michaels Island	C	2	2	3	3	3	1		1		3	1	2	2	1	1	1		1		
	D		1	1		1				1	1	1	1	1			1		1		
Brazil:																					
Bahia	C							1	2	1	2		2	1	4						
	D							1	1	2		1	2	1	2						
Porto Alègre	C																2				
Rio de Janeiro	C										1		1	2	1	1					
	D													1	2						
British East Africa:																					
Tanganyiki	C	P		P	P	P	P						2								
	D												2								
Uganda	C	456	226	99	99	67															
	D	345	158	88	96	61															
Canary Islands:																					
Las Palmas	C			9		3			2	1	1				1				2		2
	D					1				1	1				1						
Teneriffe	C										1	3	3	3							
	D										1		3								
Ceylon: Colombo	C	1	3	1		6	3	2	1	1	1	1	1		3	3	4	1	3		
	D		3			6	3	1	1	1	1	1			1	3	1	1	3		
China:																					
Tientsin	C	2																			
Tungliao	D			200																	

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

PLAGUE—Continued

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

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928				
							24	31	7	14	21	28	4	11	18	25	3	10	17	24	31
Dutch East Indies:																					
Balik-Papan	C						1														
	D						1														
Celebes—Makassar	C				6	2	2	1		3	2	1	1	1		1					
	D				6	2	2	1		2	2	1	1	1		1					
Java	D		432	779	829	1,017	209	179	176	187											
Batavia and West Java	C	71	68	130	132	154	32	36	24	36	46	37	27	31							
	D	71	68	129	132	152	32	36	24	36	44	37	27	31							
Cheribon	C					1															
	D					1															
East Java and Madura	C	28	18	17	10	8	3	2	1	1	5	2									
	D	27	18	17	10	8	3	2	1	1	5	2					P				
Pasoeroean Residency	C					P															
Surabaya Residency	C					P															
Surakarta Residency	C				P	P															
Egypt:																					
Alexandria	C	2	1			12	3	2					1		1						
	D					7	1	1					1		1						
Cairo	C							2													
	D							2													
Suez	C		1							1	1		3		3	4		3		4	
	D									1	1		1		3	3	2	1		2	
Greece:																					
Athens and Piræus	C	1	3	1				2	1												
	D			1				1													
Mitylene	C	1	5	1	3	3															
Patras	C	2	2	1	1																
	D			1	1																
Hawaii Territory: Hawaii	D	1													1						
India	C	1,391	2,710	3,246	3,600	5,518	1,085	1,197	2,596	2,219	2,544	2,699	3,601	3,808							
	D	836	1,428	1,792	2,065	3,269	733	899	1,804	1,498	1,653	1,661	2,577	2,630							
Bassein	D	12	14	8	4	4	2	13	2		3	3		2	1	2	4	5	5		
Bombay	C	14	7	4				1		2	5	4	2	3	5	14					
	D	11	5	3				1		1	2	2	3	2	6	14	7	6	4		

Calcutta	C		18																		
	D		10									1									
Madras Presidency	C	620	465	583	470	791	174	167	56	153	107	132	79		142		185				
	D	321	230	298	282	359	69	27	38	72	63	64	60		79		100				
Rangoon	C	15	6	11	11	15	2	4	4	7	8	9	7	11	15	16	6				
	D	14	6	11	11	15	2	3	4	7	7	7	6	10	12	15	6	10	4		
Indo-China: Saigon	C		2		1																
Iraq:																					
Baghdad	C										1	1		2		1	1				
	D											1		1		1	1				
Dulaim Liwa	C												1								
Nigeria: Lagos	C				17	13	2	1	1	6	2	3	3	2	2	3	2				
	D				17	13	1	1	1	5	3	3	3	2	2	3	2				
Senegal:[1]																					
Baol	C	23	72	95	P	P															
	D	13	33	40																	
Cayor	C	227	463	176	48																
	D	166	233	88	28																
Dakar	C	46	20	1																	
	D	32	12																		
Louga	C		5	8																	
	D		4																		
Rufisque	C	44	16																		
	D	38	12																		
Thies	C		9	1	1																
	D		7																		
Siam	C			13	1	3	1	7	4	4	5	3	6	6	13	4					
	D			9		2	1	1	5	4	1	1	5	5	10	4					
Bangkok	C			2				1				1	1		1						
	D				1			1				1	1		1						
Straits Settlements: Singapore	C				1								1	1	1		1				
	D				1								1	1	1						
Tunisia[2]																					
Turkey: Constantinople	C		1	1		2															
	D			1		1															
Union of South Africa:																					
Cape Province	C				2	2					1										
	D				2	1					1										
Orange Free State	C				1	8						2		3	4	1					
	D				1	6						1		3	1						
U. S. S. R.:																					
Chita district	C			1																	
	D			1																	
Northern Caucasus	C		14	1																	
	D		10																		
Venezuela: State of Miranda—Tacata and Cua	C																		P		
On vessel:																					
At La Plata, from Rosario, Argentina	C							1													
S. S. Aghios Gerasimos, at Vigo, Spain	C				3																

[1] During January, 1928, 5 cases of plague were reported in interior of Senegal, and 17 cases with 13 deaths during last 2 weeks in February.

[2] 8 cases of plague with 6 deaths were reported in Bengardane region, Tunisia, Mar. 17 to 27, 1928.

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

PLAGUE—Continued

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

Place		July–September	October	November	December	January	February
Algeria: Algiers	C		2				
British East Africa: Kenya	C	95	18	28	16	26	
Ecuador: Guayaquil	C	15	4	9	5	4	6
	D			3	2	4	3
Indo-China (French)	C	14	3	3	4	7	
Madagascar	C	31[illegible]	166	209	317	427	342
	D	286	155	189	261	388	317
Ambositra Province	C	7	6	1	18	105	67
	D	7	6	1	10	96	66
Antsirabe Province	C	39	19	18	72	117	108
	D	38	19	17	72	117	108
Itasy Province	C	46	16	26	62	33	19
	D	41	15	25	54	29	17
Moramanga Province	C	12	24	46	25	19	25
	D	12	20	41	22	19	24

Place		July–September	October	November	December	January	February
Madagascar—Continued.							
Tananarive Province	C	211	99	170	139	155	123
	D	189	93	153	108	129	102
Mauritius	C	1					
Nigeria	C	32	27	16	20	16	
	D	29	27	16	18	16	
Peru	C	34	14	6	14		
	D	19	5	2	4		
Callao	D	3			3		
Lima	C				7		
	D		1	1	1		
Syria: Beirut	C				2		

SMALLPOX

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927: 24	Dec. 31	January, 1928: 7	Jan. 14	Jan. 21	Jan. 28	February, 1928: 4	Feb. 11	Feb. 18	Feb. 25	March, 1928: 3	Mar. 10	Mar. 17	Mar. 24	Mar. 31
Algeria	C	459	382	683	661	170	81	26	7	15	17	18	20	16	30						
Algiers	C					3	3	4		2	3	1	7	4	4		5	1			
Oran	C	9	16	11	20	39	8	15	2	4	2	2	4	3	1		2	2			
Arabia: Aden	C				1	3	1								1						

Brazil:																					
Para	C	1																			
Rio de Janeiro	C	6	10		1																
	D	4	9		1																
British East Africa: Tanganyiki	D	21	8	P	P	P			2	6	4		1								
British South Africa:																					
Northern Rhodesia	C	55	39	164	185	252	2	81	141	12	3		230		79	117					
	D	1	2	11	64	62		8	23				23		5	32					
Southern Rhodesia	C				3	2	1						P	3	2	4					
	D															1					
Canada:																					
Alberta	C	17	17	23	10	19		3	3	5	1	19	1	6		3		7	7	20	
Calgary	C	1																	1		
Edmonton	C			1	1	8			3	2	1			2	1		11	1	1	11	1
British Columbia: Vancouver	C		2			4	1	3	3	1	11	3	1	11	2	1	3	4	2	5	
Manitoba	C	13	9	7	19	7	2	2	2	5		1									
Winnipeg	C	5	4	2	2	2	1			1	1	1									
New Brunswick [1]	C						1									1					
Nova Scotia	C		2	1																	
Halifax	C		1	1																	
Ontario	C	60	22	96	264	347		33	83	76	52	77	63	51	40	51	36	20	19	35	
Hamilton	C					2													2		
Kingston	C				1		1							1							
Ottawa	C	27	40	67	134	63	18	9	10	23	20	16	23	9	11	3	1	7	6	8	10
Toronto	C		2	10	34	39	7		11	10	8	5	1	6	4	4	2	4	2	3	3
Windsor	C			9																	
Quebec	C	1		8	25	16	14	3	10	17	7		11	8	11	13		18	22		35
Montreal	C				1		1		1	6	3	4	1		5	1	3		6	3	
Quebec	C					4		2		3		5				2	5	4	3	4	4
Riviere du Loup	C				3																
Saskatchewan	C	14	68	31	34	58	12	13	15	12	39	15	9	34	7	8		7	14	7	
Moose Jaw	C	10	16	3		1		1	2	1	4	2	3	2		2	6	5	2	5	
Regina	C	8		5	1	1															
Saskatoon	C					2		4			13	1		1		2					
Ceylon: Colombo	C	1			1	2					1		1	2	2	1	3				
	D	1				1					1										
China:																					
Antung	C									1											
Canton	C		1																		
	D		1																		
Chefoo	C		1	P		P															
	D		1														1				
Foochow	C	P	P	P	P	P	P	P		P		P		P		P					
Hong Kong	C	1	2							1	1		1		1	3		3	5		
	D	1	2						1			1	1			1	1	2			
Manchuria—																					
Changchun	C					1						4									
Dairen	C			1	2	1			2	3	1		5	9	3						
	D			1								1	2	5	4						
Fushun	C		1		1																

[1] The report of 2 cases of smallpox in New Brunswick during the week ended Sept. 24, 1927, which has been published in prior issues of the Public Health Reports, was erroneous. No smallpox was reported in New Brunswick during September, 1927.

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

SMALLPOX—Continued

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

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928				
							24	31	7	14	21	28	4	11	18	25	3	10	17	24	31
China—Continued.																					
Harbin	C					2		1				2	1	2	2						
Mukden	C			2	1							1		3	18		3				
Pensihu	C			1																	
Shanghai—																					
Foreigners only	C										1	2		2	1	1	1				
Including natives	D										3	2	3	3	5	4	4	6			
Tientsin	C		4	13	8	9	2			6	20	10	10	8	5						
Curaçao (alastrim)	C										2				3						
Dominican Republic: Santo Domingo	C																		2		
Dutch East Indies:																					
Borneo—																					
Samarinda district	C				P																
South and East Borneo Residency	C	P																			
Java—																					
Batavia and West Java	C	4		4	25								1	3							
	D				15																
East Java and Madura	C	4	22	8	9	9		3	1	1	2										
	D			1																	
Sumatra: Medan	C					3		8		1	3	5	5	10	7	3					
	D					2		1		2	4	4		3							
Egypt	C		3			4		4								1					
	D		1	1		1															
Cairo	C					2															
Great Britain:																					
England and Wales	C	568	508	473	902	1,011	255	247	275	398	405	370	386	369	369	392	365	347	359	342	
Birmingham	C	1		1							14	17	11	2	1		2		1		
Bradford	C				11	19	2	2	4	24	6	9	7	2	7	1		4	9		
Bristol	C			6	4	8						2		1			1	3		2	
Cardiff	C				1				1												
Leeds	C	5	3	7	5	16	4	6	1		1			2	1	2	4	2	3	5	
Liverpool	C									1								1			
London	C										2		1	5	10	1	2	1	10	5	
Manchester	C			3	6	25		1	2	2	11	6	4	4	1	4	1	2	4	3	

Newcastle on Tyne	C	1	2	6	9	55	2	13	2	5	14	3	4	6	4	1	4	3	3	4	
Nottingham	C								7	6	4	8	6	9	6	1	3	1	5	1	
Sheffield	C	2	1	10	6	9	3		1	10	4		4		1	2	2	1			
Stoke on Trent	C	1							3	1			1		2	4	3	6	11		
Greece: Saloniki	D	2																			
India	C	5,911	4,398	3,153	4,052	6,731	2,225	2,502	2,664	3,285	4,129	3,631	5,159	4,858							
	D	1,668	1,120	715	927	1,650	515	578	551	785	964	803	988	954							
Bassein	C	1												1							
	D	1																			
Bombay	C	33	12	10	4	9		4	4	6	10	23	10	18	29	23	46	51	49		
	D	19	8	2	3	2					2	8	7	7	15	13	23	22	24		
Calcutta	C	27	22	5	5	25		17	9	14	14	11	23	10	9	18	14	30			
	D	25		6	2	11		17	4	6	10	7	10	7	5	11	10	24			
Madras	C	6	7	8	7	11	2		11	8	9	16	20	29	15	33	21	31	30		
	D		2		2	3	1		4	1	3	2	2	1	3	3	3	10	5		
Negapatam	C	3	1							5		4	2	2	1		1	1			
	D	2	1							3		2	1								
Rangoon	C	14	9	17	6	14	36	28	23	49	41	34	103	97	68	82	132	95	96		
	D	3	2	3	1	4	5	13	4	9	13	10	18	23	22	24	26	32	28		
Vizagapatam	C		3						3		2	1	5	2		1		1			
	D		2								6	1		1							
India (French):																					
Karikal	C	3	1	2	P																
	D	3	1	2																	
Pondicherry	C	39	37	38	42	41	6	16	25	18	15	17	15				6	3			
	D	31	37	38	42	41	6	14	12	18	15	17	15				6	3			
Indo-China: Saigon	C	1	1			1		1	1	1								1			
Iraq:																					
Baghdad	C		1	7	5	25	9	9	3	2	7	6	3	3	2		3				
	D		1	4	4	14	7	3	2		3	5	2	1	1		1				
Basra	C	1	4	2	3	4		2			1				1		2	4	4		
	D	1	4	2	1	3		1											1		
Italy:																					
Leghorn	C																1			1	
Rome and vicinity	C		1				2														
Jamaica (outside Kingston) (alastrim)	C	6	9	9	7	3		2				4	1		1	3		6	3	2	
Kingston	C		3	2																	
Japan:																					
Nagasaki	C	2																			
	D	1																			
Tokyo	C										2	1		1		1					
	D											1									
Mauretania	C														P	P					
Mexico:																					
Acapulco	C		2		1																
	D		2		1																
Chihuahua	D								1												
Guadalajara	D					2											1				
Manzanillo	D									1									1		
Mexico City and surrounding territory	C					4							1	1	2						
San Luis Potosi	D	1																			
Tampico	C															1					
Torreon	D	1		2																	

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

SMALLPOX—Continued

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

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928				
							24	31	7	14	21	28	4	11	18	25	3	10	17	24	31
Palestine: Jerusalem	C					1						1									
	D											1									
Poland	C	2				1	5	1			1	1	1								
	D	1																			
Porto Rico	C																		P		
Portugal:																					
Lisbon	C		3	8	4	10	1	2	4	5	5	2	2	3	3	9	4		4		
	D					1															
Oporto	C		1																		
Senegal: Dakar	C															8					
Siam	C	51	27	6	1	9	2	5	8	8	13	7	5	10	1	7					
	D	10	15			1			2		1	1	2		1	1					
Bangkok	C		3		1	1		1	2												
	D		1						1												
Spain:																					
Malaga	D				1	1															
Seville	C									1											
Valencia	C			1				1	1									1		1	
Straits Settlements: Singapore	C				1								1		1				1		
Switzerland	C						2														
Tunisia: Tunis	C							2	2			3			2	4	2		1		
Union of South Africa:																					
Cape Province	C	P		P							P			P							
Orange Free State	C	P			P	P	P				P			P							
Transvaal	C			P	7																
Upper Volta	C														2	3					
Venezuela: Maracaibo	D		2	1										1				1			

Place		July, 1927	August, 1927	September, 1927	October, 1927	November, 1927			December, 1927			January, 1928			February, 1928		
						1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20	21-29
Algeria	C	376	459	382	682												
Oran	C	14	10	16	11												
Indo-China (French)	C	19	3	21	25	13	3	22	10	4	20		40	18	50	31	90
Syria:																	
Aleppo	C										1		1				
Beirut	C								1		1			15	11	26	
Damascus	C		3	5	22		13		4	6	2	11	2				

Place		July-September	October	November	December	January	February
Angola	C	51	73	71			
	D		2				
Congo	C	5	77				
Cuanza-Norte	C	1					
Cuanza-Sul	C		2				
Loanda	C	1					
Zaire	C	3	4	1			
Brazil: Porto Alegre	C	11	4	1			
British East Africa: Zanzibar	C		2				
	D		1				
Chosen	C	21	2	2		4	
	D	6		1		2	
Ecuador: Guayaquil	C	4	1	1	4	2	9
France	C	37	7	4	14	11	
Gold Coast	C	7	4				

Place		July-September	October	November	December	January	February
Greece	C	10	4		5	6	11
	D						2
Latvia	C		2				
Mexico	D	221	132	157			
Morocco	C	180	81	140	401	55	
Nigeria	C	820	223	93			
	D	173	51	30			
Persia	D			2		7	
Spain: Madrid	D			1			
U. S. S. R.:							
Railways, etc	C	26	7	11			
Other territories in Europe	C	366	220	471			
Transcaucasus, Siberia, and Central Asia	C	80	40	21			
Ukraine	C	27	11	20			

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

TYPHUS FEVER

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

Place		July 31–Aug. 27, 1927	Aug. 28–Sept. 24, 1927	Sept. 25–Oct. 22, 1927	Oct. 23–Nov. 19, 1927	Nov. 20–Dec. 17, 1927	Week ended— December, 1927		January, 1928				February, 1928				March, 1928			
							24	31	7	14	21	28	4	11	18	25	3	10	17	24
Algeria:																				
Algiers	C											1					1	2	1	
	D																1			
Oran	C						1	1	1	1		2			2	1	6	1		1
Austria: Vienna	C												1							
Bulgaria: Sofia	C			17	6	1	1	4	1		1									
	D				1															
Chile:																				
Antofagasta	D			1																
Valparaiso	C		1		1	2				1							1			
	D	2	1		2															
China:																				
Manchuria—Harbin	C	2			1															
Tientsin	C		2																	
Egypt	C	2		12	4	14	1		3	4	2			1				1		
	D	3		5		8			3	1										
Cairo	C					3														
	D					3														
Port Said	C			1		1														
Ireland ((Irish Free State):																				
Cork County	C					3			1											
Donegal County, Letterkenny	C			4																
Mexico:																				
Guadalajara	D					1														
Mexico City, including municipalities in Federal District	C	17	19	18	28	17	4	4	4	3	2	1		2	1		4	3	6	
	D				2	1	1	3	1								3	1		
Morocco	C								107	235	257	214	370	210	141			175		
Palestine	C	11	1	5	3	9				8		2	2	1	1	2	6	1		
Poland	C	50	35	19	64	93	26	33	68	68	101	92	87	66	57	62				
	D	6	2	4	11	10	1	3	6	6	4	3	5	7	10	3				
Portugal: Oporto	C	1			1									1						
Rumania	C	36	16	17	22	35	32	17	19				15	24		14				
	D	1		2				2	1				2	7						

Syria: Aleppo	C		2						2											
Tunisia	C	14	1	3	1	1	1			5	4				1				1	
Union of South Africa:																				
Cape Province	C	P	P	P	P	P	P	1	P		P	P	1	P	P	P				
Natal	C	P	P	P	P	2	2	P	P	1		P		1	P					
Orange Free State	C			P		P							P	P	P	P				
Transvaal	C	1		5	P	P														
On Vessel: S. S. Gaika at Durban, Natal—from Mauritius	C																	1		

Place		1927				November, 1927			December, 1927			January, 1928			Feb. 1-10, 1928
		July	August	September	October	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	
Algeria	C	67	33	10	12										
	D	13			1										
Algiers	C	2	2	6	2										
Bulgaria	C	12	24	7	2						2	7	6		8
	D		1	2	1						1		1		1
Morocco	C	148	76	7	11	5	14	7	5	6	75				

Place		July-September	October	November	December	January	February
Argentina: Rosario	C			1			
	D				1	1	
China: Shanghai	D			1			
Chosen	C	90	16	26	38	183	
	D	8	1	2	3	19	
Chemulpo	C	3				1	
Gensan	C	2				1	
	D					1	
Seoul	C	5	2				
	D	1	1				
Czechoslovakia	C	12	1		6		
Greece: Athens	C	3			1	2	2
Japan	C	1		1			
Latvia	C	6					

Place		July-September	October	November	December	January	February
Lithuania	C	69	9	18	27	86	
	D	14	1	1	1	10	
Mexico	D	64	36	29			
Peru:							
Arequipa	D	3	2		1	2	
Lima	D	8					
U. S. S. R.:							
Railways, etc.	C	77	23	33			
Transcaucasus, Siberia, and Central Asia	C	208	61	49			
Ukraine	C	295	151	198			
Other territories in Europe	C	1,839	521				
Yugoslavia	C	20	1	1		7	
	D	5				3	

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

YELLOW FEVER

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

Place		July 3-30, 1927	July 31-Aug. 27, 1927	Aug. 28-Sept. 24, 1927	Sept. 25-Oct. 22, 1927	Week ended—Oct. 29, 1927	November, 1927				December, 1927					January, 1928				February, 1928			
							5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25
Ashanti: Obuasi	C		1																				
	D		1																				
Belgian Congo: Boma	C														3								
	D														2								
Matadi	C														0	12	11	1	5	8			1
	D														2	6	8	2	5	6			
Dahomey: Grand Popo	C									1													
	D									1													
Porto Novo	C	1																					
	D	1																					
Ivory Coast	C	1											1										
	D	1											1										
Liberia: Monrovia	C			1																			
Nigeria	C			2																			
	D			2																			
Senegal	C	3	10	21	31	9	16	6	6	7													
	D	3	9	21	31	8	10	4	4	6													
Dakar	C	1			12	3	6		5	2	1	4			1	1							
	D				7	2	4		4	2	1	4			1	1							
Togoland	C		1																				
	D		1																				

Place		July	August	September	October
Gold Coast	C	15	2	6	1
	D	4	2	4	1