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A STUDY OF THE EFFECT OF TYPHOID VACCINE WHEN GIVEN AFTER INFECTION

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In the epidemic of typhoid fever which occurred in Helena in the latter part of 1929, a total of 216 cases occurred either in residents of Helena or in persons who had recently visited the city and who were presumed to have received the infection there. A fairly complete record was made of 182 cases, which record includes, besides the epidemiological data, certain clinical features that might be considered of importance from a public-health standpoint. Among other items of information it was noted that 77 of these patients had received one or more doses of typhoid vaccine either just prior to or during the course of the disease. All except a very few received the first dose after the probable date of infection. A study was made in the effort to determine what effect, if any, this vaccine had on the duration and severity of the disease, by comparing these 77 cases with 105 cases occurring in the same epidemic which did not receive any vaccine.

Duration was considered as the number of days elapsing from the day on which the first symptoms were noticed up to and including the last day on which the temperature went above 98.6° F. This included any relapse or other complication. Duration was determined only for those cases in which the patients recovered, and so four cases are omitted from those who received vaccine and eight cases from the control group.

It was very difficult to devise a method for measuring severity, and the plan finally adopted is a crude one and open to much criticism. It is sufficiently accurate, however, to determine wide variations in severity of the cases in this series, although it would be useless for comparison with other cases. Severity was divided into five groups or degrees, viz, "mild," "moderate," "severe," "very severe," and "fatal," and a numerical value was given to each group expressed as "per cent of severity," as follows: Mild, 20 per cent; moderate, 40 per cent; severe, 60 per cent; very severe, 80 per cent; and fatal, 100 per cent. Cases were classed as "mild" when there were just sufficient symptoms to make a positive diagnosis, such as moderate continued fever, very little toxemia, and enlarged spleen, and nervous symptoms were slight or absent. "Moderate" includes those cases which presented a definite picture of the disease, with moderate toxemia, usually slight delirium, and prognosis considered favorable throughout the course. "Severe" cases are those which presented the typical textbook type of the disease, with high temperature, considerable delirium, and doubtful prognosis. "Very severe" cases are those which had, in addition to the condition described as severe, one or more critical periods in which the prognosis was very unfavorable. "Fatal" includes all cases which died, although several had important contributing causes of death.

Nearly all of the patients were personally visited by the author, most of them several times, and in this way a definite knowledge was had of the severity of the disease in each case. After the epidemic was over, each attending physician was interviewed and the plan of classification explained. Each case was then discussed in detail, and an agreement was reached as to the group in which it should be placed.

Since the age of the patient might have an influence on duration or severity, the cases were divided into 10-year age groups, but no significant variations seemed to be shown.

The cases were separated into three classes according to the time at which the vaccine was given. "Prophylactic vaccine" group includes all cases in which the first dose was given before the onset of symptoms. Those who had the first dose after symptoms started but before going to bed were placed as "delayed prophylactic vaccine" group. A few patients had the first dose of vaccine on the day on which the symptoms started, and these are included in this second group. Patients who had the first dose after going to bed were placed as "therapeutic vaccine" group.

A total of 24 patients had three doses, three of the patients completing the treatment more than 10 days prior to onset and 7 others getting at least one dose more than 10 days prior to onset; 12 patients had their first dose between 1 and 10 days prior to onset, and 2 began the injections after onset but before going to bed. Fifteen patients had 2 doses of vaccine each, 11 of them getting the first dose between 1 and 8 days prior to onset, and 4 after onset but before going to bed. Twenty-one patients had only one dose of vaccine, 6 of them before and 15 after symptoms had started.

The vaccine used was the combined typhoid bacillus, paratyphoid bacillus A, and paratyphoid bacillus B, and for prophylaxis the usual standard doses were given at six or seven day intervals. The therapeutic doses were one-half the usual prophylactic dose and were given at three or four day intervals.

GROUP I.—*Prophylactic vaccine (three doses). First dose given before symptoms started*

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60 and over	Total
Number of cases	3	13	3	1	1	1	0	22
Number of deaths	0	0	0	0	0	0	0	0
Average duration (days)	21.3	17.8	21.3	21.0	16.0	64.0	0	21.0
Average severity (per cent)	33.3	30.8	26.7	40.0	20.0	60.0	0	31.8

GROUP II.—*Prophylactic vaccine (one and two doses). First dose given before symptoms started*

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60 and over	Total
Number of cases	1	7	3	6	0	0	0	17
Number of deaths	0	0	0	1	0	0	0	1
Average duration (days)	30.0	24.7	28.7	30.6	0	0	0	27.6
Average severity (per cent)	80.0	42.9	60.0	56.7	0	0	0	52.9

GROUP III.—*Delayed prophylactic vaccine (one, two, and three doses). First dose given after symptoms started but before patient went to bed*

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60 and over	Total
Number of cases	2	9	3	4	2	1	--------	21
Number of deaths	0	0	0	0	0	1	--------	1
Average duration (days)	27.0	32.0	31.7	38.5	52.5	0	0	34.8
Average severity (per cent)	30.0	46.7	40.0	65.0	60.0	100.0	0	51.4

GROUP IV.—*Therapeutic vaccine (one, two, and three doses). First dose given two to eight days after patient went to bed*

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60 and over	Total
Number of cases	0	4	6	7	0	0	0	17
Number of deaths	0	1	0	1	0	0	0	2
Average duration (days)	--------	30.3	27.3	31.0	0	0	0	29.4
Average severity (per cent)	--------	80.0	46.7	57.1	0	0	0	58.8

GROUP V.—*No vaccine (control group)*

Age group	0-9	10-19	20-29	30-39	40-49	50-59	60 and over	Total
Number of cases	9	25	33	15	12	7	4	105
Number of deaths	0	0	4	1	2	0	1	8
Average duration (days)	25.7	34.0	31.7	37.0	41.4	39.4	28.0	33.9
Average severity (per cent)	51.1	54.4	54.5	52.0	65.0	48.6	60.0	54.9

Group I has 22 cases which received three doses of vaccine, the first at least being given prior to onset of symptoms. Comparison of these with the control group shows that they had a very definitely shorter duration and less severity. If we study separately the 10 cases which had their first dose more than 10 days prior to onset, the difference in duration and severity is even more striking. These 10 cases had an average duration of 16.9 days and an average severity of 28 per cent. The other 12 cases in Group I had an average duration of 24.3 days and average severity of 35 per cent.

Group II has 17 cases which received only partial prophylaxis, but started before onset. Eleven of them received two doses and 6 received one dose. The duration in these subdivisions was about equal, being 28.1 days and 26.6 days, respectively; but the severity was considerably less in those who received two doses, being 47.3 per cent as compared with 63.3 per cent in those who received one dose.

Comparison of this group as a whole with the control group apparently shows that while the average duration is shortened by about six days the severity is approximately equal.

Group III represents 21 cases in which the first dose was given shortly after the onset of symptoms, but before the patient went to bed. Two of these received three doses, 4 received two doses, and 15 received one dose. Both duration and severity were greater in those receiving two and three doses than in those who had only one dose. The group as a whole shows very little variation from the control group.

Group IV contains 17 cases who received vaccine after going to bed. Eleven of them received three doses each, 2 received two doses, and 4 received one dose. The two patients in this group who died each received two doses. As previously stated, the amounts given were one-half the prophylactic dose, given at three or four day intervals, and the first dose was given two to eight days after the patient had gone to bed. The attending physicians report that there was a very noticeable reaction following each dose. In these cases the average duration was a few days less, but the severity was at least as great as in the control group.

SUMMARY

Comparison of the findings in the control group with those of the four groups who received vaccine indicates that the patients in Group I were definitely benefited as to both duration and severity. In Groups II and IV the duration was shortened a few days, but the severity was about the same. In Group III both duration and severity were about the same as in the control group.

CONCLUSIONS

The data presented in this study would seem to justify the tentative conclusion that typhoid vaccine is well worth while when given after the infection is received, provided the first dose is given before the onset of symptoms and provided further that three doses are given.

Typhoid vaccine when given soon after the onset of symptoms is of little or no benefit.

UNDULANT FEVER [1] [2]

With Special Reference to a Study of Brucella Infection in Iowa [3]

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I. INTRODUCTION

The attention of physicians and health officers has recently been directed to the problem presented by the recognition of an apparently new disease, undulant fever, due to *Brucella melitensis* var. *abortus,* and *Brucella melitensis* var. *suis.* That this infection undoubtedly has occurred in the past, though the true nature of it was not suspected, increases the interest of the problem. During the past three years pertinent facts have rapidly accumulated in studies made here and there. A general dissemination of these among the profession is highly desirable, hence the assembling and considering of the data now set forth. Believing that they may be useful to others, we have included some charts, graphs, and tables, which have been found of value in presenting the prominent features of the disease to assembled physicians.

Although separate consideration is here given to *Br. melitensis* (varieties *abortus* and *suis*) infection, it is not desirable that it be regarded as a disease entity distinct from infection with *Br. melitensis* var. *melitensis,* but its characteristics should be as thoroughly studied and as widely known. Similarities and differences would in this way become apparent, and thereby a complete picture of undulant fever be obtained. Although we have had opportunity to

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[3] This article will be reprinted later as National Institute of Health Bulletin No. 158.

observe more than 300 cases of infection with the *abortus* and *suis* varieties of *Br. melitensis*, our knowledge of undulant fever of caprine origin has of necessity been derived from the literature. It is our purpose, therefore, to present our own observations of *Br. melitensis* (varieties *suis* and *abortus*) infection, to supplement these with the findings of other investigators, and finally to compare the characteristics revealed with the features of undulant fever of caprine origin as they have been described.

In Iowa an attempt has been made personally to investigate all reported cases of undulant fever. Blood specimens for diagnostic agglutination tests are sent by physicians located in all parts of the State to the laboratories of the State department of health, conducted in conjunction with the department of preventive medicine of the State University of Iowa. Sera for specific examination for undulant fever are also sent here from hospitals and private laboratories. In this way we have obtained a clue to all suspected or established cases. Those patients whose serum agglutinated *Brucella* in a dilution of 1:80, or higher, were sooner or later visited. (The field studies were conducted by A. V. Hardy or C. F. Jordan.) Our clinical information was thus obtained directly by questioning and examining patients, and was supplemented by contributions from attending physicians and from clinical records so kindly placed at our disposal. The patient, other members of his family, and sometimes dairymen and veterinarians supplied us with data relative to sources and means of transmission of the infection. In the field we not infrequently inoculated culture media and guinea pigs with the patient's blood, or with milk from suspected cattle. Except during the early part of the study, responsibility for collecting blood or milk from animals, after we had obtained permission for their examination, was assumed by the State department of agriculture. A fairly complete study of many of our cases was made possible by this widely cooperative endeavor. It was soon apparent that *Brucella* infection of hogs as well as of cattle was widespread in the State. This situation gave us an unusual opportunity to study comparatively the *abortus* and *suis* varieties of *Br. melitensis* infection in man.

Our investigation, therefore, has been facilitated by a very liberal cooperation, received not only from the organizations under whose auspices the study was conducted, but also from the State department of agriculture, the State veterinary college, and many physicians, veterinarians, hospitals, and clinics. We wish to express personal appreciation for this generous interest and cooperation which has not only made this investigation a pleasure, but has in large measure given it such value as it may have.

The writers wish to express appreciation for the guidance, encouragement, and assistance of Dr. Henry Albert, Commissioner of Health of the State of Iowa; Dr. H. E. Hasseltine, Surgeon United States Public Health Service in charge of field studies in undulant fever; Medical Director George McCoy, Director of the National Institute of Health; and Dr. Ludvig Hektoen, Chairman of the committee on contagious abortion, National Research Council. Further acknowledgment is also made of the special services of Miss E. Felsenthal, Medical Librarian, and Miss Thelma De Capito, of the Hygienic Laboratory, State University of Iowa.

II. HISTORICAL

The history of *Br. melitensis* infection can be introduced best by reference to the outstanding features of the early history of undulant fever. Hughes (1) pointed out that Hippocrates gave descriptions of fevers which detailed the characteristics of this infection. He also stated that different writers between 1722 and 1800 gave evidence of having observed undulant fever. One, for example, described fevers which ran an irregular course, were incurable by bark, marked by excessive perspiration, and followed by relapse after relapse. Moreover, the medical officers who served in Malta from 1800 repeatedly testified as to its occurrence and increasing prevalence between the years 1854 and 1860. During these latter years Marston (2), one of the medical officers stationed in Malta, included in his "Report on Fever" for 1861 a full and accurate description of a disease which he called Mediterranean remittent, or gastric remittent, fever.

So significant is this contribution that the following is quoted from his introductory paragraph: "By this is meant a fever characterized by the following symptoms and course; a preliminary stage of subacute dyspepsia, anorexia, nausea, headache, feeling of weakness, lassitude, and inaptitude for exertion, mental or physical, chills, muscular pain, and lastly, a fever having a long course, three to five or ten weeks, marked by irregular exacerbations and remissions, great derangements of the assimilative organs, tenderness in the epigastric region, and splenic enlargement. It is prone to relapses, has a protracted convalescence, and is frequently marked by rheumatism."

The accuracy of his observations was soon recognized. Five years later Chartres (3) confirmed these in a vivid description which is applicable also to infection with all varieties of *Brucella*. "So mild were the symptoms in some of the cases that it became a matter of nice discrimination to distinguish the sick man from the mere pretender. On the other hand, the patient sometimes appeared to have been completely prostrated at once by the severity of the onset. However, in many of these the suddenness of the attack was more apparent than real, for a careful inquiry often revealed a previous stage of dyspepsia, debility, and languor." So it was that between the years 1860 and 1870, among the various fevers comprising the "miasmatic diseases," undulant fever became a distinct clinical entity.

The studies progressed, and in 1887 Surg. David Bruce (4) demonstrated the etiological agent of the infection. Ten years later Wright and Semple (5) first applied the agglutination test to aid in the diagnosis—obviously an important advance in the study of a disease with such wide clinical variations.

In view of the prevalence of Mediterranean, Malta, or undulant fever among the military and naval forces in the British Mediterranean territories, a commission was appointed representing the Army, the Navy, and the Civil Government of Malta to make further investigations of the disease. From 1904 to 1907 this group included Bruce, Bassett-Smith, Horrocks, Shaw, Eyre, Kennedy, Zammit, and others (6). By detailed and laborious studies the nature of the organism and the character of the disease were determined, but almost by accident was the source of the infection discovered, and with this a knowledge of the means of prevention. Small laboratory animals were not readily available on the island, but goats were; and so in planning animal experiments it was decided to test their susceptibility. Six goats were purchased. Much to the surprise of Zammit (6), he found in the preliminary blood examination that five of the six already had a high agglutination titer for *Micrococcus melitensis*. This finding was confirmed by Horrocks (6), and it was soon established that these animals were naturally infected. It was a simple matter then to show that goats were the common source of infection, and that the disease was acquired by the men in the Army through the drinking of raw goat's milk. On June 1, 1906, orders prohibiting the use of raw goat's milk by the men in the Army and Navy were issued. The results were striking, as demonstrated in Figure 1, a reproduction from Eyre (7). Until recently it was considered an established fact that undulant fever had its sole source in goats and was transmitted through the use of their raw products. In the diagnosis of the infection, therefore, the main consideration was given to the question of the direct or indirect contact with goats and use of their milk.

In this country the early recognized cases were among men recently returned from the Tropics, the first case being reported in 1898 by Musser and Sailer (8). Attention was again called to the infection by Curry (9) in 1901. Craig (10), however, not only detected several cases among the men in the Army, but in 1904 he established the diagnosis of a case in a nurse who had never been out of the country. At the time when she contracted her illness there were no cases of Malta fever on the wards on which she was nursing. (We have suspected that this may have been a case of infection with the *abortus* or *suis* variety of *Br. melitensis*.) Craig then suggested that many cases, supposedly atypical typhoid fever, were in reality undulant fever. This suggestion was evidently given little consideration, since the cases next recognized were those reported in Texas by Gentry and Ferenbaugh (11) (12) in 1911. Case reports by Yount and Looney (13) and others soon followed. The disease then faded from medical consciousness, and from 1915 until 1920 there were no known established diagnoses. The startling epidemic in Phoenix,

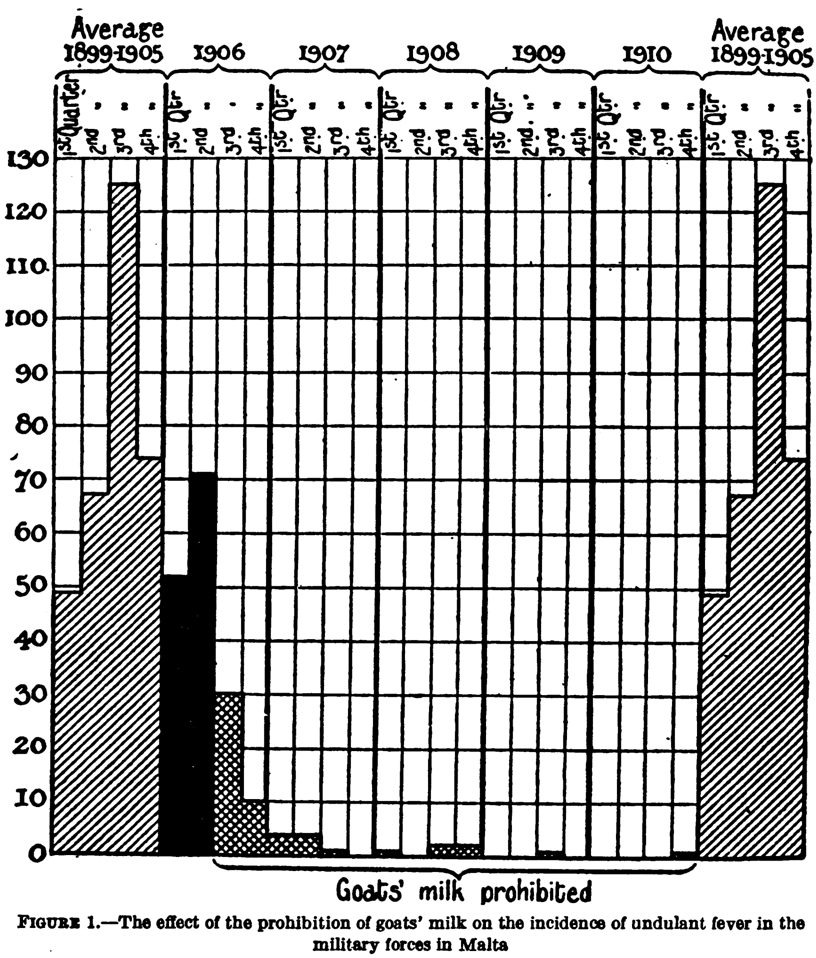

FIGURE 1.—The effect of the prohibition of goats' milk on the incidence of undulant fever in the military forces in Malta

Ariz., in 1922, studied by Lake and Watkins (14) (15) revived interest in the infection so that cases were again reported from the goat-raising areas. Thus, we see that the first cases recognized in this country either occurred in persons who had close association with goats or who had acquired their infections in foreign territory.

As *Brucella* infection of domestic animals is now very widespread throughout this country—and doubtless was even before its specific etiological agent was isolated—we have suspected that cases of human infection have also occurred, though given erroneous diagnoses or even none at all. In searching the American medical literature of the latter half of the last century, we have found numerous references to severe epidemic diseases with high mortality rates, but comparatively few sporadic infections which terminated in recovery, such as *Br. melitensis* var. *abortus* infections. A few which have come to light contain almost classical descriptions of the disease as we know it to-day. Hoff (16), writing in 1880, after describing four cases of "typho-malarial fever," which now appear to have been undulant fever rather than Rocky Mountain spotted fever or tularaemia, says: "Owing doubtless to the sparseness of population, the rarity of the disease, and most of all to the fact that the pioneers of our profession are as a rule workers, not recorders * * * the literature of the subject is extremely meager."

The term "typho-malarial fever" was coined by Woodward (17) during the Civil War, for the purpose of designating infections which occurred among the soldiers and which otherwise would have been left without a category. These fevers were supposed to be modifications of typhoid fever occurring in malarious individuals, and manifested characteristics of both typhoid fever and malaria. We have found recorded under this name descriptions of typhoid fever, malaria, Rocky Mountain spotted fever, and other diseases so altered by the drastic purgatives then in vogue as to be quite unrecognizable, and in addition some which we believe to have been undulant fever, presumably due to *Brucella* infection of the *abortus* or *suis* variety. Fly (18), of Illinois, in 1880, described in a vivid manner the characteristic chills, anorexia, and muscle soreness; Good (19), of Ohio, in 1881, the frontal headache, constipation, enlarged spleen, and prostration; Hoyt (20), of Georgia, in 1873, the stiffness and night sweats; and Caulkins (21), of Michigan, in 1878, openly flouting the idea that the presence of malaria in an individual could change typhoid into a disease relatively mild and nonfatal, recorded cases to which we later refer. His was a rural practice in southeastern Michigan, and he states that although typhoid fever and malaria had both been very prevalent in previous years, this new mild type of fever had only appeared since the autumn of 1861. "Abdominal typhus or typhoid fever," he states, "is not the fatal disease that it was 25 or 30 years ago. Not only are its most malignant features softened down, and its mortality rate of 20 per cent much diminished, but it has a somewhat different clinical history in respect that the enteric symptoms formerly visible at the outset of the disease are at first wanting. * * * The intermissions will be so distinct that the medical attendant sees nothing in the cases but an ordinary malarious attack, which he confidently expects, and probably promises the patient and friends, to arrest in a day or two. The day or two, however, pass, and in spite of his predictions and a vigorous use of his antiperiodics, the surprised and baffled doctor is obliged to stand impotently by and see the disease run on, until at last he is compelled reluctantly to acknowledge that it is a case of typhoid fever with which he has to deal. Nearly all the continued fever that practitioners, in the country district at least, meet with at present is marked by this composite character and deserves a new and expressive name typho-malarial fever, a name that describes the disease so well that it has been almost unanimously adopted by the profession."

Following a discussion of the possible cause of this infection (a new poison produced by the confluence of that of typhoid and of malaria), Caulkins briefly relates the outstanding features of cases from which the following notes are abstracted:

"*Case 1.*—Symptoms first week, chills alternating with profuse sweats, red tongue, vomiting, no diarrhea. Second week all the symptoms abated except the night sweats which, if anything, were worse. Patient was able to be up and walk about for four days. Supposed himself well if his sweats would stop and his appetite come back. Third week, relapse of all the bad symptoms." Then follow daily notes. "The bowels not having been evacuated for 48 hours, took a tablespoonful of castor oil," and later, "no diarrhea, no headache, mind clear, sweat during night excessively." The following day, "sweat as bad as ever to such a degree that from his shirt water could be wrung. Morning temperature 101°, evening temperature 104¼°." At the end of the fourth week it was noted that "gradual improvement followed until the end of the fifth week, at which time the evening temperature was 100°. The night sweats lasted some time longer."

Case 2.—Described as similar to the first, though the sweats were not so severe.

Case 3.—Described as "similar to the first two, the sweating in particular."

He then adds: "The noticeable points in these three cases are the high temperatures, slow pulse, and excessive perspiration. Two other cases of milder type of continued fever showed the same sweating disposition." Discussing treatment he notes: "Too much attention can not be given to cleanliness. Owing to the drenching sweats it is necessary to wash the patient often, and change the clothing and bedding."

Interesting also are extracts from a paper entitled "Protracted, Continued, Simple Fever," written by J. M. DaCosta (22), of Philadelphia, in 1896, who says: "With full appreciation of the difficulties of clear discernment, * * * I still believe in the existence of a continued fever of considerable duration that is not typhoid or malarious fever that has become continuous." He endeavors "to ascertain in how far these continued fevers form a type of their own," and describes two cases, the first as follows:

* * * Shortly afterwards an inexplicable fever arose that lasted for three months. The fever was never very high; it did not, I think, ever exceed 103°, was not ushered in by a chill, nor did chills happen during its continuance. There were, as in any fever, morning remissions and evening exacerbations, but never

to a marked degree. The fever was for weeks remarkably regular, only at times, and at no stated period, showing irregularities in its course, and its subsidence and disappearance were gradual and unmarked by violent changes as in onset. Late in the disease some sweating happened. Beyond the extraordinary fever there was nothing of note. There were no cerebral symptoms, save occasional headache, neither nausea nor vomiting, no epistaxis, no diarrhea—the bowels were indeed rather sluggish—no abnormal lung or heart conditions, no albumin in the high-colored fever urine, no eruption of any kind, not a single even doubtful rose spot, a slight enlargement of the spleen was made out, but it was not decided. Indeed, there was nothing whatever amiss except the apparently interminable fever. The convalescence did not prove a protracted one, emaciation was obvious, yet considering the length of the fever not extreme * * * and the long fever was totally uninfluenced by quinine, as in truth it was by any other remedy. It seemed to leave when it had determined to leave.

Though no diagnosis can be established in retrospect, still we feel that these records justify the opinion that undulant fever has for many years past occurred in widely scattered regions of this country.

Though *Bacillus abortus* was isolated by Bang (23) in 1897, it was not until after 1918 that the possibility of its pathogenicity for man was given adequate consideration. The true relationship of the so-called *Micrococcus melitensis* of Bruce and the *Bacillus abortus* of Bang was established at that time by Evans (24). After this Bevan (25) (26), Keefer (27), Gage and Gregory (28), Huddleson (29), Carpenter and Merriam (30), and others, reported cases of human infection, known or believed to be caused by *abortus* or *suis* variety of *Br. melitensis;* and as these reports were widely read, a new interest was displayed. There followed then detailed studies mainly by those concerned with animal as well as human infections, notably, Theo. Smith, Huddleson, and Carpenter. Only gradually did the medical profession become aware of the problem and the more recent studies which resulted will be described in subsequent sections.

III. ETIOLOGY, BACTERIOLOGY, AND IMMUNOLOGY

ISOLATION AND IDENTIFICATION OF THE ETIOLOGICAL AGENT

That the etiological agent of undulant fever in the Mediterranean region was first isolated by Surgeon David Bruce (4) has already been mentioned. In December, 1886, in stained sections prepared from the spleen removed from a soldier who had died of the infection, "an enormous number of micrococci were seen scattered throughout the tissues." Several months later these studies were resumed and cultures were made from the spleen of other cases. Growth appeared in 68 hours, and "when a minute portion of the culture was placed in a drop of sterilized water, and examined under a high power, innumerable small micrococci were seen." Any observations made on stained preparations were not mentioned. Bruce and others, particularly Hughes (31), were repeatedly successful in isolating a similar organism from the tissues of persons who died of undulant fever, and in time it was recognized as the etiological factor and given the name "*Micrococcus melitensis.*"

Durham (32), in 1898, also took up the work and investigated the pathogenicity for various animals. He called attention to the occurrence of bacillary forms; but as yet no one thought of associating this bacterium which often does produce abortion in goats with that which caused a similar manifestation in cattle described just one year previous. It was at that time that Bang and Stribolt (23) found small organisms in the uterus of a cow with threatened abortion which had purposely been slaughtered for study. Examining the yellow, odorless exudate found between the uterine wall and the fetal envelope, there appeared great numbers of organisms. "In clumps the bacteria mostly had the appearance of cocci, but some of the free-lying individuals were of longer shape, and these were first regarded as short oval structures. Culture examinations, however, under very high magnifications showed that we had in fact to deal with a small bacillus." Other early observations made by Bang (23) are particularly interesting. Cultures were made in serum-gelatin agar, and he noted that growth occurred ½ to 1½ centimeters under the surface, but not above or below this. Considering this phenomenon dependent on a peculiar oxygen requirement, Bang and Stribolt investigated further and observed that in either an increased or decreased oxygen tension growth was luxuriant, and took place on the surface. The fact that the tubes were sealed in these experiments was not taken into account, but we can now explain the phenomenon by the peculiar carbon-dioxide requirement of this variety of the species. That this organism was the etiological agent of contagious abortion of cattle was established by their work, and has been confirmed by Preisz (33), Nowak (34), McFadyan and Stockman (35), Zwick (36), McNeal and Kerr (37), and more recently by various others. The designation *Bacillus abortus* was generally accepted.

The isolation from swine of a similar organism, though differing in that it grew readily on the surface of solid media when incubated in air, was first reported by Traum (38), in 1914, and by Goode and Smith (39), in 1916. The observations of these workers have also been adequately confirmed, notably by Doyle and Spray (40), and Conaway and his associates (41).

The important contribution made by Evans (24) grew out of her studies of *Bacillus abortus* infection in cattle, carried out from 1916 to 1918. Comparative studies were undertaken, selecting for detailed investigation *Bacterium bronchisepticus* "and the organism which causes Malta fever." She found that, morphologically, culturally, biochemically, and by simple agglutination tests, the *Micrococcus* *melitensis* and *Bacillus abortus* were indistinguishable. At the same time she suggested and discussed the possibility that the latter might be pathogenic for man. This same possibility had been proposed by Schroeder and Cotton (42), in 1911, when they noted that the organism was found in cow's milk, and that on inoculation it produced a tubercle-like lesion in guinea pigs. Some attempts to establish such speculation as fact were made by Larson and Sedgwick (43), and Nicoll and Pratt (44). Cooledge (45) seriously questioned the whole matter.

Even after this recognition of the two organisms as one species, the work was not further pursued. However, when reports of human infections caused by the *abortus* organism appeared, veterinarians and physicians attacked the problem with a new vigor.

NOMENCLATURE

With the establishment of the true relationship of the *Micrococcus melitensis* and the *Bacillus abortus*, it became essential that one or both of these organisms be renamed and reclassified. In this there is as yet no complete accord. The generic name, *Brucella*, was suggested by Meyer (46), in 1920, and this has been quite generally adopted. Beyond this there is not entire agreement. Evans (47) has renamed the organisms as follows: The *Micrococcus melitensis* to be *Brucella melitensis* var. *melitensis;* and *Bacillus abortus* to be *Brucella melitensis* var. *abortus*. Since we now recognize two distinct types of the variety *abortus*, it is further necessary to indicate whether the organism is an *abortus* variety of the bovine or porcine type; hence one finds this rather cumbersome designation for one organism, "*Brucella melitensis* var. *abortus*, porcine type." A simplification of such a nomenclature seems desirable. Huddleson (48) has suggested that the three types be designated by the name *Brucella melitensis*, *Brucella abortus*, and *Brucella suis*. We do not favor this nomenclature, since it seems to assume the occurrence of three distinct biological species, and, in view of the slight differences, such an assumption would not be justified. We believe that the organisms under consideration should certainly be classified as the same species, but at the present time there is no generally accepted species name. Physicians and medical bacteriologists commonly use *melitensis* for all varieties; veterinarians still retain *abortus*. Since *melitensis* was proposed earlier, it would seem that it should be adopted by all according to the rule of priority.

We favor the use of the nomenclature of Evans (47), and in order to simplify the designation of the organisms generally designated as bovine and porcine types of *abortus* we suggest the terms *Brucella melitensis* var. *abortus*, and *Brucella melitensis* var. *suis*, respectively.

This would make the summary of the nomenclature of the Brucellae of undulant fever read as follows:[4]

Micrococcus melitensis (Bruce) to be *Brucella melitensis* var. *melitensis*.
Brucella abortus (Bang) to be *Brucella melitensis* var. *abortus*.
Brucella abortus (Traum) to be *Brucella melitensis* var. *suis*.

CHARACTERISTICS COMMON TO ALL VARIETIES OF BRUCELLA

The three varieties of *Brucella* have in common all the characteristics by which microorganisms are ordinarily differentiated. They are small (0.3 to 0.5 by 0.6 to 1.5 micron), nonencapsulated, nonmotile, and decolorized by Gram's method. Coccoid and bacillary forms occur, as well as intermediary oval shapes. Any slight differences in shape are inconstant and are not regarded as of value in classification. Coccoid forms may predominate in infected tissue. Grown artificially, the occurrence of bacillary forms is the rule. Growth takes place slowly. In liquid media it is rarely apparent earlier than the fourth day, and occasionally not until 10 days or later. Growth of the first subculture, planted on agar, usually makes its appearance in from 48 to 72 hours as minute, translucent, discrete colonies. These gradually increase in size and assume a pale amber hue. Subcultures made from plain broth media at 48 and 72 hours consistently fail to reveal *Brucella*, a fact responsible no doubt for the failure to recognize, at an earlier date, human infections with the *abortus* and *suis* varieties of *Brucella*. Unless a bacteriological examination is performed with *Brucella* in mind, rarely will it reveal the organism. In view of this characteristic and of the widespread occurrence of *Brucella* infection, we have adopted and recommend the prolonged incubation of blood cultures, making subcultures semiweekly for four weeks before reporting as negative. The subcultures are observed for a period of one week.

All varieties of *Brucella* fail to ferment carbohydrates. The results are identical, or nearly so, when simple serological tests are used.

THE DIFFERENTIATION OF THE VARIETIES

In differentiating the varieties four tests have been used, which singly may be inconclusive, but together allow a classification of *Brucella*.

In the simple agglutination tests, final titers may differ slightly when immune sera are combined with *melitensis*, *abortus*, or *suis* antigen. These differences are inconstant and entirely unreliable for purposes of classification. That there are actually differences in the agglutinins has been reported by Evans (47), who by agglutinin absorption was able to differentiate the *abortus* from the *melitensis*

[4] EDITORIAL NOTE: Should future research indicate that each variety should be classed as a distinct species the variety name would become the species name and agree with the species names already proposed by Huddleson.

strains, and to detect different serological types. In the hands of others, this method either has given varying results (Feusier and Meyer (49)), or has been entirely ineffective (Simonetti (50)). It is generally agreed that there is no serological difference between the bovine (*abortus*) and porcine (*suis*) varieties; hence this test is applicable only in differentiating the *melitensis*, or caprine variety, from the other varieties. Living antigens are more sensitive, but, because of the danger of infecting laboratory workers we feel that the adoption of this test is rarely justifiable.

An outstanding characteristic of the *abortus* variety is its peculiar atmospheric requirement. Bang (23) noted that growth occurred a short distance under the surface of his solid media, and believed that this indicated that the organism grew best under partially anaerobic conditions. With this suggestion in mind, Nowack (34) was able to obtain growth on the surface of solid medium if the cultures were sealed in a container along with an adequate amount of actively growing *B. subtilis* cultures. The true explanation of these observations was pointed out by Huddleson (51), who found that it was the increase in the carbon dioxide tension which stimulated growth. This observation has greatly facilitated the study of *Br. melitensis* var. *abortus*. The *suis* and *melitensis* varieties have no similar requirement, and the failure of an organism to grow on first subculture in an atmosphere without an increased carbon dioxide tension differentiates the *abortus* from the others. Occasionally, however, one finds atypical strains which, from the first, grow in an unmodified atmosphere. Moreover, by repeated subcultures, this limiting characteristic may be lost, and can not be relied upon as a final means of differentiation. The successful isolation of *Br. melitensis* var. *abortus* requires the supplying of this increased carbon dioxide tension (from 1 to 10 per cent by volume). An apparatus which we have found very convenient is illustrated in Figure 2, and was constructed according to the type observed in Huddleson's laboratory. Earlier the carbon dioxide was produced chemically by adding an acid to a carbonate. This method was also satisfactory.

Through studying the bacteriostatic action of dyes on the *Brucella*, Huddleson (48) has devised a simple and, we believe, accurate test to be used in classifying varieties. The dyes are added to fresh beef liver infusion agar, immediately after the medium has been adjusted to a pH of 6.6. Thionin in a 1:25,000 dilution inhibits the *abortus* but not the *suis* variety. Methyl violet in a 1:100,000 dilution and basic fuchsin in 1:25,000 inhibit *suis* but not *abortus*. The *melitensis* variety grows satisfactorily on all three of these dyes. For the success of this test certified dyes [5] must be obtained and the pH carefully adjusted.

[5] We have used the National Aniline dyes with good results.

True variations in pathogenicity can be determined only by the use of recently isolated strains. For this reason comparative study of the varieties has not been conclusive. Distinct differences between the *abortus* and the *suis* varieties have been demonstrated by Theo. Smith (52), Cotton (53), and others. We have found that guinea pigs infected with the *suis* variety lose weight, appear rough, and not infrequently die, whereas those similarly inoculated with the *abortus* variety often appear quite healthy and may gain weight. Involvment of joints, bones, testes, and marked general enlargement of spleen, liver, and lymph glands usually with abscesses, are common findings in guinea pigs infected with the *suis* variety. Such conditions ordinarily are not found in animals infected with the *abortus* variety. Confusing features, however, are the variations in susceptibility of guinea pigs, and in virulence of the organisms.

An *abortus* strain may occasionally give rise to lesions similar to those produced by a *suis* strain and the converse may be observed; hence a classification on this basis is not absolute.

A difference in utilization of dextrose and nitrogenous compounds has been described by McAlpine (54), (55), (56), and a variation in the amount and rate of hydrogen sulphide production by Huddleson and Abell (57). These will probably not prove of superior value in classifying the varieties. Nonspecific agglutination by heat, acid, and other chemicals, has been advocated by some as a differential test. This has been studied by Ross (58), who was not able to demonstrate its value.

STUDIES OF ORGANISMS ISOLATED FROM IOWA CASES

Brucella has been isolated from the blood stream of 48 patients in Iowa. In one case both the *abortus* and *suis* varieties were obtained from a single culture, thus giving us 49 strains. These have all been typed, including a number repeatedly isolated from the same patients. Our findings, confirmed by Huddleson, on all but a few of the more recent isolated strains, show 35 to be variety *suis* and 14 variety *abortus*.

On a few of the strains isolated early in our work agglutinin absorption tests were performed, and they were thus differentiated from the *melitensis* variety. When our epidemiological studies revealed that goats were not at all concerned in the disease in Iowa, the use of these tests in differentiation was discontinued. Pathogenicity studies were conducted on more than half of the isolated strains with the results indicated above. Of the 14 strains classified as *abortus*, only one strain grew on first subculture in air, the others requiring an increased carbon-dioxide tension. This cultural test and the bacteriostatic action of dyes were found to be of the greatest value in determining types.

We have related these strictly laboratory results to our epidemiological findings because of their significance, and reproduce here some of the important details. In general, it can be said that bovine types have their source in cattle, and porcine in hogs; but there is a fallacy in always assuming this. Eight cultures of the bovine variety were obtained from persons who had no direct contact with livestock, and it was assumed that the source of their infection was raw dairy products. Five others of this variety were from farmers in whose herds of cattle there were histories of abortion. Four of these herds were examined serologically, and in three, all, or a majority of the animals, were positive. One bovine organism was isolated from the operator of a rendering plant. He handled carcasses of cattle and hogs, used pasteurized milk and cream, but country-made butter. One organism of the *abortus* variety which grew on first subculture in air was obtained from a farmer's wife who had no contact with hogs, but who used milk freely from a cow with a history of abortion and a positive serum reaction.

Ten cultures of the *suis* variety were obtained from employees of packing plants who handled hog carcasses only. Certainly seven, and possibly all, of these men either used pasteurized milk and cream or none at all. Twenty cultures were from farmers or farmers' sons, all but one of whom had repeated contact with hogs. In five of these instances the hogs were serologically positive, and the cattle negative; in two instances both hogs and cattle were positive; in one case the hogs were negative and the cattle positive; in five cases the hogs were unexamined, while the cattle were negative in four herds, and positive in one. In six herds there were no serological examinations; in the one case of "no contact," the cattle were examined but gave only doubtful reactions.

Four cultures of the *suis* variety were obtained from farmers' wives. In the family of one of these the two male members of the family had had undulant fever, and both the cattle and hogs on the farm were found to be infected. In a second case the attending physician reported that the infection probably came from a herd of aborting hogs. The remaining two, an early and a late case, have not been investigated epidemiologically. The findings of laboratory and field studies for the most part run parallel, though in an occasional case infection seemed to have passed from hogs to cattle, and thence to man. That this may occur has been demonstrated by the fact that Huddleson (48) has isolated the porcine organism from cattle.

Though we are convinced that laboratory studies can accurately differentiate the varieties of *Brucella* the probable source of all infections must not be deduced from these alone, for two reasons: First, the *suis* organism may find its way to man through cattle; second, the *abortus* variety is relatively difficult to isolate. From 26 of our recent cases the first blood cultures, even after prolonged incubation, have failed to yield any organisms. A later culture from one of these patients, the source of whose infection was apparently in hogs, yielded a *suis* variety. In four others no opinion could be expressed as to the probable source; but in 21, epidemiological studies incriminated cattle. Here the following observation of Burnet (59) is of interest. "In goats infected with the *melitensis* variety, positive blood cultures are readily obtained (17 of 26 cultures on 11 goats), whereas from the *abortus* infected animal they are rarely obtained (1 of 26 cultures on 6 goats)." Our own observations show that human infections traced to hogs usually yield positive cultures, while those traced to cattle do so infrequently.

For reasons which will be obvious when the epidemiological data are considered, our findings do not coincide with those reported from other States and other countries. Kristensen (60) isolated 34 organisms from his cases in Denmark, but found none with porcine characteristics. Carpenter and King (61), Orr and Huddleson (62), and Simpson (63) have each expressed the opinion that the bovine type was chiefly concerned. Others have expressed the opinion that the *suis* variety alone is of danger to human beings. We, ourselves, are forced to the conclusion that both varieties are involved; and, in Iowa at least, our impression is that the *abortus* and *suis* varieties are about equally responsible for the undulant fever morbidity.

RELATIVE PATHOGENICITY FOR MAN

The *melitensis* and *suis* varieties of *Brucella* have been generally accepted as pathogenic for man, but there is still some question concerning the *abortus* variety. On account of the repeated isolation of this strain from persons suffering with undulant fever, it has become of importance to examine carefully the evidence presented. There is some ground for belief that the organism is only slightly infectious, possibly even nonpathogenic "except perhaps under unusual conditions still to be defined" (Theo. Smith (52)). "Our study of the disease shows clearly that *Br. abortus* is only slightly pathogenic for man and it must be that only the most virulent strains in milk are of danger to him," is the conclusion of Carpenter and King (61). Of the infection in Michigan, Orr and Huddleson (62) write: "This study reveals the fact that in a group of 500 individuals, equally divided into males and females, of all age groups, constantly exposed to the *abortus* organism through an infected milk supply, only 1.4 per cent showed evidence of infection with this organism and only 0.8 per cent showed any evidence of active infection. These results would indicate that among the human population susceptibility to infection with *Br. abortus*, bovine type, is very low, and that human infection is determined by some factor or factors as yet undetermined.

The low human susceptibility is, no doubt, responsible for the relatively low incidence of undulant fever."

We have commonly met with just such conclusions in the literature, and in conversation, as the result of both casual and detailed observations in practice or investigation. There are also reports of experiments in which individuals have been deliberately inoculated without developing undulant fever. Nicolle, Burnet, and Conseil (64) gave, by subcutaneous injection to five individuals, large doses of living *Br. melitensis* var. *abortus* and no clinical evidence of infection resulted. Burnet (65) even suggested that this living strain be used as a vaccine against infection with the *melitensis* variety. Otero (66), in Porto Rico, recently employed five volunteers to ingest in milk the 48-hour growth from one or more agar slants of *Br. melitensis* var. *abortus*. Two others similarly received *Br. melitensis* var. *suis*. In the first five no evidence of infection appeared, while in the latter two both clinical and laboratory evidence demonstrated undulant fever. Negative findings in this experiment can, however, be given little weight, as most, if not all, of the *abortus* strains had been carried on artificial media for a long period. In judging results of such experiments, the virulence of the strain used must be considered, as well as that of individual resistence—a factor scarcely measurable.

Similar experiments have been conducted by Huddleson (67) on monkeys. He found the *suis* variety produced a severe disease with rapid loss of weight and a fatal termination. The *abortus* variety gave rise to a mild infection, the animals showing few signs of disease and rapidly recovering. The *melitensis* variety he found to be less pathogenic than the *suis*. These results may at least suggest what occurs in human individuals.

We have examined from many angles the clinical records of Iowa patients from whom *Brucella* has been isolated, in an endeavor to determine the relative virulence of the two (*abortus* and *suis*) varieties for man. Those patients from whom an organism has been isolated have been divided, according to the severity and duration of their symptoms, into four categories, as follows: (I) Fatal; (II) severe or moderately severe; (III) mild; (IV) ambulatory. From each of three fatal cases a *suis* variety was isolated—from one of them, an *abortus* as well. From the 28 in the second category, 23 *suis* and 5 *abortus* cultures were obtained. The mild cases yielded 4 *suis* and 3 *abortus*, and the ambulatory 3 *suis* and 5 *abortus* strains. Thus 8 of the 14 *abortus* strains were derived from mild and ambulatory infections, while 26 of the 33 *suis* strains were from severe or fatal cases.

Further, we have classified the information pertaining to those patients who apparently derived their infection from one definite source—either cattle or hogs. This group includes the following:

(1) Those persons who had no direct contact with livestock but used raw dairy products; (2) the employees in packing houses whose contact was only with hogs and who used pasteurized dairy products exclusively, or chiefly; (3) those farmers whose stock had been examined and in which the infection was confined to either cattle or hogs. (In making deductions from these data some infrequent errors have perhaps occurred, but not of sufficient weight to influence our conclusions.)

Among the cases in this last group the source of which was attributable to hogs, 2 were fatal cases, 19 severe or moderately severe, 5 mild, and 8 ambulatory. Among those the source of which was attributable to cattle, 1 was fatal, 33 were severe or moderately severe, 36 mild, and 25 ambulatory. Presenting this in another way, 70 per cent of the infections known or presumed to be caused by the *suis* variety were moderately severe, severe, or fatal, and 30 per cent were mild or ambulatory; of those known or presumed to be caused by the *abortus* variety, 36 per cent were moderately severe, severe, or fatal, 36 per cent were mild, and 28 per cent ambulatory. We are able to say, then, that infections of *Br. melitensis* var. *suis* tend to be more severe than those of *Br. melitensis* var. *abortus*, though in individual cases one can not tell from clinical characteristics which variety might be involved. There are not, in human beings, as was found by Huddleson (67) in monkeys, constant differences in the degree of severity. Questions as to whether or not all strains of these varieties are pathogenic for man, and as to why strains of these organisms differ in virulence, remain as yet unanswered.

BACTERIOLOGICAL PROCEDURES

In the bacteriological study of *Brucella* infections certain modifications of the general technique of blood, urine, and stool cultures must be followed. These are here briefly noted.

Blood cultures.—Prolonged incubation is of first importance. Broth cultures occasionally reveal growth on the fourth day, if a subculture is made; but it may be the third or fourth week before the organisms have multiplied sufficiently to be evident if subcultures are not made. Particularly is this true if the *abortus* variety is involved. We have adopted and recommend the plan of incubating broth cultures for four weeks with subcultures at semiweekly intervals, before finally reporting "no growth."

Emphasis is also given to the necessity of modifying the atmosphere by increasing the carbon-dioxide content to approximately 10 per cent. This is particularly essential for the first subculture, as scarcely any strains of the *abortus* variety will begin their growth on solid media in an ordinary atmosphere, though they may grow slowly in broth. The *suis* variety, on the other hand, grows more luxuriantly in air. All subcultures, therefore, should be made in duplicate, one to be incubated in air, the other in a sealed jar containing 10 per cent carbon dioxide by volume. In hospital laboratories it is recommended that two blood cultures be taken, in broth, from the patient, so that the double incubation process may be carried out.

The *Brucellae* may be grown successfully in various enriched media. We have found fresh beef liver infusion broth and agar, with a pH of 6.6, most satisfactory (Huddleson (68)).

As only a small percentage of persons with undulant fever are cared for in hospitals, and as much additional information concerning the infection is obtained in the study of isolated organisms, a procedure for hæmoculture which may be used by general practitioners or in field studies is of much practical importance. For this purpose, we

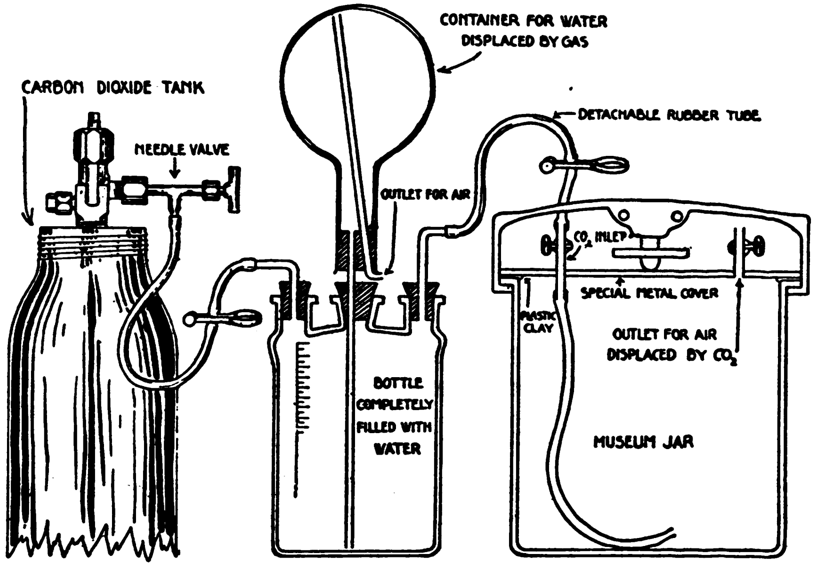

FIGURE 2.—Apparatus used in obtaining an atmosphere with carbon dioxide approximately 10 per cent by volume

supply media in tall thick glass bottles—the commercial oil sample bottles are cheap and satisfactory—equipped with a rubber stopper having a collar which fits snugly over the expanded rim of the bottle. It is the practice to send this blood culture outfit to the physician with the first positive report on an agglutination test. Directions as to inoculation are supplied—10 cubic centimeters of blood to be collected and inoculated into the medium under strict aseptic precautions. If possible, the culture is to be incubated for four to five days before it is shipped to the laboratory for study. This may be done in a near-by hospital or in a private laboratory; chicken incubators have also been used. After the culture has been received at the laboratory, subcultures are made as outlined above. The preliminary period of incubation before shipping the cultures is quite important; in our earlier work when this was not done, cultures rarely yielded positive findings. The chief drawback in the method is that an unduly high proportion of the cultures taken by general practitioners show on first subcultures a growth of some common contaminant. The proportion of positive findings does, however, justify this attempt to obtain at least one culture from each person infected. In the field investigation of cases we have obtained blood cultures which were handled as described above, and in addition, have inoculated guinea pigs with whole blood from the patient. We believe the latter to be the method of choice, if one can not begin the incubation of a culture within a few hours.

The isolation of organisms from the clots of blood sent for agglutination tests was also attempted. While others have reported success, our results were uniformly negative. Guinea pigs inoculated with the clots of 35 blood specimens giving positive serum agglutination of *Brucella*, failed in every instance to develop infection, though from some of the patients, positive blood cultures were obtained later by the method which has been described.

Urine cultures.—We have made some attempts at isolating the organism from urine, but without positive results. A specimen, obtained by catheter, may be centrifugated or agglutinated (Amoss (69)) to procure a sediment, which should be inoculated on solid medium. Guinea pig inoculation should produce a higher proportion of positive results.

Stool cultures.—The method used for the isolation of *Brucella* from feces is described by Amoss and Poston (69). To a dilute suspension of feces from which the coarser particles have been removed, there is added an amount of positive immune serum adequate to produce agglutination. After two hours' incubation the clumps are thrown down by centrifugation. The sediment is washed in saline solution three or more times and inoculation is then made on solid medium. The eosin-methylene blue medium as used in the isolation of *B. typhosus* was adovcated, but we found that few of our strains of *Brucella* would grow on it. By the addition of fresh beef liver infusion and the adjusting of the pH to 6.6, growth is usually obtained. A similar observation has been reported by Otero (66). Growth appears in 72 hours as very small translucent colonies. These may be picked to other media and further studied.

Guinea pig inoculation.—The isolation of *Brucella* is often possible only through animal inoculation, guinea pigs being most satisfactory. Whole blood may be given intraperitoneally, while sputum or the sediment from urine or feces is best injected subcutaneously in the groin. The organism may be isolated from milk by injecting 2.5 cubic centimeters of the naturally separated cream subcutaneously in each groin. An agglutination test may be performed after four weeks on serum separated from blood removed from the test animal by intracardiac puncture. Positive animals are sacrificed between the sixth and eighth weeks. With aseptic precautions, the spleen, liver, and any enlarged lymph glands are removed. If the cut surface of these organs is smeared on solid media, growth of *Brucella* usually results. If one animal only has been infected, or if from the first of two the organism was not isolated, a portion of macerated spleen is injected into two other pigs. In this way positive results are almost invariably obtained.

SEROLOGICAL PROCEDURES

The test for agglutinins for *Brucella* in body fluids is now generally used as an aid in determining the presence or absence of infection. In checking the findings of other laboratories, we have occasionally encountered marked discrepancies in agglutination titers as determined by the usual test. Certain conditions must obtain in order to secure comparable and consistent results. A discussion of these with comments on common sources of error, follows:

Variation in the agglutinability of different strains of *Brucella* has been suggested as a possible explanation for discrepancies in findings. We tested 46 of our strains, including both *abortus* and *suis* varieties, using a pooled bovine and one porcine serum, and found no variations in the titer of more than one serum dilution, a difference within the limits of experimental error. Moreover, we were unable to detect any difference relative to the specific variety of antigen or antisera. In testing sera from patients, using a variety *melitensis* antigen, we observed slightly lower titers than were obtained when the *abortus* or *suis* antigen was used. Even here, however, the differences were inconstant and slight, rarely more than one dilution in the series. Occasionally we encountered a recently isolated strain which resisted agglutination until after the fourth subculture; but excluding these, there has been no significant difference in the agglutination titer which has been due to variations in the agglutinability of the organism used in the preparation of the antigen.

Differences in the density of the antigen used do, however, often explain discrepancies in findings. As an experiment, take a moderately concentrated antigen and dilute this in series so that each dilution is but one-half the density of the previous one in the series. Then, using one serum, set up an agglutination test with each of these dilutions of antigen. The following is one of our protocols recording only complete agglutinations:

Density of antigen:	Agglutination titer
2,000 parts per million	1:80
1,000 parts per million	1:160
500 parts per million	1:320
250 parts per million	1:640
125 parts per million	1:1280

One observes, therefore, that within certain limits, doubling the dilution of the antigen, doubles the final titer.

In measuring density of the antigen the method generally adopted is the comparison of the suspension with one of the turbidity standards. We have used as a standard the one described in the "Standard Methods of Water Analysis." The McFarlane nephalometer is similar, but the opaque substance used is barium sulphate, not Fullers' earth. Since in the employment of these standards, turbidity can only be estimated and not accurately measured, we have attributed slight variations in agglutination titer as being dependent on inaccuracies in adjusting the density of the antigen. Six different dilutions of a stock antigen were made by two of us and tests set up, using one serum with these 12 dilutions of antigen. Observing complete agglutination alone, all titers were identical; and reading partial agglutination there was slight variation only. This method of estimating the density of antigens, has, therefore, been satisfactory. If agglutination tests are read at intervals, one finds that there is a progressive increase in titer up to about 48 hours. The rapidity of agglutination varies with different sera, and this increase in titer from 2 to 48 hours may be slight or it may be marked. To obtain consistent results the same interval must be allowed.

In the incubation of tests, different temperatures have been used by different workers. Sera have also been examined after inactivation and without inactivation. Any variation in titers dependent on these differences in procedure we have found to be slight and inconstant. Tests of unheated sera, incubated at a temperature of 37° C. often give slightly higher titers than do corresponding inactivated sera similarly examined, but complete agglutination in low titers (1:5 to 1:20) is frequently revealed by the inactivated sera only. Tests incubated at 56° give final titers which closely parallel those on inactivated sera incubated at 37° C.

The influence of different preservatives on the agglutinability of *Brucella* has been studied by Huddleson (70). Tricresol 0.1 per cent and formalin in concentrations higher than 0.5 per cent somewhat inhibited agglutination, while neither phenol, formalin, nor ether in concentrations below 0.5 per cent caused inhibition.

Occasionally a marked zone phenomenon is observed. Serum in dilutions of 1:80 or even 1:160 may show no agglutination, while in higher dilutions clear-cut reactions may occur. To avoid errors, therefore, sera must be examined in high as well as in low dilutions.

In connection with the work of the committee on contagious abortion of the National Research Council, one of us (A. V. H.) obtained data from most of the State laboratories concerning the procedure routinely used in performing agglutination tests for undulant fever. Antigens were also submitted to us for study. Wide differences were found; for example, the densities of the antigens ranged from well under 100 parts per million to 1,000 parts per million, and the period of incubation of the tests varied from 2 to 48 hours. The titers obtained when these different procedures were followed were, as expected, also variable. Using the same serum for all, one antigen failed to show agglutination except in low dilutions; but omitting this one the low titer was 1:320, the high 1:5120. Most, however, were in the range of 1:320 to 1:1280. To obtain comparable or even reliable results this serological procedure should be carried out according to one standard. We feel that there should be general agreement on certain points, as follows: (1) The final density of the antigen in the test should be 500 parts per million; (2) the reading should be recorded after 24 hours, preferably 4 hours of incubation at 37° C. and 16 hours in the refrigerator at from 5° to 10° C.; (3) in reporting a maximum titer only complete or almost complete agglutination should be read.

Other serological procedures are sometimes used. The microscopic agglutination test, performed on dried blood specimens, is often used as a qualitative test. The rapid method of Huddleson (71) is a simple procedure, particularly useful where large numbers of sera must be examined. Complement fixation has been used by Kristensen (60), who found its chief value to be in checking agglutination findings. The results of the tests were not strictly parallel, as some sera strongly positive by the agglutination test were negative by complement fixation, and vice versa.

SIGNIFICANCE OF BRUCELLA AGGLUTININS IN HUMAN SERA

Many workers in different localities have sought light on the significance of *Brucella* agglutinins in human sera by a study of the blood samples submitted for the Wassermann test. Unfortunately, wide variations in technique prohibit a successful comparison of results. In our laboratories a similar study has included the following groups of specimens: (1) Routine Wassermann sera; (2) a series of Wassermann specimens sent to us from the Chicago laboratories through the kindness of Doctor Tonney; (3) all samples sent to us for the Widal test; (4) the sera of 120 apparently healthy Iowa veterinarians; (5) sera from more than 200 packing-house employees; and (6) 138 samples collected at random from inmates of the Iowa tuberculosis sanitarium, the milk supply of which is from a herd known to be heavily infected with *Brucella*. Our observations are shown in Table 1, which is taken in part from the thesis of Miss Thelma DeCapito, whose work was conducted in our laboratories. In reading the tests, only complete or almost complete agglutination was considered.

TABLE 1.—*Brucella agglutinins in the sera of selected groups*

Source of sera	Iowa				Chicago		Iowa					
	Routine Wassermann		Routine Widals, excluding sera from patients found to have undulant fever		Routine Wassermann		Apparently healthy veterinarians		Inmates of tuberculosis sanitorium who used freely raw milk from infected cows		Apparently healthy packing-house employees	
Titer	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Negatives	573	57.3	212	62.4	357	90.4	84	70.0	225	70.3	150	69.0
1:5	194	19.4	44	12.9	23	5.8	6	5.0	32	10.0	----	----
1:10	130	13.0	65	19.1	9	2.3	16	13.3	32	10.0	10	4.6
1:20	90	9.0	15	4.4	6	1.5	9	7.5	11	3.4	17	8.0
1:40	11	1.1	4	1.2	0	0	5	4.2	10	3.1	10	4.6
1:80	1	.1	0	0	0	0	0	0	1	.3	5	2.3
1:160	1	.1	0	0	0	0	0	0	5	1.6	10	4.6
1:320	0	0	0	0	0	0	0	0	3	1.0	6	2.8
1:640	0	0	0	0	0	0	0	0	1	.3	4	1.8
1:1280	0	0	0	0	0	0	0	0	0	0	2	1.0
1:2500	0	0	0	0	0	0	0	0	0	0	3	1.3
Total	1,000	100.0	340	100.0	395	100.0	120	100.0	320	100.0	217	100.0

The high proportion of positive sera from persons in Iowa is apparent. Those exposed through the ingestion of large amounts of raw milk from infected cows and those who handle fresh pork showed the highest titers. The veterinarians showed slightly higher titers than the general population. That subclinical or very mild infections were responsible for the higher titers among the groups seems indisputable, since an organism of the *abortus* variety was isolated from the blood stream of such an individual (a patient at the sanitarium) showing no clinical signs of undulant fever.

Since our first report (72) of a study of employees of packing houses we have had opportunity to examine specimens from 33 men, working in a plant which handled cattle as well as hogs. One only (3 per cent) showed agglutination in a titer above 1:80.

Contact, using this term in its broadest sense, with living *Brucella* seems responsible for the low titers found; we think it probable that a generalized infection ordinarily produces agglutination in high titer (1:80 or higher). Carpenter, Boak, and Chapman (73) have concluded, as the result of definite purposeful experiments, that abortus agglutinins are not passively absorbed through the gastrointestinal tract, but are actively produced following invasion of the tissues by the organism. It seems probable that *Brucella* may establish itself in some *locus* in the human body, and stimulate antibody production apart from any manifestation of disease.

The question of the persistence of agglutinins in the blood stream after an attack of fever is an interesting one. We have examined blood sera from 45 of our patients, collected 12 or more months after the illness had been first diagnosed. Of these, 15 failed to show any agglutination in dilutions above 1:20. In five other cases the sera became negative in from three to nine months. Thirty still showed agglutinins in titers of 1:40 or higher after 12 months, but in 29 of these the findings indicated a marked reduction of titer. The thirtieth was a case of prolonged infection. Three men have had persisting titers of 1:80 and 1:160 for several months; but two of these were packing-house employees and reinfection may have occurred. On the whole, the tendency seems to be for specific agglutinins to disappear rapidly following clinical recovery from undulant fever.

Cases of febrile illnesses resembling undulant fever, but lacking *Brucella* agglutinins, have been reported. Indeed, Carpenter, Boak, and Chapman (73) record three such cases from which they isolated the *abortus* organism and at least one suffered from typical undulant fever. We have had little opportunity to study cases of this nature, though a few have been observed. Possibly here the complement fixation test or the skin test might be of value, especially if repeated agglutination tests at various time intervals continue to be negative.

In the clinical interpretation of agglutination findings, therefore, one must bear in mind these facts: (1) Mild or subclinical *Brucella* infection with production of agglutinins does occur, at times associated with other diseases; (2) specific agglutinins may sometimes persist in the blood stream for more than one year after clinical recovery from undulant fever; (3) infection, even severe infection may occasionally occur without any production of demonstrable agglutinins. In general, however, we believe the following interpretation holds: Titers below 1:40 are of slight clinical significance; 1:40, of doubtful significance; 1:80, weakly positive; 1:160 and 1:320, positive; 1:640 and above, strongly positive.

IV. BRUCELLA ABORTUS INFECTION IN ANIMALS

A STUDY OF HERDS IN IOWA

The general nature of the disease in guinea pigs produced by the *abortus* and *suis* varieties of *Br. melitensis* has already been mentioned. The gross changes and the microscopic lesions are shown in Figures 3 to 8.

The nature of the infection in domestic animals is here discussed, since a better understanding of the epidemiology of undulant fever may thereby be obtained. The pathologic findings and related signs have been summarized and are shown in Figure 9. Little study has as yet been given to hogs; but from our epidemiological data we are led to believe that in these animals the infection is disseminated and that the organisms are excreted in the urine and probably also in the feces. These assumptions are as yet lacking proof.

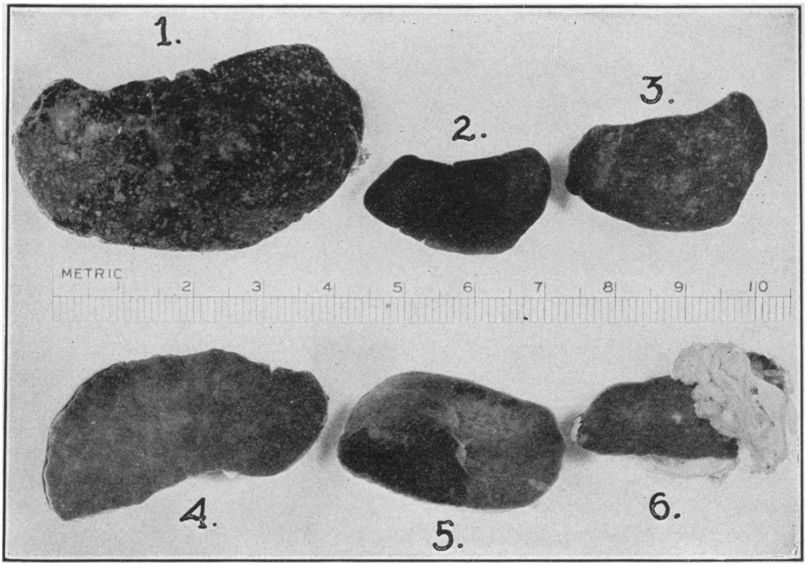

FIGURE 3.—Gross lesions in the spleen of guinea pigs infected with *Brucella*. (Pigs were between 400 and 600 grams in weight and were killed during the sixth, seventh, or eighth week of the disease.) The infections were caused by the following organisms: 1, *Br. melitensis* var. *suis*, strain S, human origin; 2, spleen of uninfected pig; 3, *Br. melitensis* var. *abortus*, strain P, human origin; 4, *Br. melitensis* var. *abortus*, strain from cow; 5, *Br. melitensis* var. *suis*, strain K, human origin; 6, *Br. melitensis* var. *suis*, strain S, human origin

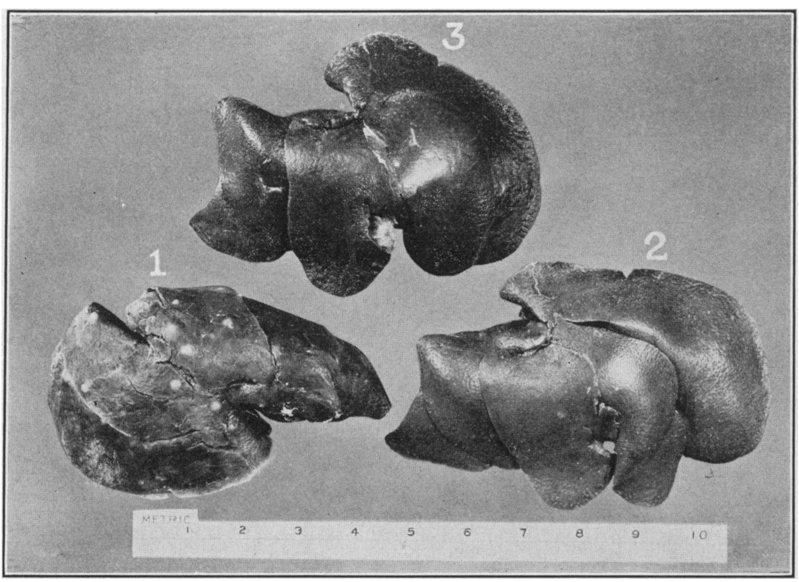

FIGURE 4.—Gross lesions in the livers of guinea pigs infected with *Brucella*. (The animals were similar in size and were killed at a similar period of the disease.) Nos. 1 and 2 were both infected with var. *suis*, strain S, of human origin. One showed large abscesses, but in the other there were only a very few small ones. No. 3 was from an animal infected with the *abortus* variety, and showed only microscopic lesions

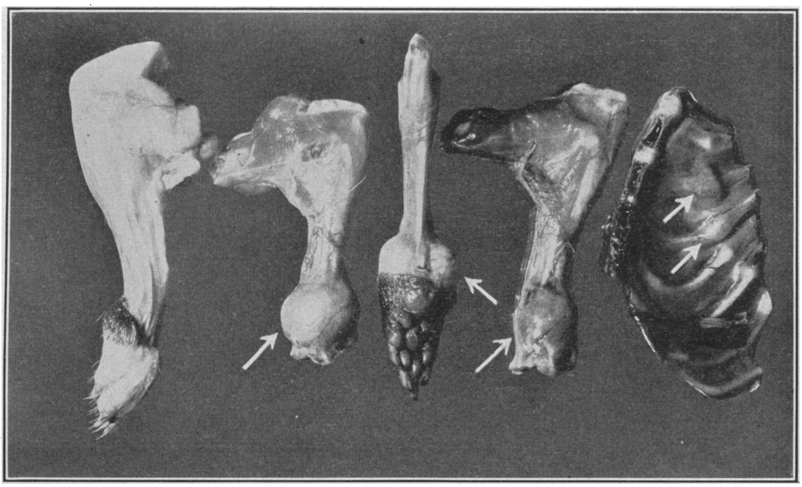

FIGURE 5.—Joint lesions characteristic of *Br. melitensis* var. *suis* infection in guinea pigs

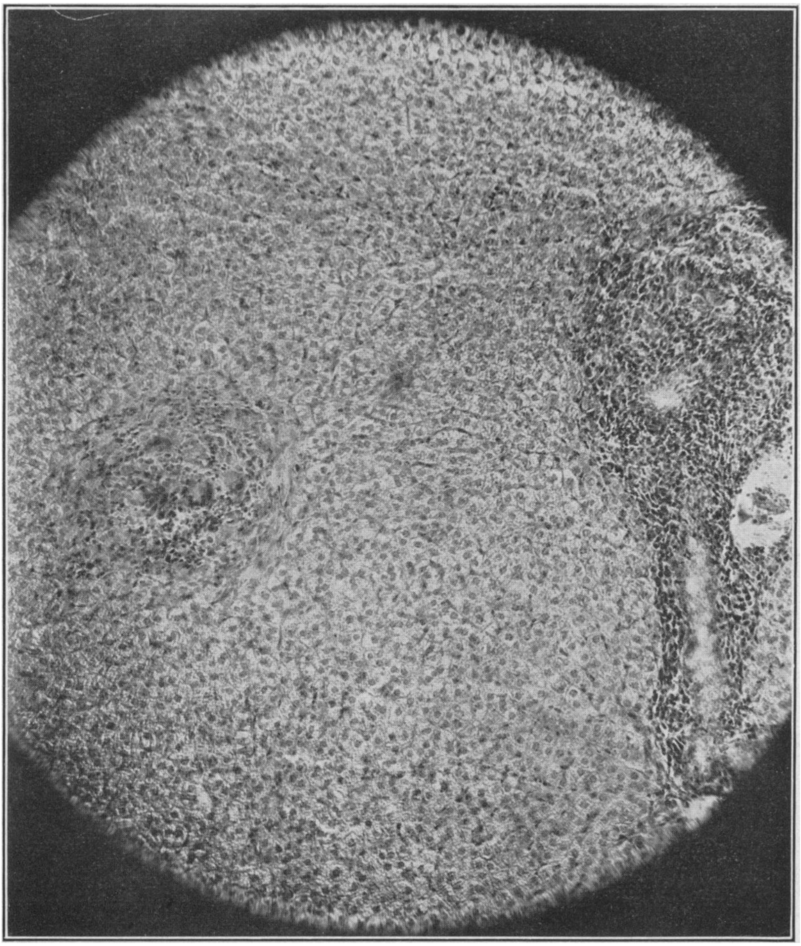

FIGURE 6.—A "tubercle" in the liver of a guinea pig infected with *Brucella*

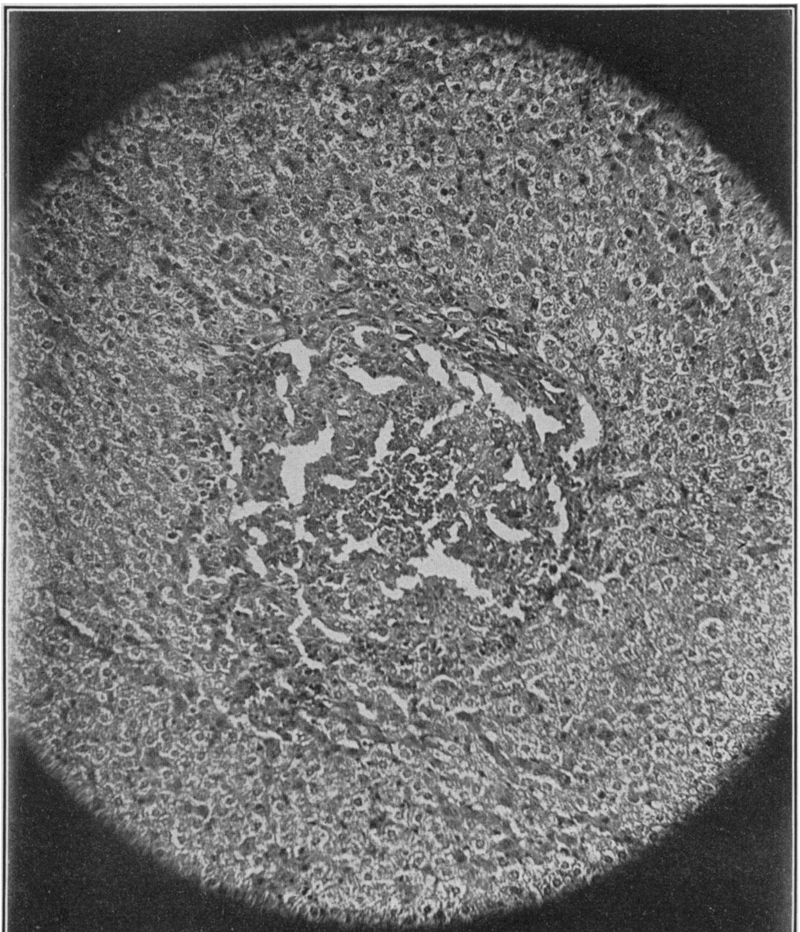

FIGURE 7.—Microscopic abscess in the liver of a guinea pig infected with *Brucella*

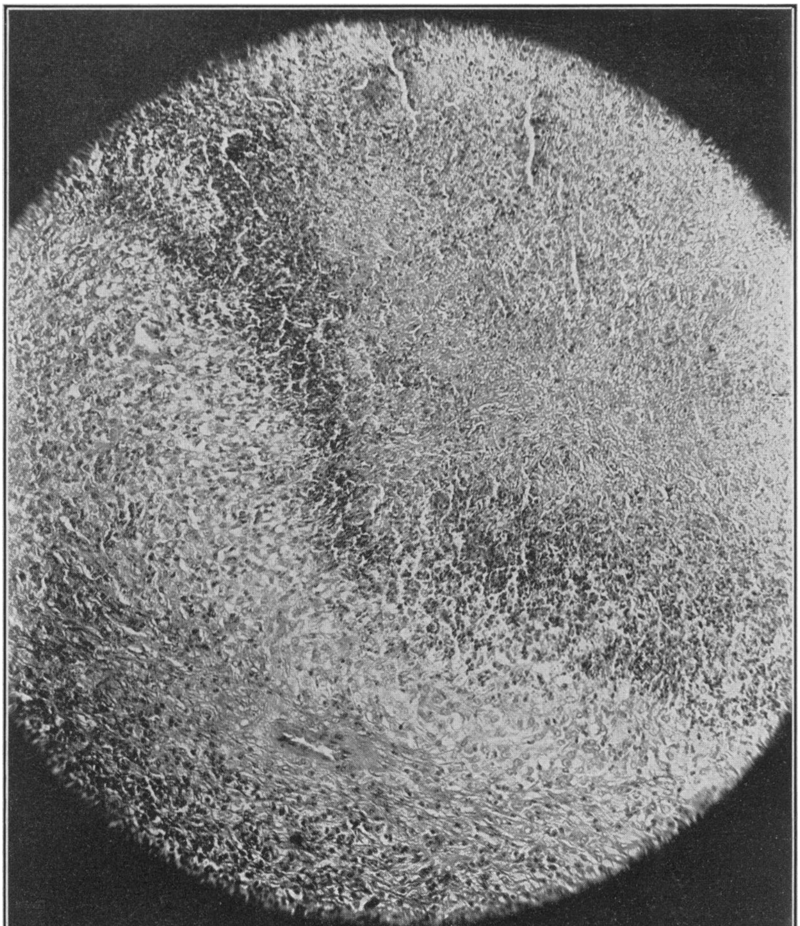

FIGURE 8.—Large abscess in the spleen of a guinea pig infected with *Brucella*

In connection with our study of the possible sources of infection, we have obtained data on 164 herds of cattle and 120 herds of hogs. We have also examined serologically 1,300 cattle from 123 herds and 611 hogs from 60 herds. A majority of these animals have also been tested by Dr. Chas. Murray, professor of veterinary investigation of Iowa State College, Ames, Iowa, and his staff. The findings in the two laboratories have been compared and notable discrepancies checked. Throughout, the titers in our laboratory have been somewhat lower than those obtained by Doctor Murray, due presumably to the more dilute antigen used at Ames. The herd histories were obtained at the time of the epidemiological investigation. On cattle, information was sought concerning abortions, retained placentæ, sterility, and calves dying shortly after birth; on hogs, concerning abortions, sterility, the birth of undeveloped dead pigs with litters, and the occurrence of an undue number of small litters. Multiple abortions in

DOMESTIC ANIMALS

FINDINGS	RELATED SIGNS
PREGNANT UTERUS CHORINITIS / PLACENTITIS / ENDOMETRITIS — LOCALIZED TO EXTENSIVE — ACUTE, SUBACUTE OR CHRONIC	ABORTIONS, PREMATURE BIRTHS RETAINED PLACENTAE, STERILITY, OR COMPLETE ABSENCE OF ALL SIGNS
UDDER CHRONIC INFLAMMATORY FOCI OF MICROSCOPIC SIZE	LABORATORY SIGNS ORGANISMS PRESENT IN THE MILK AND AN INCREASE IN THE CELL COUNT
OTHER ORGANS NO LESIONS IN THE GROSS	ORGANISMS IN SOME ANIMALS EXCRETED IN THE URINE

FIGURE 9.—Summary of pathologic findings and related signs of *Brucella* infection in domestic animals

large herds or a single abortion in a small herd, of either cows or sows, was regarded, for purposes of tabulation, as a positive herd history. The other signs, unaccompanied by abortion, were regarded as constituting a suspicious herd history. The absence of any of these signs was accepted as a negative herd history. In some instances we failed to obtain or record any details of the herd history. This is especially true of the hogs, since earlier in the study particular attention was given to cattle.

TABLE 2.—*Comparison of herd histories of cattle with the serological findings*

History	Serologically positive	Serologically suspicious	Serologically negative	No serological examination	Total
Positive	48	3	5	23	79
Suspicious	14	7	13	4	38
Negative	13	4	13	14	44
Unrecorded	3	0	0	---------	3
Total	78	14	31	41	164

TABLE 3.—*Comparison of herd histories of hogs with the serological findings*

History	Serologically positive	Serologically suspicious	Serologically negative	No serological examination	Total
Positive	11	3	3	17	34
Suspicious	3	6	0	7	16
Negative	8	8	14	36	66
Unrecorded	2	0	2	----------	4
Total	24	17	19	60	120

In Tables 2 and 3 are shown comparisons of the herd history and the serological findings. When one or more specimens gave complete agglutination in 1:40 dilution but not higher, the herd was classified as suspicious serologically. If the titer was 1:80 or higher, the herd was regarded as positive serologically. Only in the later work have we insisted on the procuring of blood specimens from hogs. Veterinarians are accustomed to drawing blood from cattle; but they frequently omitted collecting porcine blood, because of the difficulty of restraining these animals, or because of lack of cooperation on the part of the farmer. In some instances the hogs had already been sold. For these reasons, the information regarding hogs is less extensive than that regarding cattle. It is felt, however, that the data show clearly the unreliability of herd histories of hogs, as a means of detecting *Brucella* infection. Sixteen herds with completely negative histories were found to be either positive or suspicious serologically. In only 11 of the 24 herds which showed positive reactors was the history positive (two herd histories were unrecorded). The suspicious or positive histories must, however, be given much weight, since but three herds in this group gave negative serological findings. Negative herd histories of cattle may also be misleading, particularly where the past history of all the herd is not known, as for example, where animals have been recently purchased. Positive histories here may also be given much weight, while suspicious histories are rather unreliable.

The proportion of positive animals in individual herds was found to be variable. In some small herds all were infected and in several large herds no more than one animal was serologically positive. Of the total of 1,300 cattle, 339 (26 per cent) were positive, 105 (8 per cent) doubtful, and 856 (66 per cent) negative; and of the 611 hogs, 109 (18 per cent) were positive, 96 (16 per cent) doubtful, and 406 (66 per cent) negative. One is particularly impressed with the relatively large number of hog specimens reacting in a suspicious or doubtful titer only. It may be mentioned that a goodly proportion of these doubtful hog specimens were classified as positive by Doctor Murray.

Additional observations are necessary in order to determine the true significance of these doubtful reactions.

In determining the presence or absence of infection in a herd the history is of value; but on account of the fact that a single infected animal so often displays no clinical signs of disease, only laboratory procedures are of avail in finding the status in regard to *Brucella* infection of individuals in the herd. For practical purposes the agglutination test is reliable, although animals occasionally harbor *Brucella* without showing agglutinins.

The actual incidence of infection among domestic livestock is unknown, though various estimates have been offered by different workers. Among cattle, contagious abortion is recognized as being widespread, involving, as has been reported, as high as 80 to 90 per cent of the herds in some localities. Little attention has heretofore been given to the infection among hogs, since the economic loss through abortion is not great, but certainly in Iowa the disease is not of infrequent occurrence. Attention has recently been called by Fitch (74) to an unusual manifestation of this infection in horses, and by Huddleson (75) to the fact that chickens are susceptible. We have examined one bitch which aborted, and found her infected. In seeking the source of *Brucella* infection in human beings, therefore, one can not confine his attention to one species of domestic animals.

Particular emphasis has been given by others to the excretion of *Brucella* in the milk of infected cows. The organism can not be isolated from all which show positive serum agglutination. Schroeder and Cotton (42) isolated *Br. abortus* from 83.5 per cent of serologically positive cows, and Carpenter (76) from 66 per cent of those which had either aborted or had retained placenta at least once during the three previous gestations. However, the organisms are rarely found in more than small numbers—a contrast to the condition in infected goats, whose milk is often heavily contaminated. In mixed milk from one or more herds having some infected animals, the factor of dilution must be of importance in reducing the danger to the consumer of such milk in the raw state.

V. EPIDEMIOLOGY

GENERAL

The factors which determine the transmission of a particular disease from animal to man are dependent, in different localities, on (1) the incidence of the infection among animals, and (2) the degree of man's exposure, either direct or indirect. Variations in the habits and occupations of the people and their relation to animal industries, provide different contacts. For these reasons epidemiological studies on the same disease in different States or countries may bring different facts to light. Herein lies the value of intensive local studies, as each may make a contribution to the general knowledge, which of necessity must be compounded of fragments gathered here and there. From the study reported here it is obvious that our error would have been tremendous, had we been content to assume that those factors which operated in the transmission of undulant fever on the island of Malta were solely responsible here. Also, had we only the findings of Kristensen in Denmark or even of Simpson in Ohio to rely upon, the source of many of our cases would remain obscure. These facts should stimulate independent studies of *Brucella* infection in all parts of the country, particularly as so much valuable material is at hand, and so many phenomena relating to the disease are as yet not clear. We present, in order, the findings in the State of Iowa; a summary of the findings from other States as far as they are available; and a review of the work of Kristensen in Denmark. .

EPIDEMIOLOGICAL FINDINGS IN IOWA

A preliminary report on this subject has been presented by one of us (A. V. H. (77)). Since it was submitted we have collected data on nearly 300 additional cases, this report being based on a total of 375 patients. From time to time tabulations have been made with quite consistent findings. We feel, therefore, that on many points we have an accurate knowledge of the situation in Iowa. Other aspects, however, call for additional study. Some of the later findings have already been mentioned in another paper (78), but we shall here present a summary of all the epidemiological data relative to this State.

Iowa is primarily an agricultural State, although but 42.5 per cent of the population live on farms. The chief animal industry is hog raising, in which Iowa leads all other States. Within the State are large packing plants, some handling hogs exclusively. Dairying is also an important industry. There are very few goats in the State, and herds of sheep are quite scattered. It is known that *Brucella* infection is widespread in Iowa in both cattle and hogs, but the actual incidence has not been determined. Infection among goats has never been reported or detected in Iowa and we have no definite evidence that sheep are involved. Pasteurization of public milk supplies has not been widely adopted in the State; only in the two largest cities is more than 50 per cent of the milk and cream pasteurized. In the smaller cities and towns the use of raw milk is the rule. It is required that all cream used in the commercial manufacture of butter be pasteurized, and this is usually performed at a higher temperature than is used for other dairy products. From these facts it is apparent that an investigation of *Brucella* infection in this State offers an unusual opportunity to study comparatively the bovine and porcine types of disease, and their transmission from animals to man.

Our procedure in conducting the investigation in Iowa has already been detailed. We are confident that we have records of nearly all of the cases in the State in which a diagnosis of undulant fever has been substantiated by laboratory findings. On recent, as well as on a few of the early cases, our data are incomplete; but for these we are including and presenting such information as we have.

In the study of the animals we are particularly indebted to Dr. P. Malcolm, chief of the bureau of animal industry of the State department of agriculture, and Dr. Charles Murray, professor of veterinary investigation at Iowa State College.

Prevalence.—The number of recognized cases of undulant fever has continued to increase. The first case was diagnosed by Woodward (79) in 1926. In 1927 there were 42 cases; in 1928, 120; in

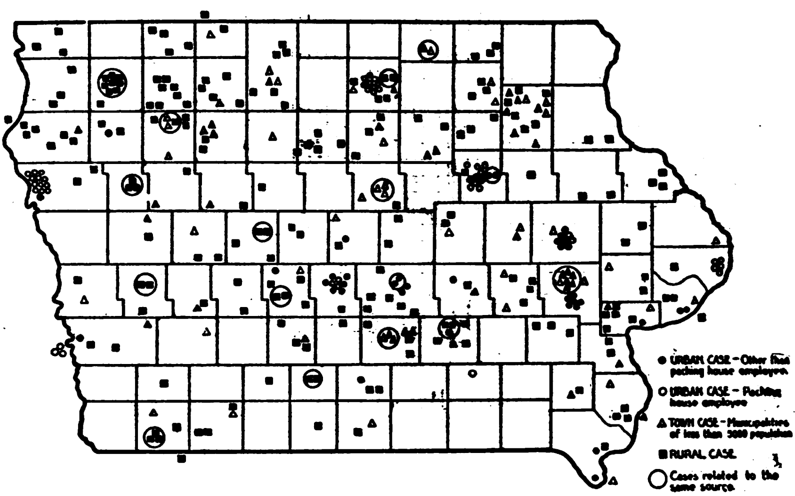

FIGURE 10.—Distribution of cases of undulant fever in Iowa

1929, 204; and the number occurring during the first two months of 1930 shows an increase over the same period in preceding years. Though we know that the true incidence is still undetermined, we believe that most of the severe or prolonged infections are now being accurately diagnosed. The annual number of cases will undoubtedly show some increase, but this will probably result chiefly from the diagnosis of more of the milder infections. During 1929 there was, on the average, one case per 12,000 population, and several of these cases were relatively mild infections. The graver forms of the disease have been of infrequent occurrence. As a general health hazard, therefore, this infection is not of major importance.

Distribution.—The cases occurred sporadically, scattered in practically every county of the State, as is shown in Figure 10. In 10 instances more than one case occurred in the same household; in three there were three cases; in one the entire family—father, mother, and six children under 9 years of age—was infected (Appendix A, case 11 A). In five other instances, two or more cases appeared to be related to the same source. There have been 37 cases among the employees of the eight large packing plants in the State.

TABLE 4.—*Distribution by age groups of the Iowa cases on whom the necessary data were available*

Age	Total	Males	Females	Cases having had contact with livestock or carcasses	Cases having had no contact with livestock or carcasses
0-4	4	2	2	0	4
5-9	8	5	3	0	8
10-14	15	10	5	5	10
15-19	27	22	5	12	14
20-24	43	41	2	32	8
25-29	42	34	8	28	12
30-34	41	31	10	28	12
35-39	58	50	8	39	13
40-44	43	34	9	26	15
45-49	25	20	5	16	7
50-54	24	16	8	14	8
55-59	5	2	3	1	4
60-64	9	5	4	3	6
65-69	5	3	2	2	2
70-74	3	2	1	1	2
75-79	2	0	2	2	0
Total	354	277	77	209	125

Occupation.—The distribution according to occupation was as follows: Farmers (including sons and farm laborers), 162 (44.7 per cent); women on farms, 24 (6.6 per cent); stock buyers, 5 (1.4 per cent); packing-house employees, 37 (10.2 per cent); butchers, 2 (0.55 pecent); housewives (other than farmers' wives), 37 (10.2 per cent); students, 18 (4.9 per cent); children, 19 (5.3 per cent); professional and business persons and laborers, 58 (16 per cent).

Sex.—Of a total of 375 cases, 289 (77 per cent) were males and 86 (23 per cent) were females. Among 186 adults living on farms, 162 (87 per cent) were males, and 24 (13 per cent) were females. The preponderance of males is striking, and the proportions have been very uniform throughout our study. In the various tabulations which have been made, the percentage of males in the total cases has always been within the range of 76 to 79. However, in a group of 125 cases, among persons who had no direct contact with livestock or carcasses, 64 (51 per cent) were males and 61 (49 per cent) were females. (See fig. 11.) One can not assume, therefore, that males are more susceptible than females, since under similar conditions equal numbers are infected. However, in a large portion of the population in which the occupation involves contact with livestock or fresh meat the number of males greatly exceeds the number of females. This evidence seems to indicate that the proportion of males to females is dependent upon direct contact exposure with livestock or fresh meats.

Age.—Distribution of our cases by age is shown in Table 4 and Figure 12. The large number of cases among young and middle-aged adult males very clearly appears to be dependent upon occupation.

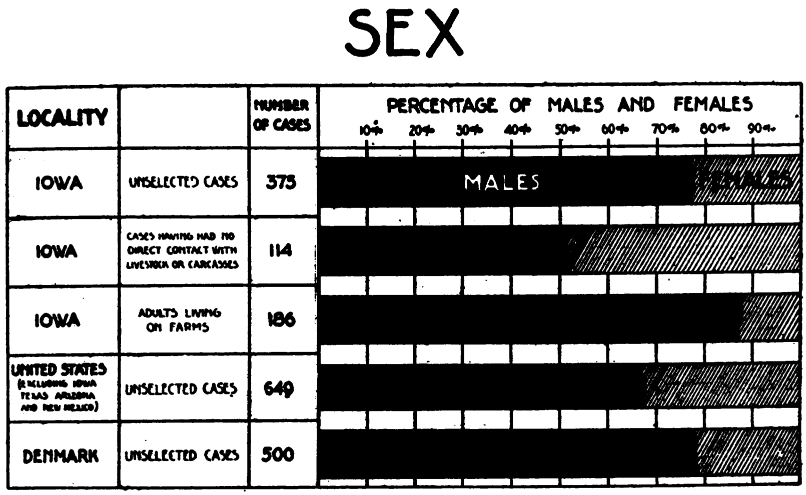

FIGURE 11.—Sex distribution of undulant fever in selected localities and groups

TABLE 5.—*Distribution by month of onset of the Iowa cases of 1928 and 1929 in which this information was available*

Month	Number of cases with onset in 1928	Number of cases with onset in 1929	Total, 1928 and 1929
January	7	8	15
February	6	12	18
March	9	20	29
April	7	13	20
May	9	18	27
June	12	20	32
July	13	19	32
August	14	20	34
September	17	15	32
October	11	5	16
November	12	13	25
December	5	10	15
Total	122	173	295

Seasonal distribution.—Undulant fever is a newly recognized disease in Iowa, and, therefore, few infections were discovered during the early period of this study. Medical interest in the disease was at first spasmodic, but became general following publicity (articles in medical journals and letters circularizing physicians), and then more cases were recognized. Cases occurring during 1928 and 1929 are arranged according to month of onset in Table 5. It will be seen that infections occur in every month of the year, the incidence apparently reaching its maximum during the summer months. As these data cover but two years, no definite conclusions as to normal variation can be made.

Sources of infection.—In analyzing the data concerning sources of infection our cases fall into three well differentiated groups as follows: (*a*) Those without direct contact with livestock or carcasses; (*b*) rural residents with direct contact with livestock; (*c*) urban residents with direct contact with carcasses or livestock. The data associated with these individual groups will now be considered.

(*a*) *Those without exposure to livestock or carcasses.*—This group, as has already been indicated, is equally divided between males and females and includes persons of all ages. There are a few rural residents, but the majority live in small towns or cities. All occupational

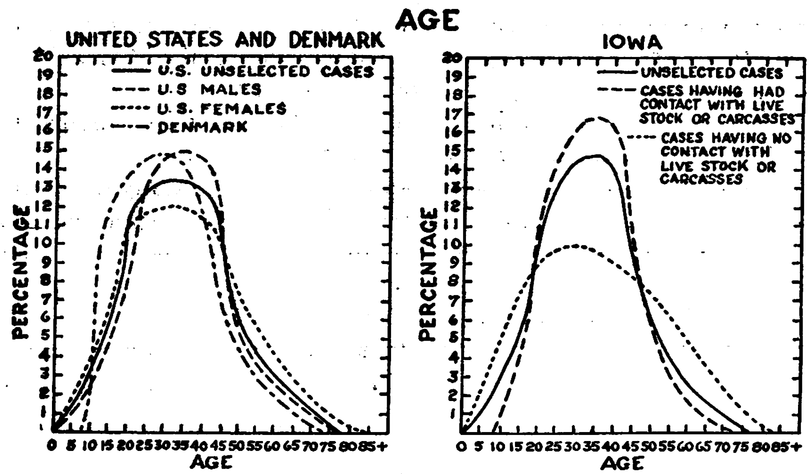

FIGURE 12.—Age distribution of undulant fever in selected localities and groups. These smooth curves were constructed from data available June 1, 1929

groups are included except farmers, stock buyers, packing-house employees, and butchers. The social and economic levels varied somewhat, the impression being that those who could better afford an abundance of raw dairy products were most likely to be attacked. There are 125 cases in this group, which is slightly more than one-third of those with sufficient data to allow grouping.

Inquiry was made concerning the diet, and the details regarding dairy products used as food recorded. With one exception, only American cheese had been ingested. The brands of cheese used were variable and the amounts small, hence this dairy product was of little importance. Nine persons used dairy butter which in six instances had been prepared by the patient. In all other cases creamery butter (prepared from pasteurized cream) had been purchased. Raw milk, or raw milk and cream, was used regularly by all but four; three supplemented the regular pasteurized supply with a raw supply; one used pasteurized products consistently, except during a vacation period which just preceded the illness. In this group therefore, the cases seem clearly to be related to the ingestion of raw dairy products.

The data were further analyzed to determine, if possible, why these particular persons had become infected. Were the dairy herds very heavily infected, or did the persons ingest an unusually large amount of raw dairy products? Ninety-nine patronized 93 public dairies, while 15 obtained milk from cows owned by the family. In 11 instances the source of the milk was not recorded. The herds supplying 18 of the public dairies and 12 of the privately owned herds were tested serologically. Of these, 24 were found to have positive animals, 3 to have doubtful reactors only, and in 3 all specimens sent to the laboratory were found to be negative. In a few instances suspicious animals had been sold before they were tested. The proportion of positive animals was not high. Excluding the three herds in which no reactors were found, only 28 per cent of the total of 341 animals were found to be definitely positive. An additional 9 per cent gave doubtful reactions. Six different patients obtained milk supplied by six different cows, in each instance an infected animal.

The milk from three herds was examined bacteriologically and found to contain *Br. melitensis* var. *abortus*. In two other instances milk was supplied by herds of three animals only, and these six animals were infected. The remaining herds were large, and the proportion of known infected animals was not high.

The amount of milk used by these 125 patients was variable: 35 used three or more glasses daily, 32 used one or two glasses a day, while 24 did not drink milk but used it irregularly or in small quantities with coffee or with cereal. Two of the latter group used cream in the way mentioned, and nine others used dairy butter. Concerning the others our records are incomplete.

Thus, among those having no contact with livestock we found some who used milk freely; in four cases (two of whom were on Sippy diets) it was used in particularly large amounts. A few patients used milk from single infected cows; a few others, from herds known to be heavily infected. There were, however, only four patients who used dairy products very freely from herds known to be heavily infected or from one infected animal. There were, on the other hand, patients who used dairy products only sparingly, and from very lightly infected herds. We assume that these cases were acquired through the ingestion of raw dairy products, but the factors which determined the occurrence of the infection are not at all clear. Dosage does not seem to be of first importance. Individual immunity or susceptibility are doubtless vital factors. There may be in addition accidental conditions of which we are not now aware. Common predisposing causes have not been apparent.

(*b*) *Rural cases having direct contact with livestock.*—This group includes farmers, farmers' sons, farmers' wives, and one veterinarian—a total of 169. One hundred and sixty-two (96 per cent) were males and 7 (4 per cent), females. All but 2 had contact with cattle, and all but 8 (5 women and 3 men) had more or less direct contact with hogs. These patients belong to the active working class and varied in age from 15 to 55 years.

Among such patients who have had contact with two distinct reservoirs of infection—cattle and hogs—it has been difficult to determine accurately the source in individual cases; nevertheless we have felt that we could suggest it in many. Hence, we have outlined what information we have concerning use of dairy products as well as the histories and serological findings on the herds.

Pasteurized milk was not used by any person in this group. The amounts of raw milk and cream used differed in no significant way from that in group (*a*). Sixty-six drank 3 or more glasses of milk daily, or used cream freely, and 15 of these also used dairy butter; 26 drank 1 to 2 glasses of milk daily, and 4 of these also used dairy butter; 60 used milk or cream only in small amounts with coffee or cereal, and 20 of these also used dairy butter. Three patients used no milk, cream, or dairy butter. In the remaining 14 cases no information was obtained concerning the amounts of dairy products ingested.

The herds of cattle concerned gave evidence of infection as follows: 51 were serologically positive, 11 serologically suspicious, and 31 negative. The proportion of positive animals in these herds was essentially the same as in the total number. Twenty-three herds, not examined serologically, gave positive histories of contagious abortion, 4 suspicious histories, and 14 negative. Data concerning the other herds were not collected.

The evidence of infection in some of the herds of hogs, to which these cases were related, is given in Table 3. We have already pointed out the significance of positive or doubtful herd histories of hogs and have shown how misleading a negative herd history may be. Of the patients on which data are available, the evidence indicates, we feel, that more than one-half had contact with hogs with *Brucella* infection. It is probable that approximately one-half of this group were exposed to infection through contact with infected hogs; on the other hand, two-thirds of this group were exposed to diseased cows either through direct contact or the ingestion of raw dairy products.

In individual patients it was only rarely possible to determine whether the source of the infection was in cattle or in hogs. In some the evidence seemed conclusive, as, for example, in the 14 cases in which hogs were serologically positive and the cattle negative, or in the 12 instances in which the cattle were serologically positive and the hogs negative. Even on the basis of herd histories alone the evidence was often strong, as in nine cases in which there had been abortion among the hogs, whereas the cattle had no history suggestive of infection. However, in other cases no conclusion as to source could be drawn, since some of the farmers had contact with herds of cattle and hogs, both of which were infected. On six farms (with 10 cases) serological findings conclusively showed this to be true; in 10 instances positive and suspicious serological findings occurred in the related herds, and in 14 others the histories of the herds of both cattle and hogs were positive or suspicious. Moreover, in the 24 instances in which cattle alone were considered and found to be serologically positive, the evidence as to the source can not be accepted as conclusive, since the hogs were not similarly tested. In the case of farmers, therefore, only through an adequate serological study of the livestock with which they have had contact can reliable evidence be gathered as to the source of infection. Even with such a study the epidemiological findings in some cases do not give a final answer.

Additional evidence concerning the source of infection in this group may be deduced from a consideration of the sex ratio. The preponderance of infected males in the farm population can only be adequately explained by their more frequent exposure through direct contact with livestock.

From patients in this group we have isolated 29 cultures, 24 *suis* variety and 5 *abortus* variety. This is in striking contrast to group (*a*), in which there were eight organisms isolated, all of the *abortus* or *bovine* type. One *suis* organism was isolated from a farmer's wife, who had had no contact with either cattle or hogs but whose illness was preceded by an infection in husband and son. (See Appendix A, case 10 A.) We can only account for this difference in the organisms isolated by assuming that the source of infection and the means of transmission were different in the two groups.

Weighing all evidence, the information indicates that in group (*b*) the sources were about equally divided between cattle and hogs. Most of the infections derived from cattle, though possibly not all, may be explained by ingestion; those derived from hogs were dependent, we believe, on direct or indirect contact, the portal of entry presumably being the skin.

(*c*) *Urban cases having direct contact with livestock or carcasses.*—This group includes the 37 packing-house employees, 2 butchers, and 1 worker in a rendering plant. All were males. The facts collected in regard to these cases are as follows: Dairy products were as a rule used sparingly; 21 obtained only pasteurized milk and cream; 3 used only "canned" milk, 4 used raw milk but only 1 drank as much as 1 pint daily, 3 others used small amounts but were unable to state the source, and in 9 cases we have no details concerning dairy products except for the note that 1 used country-made butter.

All of our packing-plant cases worked in the hog division, with one possible exception—a recent uninvestigated case whose physician volunteered the information that his patient had been engaged in cleaning the intestines of cattle. Three others had contact with cattle as well as with hogs—one a buyer, one employed in the hide cellar and occasionally on the hog-killing floor, and the third, a weigher, exposed to both beef and pork. Twenty-nine were variously employed on the hog-killing and cutting floors ("shackling hogs," "ribbing," "shaving hams," "cleaning intestines," "breaking necks" with an air gun, handling condemned meats or heads, etc.). One did clerical work for the most part, but was occasionally on the killing and cutting floors. The details as to occupation were not recorded in the three other cases. The two butchers and the operator of the rendering plant handled carcasses of both cattle and hogs.

Probably equal amounts of beef and pork are handled in the packing plants of Iowa; yet of the 10 organisms isolated from the employees all were of the *suis* variety. This bacteriological finding seems to confirm our epidemiological impressions, which indicate that contact with fresh tissues of diseased hogs not infrequently results in infection, while similar contact with the carcasses of cattle is rarely followed by undulant fever.

Modes of transmission and factors related to infection.—In the three groups described above two modes of transmission of the infection are to be discerned: Some individuals apparently receive the disease agent from infected dairy products—raw milk, cream, or butter; others acquire infection manifestly through the handling of livestock or fresh meats. Ingestion and contact appear, then, to be the chief means of transmission. Bearing in mind the ubiquity of the organism concerned, one wonders why undulant fever does not occur with greater frequency. It is likely that dairy products which serve in disseminating the infection either carry large numbers of the organism or strains of unusual virulence. We believe also that it is not casual contact but that special forms of contact with infected animals, their tissues, or discharges, operate to determine infection. In both groups the factor of relative human immunity also must be operative.

The significance of hog contact of a special form is most apparent in the group of packing house workers, particularly those on the killing floor who are intimately exposed to fresh carcasses. Here meat axe and knife lay bare porcine organisms in infected tissues, affording direct access into the skin of the worker which so often is cut or abraded, a condition common to this occupation.

Farmers also lay themselves open to infection through contacts of a special character. These contacts with hogs occur in such procedures as vaccinating, ringing, castrating, and medicating, when struggling animals must be securely held; and in loading hogs for market, in handling newborn pigs, especially the weaker ones, during the first hours of life. A special type of contact with cattle occurs in the

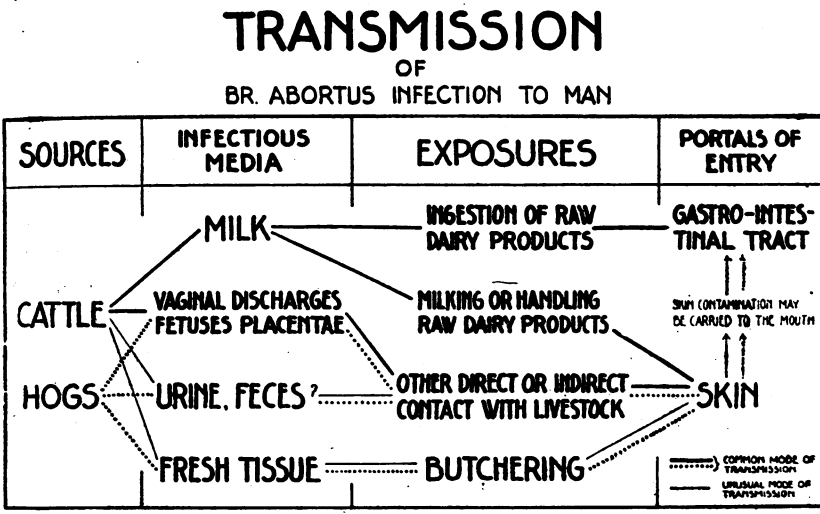

FIGURE 13.—Modes of transmission of *Br. melitensis* var. *abortus* and *suis* infections to man

manual removal of placentæ. Such contact preceded the onset of illness in a few farmer patients in our series.

Our conception of the common sources and modes of transmission is shown in Figure 13. It was suggested to us in our epidemiological work that the skin served as a portal of entry. This prompted the

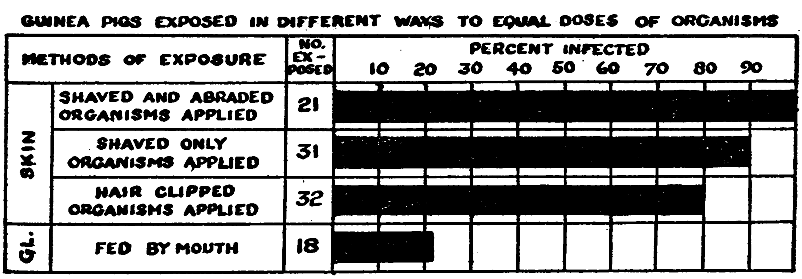

FIGURE 14.—Results of experimental study of portals of entry in *Brucella* infection

experiments on guinea pigs previously reported (72). The results of these experiments are shown in Figure 14. Taking everything into consideration, we are led to the opinion that, in no small proportion of our cases, infection resulted from direct contact, the organisms gaining entrance directly through the skin.

EPIDEMIOLOGICAL FINDINGS IN STATES OTHER THAN IOWA

The increasing recognition of undulant fever, as well as the distribution of recognized cases, is clearly illustrated by the maps in Figures 15 to 20. The data here presented have been collected in part from the numerous reports in the literature, but mainly by correspondence with the directors of various State laboratories, chiefs of divisions of communicable diseases, secretaries of State departments of health, and other investigators. The figures for 1929 have been kindly supplied by Doctor Simpson, of Dayton, Ohio. Many cases have been found in areas in which an active interest has been displayed in obtaining an accurate recognition of the disease.

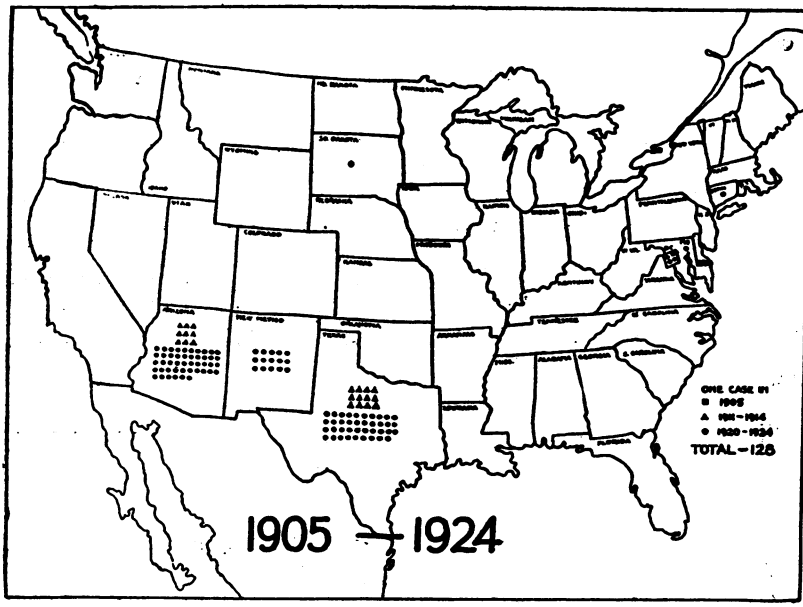

FIGURE 15.—Distribution of reported cases of undulant fever in the United States, 1905–1924

At the present time neither the true incidence nor distribution of the infection in this country can be stated. We suspect, however, that in those regions in which *Br. melitensis* var. *suis* is distributed the disease will prove to be a more serious health hazard than elsewhere.

The age distribution of cases reported up to June, 1929, is represented by curves in Figure 12. Two things are worthy of note: (1) The curve representing "males" is strikingly similar to that representing "those having direct contact with livestock or carcasses;" (2) the curve representing "females" somewhat simulates that representing "those who have no direct contact with livestock or carcasses," a group composed equally of males and females. The age distribution seems dependent on two factors, a variation in susceptibility and a variation in direct exposure to infected animals.

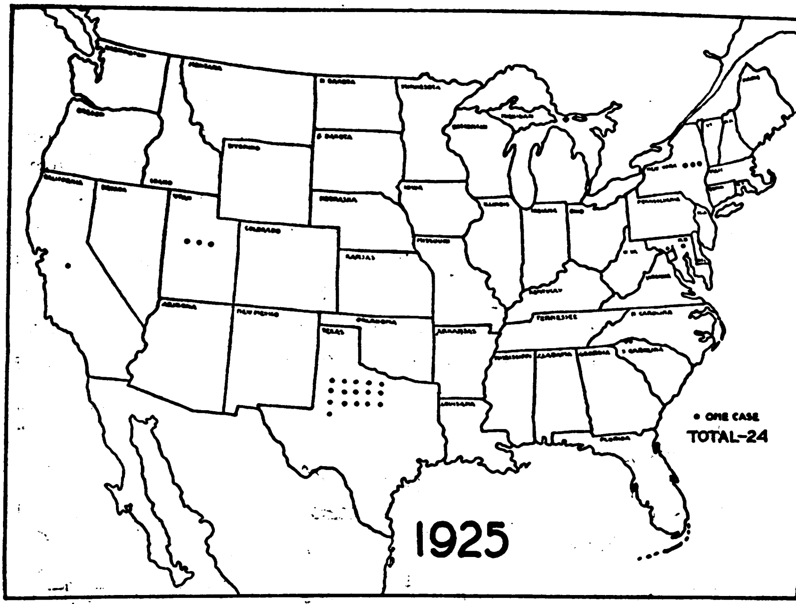

FIGURE 16.—Distribution of reported cases of undulant fever in the United States in 1925

Of 649 cases in States other than Iowa, 67 per cent were males (fig. 11). Simpson has reported no preponderance of males in Ohio, while in other localities the proportion has been similar to that in Iowa.

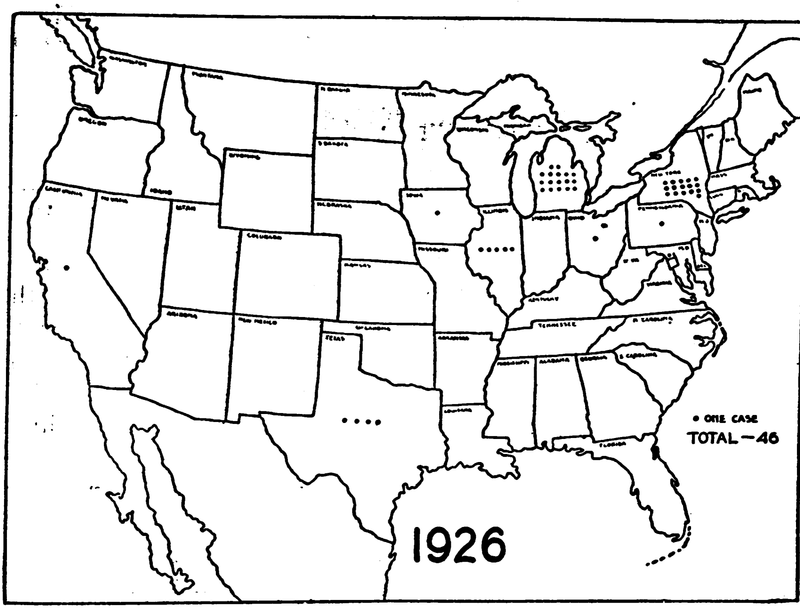

FIGURE 17.—Distribution of reported cases of undulant fever in the United States in 1926

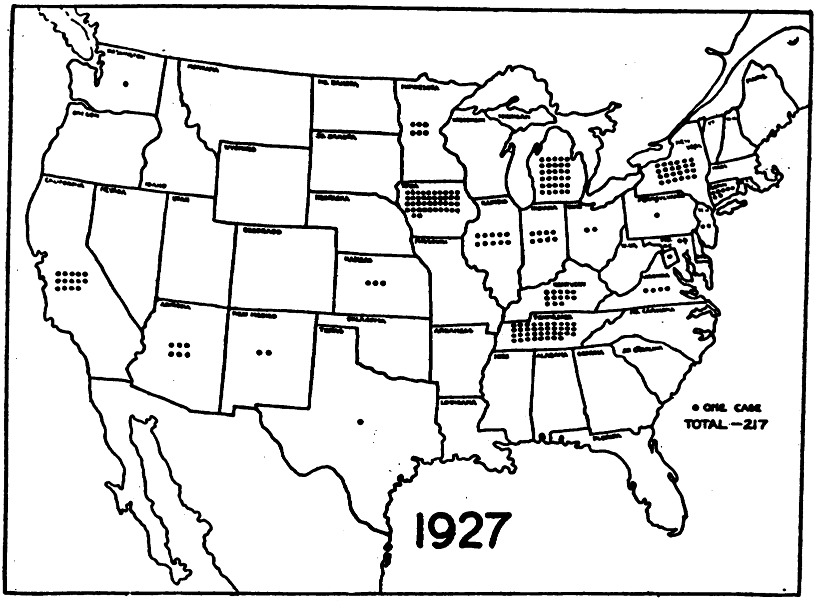

FIGURE 18.—Distribution of reported cases of undulant fever in the United States in 1927

In different States the occupational distribution of cases seems to vary greatly. Such data are, however, of significance only when they are related to the proportion of the population engaged in the several occupations.

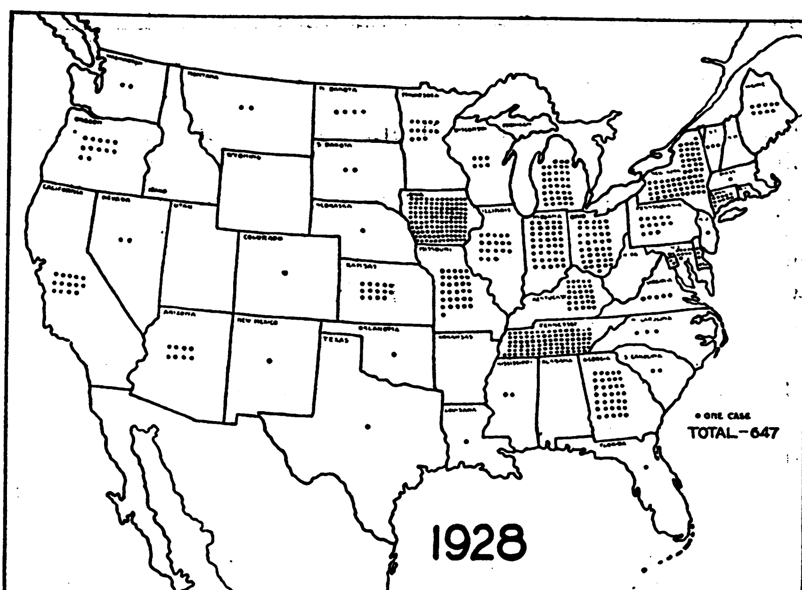

FIGURE 19.—Distribution of reported cases of undulant fever in the United States in 1928

In a number of States the common reservoir of infection has supposedly been cattle and the common mode of transmission through raw dairy products. There are, however, occasional references to cases definitely attributed to hog contact either on the farm or in packing plants.

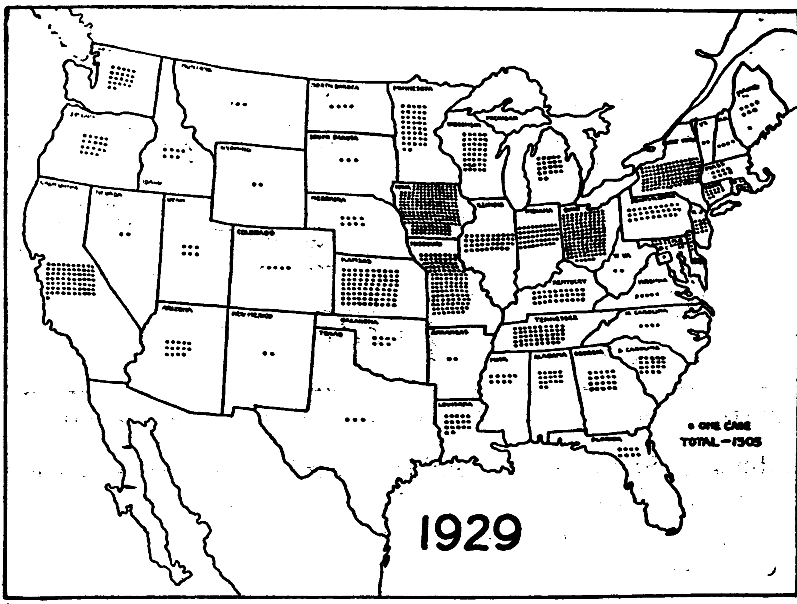

FIGURE 20.—Distribution of reported cases of undulant fever in the United States in 1929

EPIDEMIOLOGICAL FINDINGS IN OTHER COUNTRIES

Bevan (25) of Rhodesia, in 1921, first called attention to cases of undulant fever probably related to cattle infected with contagious abortion. Four years later he reported 35 cases, and of the 31 adults included 26 (84 per cent) were males. There have recently been numerous articles bearing on this infection in other countries, with a few case reports. Little data can be deduced from these scattered cases. Kristensen (60), however, has carried out a careful study of the infection in Denmark and reported on 500 cases as follows: (1) The 34 strains of *Brucella* isolated corresponded to *Br. melitensis* var. *abortus* in pathogenicity, carbon dioxide requirement, and reaction to dyes, but were very different from the American porcine type. (2) There was no characteristic seasonal distribution of the infection. (3) The cases occurred sporadically. (4) Males were attacked in greater numbers than females (78 per cent males). (5) Most cases were in the age group of 15 to 40. Young children were not involved. (6) The infection occurred chiefly in rural districts.

(7) Contact with infected animals (cattle) must have played an important rôle in the transmission of the infection. (8) Hogs did not appear to be the source of any of these infections.

SUMMARY OF EPIDEMIOLOGICAL DATA, AND COMMENT

Undulant fever due to infection with the *abortus* or *suis* varieties of *Br. melitensis* is widespread and in regions in which systematic investigations have been conducted the disease has been found to be of not infrequent occurrence. It has involved chiefly young and middle aged adults, and males have predominated in all but very few studies. Men on the farms and packing-house employees have been particularly involved. Cattle have been generally regarded as the source of human infection, but in some localities hogs have played an important part. That direct contact with animals often accounts for human infection is being more generally recognized. We have brought forth evidence to indicate that the skin may be an important portal of entry. Otero, of Porto Rico, in a personal communication writes as follows concerning his experiments on human volunteers:

> "It may be of interest to know that some of our inoculations through abraded skin have been successful, giving rise to clear-cut cases of undulant fever after a single inoculation, in some cases with strains that were fed repeatedly with apparently no symptoms. I have six such cases at present running fever."

We feel that the data presented make untenable the opinion that the ingestion of raw dairy products from infected cows is the only means of transmission of undulant fever. It is apparent, in Iowa, at least, that approximately one-half of the cases result from a second means of transmission, namely, through contact with infected animals, their tissues, or discharges; the infection in all probability entering through the skin.

(The concluding chapters of this report presenting the clinical data, preventive measures, case records, and bibliography, will be published in the following issue of PUBLIC HEALTH REPORTS.)

DEATHS DURING WEEK ENDED SEPTEMBER 20, 1930

Summary of information received by telegraph from industrial insurance companies for the week ended September 20, 1930, and corresponding week of 1929. (From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce)

	Week ended Sept. 20, 1930	Corresponding week, 1929
Policies in force	75, 532, 011	74, 688, 919
Number of death claims	13, 466	12, 802
Death claims per 1,000 policies in force, annual rate	9. 3	8. 9

Deaths[1] *from all causes in certain large cities of the United States during the week ended September 20, 1930, infant mortality, annual death rate, and comparison with corresponding week of 1929. (From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce)*

[The rates published in this summary are based upon mid-year population estimates derived from the 1930 census. The rates are not exactly comparable with similar rates published in the Public Health Reports earlier than the issue of August 22, 1930, which were based upon estimates made before the 1930 census was taken]

City	Week ended Sept. 20, 1930				Corresponding week, 1929		Death rate[2] for first 38 weeks	
	Total deaths	Death rate[2]	Deaths under 1 year	Infant mortality rate[3]	Death rate[2]	Deaths under 1 year	1930	1929
Total (78 cities)	6,876	10.4	718	[4] 57	10.0	735	12.1	12.9
Akron	35	7.2	3	28	7.0	11	7.9	9.5
Albany[5]	28	11.4	2	41	14.0	0	15.0	16.5
Atlanta	79	15.4	10	102	12.7	12	16.1	16.2
White	45	----	6	95	----	10	----	----
Colored	34	[6]	4	115	[6]	2	[6]	[6]
Baltimore[5]	224	14.5	17	59	11.1	29	14.2	14.9
White	166	----	11	49	----	22	----	----
Colored	58	[6]	6	96	[6]	7	[6]	[6]
Birmingham	56	11.3	7	67	11.6	9	14.0	16.5
White	19	----	3	48	----	5	----	----
Colored	37	[6]	4	98	[6]	4	[6]	[6]
Boston	198	13.2	25	73	9.2	13	14.2	15.4
Bridgeport	22	7.8	0	0	7.8	5	11.2	12.4
Buffalo	125	11.4	19	85	9.4	10	13.2	14.2
Cambridge	24	11.0	3	60	6.9	3	11.8	12.7
Camden	24	10.7	3	53	12.0	2	13.9	14.7
Canton	13	6.4	4	107	10.0	3	10.1	11.5
Chicago[5]	641	9.9	52	46	8.9	46	10.5	11.5
Cincinnati	114	13.2	8	47	12.2	12	15.7	17.3
Cleveland	173	10.0	19	57	8.7	10	11.3	12.8
Columbus	75	13.5	5	49	13.8	5	15.9	15.2
Dallas	40	7.9	7	----	8.2	5	11.7	11.8
White	37	----	0	----	----	5	----	----
Colored	3	[6]	1	----	[6]	0	[6]	[6]
Dayton	48	12.4	10	149	10.6	5	10.6	11.6
Denver	67	12.1	12	131	14.4	7	14.9	15.1
Des Moines	19	6.9	3	55	8.5	2	11.9	11.8
Detroit	258	8.5	44	68	9.0	45	9.5	11.4
Duluth	20	10.3	1	27	14.4	4	11.2	11.7
El Paso	20	10.2	7	----	19.2	6	17.8	20.3
Erie	28	12.6	2	44	11.8	2	11.4	12.7
Fall River[5] [7]	25	11.4	0	0	9.1	0	12.2	14.2
Flint	23	7.6	5	59	16.8	17	9.3	10.9
Fort Worth	36	11.6	6	----	8.9	2	11.3	12.8
White	25	----	4	----	----	2	----	----
Colored	11	[6]	2	----	[6]	0	[6]	[6]
Grand Rapids	34	10.5	3	45	7.2	5	10.4	10.2
Houston	71	12.7	10	----	8.9	5	12.4	12.9
White	44	----	2	----	----	3	----	----
Colored	27	[6]	8	----	[6]	2	[6]	[6]
Indianapolis	88	12.6	10	75	13.4	17	14.8	15.0
White	76	----	10	86	----	13	----	----
Colored	12	[6]	0	0	[6]	4	[6]	[6]
Jersey City	70	11.5	7	61	8.1	10	11.5	12.7
Kansas City, Kans	26	11.1	4	93	9.4	0	11.5	13.5
White	20	----	4	110	----	0	----	----
Colored	6	[6]	0	0	[6]	0	[6]	[6]
Kansas City, Mo	79	10.4	6	50	11.6	5	13.6	14.2
Knoxville	23	11.3	4	94	13.1	4	14.0	14.0
White	19	----	3	78	----	4	----	----
Colored	4	[6]	1	243	[6]	0	[6]	[6]
Los Angeles	253	10.6	24	73	9.7	17	11.2	11.5
Louisville	52	8.8	12	103	12.0	3	13.7	15.2
White	41	----	8	79	----	3	----	----
Colored	11	[6]	4	265	[6]	0	[6]	[6]
Lowell[7]	15	7.8	2	53	9.8	6	13.6	14.5
Lynn	18	9.2	3	84	7.7	2	10.6	11.5
Memphis	53	10.9	5	59	18.4	12	17.6	19.5
White	24	----	1	18	----	6	----	----
Colored	29	[6]	4	135	[6]	6	[6]	[6]
Milwaukee	99	9.0	14	61	10.4	16	9.9	11.2
Minneapolis	100	11.2	10	66	7.9	4	10.8	11.0

See footnotes at end of table.

Deaths [1] from all causes in certain large cities of the United States during the week ended September 20, 1930, infant mortality, annual death rate, and comparison with corresponding week of 1929. (From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce)—Continued.

City	Week ended Sept. 20, 1930				Corresponding week, 1929		Death rate [2] for first 38 weeks	
	Total deaths	Death rate [2]	Deaths under 1 year	Infant mortality rate [3]	Death rate [2]	Deaths under 1 year	1930	1929
Nashville	27	9.6	6	94	14.6	4	17.4	19.2
White	21	-------	5	105	-------	4	-------	-------
Colored	6	(6)	1	62	(6)	0	(6)	(6)
New Bedford [7]	13	6.6	2	51	7.8	2	10.9	12.6
New Haven	38	12.2	2	31	9.0	1	13.1	13.4
New Orleans	120	13.7	10	56	13.9	11	17.7	17.8
White	62	-------	4	34	-------	4	-------	-------
Colored	58	(6)	6	97	(6)	7	(6)	(6)
New York	1,171	8.7	119	50	8.7	137	10.9	11.5
Bronx Borough	156	6.4	10	29	5.7	13	8.0	8.4
Brooklyn Borough	421	8.4	53	56	7.7	57	9.9	10.4
Manhattan Borough	450	12.7	42	54	13.1	58	16.4	16.8
Queens Borough	116	5.5	13	52	5.3	5	7.1	7.8
Richmond Borough	28	9.2	1	19	15.5	4	14.6	16.2
Newark, N. J.	88	10.3	6	31	10.9	8	12.1	13.1
Oakland	50	9.1	5	62	10.8	6	11.0	11.6
Oklahoma City	39	11.0	7	126	7.7	6	10.9	10.8
Omaha	56	13.6	2	24	9.8	8	13.7	13.9
Paterson	28	10.6	3	52	10.2	4	12.4	13.6
Philadelphia	456	12.1	48	71	10.3	35	12.7	13.4
Pittsburgh	158	12.3	25	89	11.0	14	13.9	15.0
Portland, Oreg.	55	9.6	1	12	10.9	4	12.4	12.9
Providence	54	11.2	10	93	10.2	6	13.3	14.8
Richmond	47	13.4	5	73	10.9	4	15.1	16.5
White	29	-------	2	44	-------	3	-------	-------
Colored	18	(6)	3	128	(6)	1	(6)	(6)
Rochester	64	10.2	4	36	6.9	6	11.7	12.6
St. Louis	135	8.6	13	45	11.1	20	14.4	14.9
St. Paul	42	8.1	1	10	9.3	2	10.2	10.6
Salt Lake City [5]	28	10.4	5	79	13.9	2	12.5	13.2
San Antonio	59	12.0	7	-------	8.4	6	15.5	14.8
San Diego	35	12.2	1	21	16.4	4	14.5	15.4
San Francisco	146	12.1	7	47	10.2	6	13.9	13.3
Schenectady	24	13.1	0	0	9.8	2	11.4	12.6
Seattle	52	7.4	2	20	9.4	4	11.0	11.1
Somerville	17	8.5	0	0	8.1	0	9.9	9.4
Spokane	22	9.9	0	0	10.0	2	12.4	13.0
Springfield, Mass.	31	10.8	2	34	12.3	4	12.2	13.0
Syracuse	37	9.3	4	49	10.7	3	11.8	13.5
Tacoma	17	8.3	1	27	8.8	0	12.6	11.8
Toledo	69	12.3	11	101	12.3	7	12.7	13.8
Trenton	32	13.6	1	19	15.8	5	16.9	17.4
Utica	22	11.2	1	28	12.8	1	14.9	15.7
Washington, D. C.	112	12.0	8	47	13.2	20	15.3	15.6
White	71	-------	6	52	-------	10	-------	-------
Colored	41	(6)	2	36	(6)	10	(6)	(6)
Waterbury	10	5.2	2	49	5.2	1	9.8	9.6
Wilmington, Del. [7]	28	13.9	3	72	12.4	6	14.7	14.2
Worcester	42	11.1	2	28	11.8	7	12.9	12.9
Yonkers	17	6.5	2	48	6.3	2	8.1	9.4
Youngstown	39	11.9	2	29	5.4	4	10.3	12.3

[1] Deaths of nonresidents are included. Stillbirths are excluded.
[2] These rates represent annual rates per 1,000 population, as estimated for 1930 and 1929 by the arithmetical method.
[3] Deaths under 1 year of age per 1,000 live births. Cities left blank are not in the registration area for births.
[4] Data for 73 cities.
[5] Deaths for week ended Friday.
[6] For 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.
[7] Population April 1, 1930; decreased 1920 to 1930; no estimate made.

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 September 27, 1930, and September 28, 1929

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended September 27, 1930, and September 28, 1929

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929
New England States:								
Maine	1	4	1			2	0	0
New Hampshire	2					9	0	0
Vermont	1	3			1		0	0
Massachusetts	50	66		2	50	32	3	2
Rhode Island	6	8					0	0
Connecticut	7	10	3	1	4	6	1	0
Middle Atlantic States:								
New York	54	100	[1] 2	[1] 5	45	83	7	17
New Jersey	46	72	2	2	16	7	1	8
Pennsylvania	125	123			51	68	6	14
East North Central States:								
Ohio	63	57	11	11	21	28	9	4
Indiana	8	30	5		2	5	3	0
Illinois	102	130	3	14	20	73	5	9
Michigan	44	62			18	85	3	14
Wisconsin	11	13	34	66	21	43	1	1
West North Central States:								
Minnesota	13	30		1	1		0	2
Iowa	5	8		1	2	17	0	0
Missouri	27	36		3	13	14	4	4
North Dakota	1	6			8	3	3	1
South Dakota	8	1			9	1	1	0
Nebraska	5	29			1	8	0	2
Kansas	7	30		1	4	23	1	3
South Atlantic States:								
Delaware		1	1				0	0
Maryland [2]	14	12	4	2	4	5	0	2
District of Columbia	15	8		2	3	1	0	0
Virginia								
West Virginia	21	7	1	12	13	30	0	2
North Carolina	118	214	14		10	2	3	3
South Carolina	38	61	160	250			0	0
Georgia	21	27	15	31	5	8	0	1
Florida	5	32	1		4	3	0	0

[1] New York City only.

[2] Week ended Friday.

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Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended September 27, 1930, and September 28, 1929—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929
East South Central States:								
Kentucky		15				19	1	0
Tennessee	18	48	5	20	12	1	0	0
Alabama	30	68	5	7	16		2	3
Mississippi	23	46					0	1
West South Central States:								
Arkansas	7	9	2	3		4	0	1
Louisiana	43	26		13	3		0	0
Oklahoma [3]	33	57	2	14	2	7	1	1
Texas	15	33	2	21		1	0	0
Mountain States:								
Montana					2	112	0	3
Idaho	2						0	1
Wyoming	1			1		4	0	1
Colorado	10	9			7	6	2	0
New Mexico	3	6					0	0
Arizona	6	5					1	2
Utah [2]		2		5	2	1	2	0
Pacific States:								
Washington	3	17		1	4	5	2	2
Oregon	5	4	17	6	16	6	0	0
California	39	39	39	21	56	23	4	7

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Sept. 27–1930	Week ended Sept. 28, 1929	Week ended Sept. 27–1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27–1930	Week ended Sept. 28, 1929
New England States:								
Maine	21	0	12	20	0	0	9	6
New Hampshire	1	0	2	16	0	0	9	0
Vermont	0	1	3	2	0	0	1	1
Massachusetts	32	3	72	81	0	0	11	8
Rhode Island	2	0	3	2	0	0	1	2
Connecticut	5	0	14	23	0	0	2	5
Middle Atlantic States:								
New York	65	42	71	70	8	0	54	31
New Jersey	6	3	47	32	0	0	21	11
Pennsylvania	10	7	138	95	0	0	88	30
East North Central States:								
Ohio	100	9	184	192	19	18	75	34
Indiana	6	2	48	54	12	15	12	9
Illinois	43	3	142	180	12	22	43	33
Michigan	13	8	101	93	1	16	24	20
Wisconsin	20	0	41	44	6	7	5	4
West North Central States:								
Minnesota	17	0	32	52	4	6	7	7
Iowa	21	6	18	33	7	11	2	6
Missouri	18	1	36	29	8	8	30	14
North Dakota	2	0	11	9	1	4	4	1
South Dakota	4	0	4	6	1	8	1	5
Nebraska	26	0	12	15	10	3	7	1
Kansas	48	2	35	9	1	6	11	9
South Atlantic States:								
Delaware	0	0	4	1	0	0	3	1
Maryland [2]	2	1	11	21	0	0	51	25
District of Columbia	0	0	3	4	0	0	2	0
Virginia		17						
West Virginia	3	6	19	17	7	4	53	24
North Carolina	5	5	96	102	1	5	40	22
South Carolina	2	1	21	26	0	0	35	35
Georgia	1	2	16	41	0	0	35	11
Florida	2	1	4	2	0	0	6	0

[2] Week ended Friday.

[3] Figures for 1930 are exclusive of Oklahoma City and Tulsa.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended September 27, 1930, and September 28, 1929—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929	Week ended Sept. 27, 1930	Week ended Sept. 28, 1929
East South Central States:								
Kentucky	1	0	16	27	0	0	54	36
Tennessee	2	12	30	52	2	0	42	48
Alabama	1	2	45	51	0	0	21	17
Mississippi	2	0	12	19	0	0	35	17
West South Central States:								
Arkansas	1	0	4	8	0	0	15	18
Louisiana	11	0	8	14	1	1	27	24
Oklahoma [3]	8	0	23	50	13	7	52	31
Texas	8	0	11	17	4	7	7	96
Mountain States:								
Montana	0	0	15	18	0	11	15	56
Idaho	1	1	1	6	0	1	0	0
Wyoming	7	0	7	5	0	2	0	3
Colorado	4	1	9	10	0	1	11	8
New Mexico	2	0	8	3	0	1	20	12
Arizona	1	0	5	2	0	5	6	2
Utah [2]	2	0	3	15	0	0	2	0
Pacific States:								
Washington	3	0	31	24	12	12	5	10
Oregon	1	1	13	5	2	4	4	5
California	65	6	59	99	7	27	11	5

[2] Week ended Friday. [3] Figures for 1930 are exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

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

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
July, 1930										
Hawaii Territory	3	22	11		18		2		0	16
August, 1930										
Alabama	15	51	20	722	85	66	6	80	2	186
California	15	147	37	32	305	6	229	136	46	79
Kansas	11	40	2	3	45		182	71	27	65
Michigan	28	121	1	18	194	1	16	170	57	70
Mississippi	6	61	371	6,745	96	970	7	26	9	161
Missouri	22	78	6	53	66	1	51	78	54	148
Nevada									0	
Oklahoma [1]	7	25	15	421	47	48	47	29	43	243
Oregon	3	19	25	13	82		4	24	20	28
Rhode Island	1	11			8		5	13	0	5
South Carolina	148	86	337	2,869	13	773	4	26	2	280
South Dakota	3	30			7		24	10	29	19
Virginia	4	98	275	83	208	68	22	135	4	312
Washington	5	29	9		81		11	44	42	21

[1] Exclusive of Oklahoma City and Tulsa.

July, 1930

	Cases
Hawaii Territory:	
Chicken pox	8
Conjunctivitis, follicular	11
Hookworm disease	18
Leprosy	2
Mumps	19
Tetanus	1
Whooping cough	9

August, 1930

	Cases
Anthrax:	
California	7
Chicken pox:	
Alabama	6
California	130
Kansas	15
Michigan	79
Mississippi	142

	Cases
Chicken pox—Continued.	
Missouri	25
Nevada	4
Oklahoma [1]	2
Oregon	24
Rhode Island	5
South Carolina	46
South Dakota	7
Virginia	90
Washington	43
Dengue:	
Alabama	6
Mississippi	2
South Carolina	3
Diarrhea:	
South Carolina	926
Diarrhea and dysentery:	
Virginia	1, 186
Dysentery:	
California (amebic)	6
California (bacillary)	10
Mississippi (amebic)	93
Mississippi (bacillary)	1, 024
Oklahoma [1]	41
Oregon	3
South Carolina	1
Food poisoning:	
California	68
German measles:	
California	22
Kansas	3
Rhode Island	3
Washington	7
Granuloma, coccidioidal:	
California	1
Hookworm disease:	
Mississippi	340
Oklahoma [1]	1
South Carolina	151
Impetigo contagiosa:	
Kansas	4
Oregon	8
Jaundice:	
California	1
Leprosy:	
California	1
Michigan	1
Lethargic encephalitis:	
Alabama	2
California	4
Michigan	1
Oregon	1
South Carolina	5
Washington	1
Mumps:	
Alabama	24
California	333
Kansas	25
Michigan	72
Mississippi	156
Missouri	29
Oklahoma [1]	1
Oregon	55
South Carolina	22
Washington	75
Ophthalmia neonatorum:	
California	2
Mississippi	23
Missouri	2
Oklahoma [1]	1
Rhode Island	2
South Carolina	10
South Dakota	1
Paratyphoid fever:	
California	6
Kansas	8
Oregon	1
Rhode Island	1
South Carolina	25
Puerperal septicemia:	
Mississippi	29
Washington	3
Rabies in animals:	
California	44
Mississippi	8
Missouri	5
Rhode Island	5
South Carolina	4
Rabies in man:	
Michigan	1
Rocky Mountain spotted or tick fever:	
Oregon	3
Scabies:	
Kansas	2
Oregon	1
Septic sore throat:	
Kansas	1
Michigan	3
Missouri	12
Oklahoma [1]	18
Oregon	2
Rhode Island	2
Tetanus:	
California	5
Kansas	2
South Dakota	1
Washington	1
Trachoma:	
California	8
Missouri	43
Oklahoma [1]	6
South Dakota	1
Trichinosis:	
California	4
Tularaemia:	
Alabama	1
California	3
Missouri	1
Oregon	1
Typhus fever:	
Alabama	11
South Carolina	5
Virginia	11
Undulant fever:	
Alabama	1
California	8
Kansas	7
Missouri	31
South Carolina	1
South Dakota	3
Virginia	2
Washington	2

[1] Exclusive of Oklahoma City and Tulsa.

	Cases
Vincent's angina:	
Kansas	2
Oregon	5
Rhode Island	1
Whooping cough:	
Alabama	143
California	377
Kansas	112
Michigan	706
Mississippi	379
Whooping cough—Continued.	
Missouri	79
Nevada	4
Oklahoma [1]	32
Oregon	136
Rhode Island	37
South Carolina	233
South Dakota	9
Virginia	285
Washington	188

[1] Exclusive of Oklahoma City and Tulsa.

RECIPROCAL NOTIFICATIONS

Notifications regarding communicable diseases sent during the month of August, 1930, by departments of health of certain States to other State health departments

Disease	Alabama	Illinois	Kansas	Minnesota	Missouri	New Jersey	New York	Oregon	South Dakota	Washington
Chicken pox		1								
Diphtheria		2				1	2			
Encephalitis				1						
Gonorrhea				2						
Poliomyelitis		1			4		3			
Scarlet fever							2			
Smallpox		3								
Syphilis			17	1						
Tuberculosis	2	5		75				2		1
Typhoid fever		4		1			2		1	
Undulant fever				1						
Whooping cough		1								

GENERAL CURRENT SUMMARY AND WEEKLY REPORTS FROM CITIES

The 97 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 32,140,000. The estimated population of the 90 cities reporting deaths is more than 30,550,000. The estimated expectancy is based on the experience of the last nine years, excluding epidemics.

Weeks ended September 20, 1930, and September 21, 1929

	1930	1929	Estimated expectancy
Cases reported			
Diphtheria:			
46 States	804	1,283	
97 cities	292	453	602
Measles:			
45 States	463	433	
97 cities	101	90	
Meningococcus meningitis:			
46 States	67	91	
97 cities	28	50	
Poliomyelitis:			
46 States	503	127	
Scarlet fever:			
46 States	1,050	1,349	
97 cities	383	412	413
Smallpox:			
46 States	128	190	
97 cities	28	32	9
Typhoid fever:			
46 States	940	752	
97 cities	137	135	162
Deaths reported			
Influenza and pneumonia:			
90 cities	358	323	
Smallpox:			
90 cities	0	0	

City reports for week ended September 20, 1930

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 include 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 nonepidemic 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 1921 is included. In obtaining the estimated expectancy, the figures are smoothed when necessary to avoid abrupt deviation 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	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	3	0	1	----------	0	6	1	1
New Hampshire:								
Concord	----------	0	----------	----------	----------	----------	----------	----------
Vermont:								
Barre	0	0	0	----------	0	0	0	0
Burlington	0	0	0	----------	0	0	0	0
Massachusetts:								
Boston	12	19	8	----------	0	7	4	16
Fall River	0	2	2	----------	0	0	0	1
Springfield	0	2	1	----------	0	0	1	1
Worcester	1	3	1	----------	0	0	1	0
Rhode Island:								
Pawtucket	0	0	0	----------	0	0	0	1
Providence	1	4	1	----------	0	0	0	1
Connecticut:								
Bridgeport	0	4	0	----------	0	0	0	0
Hartford	1	2	0	----------	0	1	0	2
New Haven	0	2	0	----------	1	0	2	0
MIDDLE ATLANTIC								
New York:								
Buffalo	2	10	5	----------	0	1	2	7
New York	9	90	32	5	3	23	15	73
Rochester	1	2	4	----------	0	1	1	2
Syracuse	7	2	1	----------	0	1	1	4
New Jersey:								
Camden	1	3	1	----------	0	0	0	0
Newark	4	9	10	----------	0	1	0	6
Trenton	0	2	0	----------	0	0	0	2
Pennsylvania:								
Philadelphia	9	36	11	3	2	6	9	31
Pittsburgh	4	14	15	----------	0	1	1	18
Reading	2	1	0	----------	0	2	2	0
EAST NORTH CENTRAL								
Ohio:								
Cincinnati	10	7	2	----------	0	0	19	1
Cleveland	18	29	3	4	1	3	4	8
Columbus	2	3	5	1	0	1	1	2
Toledo	1	6	1	----------	0	0	0	2
Indiana:								
Fort Wayne	0	2	0	----------	1	0	0	1
Indianapolis	5	7	3	----------	0	0	0	7
South Bend	4	1	0	----------	0	0	0	3
Terre Haute	0	0	0	----------	0	0	0	0
Illinois:								
Chicago	6	57	66	6	1	4	14	24
Springfield	0	1	0	1	0	2	0	1
Michigan:								
Detroit	5	38	35	----------	1	6	4	13
Flint	2	2	3	----------	0	0	0	1
Grand Rapids	0	1	0	----------	0	0	0	1

City reports for week ended September 20, 1930—Continued

Division, State, and city	Chicken pox, cases reported	Diphtheria: Cases, estimated expectancy	Diphtheria: Cases reported	Influenza: Cases reported	Influenza: Deaths reported	Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
EAST NORTH CENTRAL—con.								
Wisconsin:								
Kenosha	1	1	1	----------	0	0	0	2
Madison	4	1	0	----------	----------	1	3	----------
Milwaukee	0	8	1	----------	0	6	6	4
Racine	0	1	1	----------	0	0	0	0
Superior	0	0	0	----------	0	0	0	0
WEST NORTH CENTRAL								
Minnesota:								
Duluth	0	0	0	----------	0	0	0	0
Minneapolis	8	20	7	----------	0	1	7	5
St. Paul	1	10	2	----------	0	0	1	4
Iowa:								
Davenport	0	1	0	----------	----------	0	0	----------
Des Moines	0	2	1	----------	----------	0	0	----------
Sioux City	0	1	1	----------	----------	0	2	----------
Waterloo	0	1	0	----------	----------	0	0	----------
Missouri:								
Kansas City	0	4	1	----------	0	2	1	5
St. Joseph	0	1	1	----------	0	0	1	0
St. Louis	0	23	8	----------	----------	7	3	----------
North Dakota:								
Fargo	0	0	0	----------	0	0	9	3
Grand Forks	0	0	0	----------	----------	0	0	----------
South Dakota:								
Aberdeen	0	0	0	----------	----------	0	0	----------
Sioux Falls	0	0	0	----------	----------	0	0	----------
Nebraska:								
Omaha	1	8	5	----------	0	0	1	4
Kansas:								
Topeka	0	1	0	----------	0	0	0	1
Wichita	0	2	0	----------	0	0	0	3
SOUTH ATLANTIC								
Delaware:								
Wilmington	0	0	0	----------	0	0	0	2
Maryland:								
Baltimore	0	17	3	----------	0	2	4	10
Cumberland	0	0	0	----------	0	0	0	0
Frederick	0	0	0	----------	0	0	0	0
District of Columbia:								
Washington	0	9	3	----------	0	7	0	4
Virginia:								
Lynchburg	0	2	2	----------	0	0	1	0
Norfolk	0	2	2	----------	0	0	1	6
Richmond	0	15	3	----------	0	0	0	0
Roanoke	0	4	4	----------	0	0	0	0
West Virginia:								
Charleston	0	1	0	----------	0	0	1	1
Wheeling	0	1	0	----------	0	1	0	0
North Carolina:								
Raleigh	0	4	1	----------	0	0	0	1
Wilmington	0	0	3	----------	0	0	0	3
Winston-Salem	0	3	0	----------	0	0	0	1
South Carolina:								
Charleston	0	0	0	10	0	0	0	1
Columbia	0	1	0	----------	0	0	1	1
Georgia:								
Atlanta	0	7	3	2	0	0	0	3
Brunswick	0	0	0	----------	0	0	0	0
Savannah	0	1	1	2	0	1	0	0
Florida:								
Miami	0	2	1	----------	0	0	0	1
St. Petersburg	----------	0	----------	----------	0	----------	----------	0
Tampa	0	1	0	1	0	0	0	1

City reports for week ended September 20, 1930—Continued

Division, State, and city	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
		Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
EAST SOUTH CENTRAL								
Kentucky:								
Covington	0	1	0	----------	0	0	0	1
Tennessee:								
Memphis	3	4	2	----------	1	0	0	2
Nashville	0	3	2	----------	0	0	2	2
Alabama:								
Birmingham	0	4	0	----------	2	0	1	5
Mobile	0	1	0	----------	1	0	0	1
Montgomery	0	3	0	2	----------	0	1	----------
WEST SOUTH CENTRAL								
Arkansas:								
Fort Smith	0	0	0	----------	----------	0	0	----------
Little Rock	0	0	1	----------	0	0	0	0
Louisiana:								
New Orleans	0	8	9	1	1	0	0	7
Shreveport	0	0	1	----------	0	0	0	0
Oklahoma:								
Tulsa	0	3	1	----------	----------	0	0	----------
Texas:								
Dallas	0	9	3	1	1	0	1	0
Fort Worth	0	2	1	----------	0	0	0	6
Galveston	0	0	0	----------	0	0	0	2
Houston	0	5	3	----------	0	0	0	2
San Antonio	0	2	1	----------	0	0	0	2
MOUNTAIN								
Montana:								
Billings	0	0	0	----------	0	0	0	0
Great Falls	2	0	0	----------	0	0	0	0
Helena	0	0	0	----------	0	0	0	0
Missoula	0	0	0	----------	0	0	0	0
Idaho:								
Boise	0	0	0	----------	0	0	0	2
Colorado:								
Denver	0	10	3	----------	2	0	2	5
Pueblo	0	1	0	----------	0	5	2	3
New Mexico:								
Albuquerque	0	0	1	----------	0	1	0	0
Arizona:								
Phoenix	0	0	0	----------	0	0	0	1
Utah:								
Salt Lake City	3	3	0	----------	0	0	1	2
Nevada:								
Reno	0	0	0	----------	0	0	0	1
PACIFIC								
Washington:								
Seattle	4	3	0	----------	----------	3	5	----------
Spokane	5	2	2	----------	----------	1	0	----------
Tacoma	2	2	0	----------	0	0	0	2
Oregon:								
Portland	3	6	0	----------	0	2	3	2
Salem	4	0	1	----------	0	0	1	0
California:								
Los Angeles	4	25	2	5	0	3	4	12
Sacramento	2	2	0	----------	0	1	10	0
San Francisco	14	12	2	----------	0	1	2	2

City reports for week ended September 20, 1930—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		
NEW ENGLAND											
Maine:											
Portland	0	1	0	0	0	0	1	1	0	8	22
New Hampshire:											
Concord	0	-------	0	-------	-------	-------	0	-------	-------	-------	-------
Vermont:											
Barre	0	0	0	0	0	1	0	0	0	0	2
Burlington	1	0	0	0	0	0	0	0	0	0	6
Massachusetts:											
Boston	20	11	0	0	0	8	3	2	0	24	198
Fall River	1	0	0	0	0	2	1	1	1	3	25
Springfield	1	1	0	0	0	0	0	1	0	1	39
Worcester	3	10	0	0	0	0	0	0	0	7	42
Rhode Island:											
Pawtucket	1	0	0	0	0	0	0	0	0	0	9
Providence	2	2	0	0	0	4	2	0	1	11	54
Connecticut:											
Bridgeport	2	0	0	0	0	3	0	0	0	1	22
Hartford	1	6	0	0	0	2	1	0	0	4	41
New Haven	1	1	0	0	0	1	1	0	0	2	38
MIDDLE ATLANTIC											
New York:											
Buffalo	7	4	1	0	0	6	2	4	2	32	120
New York	35	16	0	0	0	95	38	13	4	113	1,171
Rochester	2	8	0	0	0	1	1	0	0	10	61
Syracuse	2	2	0	0	0	0	0	0	0	32	37
New Jersey:											
Camden	1	1	0	0	0	0	1	1	0	0	24
Newark	4	5	0	0	0	11	3	1	0	18	88
Trenton	1	3	0	0	0	4	1	0	0	0	32
Pennsylvania:											
Philadelphia	23	37	0	0	0	30	11	6	2	17	456
Pittsburgh	16	23	0	0	0	8	4	8	2	16	158
Reading	0	0	0	0	0	2	1	0	0	1	18
EAST NORTH CENTRAL											
Ohio:											
Cincinnati	6	5	0	0	0	7	3	0	0	2	114
Cleveland	14	22	0	0	0	10	3	3	2	38	173
Columbus	4	1	0	9	0	4	0	1	0	3	75
Toledo	4	3	0	1	0	2	2	1	0	6	66
Indiana:											
Fort Wayne	1	0	1	0	0	1	1	0	0	0	20
Indianapolis	5	2	1	0	0	2	3	0	0	8	-------
South Bend	2	2	0	0	0	1	0	1	0	1	18
Terre Haute	1	0	0	0	0	0	1	1	0	0	18
Illinois:											
Chicago	45	52	0	4	0	44	6	3	1	57	641
Springfield	0	0	0	0	0	1	1	1	0	1	13
Michigan:											
Detroit	34	31	0	1	0	26	4	3	1	50	258
Flint	6	8	1	1	0	0	1	1	0	2	23
Grand Rapids	4	7	0	0	0	2	0	0	0	0	34
Wisconsin:											
Kenosha	1	2	0	0	0	0	0	0	0	0	13
Madison	0	1	0	0	-------	-------	0	0	-------	1	-------
Milwaukee	13	4	0	0	0	9	1	3	0	31	99
Racine	3	8	0	0	0	1	0	0	0	5	16
Superior	1	1	0	0	0	0	0	0	0	0	10
WEST NORTH CENTRAL											
Minnesota:											
Duluth	5	0	0	0	0	3	0	0	0	8	20
Minneapolis	22	3	0	0	0	6	1	2	0	6	100
St. Paul	9	1	1	0	0	2	1	1	0	8	44
Iowa:											
Davenport	1	0	0	1	-------	-------	0	0	-------	0	-------
Des Moines	3	2	0	0	-------	-------	0	0	-------	0	19
Sioux City	0	5	0	0	-------	-------	0	1	-------	1	-------
Waterloo	1	1	0	0	-------	-------	0	0	-------	1	-------
Missouri:											
Kansas City	5	0	0	0	0	4	2	1	1	8	79
St. Joseph	0	3	0	0	0	0	0	0	0	0	22
St. Louis	12	4	0	1	0	8	5	7	0	0	142

City reports for week ended September 20, 1930—Continued

Division, State, and city	Scarlet fever: Cases, estimated expectancy	Scarlet fever: Cases reported	Smallpox: Cases, estimated expectancy	Smallpox: Cases reported	Smallpox: Deaths reported	Tuberculosis, deaths reported	Typhoid fever: Cases, estimated expectancy	Typhoid fever: Cases reported	Typhoid fever: Deaths reported	Whooping cough, cases reported	Deaths all causes
WEST NORTH CENTRAL—contd.											
North Dakota:											
Fargo	1	0	0	0	0	1	0	3	0	3	12
Grand Forks	0	0	0	0	-------	-------	0	0	-------	0	-------
South Dakota:											
Aberdeen	0	1	0	0	-------	-------	0	0	-------	0	-------
Sioux Falls	1	1	0	2	-------	-------	1	2	-------	0	7
Nebraska:											
Omaha	2	6	0	10	0	3	0	0	0	0	56
Kansas:											
Topeka	2	0	0	0	0	0	0	0	0	1	17
Wichita	2	0	0	0	0	1	2	0	0	1	26
SOUTH ATLANTIC											
Delaware:											
Wilmington	1	0	0	0	0	0	1	2	1	0	28
Maryland:											
Baltimore	7	3	0	0	0	16	8	8	2	24	224
Cumberland	0	0	0	0	0	0	0	0	0	0	4
Frederick	0	1	0	0	0	0	0	1	0	0	4
Dist. of Columbia:											
Washington	7	3	0	0	0	10	3	4	1	2	112
Virginia:											
Lynchburg	0	0	0	0	0	0	0	2	0	0	10
Norfolk	1	4	0	0	0	0	0	4	1	0	-------
Richmond	5	4	0	0	0	1	1	0	0	0	40
Roanoke	2	0	0	0	0	0	0	0	0	2	14
West Virginia:											
Charleston	3	1	0	0	0	0	0	2	0	1	12
Wheeling	1	1	0	0	0	1	0	0	0	1	17
North Carolina:											
Raleigh	0	2	0	0	0	0	0	1	0	3	11
Wilmington	1	1	0	0	0	1	0	0	0	2	17
Winston-Salem	3	1	0	0	0	1	1	0	0	0	16
South Carolina:											
Charleston	0	1	0	0	0	1	2	4	0	0	20
Columbia	0	1	0	0	0	1	0	0	0	0	19
Georgia:											
Atlanta	5	2	0	0	0	10	3	3	2	1	79
Brunswick	0	0	0	0	0	0	0	3	0	0	8
Savannah	0	1	0	0	0	2	0	4	0	0	26
Florida:											
Miami	0	0	0	0	0	1	1	0	0	0	22
St. Petersburg	0	-------	0	-------	0	0	0	-------	0	-------	7
Tampa	0	0	0	0	0	1	1	0	0	3	22
EAST SOUTH CENTRAL											
Kentucky:											
Covington	1	0	0	0	0	0	0	0	0	0	20
Tennessee:											
Memphis	2	3	0	0	0	3	5	2	1	2	89
Nashville	2	1	0	0	0	3	4	2	0	0	27
Alabama:											
Birmingham	4	1	0	0	0	4	4	3	0	1	56
Mobile	0	1	0	0	0	0	0	1	0	0	27
Montgomery	1	0	0	0	-------	-------	0	0	-------	0	-------
WEST SOUTH CENTRAL											
Arkansas:											
Fort Smith	0	0	0	0	-------	-------	1	0	-------	0	-------
Little Rock	0	1	0	0	0	1	2	0	0	0	-------
Louisiana:											
New Orleans	2	8	0	0	0	10	4	13	0	0	120
Shreveport	0	2	0	0	0	2	0	1	0	0	29
Oklahoma:											
Tulsa	2	3	0	1	-------	-------	2	0	-------	0	-------
Texas:											
Dallas	3	1	0	0	0	2	3	2	1	2	40
Fort Worth	1	0	0	0	0	1	0	1	1	0	36
Galveston	0	1	0	0	0	0	0	1	1	0	10
Houston	1	0	0	0	0	4	0	1	0	0	71
San Antonio	0	2	0	0	0	9	1	0	0	0	59

City reports for week ended September 20, 1930—Continued

Division, State, and city	Scarlet fever: Cases, estimated expectancy	Scarlet fever: Cases reported	Smallpox: Cases, estimated expectancy	Smallpox: Cases reported	Smallpox: Deaths reported	Tuberculosis, deaths reported	Typhoid fever: Cases, estimated expectancy	Typhoid fever: Cases reported	Typhoid fever: Deaths reported	Whooping cough, cases reported	Deaths all causes
MOUNTAIN											
Montana:											
Billings	0	0	0	0	0	0	0	0	0	9	5
Great Falls	0	1	0	0	0	0	0	0	0	2	4
Helena	0	3	0	0	0	0	0	0	0	0	7
Missoula	1	0	0	0	0	0	0	0	0	0	3
Idaho											
Boise	0	0	0	0	0	0	0	0	0	0	6
Colorado:											
Denver	5	3	0	0	0	7	2	0	0	18	65
Pueblo	0	0	0	0	0	1	1	0	0	2	11
New Mexico:											
Albuquerque	0	0	0	0	0	4	1	2	1	0	12
Arizona:											
Phoenix	1	1	0	0	0	1	0	0	0	0	13
Utah:											
Salt Lake City	3	1	0	0	0	2	2	0	0	21	
Nevada:											
Reno	0	0	0	0	0	0	0	0	0	0	5
PACIFIC											
Washington:											
Seattle	5	19	0	0			2	1		12	
Spokane	3	0	1	0			0	0		4	
Tacoma	1	3	1	2	0	0	0	1	0	0	17
Oregon:											
Portland	4	0	2	0	0	1	1	2	0	4	55
Salem	0	0	0	0	0	0	1	0	0	0	
California:											
Los Angeles	11	6	1	0	0	23	2	1	0	32	253
Sacramento	1	1	1	0	0	4	1	4	1	8	20
San Francisco	8	4	0	0	0	9	2	0	0	7	134

Division, State, and city	Meningococcus meningitis: Cases	Meningococcus meningitis: Deaths	Lethargic encephalitis: Cases	Lethargic encephalitis: Deaths	Pellagra: Cases	Pellagra: Deaths	Poliomyelitis (infantile paralysis): Cases, estimated expectancy	Poliomyelitis: Cases	Poliomyelitis: Deaths
NEW ENGLAND									
Maine:									
Portland	0	0	0	0	0	0	1	12	0
Massachusetts:									
Boston	0	0	0	0	0	0	3	13	3
Rhode Island:									
Providence	0	0	0	0	0	0	1	2	0
MIDDLE ATLANTIC									
New York:									
Buffalo	0	0	0	0	0	0	1	3	0
New York [1]	6	5	4	5	0	0	19	4	0
Rochester	0	0	0	0	0	0	1	13	6
Syracuse	0	0	0	0	0	0	1	9	1
New Jersey:									
Trenton	1	0	0	0	0	0	0	0	0
Pennsylvania:									
Philadelphia	1	1	0	0	0	0	2	7	0
Pittsburgh	1	0	0	0	0	0	1	1	0
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	0	0	0	0	0	0	0	4	0
Cleveland	0	0	0	0	0	0	2	20	1
Columbus	1	1	1	1	1	1	0	2	0
Toledo	0	0	0	0	0	0	0	3	0

[1] Typhus fever, 2 cases and 1 death: 1 case at New York City, N. Y.; 1 case at Savannah, Ga.; and 1 death at Mobile, Ala.

City reports for week ended September 20, 1930—Continued

Division, State, and city	Meningococcus meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
EAST NORTH CENTRAL—con.									
Indiana:									
Indianapolis	3	1	0	0	0	0	0	6	0
Illinois:									
Chicago	2	1	0	0	0	0	3	16	0
Springfield	1	0	0	0	0	0	0	1	0
Michigan:									
Detroit	3	1	1	0	0	0	4	3	1
Grand Rapids	0	0	0	0	0	0	0	1	0
Wisconsin:									
Madison	0	0	0	0	0	0	0	1	0
Milwaukee	0	0	0	0	0	0	0	6	1
WEST NORTH CENTRAL									
Minnesota:									
Minneapolis	0	0	0	0	0	0	0	4	0
St. Paul	0	0	1	0	0	0	1	1	0
Iowa:									
Davenport	0	0	0	0	0	0	0	1	0
Des Moines	0	0	0	0	0	0	1	5	0
Sioux City	0	0	0	0	0	0	0	5	2
Waterloo	0	0	0	0	0	0	1	2	0
Missouri:									
Kansas City	0	1	0	0	0	0	0	4	0
St. Louis	2	1	0	0	0	0	1	1	0
North Dakota:									
Grand Forks	0	0	0	0	0	0	0	1	0
South Dakota:									
Sioux Falls	0	0	0	0	0	0	1	2	0
Nebraska:									
Omaha	0	0	0	0	0	0	1	2	0
Kansas:									
Topeka	0	0	0	0	0	0	0	5	0
Wichita	0	0	0	0	0	0	0	2	0
SOUTH ATLANTIC [1]									
Maryland:									
Baltimore	0	0	1	1	0	0	2	0	0
Virginia:									
Norfolk	0	0	0	0	0	0	0	2	0
Richmond	0	0	0	0	0	1	1	0	0
North Carolina:									
Raleigh	0	0	0	0	3	3	0	0	0
Winston-Salem	0	0	0	0	1	0	0	0	0
South Carolina:									
Charleston	0	0	0	0	6	1	0	0	0
Columbia	0	1	0	0	0	0	0	0	0
Georgia:									
Atlanta	1	1	0	0	1	1	0	0	0
Brunswick	0	0	0	0	1	1	0	0	0
EAST SOUTH CENTRAL									
Tennessee:									
Memphis	1	2	1	0	0	0	0	1	0
Alabama:									
Birmingham	0	0	0	0	1	0	0	0	0
Mobile [1]	0	0	0	0	1	1	0	0	0
Montgomery	0	0	0	0	1	0	0	0	0
WEST SOUTH CENTRAL									
Arkansas:									
Little Rock	0	0	1	0	0	0	0	0	0
Louisiana:									
New Orleans	0	0	0	0	5	0	0	0	0
Shreveport	0	0	0	0	0	0	0	1	0
Texas:									
Dallas	0	0	0	0	1	0	1	0	0
Fort Worth	0	0	0	0	0	0	0	1	0
Galveston	0	0	0	0	0	0	0	2	0
Houston	0	0	0	0	0	0	0	1	0
San Antonio	0	0	0	0	0	0	0	1	0

[1] Typhus fever, 2 cases and 1 death: 1 case at New York City, N. Y.; 1 case at Savannah, Ga.; and 1 death at Mobile, Ala.

City reports for week ended September 20, 1930—Continued

Division, State, and city	Meningococcus meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
MOUNTAIN									
Montana:									
Great Falls	0	0	0	0	0	0	1	1	0
Colorado:									
Pueblo	0	0	0	0	0	0	0	2	0
Utah:									
Salt Lake City	3	0	0	0	0	0	0	0	0
PACIFIC									
Washington:									
Tacoma	0	1	0	0	0	0	1	0	0
California:									
Los Angeles	0	0	0	0	0	0	1	19	0
San Francisco	2	1	0	0	0	0	0	16	0

The following table gives the rates per 100,000 population for 98 cities for the 5-week period ended September 20, 1930, compared with those for a like period ended September 21, 1929. The population figures used in computing the rates are approximate estimates, authoritative figures for many of the cities not being available. The 98 cities reporting cases have an estimated aggregate population of more than 32,000,000. The 91 cities reporting deaths have more than 30,500,000 estimated population.

Summary of weekly reports from cities, August 17 to September 20, 1930—Annual rates per 100,000 population, compared with rates for the corresponding period of 1929 [1]

DIPHTHERIA CASE RATES

	Week ended—									
	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
98 cities	34	61	[2] 40	62	41	[3] 64	45	66	[4] 47	75
New England	40	63	[5] 53	45	35	[3] 46	55	47	[4] 31	49
Middle Atlantic	28	58	31	54	31	45	28	41	38	54
East North Central	41	69	46	75	49	86	64	95	75	96
West North Central	25	25	27	25	34	38	55	58	47	64
South Atlantic	37	75	[6] 60	90	60	92	62	133	42	114
East South Central	13	55	13	116	54	75	27	116	27	137
West South Central	67	141	71	137	60	133	49	61	67	149
Mountain	43	26	[7] 70	17	43	70	34	26	26	70
Pacific	26	29	19	27	38	34	26	22	14	19

[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 estimates as of July 1, 1930 and 1929, respectively.
[2] Hartford, Conn., Columbia, S. C., and Helena, Mont., not included.
[3] Pawtucket, R. I., not included.
[4] Concord, N. H., not included.
[5] Hartford, Conn., not included.
[6] Columbia, S. C., not included.
[7] Helena, Mont., not included.

Summary of weekly reports from cities, August 17 to September 20, 1930—Annual rates per 100,000 population, compared with rates for the corresponding period of 1929—Continued

MEASLES CASE RATES

	Week ended—									
	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
98 cities	28	20	[2] 20	14	24	[3] 12	16	16	[4] 16	15
New England	60	38	[5] 19	20	33	[3] 21	38	16	[4] 18	31
Middle Atlantic	33	13	23	8	28	7	20	12	17	7
East North Central	21	33	8	22	13	16	9	20	14	17
West North Central	19	8	27	8	30	2	15	6	19	6
South Atlantic	18	0	[6] 30	13	26	2	5	7	20	7
East South Central	7	14	13	7	27	14	7	7	0	7
West South Central	0	4	11	8	0	4	4	11	0	8
Mountain	26	52	[7] 35	44	51	26	34	61	43	26
Pacific	47	39	35	19	40	46	19	39	21	51

SCARLET FEVER CASE RATES

	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
98 cities	33	41	[2] 42	41	43	[3] 52	51	54	[4] 62	68
New England	47	45	[5] 53	38	55	[3] 83	51	52	[4] 72	49
Middle Atlantic	27	15	28	16	25	25	27	16	47	25
East North Central	35	63	48	63	47	70	85	90	91	121
West North Central	34	58	42	44	57	67	34	58	44	92
South Atlantic	27	34	[6] 67	45	66	64	51	47	40	66
East South Central	34	68	115	34	67	41	40	96	40	28
West South Central	37	65	15	72	67	34	26	91	56	72
Mountain	86	44	[7] 88	61	34	17	77	70	69	113
Pacific	33	51	31	46	33	77	73	72	78	68

SMALLPOX CASE RATES

	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
98 cities	2	3	[2] 2	4	3	[3] 4	3	3	[4] 5	5
New England	0	0	[5] 0	0	0	[3] 0	0	0	[4] 0	0
Middle Atlantic	0	0	0	0	0	0	0	0	0	0
East North Central	0	4	0	10	3	10	2	4	9	10
West North Central	8	6	8	4	13	2	27	8	21	6
South Atlantic	2	0	[6] 0	0	4	0	0	2	0	0
East South Central	0	0	0	0	0	0	0	0	0	0
West South Central	7	8	4	4	0	0	0	0	0	0
Mountain	0	26	[7] 0	0	0	9	0	9	0	52
Pacific	12	17	12	14	14	14	9	12	5	17

TYPHOID FEVER CASE RATES

	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
98 cities	19	30	[2] 25	27	21	[3] 18	27	21	[4] 22	22
New England	16	27	[5] 12	29	11	[3] 2	20	16	[4] 11	13
Middle Atlantic	14	34	21	28	22	20	25	18	16	14
East North Central	9	12	10	13	12	13	17	10	11	11
West North Central	21	13	19	23	13	12	21	17	28	6
South Atlantic	55	51	[6] 82	52	53	34	64	34	62	26
East South Central	88	103	47	103	54	55	54	89	54	0
West South Central	26	88	71	50	49	15	56	50	67	84
Mountain	26	70	[7] 14	17	9	44	60	70	0	340
Pacific	7	5	9	12	9	14	5	19	17	7

[2] Hartford, Conn., Columbia, S. C., and Helena, Mont., not included.
[3] Pawtucket, R. I., not included.
[4] Concord, N. H., not included.
[5] Hartford, Conn., not included.
[6] Columbia, S. C., not included.
[7] Helena, Mont., not included.

Summary of weekly reports from cities, August 17 to September 20, 1930—Annual rates per 100,000 population, compared with rates for the corresponding period of 1929—Continued

INFLUENZA DEATH RATES

	Week ended—									
	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
91 cities	3	3	[2] 4	2	3	[3] 3	3	3	[4] 3	2
New England	0	2	[5] 0	0	0	[3] 2	0	0	[4] 2	2
Middle Atlantic	3	3	3	2	3	2	4	2	2	0
East North Central	1	4	4	2	2	6	3	2	3	2
West North Central	0	0	3	0	6	0	0	6	0	6
South Atlantic	7	2	[6] 7	2	7	4	2	2	0	2
East South Central	0	0	7	0	0	7	22	7	29	7
West South Central	4	8	8	4	11	0	0	12	8	0
Mountain	9	9	[7] 0	9	9	0	0	9	17	9
Pacific	9	0	3	0	0	3	0	0	0	9

PNEUMONIA DEATH RATES

	Aug. 23, 1930	Aug. 24, 1929	Aug. 30, 1930	Aug. 31, 1929	Sept. 6, 1930	Sept. 7, 1929	Sept. 13, 1930	Sept. 14, 1929	Sept. 20, 1930	Sept. 21, 1929
91 cities	46	54	[2] 53	55	55	[3] 57	55	55	[4] 58	54
New England	51	25	[5] 48	49	51	[3] 44	62	36	[4] 51	29
Middle Atlantic	55	60	60	61	68	75	67	66	68	59
East North Central	28	47	50	51	36	44	43	47	43	47
West North Central	35	48	38	33	50	57	44	45	74	39
South Atlantic	48	73	[6] 52	56	62	64	53	52	51	66
East South Central	74	37	52	52	103	75	29	90	81	67
West South Central	61	66	38	98	54	31	61	55	50	51
Mountain	51	52	[7] 53	44	51	52	120	70	112	104
Pacific	49	50	55	28	34	31	31	41	49	57

[2] Hartford, Conn., Columbia, S. C., and Helena, Mont, not included.
[3] Pawtucket, R. I., not included.
[4] Concord, N. H., not included.
[5] Hartford, Conn., not included.
[6] Columbia, S. C., not included.
[7] Helena, Mont., not included.

FOREIGN AND INSULAR

AUSTRALIA

Infant mortality—Year 1929.—During the year 1929 the infant mortality rates per 1,000 births in the States of Australia were as follows:

Year 1929

State	Infant mortality rate per 1,000 births	State	Infant mortality rate per 1,000 births
New South Wales	56.44	South Australia	40.93
Victoria	47.23	Western Australia	56.24
Queensland	46.03	Tasmania	53.16

CANADA

Provinces—Communicable diseases—Week ended September 13, 1930.—The Department of Pensions and National Health of Canada reports cases of certain communicable diseases for the week ended September 13, 1930, as follows:

Province	Cerebrospinal fever	Dysentery	Influenza	Poliomyelitis	Smallpox	Typhoid fever
Prince Edward Island [1]						
Nova Scotia	2			1		
New Brunswick						7
Quebec	2			1		18
Ontario	2		2	45	6	8
Manitoba				5		6
Saskatchewan	1			10	1	5
Alberta				17		2
British Columbia	2	12			1	
Total	9	12	2	79	8	46

[1] No disease included in the table was reported during the week.

Ontario Province—Communicable diseases—Five weeks ended August 30, 1930.—During the five weeks ended August 30, 1930, and in the corresponding period of the year 1929, certain communicable diseases were reported in the Province of Ontario, Canada, as follows:

Disease	1929		1930	
	Cases	Deaths	Cases	Deaths
Cerebrospinal meningitis	8	1	27	4
Chancroid	1		1	
Chicken pox	228		218	
Conjunctivitis			1	
Diphtheria	189	9	225	13
Dysentery	2	1	1	
Erysipelas	1	1		1
German measles	2		14	
Goiter			4	3
Gonorrhea	223		204	
Influenza	1	2	9	2
Lethargic encephalitis				1
Measles	403	1	201	
Mumps	116		28	
Paratyphoid fever	1		2	
Pneumonia		102		74
Poliomyelitis	104	5	175	16
Puerperal septicemia			2	2
Scarlet fever	145		182	3
Septic sore throat	4		3	
Smallpox [1]	17		22	
Syphilis	178	2	187	1
Tetanus		1	1	1
Tuberculosis	157	58	98	91
Typhoid fever	102	3	71	
Undulant fever			10	
Whooping cough	486	2	367	3

[1] Cases of smallpox for the 5-week period of 1930 were distributed as follows: Ottawa, 9; Orangeville, 3; Hanover, 2; Kingston, 2; Nairn, 2; North Bay, 2; Gloucester, 1; and Humberstone, 1.

Quebec Province—Communicable diseases—Week ended September 20, 1930.—The Bureau of Health of the Province of Quebec, Canada, reports cases of certain communicable diseases for the week ended September 20, 1930, as follows:

Disease	Cases	Disease	Cases
Chicken pox	4	Poliomyelitis	3
Diphtheria	22	Scarlet fever	52
Erysipelas	2	Smallpox	1
German measles	1	Tuberculosis	44
Measles	19	Typhoid fever	30
Mumps	12	Whooping cough	40
Ophthalmia neonatorum	1		

MEXICO

Vera Cruz—Deaths from certain diseases—Six weeks ended August 23, 1930.—During the six weeks ended August 23, 1930, deaths from certain diseases were reported in Vera Cruz, Mexico, as follows:

Disease	Week ended—					
	July 19, 1930	July 26, 1930	Aug. 2, 1930	Aug. 9, 1930	Aug. 16, 1930	Aug. 23, 1930
Bronchitis	1	1		1		2
Cancer	3	1		1		1
Cerebrospinal meningitis	2				1	
Dysentery			1			
Gastrointestinal disorders	12	14	6	11	11	13
Hookworm disease				1	1	
Malaria		1	1	1	1	2
Measles	1			1		
Pneumonia	3	7		2	1	6
Syphilis		2			2	
Tetanus		1	1			
Tuberculosis	6	3	3	8	3	
Typhoid fever	1		1	1		2

TRINIDAD (BRITISH WEST INDIES)

Port of Spain—Vital statistics (comparative)—July, 1930.—The following statistics for the month of July for the years 1929 and 1930 are taken from a report issued by the Public Health Department of Port of Spain, Trinidad:

	July, 1929	July, 1930		July, 1929	July, 1930
Number of births	178	147	Deaths under 1 year	30	14
Birth rate per 1,000 population	31.6	25.7	Infant mortality rate per 1,000 births	168.5	95.2
Number of deaths	150	80			
Death rate per 1,000 population	26.6	14.00			

VIRGIN ISLANDS

Communicable diseases—August, 1930.—During the month of August, 1930, cases of certain communicable diseases were reported in the Virgin Islands, as follows:

St. Thomas and St. John:	Cases	St. Croix:	Cases
Gonorrhea	5	Gonorrhea	1
Syphilis	18	Leprosy	1
Tuberculosis, chronic pulmonary	1	Syphilis	11

YUGOSLAVIA

Communicable diseases—August, 1930.—During the month of August, 1930, certain communicable diseases were reported in Yugoslavia, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	110	13	Puerperal fever	9	1
Cerebrospinal meningitis	4	2	Rabies	2	2
Diphtheria and croup	631	88	Scarlet fever	714	124
Dysentery	468	45	Tetanus	36	20
Lethargic encephalitis		1	Typhoid fever	688	54
Measles	110	13	Typhus fever	2	1
Poliomyelitis	1	1			

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

From medical officers of the Public Health Service, American consuls, International Office of Public Hygiene, Pan American Sanitary Bureau, 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		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930: 5	12	19	26	August, 1930: 2	9	16	23	30	September, 1930: 6	13	20	27
Afghanistan	C						[1] P						P					
China:																		
Canton	C			3	2		2	1										
	D						1											
Shanghai	C													8	4			
Swatow	C			3	7					1								
India	C	10,817	41,462	56,311	37,102	6,728	5,520	5,701	8,172	7,199								
	D	5,866	27,906	44,878	25,711	3,712	3,095	3,133	3,882	3,676								
Bassein	C		7	7											1			
	D		5	5														
Bombay	C	4								3	2	3	6					
	D									2	1	1	4					
Calcutta	C	354	647	609	327	81	53	49	37	18	10	17	18	8	10			
	D	220	414	372	179	54	28	23	23	7	7	10	6	3	3			
Negapatam	C				1													
	D				1													
Rangoon	C	2	1	9	6	1				1					1			
	D	2	1	3	4	1				1								
India (French):																		
Chandernagor	C	1	6	6	3			1										
	D	3	5	6	2													
Karikal	C	12	1		3													
	D	9	1		3													
India: Portuguese	C											1						
Indo-China (see also table below):																		
Pnompenh	C		2	1	40	9	16	7		5	3	3						
	D	6		5	18	6	9	5	2	3	2	1						
Saigon and Cholon	C	14	76	160	48	7	1	1	1	2	2	1						
	D	6	55	101	23	3					1							

[1] An outbreak of cholera was reported in June, 1930, in Afghanistan.

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

CHOLERA—Continued

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

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930 5	12	19	26	August, 1930 2	9	16	23	30	September, 1930 6	13	20	27
Philippine Islands: [2]																		
Ports—																		
Cebu	C				1	20	13	13	9	5	4			1	1			
	D					9	7	12	8	4	4			1	1			
Iloilo	C						1	11	17	9	19	32	4	3	4	1	2	1
	D							9	13	10	18	19	9	4	5	2	3	2
Manila	C			1							1			16	13	5	4	2
	D													5	6	1		
Provinces—																		
Antique	C									14	3		3	2	21	12	8	12
	D									7	3		2	1	10	12	7	8
Bohol	C										54	54	31	24	26	4	1	
	D										29	32	15	11	11	2		
Bulacan	C				3		1	1	2	1				1	1	1		
	D				1									1				
Capiz	C							2	1	1	1			1				
	D							1	1	1	1							
Cebu	C			1	355	313	222	115	63	55	26	4		1	16	8		
	D			1	170	131	83	60	29	32	15	3		1	6	4		
Iloilo	C				2	20	45	85	159	143	209	127	88	74	57	66	46	18
	D				1	10	23	64	96	77	143	91	64	51	44	37	26	15
La Union	C						1											
Leyte	C				47	11												
	D				19	11												
Masbate	C				10	14	32	25	21	15	19							
	D				3	2	18	5	10	5	9							
Misamis, Occidental	C					1	2											
	D					1	2											
Negros, Occidental	C			10	140	62	163	172	171	151	79	45	72	40	47	21	15	8
	D			7	88	42	90	122	114	97	64	33	47	31	32	18	9	6
Negros, Oriental	C					1	1	6	15	6	2							
	D						1	3	9	1	3							
Nueva Acija	C								1									
	D								1									

Pampanga	C				2								1				
Pangasinan	C					2		1		1							
	D					2				1							
Rizal	C				1		1										
	D				1		1										
Samar	C										5	8	10			2	1	4
	D										5	8	8			2		4
Surigao	C										15	2	21	3				
	D										9	2	10	3				
Tarlac	C									1								
Siam	C	1	29	33	27	8	3	8	1		1	1	15					
	D		13	21	19	4	1	3	1		1		1					
Bangkok	C	2	15	9	12		3	4	1	1		1						
	D	1	4	3	5		1	1	1	1		1						
Nagara Pathom	C		10															
	D		2															
Songkla	C						8		2									
	D						4		2									
On vessel:																		
S. S. Sassari at Massoua, from Jeddah	C			1														
	D			1														
On small boat at Port Cebu, from Bantayan Island	C				1													
	D				1													

Place		February, 1930	March, 1930	April, 1930	May, 1930			June, 1930			July, 1930			August, 1930	
					1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20
Indo-China (French) (see also table above):															
Annam [3]	C	4	52	60		20	3	2	14				1		3
Cambodia [3]	C	90	81	24	5	31	52	56	88				43	37	22
Cochin-China [3]	C	65	82	48	188	224	259	147	126				46	22	5

[2] Figures for cholera in the Philippine Islands are subject to correction.
[3] Reports incomplete.

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

PLAGUE

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

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930: 5	12	19	26	August, 1930: 2	9	16	23	30	September, 1930: 6	13	20
Algeria:																	
Algiers	C						1	2			1		6	1	2	6	2
Constantine	C				1	1											
Oran	C							2	1	1	1	1	1	1	2	3	
Philippeville	C														1		
Azores: Ponta Delgada	C		8														
	D		5														
Belgian Congo	C					2				1		1		2	3		
	D					2				1		1			3		
British East Africa (see also table below):																	
Tanganyika	C		44														
	D		20														
Uganda	C	98	117	227	406		50	100	78	52	67						
	D	87	105	195	328		47	97	69	50	64						
Canary Islands: Las Palmas	D										1						
Ceylon:																	
Colombo	C	4	1	6	1	1	2					1	1	2			
	D	4	1	5	1	1	2					1	1	3			
Plague-infected rats		2	4		1												
Chile: Antofagasta	C	1	1														
	D	2	1														
China: Manchuria—Tungliau and Nungan	C												30			29	P
Dutch East Indies:																	
Batavia and West Java	C	124	87	82	98	19	25	18	22	19	30	20					
	D	122	81	82	98	19	25	18	22	19	30	20					
Plague-infected rats		3	8	5	4						1						
Java and Madura	D	223	178	185	202	55	56	58	48	45	51						
Ecuador (see table below).																	
Egypt:																	
Alexandria	C	4	2	13	19	8	8	3	4	2	2	4	8	3	3	2	2
	D	1	2	3	9	2	8	2	3	2	1	3		5	1	2	
Assiout	C		14	20	9	1	1										
	D		5	5	3	1	1										
Beheira	C	4															

Beni-Suef	C	4											1				
Dakahlieh	C	5	5	11	1												
	D	1		2													
Gharbieh	C		1							3							
	D		1							1							
Girga	C		1				1							1			
Minieh	C			7	10	2	1										
	D			1	1												
Port Said	C		1	2	2				1	1							
France:																	
Marseille	C													2	2	1	
St. Ouen	C							1									
	D							1									
Gambia	C												4				
	D												4				
Greece (see also table below):																	
Patras	C	1			1			1									
Pyrgos	C	1															
Hawaii Territory, Hamakua, Hawaii: Plague-infected rats					1												
India	C	4,087	2,215	648	240	70	75.	87	145	145							
	D	3,344	1,960	635	187	46	46	62	102	98							
Bassein	C	3												1		1	
	D	1												1		2	
Bombay	C	7	4	6	3				1						1		
	D	5	8	5	2				1						1		
Plague-infected rats		86	108	81	26	13	14	10	15	10	8	9	9	12	9	11	
Madras Presidency	C	157	44	38	39	10	1	10	26	35	21	7					
	D	87	19	11	22	4	1	9	17	13	9	1					
Rangoon	C	3	5	4	1				2	2	1			2	1	5	
	D	3	4	3	1				2	1	1			2	1	4	
Plague-infected rats		3	4	5	1	2	2		2	4		2	1	2			
India (Portuguese)	D			7								P					
Indo-China (see also table below):																	
Pnompenh	C		3	8	6		1	1			2		2	2	1		
	D	13	4	1	7		1	1									
Saigon and Cholon	C	1		1	2							1			1		
	D	1			1												
Iraq: Baghdad	C	7	6	37	28	10	4	2	2	4	3	2					
	D	4	2	18	15	5		1	1		2	1					
Japan: Osaka (vicinity of)—Plague-infected rats		4	3														
Kwang-Chow-Wan	C	7	37	34	31				4			1					
Madagascar (see also table below): Tamatave	C		1		1											P	
Morocco	C	55	121	71	3				1		8	7					
	D	18	45	34	4						1	1					
Nigeria: Lagos	C	13		2	5	1				2	1	3	1		1		
	D	5		2	5	1				2	1	3	1				
Plague-infected rats		25	7	17	11	2	3	6	7			4	4				
Senegal (see table below).																	

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

PLAGUE—Continued

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

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930: 5	12	19	26	August, 1930: 2	9	16	23	30	September, 1930: 6	13	20
Siam	C	16	5	5						2	3						
	D	15	6	4						1	3						
Bangkok	C	5		5						1	2						
	D	4		4							2						
Nagara Pathom	C	1	10														
	D	1	9														
Nagara Rajsima	C	1	1							1			1		1		
	D	1	1							1			1		1		
Syria: Beirut	C				12		2	4	3		1		1	3	2		
Tripolitania	C											2					
Tunisia:																	
Sfax district	C		1	21	9				6		1						
Tunis	C	1	4	1	1		1	4									
	D				1		1										
Union of Socialist Soviet Republics:																	
Salsk Region	C				2			3	2	4		3					
	D				1			2	2	3		2					
Stavropol Region	C				1												
	D				1												
Union of South Africa:																	
Cape Province	C	1		P	1			1									
	D	1						1				1					
Orange Free State	C	5	1														
	D	3															
Transvaal	C	1															
	D	1															

Place		March, 1930	April, 1930	May, 1930	June, 1930	July, 1930	August, 1930
British East Africa (see also table above):							
Kenya	C	85	16	171	107	97	27
Ecuador: Guayaquil	C	2	0	0	0		
	D	0	0	0	0		
Plague-infected rats		2	0	0	0		
Greece (see also table above)	C		1		1		
Indo-China (see also table above)	C	27	4		11	1	2
Madagascar (see also table above):							
Ambositra Province	C	25	14	1			
	D	20	12	1			
Antisirabe Province	C	38	46	19	3		
	D	36	45	19	3		
Itasy Province	C	4					
	D	4					
Miarinarivo Province	C	14	1	5	1		
	D	14	1	5	1		
Madagascar (see also table above)—Con.							
Moramanga Province	C	5	3	1	3		
	D	5	3		3		
Tananarive Province	C	52	39	15	16		
	D	52	38	14	16		
Senegal:							
Baol [1]	C	18	24	13	2	62	74
	D	8	12	11	2	48	20
Dakar [1]	C		2	52	53	140	90
	D		2	42	117	122	71
Louga [1]	C		33	54	60	138	49
	D		10	27	21	103	20
Thies [1]	C	3	12	21	52	54	34
	D	2	9	8	35	30	19
Tivaouane [1]	C	11	71	135	43	119	74
	D	8	38	69	28	70	40

[1] Incomplete reports.

SMALLPOX

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930				August, 1930					September, 1930		
						5	12	19	26	2	9	16	23	30	6	13	20
Algeria:																	
Algiers	C	5	1	3			1				1		2				
Constantine	C				1			1									
Oran	C	1															
Arabia: Aden	C	3	1			1											
Bolivia: La Paz.[1]																	
British East Africa (see also table below):																	
Tanganyika	C	103	57	409	1,610	64	4		100	26	51	44	121				
	D	7	14	70	301	13	2		27	4		3	30				
British South Africa:																	
Northern Rhodesia	C	9	1	59													
	D		2	9													
Southern Rhodesia	C		66	155	79	1	12	18									
	D		1	18													

[1] From Jan. 1 to May 31, 1930, 44 deaths from smallpox were reported in La Paz, Bolivia.

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

SMALLPOX—Continued

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

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930: 5	12	19	26	August, 1930: 2	9	16	23	30	September, 1930: 6	13	20
Canada:																	
Alberta	C	10	4				2	1	2	1							
Edmonton	C	4	3														
British Columbia—Vancouver	C	20	17	4	2	2	2	1	1	1	1		2			1	
Manitoba	C	4	4	10	4												
Ontario	C	100	77	82	47	3	5	6	10	8		5	4			6	
North Bay	C			1													
Ottawa	C	19	21	25	15	1	1	4	7	5	1	1		2	1	2	
Toronto	C			4	4		1									1	
Quebec	C				4	3					2		1				
Montreal	C									7							
Saskatchewan	C	47	41	39	22		2		3				8			1	
Regina	C			4													
Ceylon: Angoda, Western Province	C		6														
	D		2														
China:																	
Canton	C	6	3														
	D	2	3														
Chungking	C		P	P	1	P	P	P	P	P		P					
Foochow	C		P	P	P		P		P		P						
Hong Kong	C	38	18	12	4		2										
	D	25	23	9	3		1										
Manchuria—																	
Harbin	C		1	20	4												
Kwantung—Dairen	C		2	8	16	8											
	D			4	1												
Nanking	C	P	P	P	P		P	P	P	P	P	P	P				
Shanghai—																	
Foreigners only	C	2	3	2	5	1	1	1	1	3						18	
Including natives	D	10	10	5	3											2	
Swatow	D	6	3	6	4	1				1		2	1	1	1		
Tientsin	C	2	2	1													
Chosen (see table below).																	
Colombia:																	
Barranquilla	C	2	1							2							
Buenaventura	C		15	4	6	4	3	2	1		1	1					

Costa Rica:																
Port Limon	C		6	2	2											
San Jose [1]	C	10	7	2												
Curacao (alastrim)	C	14	2	2	1	2					1					
Dutch East Indies:																
Borneo	C	185	90	16	12		2									
	D	12	31	1	1											
Java—																
Batavia and West Java	C	78	64	12	13	3	1	3	1	1		1	2			2	
	D	6	11	7	8	2	1	1	1	1		1	2			1	
East Java and Madura	C		4					1									
Sanggi Islands	C	5	160	26				11		36							
	D	1	24	5				3		2							
Sumatra	C	48															
	D	5															
Egypt: Port Said	C		1	1			2		1								
Great Britain:																
England and Wales	C	1,700	1,427	1,417	926	156	138	126	109	70	86	95	93	99	106	75	
Ashton under Lyne	C	15	18	17	7		4	2	2					1			
Bradford	C		3	2		1											
Cardiff	C	2	3			2											
Leeds	C	16	2			1											
London	C	710	602	637	498	84	52	62	48	36	50	41	51	43	44	36	
London and Great Towns	C	1,239	1,066	1,078	753	127	96	102	83	61	73	71	80	79	84	51	
	D	3	3														
Sheffield	C	8	2														
Stoke-on-Trent	C	122	85	62	32	3	2	1	3	1	1					1	
Scotland	C				4		1								5		
	D						1										
Honduras: Naco	C															5	
India	C	39,329	34,843	22,835	12,962	2,258	2,006	1,853	1,513	1,313							
	D	9,109	6,983	5,451	3,531	733	580	577	458	368							
Bombay	C	718	430	218	113	17	15	11	7	6	2		2		1	1	
	D	431	270	161	79	13	9	9	2	5	2		2		1	2	
Calcutta	C	361	495	302	161	27	19	13	14	4		12	9		5	3	
	D	305	403	258	146	17	17	12	10	4		8	9		4	1	
Cochin	C	291	183	37	16			4	2	2	4	4	4	1	1		
	D	35	13	8	4									1			
Karachi	C	33	30	14	7				1	2		2				1	
	D	47	17	4	3					2		1					
Madras	C	173	133	72	35	6	10	17	16	19		9	10	9	11	6	
	D	36	27	15	10	4	1	3	4	3		5	3	1	1	1	
Moulmein	C	146	43	89	21	4	10	3	1				2	1			
	D	41	7	21	7	3	4	1	2				1			1	
Negapatam	C			1	2			1		2		2		1	2		
Rangoon	C	10	4	6	9	2	1	1		1	1	1					
	D	5		1	2												
Tuticorin	C			5	1												
Vizagapatam	C	69	6	5	1												
	D	18	2	3													

[1] 5 cases of smallpox were reported Apr. 14, 1930, in Costa Rica, outside of city of San Jose.

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

SMALLPOX—Continued

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

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	June 1–28, 1930	Week ended— July, 1930: 5	12	19	26	August, 1930: 2	9	16	23	30	September, 1930: 6	13	20
India (French):																	
Chandernagor	C	6	10	24	19	3	1	4									
	D	2	2	7	8	1	1	1								1	
Karikal	C	24	19	12	11	1		1			8		1		5		
	D	7	8	3	8	1		1			8		1		2		
Pondicherry Province	C	21	24	40	23	4	9	8	5	7	8		7		7	1	
	D	13	20	36	73	3	9	8	5	7	8		7		7	1	
India (Portuguese)	C	38	44	47	28	1				1	6	1					
	D	2	8	8	10				1	1							
Indo-China (see also table below):																	
Pnompenh	C			3				1									
	D		2		1			1				1					
Saigon and Cholon	C	3	5	3	1						1						
	D	1	5	2						1	1	1		1			
Iraq:																	
Baghdad	C		8	1	1	1	1	1				1					
	D		1	1				1				1					
Basra	C		1														
Mossoul Liwa	C		22	21	4	47	20										
	D		3	3	1	19	1										
Ivory Coast (see table below).																	
Jamaica (alastrim)	C			2													
Japan: Tokyo	C		1														
	D		1														
Macao	D	3	2	1													
Mexico (see also table below):																	
Jalisco (State) Guadalajara	D	22	20	7	15	3	1				1						
Juarez	C	2			6						2						
	D				1						1						
Mexico City and surrounding territory	C	106	99	80	77	10	12	4	11	2	3	3		7			
	D	31	47	32	17	2	3	1	2	1	3	2		1			
Progreso	C			1													
	D			1	1												

Morocco (see table below).																	
Nigeria: Lagos	C	1	1		1												
Poland	C		7	3	2												
Portugal:																	
Lisbon	C	7	8	8	10		7		6		6	19	25	7	8		
Oporto	C												1				
Rumania	C	2															
Siam	C		8	2		2		4									
	D		4					3									
Somaliland, British: Boales	C	2															
	D	6															
Spain	C				12		1	1	3	2						1	
Straits Settlements	C	5	5	11	9	1	2	7	1	1	1	1	5	1	2	2	
	D	1	2	3	2	1	1	1				1	1		1		
Sudan (Anglo-Egyptian)	C	60	42	19	67	8	1		3				42	102	5	20	1
	D	5	4	2	3		1						3	50	2		
Sudan (French) (see table below).																	
Switzerland: Berne Canton	C								1	1	1						
Syria (see table below).																	
Taiwan: Taihoku (see table below).																	
Tunisia: Tunis	C	3	4	2	2				1								
Turkey (see table below).																	
Union of South Africa:																	
Cape Province	C	P	P	P					P								
Orange Free State	C	P						P	P	P							
Transvaal	C	P									P	P					
Upper Volta	C	2	3	1	13												
Zanzibar	C	13															
On vessel:																	
S. S. Elysia, at Port Sudan, from Bombay	C		1														
S. S. Naldera, at Port Said	C			1													
S. S Manoa, from Honolulu to San Francisco	C					1											

Place		February, 1930	March, 1930	April, 1930	May, 1930			June, 1930			July, 1930			August, 1930	
					1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20
Indo-China (see also table above)	C	434	26	261		173	132	80	133				238	59	34
Ivory Coast	C		7												
Sudan (French)	C	213	609	521	40	56	178	76				34			
	D	11	49	36	7	7	18	18							
Syria: Beirut	C	18	17	19			7	6	1				2		
Taiwan: Taihoku	C	43	58	12											

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

SMALLPOX—Continued

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

Place		February, 1930	March, 1930	April, 1930	May, 1930	June, 1930	July, 1930
British East Africa (see also table above):							
Kenya	C	12	175	174	171	142	186
Uganda	C	109			78		
	D	99			69		
Chosen	C	263	236	253	107		
	D	71	53	53	35		
Seishin	C	4		5	2	1	
	D	1		1	1		
France	C	23	8	58	51		
Mexico: Durango (see also table above)	D	6	5	4	4	3	3
Morocco	C	74	17	10	18	5	3
Turkey	C	114		3	16		
	D	42					

TYPHUS FEVER

Place		Mar. 9–Apr. 5, 1930	Apr. 6–May 3, 1930	May 4–31, 1930	Week ended—June, 1930: 7	June 14	June 21	June 28	July, 1930: 5	July 12	July 19	July 26	August, 1930: 2	Aug. 9	Aug. 16	Aug. 23	Aug. 30	September, 1930: 6	Sept. 13
Algeria:																			
Algiers	C	6	8	15	2		1			1	2	3				2		3	
Constantine Department	C	11	15	6	11		1			1	1					3			
Oran	C			3				4		2	1			1			1		
Arabia: Aden	C	1																	
	D	1																	
Bolivia: La Paz.[1]																			
Brazil: Porto Alegre	C			1															
Bulgaria	C	9	15	6	1		9	6		4	5	1		1				2	
	D		1	2	1						1								
China:																			
Manchuria—Harbin (see also table below)	C	4	52	13	3	3	2		2										
Shanghai	C	1												1					
Chosen (see table below).																			
Czechoslovakia (see table below).																			

Egypt:																			
Alexandria	C		1				1	1	1						1			1	
Beheira Province	C	2	2	49	17	16	7	5		5	1	9							
	D			13	1	1		2		1		1							
Cairo	C												2			5			1
Port Said	C															4		1	
Great Britain: Scotland—																			
Dunfermline	C									1									
Glasgow	C			1															
	D			1															
Greece (see table below).																			
Iraq: Baghdad Liwa	C	2																	
Ireland:																			
Irish Free State—																			
Galway County—Oughterard	C											2							
Kerry County—Dingle	C		5																
Leitrim County—Mohill	C							9				1							
Mayo County—																			
Ballina	C			2		1				1									
Castlebar	C															1			
Swinford	C			14															
Westport	C										2		1						
Roscommon County—																			
Roscommon	C										1								
Strokestown	C										1								
Wicklow County—Shillelagh	C					1		3	1		1								
Latvia (see table below).																			
Lithuania (see table below).																			
Mexico: Mexico City, including municipalities in Federal District	C	4	4	6	2	3	1	3	2		2	1	2	2	2	3	2		
	D	1	4	3		1							1	1					
Morocco	C	38	15	11	1		6	8		4	3	4				8		2	
	D	7	3																
Palestine	C	6	1	2	2				3	1	1	1		1	1	1		1	1
Poland	C	228	243	171	39	15	26	37		24		12	10	15	2	7		3	
	D	13	15	5	3	3	2	3		4			1		1	1		1	
Portugal:																			
Lisbon	C		4																
Oporto	C	2	1												1				
Rumania	C	185	186	227		32	26												
	D	12	11	35		3	2												
Spain: Valencia	C					2		1		3									
	D									1									
Tunisia	C			6			2	16			14	10	2	5		3	1	1	
Turkey (see table below).																			
Union of South Africa:																			
Cape Province	C	P	P	P			P	P	P	P	P								
Natal	C	P	P	P			P		P	P	P	1	P	P	P				
Orange Free State	C	P		P			P	P	P	P	P	P	P	P	P				
Transvaal	C		P								P		P	P	P				
Yugoslavia (see table below).																			

[1] 12 deaths from typhus fever were reported in La Paz, Bolivia, from Jan. 1 to May 31, 1930.

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

TYPHUS FEVER—Continued

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

Place		February, 1930	March, 1930	April, 1930	May, 1930	June, 1930	July, 1930
China: Harbin (see also table above)	C		37	204	240		
Chosen: Seoul	C	17		3	43	2	
Czechoslovakia	C	2	42	29	12	1	
Greece: Athens	C	6	3	1	3	3	6
Latvia	C				8	3	3

Place		February, 1930	March, 1930	April, 1930	May, 1930	June, 1930	July, 1930
Lithuania	C	70	62	73	27	16	3
	D	5	4	4			
Turkey	C	3	1	3	16	2	
Yugoslavia	C	33	46	22	16	6	
	D	5	2	4	1		

YELLOW FEVER

Place	Cases
Brazil:	
Mage, on the Leopoldina Railway, between Rio de Janeiro and Nictheroy, Apr. 22, 1930	2
Campos, Rio de Janeiro Province, May 23, 1930	1
Para, June 23, 1930	2
Gold Coast:	
July 10, 1930	1
Albosso, Aug. 5, 1930 (deaths)	1
Liberia, Monrovia, June 3, 1930	1
Nigeria, Lagos, July 12, 1930 (probably laboratory infection)	1

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