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VACCINE VIRUS PNEUMONIA IN RABBITS[1]

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INTRODUCTION AND LITERATURE

That rabbit lung tissue is susceptible to the action of vaccinia has been shown by various workers. Calmette and Guérin (1901) found that vaccine introduced into the trachea, lung, or pleura conferred immunity without producing apparent lesions. Ohtawara (1922), employing both rabbit testicular and calf dermo-virus, demonstrated the presence of vaccine virus in the lungs of rabbits, as well as in certain other organs, from the fourth to eighth day following intravenous and dermo-vaccination. The lungs, however, appeared normal.

Levaditi (1923), in a similar study of three intravenously and one intratracheally inoculated rabbit, rabbit neuro-vaccine being employed, found the lungs free from gross lesions but rich in virus.

Winkler (1927) likewise demonstrated virus in the lungs of a corneally inoculated rabbit (No. 718).

Douglas, Smith, and Price (1929), in a series of rabbits inoculated by the intravenous, intratracheal, intraneural, intratesticular, intraperitoneal, and dermal routes, found the lungs to be the most susceptible of all organs to the development of macroscopic lesions which they considered to be vaccinial in nature.

These organs microscopically "showed foci resembling in essentials vaccinial skin lesions." These lung "pocks" were first punctiform hemorrhages; when fully developed, glistening gray nodules with punctate hemorrhagic centers and frequently peripheral congestion. The lungs from six animals killed from the second to fourteenth day following intravenous inoculation were shown to contain vaccine virus by rubbing pieces of the organ on to the scarified skin of fresh rabbits. These authors, with few exceptions, employed a brain or testicular rabbit strain of virus in their studies.

McIntosh and Scarff (1929), using a recently established variolous strain, enhanced in virulence through rabbit brain passage, found that the lungs were second only to the skin and mucous membranes in the frequency with which they became involved in the generalization of the virus following intravenous and cutaneous vaccination.

Nicolau and Kopciowska (1929), in studying a spontaneous laboratory epizootic of malignant vaccinia in rabbits, noted the frequent

[1] From the Hygienic Laboratory, United States Public Health Service.

occurrence of a purulent pneumonia. Pneumonia has been noted as a complication of post-vaccinal encephalitis in man. (*cf.* Bijl. 1928.)

A full discussion of the lung lesions of human smallpox and their relation to those of experimental vaccinia will not be entered into here, but will be reserved for a later report.

Several authors have reported hemorrhages in the lungs in hemorrhagic smallpox, and broncho-pneumonia has been the most frequent complication in fatal pustular cases. A bronchitis with or without pustules has been of almost constant occurrence. Pleurisy has been noted by Bowen (1887), Roger (1903), Stokes (1903) in one instance with numerous small pleural vesicles showing large lymph spaces filled with serous fluid, and by Perkins and Pay (1903). Sörensen and Sörensen (1925) described a gelatinous pleurisy with hypostatic pneumonia in a case of purpura variolosa. Keysselitz and Mayer (1909) saw focal lesions in the lungs of one patient, and in these lesions Guarnieri bodies were seen both in cytoplasm and nuclei of fixed and desquamated alveolar epithelial cells. This is the only report we have found in the literature of such inclusions in the alveolar epithelium in either vaccinia or variola. Councilman, Magrath, and Brinckerhoff (1904) saw Guarnieri bodies in the epithelium of a primary bronchus of one case.

M. H. Gordon (1925) inoculated rabbits intranasally with diluted calf virus. In some instances this was previously heated to 55° C. for 40 minutes. There was produced a nasal catarrh, usually afebrile, lasting from the seventh to the tenth day after inoculation. The discharge was at first clear and rich in vaccine, later becoming purulent and weaker in virus. Immunity was produced and no fatalities occurred.

Gins (1929) similarly produced immunity by the intratracheal route of inoculation. Gins and Iwanoff (1928), moreover, showed that in rabbits hyperimmunized against vaccinia, the lungs, while not so potent as the marrow and spleen, did contain "viricidal" anti-bodies.

In view of such findings, it was felt that perhaps the lungs might remove circulating virus or perhaps render it inert through the action of locally produced "viricidal" antibodies. As we were attempting to produce experimental post-vaccinal encephalitis, it was deemed desirable to attempt to disorganize any such possible action of the lungs by producing the primary lesion therein—it being felt that thereby the brain would be flooded with virus-containing blood without the interposition of a relatively intact filter. We failed in the attempt thus to produce encephalitis but did secure an interesting type of vaccinal pneumonia, as far as we are aware, heretofore undescribed.

VIRUS

The virus employed in these studies was the heat-selected strain (28628) described by Armstrong (1929), which consisted of a com-

mercial calf virus adapted to the rabbit testicle in 1926 and since carried in this gland, with an occasional monkey and one calf dermopassage intervening. The virus during the process of its propagation and heat selection has developed enhanced virulence for rabbits and monkeys, as judged by the character of the local and generalized lesions produced in these species.

METHOD OF INOCULATION

In the earlier attempts the inoculations were made by simply allowing 0.5 to 1 c. c. of varying dilutions of virus (see Table 1) to flow from a pipette into each nostril while the animal's head was held in a position favoring the entrance of the virus into the nose. Later, in an attempt to avoid contamination of the virus from the upper air passages, the inoculum was introduced through the skin and underlying tissues into the trachea by means of a hypodermic needle.

CLINICAL COURSE

Rabbits thus inoculated show few symptoms of illness; they continue to eat almost to the end, and the eyes remain bright and the coat remains smooth. The most common symptom of illness is rapid breathing; the respirations, while not labored, may become so rapid as to be difficult to count—140 to 150 per minute. A slight respiratory rattling is often present in later stages.

The temperature may reach 40° C. or above for a day or more; but quite as frequently it does not go above normal. The temperature, however, often falls below normal late in the course of the ailment, a sign which usually portends approaching death.

In nonimmune animals the condition is practically always fatal. Out of 54 animals inoculated either via the nostrils or trachea (Table 1), there were 34 which died with typical findings in from three to seven days following the inoculations. (One died of empyema on the second day.) Of the remaining 20 animals 17 were killed on the second to fifth day following inoculation in order to secure early lesions, some were *in extremis* when etherized, and nearly all showed lung lesions which would probably have caused death if allowed to progress. One rabbit (No. 472), etherized at the end of 24 hours, showed no gross lung lesions, probably due to the shortness of the interval. Two rabbits (Nos. 463 and 580) which had exhibited no symptoms, were etherized on the fourth and ninth days, respectively, and revealed no gross lung lesions. It is possible that these animals were immune, as we have occasionally encountered immunity in animals which we are at a loss to explain, unless it is due to a spontaneous infection at some time, such as was noted by Levaditi and Sanchis-Bayarri (1927) and by Nicolau and Kopciowska (1929).

TABLE 1.—*Summary of gross protocols*

Rabbit No.	Date inoculated	Virus inoculated	Dose inoculated	Route of inoculation	Date of death	Days between injection and death	Lobes involved					Remarks on other organs than lungs
							Right lung			Left lung		
							Upper	Middle	Lower	Upper	Lower	
386	Apr. 9, 1928	28628T	1 c. c. 1:16	Nose	Apr. 13, 1928	4	−	+	−	+	−	Appeared normal.
387	do	28628T	do	do	Apr. 16, 1928	7	+	+	−	+	+	Do.
405	Apr. 20, 1928	28628T	do	do	Apr. 26, 1926	6	P	+	P	+	+	Turbinates red.
406	do	28628T	do	do	do	6E	−	+	−	+	−	Submental glands hemorrhagic.
412	May 4, 1928	28628T	2 c. c. 1:16	do	May 8, 1928	4	P	+	P	P	P	Appeared normal.
413	do	28628T	do	do	do	4E	−	+	−	+	P	Do.
414	do	28628T	do	do	May 9, 1928	5E	−	+	−	−	−	Spleen large.
420	May 7, 1928	28628T	do	do	do	2E	P	−	−	−	−	Appeared normal.
421	do	28628T	do	do	May 10, 1928	3E	P	−	−	−	−	Spleen enlarged; old scars on liver.
425	do	28628T	do	do	May 11, 1928	4	−	+	+	+	+	Old scars on liver.
460	June 1, 1928	28628T	1.5 c. c. 1:16	do	June 7, 1928	6	+	+	+	−	−	Appeared normal.
462	June 7, 1928	28628L	1.2 c. c. 1:16	do	June 12, 1928	5E	−	−	P	−	P	Turbinates swollen.
463	do	28628L	do	do	June 11, 1928	4E	−	−	−	−	−	Old scars on liver; temperature 40.2° C.
470	June 11, 1928	28628T	1.5 c. c. 1:16	do	June 15, 1928	4	P	+	P	+	+	Do.
471	do	28628T	do	do	do	4E	−	−	P	P	P	Appeared normal.
472	June 14, 1928	28628T	2 c. c. 1:16	do	do	1E	−	−	−	−	−	Do.
473	do	28628T	do	do	June 16, 1928	2E	−	P	−	−	−	Spleen enlarged.
474	June 16, 1928	28628L	2 c. c. 1:4	do	June 19, 1928	3	+	+	+	−	−	Appeared normal.
475	do	28628L	do	do	June 20, 1928	4E	+	−	P	−	−	Spleen enlarged.
520	June 22, 1928	28628L–2	2 c. c. 1:8	do	June 25, 1928	3	−	−	−	+	+	Turbinates red.
522	do	28628L–2	do	do	do	3E	+	−	−	−	+	Free fluid abdomen.
523	June 26, 1928	28628L–3	3 c. c. 1:16	do	June 29, 1928	3	+	+	P	+	P	Appeared normal.
524	do	28628L–3	do	do	do	3	+	+	P	P	−	Do.
525	June 30, 1928	28628L–4	2 c. c. 1:16	do	July 4, 1928	4	P	+	−	−	−	Left turbinate red.
526	do	28628L–4	do	do	July 5, 1928	5	+	+	−	P	P	Appeared normal.
541	July 6, 1928	28628L–4	do	do	July 10, 1928	4	+	+	−	P	P	Turbinates red.
542	do	28628L–4	do	do	July 9, 1928	3E	−	−	−	+	−	Appeared normal.
543	do	28628L–4	2 c. c. 1:200	do	July 11, 1928	5	+	P	P	+	+	Do.
545	July 11, 1928	28628L–4 and L–5	2 c. c. 1:800	do	July 16, 1928	5E	P	+	−	−	P	Turbinates red.
546	do	28628L–4 and L–5	2 c. c. 1:160	do	July 13, 1928	2	−	−	−	−	−	Empyema both chests. Not vaccinal.
570	July 16, 1928	28628L–5	4 c. c. 1:200	Trachea	July 19, 1928	3	−	P	P	+	+	Appear normal.
571	do	28628L–5	do	do	July 20, 1928	4	+	+	P	+	P	Spleen enlarged; turbinates red.
572	do	28628L–5	do	do	July 21, 1928	5	P	P	−	+	−	Appeared normal.
530	Aug. 6, 1928	28628L–6	2 c. c. 1:160	Nose	Aug. 9, 1928	3E	−	P	−	−	−	Do.
573	July 27, 1928	28628L–6	2 c. c. 1:200	Trachea	July 30, 1928	3E	−	P	P	−	P	Do.
574	do	28628L–6	do	do	July 31, 1928	4	+	+	P	P	P	Do.

575	-----do-----	28628L-6----------	-----do----------	---do-------	---do----------	4	+	+	P	P	P	Do.
576	-----do-----	28628L-6----------	-----do----------	---do-------	Aug. 1, 1928	5	P	P	P	P	P	Few small spots on liver.
578	Aug. 6, 1928	28628L-7----------	2 c. c. 1:160----	---do-------	Aug. 10, 1928	4	P	P	P	+	+	Appeared normal.
579	-----do-----	28628L-7----------	-----do----------	---do-------	Aug. 8, 1928	2E	-	-	-	P	P	Do.
580	-----do-----	28628L-7----------	-----do----------	---do-------	Aug. 15, 1928	9E	-	-	-	-	-	Scars on liver; free fluid in abdomen.
581	-----do-----	28628L-7----------	-----do----------	---do-------	Aug. 9, 1928	3	P	-	P	+	+	Heart dilated.
584	Sept. 18, 1928	28628L-8----------	1.5 c.c . 1:24----	---do-------	Sept. 23, 1928	5	P	-	-	+	P	Appeared normal.
585	-----do-----	28628L-8----------	-----do----------	---do-------	-----do-------	5	-	+	-	-	-	Do.
601	Oct. 1, 1928	28628T------------	2 c. c. 1:40-----	---do-------	Oct. 4, 1928	3	-	+	P	+	+	Do.
602	-----do-----	28628T------------	-----do----------	---do-------	-----do-------	3	-	+	-	+	+	Right turbinate inflamed.
859	Apr. 22, 1929	28628T------------	1.5 c. c. 1:40----	---do-------	Apr. 26, 1929	4	-	+	-	+	-	Appeared normal.
860	-----do-----	28628T------------	-----do----------	---do-------	-----do-------	4	+	P	P	+	P	Do.
861	-----do-----	28628T------------	-----do----------	---do-------	-----do-------	4	P	P	P	P	P	Do.
1009	Sept. 13, 1929	28628T------------	2 c. c. 1:40-----	Nose-------	Sept. 17, 1929	4	P	P	P	+	+	Turbinate red.
1013	Sept. 17, 1929	28628L-1----------	1 c. c. 1:40-----	Trachea----	Sept. 21, 1929	4E	-	-	P	-	P	Old spots on liver.
1014	-----do-----	28628L-1----------	-----do----------	---do-------	-----do-------	4	-	+	-	+	+	Appeared normal.
1016	Sept. 23, 1929	28628L-2----------	-----do----------	---do-------	Sept. 26, 1929	3	-	-	P	+	+	Do.
1017	-----do-----	28628L-2----------	-----do----------	---do-------	Sept. 27, 1929	4	-	+	P	+	P	Do.

P=Partial involvement. E=Etherized. L=Lung strain. T=Testicular strain. +=Lobe consolidated.

GROSS PATHOLOGY

On intranasal or intratracheal inoculation with vaccine virus 28628, there is produced a pneumonia, usually lobar in distribution, involving whole lobes or large sections of lobes. Usually more than one lobe is involved, in one instance four out of the five lobes being consolidated. On gross examination, the consolidated lungs are grayish pink, gelatinous and translucent in appearance; the pleura is sometimes covered by a clear gelatinous exudate, which may fill the pleural cavity. There is considerable gelatinous edema of the mediastinal tissues and necrosis of the lymph nodes.

On the first day after inoculation no gross changes are evident in the lungs. Animals killed after two days may show no changes or may show edema of one or more lobes. Consolidation replaces edema by the fourth day. On the fourth and fifth days one may find consolidation in one lobe and edema in another. Deaths occur on the third to seventh day.

As the work progressed and virus was used that had been passed rapidly from lung to lung, gray hepatization with purulent alveolar exudate began to appear, some of the histologic characteristics of the vaccinal type of infection being retained, however. After this virus had been repurified by centrifugalization and glycerination, the typical gelatinous pneumonia was again produced.

HISTOLOGY

The following description is based on the histologic study of blocks from one to five lobes of the lung and one through the mediastinum from some 40 rabbits inoculated by the nasal or intratracheal routes.

As early as 26 hours after inoculation there was found in a main bronchus a patch of epithelial proliferation and thickening to three or four layers. Guarnieri bodies were not identified in this lesion. The mediastinal lymph nodes showed marked edema and beginning coagulation with demonstrable fibrin in the sinuses.

Another animal killed after 24 hours showed no lesions whatever in lungs, trachea, or mediastinum.

After 48 hours one sees subepithelial necroses with nuclear fragmentation about bronchioles, sometimes with deranged, swollen, partially desquamated epithelium; patches of necrosis with nuclear fragmentation in the adventitiae of the arterioles and foci of necrosis of the alveolar walls. Larger bronchi may show vesiculation with necrosis of the epithelium and fibrin in the vesicle spaces. With iron-hematoxylin one sees both in lesions and in apparently intact bronchial and alveolar epithelium rounded, sharply contoured cytoplasmic inclusions, usually 1 micron or less in diameter, occasionally as large as 5 microns. They are often surrounded by a narrow,

clear, halo-like zone. They occur in cells with well-preserved and stained nuclei. With Weigert's iron-hematoxylin and van Gieson's picrofuchsin they are gray to black. With alum-hematoxylin and eosin they are deep blue, gray-violet, or dirty reddish violet. By the modified Gerlach method they range from deep red through shades of purple and violet to deep blue. It is probable that some of these latter are nuclear débris, but it also seems quite probable that at least some of these inclusions correspond to the bodies described by Guarnieri and others in the skin and corneal lesions of variola and vaccinia.

Edema and patches of sinus infiltration with polymorphonuclears were seen in the mediastinal lymph nodes in one but not in a second rabbit.

On the third day, in one instance as early as two days, the alveoli of one or more lobes become filled with coagulated serous exudate, with more or less fibrin deposit, which usually appears first in the centers and dorsal portions of the lobes and near the bronchus. A serous exudate appears in the adventitiae of the arteries and veins, often with necrosis of the adventitial areolar tissue, as manifested by cell disintegration and karyorrhexis. The muscular mediae of the smaller arteries swell and become filled with vacuoles which, on staining with the toluidine blue, are seen to be filled with a mucin-like substance. These vacuoles appear to be located largely between the swollen muscle cells, but are also, in some instances, definitely within them. Scattered minute focal necroses of the alveolar walls are often seen, especially in the pneumonic areas. There is also much scattered nuclear fragmentation in the alveolar walls in consolidated areas. Coagulation necroses with, or, oftener, without, vesiculation occur in the bronchial epithelium. These are sharply demarcated laterally against surviving epithelium and are often underlined by a zone of nuclear fragmentation in the subepithelial connective tissue. Often a deposit of fibrin occurs with fibrils over and between the epithelial cells, filling the vesicular spaces and all or part of the lumen. The necrosis of the epithelium may be complete in smaller bronchi, the entire lumen plugged with a network of fibrin from which fibers extend between the coagulated cells. Epithelium of other bronchi and the surviving portions of partially necrosed bronchi still show cell inclusions like those described on the second day.

The mediastinal lymph nodes now show focal necroses which are manifested by sharply defined areas of cytoplasmic oxyphilia and karyorrhexis. In one instance the thymus was shown to have escaped in spite of surrounding edema and necrosis.

By the fourth day the mediastinal connective tissues have developed a marked edema, and there are extensive coagulation necroses of the lymph nodes, fibrin being deposited in the necrotic areas and their margins. Necrosis appears to involve the peripheral sinus area

first, but is usually so extensive as to prevent any estimate of where the lesion originated. Sometimes the entire node becomes necrotic.

Necrosis and nuclear fragmentation become somewhat more extensive in the alveolar walls. A greater proportion of the alveoli are now filled with fibrin, edema now being limited to the anterior margin and periphery of the lobes. Some lobes may show a less advanced picture than others, more edema and less necrosis and fibrin being present.

The arteries now show marked adventitial swelling and necrosis with much coagulated edema and deposition of fibrin. Their muscular coats are markedly swollen, vacuolated, and filled with the mucinlike substance previously described. In the lobes containing air, the vessels remain relatively normal, and less advanced changes are seen in lobes showing only edema. The veins may show adventitial changes similar to those in the arteries.

Bronchial necroses in the pneumonic lobes appear to be more numerous, but are otherwise similar to those seen on the third day. No Guarnieri bodies are now identified. In the larger bronchi the subepithelial necrosis extends to the cartilages and even between them. Smooth muscle fibers here appear to survive unaffected in the midst of necrotic connective tissues. Such bronchial necroses now occur also in air filled lobes and in those the seat of simple edema.

Occasionally there occur swelling and vacuolation of the intima of the arteries within the lamina elastica interna.

The pleura may also show swollen vacuolated surface epithelial cells. A dense fibrinous exudate overlies these swollen cells. In one instance the parietal pericardium also participated in this process.

Little further change in the lesions is noted on the fifth, sixth, and seventh days.

The foregoing description applies to the pure virus pneumonia. When frequent lung passage is made with lung virus a bronchopneumonia supervenes and a mixed lesion is produced in which there are islets of alveoli filled with polymorphonuclear pseudoeosinophil leucocytes lying in a matrix of a pure fibrinous pneumonia. All gradations are seen between a purely fibrinous pneumonia with bronchial necroses and swollen arteries and a pure gray hepatization with pus filled bronchi and swollen or normal arteries.

MULTIPLICATION OF VIRUS

That the virus multiplies in lung tissue is apparent from the fact that the virus was carried through eight lung transfers without apparent loss in its ability to produce typical skin "takes." The lungs from several rabbits dead of vaccinal pneumonia averaged 35 grams in weight. In the passage through rabbits 1009 to 1013 to 1016, using 1 c. c. of $\frac{1}{40}$ testicular tissue for the first inoculation and

the same dilution and dose of macerated lung for succeeding transfers, it may be readily calculated that the lungs of rabbit 1016, third generation, would represent a dilution of 1 : 274,400,000 of the originally introduced virus. It was found, moreover, that lung tissue from this rabbit gave typical skin lesions in dilution of 1 : 1,000,000 when injected intradermally in rabbits (0.2 c. c.). It was found, moreover, that the pleural fluid, when present in these cases, was also rich in virus.

These findings naturally suggest the lungs as an abundant source of vaccine virus. There is, however, the obvious objection that lung tissue is subject to contamination via the respiratory tract.

While it is not intended to enter into a discussion of the filterability of vaccine virus, the influence of the menstruum, etc., it may be noted that this congealed pleural exudate in these cases, when freed of fibrin by "whipping" and filtered through a Berkefeld N candle, repeatedly gave rise to typical vaccinal meningoencephalitis when injected intracerebrally into fresh rabbits. This procedure offers a ready and sure means of securing a sterile vaccine suspension with this strain and proved the presence of a pathogenic filterable agent apart from any bacterial contamination.[2]

EVIDENCE OF VACCINAL NATURE OF THE PNEUMONIA

The metastatic lesions produced in the peribronchial lymph nodes following intratracheal or intranasal inoculation are identical histologically with the lesions noted in the axillary and inguinal glands following cutaneous vaccination with this virus.

The macerated glycerinated lung tissue produced typical Paul ulcers on the scarified cornea of rabbits and guinea pigs and typical vaccinal lesions upon the scarified skin.

From Table 2 it may be noted that the intratracheal injection of lung virus was uniformly fatal within four days in five normal rabbits, while in eight identically treated control animals, which had been previously immunized with commercial vaccine, there was one fatality on the third day. The other seven animals showed either no symptoms or only a transient elevation of temperature.

Immunity in the opposite direction was not tested, since we had no recoveries following lung infection.

The lung virus did, however, immunize rabbits against commercial calf vaccine when rubbed upon the abraded skin, and immunity in the opposite direction was also demonstrated.

The presence of cell inclusions resembling Guarnieri bodies has already been noted in the section on histology.

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[2] The lung virus usually contained bacteria (not identified), especially where rapid lung transfers had been made by the intranasal route.

TABLE 2.—*The occurrence of pneumonia in normal and immunized rabbits inoculated intratracheally with rabbit testicular virus (28628) and with same strain of lung virus*

Rabbit No.	Preliminary vaccination			Intratracheal vaccination			Interval between intratracheal inoculation and death	Remarks
	Date	Virus	Route	Date	Virus	Dose		
859				April 22, 1929	28628 T	1.5 cc. 1:40	4 days	Typical pneumonia, vaccinal.
860				do	28628 T	do	do	Do.
861				do	28628 T	do	do	Do.
1016				Sept. 23, 1929	28628 (lung)	1 cc. 1:40	3 days	Do.
1017				do	28628 (lung)	do	4 days	Do.
835	Apr. 6, 1929	Commercial calf	Cutaneous	Apr. 22, 1929	28628 T	1.5 c. c. 1:40		Discharged well, July 19, 1929.
836	do	do	do	do	28628 T	do	53 days	Nonvaccinal, broncho-pneumonia.
837	do	do	do	do	28628 T	do	do	Discharged well, Apr. 29, 1929.
838	do	do	do	do	28628 T	do	do	Do.
833	do	do	do	do	28628 T	do	do	Do.
798	Mar. 11, 1929–Mar. 21, 1929	do	Subcutaneous	do	28628 T	do	do	Do.
799	do	do	do	do	28628 T	do		Do.
899	Aug. 10, 1929–Aug. 16, 1929	do	do	Sept. 23, 1929	28628 (lung)	1 c. c. 1:40		Do.
1018	do	do	do	do	28628 (lung)	do	3 days	Typical pneumonia, vaccinal.

DISCUSSION

Summarizing the pathology, one is first struck by the large amount of necrosis present, by the peculiar mucinoid degeneration of the arterial musculature, and by the presence of coagulation necroses even in the smallest bronchioles. The absence of polymorphonuclear leucocytes from the alveolar exudate when purified virus is used agrees with the general concept that this leucocyte is not a primary participant in the variolo-vaccinal process (Weigert (1874–75), Councilman et al. (1904), Unna (1894), and others) and contrasts sharply with the general finding of leucocytes and pyogenic cocci in the bronchopneumonias of smallpox. Gram positive organisms have not been encountered in the numerous Weigert fibrin preparations in the pure virus pneumonia.

It is believed that the above findings may indicate that the bronchopneumonia of smallpox is primarily due to the virus, and the leucocyte reaction in it to the presence of the various pyogenic cocci so regularly found. We have not yet carried out sufficient cultural work on this vaccinal pneumonia to be able to determine definitely whether the presence or absence of bacteria bears a definite relation to the character of the reaction, though we believe that we have, in the reproduction of the purely serofibrinous pneumonia on repurification of the virus, presumptive evidence that bacterial contamination does provoke a polymorphonuclear leucocyte response which is absent when that bacterial contamination is removed.

Concluding, we believe that we have shown that vaccine virus alone is capable of producing pneumonia in rabbits. While the concept of vaccine being able to produce lung lesions is not entirely new, we believe this to be the first experimental production of a definite pneumonia readily distinguishable from the ordinary types.

SUMMARY

1. Employing a virulent, heat-resistant, testicular vaccine virus and the respiratory route of inoculation, a highly fatal heretofore undescribed vaccinal pneumonia, usually lobar in type, was produced in rabbits and carried in series through eight generations.

2. This pneumonia is essentially serofibrinous in nature, without leucocyte exudation, with focal coagulation necroses in bronchial and alveolar epithelium, and with a lymphangitis and peribronchial lymphadenitis identical histologically with that produced in regional lymph nodes by skin vaccination of both rabbits and monkeys with this virus.

3. The vaccinal nature of the lung lesions is indicated by the character of the reaction, including the occurrence of Guarnieri bodies in the alveolar and bronchial epithelium; by the demonstration of the

rich virus content of the affected lungs; by the fact that animals immune to commercial calf virus are relatively highly resistant to pneumonic infection when the macerated pneumonic lung tissue is employed as the inoculum; and by the existence of mutual cross protection between the rabbit lung virus and commercial calf virus, employing the customary cutaneous vaccinations.

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EXPERIMENTAL STUDIES OF NATURAL PURIFICATION IN POLLUTED WATERS

II. DEVELOPMENT OF A SUITABLE DILUTE MEDIUM

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In the course of a study on the influence of the animal plankton on bacterial death rates, Purdy and Butterfield (1918) observed that the apparent purification which took place when sterilized sewage was inoculated with bacteria only, did not even approach that observed when plankton also were present. This conclusion was based on the physical condition, turbidity, and odor of the samples, as chemical determinations were not made. These incomplete observations were, however, a stimulus for further investigation of the relationships that exist between the bacteria and the plankton in effecting the chemical changes which take place during the natural purification of polluted water and sewage.

In January, 1925, a systematic investigation of the changes which occur in stored samples of polluted water was begun. The study included an enumeration of the bacteria and of the plankton and a determination of the extent of depletion of dissolved oxygen after various periods of storage at known temperatures. Results obtained early in this study indicated quite clearly that, in order to acquire definite knowledge of the factors concerned in this bacteria-plankton relationship, it would be necessary, at least in the preliminary studies, to reduce the number of variables in three ways: (1) By limiting the bacteria to one genus or to known mixtures,[1] (2) by likewise limiting the varieties of plankton, and (3) by using, instead of sewage-polluted water, a medium which could be reproduced accurately from time to time.

The first two restrictions on variable factors were carried out by sterilizing all materials and controlling the inoculations introduced. The third condition, of selecting or preparing a culture medium which would be suitable for the studies planned, is the subject of this paper.

[1] The necessity for limiting the bacteria becomes more evident when one considers that there might be present in a natural mixed infection many bacteria which would not grow in the counting medium employed and as a result would not be recorded in the bacterial data while their effects might be reflected in the plankton and chemical data.

To satisfy the requirements of our experiments the medium sought should resemble in its essential characteristics a moderately sewage-polluted water, such for instance, as the water of the Ohio River, a few miles below the sewer outlets of Cincinnati. That is, the medium must be capable of supporting growths of bacteria and plankton to about the same extent as polluted river water, and to this end must contain food materials, comparable in kind and amount. As one of the primary objects of the study was to determine the extent of deoxygenation during definite periods of activity of the bacteria and plankton, an important condition was that the organic material present in the water must be in concentration sufficient to produce accurately determinable depletions of the dissolved oxygen content, while at the same time it must be diluted sufficiently to prevent the creation of an anærobic condition. In other words, the depletion of dissolved oxygen must be in the range from 2.0 to 7.5 p. p. m.

A large amount of literature is available describing the growth characteristics and the factors which influence the growth of bacteria in liquid media containing 5.0 grams per liter or more of carbonaceous and nitrogenous materials. Such media have a 5-day biological oxygen demand of at least 6,000 p. p. m., which means that in terms of putrescible material they are approximately 50 times as concentrated as ordinary domestic sewage. When bacteria develop in such a medium, the rate at which oxygen is used up very greatly exceeds the rate of solution of oxygen from the atmosphere; and the medium, even though stored in open containers, becomes anærobic after a few hours' incubation. Hence concentrations of this order were entirely unserviceable for our purpose. Adequate information was not found in the literature in regard to the requirements for the growth of bacteria in media diluted to such an extent that ærobic conditions are maintained in completely filled containers. Under such conditions the bacteria may respond to their environment in an entirely different manner from that observed in concentrated media, and it was necessary for us to develop the required medium experimentally.

TESTS WITH NATURAL SEWAGE

Effort was directed at first to the preparation of a stock solution of natural sewage from which the bacteria and the plankton had been removed or killed, with the idea that appropriate dilutions of such a solution would provide media substantially identical in chemical composition with those found under natural conditions. Two methods were tried for freeing sewage of its normal bacteria and plankton; namely, (1) filtration through a Berkefeld filter and (2) sterilization in the autoclave.

Filtration through a Berkefeld filter, while apparently successful, could not be relied upon, in the light of present-day theories of

microbic dissociation, to remove all phases of the life cycles of bacteria and plankton. Such filtration also would not remove filterable viruses or bacteriolytic substances. For these reasons, when the filtrate was inoculated with a pure culture of bacteria or plankton or both, it would not be allowable to assume that the resulting culture was pure.

Also, it was found that when the sewage available at this laboratory was sterilized in the autoclave, it was changed to such an extent that it was not suitable for the growth of either bacteria or plankton. This was shown by the fact that when such sterilized sewage was inoculated with bacteria and plankton, either in pure or in grossly mixed culture, growth either did not occur or took place only after quite extended periods of lag. This difficulty could be overcome, for if the carbon dioxide balance in the sterilized sewage was restored, growth would take place; but an additional objection to the use of natural sewage was that, once the original stock sample was exhausted, there would be no method of obtaining another supply of precisely the same strength or with exactly the same constituents. This was an important feature; for, in order to obtain comparative results, it was essential that the dilute medium might be reproduced accurately. Effort was then directed to the preparation of artificial mixtures.

ARTIFICIAL MIXTURES

Tests made with some of the mixtures used by Adeney (1908) in his studies of the two stages of oxidation did not result in good growths of either the bacteria or the plankton. This may have been caused by our chemicals lacking some ingredient essential for growth, or else they may have contained some material which was inhibitive. This was particularly true in the case of Adeney's "Solution A," which contained 0.066 gram of asparagin, 0.141 gram of sodium potassium tartrate, and 0.1 gram of potassium phosphate per liter of water. Definite comparison of the growth results obtained by Adeney with ours can not be made, as he does not report any biological data.

It was finally decided to adopt one of the ordinary liquid bacteriological culture media as a stock standard solution and to determine experimentally the extent of the dilution required to make it suitable for our purposes. Dextrose-peptone-phosphate broth, as described by Clark and Lubs (1915), was tentatively selected as the most satisfactory medium, for the following reasons:

(1) All of its components (Proteose-Difco standardized peptone, Kahlbaum's chemically pure dextrose, and dipotassium hydrogen phosphate) were readily available in sufficient quantity.

(2) The choice of dextrose as a source of carbon was influenced by the beliefs that (*a*) dextrose in dilute solution is readily available as

a source of energy to a great variety of bacteria, (*b*) it is not inhibitory to the growth of plankton and may be utilized by them, and (*c*) it can readily be determined chemically both qualitatively and quantitatively.

(3) Peptone was accepted as a source of nitrogen because, (*a*) it contains many of the complex compounds of nitrogen found in sewage, and (*b*) it is widely used as a food for bacteria and is readily available for their structural requirements.

It is recognized, however, that peptone is not in all respects a satisfactory source of nitrogen, because its chemical composition is indefinite and if, in the course of experimental work, the chemical by-products of the biochemical reactions occurring are to be determined, it would be advantageous to replace the peptone with a simpler compound. Later in this paper, data are presented which provide for the use of simpler nitrogen compounds of known chemical structure.

The required dilution of the standard medium was first tentatively fixed by calculation based upon the requirements as to oxygen depletion. The total amount of dissolved oxygen available (in saturated solution at 20° C.) being about 9.1 p. p. m., it was thought desirable that the carbonaceous portion of the diluted medium should have a 5-day biological oxygen demand of about 5 p. p. m., as this would make an accurately readable depletion, and would leave some oxygen available for possible oxidation of a fraction of the nitrogenous constituents of the medium. Since each milligram of dextrose requires, for its oxidation, approximately 1 milligram of oxygen, it was estimated that 5 milligrams of dextrose per liter would be about the right concentration. The standard dextrose-peptone-phosphate medium contains 5 grams of dextrose per liter; hence a dilution of one one-thousandth gives the required concentration of 5.0 milligrams per liter.

Bact. aerogenes was selected as the test organism. In preliminary experiments with this organism in the standard medium diluted one one-thousandth with distilled water, growth either did not occur at all or took place only after extended lags. The results obtained in a series of such tests are given in Table 1. By gradually decreasing the dilution until the amounts of peptone and dextrose present were increased to 100 milligrams per liter, growth was stimulated and the lag periods were reduced materially. However, with such concentrations of dextrose and peptone, the dissolved oxygen originally present in the samples was used up in a few hours, thereby defeating one of the purposes for which the medium was desired. Moreover it was believed that it should not be necessary to increase the concentration of dextrose or peptone in this dilute medium; for past experience with oxygen demand determinations in natural waters

and diluted sewage had shown that when sufficient oxidizable materials were present to produce marked depletions of the dissolved oxygen extensive bacterial multiplication also occurred. Dextrose and peptone are readily utilized by *Bact. aerogenes*, and its failure to grow in these tests must therefore be ascribed to causes other than excessive dilution of the organic constituents.

TABLE 1.—*Rates of growth of Bact. aerogenes at 20° C. in dextrose-peptone-phosphate broth diluted 1:1,000 with distilled water*

Hours from start	Experiment numbers									
	1A	2A	3A	4A	5A	6A	7A	8A	9A	1
	Bact. aerogenes per c. c.									
0	11,700	19,200	5,900	14,300	5,050	5,650	2,250	1,020	7,600	59,000
24	4,800	3,100	3,130	2,200	4,800	4,900	10,700	138,000	270,000	46,000
48			37,000	8,500	2,350	2,500	35,500	1,490,000		17,100
72	1,640	950	932,000	1,610,000			855,000			11,200
120	1,820	980,000	3,300,000		4,100	1,390				1,600
168	180,000	1,200,000			31,400	420		2,090,000	910,000	2,300
240	620,000	3,180,000	2,830,000		870,000	1,500				2,100,000

Hydrogen-ion and salt concentration.—In seeking the reason for the failure of *Bact. aerogenes* to grow in the dilute medium, the reaction and the concentration of buffer salts were the first factors considered. Although the hydrogen-ion concentration of the broth was not changed materially by dilution, the concentration of the buffer salts was reduced a thousand fold. It seemed probable, therefore, either that the pH range at which satisfactory growths of *Bact. aerogenes* were obtained was not the same in dilute as it was in concentrated media where the stimulus to grow is greater, or that higher concentrations of inorganic salts were required in dilute media to make the food present available for bacterial use. To obtain information in regard to these possibilities, experiments were conducted to determine the following points:

(1) The optimum pH zone for the growth of *Bact. aerogenes* in dilute media.

(2) The concentration of phosphate buffer (at the optimum pH zone) that would result in maximum bacterial multiplication.

1. *Optimum pH zone for the growth of Bact. aerogenes in dilute media.*—A number of extensive studies of the growth of certain bacteria at various hydrogen-ion concentrations have been made. Among these, Clark (1915) and Cohen and Clark (1919) reported that, under conditions of favorable food supply and for the period of the logarithmic phase of growth, there is a broad zone of pH within which the rate of growth is quite uniform for a number of bacteria. Sherman and Holm (1922) found that the presence of certain salts

in proper concentrations might either widen or narrow the zone of pH at which good growth would be obtained. However, in the studies reported by these and other research workers, media fairly rich in bacterial food were employed.

Tests were accordingly made on the rate and limits of growth of *Bact. aerogenes* in the standard medium diluted one one-thousandth with distilled water which was buffered with phosphates at various hydrogen-ion concentrations. The phosphate buffers were prepared according to Clark (1922), and the amounts added to the dilution water for each hydrogen-ion concentration were proportioned so that the final concentration of inorganic salt in each diluted medium was 2.5 grams per liter, corresponding to one-half that present in the full-strength broth.

The inoculation added to each 100 c. c. portion of diluted medium was one-millionth part of the growth of *Bact. aerogenes* on a 24-hour, 37° C. agar slant, providing an initial bacterial content of less than 5,000 organisms per c. c. These samples were stored at 20° C. in 100 to 200 c. c. portions in 300 c. c. Pyrex Erlenmeyer flasks. Portions for bacterial analysis and for pH determinations made at the start and at each successive time interval were taken from the same container for each hydrogen-ion concentration under trial. The average results obtained from eight such experiments are presented in Table 2 and Figure 1.

TABLE 2.—*Rates and limits of growth of Bact. aerogenes at 20° C. in dextrose-peptone-phosphate broth diluted 1: 1,000 with phosphate-buffered dilution water adjusted at various hydrogen ion concentrations*

(Each series represents the average of eight experiments)

Hours from start	Hydrogen ion concentration expressed in pH *					
	5.7	6.4	6.8	7.2	7.5	7.8
	Bact. aerogenes per c. c.					
0	2,480	2,480	2,480	2,480	2,480	2,480
6	3,450	3,480	3,460	2,960	3,750	3,160
17	166,000	348,000	402,000	467,000	274,000	33,000
19	437,000	915,000	849,000	980,000	680,000	59,000
21	772,000	1,970,000	2,240,000	2,680,000	1,740,000	60,000
24	1,318,000	2,850,000	3,240,000	3,450,000	2,840,000	336,000
30	2,680,000	4,410,000	5,180,000	5,020,000	5,200,000	2,490,000
41	3,720,000	5,550,000	6,540,000	6,210,000	5,780,000	4,640,000
48	3,550,000	6,000,000	6,240,000	6,160,000	6,400,000	5,480,000
72	3,360,000	5,820,000	6,300,000	6,320,000	6,870,000	6,530,000
90	3,680,000	6,320,000	6,880,000	7,050,000	7,420,000	6,600,000

* pH determined daily, no change observed.

Under the conditions of these tests it is evident that, at a pH as low as 5.7 and as high as 7.8, there is a marked inhibition of the reproductive activity of *Bact. aerogenes*. This inhibitory effect is permanent at the lower pH, but is overcome at the higher pH after

24 to 48 hours, although there was no observed change in the hydrogen-ion concentration. Fairly good growths were obtained between the pH range of 6.4 to 7.5, with the optimum growth at pH 6.8 to 7.2.[2]

The culture used in these tests had been growing on media adjusted to a pH between 6.8 and 7.2. In order to determine the effect of previous environment, one culture was carried for 16 serial transfers alternately on standard agar and broth, both adjusted to pH 5.5,

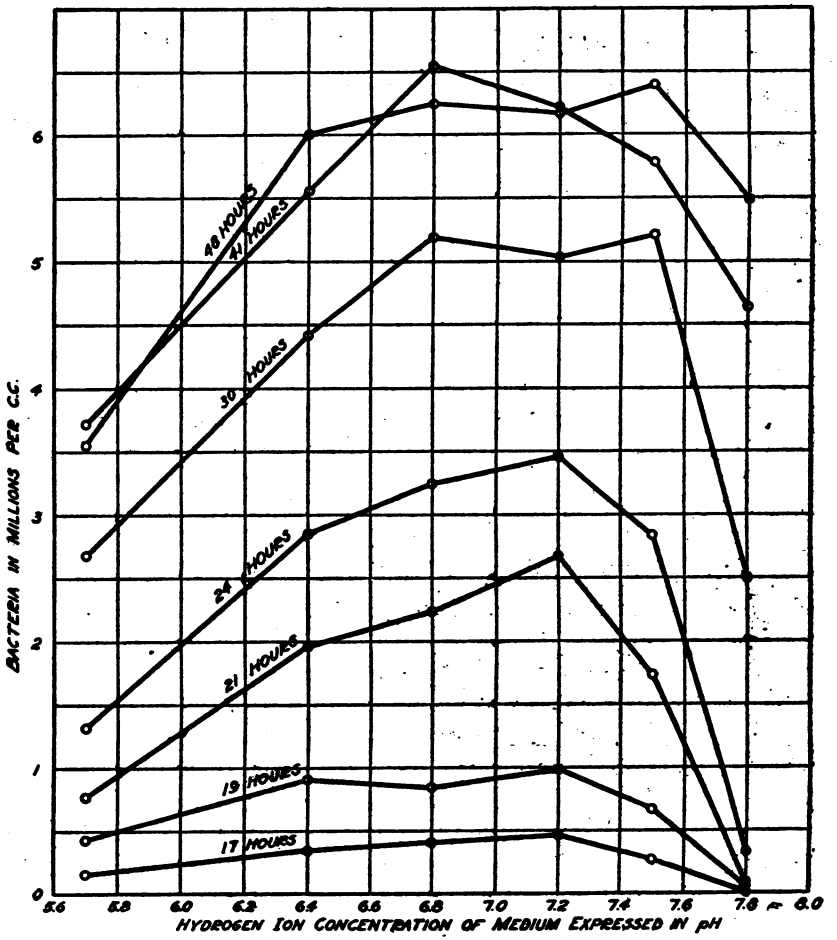

FIGURE 1.—The relation of the initial hydrogen-ion concentration to the growth of *Bact. aerogenes* in dilute media, after various periods of incubation at 20° C.

and another culture similarly carried on media adjusted to pH 8.0. (In higher concentrations of food, active bacteria will grow well at these pH values.) These two cultures were then used for inoculations in two series of tests similar to those described above. The results obtained agreed with those of the earlier study; that is, repeated

[2] In a recently reported study, Parsons et al. (1929) found that the optimum hydrogen-ion concentration for the growth of certain of the anaerobes was in the zone of pH 7.0 to 8.0. The results presented in their Figure 3 are quite similar to those given here.

cultivation at a high or a low hydrogen ion concentration did not tend to make the bacterium grow better at that particular pH.

As a result of this finding, a pH of 7.2, which is about the average for natural polluted water and sewage, was adopted as the optimum for further studies.

2. *Concentration of phosphate buffer.*—The concentration of phosphate salts used in the preceding study in determining the optimum pH for *Bact. aerogenes* was approximately 2.5 grams per liter. This amount seemed excessive, and tests were made following the technique of the preceding study to ascertain whether lesser amounts, at the same pH, would be as favorable to bacterial activity. The dilution waters used in these tests contained, respectively, 0.025, 0.05, 0.25, and 2.5 grams of phosphate per liter. The data obtained from a typical series are given in Table 3.

TABLE 3.—*Rates and limits of growth of Bact. aerogenes at 20° C. in dextrose-peptone-phosphate broth diluted 1:1,000 with phosphate dilution water adjusted at pH 7.2 but containing various amounts of phosphate salts*

Hours from start	Grams per liter of phosphate salts in dilution water			
	0.025	0.05	0.25	2.5
	Bact. aerogenes per c. c.			
0	24,800	24,800	24,800	24,800
5	31,000	31,000	23,000	23,000
24	1,560,000	1,690,000	202,000	3,460,000
29	1,990,000	1,930,000	485,000	4,100,000
48	3,100,000	3,550,000	2,430,000	4,100,000
72	3,720,000	3,850,000	3,080,000	4,350,000
96	4,380,000	4,450,000	2,700,000	4,320,000

In all cases the rate of bacterial growth was accelerated, and it progressed to a higher limit when the 2.5 gram amount of phosphate was present. Two assumptions may be made to explain this: (*a*) That ions other than those present in dilute solutions of dextrose, peptone, and phosphate are necessary for the structural requirements of bacteria and that these ions, as impurities, are present in sufficient quantity when larger amounts of these chemicals are used; or (*b*) that fairly high and perhaps definite concentrations of inorganic salts may be decidedly favorable to the growth of bacteria in dilute media.

In support of the latter assumption it would appear reasonable that in such dilute media the addition of a sufficient amount of inert salts to create a proper osmotic balance between the solution and the bacterial cell would favor the growth of the bacteria. Holm and Sherman (1921) and Sherman and Holm (1922) found that certain salts at definite concentration zones materially influenced both the rate and the extent of bacterial multiplication.

In consideration of the results obtained it was decided to use, as a diluent of the standard medium, distilled water buffered at pH 7.2 with phosphate salts in a concentration of 2.5 grams per liter.

Nitrogen sources other than peptone.—As stated above, peptone was accepted as the standard nitrogen-supplying constituent of the medium. However, comparative studies were made, using other nitrogen-containing substitutes such as sodium nitrate, ammonium sulphate, urea, and asparagin. Tests were made with each of these salts in combination with dextrose diluted with distilled water, properly buffered with phosphates, so that the concentration of each nitrogen compound was exactly 5.0 milligrams per liter. Two controls were run with each test—one in which peptone was the source of nitrogen and one to which no nitrogen was added. The results obtained from one such series are given in Table 4.

TABLE 4.—*Rates and limits of growth of Bact. aerogenes at 20° C. in media containing dextrose and nitrogen, in various compounds, in concentrations, 5.0 milligrams per liter, prepared with phosphate dilution water adjusted at pH 7.2*

Hours from start	Sources of nitrogen					
	$NaNO_3$	$(NH_4)_2SO_4$	Urea	Asparagin	Peptone	None
	Bact. aerogenes per c. c.					
0	[1] 185	185	185	185	185	185
18	10,400	11,500	13,700	28,000	229,000	10,800
24	131,000	214,000	177,000	319,000	4,030,000	106,000
42	5,920,000	6,230,000	6,250,000	9,850,000	9,200,000	2,080,000
48	8,500,000	6,200,000	7,400,000	10,900,000	7,600,000	2,600,000
66	6,280,000	6,460,000	6,470,000	11,300,000	9,750,000	2,360,000
72	6,150,000	8,050,000	7,450,000	13,800,000	9,450,000	2,370,000
96	6,500,000	6,900,000	5,800,000	12,000,000	9,300,000	2,810,000
120	7,350,000	6,400,000	7,500,000	11,600,000	10,400,000	2,240,000
192	7,300,000	6,050,000	6,050,000	11,800,000	10,700,000	2,880,000

[1] In 12 initial plates made from stock solution, the maximum variation was 161–203 colonies per plate.

In the control to which no nitrogen compound was added, the rate of growth was retarded and the extent limited. In the medium containing peptone there was the most rapid growth and the extent of growth apparently progressed to its limit. In the four media containing the other compounds of nitrogen, the rate of growth was initially retarded in all cases, while the extent of growth was approximately the same as that obtained in media containing peptone. In the asparagin and ammonium sulphate media the initial lag was less than in media containing either urea or sodium nitrate, but the asparagin and ammonium sulphate seemed not as readily available as peptone. Repeated efforts were made to overcome the initial lag observed with these nitrogen compounds, but they were unsuccessful.

Additional tests made with *Bact. aerogenes* indicate that the depletions of dissolved oxygen, when simpler compounds of nitrogen are

substituted for peptone, are the same as those obtained with peptone, providing due allowance is made for the initial lag in biological activity. This would indicate that either ammonium sulphate or asparagin might be substituted for peptone when the analyses to be made require the use of a simpler nitrogen compound.

Amount of nitrogen required.—In the foregoing tests the concentration of nitrogenous materials was in each case 5.0 milligrams per liter. This amount was considered ample for the structural requirements of the bacteria in utilizing the energy available in a 5.0 milligrams per liter solution of dextrose. It was thought probable that a lesser amount of nitrogen might be sufficient. Tests were accordingly made with varying amounts of peptone and of ammonium sulphate in combination with concentrations of dextrose of 5.0 milligrams per liter. The results obtained with peptone are recorded in Table 5.

TABLE 5.—*Rates and limits of growth of Bact. aerogenes at 20° C. in media containing dextrose, 5.0 milligrams per liter, and peptone in varying amounts, prepared with phosphate dilution water adjusted at pH 7.2*

Hours from start	Milligrams per liter of peptone in media					
	5.0	0.5	0.05	0.005	0.0005	None
	Bact. aerogenes per c. c.					
0	12,100	12,100	12,100	12,100	12,100	12,100
6	12,000	12,100	12,100	11,200	12,100	12,200
24	1,350,000	60,000	10,000	19,500	16,500	14,000
27	4,000,000	100,000	20,000	13,000	13,000	11,500
30	4,500,000	230,000	10,000	27,000	20,500	15,500
48	5,500,000	2,740,000	1,720,000	1,720,000	1,360,000	1,320,000
53	6,350,000	4,000,000	1,800,000	2,060,000	1,720,000	1,870,000
72	7,050,000	2,570,000	3,100,000	2,700,000	2,950,000	2,700,000
96	4,550,000	2,200,000	1,650,000	1,400,000	1,810,000	2,060,000
120	4,560,000	1,180,000	950,000	690,000	990,000	810,000

Similar results were obtained with ammonium sulphate, except that an initial lag was observed in all cases with this salt.

These results show that in a solution containing 5.0 milligrams of dextrose in combination with 0.5 milligram or less of peptone or ammonium sulphate per liter both the rate and the limit of growth of *Bact. aerogenes* are very markedly reduced. Additional tests in which the concentrations of peptone or ammonium sulphate were varied between 5.0 and 0.5 milligram per liter indicated that a concentration of 3.0 milligrams per liter yielded as satisfactory growths as were obtained when 5.0-milligram concentrations were employed. The 5.0-milligram per liter concentration selected, therefore, provided a slight excess of nitrogenous substance, which was considered advisable.

Suitability of the dilute medium to studies of biological oxidation.—In addition to the results presented, confirmatory evidence of the suit-

ability of this medium for studies of natural purification has been obtained in further experimental work with a number of biological organisms, in pure and in mixed culture, in connection with the general study of natural purification in polluted waters. Thus observations have been made on the growth characteristics and the resulting dissolved oxygen depletions in the medium, of a number of species of bacteria, both in pure and in mixed culture, as well as of various mixtures of bacteria and plankton. In pure cultures of *Bact. aerogenes*, *proteus*, *coli*, and of a small sewage coccus, in mixed bacterial cultures free from plankton extending in complexity from a few species to those obtained by washings from agar plates made from river water and sewage, and in mixed cultures containing both bacteria and plankton in varying complexity, the results have closely simulated those obtained in natural polluted waters. In each instance the bacteria increased rapidly in numbers to a rather definite limit, depletion of dissolved oxygen meanwhile occurring at the usual, well-defined rate. In experiments with bacteria only, the bacteria after reaching their limiting numbers tended to remain constant, and no further oxygen depletions were observed. In experiments in which both bacteria and plankton were present, following the preliminary increase in bacterial numbers, the usual rapid decline occurred, coincident with the increase in the concentration of plankton organisms. Under these conditions the usual rate of oxygen depletion was maintained.

Similarly higher concentrations of the food in this medium are required to support bacteria-free cultures of the animal plankton, such as *Colpidium*, in the same way that only higher concentrations of natural pollution support such biological growths.

The results of these additional studies, which will be presented and discussed in detail in later papers of this series, have shown in general that this dilute medium is suitable for use in a study of the interrelationships of these various biological factors.

SUMMARY

Dextrose and peptone or dextrose and ammonium sulphate, in equal proportions properly diluted, provide a medium which produces satisfactory growths of many bacteria. When oxygen demand determinations are to be made by the excess oxygen dilution method in such a medium it is necessary, in order to maintain aerobic conditions, to dilute the dextrose and peptone until not over 5.0 milligrams of each are present per liter. Distilled water, when used for such dilution, was found to be quite unsatisfactory. Distilled water, containing 2.5 grams of phosphate salts per liter, adjusted to a pH of approximately 7.2, has been found to be a satisfactory dilution

water. When thus prepared, the dilute medium sustains vigorous growth without excessive lag.

The artificial mixture, or "synthetic sewage," described here, can be exactly reproduced and it has proved of value in the study of some of the fundamental relationships existing between the bacteria and the plankton in the processes of natural purification. This mixture, while not ideal, does simulate the organic growth-supporting characteristics of ordinary sewage to a remarkable degree, for, in addition to an adequate support of bacterial life, it possesses the following characteristics, which will be covered in detail in subsequent papers:

(1) If previously aerated and maintained under sterile conditions, the synthetic sewage will not use up oxygen, even in traces.

(2) It will not become alkaline when sterilized by heat or acid during incubation, if the amount of dextrose present does not greatly exceed 100 milligrams per liter.

(3) It will support plankton life in the presence of bacteria and will support the plankton, *Colpidium*, in the absence of bacteria if the concentrations of dextrose and peptone are increased sufficiently to provide for the food requirements of the larger organism.

(4) Under the action of various bacteria and plankton the processes of biological oxidation in this medium are qualitatively the same as those observed in polluted water and sewage.

The influence of certain factors—concentration of mineral salts, pH of media, and the nature and concentration of food materials—is shown to be of marked significance on the growth of bacteria in dilute media.

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CURRENT PREVALENCE OF COMMUNICABLE DISEASES IN THE UNITED STATES[1]

August 4–September 28, 1929

The prevalence of certain important communicable diseases as indicated by weekly telegraphic reports from State health departments[2] to the Public Health Service is summarized below. This summary is prepared from the data published weekly in the PUBLIC HEALTH REPORTS under the section entitled "Prevalence of Disease."

Poliomyelitis.—The poliomyelitis rate, although following the usual seasonal rise during the months of August and September, was the lowest rate for the corresponding season in recent years. The disease appeared to be quite prevalent in the Middle and South Atlantic States; a considerable number of cases were reported in New York and Pennsylvania, and the outbreak in Virginia showed a strong resistance to a decline. An increase in the disease was also noted in Michigan during the month of September. On the other hand, the outbreak in North Carolina had apparently come to an end. For the 8-week period ended September 28 the number of cases totaled 881.

Typhoid fever.—Preliminary reports indicate that the maximum incidence of typhoid fever for the current year was reached during the week ended August 3. For the eight weeks ended September 28 an average of only 650 cases was reported weekly. The disease continued much less prevalent than in any of the three preceding years—less than half the number of cases were reported during August and September than occurred during the same months in 1926.

Meningococcus meningitis.—Meningococcus meningitis continued quite prevalent in Michigan. An appreciable number of cases was also reported in Utah, Washington, California, and Pennsylvania. In general, however, the meningococcus meningitis rate more nearly approximated the 1928 rate than at any time during the current year. The incidence (759 cases for the 8-week period) was about double the rate in 1927 and was more than three times as high as the 1926 rate for the same period.

Smallpox.—The number of cases of smallpox reported during August and September was slightly higher than the number reported during the same period in each of the three preceding years. The East and West North Central and the Pacific States reported the majority of the 1,250 cases that occurred during the 8-week period ended September 28.

Diphtheria.—The lowest incidence of diphtheria for the current year occurred in July, which was earlier than it had occurred in any

[1] From the Office of Statistical Investigations, U. S. Public Health Service.

[2] The numbers of States reporting for the various diseases are as follows: Typhoid fever, 41; poliomyelitis, 43; meningococcus meningitis, 42; smallpox, 42; measles, 38; diphtheria, 42; scarlet fever, 41; influenza, 31.

of the three preceding years. A very gradual increase was noted during August and September. The disease was very prevalent in the Middle Atlantic States, and North Carolina, in the South Atlantic group, reported a large number of cases. The total number of cases (7,550) was slightly higher than in 1928, but was much less than in 1926 and 1927 for the same months.

Scarlet fever.—The scarlet fever rate reached its seasonal low level during the week ended August 24, and started upward in September, as is usual for this disease. The 7,300 reported cases were near the average for the season. Practically all sections of the country shared in the increase.

Measles.—As expected, the measles rate reached its low level for the current year during the month of September. The number of cases (4,400) reported for the 8-week period ended September 28, was the lowest recorded for that period in four years.

Influenza.—In general, influenza maintained its previous low level. There were 1,000 cases reported for August and September—the lowest number in the past four years for those two months. In September a slight increase in the number of cases was noted in California, Texas, Wisconsin, Georgia, Louisiana, and South Carolina.

Mortality from all causes.—The mortality rate for large cities, during August and September, as reported by the Bureau of the Census, averaged 10.6 per 1,000 population (annual basis). This rate was slightly lower than the rate for the corresponding period of last year (11.0), and was about the same as in 1926 and 1927.

DEATHS DURING WEEK ENDED OCTOBER 19, 1929

Summary of information received by telegraph from industrial insurance companies for the week ended October 19, 1929, and corresponding week of 1928. (From the Weekly Health Index, October 23, 1929, issued by the Bureau of the Census, Department of Commerce)

	Week ended Oct. 19, 1929	Corresponding week, 1928
Policies in force	74, 934, 881	71, 981, 748
Number of death claims	13, 292	14, 176
Death claims per 1,000 policies in force, annual rate	9. 2	10. 3

Deaths from all causes in certain large cities of the United States during the week ended October 19, 1929, infant mortality, annual death rate, and comparison with corresponding week of 1928. *(From the Weekly Health Index, October 23, 1929, issued by the Bureau of the Census, Department of Commerce)*

City	Week ended Oct. 19, 1929		Annual death rate per 1,000, corresponding week, 1928	Deaths under 1 year		Infant mortality rate, week ended Oct. 19, 1929 [3]
	Total deaths	Death rate [1]		Week ended Oct. 19, 1929	Corresponding week, 1928	
Total (62 cities)	6,641	11.9	12.2	599	715	[3] 53
Akron	39			3	4	31
Albany [4]	35	15.2	20.0	5	1	99
Atlanta	89	18.2	14.6	4	6	42
White	44			1	1	
Colored	45	(5)	(5)	3	5	
Baltimore [4]	220	13.9	14.0	22	31	71
White	172			14	19	56
Colored	48	(5)	(5)	8	12	127
Birmingham	77	18.1	15.8	8	14	72
White	32			3	5	45
Colored	45	(5)	(5)	5	9	115
Boston	170	11.1	15.2	24	17	66
Bridgeport	29			2	4	35
Buffalo	160	15.1	12.3	16	9	69
Cambridge	37	15.4	10.4	7	3	125
Camden	33	12.7	11.2	5	7	86
Canton	24	10.7	12.5	1	4	24
Chicago [4]	682	11.3	11.1	44	76	39
Cincinnati	148			14	13	82
Cleveland	197	10.2	9.5	18	23	53
Columbus	60	10.5	10.3	5	5	47
Dallas	55	13.2	11.8	8	9	
White	46			8	8	
Colored	9	(5)	(5)	0	1	
Dayton	49	13.9	11.3	7	7	111
Denver	85	15.1	14.0	8	11	77
Des Moines	26	8.9	13.1	3	1	54
Detroit	284	10.8	10.9	31	32	50
Duluth	14	6.3	10.7	0	3	0
Erie	26			2	2	41
Fall River [4]	29	11.3	9.0	2	4	38
Flint	25	8.8	11.9	6	9	73
Fort Worth	28	8.6	8.0	1	2	
White	26			1	2	
Colored	2	(5)	(5)	0	0	
Grand Rapids	34	10.8	10.5	4	4	60
Houston	70			13	5	
White	54			11	4	
Colored	16	(5)	(5)	2	1	
Indianapolis	98	13.4	12.9	6	5	48
White	90			6	4	56
Colored	8	(5)	(5)	0	1	0
Jersey City	59	9.5	11.1	4	10	31
Kansas City, Kans	28	12.4	12.8	3	5	66
White	20			1	4	25
Colored	8	(5)	(5)	2	1	358
Kansas City, Mo	107	14.3	11.9	8	8	67
Knoxville	20	9.9	7.4	0	0	0
White	19			0	0	0
Colored	1	(5)	(5)	0	0	0
Los Angeles	255			19	24	56
Lowell	26			3	6	68
Lynn	16	7.9	11.9	2	2	55
Memphis	59	16.2	16.8	4	3	47
White	27			2	1	38
Colored	32	(5)	(5)	2	2	63
Milwaukee	95	9.1	9.6	15	9	66
Minneapolis	82	9.4	10.9	4	10	25
Nashville	53	19.9	21.3	9	5	145
White	32			7	2	152
Colored	21	(5)	(5)	2	3	126

Footnotes at end of table.

Deaths from all causes in certain large cities of the United States during the week ended October 19, 1929, infant mortality, annual death rate, and comparison with corresponding week of 1928—Continued

City	Week ended Oct. 19, 1929		Annual death rate per 1,000, corresponding week, 1928	Deaths under 1 year		Infant mortality rate, week ended Oct. 19, 1929
	Total deaths	Death rate		Week ended Oct. 19, 1929	Corresponding week, 1928	
New Bedford	10			0	7	0
New Haven	44	12.2	10.6	0	4	0
New Orleans	138	16.8	15.1	16	18	79
White	72			4	12	28
Colored	66	(5)	(5)	12	6	202
New York	1,372	11.9	12.8	114	161	47
Bronx Borough	185	10.2	10.9	15	16	44
Brooklyn Borough	489	11.1	10.9	60	65	61
Manhattan Borough	508	15.2	18.0	33	66	40
Queens Borough	143	8.8	8.4	5	13	20
Richmond Borough	47	16.3	18.4	1	1	18
Newark, N. J	92	10.2	11.6	11	12	58
Oakland	46	8.8	10.9	2	5	22
Oklahoma City	38			3	2	60
Omaha	52	12.2	13.1	8	4	94
Paterson	28	10.1	15.2	2	4	35
Philadelphia	489	12.4	11.9	33	50	47
Pittsburgh	151	11.7	13.5	20	11	69
Portland, Oreg	61			1	3	11
Providence	65	11.9	13.3	12	7	106
Richmond	67	18.0	17.5	8	6	112
White	37			3	2	64
Colored	30	(5)	(5)	5	4	205
Rochester	75	11.9	10.0	5	3	42
St. Louis	191	11.8	13.7	10	14	34
St. Paul	67			2	4	21
Salt Lake City [4]	28	10.6	9.9	3	3	46
San Antonio	52	12.5	13.9	7	8	
San Diego	43			1	3	19
San Francisco	105	9.4	12.2	6	4	38
Schenectady	14	7.8	9.0	2	2	64
Seattle	89	12.1	9.8	5	0	53
Somerville	12	6.1	8.1	1	2	36
Spokane	26	12.5	12.9	1	0	26
Springfield, Mass	32	11.2	11.9	4	4	66
Syracuse	51	13.4	12.3	5	3	60
Tacoma	27	12.8	10.9	1	4	26
Toledo	67	11.2	12.4	7	10	65
Trenton	28	10.5	11.3	5	8	91
Washington, D. C	131	12.4	12.7	8	15	47
White	83			4	10	34
Colored	48	(5)	(5)	4	5	76
Waterbury	21			3	4	76
Wilmington, Del	31	12.6	12.2	2	5	52
Worcester	50	13.2	11.9	5	5	63
Yonkers	21	9.1	7.3	3	0	70
Youngstown	37	11.1	11.4	9	8	129

[1] Annual rate per 1,000 population.
[2] Deaths under 1 year per 1,000 births. Cities left blank are not in the registration area for births.
[3] Data for 71 cities.
[4] Deaths for week ended Friday.
[5] In the cities for which deaths are shown by color, the colored population in 1920 constituted the following percentages of the total population: Atlanta, 31; Baltimore, 15; Birmingham, 39; Dallas, 15; Fort Worth, 14; Houston, 25; Indianapolis, 11; Kansas City, Kans., 14; Knoxville, 15; Louisville, 17; Memphis, 38; Nashville, 30; New Orleans, 26; Richmond, 32; and Washington, D. C., 25.

PREVALENCE OF DISEASE

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

UNITED STATES

CURRENT WEEKLY STATE REPORTS

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

Reports for Weeks Ended October 19, 1929, and October 20, 1928

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 19, 1929, and October 20, 1928

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928
New England States:								
Maine	3	7	2	----	17	34	1	0
New Hampshire	1	2	5	8	23	89	0	0
Vermont	----	1	----	----	1	1	0	0
Massachusetts	106	92	4	12	77	243	2	3
Rhode Island	7	10	----	----	----	11	0	0
Connecticut	36	19	4	2	3	35	0	4
Middle Atlantic States:								
New York	158	104	[1] 22	[1] 19	171	191	18	27
New Jersey	100	116	2	15	11	46	3	1
Pennsylvania	155	181	----	----	150	273	5	5
East North Central States:								
Ohio	63	75	12	6	114	70	2	1
Indiana	29	63	----	11	6	7	0	0
Illinois	205	162	15	22	82	75	6	3
Michigan	116	85	2	6	91	66	23	6
Wisconsin	15	25	28	24	194	50	1	4
West North Central States:								
Minnesota	44	33	1	----	21	43	0	1
Iowa	18	13	----	----	6	----	1	0
Missouri	74	58	3	----	11	19	5	2
North Dakota	11	10	----	3	1	5	2	1
South Dakota	2	11	----	----	----	1	0	0
Nebraska	54	26	----	----	27	----	1	0
Kansas	36	12	----	5	64	2	1	1
South Atlantic States:								
Delaware	3	2	----	----	1	2	0	0
Maryland [2]	40	41	10	3	6	12	1	0
District of Columbia	15	42	----	----	1	5	1	0
Virginia	----	----	----	----	----	----	----	----
West Virginia	26	47	11	7	28	8	0	0
North Carolina	299	189	4	----	1	5	1	0
South Carolina	83	110	----	546	----	----	0	0
Georgia	40	47	49	87	2	7	1	0
Florida	22	18	3	6	2	2	0	0
East South Central States:								
Kentucky	20	32	----	----	----	----	0	0
Tennessee	51	57	21	24	13	----	1	0
Alabama	75	132	7	61	12	8	1	1
Mississippi	103	39	----	----	----	----	0	0

[1] New York City only.

[2] Week ended Friday.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 19, 1929, and October 20, 1928—Continued

Division and State	Diphtheria		Influenza		Measles		Meningococcus meningitis	
	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928
West South Central States:								
Arkansas	25	14	21	16	1	1	1	0
Louisiana	38	18	7	3	4	3	3	0
Oklahoma [2]	89	109	38	35	12	6	1	2
Texas	79	40	15	6	1	20	0	0
Mountain States:								
Montana	4	1	----	----	114	14	2	2
Idaho	----	3	----	----	10	4	4	0
Wyoming	----	----	----	----	----	1	0	0
Colorado	11	12	----	3	4	2	3	1
New Mexico	5	3	----	----	1	1	0	2
Arizona	6	----	----	----	----	----	3	0
Utah [3]	1	4	4	5	3	----	1	1
Pacific States:								
Washington	17	6	----	----	11	22	1	0
Oregon	15	19	17	25	14	16	1	2
California	68	84	25	158	52	27	9	0

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928
New England States:								
Maine	1	4	24	41	0	1	2	1
New Hampshire	0	1	15	8	0	0	0	3
Vermont	0	0	2	2	0	0	0	0
Massachusetts	9	10	156	151	0	0	9	13
Rhode Island	0	3	6	11	0	0	0	1
Connecticut	2	3	24	21	0	0	5	1
Middle Atlantic States:								
New York	31	27	129	176	22	0	33	78
New Jersey	2	4	70	57	0	0	8	6
Pennsylvania	11	7	214	214	0	0	44	55
East North Central States:								
Ohio	7	11	153	153	15	4	41	25
Indiana	1	1	82	57	13	10	6	10
Illinois	12	4	336	152	42	25	48	37
Michigan	14	5	183	125	44	9	17	12
Wisconsin	0	1	61	100	1	4	17	6
West North Central States:								
Minnesota	0	8	76	86	7	0	7	11
Iowa	6	1	32	61	8	5	8	4
Missouri	0	0	72	60	6	4	10	15
North Dakota	0	6	21	16	9	0	2	2
South Dakota	0	0	14	10	15	3	8	1
Nebraska	0	3	18	23	7	2	2	1
Kansas	1	0	92	66	20	4	5	9
South Atlantic States:								
Delaware	0	0	4	3	0	0	0	7
Maryland [3]	0	3	51	42	0	0	23	25
District of Columbia	0	2	10	12	0	0	3	6
Virginia	15	----	----	----	----	1	----	----
West Virginia	1	9	82	81	5	3	32	29
North Carolina	2	1	140	112	11	4	16	23
South Carolina	1	2	44	17	0	4	27	39
Georgia	1	0	42	38	0	0	12	17
Florida	0	0	5	5	1	1	3	3
East South Central States:								
Kentucky	0	2	15	58	7	14	19	21
Tennessee	2	0	60	34	2	0	30	35
Alabama	2	0	63	53	0	2	12	26
Mississippi	0	0	26	35	1	3	13	10

[2] Week ended Friday.

[3] Figures for 1929 are exclusive of Oklahoma City and Tulsa.

Cases of certain communicable diseases reported by telegraph by State health officers for weeks ended October 19, 1929, and October 20, 1928—Continued

Division and State	Poliomyelitis		Scarlet fever		Smallpox		Typhoid fever	
	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928	Week ended Oct. 19, 1929	Week ended Oct. 20, 1928
West South Central States:								
Arkansas	0	0	19	13	1	1	20	17
Louisiana	0	0	26	3	0	2	12	9
Oklahoma [2]	0	0	35	53	12	13	34	49
Texas	2	1	28	22	0	0	7	6
Mountain States:								
Montana	0	0	18	7	15	11	25	2
Idaho	0	0	12	2	3	11	0	2
Wyoming	0	0	2	24	0	6	6	0
Colorado	0	3	13	15	9	13	5	9
New Mexico	0	0	7	13	2	0	18	15
Arizona	0	0	1	0	0	0	3	3
Utah [3]	0	0	4	13	0	16	5	1
Pacific States:								
Washington	2	11	40	20	42	11	18	4
Oregon	1	4	15	32	14	29	5	3
California	5	1	141	114	17	27	12	13

[2] Week ended Friday.
[3] Figures for 1929 are exclusive of Oklahoma City and Tulsa.

SUMMARY OF MONTHLY REPORTS FROM STATES

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

State	Meningococcus meningitis	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
August, 1929										
Hawaii Territory	4	27	8	----	11	----	1	1	0	7
September, 1929										
Alabama	6	240	18	2,316	13	52	15	155	0	103
Illinois	24	475	44	27	165	1	14	590	64	113
Maine	----	10	----	----	34	----	3	69	0	8
Maryland	1	54	10	2	10	1	3	98	0	82
Minnesota	5	68	8	----	14	----	6	226	16	25
Missouri	17	97	20	71	43	----	3	134	48	66
New York	59	345	----	10	358	----	163	280	7	190

August, 1929

Hawaii Territory:	Cases
Chicken pox	5
Conjunctivitis, follicular	3
Dysentery (amebic)	1
Hookworm disease	5
Impetigo contagiosa	2
Leprosy	5
Mumps	7
Plague	1
Tetanus	3
Trachoma	1
Whooping cough	23

September, 1929

Chicken pox:	Cases
Alabama	7
Illinois	214
Maine	20
Maryland	23
Minnesota	81
Missouri	38
New York	200
Conjunctivitis:	
Illinois	1
Dengue:	
Alabama	4

	Cases
Diarrhea:	
Maryland	81
Dysentery:	
Illinois	32
Maryland	45
Minnesota (amebic)	6
Missouri	2
New York	74
German measles:	
Illinois	12
Maine	11
Maryland	7
New York	31
Impetigo contagiosa:	
Maryland	13
Lead poisoning:	
Illinois	8
Lethargic encephalitis:	
Alabama	5
Illinois	3
Maryland	3
Minnesota	1
New York	12
Mumps:	
Alabama	5
Illinois	110
Maine	17
Maryland	13
Missouri	17
New York	263
Ophthalmia neonatorum:	
Illinois	52
New York	4
Paratyphoid fever:	
Illinois	6
Maine	1
New York	9
Puerperal septicemia:	
Illinois	9
New York	22
Remittent fever:	
Illinois	1
Rabies in animals:	
Illinois	2
Maryland	6
Missouri	9
New York	3
Rabies in man:	
Illinois	1
Scabies:	
Maryland	2
Septic sore throat:	
Illinois	3
Maine	1
Maryland	1
Missouri	5
New York	10
Tetanus:	
Illinois	9
Maryland	4
Missouri	1
New York	9
Trachoma:	
Illinois	3
Minnesota	2
Missouri	2
New York	1
Trichinosis:	
Illinois	1
Tularaemia:	
Maryland	2
Minnesota	1
Typhus fever:	
Alabama	11
Undulant fever:	
Illinois	3
Maryland	2
Minnesota	5
Missouri	26
New York	12
Vincent's angina:	
Illinois	3
Maine	3
Maryland	4
New York	63
Whooping cough:	
Alabama	75
Illinois	972
Maine	30
Maryland	147
Minnesota	147
Missouri	162
New York	1,354

RECIPROCAL NOTIFICATIONS

Notifications regarding communicable diseases sent during the month of September, 1929, by departments of health of certain States to other State health departments

Disease	California	Illinois	Florida	Kansas	Massachusetts	Minnesota	New Jersey	New York
Diphtheria			[1] 1			1		
Gonorrhea						3		
Pneumonia		1						
Poliomyelitis		2						1
Scarlet fever		1				1		
Smallpox		3				2		1
Syphilis				10		9		
Trachoma						1		
Tuberculosis	1	4				43		
Typhoid fever	2	6	1		3		1	7

[1] Carrier.

PLAGUE-INFECTED GROUND SQUIRRELS IN CALIFORNIA

Under date of October 11, 1929, plague infection was reported proved in a lot of three ground squirrels and one wood rat from a ranch 16 miles east of Gilroy, Santa Clara County, Calif.

ADMISSIONS TO HOSPITALS FOR THE INSANE, JANUARY, 1929

Reports for the month of January, 1929, showing new admissions to hospitals for the care and treatment of the insane, have been received by the Public Health Service from 99 institutions located in 37 States, the District of Columbia, and the Territory of Hawaii. These hospitals reported a total of 149,848 patients on January 31, 1929, including those on parole.

The following table shows the number of new admissions for the month of January, 1929, by psychoses:

Psychoses	Male	Female	Total
1. Traumatic psychoses	16	2	18
2. Senile psychoses	162	109	271
3. Psychoses with cerebral arteriosclerosis	147	81	228
4. General paralysis	156	48	204
5. Psychoses with cerebral syphilis	36	8	44
6. Psychoses with Huntington's chorea	3	1	4
7. Psychoses with brain tumor	0	0	0
8. Psychoses with other brain or nervous disease	28	12	40
9. Alcoholic psychoses	121	26	147
10. Psychoses due to drugs and other exogenous toxins	24	12	36
11. Psychoses with pellagra	3	9	12
12. Psychoses with other somatic diseases	38	44	82
13. Manic-depressive psychoses	137	190	327
14. Involution melancholia	14	36	50
15. Dementia præcox	316	191	507
16. Paranoia and paranoid conditions	19	25	44
17. Epileptic psychoses	40	25	65
18. Psychoneuroses and neuroses	22	36	58
19. Psychoses with psychopathic personality	12	9	21
20. Psychoses with mental deficiency	60	30	90
21. Undiagnosed psychoses	105	56	161
22. Without psychosis	148	38	186
Total	1,607	988	2,595

Sixty-one and nine-tenths per cent of the new admissions were males and 38.1 per cent were females, giving a ratio of 163 males per 100 females. The 99 institutions on January 31, 1929, had 79,785 male patients and 70,063 female patients, the ratio being 114 males per 100 females.

At the end of the month 8.7 per cent of the total patients were on parole, 8.9 per cent of the male patients, and 8.5 per cent of the female patients.

Cases of dementia præcox constituted 19.5 per cent of the first admissions; manic-depressive psychoses, 12.6 per cent; senile psychoses, 10.4 per cent; psychoses with cerebral arteriosclerosis, 8.8 per cent; general paralysis, 7.9 per cent; 6.2 per cent of the cases were undiagnosed, and 7.2 per cent were without psychosis.

GENERAL CURRENT SUMMARY AND WEEKLY REPORTS FROM CITIES

The 94 cities reporting cases used in the following table are situated in all parts of the country and have an estimated aggregate population of more than 31,180,000. The estimated population of the 88 cities reporting deaths is more than 29,640,000. The estimated expectancy is based on the experience of the last nine years, excluding epidemics.

Weeks ended October 12, 1929, and October 13, 1928

	1929	1928	Estimated expectancy
Cases reported			
Diphtheria:			
46 States	1,936	2,094	
94 cities	666	678	904
Measles:			
45 States	1,944	921	
94 cities	131	192	
Meningococcus meningitis:			
45 States	93	80	
94 cities	44	43	
Poliomyelitis:			
46 States	148	180	
Scarlet fever:			
46 States	2,074	2,360	
94 cities	688	660	642
Smallpox:			
46 States	289	167	
94 cities	41	7	11
Typhoid fever:			
46 States	668	879	
94 cities	158	122	129
Deaths reported			
Influenza and pneumonia:			
88 cities	501	489	
Smallpox:			
88 cities	0	0	

City reports for week ended October 12, 1929

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 non-epidemic years.

If the reports have not been received for the full nine years, data are used for as many years as possible, but no year earlier than 1920 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	Population, July 1, 1928, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
NEW ENGLAND									
Maine:									
Portland	78,600	1	1	0		0	0	2	0
New Hampshire:									
Concord	(1)	0	0	1		0	0	0	0
Nashua	(1)	0	0	0		0	0	0	2
Vermont:									
Barre	(1)		0						
Massachusetts:									
Boston	799,200	10	35	21	3	0	4	17	16
Fall River	134,300	0	4	3		0	0	0	2
Springfield	149,800	3	3	3		0	0	0	2
Worcester	197,600	3	5	0		0	3	0	2
Rhode Island:									
Pawtucket	73,100	0	1	0		0	0	0	0
Providence	286,300	0	7	9		0	0	0	3
Connecticut:									
Bridgeport	(1)	0	6	1		0	0	0	2
Hartford	172,300	4	5	4		0	0	3	4
New Haven	187,900	12	1	0	2	0	0	0	2
MIDDLE ATLANTIC									
New York:									
Buffalo	555,800	10	14	12		0	1	7	8
New York	6,017,500	21	129	70	14	7	9	14	95
Rochester	328,200	1	6	3		1	1	2	5
Syracuse	199,300	6	6	0		0	0	12	3
New Jersey:									
Camden	135,400	1	6	2		0	0	0	1
Newark	473,600	13	12	35	2	0	2	3	3
Trenton	139,000	0	2	4		0	0	0	3
Pennsylvania:									
Philadelphia	2,064,200	19	51	22	4	4	1	4	40
Pittsburgh	673,800	9	26	7		4	10	0	21
Reading	115,400	0	1	0		0	1	0	1
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	413,700	4	10	10		2	1	1	3
Cleveland	1,010,300	24	48	21	5	1	3	8	13
Columbus	299,000	39	6	3		0	2	2	3
Toledo	313,200	19	12	2	1	1	25	2	1
Indiana:									
Fort Wayne	105,300	1	3	0		0	0	0	3
Indianapolis	382,100	6	15	8		0	1	5	9
South Bend	86,100	0	2	0		0	0	0	0
Terre Haute	73,500	3	2	1		1	0	0	0
Illinois:									
Chicago	3,157,400	36	73	107	3	6	6	6	39
Springfield	67,200	0	1	0		0	0	2	0
Michigan:									
Detroit	1,378,900	25	59	66	2	1	15	17	15
Flint	148,800	3	7	0		0	0	0	6
Grand Rapids	164,200	4	3	0		0	0	0	3

[1] No estimate of population made.

City reports for week ended October 12, 1929—Continued

Division, State, and city	Population, July 1, 1928, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
EAST NORTH CENTRAL—continued									
Wisconsin:									
Kenosha	56,500	3	0	0		0	0	0	0
Milwaukee	544,200	19	15	2	1	1	2	7	5
Racine	74,400	0	2	0		0	0	0	1
Superior	(1)	1	0	0		0	16	0	2
WEST NORTH CENTRAL									
Minnesota:									
Duluth	116,800	7	2	0		0	0	0	1
Minneapolis	455,900	22	30	7		1	6	16	1
St. Paul	(1)	9	14	0		0	2	9	3
Iowa:									
Davenport	(1)	0	0	0			0	0	
Des Moines	151,900	0	5	1			0	0	
Sioux City	80,000	3	2	0			0	1	
Waterloo	37,100	5	1	0			0	0	
Missouri:									
Kansas City	391,000	11	8	3		0	0	0	7
St. Joseph	78,500	0	2	0		0	0	0	2
St. Louis	848,100	6	42	32	1		2	1	
North Dakota:									
Fargo	(1)	3	0	0		0	1	1	0
Grand Forks	(1)	2	0	0			0	0	
South Dakota:									
Aberdeen	(1)	0	0	0			0	1	
Sioux Falls	(1)	0	0	0			0	0	
Nebraska:									
Omaha	222,800	13	14	19		0	1	0	4
Kansas:									
Topeka	62,800	1	2	0		0	0	2	0
Wichita	99,300	1	3	3		0	0	0	0
SOUTH ATLANTIC									
Delaware:									
Wilmington	128,500	1	2	1		0	0	0	2
Maryland:									
Baltimore	830,400	12	24	9	4	1	2	2	22
Cumberland	(1)	0	1	1		0	0	0	3
Frederick	(1)	0	1	0		0	0	0	0
District of Columbia:									
Washington	552,000	3	15	6	1	1	1	0	8
Virginia:									
Lynchburg	38,600	1	3	2		0	0	3	1
Norfolk	184,200	0	2	8		0	0	2	1
Richmond	194,400	2	25	22		1	1	0	2
Roanoke	64,600	1	8	1		0	0	0	0
West Virginia:									
Charleston	55,200	0	2	0	1	0	0	0	1
Wheeling	(1)	0	1	0		0	1	0	2
North Carolina:									
Raleigh	(1)	0	5	2		0	0	0	0
Wilmington	39,100	1	2	4		0	0	0	0
Winston-Salem	80,000	0	5	7		0	0	4	2
South Carolina:									
Charleston	75,900	0	2	2	12	0	0	0	3
Columbia	50,600	1	2	0		0	0	1	2
Georgia:									
Atlanta	255,100	0	10	12	18	1	0	0	5
Brunswick	(1)	0	0	0		0	0	0	0
Savannah	99,900	0	2	3	2	0	0	0	1
Florida:									
Miami	156,700	0	0	5		0	0	0	2
St. Petersburg	53,300		0			0			0
Tampa	113,400	0	2	2		2	0	1	1
EAST SOUTH CENTRAL									
Kentucky:									
Covington	59,000	0	2	0		0	1	0	3
Tennessee:									
Memphis	190,200		7						
Nashville	139,600		6						

[1] No estimates of population made.

City reports for week ended October 12, 1929—Continued

Division, State, and city	Population, July 1, 1928, estimated	Chicken pox, cases reported	Diphtheria		Influenza		Measles, cases reported	Mumps, cases reported	Pneumonia, deaths reported
			Cases, estimated expectancy	Cases reported	Cases reported	Deaths reported			
EAST SOUTH CENTRAL—continued									
Alabama:									
Birmingham	222,400	0	6	11	6	1	0	0	3
Mobile	69,600	0	2	6		0	0	0	1
Montgomery	63,100	0	4	7			0	1	
WEST SOUTH CENTRAL									
Arkansas:									
Fort Smith	(1)		2						
Little Rock	79,200	3	2	3		0	0	0	2
Louisiana:									
New Orleans	429,400	0	10	10	2	1	0	0	11
Shreveport	81,300	1	1	1		0	0	0	2
Oklahoma:									
Tulsa	170,500	1	4	9			1	0	
Texas:									
Dallas	217,800	0	13	24		0	1	0	1
Forth Worth	170,600	0	4	2		1	0	0	0
Galveston	50,000	0	0	2		0	0	0	4
Houston	(1)	0	5	22		0	0	0	5
San Antonio	218,100	0	3	2		3	0	0	4
MOUNTAIN									
Montana:									
Billings	(1)	1	0	0		0	0	7	2
Great Falls	(1)	14	0	0		0	3	32	3
Helena	(1)	0	0	0		0	0	0	0
Missoula	(1)	9	0	0		0	0	1	0
Idaho:									
Boise	(1)	0	0	0		0	0	1	1
Colorado:									
Denver	294,200	9	17	0		3	3	0	7
Pueblo	44,200	0	2	0		0	0	0	1
New Mexico:									
Albuquerque	(1)	0	1	1	1	0	0	0	0
Utah:									
Salt Lake City	138,000	16	3	0		0	1	14	0
Nevada:									
Reno	(1)	0	0	0		0	0	0	0
PACIFIC									
Washington:									
Seattle	383,200	41	5	1			1	8	
Spokane	109,100	8	3	0	2		0	0	
Tacoma	110,500	14	3	4		0	1	3	1
Oregon:									
Portland	(1)	8	10	1		1	0	3	8
Salem	(1)	0	0	0		0	0	1	0
California:									
Los Angeles	(1)	9	38	15	17	1	4	13	11
Sacramento	75,700	2	2	1		0	0	4	2
San Francisco	585,300	24	16	4	1	1	21	6	4

[1] No estimate of population made.

City reports for week ended October 12, 1929—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	2	0	0	0	0	0	0	0	1	17
New Hampshire:											
Concord	0	0	0	0	0	0	0	0	0	0	8
Nashua	0	0	0	0	0	0	0	0	0	0	8
Vermont:											
Barre	0	-------	0	-------	-------	-------	0	-------	-------	-------	-------
Massachusetts:											
Boston	29	45	0	0	0	23	3	3	0	26	212
Fall River	2	5	0	0	0	1	2	2	1	2	26
Springfield	4	3	0	0	0	1	0	0	0	1	25
Worcester	7	4	0	0	0	3	1	0	0	12	41
Rhode Island:											
Pawtucket	1	0	0	0	0	0	0	0	0	0	12
Providence	3	5	0	0	0	2	1	1	0	2	66
Connecticut:											
Bridgeport	4	1	0	0	0	1	0	0	0	0	39
Hartford	2	5	0	0	0	1	1	1	0	3	56
New Haven	3	2	0	0	0	2	1	0	0	0	39
MIDDLE ATLANTIC											
New York:											
Buffalo	11	13	0	0	0	5	2	0	1	12	113
New York	56	20	0	0	0	97	28	13	1	29	1,302
Rochester	4	3	0	3	0	2	1	0	0	1	60
Syracuse	4	1	0	0	0	0	1	0	0	14	40
New Jersey:											
Camden	3	0	0	0	0	1	1	0	0	0	25
Newark	7	7	0	0	0	3	2	2	0	28	92
Trenton	1	3	0	0	0	0	1	0	0	5	35
Pennsylvania:											
Philadelphia	38	34	0	0	0	18	10	6	0	8	424
Pittsburgh	29	16	0	0	0	8	2	0	1	25	152
Reading	1	2	0	0	0	1	1	0	0	6	30
EAST NORTH CENTRAL											
Ohio:											
Cincinnati	10	22	0	1	0	10	1	3	0	0	127
Cleveland	20	26	0	0	0	18	2	2	0	29	197
Columbus	7	12	0	0	0	1	1	0	0	15	71
Toledo	8	3	0	0	0	7	2	0	0	2	62
Indiana:											
Fort Wayne	1	2	0	0	0	1	1	0	0	1	24
Indianapolis	9	3	1	0	0	4	2	0	0	5	90
South Bend	1	3	0	0	0	0	0	0	0	0	11
Terre Haute	2	1	0	0	0	1	0	0	0	0	13
Illinois:											
Chicago	57	130	0	0	0	43	7	2	1	77	618
Springfield	2	0	0	0	0	0	1	0	0	6	21
Michigan:											
Detroit	48	51	1	3	0	22	4	4	0	29	268
Flint	8	10	1	1	0	0	0	0	0	3	38
Grand Rapids	6	2	0	0	0	0	0	0	0	3	32
Wisconsin:											
Kenosha	1	2	0	0	0	0	0	0	0	6	6
Milwaukee	17	3	0	0	0	1	1	2	0	29	112
Racine	3	1	0	0	0	1	0	0	0	9	12
Superior	2	3	0	0	0	1	0	0	0	2	6
WEST NORTH CENTRAL											
Minnesota:											
Duluth	7	2	0	0	0	0	0	0	0	7	19
Minneapolis	34	10	0	0	0	0	1	1	1	9	78
St. Paul	15	16	2	0	0	3	1	0	0	6	50
Iowa:											
Davenport	1	1	0	1	-------	-------	0	0	-------	0	-------
Des Moines	7	12	0	0	-------	-------	0	0	-------	0	26
Sioux City	2	1	0	0	-------	-------	0	0	-------	6	-------
Waterloo	1	0	0	2	-------	-------	1	0	-------	3	10

City reports for week ended October 12, 1929—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		
WEST NORTH CENTRAL—contd.											
Missouri:											
Kansas City	10	18	0	0	0	5	2	1	0	4	78
St. Joseph	4	0	0	1	0	0	0	0	0	0	26
St. Louis	24	10	0	1	0	10	4	1	0	4	192
North Dakota:											
Fargo	2	3	0	0	0	0	0	1	0	2	4
Grand Forks	1	1	0	2	---	---	0	1	---	0	---
South Dakota:											
Aberdeen	0	0	0	0	---	---	0	1	---	3	---
Sioux Falls	2	0	0	0	---	---	0	0	---	0	9
Nebraska:											
Omaha	3	1	0	2	0	2	1	0	0	5	50
Kansas:											
Topeka	4	11	0	1	0	0	0	0	0	3	12
Wichita	3	1	0	0	0	0	0	0	0	0	35
SOUTH ATLANTIC											
Delaware:											
Wilmington	2	1	0	0	0	0	0	0	0	0	21
Maryland:											
Baltimore	10	11	0	0	0	9	8	2	0	35	193
Cumberland	0	0	0	0	0	0	0	0	0	0	13
Frederick	0	1	0	0	0	0	0	0	0	7	3
District of Columbia:											
Washington	12	7	1	0	0	8	3	1	0	3	142
Virginia:											
Lynchburg	2	0	0	0	0	2	0	4	0	37	11
Norfolk	1	0	0	0	0	0	1	2	0	1	---
Richmond	8	11	0	0	0	4	1	1	0	0	57
Roanoke	3	6	0	0	0	1	1	0	0	0	8
West Virginia:											
Charleston	2	3	0	0	0	0	1	0	2	0	16
Wheeling	4	3	0	0	0	1	0	0	0	4	14
North Carolina:											
Raleigh	2	2	0	0	0	0	0	2	0	0	19
Wilmington	1	1	0	0	0	1	0	0	0	0	10
Winston-Salem	3	6	0	0	0	1	1	1	0	1	14
South Carolina:											
Charleston	1	1	0	0	0	1	2	2	0	1	23
Columbia	1	2	0	0	0	0	1	1	0	4	17
Georgia:											
Atlanta	7	17	0	0	0	7	1	0	1	0	84
Brunswick	0	0	0	0	0	0	0	0	0	0	5
Savannah	1	0	0	0	0	5	0	0	0	0	30
Florida:											
Miami	1	1	0	0	0	2	0	0	0	1	17
St. Petersburg	0	---	0	---	0	0	0	---	0	---	10
Tampa	0	2	0	0	0	1	1	0	0	0	15
EAST SOUTH CENTRAL											
Kentucky:											
Covington	1	2	0	0	0	1	0	1	0	0	20
Tennessee:											
Memphis	5	---	0	---	---	---	4	---	---	---	---
Nashville	3	---	0	---	---	---	3	---	---	---	---
Alabama:											
Birmingham	5	5	0	0	0	2	2	1	0	3	56
Mobile	1	1	0	0	0	2	0	0	0	0	17
Montgomery	0	5	0	0	---	---	0	1	---	0	---
WEST SOUTH CENTRAL											
Arkansas:											
Fort Smith	1	---	0	---	---	---	0	---	---	---	---
Little Rock	3	1	0	0	0	2	1	0	0	0	---
Louisiana:											
New Orleans	3	16	0	0	0	8	3	1	0	0	139
Shreveport	0	0	0	0	0	2	1	0	0	0	28

City reports for week ended October 12, 1929—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		
WEST SOUTH CENTRAL—contd.											
Oklahoma:											
Tulsa	2	7	0	0	----	----	1	0	----	3	----
Texas:											
Dallas	5	3	0	0	0	2	2	1	0	1	41
Fort Worth	1	5	0	0	0	0	1	0	0	0	21
Galveston	0	0	0	0	0	2	0	1	0	0	16
Houston	0	5	0	0	0	6	0	1	0	0	53
San Antonio	1	8	0	1	0	11	1	3	2	0	60
MOUNTAIN											
Montana:											
Billings	0	0	0	0	0	0	1	1	0	0	7
Great Falls	1	4	0	0	0	0	0	1	0	1	11
Helena	1	0	0	0	0	1	0	70	1	0	7
Missoula	0	0	0	9	0	0	0	8	0	0	6
Idaho:											
Boise	0	0	0	0	0	0	0	1	0	0	6
Colorado:											
Denver	7	7	0	1	0	8	1	1	1	7	83
Pueblo	1	1	0	0	0	2	0	0	0	0	10
New Mexico:											
Albuquerque	1	0	0	0	0	2	3	3	0	1	5
Utah:											
Salt Lake City	2	5	0	1	0	2	2	4	0	9	26
Nevada:											
Reno	0	0	0	0	0	0	0	0	0	0	3
PACIFIC											
Washington:											
Seattle	6	1	1	0	----	----	1	1	----	6	----
Spokane	7	2	1	1	----	----	0	0	----	0	----
Tacoma	2	5	1	4	0	1	0	0	0	1	20
Oregon:											
Portland	7	3	4	0	0	2	1	0	0	1	56
Salem	0	2	0	0	0	0	2	0	0	1	----
California:											
Los Angeles	14	13	2	0	0	25	3	1	1	21	275
Sacramento	2	6	0	0	0	2	1	1	0	2	17
San Francisco	9	9	0	9	0	12	1	0	0	10	141

Division, State, and city	Meningococcus meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
NEW ENGLAND									
Massachusetts:									
Boston	1	1	0	0	0	0	3	3	0
Worcester	1	0	0	0	0	0	0	0	0
Rhode Island:									
Providence	1	0	0	0	0	0	0	1	0
MIDDLE ATLANTIC									
New York:									
Buffalo	0	0	1	1	0	0	0	0	0
New York	4	11	3	2	0	0	17	1	0
Rochester	0	0	0	0	0	0	1	5	2
New Jersey:									
Newark	0	0	0	0	0	0	0	1	0

City reports for week ended October 12, 1929—Continued

Division, State, and city	Meningococcus meningitis		Lethargic encephalitis		Pellagra		Poliomyelitis (infantile paralysis)		
	Cases	Deaths	Cases	Deaths	Cases	Deaths	Cases, estimated expectancy	Cases	Deaths
MIDDLE ATLANTIC—continued									
Pennsylvania:									
Philadelphia	4	2	0	0	0	0	0	2	0
Pittsburgh [1]	0	0	0	1	0	0	0	0	0
EAST NORTH CENTRAL									
Ohio:									
Cincinnati	1	0	0	0	0	0	1	0	1
Cleveland	0	0	0	0	0	0	1	1	0
Columbus	1	1	0	0	0	0	0	2	0
Toledo	1	0	0	0	0	0	0	1	0
Indiana:									
South Bend	0	1	0	0	0	0	0	0	0
Illinois:									
Chicago	7	5	0	0	0	0	4	4	0
Springfield	1	0	0	0	0	0	0	0	0
Michigan:									
Detroit	9	4	0	0	0	0	2	8	3
Flint	0	0	0	0	0	0	0	1	0
Wisconsin:									
Milwaukee	1	0	0	0	0	0	1	0	0
WEST NORTH CENTRAL									
Minnesota:									
Minneapolis	1	0	1	0	0	0	0	0	0
Iowa:									
Davenport	1		0	0	0	0	0	0	0
Des Moines	0	0	0	0	0	0	0	4	0
Missouri:									
St. Louis	3	0	0	0	0	0	0	0	0
SOUTH ATLANTIC									
Virginia:									
Lynchburg	0	0	0	0	0	0	0	1	0
Richmond	0	0	0	0	0	0	0	1	0
Roanoke	0	0	0	0	0	0	0	2	0
North Carolina:									
Wilmington	0	0	0	0	2	0	0	0	0
Winston-Salem	0	0	0	0	1	0	0	0	0
South Carolina:									
Charleston [2]	0	0	0	0	4	1	0	0	0
Georgia:									
Savannah [2]	1	1	0	0	0	0	0	0	0
WEST SOUTH CENTRAL									
Louisiana:									
New Orleans	2	2	0	0	4	3	0	0	0
Texas:									
Dallas	0	0	0	0	1	0	0	0	0
Fort Worth	0	0	0	0	0	0	0	1	0
Houston	0	0	0	0	0	2	0	0	0
MOUNTAIN									
Montana:									
Great Falls	1	0	0	0	0	0	0	0	0
Colorado:									
Pueblo	0	1	0	0	0	0	0	0	0
Utah:									
Salt Lake City	3	1	0	0	0	0	0	0	0
PACIFIC									
Washington:									
Seattle	1	0	0	0	0	0	1	0	0
Oregon:									
Portland	1	0	0	0	0	0	0	1	0
California:									
Los Angeles	0	1	0	0	0	0	1	3	0
San Francisco	1	1	1	1	0	0	1	0	0

[1] Rabies in man, 1 case and 1 death.
[2] Typhus fever: 3 cases; 1 case at Charleston, S. C., and 2 cases at Savannah, Ga.

The following table gives the rates per 100,000 population for 98 cities for the 5-week period ended October 12, 1929, compared with those for a like period ended October 13, 1928. 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 31,000,000. The 91 cities reporting deaths have nearly 30,000,000 estimated population. The number of cities included in each group and the estimated aggregate populations are shown in a separate table below.

Summary of weekly reports from cities, September 8 to October 12, 1929—Annual rates per 100,000 population, compared with rates for the corresponding period of 1928 [1]

DIPHTHERIA CASE RATES

	Week ended—									
	Sept. 14, 1929	Sept. 15, 1928	Sept. 21, 1929	Sept. 22, 1928	Sept. 28, 1929	Sept. 29, 1928	Oct. 5, 1929	Oct. 6, 1928	Oct. 12, 1929	Oct. 13, 1928
98 cities	66	[2] 75	75	79	83	88	[3] 97	100	[4] 111	117
New England	48	87	50	67	77	62	88	103	[5] 95	124
Middle Atlantic	41	58	54	63	60	72	62	84	75	83
East North Central	95	67	96	92	90	97	124	92	139	111
West North Central	58	98	63	92	100	76	[6] 107	127	123	137
South Atlantic	133	[3] 113	114	92	112	138	129	134	139	210
East South Central	115	154	136	182	136	161	156	154	[7] 294	231
West South Central	63	142	154	93	170	109	206	174	[8] 260	211
Mountain	26	35	70	62	26	106	[9] 27	106	0	44
Pacific	22	49	20	54	67	72	57	64	62	79

MEASLES CASE RATES

98 cities	16	[3] 18	15	18	13	19	[3] 16	28	[4] 22	32
New England	16	39	32	48	18	55	34	85	[5] 16	69
Middle Atlantic	12	15	7	15	10	10	12	18	12	27
East North Central	20	24	17	20	13	22	12	23	29	31
West North Central	6	14	6	18	10	14	[6] 6	43	23	49
South Atlantic	7	[3] 12	7	17	13	13	11	23	9	40
East South Central	7	14	7	7	0	0	0	0	[7] 12	7
West South Central	12	0	8	4	12	8	0	4	[8] 4	0
Mountain	61	44	26	0	44	9	[9] 36	44	61	53
Pacific	40	13	52	10	25	41	67	41	67	18

SCARLET FEVER CASE RATES

98 cities	54	[3] 57	68	63	95	77	[3] 102	99	[4] 115	113
New England	52	78	50	101	100	83	136	90	[5] 164	138
Middle Atlantic	16	28	25	24	42	38	48	42	48	68
East North Central	90	88	120	91	161	100	149	132	173	153
West North Central	58	68	92	104	108	115	[6] 121	182	140	186
South Atlantic	47	[3] 45	66	71	105	80	120	121	139	142
East South Central	95	105	48	56	75	210	81	133	[7] 159	154
West South Central	95	45	75	28	75	85	75	150	[8] 134	97
Mountain	70	27	113	53	139	62	[9] 133	18	148	89
Pacific	75	64	70	77	87	87	132	113	90	97

[1] The figures given in this table are rates per 100,000 population, annual basis, and not the number of cases reported. Populations used are estimated as of July 1, 1929 and 1928, respectively.
[2] Lynchburg, Va., not included.
[3] Waterloo, Iowa, and Helena, Mont., not included.
[4] Barre, Vt., Memphis and Nashville, Tenn., and Fort Smith, Ark., not included.
[5] Barre, Vt., not included.
[6] Waterloo, Iowa, not included.
[7] Memphis and Nashville, Tenn., not included.
[8] Fort Smith, Ark., not included.
[9] Helena, Mont., not included.

Summary of weekly reports from cities, September 8 to October 12, 1929—Annual rates per 100,000 population, compared with rates for the corresponding period of 1928—Continued

SMALLPOX CASE RATES

	Week ended—									
	Sept. 14, 1929	Sept. 15, 1928	Sept. 21, 1929	Sept. 22, 1928	Sept. 28, 1929	Sept. 29, 1928	Oct. 5, 1929	Oct. 6, 1928	Oct. 12, 1929	Oct. 13, 1928
98 cities	3	[2] 1	5	1	4	2	[2] 6	3	[4] 7	1
New England	0	0	0	0	0	0	0	0	[5] 0	0
Middle Atlantic	0	0	0	0	0	0	0	0	1	0
East North Central	4	0	10	1	3	1	7	5	3	2
West North Central	8	4	6	4	8	2	[6] 0	2	13	0
South Atlantic	2	[3] 0	0	0	0	0	0	0	0	0
East South Central	0	0	0	0	0	7	48	0	[7] 0	0
West South Central	0	4	0	4	0	4	0	0	[8] 4	4
Mountain	9	9	52	0	96	9	[9] 53	9	96	9
Pacific	12	3	17	5	10	15	37	18	35	5

TYPHOID FEVER CASE RATES

98 cities	21	[2] 28	22	27	20	23	[2] 15	24	[4] 26	22
New England	16	14	14	21	7	9	11	16	[5] 16	16
Middle Atlantic	18	29	14	23	12	26	14	25	10	20
East North Central	10	14	11	16	9	14	12	13	8	11
West North Central	17	25	6	31	23	27	[6] 16	12	8	16
South Atlantic	34	[3] 39	26	33	17	27	30	33	26	38
East South Central	88	140	0	112	81	77	20	42	[7] 37	63
West South Central	51	28	87	69	28	41	8	53	[8] 28	28
Mountain	70	18	340	27	313	18	[9] 27	124	749	89
Pacific	20	38	7	18	10	13	10	28	7	26

INFLUENZA DEATH RATES

91 cities	3	[2] 5	2	4	5	6	[9] 6	7	[10] 8	7
New England	0	0	2	2	2	5	5	7	[5] 0	9
Middle Atlantic	2	4	0	5	5	2	7	7	8	4
East North Central	2	5	2	4	4	3	5	5	8	7
West North Central	6	15	6	3	3	3	6	3	3	3
South Atlantic	2	[3] 8	2	4	6	8	7	10	11	4
East South Central	7	23	7	15	0	8	0	23	[7] 14	15
West South Central	12	8	0	4	12	29	16	8	16	29
Mountain	9	0	9	0	17	0	[9] 0	18	26	9
Pacific	0	3	10	0	3	24	10	7	7	17

PNEUMONIA DEATH RATES

91 cities	55	[2] 65	54	68	67	68	[9] 77	87	[10] 80	81
New England	36	62	29	76	72	60	36	51	[5] 75	64
Middle Atlantic	66	69	59	74	72	75	93	106	87	94
East North Central	47	64	47	59	54	51	61	76	65	67
West North Central	45	64	39	61	81	81	108	89	54	64
South Atlantic	52	[3] 70	66	84	60	80	61	96	103	96
East South Central	89	38	67	69	118	123	30	107	[7] 101	92
West South Central	57	71	65	12	97	100	118	100	118	79
Mountain	70	44	104	71	70	35	[9] 124	62	122	115
Pacific	43	61	59	91	39	64	49	47	59	54

[2] Lynchburg, Va., not included.
[3] Waterloo, Iowa, and Helena, Mont., not included.
[4] Barre, Vt., Memphis and Nashville, Tenn., and Fort Smith, Ark., not included.
[5] Barre, Vt., not included.
[6] Waterloo, Iowa, not included.
[7] Memphis and Nashville, Tenn., not included.
[8] Fort Smith, Ark., not included.
[9] Helena, Mont., not included.
[10] Barre, Vt., Memphis, and Nashville, Tenn., not included.

Number of cities included in summary of weekly reports and aggregate population of cities of each group, approximated as of July 1, 1929 and 1928, respectively

Group of cities	Number of cities reporting cases	Number of cities reporting deaths	Aggregate population of cities reporting cases		Aggregate population of cities reporting deaths	
			1929	1928	1929	1928
Total	98	91	31,568,400	31,052,700	29,995,100	29,498,600
New England	12	12	2,305,100	2,273,900	2,305,100	2,273,900
Middle Atlantic	10	10	10,809,700	10,702,200	10,809,700	10,702,200
East North Central	16	16	8,181,900	8,001,300	8,181,900	8,001,300
West North Central	12	9	2,712,100	2,673,300	1,736,900	1,708,100
South Atlantic	19	19	2,783,200	2,732,900	2,783,200	2,732,900
East South Central	6	5	767,900	745,500	704,200	682,400
West South Central	8	7	1,319,100	1,289,900	1,285,000	1,256,400
Mountain	9	9	598,800	590,200	598,800	590,200
Pacific	6	4	2,090,600	2,043,500	1,590,300	1,551,200

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—Week ended October 5, 1929.—The Department of Pensions and National Health of Canada reports cases of certain communicable diseases for the week ended October 5, 1929, as follows:

Province	Cerebro-spinal fever	Influenza	Lethargic encephalitis	Polio-myelitis	Smallpox	Typhoid fever
Prince Edward Island						
Nova Scotia						1
New Brunswick						5
Quebec		2		3	2	21
Ontario	4		1	41	1	24
Manitoba				2		10
Alberta				2	1	6
British Columbia				6	13	2
Total	4	2	1	54	17	69

Quebec Province—Communicable diseases—Week ended October 5, 1929.—The Bureau of Health of the Province of Quebec, Canada, reports cases of certain communicable diseases for the week ended October 5, 1929, as follows:

Disease	Cases	Disease	Cases
Chicken pox	10	Poliomyelitis	3
Diphtheria	38	Scarlet fever	21
German measles	48	Smallpox	2
Influenza	2	Tuberculosis	62
Measles	3	Typhoid fever	48
Mumps	5		

CUBA

Provinces—Communicable diseases—Four weeks ended July 6, 1929.—During the four weeks from June 9 to July 6, 1929, cases of certain communicable diseases were reported in the Provinces of Cuba as follows:

	Pinar del Rio	Habana	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer	5	2		2		1	10
Chicken pox	1	9		3	6	2	21
Diphtheria		21		2	2		25
Malaria		23			20	51	94
Measles	1	29	1	15			46
Paratyphoid fever	3	5	2	8	2	3	23
Scarlet fever		6					6
Tetanus (infantile)				1			1
Typhoid fever	22	59	15	26	25	33	180

LATVIA

Communicable diseases—August, 1929.—During the month of August, 1929, cases of certain communicable diseases were reported in Latvia as follows:

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	15	Puerperal fever	9
Diphtheria	39	Scabies	1
Dysentery	8	Scarlet fever	104
Erysipelas	42	Tetanus	1
Influenza	154	Trachoma	105
Measles	24	Typhoid fever	197
Mumps	33	Typhus fever	1
Poliomyelitis	34	Whooping cough	163

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 table must not be considered as complete or final as regards either the list of countries included or the figures for the particular countries for which reports are given.

CHOLERA

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

Place		Mar. 10–Apr. 6, 1929	Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929					Week ended— September, 1929				Oct. 5, 1929
							3	10	17	24	31	7	14	21	28	
Ceylon	C			3												
	D			3												
Colombo	C		1	3	1											
	D			3	1											
China:																
Amoy	C				4	7	1									
Canton	C	3	3	2	10	6	1	2	2			1				
	D		3	1	5	5	1		2			1				
Manchuria—																
Kwantung—Dairen	C							1								
Newchwang	C											P	1			
Shanghai	C					2		9	797	500	483	360	139			30
	D					3	4	24	41	29	30	23	8		9	
Swatow	C				P											
	D				4	7	2	5	3	2	1	20	6	10	8	
Tientsin	C													P		
Chosen: Chemulpo	C												P			
India	C	9,046	18,521	30,616	29,449	32,081	10,105	10,269	10,662							
	D	4,997	11,069	20,311	19,910	19,343	6,129	6,230	5,939							
Bassein	D	45	118	38	2		3		3							
Bombay	C	6	3		2		1	1							1	
	D	2		2	2		1									
Calcutta	C	552	788	924	354	275	65		64	41	43					
	D	307	461	605	176	157	24	28	36	18	13	15	15	16		
Karachi	C							1	3	6	1	4	6			
Madras	C			1		1										
	D					2										
Moulmein	D	7	6	31	5	1										
Negapatam	C				1	1										
Rangoon	C	15	8	13	8	1	1									
	D	37	10	7	8	1	1									

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

CHOLERA—Continued

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

Place		Mar. 10–Apr. 6, 1929	Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	Oct. 5, 1929
India—Continued.																
Tuticorin	C				34	6										
	D				30	2										
Vizagapatam	D					1										
India (French):																
Chandernagor	C	3	3	3	3	2		1								
	D	3	1	3	3	2										
Karikal	C	20	3					1								
	D	15	3													
Pondicherry Province	C	46		3	3											
	D	38		3	3											
India (Portuguese)	C								1							
	D								1							
Indo-China (see also table below):																
Pnompenh	C	13	15	14	11	7			1	2		2		1		
	D	10	9	10	4	5			1	2		2				
Saigon and Cholon	C	12	13	71	188	9	2									
	D	2	8	37	139	14	2									
Japan:																
Kobe	C								P	2	4	3		2		
Osaka	C								1	4	18	14	8	1		
Shimonoseki	C									P	2					
Siam	C	397	619	619	469	371	123	29	13	15	12					
	D	269	404	436	285	202	80	17	10	5	11					
Anthoang	C					4				10						
	D					4				3						
Ayudhaya	C	1	29	2	25	18		2								
	D	1	19		11	11										
Bangkok	C	38	111	131	80	7		2	3	4	1	3	4	2		
	D	21	74	77	13	1			2	1	1	2	1	1		
Chaxoengsao	C			1												
	D			1												
Dhannapuri	C		17													
	D		7													

Lobpuri	C		1							2	3						
	D		1							2	3						
Nagara Pathom	C		36	13													
	D		20	10													
Nagara Rajsima	C					57											
	D					29											
Smud Songram	C					3											
	D					3											
Sridharmaraj Province [1]	C						2	13									
	D						2	11									
On vessel:																	
S. S. Angby, at Saigon-Cholon	C				1												
	D				1												
S. S. Cap. St. Jacques, at Singapore, from Saigon-Cholon	C					P											
S. S. Elephanta, at Penang, from Calcutta	C	P															
S. S. Erinpura, at Madras	C			2													
S. S. Media, at Colombo, from Calcutta	C			1													
S. S. Saka Maru, at Calcutta	C			6													
S. S. Shinsei, at Shanghai	D											3					
S. S. Tilawa, at Penang, from Singapore	C	P															
S. S. Tokushima, at Hong Kong	C				2												
	D				2												
S. S. Texas Maru, at Nagasaki, from Shanghai	C								1								

Place		February, 1929	March, 1929	April, 1929	May, 1929	June, 1929			July, 1929			August, 1929			Sept. 1-10, 1929
						1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-31	
Indo-China (French) (see also table above):															
Annam	C		6	20	[2] 20				2	5	2		3	14	1
Cambodia	C	69	29	84	[2] 215				55	71	60		21	14	4
Cochin-China	C	223	183	88	[2] 123				146	123	46		45	15	45
Laos	C								1		12				
Tonkin	C				5	4									

[1] There were 98 cases of cholera with 16 deaths in Nagara Sridharmaraj Province, Siam, from May 16 to July 7, 1929.
[2] Reports incomplete.

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

PLAGUE

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	October, 1929 5	12	19
Algeria:																	
Algiers	C										1	1					
Philippeville	C				3	3											
Argentina:																	
Buenos Aires	C	1															
Rosario	C	5															
Azores: St. Michaels Island	C				1												
Belgian Congo:																	
Blukwa	C			3													
	D			3													
Buki	C				2												
	D				2												
Djugu	C		2	3	5			1		1	1						
	D		3	3	5			1		1	1						
Rekwa	C				2												
	D				2												
Brazil: Porto Alegre	C	1															
British East Africa (see also table below): Uganda	C	231	450	1,437	1,437	296	270	152	122								
	D	219	409	1,072	1,199	263	235	125	107								
Canary Islands: Tenerife	D				1												
Laguna	C		1														
Ceylon:																	
Colombo	C	5	7	2	P						1					1	
	D	4	6	3							1						
Plague-infected rats		1			6				1	7							
Galle	C				3					1	3	1	3				
	D				3					1	2	1	2				
Kandy	C								1	1							
	D								1	1							
Matara	C				12												
	D				11												
China																	
Amoy	C					P											
Foochow	C				P		P		P		P						

Hong Kong	C									1		1					
	D									1		1					
Plague-infected rats										3	1	1					
Manchuria—Tungliao District	C				P	13	3										
Dutch East Indies: Java—																	
Batavia and West Java	C	63	58	47	69	33	33		56	49	39						
	D	63	56	47	68	33	32		56	49	39						
Plague-infected rats		8															
East Java and Madura	C				3		2	1		4							
	D				3		2	1		4							
Surabaya	C			3	11	3											
	D			3	11	3											
Ecuador (see table below).																	
Egypt:																	
Alexandria	C		1	1	7	1		1	3	3	2	4	2	3	1	3	6
	D			1	3		1			1	1	2	1	1		1	1
Assuan	C				4							1					
	D				4												
Beheira	C				2												
	D				2												
Beni Suef	C	7		6	4	1						1					
	D	2		2													
Dakahlieh	C		9	1	1							2					
	D		1					1				2					
Gharbieh	C				9			1								4	1
	D				1			1								4	
Girga	C				3												
Kena	C				2												
	D				2												
Menufieh Province	C				3												
Miniah	C				7			1									
Port Said	C	2	3	2	3	2	1	2	1	2					1	1	
	D	1	2	1	2	1	1	3	1	3						1	
Suez	C				1												
France: Paris	C													1			
Greece (see also table below):																	
Patras	C									1		1	1			1	1
Piræus	C									1	1	1					
Hawaii: Hamakua—Kukuihaele—Plague-infected rats			6	1										3			
India	C	6,884	1,394	677	1,812	909	1,070	1,033	1,209	1,395							
	D	5,623	1,205	414	1,059	536	599	487	644	718							
Bassein	C	1			9	4	3	2	4	2	1	1					
	D	2	2	4	1	5	3	2	4	1	1	2					
Bombay	C	8	1			1				1							
	D	6	1	4		1				1		1			1		
Plague-infected rats		81	44	35	23	7			3	9	8	7	4	7			
Madras Presidency	C	38	64	85	97	62	72	41	40	37			37				
	D	14	40	38	52	27	36	29	20	20			20				
Rangoon	C	11	2		24	5	4	3	3	4	2	2					
	D	15	3	9	18	5	2	3	2	4	2	1	2	2			
Plague-infected rats		10	5	6	9				10	7	6	2		3			

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

PLAGUE—Continued

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929					September, 1929				October, 1929		
						3	10	17	24	31	7	14	21	28	5	12	19
Indo-China (see also table below):																	
Pnompenh	C	8	5	4	7	1	5	2		1	1	2		1			1
	D	8	3	3	8	1	5	2		1	1	2		1			
Saigon and Cholon	C			1	6	2	1		1		1				1		
	D				1	2	1		1						1		
Iraq:																	
Baghdad	C	8	14	12	1		1	1								P	
	D	7	5	2													
Plague-infected rats		2	1														
Diyalah Liwa	C	7	12	1	1												
	D	7	7														
Naudham	C			1	1												
Japan: Osaka—Plague-infected rats			2														
Madagascar (see also table below):																	
Tamatave	C		P	2	5								2	1			
	D	1		2													
Morocco	C	31	42	16	39				4	1							
	D	16	4	5	17												
Nigeria: Lagos	C	8	5	2	1		1	2	6		4	6	5	7	5		
	D	8	4	1	1		1	2	5		4	6	5	7	5		
Plague-infected rats		6	8	4	13	3	8	2	3		8						
Peru (see table below).																	
Senegal (see table below).																	
Siam	C	10	9	1	4		3			2	1						
	D	8	5	1	3		3			1	1						
Bangkok	C		2		1		3				1						
	D		1		1		3				1						
Nagara Pathom	C	2	3														
	D	2	2														
Straits Settlements: Singapore	C	1										1					
	D	1	1									1					
Tunisia:																	
Tunis	C				P					4	4	2					
	D									1							
Plague-infected rats												4					
Turkey:																	
Adalia	C						1										
Constantinople	C			P	2												

Union of Socialist Soviet Republics:																		
Caucasia	C			1	7		2											
	D			1	3		1											
Ural—Kirghiz	C			4														
	D			4														
Union of South Africa:																		
Cape Province	C	2			3													
	D	1			2													
Orange Free State	C	4									1							
	D	1																
On vessel:																		
S. S. Chaban, at Port Said, from Jaffa	C									1								
	D									1								
S. S. Tokio, at Shanghai, from Singapore	C				1													
	D				1													
S. S. Ganzan Maru, at Osaka, from Haipong	C		1															
S. S. Seigo Maru, at Osaka, from Bombay—Plague-infected rats			1															
S. S. Soudades, at Hamburg, from Rosario, Argentina—Plague-infected rats		2																
S. S. Sumatra, at Osaka, from Bombay	C	1	1															

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
British East Africa (see also table above):							
Kenya	C	10	4	22	69		
Uganda	C	121	282		1,215	1,203	
	D	113	264		932	973	
Ecuador: Guayaquil	C	26	19	2		1	6
	D	4	5	1			1
Plague-infected rats		14	13	3	1		4
Greece (see also table above)	C		1			3	2
	D					1	1
Indo-China (see also table above)	C	3	13			42	
Madagascar (see also table above)	C	196	92			14	
	D	194	88			14	
Ambositra Province	C	90	8				
	D	90	8				
Antisirabe Province	C	13				2	1
	D	13				2	1
Itasy Province	C	8	2				
	D	7	2				
Moramanga Province	C	5	3			1	
	D	5	3			1	
Tananarive Province	C	120	78		11	16	
	D	119	74		11	16	

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
Peru	C	35		10	16	11	
	D	13		5	8	3	
Senegal:							
Baol [1]	C	6	1	21	43	22	32
	D	3	1	6	18	9	13
Dakar [1]	C		6	17	67	62	76
	D		4	11	45	45	65
Louga [1]	C					59	121
	D					39	70
Rufisque [1]	C					22	
	D					7	
Thies [1]	C	4	20	6	10	61	53
	D	3	20	3	6	24	33
Tivaouane [1]	C			22	93	161	188
	D			10	50	96	119

[1] Incomplete reports.

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

SMALLPOX

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	October, 1929 5	12	19
Algeria:																	
Algiers	C	5	5	6	7		1								1		
Cherchell	C	1		1													
Oran	C	2	5	1	1							4	1				
Angola (see table below).																	
Arabia: Aden	C	69	40	110	103	11	17	6	4	1	2	1					
	D	20	20	20	56	20	10	4	3	1							
Australia: Fremantle Quarantine Station	C				1												
Bermuda: Hamilton	C			1													
Brazil:																	
Port Alegre	C		1							3		1					
Rio de Janeiro	C		3														
British East Africa (see also table below):																	
Tanganyika	C	8	4	7	10		2			2							
British South Africa:																	
Northern Rhodesia	C				73												
	D				4												
Southern Rhodesia	C	13	12		5					1		2					
Canada:																	
Alberta	C	8		12		1	2	1					4		1		
Calgary	C	2				1	1								1		
Edmonton	C	5		4				1									
British Columbia—Vancouver	C	46	28	13	14	5		2	1		2	3			13		
Manitoba	C	12	6	6	1												
Winnipeg and vicinity	C			2													
Nova Scotia	C	1				2										1	
Ontario	C	113	40	84	57		2	5		5	4	3	7	5	1	1	
Niagara Falls	C		3														
North Bay	C	3	8	2	7								3	4	2		1
Ottawa	C			1	1		1										
Toronto	C	1		5	7					1	1		1	1			
Windsor	C	3	3	2	2												
Prince Edward Island	C					1	1										
Quebec	C	34	12	10	2	1	1	1					1		2		
Montreal	C	4	1	1													

Quebec	C	1	1	2		1											
Riviere du Loup	C	1			2												
Saskatchewan	C	13	14					1		1	3						
Saskatoon	C									1				5			
China:																	
Amoy	C	4	2														
Canton	C	85	46	16	12	2											
	D	12	4	1	2												
Chefoo	C	P	P														
Foochow	C	P			P		P		P		P						
Hong Kong	C	53	29	10	1	1		3	1		1		1	1			
	D	97	25	6	5		1	2	1		1		1	1			
Manchuria—																	
Changshun	C	1															
Harbin	C	4					1										
Kwantung—																	
Dairen	C	11	21	11	14						1						
	D	4	8	3	9		1										
Port Arthur	C		3														
Nanking	C				P	P	P	P	P	P							
Shanghai—																	
Foreigners only	C	1	6	7	3												
Including natives	D	16	16	5	3												
Swatow	D	93	62	24	15	2											
Tientsin	C	6	12								2						
Tsingtao	C	P	P	P													
Yunnanfu	C	P															
Chosen (see table below).																	
Colombia:																	
Barranquilla	C				2						1			3			
Buenaventura	C														4		
Curacao (alastrim)	C	1															
Dutch East Indies:																	
Balikpapan	C	3	4	1													
Belawan Deli	C	4		1	2				1	1							
	D				1										9		
Borneo—Samarinda	C	1		3	13	7									1		
	D			1													
Celebes—Makassar	C	39	43	20	21	2	1		1	1	5	4	2	3			
	D	25	33	15	11	1	1		1	1	1	2	1				
Java—																	
Batavia and West Java	C		1	6	8	1	2	5	2	3	1	1	3	7		12	
	D			1	2	1	2	2			1	3		2			
East Java and Madura	C					1	2										
	D					1											
Sumatra—Medan	C	2	1	1	3	1	1		1	1	2						
	D		1		1												
Ecuador (see table below).																	
Egypt:																	
Port Said	C	1		1													
Suez	C	5								3	2						
France (see table below).																	

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

SMALLPOX—Continued

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	October, 1929 5	12	19
Great Britain:																	
England and Wales	C	1,423	1,179	789	541	129	114	120	139	131	150	96	119	108			
Ashton under Lyne	C				7		2	1									
Birmingham	C	1	1														
Bradford	C	1	4	4	3					1	3	1	3	2			
Bristol	C				1												
Cardiff	C	1	4						1					1			
Castleford	C	31	12	3	1												
Leeds	C	3		1	1				1		2						
London	C	201	193	167	107	31	19		28	37	41	27	39	46			
London and Great Towns	C	888	656	496	363	73	60	74	90	79	81	59	85	81			
	D	6	3	1	4												
Newcastle-on-Tyne	C	3	37	20	15	1	2		1	2				1			
Stoke-on-Trent	C	133	86	62	32	1	10	1	6	2	2	7	7	3			
West Ham	C				26	22	17	20									
Scotland—																	
Aberdeen	C	2															
Glasgow	C	19	1														
Greece (see table below).																	
Hedjaz	C	77	40	83	53	4	2		5	17	2	2	1				
	D	52	24	53	35	3	2		14	3	1	2	1				
Honduras:																	
Choluteca	C															1	
Puerto Castilla	C		1														
India	C	22,556	17,011	11,549	7,838	1,717	1,435	1,194	1,135	1,166							
	D	5,069	4,185	3,006	2,062	472	397	275	274	231							
Bombay	C	315	208	147	92	18	18	16	11	18	5	6	8	7			
	D	175	131	99	55	7	9	12	3	10	3	5	6	2			
Calcutta	C	101	39	27	16	13	2	9	7	2	7	9	3	1			
	D	74	36	24	11	11	2	3	6		7	6	3	1			
Cochin	C								4	2	1	4	6	2			
	D									1							
Karachi	C	144	84	35	25	6	1	2	6	5	6	8	8	3			
	D	59	59	25	13	1	1	1	4	1	6	3	6				

Madras	C	327	174	88	122	28	16	33	12	19	14	16	33	22			
	CD	84	61	20	32	8	6	2	6	3	4	7	7	2			
Moulmein	C	7	8	6	10	2	8	1		2	1	2		2			
	D	6	6	5	5	1	3	1		1	1						
Negapatam	C	7	2	6	4				1	1	1	1		1			
	D										1						
Rangoon	C	7	1		3	1											
	D	3	1		1												
Tuticorin	C	1		1													
Vizagapatam	C	28	2	4	3						1						
	D	8		2	2		1				1						
India (French):																	
Karikal	C	2	3	5	1	2	10				8		4				
	CD	2	3	5	1	2					7		4				
Pondicherry Province	C	60	32	18	21	6	3	2	1	2	2	2	2	3			
	D	51	30	15	16	1	3	2	1	2	2	2	2	3			
India (Portuguese)	C		3	9	4							1					
Indo-China (see also table below):																	
Pnompenh	C	40	22	8	9		2	1		1					1		
	CD	24	12	2	3	1	1	1		1							
Saigon and Cholon	C	2	1		1												
	D		1	1													
Iraq:																	
Baghdad	C	6	3	1	1												
Basra	C	8	8	9	1												
	CD	6	8	1													
Diyalah Liwa	C		48		8				13				4				
	D		13		2				12								
Kirkuk Liwa	C												21	16			
Mossoul	C			20	12	21			60	35	7	18	8				
	D					1			12	12		5					
Ivory Coast (see table below).																	
Jamaica (outside Kingston) (alastrim)	C	1	1		7												
Japan:																	
Niigata	C		12	2													
Osaka	C		1														
Shimane Province	C	3															
Tokyo	C		2	1													
Macao	D	20	5	2													
Mexico:																	
Acapulco	C	1	1	2	3	1	2		1	1							
	CD	1	1	2	3	1	2		1	1							
Aguascalientes	D	9	6	17	11	2	3	1	1	3	1	2			3	2	
Coahuila	D			1													
Jalisco (State): Guadalajara	D	12	15	11	6	1	2		2	5	1	2		2			
Juarez	D								3	P				8			
Mexico City and surrounding territory	C		1	9	13	5	5	7	4	1	2	2	3	3			
	D			10	3		3	3			1			2			
Morocco (see table below).																	
Netherlands: Rotterdam	C				40	30	58	58		33	31	21	25	13	13		
	D					1					4	2	1	4			

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

SMALLPOX—Continued

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	October, 1929 5	12	19
Nicaragua: Managua	C	P															
Nigeria: Lagos	C	1	2		1												
Norway: Stavanger	C	2															
Palestine	C		1														
Panama [1]	C				14		1		4	4	14		77		62	67	
Panama Canal Zone	C		1	1													
Persia (see table below).																	
Poland	C	6	2	66				1	1								
	D			2													
Portugal:																	
Lisbon	C	4	1	6	4		1					16	1				
Oporto	C	2		2	2												
Senegal (see table below).																	
Siam	C	55	32	27	71	1	19	4	8	10	10						
	D	8	9	7	14	2	1	2	2	3	1						
Somaliland, British: Boales	C			11	4							3	1	1	1	1	
	D			4									2	1	1		
Somaliland, French: Jibuti	C		3	16	123	8	10	6	7	5	3		2				
	D		1	8	21	11	1	6	3	5	3	1	2				
Spain: Valencia	C			1													
Sudan (Anglo-Egyptian)	C	377	1,570	1,172	1,121	55	11	12	9	10	580		8	8	172	29	
	D	26	132	195	164	51	1	5	16	16	79					5	
Sudan (French) (see table below).																	
Syria (see table below).																	
Tunisia: Tunis	C	2		2	1												
Turkey (see table below).																	
Union of Socialist Soviet Republics: Vladivostok	C		2														
Union of South Africa:																	
Cape Province	C	P	P	P													
Transvaal	C	P	P	P						P							
Upper Volta	C	15	2	10													

On vessel:																		
S. S. Aorangi, at Sydney	C			1														
S. S. Assyria, at Suez, from Bombay	C		1															
S. S. City of Hereford, at Brisbane, from Calcutta	C				1													
S. S. City of Venice, at Suez, from Calcutta	C		1															
S. S. Fern, at Port Said, from Abadan	C		P															
S. S. British Birch, at Suez, from Abadan	C			1														
S. S. Karoa, at Zanzibar	C										1							
S. S. Keneh, at Suakim, from Jeddah	C			4														
S. S. Le Panto, at Suez, Egypt	C		4															
S. S. Lopez-Lopez, at Suez	C	1																
S. S. Malwa, at Suez	C	1																
S. S. Mancar, at Suez, from Calcutta	C	1																
S. S. Tuscania, at Glasgow, from Bombay	C	P																

Place		February, 1929	March, 1929	April, 1929	May, 1929	June, 1929	July, 1929			August, 1929			September, 1929	
							1-10	11-20	21-31	1-10	11-20	21-31	1-10	11-20
Indo-China (see also table above)	C	364	561	755	410		87	72			123	140	64	
Ivory Coast	C		4						22		2			
Senegal	C	80	70	57	1									
	D	8	11	15										
Sudan (French)	C		26	83	2	57	2	13						
	D		3			15								
Syria: Beirut	C	48	12	18	12	36	26	1		16	6	7	4	18

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
British East Africa (see also table above):							
Kenya	C	23	91	38	45		
Chosen	C	121	127	97			
	D	12	41	29			
Ecuador: Guayaquil	C	2	2	1			

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
France	C	5	5	11	15		
Greece	C	2	4	5	2		
Morocco	C	8	12	39	2	9	10
Persia	D	8				51	
Turkey	C		1		11		1

[1] 354 cases of smallpox were reported from June 16 to Oct. 11, 1929, in Panama City, Panama.

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

TYPHUS FEVER

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

Place		Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929 3	10	17	24	31	September, 1929 7	14	21	28	Oct. 5, 1929
Algeria:															
Algiers	C	11	1	1	9		3	1			2	1	1		
Constantine Department	C			11			2								
Oran	C	8	14	5	9		2					3			
Bolivia: Pacajes Province—Calacoto Canton	C						19								
	D						5								
British South Africa: Northern Rhodesia	C		3												
	D		3												
Bulgaria	C	28	21	4	12					7		7			
	D	2	1	1	2										
Sofia	C				1										
Chile:															
Concepcion	C		1												
Valparaiso	C				1	1									
China: Tientsin	C							1							
Chosen (see table below).															
Czechoslovakia (see table below).															
Egypt:															
Alexandria	C	1											1		1
	D		1												
Beheira Province	C	50	159	13	8	25		6				6		9	3
	D	9	24	6	4							2		2	
Cairo	C		2		2				4	1	1		1		
Menufieh Province	C	35													
Port Said	C		2	2	4	1	1		1						
Suez	C							1	1						
Greece (see table below).															
Hungary	C		1												
Indo-China (see table below).															
Ireland (Irish Free State):															
Cavan County—Carrickmacross	C		1												
Donegal County—															
Inishower	C	1													
Stranorlar	C			1											

Kerry County—															
Dingle	C	2													
Killarney	C	2													
Tyrone County—Strabane.[1]															
Latvia (see table below).															
Lithuania (see table below).															
Mexico:															
Aguascalientes	D				1				1						
Mexico City, including municipalities in Federal District	C	4	8	14	11		7	2	2	3	3	3	5	3	
	D	1	2	1					1	2	3	1			
Morocco	C	28	5	12	27	3		3						1	
	D	4			11										
Norway: Oslo	C	12	2												
Palestine	C		2	2	4				1	1	3	1		1	1
Persia	C			5	53		23								
	D			4	10		8								
Poland	C	314	264	177	90	16	12	12	8	2	8	7	9	5	
	D	25	19	7	4	3	1	3		1	2	1		1	
Portugal:															
Lisbon	C			1											
Oporto	C			1				1						1	
Rumania	C	135	179	91	33		5		4	10	8	12	9		
	D	16	31	13	2		1			2	2				
Tunisia	C	19	22	23	3		4								
Turkey (see table below).															
Union of South Africa:															
Cape Province	C	P	P	P	P	1	P	P	P	P	P				
Natal	C	P	P	P					P	P	P				
Orange Free State	C	P	P	P	P		P	P	P	P	P				
Transvaal	C	P	P	P	P		P	P	P	P					
Yugoslavia (see table below).															

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
Canada: Ontario	C				1		
Chosen	C	177	153	272			
	D	22	9	15			
Seoul	C	3	2	1	2		
Czechoslovakia	C	41	25	18	2	2	
	D	1		1			
Greece: Athens	C	4	2		3		6
Indo-China: Tonkin	C		2				

Place		March, 1929	April, 1929	May, 1929	June, 1929	July, 1929	August, 1929
Latvia	C	1	10	7	5		1
Lithuania	C	62	101	63	27	10	7
	D	1	7	5	4	1	1
Turkey	C	11	3	7	10		3
	D			1	3		
Yugoslavia	C	7		19		3	7
	D			1		1	2

[1] During the period from Apr. 14 to May 21, 1929, 18 cases of typhus fever with 4 deaths were reported in Strabane, Tyrone County, Ireland.

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

YELLOW FEVER

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

Place		Mar. 10–Apr. 6, 1929	Apr. 7–May 4, 1929	May 5–June 1, 1929	June 2–29, 1929	June 30–July 27, 1929	Week ended— August, 1929					September, 1929				October, 1929		
							3	10	17	24	31	7	14	21	28	5	12	19
Belgian Congo: Tumba	C		1															
Brazil:																		
Bahia	C	1				1												
	D	1				1												
Nictheroy	C											1						
Para	C	2	1	2		1												
	D		1		1	1												
Pernambuco	C	4																
Porto Alegre	D			[1] 1														
Rio de Janeiro	C	252	180	70	7	1	0	0	0	0	0	1	1	0	0	0	0	0
	D	132	94	38	5	1												
Colombia:																		
Simacota	C					4												
Socorro [2]	C					12												
Liberia: Monrovia	C	10	2		4	4												
	D	4			3	1												
On vessel:																		
S. S. Skogland, at Porto Alegre, from Rio de Janeiro	C			1														

[1] Imported.
[2] From June 19 to July 8, 1929, 41 cases of yellow fever with 23 deaths were reported in Socorro, Colombia.