PUBLIC HEALTH REPORTS

VOL. 53 AUGUST 26, 1938 NO. 34

THE FLORA AND FAUNA OF SURFACE WATERS POLLUTED BY ACID MINE DRAINAGE

By JAMES B. LACKEY, *Cytologist, U. S. Public Health Service, Stream Pollution Investigations Station, Cincinnati, Ohio*

One of the most noticeable features of streams or pools receiving drainage from coal mines, either active or abandoned, and their accompanying refuse piles, is the color, varying from almost clear to a deep copper or dark brown. In some instances the water may be clear but appear colored because the bed of the stream is entirely lined with a deposit of iron oxide. Such waters have long been known to be highly acid and to be destructive to fish and other aquatic life. When the economic aspects of lowering the acidity in such waters became apparent (*1*, *2*), a number of States enlisted the aid of Federal and State agencies and instituted extensive acid-reducing operations. During the present investigation, studies were made, in West Virginia, of surface streams in which the acid concentration had been reduced by the sealing of mines and, in Indiana, of lakes, long, narrow, and often deep, which have been formed by damming the outlets of abandoned strip pits and raising the water level to cover exposed coal seams and mine waste "gob" piles.

Following the improvement in certain streams and lakes, various State conservation agencies began to inquire about their biological condition, particularly with reference to fish stocking and propagation. In the spring of 1938, the Office of Stream Sanitation of the U. S. Public Health Service, furnishing technical supervision over the sealing of abandoned coal mines, authorized a brief biological survey of the acid streams and seepages in the region about Fairmont, West Virginia, and of the lakes in southern Indiana.[1] Mining areas in eight counties in these States were visited, and general conditions resulting from acid mine drainage were studied, while the microbiology of over a hundred water samples was investigated.

The acid in such waters is generally detrimental to living things with which it comes in contact, but just what plants and animals might actually tolerate such conditions seems to be unknown. It was anticipated that few organisms would be found living in such a restrictive environment that submerged metal objects are quickly and

[1] Sincere thanks are due Mr. Fred Jennewine and Mr. J. P. McNutt, of Clarksburg, W. Va., and Mr. R. H. Jackson, of Linton, Ind., in charge of the abandoned-mine-sealing projects at these places, for the facilities they offered and the time they gave to this survey.

completely disintegrated and in which leaves, stones, and pieces of wood become encrusted with a heavy, stiff deposit of iron. Where small, quiet pools are formed, they may become filled with a yellow flocculent deposit, probably of iron compounds, having the appearance of mud, but which is often of such loose texture that objects will sink from sight in it.

Aside from their varying color, between a clear, light brown and a deep, yellow brown, the swifter streams of these regions do not present an unusual appearance. Slowly flowing streams frequently show a brilliant, dark green coating on leaves, stones, and along their margins, and even stones in swift water are often so coated, while algal streamers and what appear to be fungal streamers are also common. Notes made on many streams of the two regions show, however, that only a very few species of plants and animals are to be found in them. Of all the samples studied microscopically, 62 had a hydrogen-ion concentration of 3.9 or less, and each of these was from streams having a distinctive brown color, either in the water or as a deposit on the bottom. Eight samples had pH values ranging from 4.0 to 4.9 and were also easily distinguishable by the brown color. The remaining samples had pH values between 5.8 and 7.2 and showed no brown color. Using color as an indication of acidity, notes were made concerning macroscopic aquatic plant life over a considerable area.

No bryophytes except a few mosses were found in these acid waters. Moist, shaded stone faces never showed liverworts, and the only mosses were either *Catharinea* or a related form. The only pteridophytes actually growing in the waters were Isoetes, but *Equisetum arvense* was found in mud only a few inches from a stream whose pH was 3.2. Cattails (*Typha latifolia*) were observed in several streams, but no other spermatophyte was actually growing in the waters. In the strip pits in Indiana, cattails were frequently very abundant, often growing in several feet of water which showed no algae or other macroscopic plants. Wherever mine seeps or streams overflow their banks, all grass, herbaceous and shrubby growths, and trees were apparently dead, in most cases indisputably so; and such areas, even when no longer overflowed, remain ugly scars on the landscape. A sharp line of demarcation was noted between the actual water line and the adjacent mud or bank, where growth seemed normal, but actual contact was a killing contact.

Animal life fares no better than plant life in these waters. If we except the microscopic forms, no sponges, hydras, platyhelminthine worms, mollusks, or vertebrates were found. Such earthworms as were found were dead, and they hardened very quickly. Of the arthropods, the only Crustacea were a few *Gammarus* in two streams whose pH values were 2.2 and 3.2. Great numbers of stones were

turned over and searched for insects, but few were found. The most abundant were *Corethra* sp. In both areas the empty pupa cases of this small fly were present in great abundance in all pools. Only two larvae were secured, however, despite much searching, and these were not identified as to species. In many of the Indiana strip pits, *Chironomus* larvae were frequent. Easily located by their bright red color, swimming individuals were easily dipped up, but those in the yellow deposit were difficult to secure. Whirligig beetles were numerous on the surface of the lakes. A quiet West Virginia pool, pH 2.4, showed a brood of mosquito larvae; several beetles and some Mayfly larvae were found in this same pool. A stream, pH 2.3, contained numerous caddis fly larvae, whose tracks were frequent in the flocculent deposits, and a few Mayfly larvae.

Inquiry failed to reveal any instance of fish having been found in these acid streams or lakes.

Microscopic life was somewhat more abundant. No bacterial samples were taken, but suitable samples frequently showed motile forms. The long, colorless or light brown streamers, at first believed to be fungi, proved to be bacterial masses, presumably in a zoogleal jelly. Fungi were surprisingly rare; colorless branching forms appeared in a few samples, and *Galionella* was abundant in four samples, but as a rule they were absent despite many attempts to scrape up supposed fungus growths. Algae were common in some streams, completely absent in others, and practically lacking in the strip pits. The first reaction to the brilliant dark green covering on submerged objects was that it consisted of blue-green algae, but actually no blue-greens were found at pH 3.7 or lower, and only one blue-green, *Oscillatoria* sp., was noted below pH 7.0. Five, possibly six, genera of green algae were found; *Ulothrix zonata* was common, and great growths waved in the clear cold waters of some streams. Stigeoclonium was also fairly abundant. *Mougeotia* and possibly a species of *Cladophora* occurred occasionally. The filamentous desmid *Desmidium* occurred sparingly in Indiana. One other small but abundantly branching alga, believed to be *Phaeothamnion* because of its yellow-brown chloroplasts, occurred in a number of samples. Hydrurus was not noted.

Naviculoid diatoms were numerous in many samples; one species of *Tabellaria* was noted.

Protozoa were more abundant. In the highly acid streams (pH 3.9 or lower), 11 genera of flagellates, 7 rhizopods, and 12 ciliates were found. Species identifications were not attempted for some of the minute flagellates and for some of the ciliates because of the limited time.

Four species of *Rotifera* and one of *Nematoda* were also found; one rotifer was abundant everywhere and one only in the Indiana samples.

Table 1 gives a summary of the occurrence of those organisms in the more acid waters. It includes all organisms of the samples up to pH 4.8, except for nematodes and moss protonema at one mine, but does not include additional organisms which appeared at higher pH values. In streams or pools below a pH of 6.2, microscopic organisms comprised only a few species; but at that value, or above, the number increased markedly. In some places at or above this pH it will be seen that the acid-tolerant species were present but were few in number, in sharp contrast to their abundance in more acid samples.

It cannot be argued that the small number of species at pH values below 4.8 is due to lack of pooling or age of water, for the samples were taken in accumulated debris and with a deliberate effort to get bottom-dwelling and crawling forms, in some cases from pools whose flow was small. Besides, the samples from the "Unnamed Pool," "Salt Well", and Eel River were taken, respectively, from a small body of water with a slight seepage (a few feet from a highly acid stream), from almost the point at which the water issued from the ground, and from a typical clear river with occasional pooling. This was done to show that surface waters, stagnant or running, and unpolluted by mine acid, contained typical species lists for such locations.

The samples indicate a very decided tolerance for a highly acid condition on the part of *Actinophrys sol*, *Chlamydomonas* sp., *Chromulina* sp., *Euglena mutabilis*, *Oxytricha* sp., *Urotricha farcta*, *Navicula* sp., *Ulothrix zonata*, and a rotifer, presumably of the genus *Distyla*. *Pleuromonas jaculans* also seems to favor the acid range. Of these 10 organisms, *Euglena mutabilis*, *Oxytricha*, *Navicula*, and the rotifer were most abundant. The *Euglena* was especially so, being responsible for the green coating, spoken of previously, on sticks, leaves, and stones. Such a coating, often completely obscuring the surface beneath, and at least a millimeter in thickness, comprised, at a conservative estimate, over 1,000,000 organisms per square millimeter of surface. This one organism was the most characteristic of the highly acid streams. It was present in even the thinnest trickles over vertical faces of rock in some instances, extending well back into mine openings, where there is but little light. Inasmuch as it is a *Euglena* which is apparently devoid of a flagellum, its migrations to favored situations must be accomplished by crawling, and it is a vigorous mover by this method. If a bottle of water containing a large number of the organisms and a half inch of mud be vigorously shaken, the mud settles within two or three minutes, and in a half hour or less there is a green covering of *Euglena* on its surface. How the thick

TABLE 1.—*Microscopic organisms occurring in 92 habitats polluted by or near mine waters* [1]

Mine or other source of sample	State	pH	Number of species of organisms present	Bodo sp.	Monas sp.	Pleuromonas jaculans	Chromulina sp.	Cryptomonas erosa	Dinobryon sp.	Chlamydomonas spp.	Euglena mutabilis	Euglena sp.	Lepocinclis ovum	Trachelomonas euchlora	Metanema variabilis	Unidentified flagellates	Vahlkampfia limax	Acanthocystis aculeata	Actinophrys sol	Cochliopodium bilimbosum	Hartmanella hyalina	Unid. rhizopod	Nuclearia simplex	Amphisia sp.	Cinetochilium margaritaceum	Cyclidium sp.	Drepanomonas sp.	Oxytricha sp.	Prorodon sp.	Uroleptus sp.	Urotricha sp.	Vorticella sp.	Glaucoma scintillans	Pleurotricha lanceolata	Unid. ciliates	Navicula spp.	Tabellaria sp.	Ulothrix zonata	Stigeoclonium sp.	Mougeotia sp.	Cladophora sp.	Phaeothamnion sp.	Desmidium sp.	Rotifera	Distyla sp.
Patoka Coal Co.	Indiana	1.8	4																		+																							
Do.	do	1.8	6							+	+											+												+											
Do.	do	1.8	7																																										
Pirkle	do	1.8	9	+																																									
Rosedale No. 1	West Virginia	2.2	5			+				+	+																+																	
Rosedale No. 2	do	2.2	5			+				+	+						+										+																	
Bosworth Barbour	do	2.4	6				+			+	+																																		
Scott No. 3, Open. 53	do	2.5	4			+					+																																		
Open. 50	do	2.6	7		+	+				+	+													+		+	+																	
Open. 51	do	2.6	9							+	+													+			+																	
Open. Seep	do	2.6	11			+				+	+					+	+	+						+			+																	
Robinsons Run	do	2.6	7			+					+						+																												
Do.	do	2.6	6			+					+						+																												
Lamberts Run	do	2.6	4			+					+																																		
Erie No. 1	do	2.6	5							+	+																+																	
Solon No. 4	do	2.7	2								+																																		
Cartwright Inside	do	2.7	4	+	+						+										+															+									
Do.	do	2.7	5	+							+																									+									
Murphy's Run	do	2.7	4		+						+																									+									
Fairmore No. 11	do	2.7	4	+							+																									+									
Wolf Summit	do	2.7	2								+																																		
Do.	do	2.8	2		+						+																																		
Murphy's Run	do	2.8	5							+	+																	+																	
Brown's Creek	do	2.8	5	+							+					+												+																	
Do.	do	2.8	4		+		+				+																	+																	
City Grove	do	2.8	3				+				+																	+																	
Alum Springs	Indiana	2.9	3		+						+										+																								
Do.	do	3.0	3		+						+																																		
Do.	do	3.0	7		+					+	+																	+																	

[1] A few of these samples came from short, very turbulent streams with no pooling whatever.

TABLE 1.—*Microscopic organisms occurring in 92 habitats polluted by or near mine waters*—Continued

Mine or other source of sample	State	pH	Number of species of organisms present	Bodo sp.	Monas sp.	Pleuromonas jaculans	Chromulina sp.	Cryptomonas erosa	Dinobryon sp.	Chlamydomonas spp.	Euglena mutabilis	Euglena sp.	Lepocinclis ovum	Trachelomonas euchlora	Metanema variabilis	Unidentified flagellates	Vahlkampfia limax	Acanthocystis aculeata	Actinophrys sol	Cochliopodium bilimbosum	Hartmanella hyalina	Unid. rhizopod	Nuclearia simplex	Amphisia sp.	Cinetochilum margaritaceum	Cyclidium sp.	Drepanomonas sp.	Oxytricha sp.	Prorodon sp.	Uroleptus sp.	Urotricha sp.	Vorticella sp.	Glaucoma scintillans	Pleurotricha lanceolata	Unid. ciliates	Navicula spp.	Tabellaria sp.	Ulothrix zonata	Stigeoclonium sp.	Mougeotia sp.	Cladophora sp.	Phaeothamnion sp.	Desmidium sp.	Rotifera	Distyla sp.
Sherwood-Cent. Indiana	Indiana	3.0	7	--	--	--	--	--	--	--	+	+	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	+	--	--	--	--	--	--	--	--	--
Jewell II	do	3.0	9	--	--	--	+	--	--	--	+	+	+	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--
Sherwood	do	3.0	2	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rain Barrel	do	3.0	4	--	--	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Blackfoot 13 Seepage	do	3.0	5	--	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--
Dartmoor	West Virginia	3.0	8	--	--	--	+	--	--	--	+	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	+	+	--	--	--	--	--	+	--	--	--	--	--	--	--	+	+
Riverdale	do	3.0	12	--	--	--	--	--	--	+	+	+	--	--	--	--	--	--	--	+	--	+	--	--	--	--	+	+	+	--	--	--	--	--	+	--	--	--	+	--	--	--	+	+
Beaver	do	3.1	4	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	--	+	--	--	--	--	--
Lamberts Run	do	3.2	5	+	--	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	--	--	--	+	--	--	--	--	--
Marshall	do	3.2	3	--	--	--	+	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	--	--	--
Alum Springs	Indiana	3.2	3	--	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	--	--	--
Pryor II	do	3.2	5	--	--	--	+	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	+	--	--	--	--	--	--	+	--	--	--	+	--	--	--	+	+
Jewel II	do	3.2	7	--	--	--	+	--	--	+	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	+	+	--	--	--	+	--	--	--	+	+
Blackfoot No. 7	do	3.2	5	--	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	+	--	--	--	+	--	--	--	+	+
Blackfoot No. 13	do	3.2	4	--	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+	--	--	--	+	--	--	--	+	+
Electric No. 8	do	3.2	5	--	+	--	--	+	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	+	+	--	--	--	+	--	--	--	+	+
Do	do	3.2	4	--	--	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	+
Do	do	3.2	6	--	+	--	--	--	--	--	+	+	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	--	--	--	+	--	--	--	+	+
Do	do	3.2	5	--	--	--	--	--	+	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	+
Vandalia	do	3.2	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Electric No. 1	do	3.3	6	--	--	--	--	+	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	+	+
Otter Creek	do	3.3	3	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+
Fairmore No. 12	West Virginia	3.4	3	--	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	--	--	--	--	--	--	--
Electric No. 1	Indiana	3.4	8	--	+	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	+	--	--	--	--	--	--	--	--	--
Do	do	3.4	8	--	--	+	+	--	--	--	+	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	+	--	--	--	--	--	--	--	--	--
Blackfoot No. 9	do	3.4	6	--	+	--	+	+	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	--	--	--	--	--	--	--
New Hope	do	3.4	6	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	+	+
Williams	West Virginia	3.6	3	--	--	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Stewarts Run	do	3.7	10	--	--	--	--	+	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	+	+	--	--	--	--	--	+	+	+	+
Blackfoot No. 11	Indiana	3.8	6	--	+	--	--	+	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	+	--	--	--	--	--	--	+	+	+
Coal Creek	do	3.8	6	--	+	--	--	+	+	--	+	+	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	+	--	--	--

W. D.	do.	3.8	8	--	+	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	+
Blackfoot	do.	3.9	6	--	--	--	--	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+
Buckeye	do.	4.0	3	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--
Jackson Hill	do.	4.2	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--
Barren Creek	do.	4.5	9	--	+	--	--	--	--	+	+	--	+	--	--	--	--	--	+	--	--	+	--	--	--	+	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	+
Waldo	West Virginia	4.6	3	--	+	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--
Monongahela River	do.	4.8	[2] 15	+	+	--	--	+	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	+	--	--	+	--	--	--	--	+	+	--	--	--	--	--	--	--	--
Tygart River	do.	4.9	[2] 10	--	+	--	--	--	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+
Blackfoot No. 8	Indiana	4.9	8	--	+	--	--	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	+	--	--	--	+	--	--	--	--	--
Tin Lizzie	do.	4.9	5	--	--	--	--	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Little Giant	do.	5.8	2	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Stark and Coffee	do.	6.0	12	--	--	--	--	--	--	+	+	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	+	--	+	--	--	--	--	--	+	+
Patoka River, So. Fork	do.	6.2	[2] 20	--	--	--	--	+	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	+
Sunflower	do.	6.0	10	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	+	--	--	--	+	--	--	+	--	--	--	--	+	--	--	+	--	--	--	--	--	--	--	--	--
Elk River	West Virginia	6.2	[2] 30	+	--	--	--	+	--	+	+	+	--	--	+	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	+	--	+	--	+	--	--	--	--	--
Lewis	do.	6.2	3	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Red Onion	Indiana	6.3	5	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Nickel Plate	do.	6.4	6	--	+	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	+	--	--	--	--	--	+	--	--	--	--	--	--
Delta	West Virginia	6.5	[2] 15	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	+	--
Hamilton	Indiana	6.6	12	--	--	--	+	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--
Patoka River, Princeton	do.	6.8	[2] 15	--	--	--	--	+	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Busseron Creek	do.	6.8	[2] 26	--	--	--	--	+	--	+	--	+	--	--	+	--	--	--	--	--	--	+	--	--	--	+	--	+	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--
Delta	West Virginia	6.9	8	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	+	--
Little Ten Mile	do.	6.8	[2] 30	+	--	--	--	+	--	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	+	+	--	+	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	+	--
Dixie Bee	Indiana	7.0	6	+	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--	--	+	--	--	--	--	--	--	--
Vandalia	do.	7.0	[2] 30	+	--	--	--	+	--	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	+	+	--	+	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	+	--
Pool	West Virginia	7.0	[2] 40	+	--	--	--	+	--	+	--	+	+	--	--	--	+	--	--	--	--	--	+	--	+	--	--	+	--	--	--	+	--	--	+	+	--	--	--	--	--	--	--	+	--
Eel River	Indiana	7.2	[2] 20	+	+	--	--	+	+	+	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	+	--
Do.	do.	7.2	[2] 30	+	+	--	--	+	+	+	--	+	+	+	--	--	--	--	--	--	--	--	--	--	--	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	+	--	--	+	--
Small Stream	do.	7.2	[2] 26	+	+	--	--	+	--	+	+	+	--	+	--	--	--	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	--	--	--	+	--	--	--	--	+	--	--	+	--
Wolf Summit	West Virginia	7.2	[2] 15	--	--	--	--	--	--	+	--	+	--	+	--	--	--	--	--	--	--	--	--	--	--	+	--	+	--	--	--	--	--	--	--	+	+	--	--	--	--	--	--	+	--
Stagnant Pool	do.	7.2	[2] 30	+	+	--	--	--	--	--	--	+	--	+	--	--	--	--	--	--	--	--	--	--	+	+	--	+	--	--	--	--	+	--	+	+	--	--	--	--	+	--	--	+	--
Total occurrences			92	17	33	10	12	21	3	43	65	13	7	5	4	4	7	2	5	2	6	6	2	3	8	16	4	39	1	1	11	6	4	4	9	42	4	19	2	6	3	7	2	28	31
Occurrences below pH 5.0				7	26	10	11	10	1	25	56	1	4	0	2	4	5	2	5	2	5	4	1	3	1	5	4	29	1	1	10	5	1	3	4	26	2	16	1	5	7	2	0	15	29

[2] A complete list of organisms was not compiled, owing to lack of time, but presence of those from low pH values was carefully noted.

colonies maintain themselves in the turbulent swift water on stones is a mystery.

These *Euglenas* and *Chromulinas* (when present) constitute food for *Oxytricha, Urotricha, Actinophrys* and the rotifer *Distyla.* In addition, they are photosynthetic organisms. We do not know the products of metabolism and death of these organisms, but they may play an important part in beginning the return of the acids and minerals of the waters to a more neutral condition, just as the first lichens to invade a glaciated rock at once begin to break that rock into soil. Their presence in acid waters demonstrates once more that there are few environments on this earth not suitable to some form of life.

SUMMARY

The brief study outlined here indicates that—

1. The most highly acid-polluted waters support a few species of microorganisms which occur in large numbers and are distinctive indicators of this acid condition.

In many years of experience the writer has never encountered elsewhere in such abundance (except *Oxytricha* sp. and *Pleuromonas jaculans*) the ten most common species found in the highly acid waters of the area investigated. A high tolerance for low pH values by *Pleuromonas jaculans* has already been noted under laboratory conditions. Occasional tolerances or occasional findings as in the case of *Lepocinclis ovum*, which occurred in samples from Jewell II, Linton (Indiana), mine at a pH of 3.0 and a few specimens of *Cinetochilum margaritaceum* from Lamberts Run, West Virginia, occurring at pH 3.2, are significant in extending the limits of pH range for these organisms, but also indicate that they may not be safely used as indicator organisms for this particular condition.

2. Under the extremely restrictive conditions of high acid concentration, there is a group of micro-organisms, present in abundance, which have the potentiality for becoming the first link in the food chain beginning with the microscopic organisms and reaching by way of the minute crustaceans and insects to the fishes.

While their numbers are frequently large, their environment is prohibitive to other forms and it should be emphasized that large numbers of other species do not appear until the pH nears neutrality (in these waters, 6.2 or above). This stringency of environment is strikingly illustrated by some of the Indiana pit lakes, beautiful, clear, bluish-green bodies of water, but with no plants except cattails, no visible algae, but few protozoa and no sign of Copepoda or Cladocera, and devoid of fish life.

3. It is entirely possible to determine the condition of the acid waters of these regions by biological surveys, not involving a knowl-

edge of large numbers of species, but by the relative abundance of a limited number of easily recognizable species.

REFERENCES

(1) Accomplishments of three years in sealing abandoned coal mines in West Virginia. By E. S. Tisdale, Director, Division of Sanitary Engineering, West Virginia State Department of Health. Published by the State Health Department and the State Water Commission, 1936.

(2) The effect of coal-mine drainage on West Virginia rivers and water supplies. By W. W. Hodge. Research Bulletin No. 18, Engineering Experiment Station, West Virginia University, Series 38, No. 7, 1938.

STUDIES ON CHRONIC BRUCELLOSIS

IV. An Evaluation of the Diagnostic Laboratory Tests *

By ALICE C. EVANS, *Senior Bacteriologist;* FRANK H. ROBINSON, *Consultant;* and LEONA BAUMGARTNER, *Acting Assistant Surgeon, United States Public Health Service, National Institute of Health*

INTRODUCTION

The interpretation of the laboratory tests which have been developed as aids in the diagnosis of human infection with organisms of the genus *Brucella* has presented difficulties. Diagnosis can be unquestionably established by isolating the organism from the patient, but this can be accomplished in only a relatively small percentage of cases. The protean manifestations of the disease and its occurrence in atypical, chronic, and latent forms make it imperative to obtain as complete an understanding as possible of the diagnostic significance of the various laboratory procedures. The present study of specific reactions in the chronic form of the disease is offered as a contribution to that end.

The agglutination test has been used to detect *Brucella* infections since 1897, when it was introduced by Wright and Smith. A minimum titer of 1:80 is the one most commonly accepted as evidence of active infection, but opinions differ as to the validity of that interpretation. It is a common practice to regard a negative reaction or a low agglutinin titer as evidence against active *Brucella* infection. The fallacy in that assumption has been pointed out by a number of investigators who have cultivated *Brucella* from patients with negative agglutination reactions (Burnet; Carpenter, Boak, and Chapman; Gilbert and Dacey; Evans; Meyer et al.; Taylor, Lisbonne, and Vidal; Huddleson, Johnson, and Beattie; Poston and Smith; Poston and Thomason; Huddleson, Munger, Gould, and Paulson).

* Preceding papers of this series are as follows:

I. Introduction. By Alice C. Evans. Pub. Health Rep., 52:1072 (1937). (Reprint 1844).

II. Description of techniques for specific tests. By Alice C. Evans. Pub. Health Rep., 52:1419 (1937). (Reprint 1867.)

III. Methods used in obtaining cultures. By Mary A. Poston. Pub. Health Rep., 53:1 (1938). (Reprint No. 1895.)

Another source of error in the interpretation of the agglutination reaction is the fact that the titer may remain high after recovery from the disease. Meyer and others observed some patients in whom the agglutinins disappeared rapidly from the blood, and others in whom relatively high titers were demonstrated a year or more after subsidence of symptoms. Olin, and also Carpenter, Boak, and Chapman, reported cases in which the agglutinins were retained for several years after recovery.

Still another source of error in the interpretation of agglutination reactions is the fact that individuals exposed to infection may develop agglutinins without notable illness (Carpenter, Boak, and Chapman; Huddleson and Johnson; Jordan; Dooley; Huddleson, Munger, Gould, and Paulson).

Fleischner and Meyer were the first to investigate cutaneous hypersensitiveness to a specific antigen as a test for *Brucella* infection. Burnet followed with an investigation which aided in making the test practical. Subsequently, many investigators have experimented with the use of this test. The diversity of preparations used as antigens makes the correlation of their results difficult. Heathman, and Poston and Thomason used heat-killed cells. Taylor, Lisbonne, and Vidal used a filtered extract of the ground bacterial cells. Burnet; Dubois and Sollier, Bastai and Rotta, and Meyer and others used the filtrate of old cultures. Others (Fleischner and Meyer; Levin; Johns, Campbell and Tennant; and Huddleson) used an antigen from which the lipoid substances were removed.

Generally a positive skin reaction is regarded as denoting the occurrence of past or present infection. That the infection which sensitizes the patient may be latent was pointed out by Meyer and Geiger, who investigated the cutaneous sensitivity of a large number of persons and found that the percentage of positive reactions was correlated with frequency of contact with infected animals. The percentage of positive reactions varied from 10.9 percent in a group of medical students to 60.3 percent in veterinarians. Heathman investigated cutaneous sensitiveness in workers in packing plants and found that, in general, the incidence of the allergic state increased with length of service. She obtained positive reactions in 54.7 percent of subjects, and from those results concluded that the intradermal test is of little value as a diagnostic aid. Other investigators have concluded that repeated contacts with the organism either by handling infected animals or by drinking infected milk may cause the development of a state of hypersensitiveness without symptoms of disease (Sorge; Bastai and Rotta; Dubois and Sollier; Huddleson and Johnson; Thomsen; Dooley; Johns, Campbell, and Tennant; McBride, Daniel, and Poston; Molinelli; Olin; Binder and Fauszt).

The retention of the hypersensitive state for long periods after recovery from the disease provides another source of confusion in interpreting positive skin reactions (Olmer; Dubois and Sollier; Taylor, Lisbonne, and Vidal; Olin).

Although healthy individuals may be hypersensitive to *Brucella* antigen, nevertheless, the intradermal test has been found negative sometimes in patients in whom infection was proved by culture (Dubois and Sollier; Taylor, Lisbonne and Vidal; Poston and Thomason; Vedel, Puech and Janbon; Robinson and Evans).

The imperfections of the agglutination and intradermal reactions led Huddleson, Johnson, and Hamann to investigate the possibility of the opsono-cytophagic reaction as a diagnostic aid in brucellosis. Huddleson concluded that individuals susceptible to the disease give a negative or very slight reaction; infected individuals give a negative, weak, or moderate reaction; and immune subjects give a marked reaction. Meyer and others confirmed the usefulness of the opsonocytophagic test, but warned that it would be premature to accept Huddleson's interpretations unconditionally.

The estimations of the value of the agglutination, intradermal, and phagocytic reactions in the literature cited in the preceding paragraphs may be summarized, in general, as follows: A positive agglutination reaction is the most accurate indicator of present infection (Dubois and Sollier; Taylor, Lisbonne, and Vidal; Meyer and others; Keller, Pharris, and Gaub). However, it may be lacking in cases proved by culture; it may develop in latent infections; and it may be retained for years after recovery from the disease. The intradermal test is regarded as a less accurate indicator of present infection because the allergic state usually develops later than agglutinins and because it is generally retained for longer periods after recovery. The reported data are insufficient to make a comparable statement as to the value of the opsono-cytophagic test.

The results of the present study may be expected to differ more or less from those of other investigators, because it differs from any previously reported in that the data were obtained from individuals with chronic disease.

CASE FINDING METHODS

In 1936, the National Institute of Health initiated field investigations to study chronic brucellosis. The primary object was to gain information on the prevalence of the disease in the survey areas, to be discussed in a subsequent paper. The subjects were studied clinically, and agglutination, opsono-cytophagic and intradermal tests were performed according to techniques described in the second paper of this series, the brucellergin for the skin tests being used in the 1:10,000 dilution. This paper presents the analyses of the data on

the specific tests. It includes data obtained in the study of 511 subjects in the surveys made in Charlotte, Mecklenburg County, N. C. (325 subjects), in Kansas City, Kans. (167 subjects), and 19 subjects studied at the National Institute of Health, in Washington, D. C. For convenience, the areas will be referred to in the tables as M, KC, and NIH, respectively.

In both survey areas a large quantity of raw milk was consumed. In both communities some of the subjects studied had at some time lived on farms. Some of the Kansas City patients had worked in packing plants. The inhabitants of both areas, therefore, had opportunity to be exposed to infection.

In Kansas City, specific vaccine therapy had been in vogue and skin tests with killed organisms had been used in diagnosis. Cases which had received such treatment are generally omitted from the tables and discussions because vaccine treatments might stimulate the production of antibodies. Wherever cases which had been treated with vaccine are included in the tables they are distinguished by the letter "V" following the case number.

In both areas, many cases of unexplained fevers, psychoneuroses, and chronic aches and pains of various kinds, seen through the courtesy of the local physicians, were investigated. In Charlotte a group of patients suffering with a variety of clearly defined disorders other than brucellosis were studied as controls.

In Kansas City, in addition to the patients referred by the local physicians, other subjects were sought out for study with the "rapid" agglutination test, according to Huddleson's method. The tests were made on all serums coming into three laboratories for Wassermann tests from September 15 to December 15, 1936, using an antigen prepared with *abortus* strain No. 456. A total of 3,365 serums was tested, and 187 (5.6 percent) were found to be positive. From among the cases giving positive reactions, 80 were chosen for further study. Only 21 of the 80 gave an agglutination reaction of 1:40 or higher, according to the test tube method. In the remaining cases the titer was below 1:40 and was considered negative in the analysis of the data, for reasons to be discussed further on. Hence by the screening procedure of the rapid agglutination test, 21 cases with positive agglutination reaction were selected for further study. They were allocated into clinical groups on the basis of clinical impressions alone. One (KC 79, table 2) had suffered with brucellosis in the past; in 2 (KC 127 and 164, table 4) a diagnosis of chronic brucellosis seemed reasonable; 8 showed less convincing evidence of Brucella infection, and were classified as "possible chronic brucellosis." The remaining 10 cases were classified as "ill with other diseases."

The different case-finding methods of the two areas yielded different groups for study which conveniently complemented each other. All

clinical histories and diagnoses were studied by both field investigators (F. H. R. and L. B.), and doubtful or confused cases were eliminated. That many cases would have profited by more prolonged study is readily conceded.

Four cases of tularaemia were encountered in these studies. They are omitted from the brucellosis tables and are discussed separately on account of the well-known cross agglutination reactions between tularaemia and brucellosis. The reactions to the specific brucellosis tests and the agglutinin titer with *tularense* antigen in the four cases of tularaemia are summarized in table 1. In three of the four cases, there was no significant reaction with the *Brucella* agglutinating antigens. In one case, however, the *Brucella* titer was high enough to be regarded as evidence of *Brucella* infection if the higher titer with tularense antigen were not known. This cross agglutination reaction with *Brucella* antigen in tularaemia agrees with the observations of Francis and Evans, and of subsequent investigators. The results of the opsono-cytophagic reaction with *Brucella* antigen varied in the three cases in which the tests were performed. On the other hand, the skin reactions were consistently negative in all four cases.

TABLE 1.—*Reactions to the specific brucellosis tests in four cases of tularaemia*

Case No.	Agglutination reactions			Opsono-cytophagic reaction	Skin reaction
	Tularense	*Melitensis*	*Abortus*		
M 87	1:160	1:10	1:10	No test	[1] –
M 136	1:160	1:10	1:10	Strong	–
KC 78	1:5120	1:320	1:160	Very strong	–
KC 114	1:1280	0	0	Negative	–

[1] The minus sign indicates a negative reaction.

The three following controversial cases were also omitted from the analysis of data:

Case KC 37 was a woman, aged 66, who had had many opportunities to drink infected milk in Iowa. She had been ill for about 4 years, most of her symptoms being apparently related to recurring attacks of gall-bladder and kidney disease. Laboratory and clinical studies established a diagnosis of arteriosclerotic heart disease and carcinoma of the biliary tract. She died shortly after her admission to the hospital and before results of the routine agglutination tests were obtained which would have selected her as a case of particular interest. Autopsy confirmed the cardiac disease and the adenocarcinoma of the gall bladder with metastases to the liver and lymph nodes. An acute suppurative periportal hepatitis with multiple abscesses, acute and chronic splenitis, and chronic glomerulonephritis were also found. No cultures were taken. Satisfactory explanation of a 1:640 titer of agglutinins for *B. melitensis* is lacking.

Case KC 136 was a robust young man, aged 23, who was known to have had an acute attack of gonorrhea 2 years previously. He came into the hospital with an acute orchitis and epididymitis, supposedly gonococcal in origin, though no smears were taken by his physician. He was subsequently found by the rapid test method to have a positive agglutination reaction and so was searched out for study. He had recovered clinically but an agglutinin titer of 1:1280 was found with positive phagocytic and skin tests. Attempts to culture *Brucella* from seminal and prostatic fluids were unsuccessful. On account of the previous gonococcal infection it is uncertain whether the orchitis and epididymitis were due to *Brucella* or to *N. gonorrheae.*

Case KC 137 was a stenographer, aged 25, who had always been in good health. During the past 4 years she had had four or five attacks simulating erythema nodosum. She had some pain in the knee joints, and slight swelling and redness over the bones above and below the joints. The attacks lasted 4 to 5 days with rather severe pain for 2 days. The patient was of the opinion that she never had an elevated temperature during the attacks. She usually carried on her work. *Brucella* agglutinins were demonstrated in her blood serum by means of the rapid agglutination test, and were confirmed by the tube method in a titer of 1:320. The skin test was negative to 0.2 cc of brucellergin, but ulceration followed the injection of 0.03 cc of *Brucella* vaccine. The opsono-cytophagic test was weakly positive. Physical examination revealed nothing of interest. Reactions to tuberculin, Wassermann and Kahn tests were negative. The blood count was essentially normal.

ANALYSIS OF DATA

For the purpose of the analysis of data the subjects of this study were divided into six groups as follows:

1. *Brucellosis in the past.*—A history of acute brucellosis within the last 14 years. Brief histories of the 14 cases in this group are given in table 2.

2. *Acute brucellosis.*—The survey was particularly concerned with chronic forms of brucellosis. However, 4 cases of the acute disease (disabling illness of less than 6 months' duration, with a significant temperature curve) were encountered. Since this group is too small for accurate statistical study, it is included in the analyses of data only in table 5 where the significance of agglutinin titers is under consideration. Brief histories of the four acute cases are given in table 3.

3. *Chronic brucellosis.*—The term chronic brucellosis is used loosely in this paper to include all cases in which the history, symptoms, and lack of objective signs of disease suggested brucellosis as the most logical diagnosis (excepting the four acute cases included in group 2).

TABLE 2.—*Specific reactions in individuals with a history of brucellosis in the past*

Case No.	Clinical history			Date the tests were made	Skin reaction	Opsono-cytophagic reaction	Agglutinin titer [1]	Remarks
	Date of onset of disease	Agglutination titer during illness	Date last dose of vaccine was given					
KC 5	Summer 1930	1:160		September 1936	[2] −	Negative	1:20	Spontaneous abortion in 1936.
KC 10V [3]	Summer 1935	Unknown	October 1935	do	+	Weak	1:80	
KC 14V	January 1936	1:640	January 1936	do	+	Moderate	1:10	Only 1 dose of vaccine was given.
KC 16V	Spring 1928	1:1280	Spring 1928	October 1936	+	Weak	1:160	
KC 38V	Spring 1933	1:160	Fall 1934	do	+	Moderate	1:10	Recurrent attacks have occurred, but asymptomatic now.
KC 79	1932	Unknown		November 1936	+	Weak	1:40	Brucellosis lasted 2 months. Multiple sclerosis now.
KC 122	Spring 1933	1:160		do	+	Negative	0	C. N. S. lues.
KC 158V	1932	1:80	1933	December 1936	+	Strong	1:20	Acute glomerulo-nephritis now.
M 57	1920	Unknown		August 1936	+	Moderate	1:20	
NIH 3	November 1928	1:5160		October 1936	+	do	1:40	Laboratory infection.
NIH 4	March 1929	1:320		do	[4] +	Weak	(1:20)	Do.
NIH 5	June 1923	1:5160		do	[4] +	Strong	(1:20)	Do.
NIH 6	Spring 1925	Unknown		do	+	do	(1:10)	Mild symptoms with fever. Undiagnosed at the time of illness.
NIH 7	Spring 1923	do		do	[4] +	Weak	(1:20)	Veterinarian. Undiagnosed at the time of illness.

[1] The titer recorded is the highest dilution which gave 75 percent precipitation of either *abortus* or *melitensis* antigen. Parenthesis around the agglutinin titer indicates partial agglutination in the given and lower dilutions, with precipitation of 75 percent of antigen in no dilution.
[2] The minus sign indicates a negative skin reaction.
[3] The letter "V" following the case number indicates that vaccine treatment was given.
[4] The skin test gave an incapacitating systemic as well as a local reaction.

TABLE 3.—*Specific reactions in 4 cases of acute brucellosis*

Case No.	Date of onset of the disease	Date the tests were made	Status at the time the tests were made	Skin reaction	Opsono-cytophagic reaction	Agglutinin titer [1]	Remarks
KC 160 V[1]	Dec. 7, 1936	Dec. 14, 1936	Acutely ill	+	Weak	1:2560	This patient had received 1 dose of vaccine on the day before the blood was drawn for serological tests. *Br. abortus* was cultivated from the blood.
M 38	April 1936	July 27, 1936	do	+	Negative	1:1280	
M 137	August 1936	Sept. 12, 1936	Typical symptoms of the acute disease.	+	Weak	1:640	
NIH 1	July 1936	Oct. 28, 1936	Not entirely well, but is working.	(2)	do	1:640	

[1] See footnotes to table 2.
[2] Not tested.

TABLE 4.—*Specific reactions in patients suffering with chronic brucellosis*

Case No.	Date of onset of disease	Date the tests were made	Status at the time tests were made	Skin reaction [1]	Opsono-cytophagic reaction	Agglutinin titer [1]	Remarks
KO 57	1934	Nov. 24, 1936	At work, but not well	+	Weak	0	Cultures and animal inoculations gave negative results.
KO 127	1933	Nov. 18, 1936	Chronically ill	+	Moderate	1:40	Do.
KO 150	Fall 1935	Dec. 11, 1936	do	−	Weak	1:10	In April 1936, the agglutinin titer was reported to be 1:200. Cultures and animal inoculations gave negative results.
KO 164	Spring 1936	Dec. 14, 1936	do	+	Strong	1:640	The clinical diagnosis is not clear.
KO 200	November 1936			+		1:800	*Br. abortus* was cultivated from infected bursa.
M 5V [1]	March 1936	July 16, 1936	Low grade fever	−	Weak	[2]1:80	The agglutinin reaction was negative previous to vaccine treatments, which had been given for 4 months preceding July 1936. *Br. suis* was cultivated from the blood and joint fluid in December 1936. Death occurred in March 1937.
		Oct. 22, 1936	Severe joint pains		Strong	1:320	
		Dec. 23, 1936	Progressively worse		Moderate	1:160	
M 11	September 1934	July 13, 1936	Recurrent attacks	+	do	1:160	
M 12	Fall 1935	do	Headaches; fatigability	+		0	
M 14	February 1935	July 16, 1936	Disease is subsiding	+		1:40	
M 23	January 1934	July 18, 1936	Active chronic disease	+	Negative	[2]1:80	Cultures and animal inoculations gave negative results.
		Sept. 18, 1936			Moderate	1:20	
		Dec. 23, 1936			Negative	1:20	
M 24	About January 1934	July 18, 1936	Weak; run down	−	do	[2]1:80	This patient was treated with antibrucella goat serum in August 1936; and with 4 daily doses of *Brucella* vaccine, December 15–18, 1936. Cultures and animal inoculations gave negative results.
		Sept. 18, 1936			Weak	1:20	
		Dec. 23, 1936	No improvement		do	1:40	
M 34	January 1934	July 25, 1936	Active chronic disease	+	do	1:160	
M 36	About May 1936	July 27, 1936	Ambulatory; mild symptoms.	+	do	1:20	
M 59	About 1926	Aug. 8, 1936	Mild symptoms	−	do	[2]1:40	*Br. melitensis* was obtained from the blood in December 1936.
		Oct. 2, 1936	Recurrent attacks		Very strong	1:40	
		Dec. 23, 1936			Weak	1:40	
M 67	January 1936	Aug. 11, 1936	Confined to bed	+	Strong	[2]1:10	*Br. abortus* was obtained from the blood in December 1936.
		Oct. 22, 1936	Improving		do	1:20	
		Dec. 23, 1936	Occasional fever, but patient has returned to work.		Moderate	1:40	
M 68	July 1936	Aug. 13, 1936	Mild symptoms	+	Weak	0	Cultures gave negative results.
M 103	Spring 1932	Aug. 26, 1936	Nervousness and fever	−		[2]0	
		Aug. 29, 1936			Negative		
		Dec. 23, 1936	No change		do	0	
M 107	January 1936	Aug. 28, 1936	Kept in bed for rest cure	−	do	[2]0	*Br. melitensis* was cultivated from the blood in December 1936.
		Dec. 23, 1936	Has returned to school, although symptoms continue.		do	0	
M 116	About September 1935	Aug. 31, 1936	Subsiding chronic disease	+	do	0	

[1] See footnotes to table 2.
[2] In cases in which repeated tests were made, the results of the first test alone are considered in the analyses of data.

TABLE 4.—*Specific reactions in patients suffering with chronic brucellosis*—Continued

Case No.	Date of onset of disease	Date the tests were made	Status at the time tests were made	Skin reaction	Opsono-cyto-phagic reaction	Agglutinin titer	Remarks
M 140	About September 1932	Sept. 18, 1936	Recurrent attacks	+	Moderate	1:320	
M 157	2 to 3 years ago	Sept. 21, 1936	Active disease	+	do	1:40	
M 186	About August 1935	Oct. 2, 1936	Mild symptoms	−	do	1:80	
M 209	6 to 9 months ago	Oct. 3, 1936	Hypertensive arteriosclerosis; brucellosis.	+	Very strong	1:160	
M 257	July 1936	Nov. 6, 1936	Daily elevation of temperature.	−	Negative	0	Cultures gave negative results.
M 258	August 1936	do	Slight daily elevation of temperature.	−	do	0	
M 319	December 1935	Nov. 30, 1936	Recurrent attacks	−	do	0	*Br. abortus* was cultivated from the blood in December 1936.
M 411	May 1936	Dec. 23, 1936	Mild symptoms	−	Strong	1:20	*Br. melitensis* was cultivated from the blood in December 1936.
NIH 2	November 1922	Oct. 28, 1936	do	+	Weak	1:80	There have been many recurrences.

Obviously, in an evaluation of the significance of laboratory tests, those tests should not be the criteria on which diagnoses are made. Therefore the present classification of cases is based on clinical history and symptoms alone. Most of the patients gave a history of low grade fever, malaise, fatigability, weakness, muscle or joint pains, headache, slight loss in weight, all without satisfactory explanation. Possibly there are included in the group of "chronic brucellosis" some cases of other disease. On the other hand, convincing evidence is presented further on to show that some cases of chronic brucellosis which could not be identified were placed in the group of "possible chronic brucellosis." However, the criteria used in defining the group are the best available at the present time. Some of the chronic brucellosis patients were studied culturally and cultures of *Brucella* were obtained from a few of them. (See table 4.)

Brief histories of the 28 chronic brucellosis cases are given in table 4. Five of the 28 cases were of less than 6 months' duration (KC 200, M 36, M 68, M 257, and M 258). They were included in the group of chronic cases because in them the disease was mild and atypical. One case (M 5) is included in which the disease progressed to a fatal termination after about 1 year of illness. From 7 of the cases in this group *Brucella* were cultivated, 6 of them having been reported by Poston in the third paper of this series. In 15 cases the clinical impression of chronic brucellosis was confirmed by an agglutinin titer of 1:40 or higher. (It will be shown further on that a titer of 1:40 is the minimum to be regarded as indicative of infection.) In 9 of the 28 cases the clinical impression of chronic brucellosis was not confirmed by culture nor by the agglutination test.

4. Possible chronic brucellosis. The clinical evidence was less convincing than in group 3 (41 cases).

5. Subjects ill with many other diseases and with no history suggesting brucellosis in the past (321 cases, of which 95, or 29 percent, were cases of tuberculosis).

6. Healthy subjects, with no history of brucellosis (28 cases).

The six groups include a total of 436 cases from which data are available. In 61 cases, however, data on one or another of the specific tests are lacking.

In table 5 an analysis of the data is made to determine the minimum agglutinin titer offering evidence of *Brucella* infection. All of the four acute cases showed agglutinin titers of 1:80 or higher. In fact, they were all 1:640 or higher (table 3). The group is too small, however, to draw general conclusions.

The data in table 5 show that an agglutinin titer of 1:80 or higher occurs about 24 times as frequently in chronic brucellosis as in cases ill with other diseases; and a titer of 1:40 occurs more than 4 times as frequently in the former as in the latter group. On the other hand

the percentage of cases with titers of 1:10 and 1:20 are slightly higher in the latter group. From these data, it appears that a titer of 1:40 is the minimum to be regarded as suggestive of brucellosis. Hence, in the following tables, titers below 1:40 are recorded as negative.

TABLE 5.—*Relationship between clinical history and range of agglutinin titer in 429 subjects. (Data are given in percentages)*

History	Number of cases	Percentage of cases with agglutinin titer				
		Negative	1:10 [1]	1:20 [1]	1:40 [1]	1:80 or higher [1]
Brucellosis in the past [2]	14	35.7	14.3	21.4	14.3	14.3
Acute brucellosis [2]	4	0	0	0	0	100.0
Chronic brucellosis [2]	28	32.1	7.1	7.1	14.3	39.3
Possible chronic brucellosis [2]	41	48.8	9.8	17.1	24.4	0
Ill with other diseases [2]	316	68.8	13.6	12.6	3.2	1.6
Healthy subjects [2]	26	84.6	7.7	7.7	0	0

[1] All calculations are based on the higher titer obtained with *abortus* or *melitensis* antigen.
[2] See the text for the definition of the groups.

In table 6 the percentages of positive and negative reactions of all three specific tests are summarized for the various clinical groups. According to these data a positive skin reaction occurs more than four times as frequently in chronic brucellosis as in cases ill with other diseases; and the percentage of positive skin reactions in cases recovered from acute brucellosis is notably higher than in those suffering with chronic brucellosis.

TABLE 6.—*A summary of the results (in percentages) of the brucellosis tests on 432 subjects*

History	Skin reactions			Opsono-cytophagic reactions				Agglutination reactions		
	Number of cases tested	Negative	Positive	Number of cases tested	Negative	Weak or moderate	Strong or very strong	Number of cases tested	Negative [1]	Positive
		Percent	*Percent*		*Percent*	*Percent*	*Percent*		*Percent*	*Percent*
Brucellosis in the past [2]	14	7.1	92.9	14	14.3	64.3	21.4	14	71.4	28.6
Chronic brucellosis [2]	28	39.3	60.7	25	32.0	52.0	16.0	28	46.3	53.6
Possible chronic brucellosis [2]	41	48.8	51.2	37	48.6	40.5	10.8	41	75.6	24.4
Ill with other diseases [2]	321	86.3	13.7	270	69.3	22.2	8.5	316	95.2	4.8
Healthy subjects [2]	28	89.3	10.7	24	95.8	4.2	0	26	100.0	0

[1] Agglutinin titers below 1:40 are recorded as negative in these calculations.
[2] See the text for the definition of the groups.

The data in table 6 show that in chronic brucellosis the opsono-cytophagic reaction may be negative, or it may be positive in any degree. More than one-half of the cases, however, gave a weak or moderate reaction. Comparing the chronic brucellosis group with the group ill with other diseases, the former shows a definitely higher percentage of positive opsonocytophagic reactions than the latter. The differ-

ences between the two groups are less significant, however, when compared on the basis of the opsono-cytophagic reaction than when they are compared on the basis of skin reactions.

According to table 6, the greatest difference between the chronic brucellosis group and the group ill with other diseases is indicated by the agglutination reactions. Positive reactions occur more than 11 times as frequently in the former as in the latter group. It should be emphasized that there are included in the chronic brucellosis group only two cases with positive agglutination reaction which were originally selected for study on the basis of a positive agglutination reaction (KC 127 and KC 164). It was the fact that they gave the clinical impression of chronic brucellosis, and not their positive agglutination reactions, however, which determined the grouping of these 2, as well as all others included in the 28 chronic brucellosis cases.

To summarize the data in table 6, a positive agglutination reaction is the most reliable indicator of infection in chronic brucellosis; the skin test ranks second, and the opsono-cytophagic reaction gives the least reliable information.

TABLE 7.—*Correlation of specific tests and clinical history in 372 subjects. The data are given in percentages*

Skin reaction	Opsono-cytophagic reaction	Agglutination reaction [1]	Brucellosis in the past [2] (14 cases)	Chronic brucellosis [2] (25 cases)	Possible chronic brucellosis [2] (37 cases)	Ill with other diseases [2] (270 cases)	Healthy subjects [2] (26 cases)
+	+	+	28.6	32.0	10.8	3.0	
+	+	−	57.1	16.0	24.3	5.6	3.8
+	−	+		4.0	2.7	0	
−	+	+		12.0	10.8	1.8	
+	−	−	7.1	4.0	18.9	4.8	7.7
−	+	−		8.0	5.4	20.7	
−	−	+		4.0	0	0.7	
−	−	−	7.1	20.0	27.0	63.3	88.5

[1] Titers below 1:40 are regarded as negative.
[2] See the text for the definition of the groups.

Table 7 shows the distribution, among the clinical groups, of the eight possible combinations of positive and negative reactions. In this table the combination of reactions forming the largest percentage in each clinical group is indicated in heavy type. Every possible combination of reactions was found both in the group of chronic brucellosis and in the group ill with other diseases. In each clinical group, however, one combination stands out as more or less characteristic. In the group of chronic brucellosis 32 percent of cases gave all 3 reactions positive—a combination occurring more than 10 times as frequently as in the group ill with other diseases. In the latter group 63 percent of cases gave negative reactions in all 3 tests. The combination of positive skin and opsono-cytophagic reactions and negative agglutination reaction occurs in the majority of recovered cases—about 10 times as frequently as in cases with no history of brucellosis.

The combination of all 3 tests negative occurs in a definitely higher percentage in the group of healthy subjects than in the group ill with various diseases.

Comparing the specific reactions in the group of possible brucellosis with those in the chronic brucellosis group on the one hand, and with those in the group ill with other diseases on the other hand (see table 6), the percentages in the former are found to lie midway between the latter two groups. The data suggest that some cases which were not, and some that were infected with *Brucella* were included in the "possible chronic brucellosis" group.

There are two notable differences between the percentages of positive reactions in the groups with past and present brucellosis. The percentages of positive skin reactions is definitely higher and the percentage of agglutination reactions is definitely lower in the former group (table 6). There were no significant differences between the percentages of positive opsono-cytophagic reactions in the two groups. On the whole, the percentages of positive reactions in the two groups are so nearly alike that in a given case the specific tests alone would not give information as to whether infection exists at the time the tests are made, or whether it occurred some time in the past.

The varied response to the specific tests in chronic brucellosis patients is further illustrated in table 4 where the data are given for each case included in the group "chronic brucellosis." The most important point brought out in this table is that 2 of the 5 cases with all 3 reactions negative were proved to be infected by cultivation of the organism. Among the 28 cases included in the table, all showing symptoms of the disease at the time the tests were made, the skin reaction was negative in 11 cases; the opsono-cytophagic reaction was negative in 7 cases, and the agglutination reaction was negative in 13 cases.

In table 2 the data are given for the 14 cases with a history of brucellosis in the past. These data, compared with those in table 4, illustrate the fact already mentioned, that in individual cases the specific reactions cannot differentiate a present from a past infection.

DISCUSSION

Our data agree with those of other investigators in indicating that in communities where the inhabitants are exposed to *Brucella* infection, serologic or allergic reactions are sometimes positive in subjects from whom no history suggestive of brucellosis can be elicited. There are chances of error, however, which might account for positive reactions in cases with apparently negative histories, for in the group "ill with other diseases" it was impossible to rule out brucellosis as a complicating factor in cases in which some other disease dominated the picture.

Further, it is impossible to rule out a past *Brucella* infection in cases from which the history cannot be elicited. In the presence of these and other complicating factors it is difficult to define reactions or combinations of reactions which may be regarded as evidence of the disease.

Our analysis of data is an attempt to evaluate the significance of the specific tests. In discussing results, it should be borne in mind constantly that our data were collected from a group of persons who were suffering with mild disease of obscure etiology, a group not previously studied with the aid of the specific brucellosis tests.

Thirty-nine percent of our chronic brucellosis cases gave a negative skin reaction. These results do not agree with the conclusion of Gould and Huddleson that if the brucellergin test is negative, brucellosis may usually be ruled out. The explanation for the discrepancy between our results and theirs is to be found in the different case finding methods. As already stated, most of our cases were selected for study on account of mild disease of obscure etiology. No case was regarded as chronic brucellosis on the basis of specific reactions alone. On the other hand, Gould and Huddleson selected their cases for study on the basis of a positive skin reaction, thus excluding the possibility of finding cases of infection with a negative skin reaction.

In a comparison of specific reactions in chronic cases with those in recovered cases, the higher percentage of positive skin reactions in the recovered cases (table 6), and the higher percentage of positive agglutination reactions in the infected cases (tables 5 and 6) have already been mentioned. Our data fail to confirm the reports of Huddleson; Keller, Pharis, and Gaub; and Gould and Huddleson, that strong opsono-cytophagic reactions indicate immunity, and that weak opsono-cytophagic reactions indicate infection, for we found strong positive reactions in patients with chronic brucellosis (table 4) and we found weak or moderate reactions in recovered cases (table 2).

In those cases in which the specific tests were repeated (table 4), the opsono-cytophagic reaction, as well as the agglutination reaction, was found to vary from time to time. It is to be noted (table 4) that in four cases from which *Brucella* were cultivated, strong opsono-cytophagic reactions were found at some time during the course of the disease. On the whole the opsono-cytophagic reaction proved to be an unreliable indicator of infection and of the future outlook for the patient.

In the consideration of these data, attention is called to the fact that it is not the percentage of positive reactions in the cases of chronic brucellosis which determines the value of a given test, but rather the frequency of positive reactions in chronic brucellosis cases as compared with the frequency of positive reactions in the group of patients ill with other chronic diseases.

The most reliable indicator of infection was found to be a positive agglutination reaction in dilution of 1:40 or higher. A reaction of this titer does not occur commonly in cases with no history of brucellosis (table 6). On the other hand, a negative agglutination reaction (i. e., a titer below 1:40) cannot be interpreted as evidence against infection because almost half of the chronic cases reacted negatively (table 6). Among the 28 cases with diagnosis of chronic brucellosis recorded in table 3, only 11 would have received that diagnosis by physicians who disregard agglutinin titers below 1:80. If a titer of 1:40 were considered as suggestive of brucellosis, 4 more would have received further consideration as possibly harboring *Brucella* infection.

When all 3 specific tests are positive in a case of obscure disease, the combined reactions may be regarded as suggestive of infection, for such a combination is not common in cases without history of infection (table 7).

The results of this study emphasize that there is no reliable test to detect chronic brucellosis. In some cases positive specific reactions may give satisfactory evidence of infection, but negative reactions cannot be interpreted as evidence against infection. The only proof of brucellosis is the cultivation of the organism—a difficult and time-consuming procedure. Hence an effort should be made to rule out diseases producing a similar clinical picture before a diagnosis of chronic brucellosis is made. Until specific tests are further perfected, there can be no satisfactory diagnosis in many cases of chronic brucellosis. In some cases the evidence based on history and clinical symptoms will be confirmed by specific tests. In other cases (as in cases M 107 and M 319, table 4) the specific tests will be misleading. There is great need for further perfection of methods for the diagnosis of chronic brucellosis.

SUMMARY AND CONCLUSIONS

A group of 28 cases in which chronic brucellosis appeared to be the logical diagnosis was studied in order to compare the responses to specific tests with those in other clinical groups commonly exposed to *Brucella* infection. Cultures of *Brucella* were obtained from 7 of the 28 cases.

Included in the comparative study were 14 recovered cases with a history of acute brucellosis within the last 14 years; 4 cases of acute brucellosis; 41 cases regarded as possible chronic brucellosis, in which the clinical evidence was less convincing than in the group of cases regarded as chronic brucellosis; 321 subjects ill with other chronic diseases; and 28 healthy subjects. An analysis of the data led to the following conclusions:

No single test (other than the isolation of the *Brucella* organism from the patient) can be relied on to determine *Brucella* infection in a given case.

An agglutinin titer of 1:40 was found to be the minimum suggestive of brucellosis. Hence lower titers were considered negative in this study.

Forty-six percent of the 28 cases of chronic brucellosis gave a negative agglutination reaction and 4 of the 7 cases from which *Brucella* was cultivated gave a negative agglutination reaction; therefore a negative agglutination reaction cannot be regarded as evidence against infection. On the other hand, a positive agglutination reaction is evidence of infection. The data show that an agglutinin titer of 1: 40 or higher occurred about 11 times as frequently in chronic brucellosis as in cases ill with other diseases. The higher the titer, the greater is its significance.

A positive skin reaction occurred more than 4 times as frequently in the group of chronic brucellosis cases as in the group of cases ill with other diseases. It may, therefore, be regarded as suggestive of infection, though it is less reliable evidence than a positive agglutination reaction.

The opsono-cytophagic reaction was found to be the least reliable of the specific tests, because positive reactions are not uncommon in cases ill with other diseases. A positive opsono-cytophagic reaction occurred about twice as frequently in chronic brucellosis as in cases ill with other diseases.

Positive opsono-cytophagic and skin reactions add weight to the evidence given by a positive agglutination reaction. The combination of all 3 positive reactions occurred about 10 times as frequently in chronic brucellosis as in cases ill with other diseases.

On the other hand, cases of *Brucella* infection may occur in which all three specific tests give negative results. Two of our cases from which *Brucella* were obtained reacted negatively to all three specific tests.

BIBLIOGRAPHY

Bastai, P. and Rotta, C.: (1928) Sul significato clinico e biologico delle reazioni allergiche e delle agglutinazioni antimelitensi negli individui normali e nei maladi di febbre ondulante. Policlinico, **35**: 393–422.

Binder, Ladislaus, and Fauszt, Emerich: (1937) Zur Frage der latente Bang-Infektion. Klin. Wchnschr. **16**: 496–498.

Burnet, Et.: (1922) Diagnostic de la fièvre méditerranéenne par intradermoreaction du filtrate de culture du *M. melitensis*. Arch. Inst. Past. de l'Afrique du Nord, **2**: 187–201.

Burnet, Et.: (1925) Sur la notion de paramelitensis. Arch. Inst. Past. de Tunis, **14**: 247–263.

Carpenter, C. M., Boak, Ruth, and Chapman, O. D.: (1929) The significance of *Brucella abortus* agglutinins in human serum. J. Immunol., **17**: 65–83.

Dooley, Parker: (1932) Undulant fever. An epidemic of subclinical infection with *Brucella*. Arch. Int. Med., **50**: 373–379.

DuBois, Ch. and Sollier, Noel: (1930) Sur l'emploi de l'intradermoréaction à la mélitine chez les subjects atteints de fièvre ondulante et chez les sujets sains vivant en milieu contaminé de mélitococcie animale. Compt. rend. Soc. de Biol., **105**: 191–193.

DuBois, Charles, and Sollier, Noel: (1931) Valeur de l'intradermoréaction à la mélitine comme procédé de diagnostic de la fièvre ondulante et de recherche des états d'allergie et d'immunité à l'égard du *Br. melitensis*. Ann. Inst. Past., **47**: 311–331.

Evans, Alice C.: (1934) Chronic brucellosis. J. Am. Med. Assoc., **103**: 665–667.

Evans, Alice C.: (1937) Studies on chronic brucellosis. II. Description of techniques for specific tests. Pub. Health Rep., **52**: 1419–1427.

Fleischner, E. C., and Meyer, K. F.: (1918) The bearing of cutaneous hypersensitiveness on the pathogenicity of the *Bacillus abortus bovinus*. Am. J. Dis. Child., **16**: 268–273.

Francis, Edward, and Evans, Alice C.: (1926) Agglutination, cross-agglutination, and agglutinin absorption in tularaemia. Pub, Health Rep., **41**: 1273–1295.

Gilbert, Ruth, and Dacey, H. Gladys: (1932) The isolation of an organism of the *abortus-melitensis* group from a blood clot, the serum of which failed to give agglutination with *B. abortus*. J. Lab. and Clin. Med., **17**: 345–346.

Gould, S. E., and Huddleson, I. F.: (1937) Diagnostic methods in undulant fever (brucellosis) with results of a survey in 8,124 persons. J. Am. Med. Assoc., **109**: 1971–1974.

Heathman, Lucy S.: (1934) A survey of workers in packing plants for evidence of Brucella infection. J. Inf. Dis., **55**: 243–265.

Huddleson, I. Forest: (1934) Brucella infections in animals and man. Commonwealth Fund, New York.

Huddleson, I. Forest, Johnson, Howard W., and Beattie, Colin P.: (1936) Undulant fever. A report of 100 cases treated with Brucellin. Michigan Agricultural Experiment Station. Tech. Bull. 149, pp. 35–51.

Huddleson, I. Forest, and Johnson, Howard W.: (1930) The significance of *Brucella* agglutinins in the blood of veterinarians. J. Am. Med. Assoc., **94**: 1905–1907.

Huddleson, I. Forest, Johnson, Howard W., and Hamann, E. E.: (1933) A study of the opsonocytophagic power of the blood and allergic skin reaction in Brucella infection and immunity in man. Am. J. Pub. Health, **23**: 917–929.

Huddleson, I. Forest, Munger, Myrtle, Gould, S. E., and Paulson, Doris: (1937) A study of Brucella infection and immunity in humans. Am. J. Trop. Med., **17**: 863–880.

Johns, E. P., Campbell, F. J. H., and Tennant, C. S.: (1932) A serological and clinical investigation of individuals exposed to *Br. abortus*. Can. Med. Assoc. J., **27**: 490–497.

Jordan, Carl F.: (1931) Infection in the epidemiology of undulant fever in the general population and in selected groups in Iowa. J. Inf. Dis., **48**: 526–540.

Keller, Alvin E., Pharris, Crit and Gaub, W. H.: (1936) Diagnosis of undulant fever. The opsonocytophagic, allergic and agglutination reactions. J. Am. Med. Assoc., **107**: 1369–1374.

Levin, William: (1930) The intradermal test as an aid in the diagnosis of undulant fever. J. Lab. and Clin. Med., **16**: 275–281.

McBryde, Angus, Daniel, N. C., and Poston, M. A.: (1934) Brucella infection in children. Agglutination reactions and intracutaneous tests. J. Pediat., **4**: 401–405.

Meyer, K. F., Eddie, B., Veazie, L., Stevens, I. M., Stewart, B., and Geiger, J. C.: (1934) The heterogenous infection chains as occupational diseases. Bang disease and Malta fever (Brucella infections). Arch. f. Gewerbepath. u. Gewerbehyg., **5**: 514–559.

Meyer, K. F., and Geiger, J. C.: (1935) The increasing importance of brucelliasis as an occupational hazard. J. Am. Vet. Med. Assoc., **86**: (n. s. **39**): 280–286.

Molinelli, Ernesto A.: (1934) Occupational infection with Brucella in certain urban and rural districts of the Argentine Republic. La Semana Médica, **11**: 1248–1258.

Olin, Gunnar: (1935) Studien über das Undulantfieber in Schweden. Stockholm.

Olmer, D.: (1929) La mélitine de Burnet. Son intérêt pour le diagnostic, le traitement et la prophylaxie. J. méd. française, **18**: 182–186.

Poston, Mary A.: (1938) Studies on chronic brucellosis. III. Methods used in obtaining cultures. Pub. Health Rep., **53**: 1–4.

Poston, Mary A., and Smith, David T.: (1936) Successful treatment of *Brucella* meningitis with immune human serum; isolation of the organism by a modified cultural method. New Eng. J. Med., **215**: 369–370.
Poston, Mary A., and Thomason, Robert H.: (1936) Meningitis due to *Brucella* in a child. Am. J. Dis. Child., **52**: 904–906.
Robinson, Frank H., and Evans, Alice C.: Unpublished data.
Sorge, Giuseppe: (1925) The value of the intradermal test for melitensis infection in children. Revista di clinica pediatrica, **23**: 471–481.
Taylor, R. M., Lisbonne, M., and Vidal, L. F.: (1935) La fièvre ondulante en France d'après les investigations du "Centre du Recherches sur la Fièvre Ondulante" de Montepellier. Mouvement Sanitaire, **12**: 51–90.
Thomsen, Axel: (1931) Correlation of occupation with serologic reactions for *Brucella abortus*. J. Inf. Dis., **48**: 484–497.
Vedel, A., Puech, A., and Janbon, M.: (1926) Deux cas de polynévrite mélitococcique. Bull. Soc. Scien. méd. et biol. de Montpellier et du Languedoc Méditerranéen, **7**: 406–410.
Wright, A. E., and Smith, F.: (1897) On the application of the serum test to the differential diagnosis of typhoid and Malta fever. Lancet, **1**: 656–659.

A COMPARATIVE STUDY OF TWO STRAINS OF ROCKY MOUNTAIN SPOTTED FEVER VIRUS WITH SPECIAL REFERENCE TO THE WEIL-FELIX REACTION*

By GORDON E. DAVIS, *Bacteriologist*, and R. R. PARKER, *Special Expert, United States Public Health Service*

Sera from patients reported ill with Rocky Mountain spotted fever exhibit five types of serological reactions with *Proteus* OX19 and OX2 strains: high OX19 and low OX2 agglutinin titers (the most frequent reaction) or the reverse, only OX19 or only OX2 agglutinins, or the agglutinin titer for both strains may be approximately equal.

Two strains of virus isolated from patients whose sera showed high OX2 and low OX19 agglutinin titers, and only OX19 agglutinins, respectively, have been studied to determine whether they would exhibit any differences in immunological or serological reactions in laboratory animals.

Serum from patient "B", taken on the 16th day following onset, agglutinated *Proteus* OX2 to a titer of 640 and *Proteus* OX19 to a titer of 160. Serum samples from patient "S," taken 8 and 19 days after onset, failed to agglutinate OX2 in a serum dilution as low as 1:20, but did agglutinate OX19 to titers of 2,560 and 10,240, respectively.

A comparative study of these strains was made.

* Contribution from the Division of Infectious Diseases, National Institute of Health, Rocky Mountain Laboratory, Hamilton, Mont.

Presented before the Northern California-Hawaiian Branch of the Society of American Bacteriologists at Seattle, Wash., June 19, 1936.

CROSS-IMMUNITY TESTS IN GUINEA PIGS

On August 15, 1935, each of six guinea pigs received 1 cc of "S" virus (OX19 agglutinins only) intraperitoneally. In each case there was a marked rise in temperature and a typical scrotal reaction.

CHART—1

CROSS IMMUNITY TESTS-RESULTS OF THE INOCULATION OF GUINEA-PIGS WITH 'B' VIRUS AND SUBSEQUENTLY ~ ~ WITH 'S' VIRUS

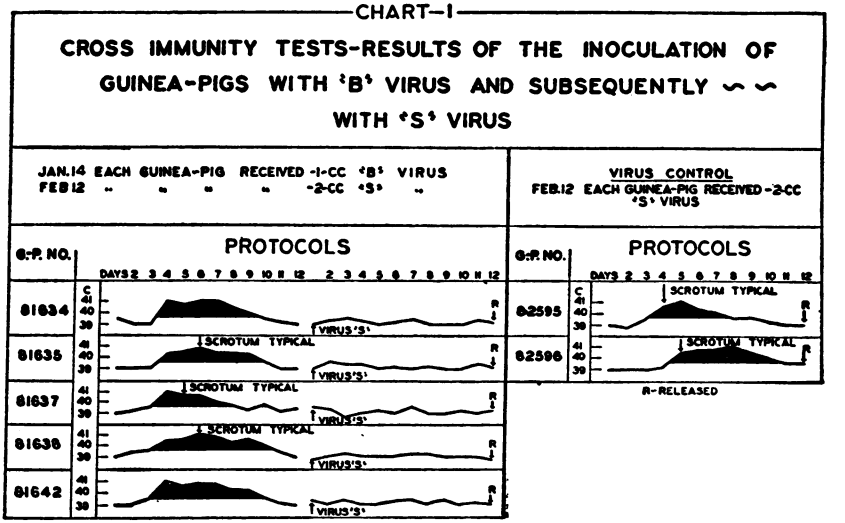
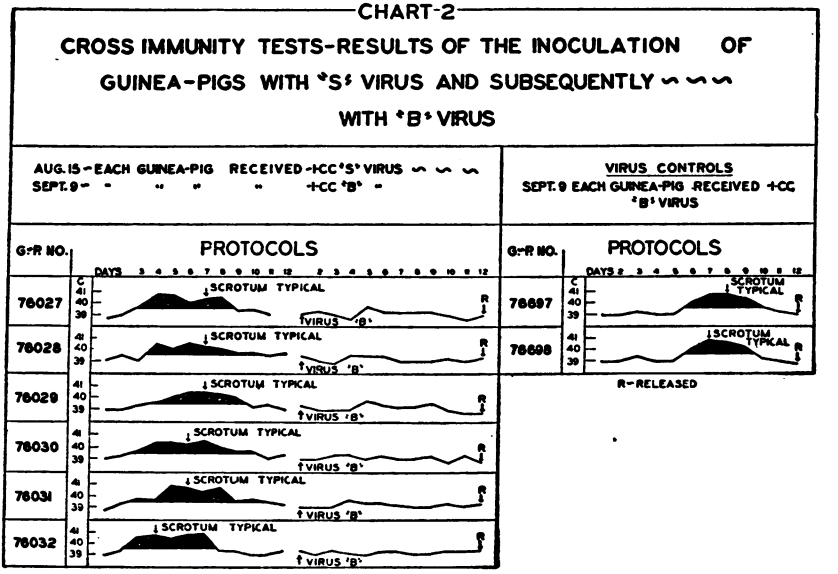


CHART-2

CROSS IMMUNITY TESTS-RESULTS OF THE INOCULATION OF GUINEA-PIGS WITH 'S' VIRUS AND SUBSEQUENTLY ~ ~ ~ WITH 'B' VIRUS



On September 9, 25 days following the initial injection, each test guinea pig and two controls received 1 cc of "B" virus (high OX2 and low OX19 agglutinins) intraperitoneally. In none was there a

temperature above normal, while the two controls showed typical spotted fever.

Corresponding results were obtained when six guinea pigs received an initial injection of "B" virus followed by "S" virus.

These cross immunity tests indicate no immunological difference between the two viruses in guinea pigs.

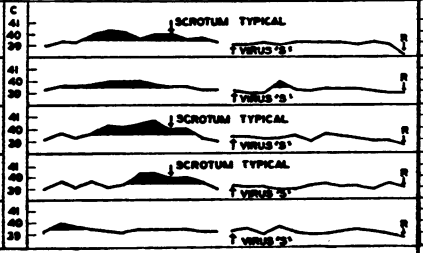
CROSS-IMMUNITY TESTS AND THE WEIL-FELIX REACTION IN RABBITS

CHART-3

CROSS IMMUNITY TESTS AND THE WEIL-FELIX REACTION ~ RESULTS OF THE INOCULATION OF RABBITS WITH 'B' VIRUS AND ~ ~ ~ SUBSEQUENTLY WITH 'S' VIRUS

AUG. 19 EACH RABBIT RECEIVED +CC 'B' VIRUS
SEPT. 19 " " " +CC 'S' "

PROTOCOLS



WEIL-FELIX REACTION

AGGLUTININ TITER ~ FOR PROTEUS X STRAINS

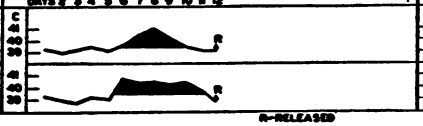
	OX19	OX2	HX2	OXK	DAYS AFTER INOCULATION
4072	0	0	0	0	(BEFORE)
	20	80	160	0	14 TO 16 AFTER FIRST
	0	0	0	0	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND
4085	0	0	20	0	(BEFORE)
	160	160	320	20	14 TO 16 AFTER FIRST
	40	40	80	0	30 " "
	40	20	40	0	14 TO 16 AFTER SECOND
4079	0	0	0	0	(BEFORE)
	160	160	320	0	14 TO 16 AFTER FIRST
	40	40	80	0	30 " "
	40	0	0	0	14 TO 16 AFTER SECOND
4080	0	0	20	0	(BEFORE)
	40	320	640	20	14 TO 16 AFTER FIRST
	0	80	160	0	30 " "
	0	20	40	0	14 TO 16 AFTER SECOND
4081	0	0	20	20	(BEFORE)
	160	80	160	0	14 TO 16 AFTER FIRST
	40	0	20	0	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND

VIRUS CONTROLS

SEPT. 19 EACH RABBIT RECEIVED +CC 'S' VIRUS

WEIL-FELIX REACTION ON ~ 'S' CONTROL RABBITS

PROTOCOLS



AGGLUTININ TITER ~ FOR PROTEUS X STRAINS

	OX19	OX2	HX2	OXK	DAYS AFTER INOCULATION
4109					
	0	0	0	20	(BEFORE)
	160	160	320	20	14 TO 16 AFTER
4110					
	0	0	0	0	(BEFORE)
	80	20	40	0	14 TO 16 AFTER

R-RELEASED

On August 19, 1935, each of five domestic rabbits received 1 cc of "B" virus intravenously. Four showed a marked rise in temperature, and three of these had typical scrotal lesions. The agglutinin titer for *Proteus* strains OX19, OX2, and OXK were zero or negligible previous to the injection. Following the injection the titers for the first three strains rose sharply in all five rabbits, but in 30 days had fallen to a low titer or to zero.

On September 19, 1935, these test rabbits and two normal controls each received 1 cc of "S" virus intraperitoneally. One test rabbit

showed 1 day of temperature above 39.6° C., while the controls showed a typical febrile period. Of further significance is the fact that there was no rise in agglutinin titer for any of the *Proteus* X strains.

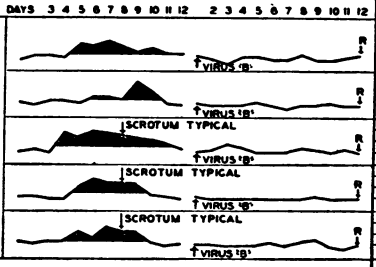
Although the more complex "B" strain, as indicated by the agglutinin content of human blood, might immunize against the less complex "S" strain, there was a possibility that the converse might not hold; consequently five rabbits were first injected with the "S" strain and later with the "B" strain. All showed a marked rise in

CHART 4

CROSS IMMUNITY TESTS AND THE WEIL-FELIX REACTION—RESULTS OF THE INOCULATION OF RABBITS WITH "S" VIRUS AND ~ ~ ~ SUBSEQUENTLY WITH "B" VIRUS

OCT. 3 EACH RABBIT RECEIVED +I CC "S" VIRUS
NOV. 5 " " " +I CC "B" "

PROTOCOLS



WEIL-FELIX REACTION

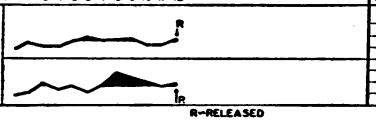
AGGLUTININ TITER FOR PROTEUS X STRAINS

	OX19	OX2	HX2	OXK	DAYS AFTER INOCULATION
4138	0	0	0	0	(BEFORE)
	80	160	320	80	14 TO 16 AFTER FIRST
	0	0	0	20	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND
4140	0	0	0	20	(BEFORE)
	160	320	640	20	14 TO 16 AFTER FIRST
	20	40	40	0	30 " "
	0	20	20	0	14 TO 16 AFTER SECOND
4141	0	0	0	0	(BEFORE)
	20	160	320	40	14 TO 16 AFTER FIRST
	0	0	0	0	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND
4143	0	0	0	0	(BEFORE)
	80	320	640	40	14 TO 16 AFTER FIRST
	0	0	0	0	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND
4144	0	0	0	0	(BEFORE)
	80	320	640	40	14 TO 16 AFTER FIRST
	0	0	0	0	30 " "
	0	0	0	0	14 TO 16 AFTER SECOND

VIRUS CONTROLS

NOV. 5 EACH RABBIT RECEIVED +I CC "B" VIRUS

PROTOCOLS



WEIL-FELIX REACTION ON "B" CONTROL RABBITS

AGGLUTININ TITER FOR PROTEUS X STRAINS

	OX19	OX2	HX2	OXK	DAYS AFTER INOCULATION
4179	0	0	0	0	(BEFORE)
	0	160	160	0	14 TO 16 AFTER
4180	0	0	0	0	(BEFORE)
	0	40	80	0	14 TO 16 AFTER

R—RELEASED

temperature following the first injection, and three showed typical scrotal lesions. Following the injection of the "B" strain, there was neither a thermic nor scrotal reaction. The rabbits which received only the "B" strain both showed definite evidence of infection.

There was a sharp rise in agglutinins for *both* the OX19 and OX2 strains following injection of the "S" virus, which had produced only OX19 agglutinins in man, but there was no re-stimulation of agglutinin production following the injection of the "B" virus.

No difference in the immunological or serological response to the "S" and "B" viruses was noted in domestic rabbits.

PROTECTION TESTS

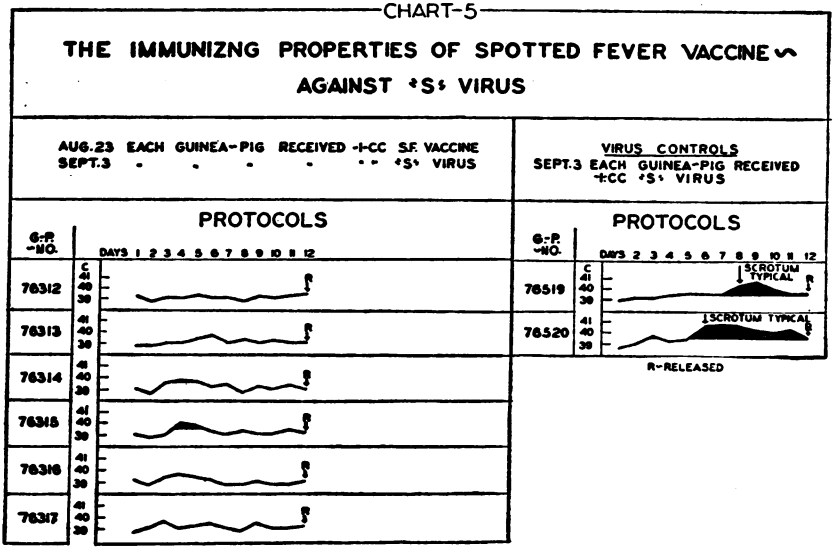
The protective value of immune rabbit sera against both the "S" and "B" viruses was tested as follows (all tests were made in duplicate):

0.5 cc anti-"B" serum, 0.5 cc "B" virus.
0.5 cc anti-"B" serum, 0.5 cc "S" virus.
0.5 cc anti-"S" serum, 0.5 cc "S" virus.
0.5 cc anti-"S" serum, 0.5 cc "B" virus.

The serum-virus mixtures were allowed to remain at room temperature for 30 minutes and were then injected into guinea pigs intraperitoneally. As virus controls, two normal guinea pigs each received 0.5 cc of "B" virus and two others 0.5 cc of "S" virus. While there was no rise in temperature in any of the animals receiving the serum-virus mixtures, the control animals showed typical spotted fever, i. e., a definite rise in temperature with scrotal swelling and reddening.

This experiment shows that immune serum of either strain neutralized the opposing virus.

PROTECTIVE VALUE OF SPOTTED FEVER VACCINE AGAINST INFECTION WITH THE "S" (OX19) AND "B" (OX19–OX2) STRAINS



Inasmuch as the failure of spotted fever vaccine to protect guinea pigs against the virus of boutonneuse fever (*1*), an immunologically identical disease, has provided evidence of a definite antigenic difference between this virus and that of Rocky Mountain spotted fever,

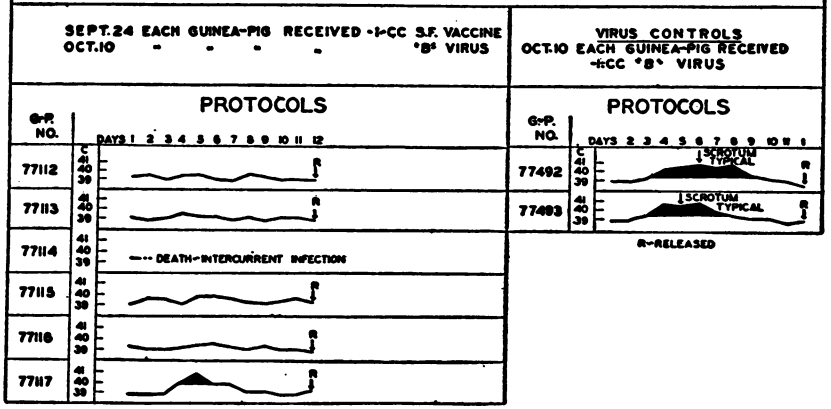
it was thought that a similar test with the two strains of spotted fever virus being studied might show an antigenic dissimilarity not indicated by standard tests.

On August 23, 1935, each of 12 guinea pigs received 1 cc of spotted fever vaccine No. 2945. When tested against stock strains of passage virus on June 3, 1935, this vaccine was considered a "perfect" lot, i. e., none of the 6 guinea pigs thus vaccinated showed temperature above 39.6° C. following a subsequent injection of spotted fever virus.

On September 4, 1935, 12 days later, 6 of the above vaccinated guinea pigs each received 1 cc of the "S" virus and the remaining 6 each received 1 cc of the "B" virus, intraperitoneally. Of the 6 guinea pigs receiving the "S" virus one showed a temperature of 39.8° C. on the fourth day and another 40.0° C. and 39.8° C. on the fourth and fifth days, respectively.

CHART 6

THE IMMUNIZING PROPERTIES OF SPOTTED FEVER VACCINE AGAINST "B" VIRUS



Of the five guinea pigs receiving the "B" virus (one animal died before receiving the virus), one showed a temperature of 40.4° C. on the fifth day.

The same lot of vaccine was subsequently tested against several stock strains of virus with results similar to those just described, i. e., one or more guinea pigs of each group showed 1 or 2 days of fever.

These tests indicate that spotted fever vaccine protected equally against both strains of virus.

SUMMARY

Two strains of virus isolated from patients who exhibited typical symptoms of Rocky Mountain spotted fever, but whose sera showed,

respectively, (*a*) high OX2 and low OX19 agglutinin titers and (*b*) only OX19 agglutinins have been shown to be immunologically identical and both produce high OX2 and low OX19 agglutinins in rabbits.

REFERENCE

(1) Davis, Gordon E., and Parker, R. R.: Comparative experiments on spotted fever and boutonneuse fever. Pub. Health Rep., **49**: 423–427 (1934).

DEATHS DURING WEEK ENDED AUGUST 6, 1938

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

	Week ended Aug. 6, 1938	Corresponding week, 1937
Data from 88 large cities of the United States:		
Total deaths	7,266	[1] 7,335
Average for 3 prior years	[1] 7,162	
Total deaths, first 31 weeks of year	258,489	281,936
Deaths under 1 year of age	535	[1] 541
Average for 3 prior years	[1] 512	
Deaths under 1 year of age, first 31 weeks of year	16,492	17,924
Data from industrial insurance companies:		
Policies in force	68,976,881	69,616,242
Number of death claims	11,017	11,894
Death claims per 1,000 policies in force, annual rate	8.3	8.9
Death claims per 1,000 policies, first 31 weeks of year, annual rate	9.5	10.4

[1] Data for 86 cities.

PREVALENCE OF DISEASE

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

UNITED STATES

CURRENT WEEKLY STATE REPORTS

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

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

Cases of certain diseases reported by telegraph by State health officers for the week ended August 13, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median

Division and State	Diphtheria				Influenza				Measles			
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median
NEW ENG.												
Maine	0	0	0	0	67	11	------	------	6	1	------	4
New Hampshire	0	0	0	0	------	------	------	------	------	------	------	2
Vermont	0	0	0	0	------	------	------	------	27	2	------	5
Massachusetts	4	3	7	7	------	------	------	------	104	88	23	32
Rhode Island	0	0	0	0	------	------	------	------	8	1	------	1
Connecticut	0	0	7	2	------	------	------	1	18	6	15	16
MID. ATL.												
New York	4	9	14	14	(1)	(1)	[1] 7	4	81	202	130	204
New Jersey	1	1	7	6	4	3	------	3	40	33	91	41
Pennsylvania	8	16	9	29	------	------	------	------	77	150	213	116
E. NO. CEN.												
Ohio	28	36	12	12	------	------	6	6	45	58	125	65
Indiana	8	5	12	9	14	9	3	14	18	12	23	8
Illinois [2]	9	13	14	14	1	2	4	4	20	30	72	66
Michigan [2]	13	12	16	14	------	------	------	1	133	123	60	28
Wisconsin	2	1	2	2	25	14	21	19	239	134	18	61
W. NO. CEN.												
Minnesota	4	2	3	3	6	3	1	1	59	30	3	5
Iowa	4	2	1	3	4	2	------	------	43	21	5	4
Missouri	7	5	15	15	18	14	32	25	5	4	15	13
North Dakota	0	0	2	2	------	------	3	------	162	22	2	11
South Dakota	15	2	0	1	------	------	------	------	------	------	2	2
Nebraska	4	1	0	4	------	------	------	------	------	------	1	3
Kansas	8	3	0	6	17	6	------	1	20	7	6	6

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended August 13, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Diphtheria				Influenza				Measles			
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median
SO. ATL.												
Delaware	0	0	0	0							2	2
Maryland [2 3]	9	3	3	3	19	6		1	19	6	4	8
Dist. of Col. [3]	25	3	3	3					25	3	5	5
Virginia [3]	42	22	10	10					64	33	31	31
West Virginia	14	5	3	12	20	7	12	12	3	1	13	13
North Carolina [2 4]	37	25	22	18					122	82	32	27
South Carolina [4]	33	12	8	4	197	71	54	54	42	15		8
Georgia [4]	46	27	10	8								
Florida [4]	12	4	5	6	3	1	1				7	7
E. SO. CEN.												
Kentucky	20	11	10	10	2	1			7	4	17	14
Tennessee	32	18	4	8	11	6	10	7	34	19	25	15
Alabama [4]	22	12	11	16	22	12	3	3	5	3	4	5
Mississippi [3]	18	7	15	12								
W. SO. CEN.												
Arkansas	23	9	13	5	46	18	7	1	10	4	4	3
Louisiana	27	11	16	13	49	20	11	4	32	13	1	2
Oklahoma	4	2	6	6	35	17		4	8	4	4	2
Texas [4]	33	39	20	33	81	96	39	39	18	21	68	43
MOUNTAIN												
Montana	0	0	1	1					223	23	3	3
Idaho	0	0	0	0	42	4	1		63	6	2	3
Wyoming	0	0	0	0					22	1	4	4
Colorado	68	14	3	3					49	10	14	7
New Mexico	37	3	0	0					62	5	11	1
Arizona	38	3	0	1	278	22	12	4	139	11		2
Utah [3]	0	0	0	0	50	5			221	22	21	4
PACIFIC												
Washington	0	0	1	0	3	1			38	12	10	15
Oregon	5	1	6	1	30	6		4	56	11	7	7
California [4]	8	10	18	17	4	5	5	5	117	138	18	67
Total	14	352	309	351	18	362	232	232	56	1,371	1,111	1,112
32 weeks	18	14,089	13,402	17,719	72	45,734	274,261	141,470	974	759,641	240,265	341,146

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median
NEW ENGLAND												
Maine	6	1	0	0	0	0	8	1	12	2	5	4
New Hampshire	0	0	0	0	0	0	1	0			1	1
Vermont	0	0	0	0	0	0	2	1	0	0		1
Massachusetts	0	0	5	1	0	0	25	25	27	23	20	35
Rhode Island	0	0	0	0	0	0	2	1	23	3	3	4
Connecticut	3	1	0	0	3	1	3	2	9	3	6	8
MIDDLE ATLANTIC												
New York	1.2	3	3	7	4	9	22	22	23	58	76	100
New Jersey	0	0	3	1	5	4	6	7	16	13	14	14
Pennsylvania	0.5	1	6	5	0.5	1	14	10	22	42	74	101

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended August 13, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Meningitis, meningococcus				Poliomyelitis				Scarlet fever			
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median
EAST NORTH CENTRAL												
Ohio	1.5	2	5	3	0.8	1	45	15	64	82	106	77
Indiana	3	2	2	2	0	0	8	1	33	22	23	22
Illinois [2]	0.7	1	2	4	5	8	32	11	42	64	90	92
Michigan [2]	0	0	0	0	2.2	2	24	4	84	78	104	66
Wisconsin	1.8	1	0	0	4	2	10	2	55	31	30	31
WEST NORTH CENTRAL												
Minnesota	0	0	0	0	8	4	5	1	26	13	19	19
Iowa	4	2	0	1	4	2	8	1	18	9	9	13
Missouri	0	0	0	0	0	0	16	2	21	16	36	12
North Dakota	0	0	1	0	15	2	0	0	37	5	4	4
South Dakota	0	0	1	0	15	2	0	0	38	5	5	5
Nebraska	0	0	0	0	0	0	14	0	8	2	1	3
Kansas	0	0	1	0	0	0	13	2	98	35	21	21
SOUTH ATLANTIC												
Delaware	0	0	0	0	0	0	0	0	20	1	1	2
Maryland [2 3]	3	1	5	2	3	1	13	2	25	8	7	10
District of Columbia [2]	8	1	0	0	17	2	1	0	17	2	4	4
Virginia [2]	1.9	1	4	0	4	2	4	4	25	13	5	15
West Virginia	2.8	1	0	1	2.8	1	1	4	39	14	14	17
North Carolina [2 4]	6	4	3	1	3	2	6	4	37	25	28	21
South Carolina [4]	0	0	0	0	6	2	2	2	3	1	6	2
Georgia [4]	0	0	0	0	0	0	0	0	10	6	4	5
Florida [4]	0	0	0	0	6	2	2	1	3	1	4	2
EAST SOUTH CENTRAL												
Kentucky	4	2	1	2	4	2	2	2	30	17	27	15
Tennessee	4	2	1	1	0	0	1	1	27	15	8	8
Alabama [4]	0	0	4	1	4	2	4	3	23	13	2	8
Mississippi [2]	2.6	1	0	0	0	0	11	0	8	3	1	5
WEST SOUTH CENTRAL												
Arkansas	5	2	1	0	0	0	19	0	28	11	6	2
Louisiana	5	2	0	0	2.4	1	8	1	7	3	7	7
Oklahoma	0	0	4	0	2	1	23	0	16	8	6	6
Texas [4]	2.5	3	6	1	0	0	45	5	45	53	34	20
MOUNTAIN												
Montana	0	0	0	0	10	1	1	0	68	7	6	5
Idaho	11	1	0	0	0	0	0	1	11	1	3	3
Wyoming	0	0	0	0	0	0	6	0	44	2	----	2
Colorado	0	0	1	1	5	1	8	0	58	12	2	11
New Mexico	0	0	0	0	0	0	2	0	62	5	3	3
Arizona	0	0	1	0	0	0	0	0	13	1	1	1
Utah [2]	0	0	0	0	0	0	1	0	80	8	7	4
PACIFIC												
Washington	3	1	0	0	0	0	0	1	25	8	5	15
Oregon	0	0	0	0	0	0	1	1	41	8	5	10
California [4]	5	6	3	2	4	5	36	20	39	46	22	53
Total	1.7	42	63	60	2.5	63	455	299	32	798	865	885
32 weeks	2.7	2,114	4,120	4,087	1.1	857	2,940	2,801	172	136,453	164,040	164,040

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended August 13, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough	
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases
NEW ENGLAND										
Maine	0	0	0	0	18	3	4	1	195	32
New Hampshire	0	0	0	0	10	1	0	0	------	------
Vermont	0	0	0	0	27	2	0	0	449	33
Massachusetts	0	0	0	0	0	0	4	4	107	91
Rhode Island	0	0	0	0	0	0	2	1	230	30
Connecticut	0	0	0	0	3	1	2	2	222	74
MIDDLE ATLANTIC										
New York	0	0	11	0	10	26	25	29	269	669
New Jersey	0	0	0	0	2	2	10	6	322	268
Pennsylvania	0	0	0	0	7	14	33	29	130	254
EAST NORTH CENTRAL										
Ohio	0	0	0	0	22	28	41	39	303	391
Indiana	6	4	6	0	9	6	9	9	15	10
Illinois [2]	3	5	5	1	24	37	40	30	320	483
Michigan [3]	4	4	1	0	13	12	12	9	527	488
Wisconsin	0	0	1	4	4	2	3	3	820	460
WEST NORTH CENTRAL										
Minnesota	6	3	7	1	0	0	0	1	138	70
Iowa	8	4	4	1	25	12	6	4	55	27
Missouri	5	4	10	0	21	16	34	30	24	18
North Dakota	30	4	6	0	0	0	2	1	355	48
South Dakota	15	2	0	0	0	0	0	0	60	8
Nebraska	11	3	0	0	4	1	0	0	61	16
Kansas	0	0	0	0	22	8	10	10	129	46
SOUTH ATLANTIC										
Delaware	0	0	0	0	40	2	0	1	60	3
Maryland [2 3]	0	0	0	0	43	14	15	19	112	36
District of Columbia [2]	0	0	0	0	25	3	6	1	91	11
Virginia [2]	0	0	0	0	33	17	37	37	129	67
West Virginia	0	0	1	0	62	22	29	29	98	35
North Carolina [2 4]	0	0	0	0	19	13	22	30	373	250
South Carolina [4]	0	0	0	0	75	27	15	20	195	70
Georgia [4]	0	0	0	0	44	26	33	33	57	34
Florida [4]	0	0	0	0	6	2	1	1	37	12
EAST SOUTH CENTRAL										
Kentucky	0	0	0	0	96	54	50	50	193	108
Tennessee	2	1	0	0	50	28	30	71	79	44
Alabama [4]	0	0	0	0	32	18	26	28	40	22
Mississippi [3]	0	0	0	0	15	6	13	17	------	------
WEST SOUTH CENTRAL										
Arkansas	0	0	0	0	61	24	23	25	13	5
Louisiana	0	0	0	0	46	19	17	39	115	47
Oklahoma	2	1	0	0	43	21	44	44	10	5
Texas [4]	0	0	0	1	89	105	87	87	216	256
MOUNTAIN										
Montana	0	0	7	0	10	1	5	5	580	60
Idaho	0	0	1	1	11	1	2	1	21	2
Wyoming	0	0	0	0	44	2	0	0	44	2
Colorado	19	4	0	0	24	5	1	2	219	45
New Mexico	0	0	0	0	74	6	13	8	99	8
Arizona	0	0	0	0	38	3	0	3	278	22
Utah [3]	0	0	1	1	0	0	1	1	372	37

See footnotes at end of table.

Cases of certain diseases reported by telegraph by State health officers for the week ended August 13, 1938, rates per 100,000 population (annual basis), and comparison with corresponding week of 1937 and 5-year median—Continued

Division and State	Smallpox				Typhoid and paratyphoid fever				Whooping cough	
	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases	Aug. 14, 1937, cases	1933–37 median	Aug. 13, 1938, rate	Aug. 13, 1938, cases
PACIFIC										
Washington	22	7	1	1	25	8	3	3	157	50
Oregon	56	11	0	1	15	3	5	3	102	20
California [4]	3	3	5	4	7	8	15	15	141	167
Total	2	60	67	33	25	609	730	732	202	4,934
32 weeks	16	12,663	7,914	5,290	10	7,591	7,543	8,518	179	139,834

[1] New York City only.
[2] Rocky Mountain spotted fever, week ended Aug. 13, 1938, 11 cases as follows: Illinois, 1; Maryland, 6; District of Columbia, 1; Virginia, 1; North Carolina, 2.
[3] Period ended earlier than Saturday.
[4] Typhus fever, week ended Aug. 13, 1938, 78 cases as follows: North Carolina, 3; South Carolina, 6; Georgia, 41; Florida, 1; Alabama, 8; Texas, 18; California, 1.

SUMMARY OF MONTHLY REPORTS FROM STATES

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

State	Meningitis, meningococcus	Diphtheria	Influenza	Malaria	Measles	Pellagra	Poliomyelitis	Scarlet fever	Smallpox	Typhoid fever
June 1938										
Alaska	0	0	38					4	0	0
July 1938										
Arkansas	0	27	42	773	101	114	3	15	8	107
Indiana	3	39	33		109		3	99	79	53
Iowa	1	7	0		286		4	75	41	13
Maryland	2	14	12	2	113	4	0	38	0	30
Nebraska	2	2			71		1	14	6	1
New Jersey	4	29	17	3	346		3	76	0	21
New Mexico	0	32		6	23	3	2	23	4	16
West Virginia	4	16	49		126	1	1	55	0	35
Wyoming	0	2	0		12		0	11	1	0

Summary of monthly reports from States—Continued

June 1938

Alaska:	Cases
Chickenpox	2
Impetigo contagiosa	1

July 1938

Anthrax:	
Arkansas	2
Chickenpox:	
Arkansas	15
Indiana	28
Iowa	37
Maryland	70
Nebraska	17
New Jersey	336
New Mexico	6
West Virginia	56
Wyoming	9
Colorado tick fever:	
Wyoming	12
Diarrhea:	
Maryland	90
New Mexico	5
Dysentery:	
Arkansas (amoebic)	6
Arkansas (bacillary)	76
Indiana (amoebic)	2
Iowa (bacillary)	5
Maryland	56
New Jersey (amoebic)	1
New Jersey (bacillary)	1
New Mexico (bacillary)	8
New Mexico (unspecified)	3
West Virginia	56
Encephalitis, epidemic or lethargic:	
Iowa	1
German measles:	
Iowa	1
Maryland	13
New Jersey	35

July 1938—Contd.

Hookworm disease:	Cases
Arkansas	2
Impetigo contagiosa:	
Maryland	7
Mumps:	
Arkansas	14
Indiana	14
Iowa	11
Maryland	48
Nebraska	14
New Jersey	485
New Mexico	2
West Virginia	3
Wyoming	10
Ophthalmia neonatorum:	
New Jersey	6
Paratyphoid fever:	
Arkansas	1
Maryland	2
New Jersey	6
New Mexico	1
Rabies in animals:	
Arkansas	24
Indiana	48
Maryland	2
New Jersey	39
Puerperal septicemia:	
New Mexico	4
Rocky Mountain spotted fever:	
Indiana	1
Iowa	3
Maryland	7
New Jersey	5
Wyoming	2
Septic sore throat:	
Arkansas	15
Iowa	1
Maryland	15
New Jersey	34
New Mexico	7

July 1938—Contd.

Tetanus:	Cases
Arkansas	1
Iowa	1
Maryland	2
New Jersey	1
New Mexico	2
Trachoma:	
Arkansas	8
Maryland	1
New Mexico	1
Trichinosis:	
New Jersey	1
Tularaemia:	
Arkansas	9
Indiana	1
Wyoming	2
Typhus fever:	
Maryland	3
New Jersey	1
Undulant fever:	
Arkansas	3
Indiana	11
Iowa	7
Maryland	8
New Jersey	5
New Mexico	3
Vincent's infection:	
Maryland	9
Whooping cough:	
Arkansas	86
Indiana	69
Iowa	102
Maryland	170
Nebraska	53
New Jersey	1,226
New Mexico	76
West Virginia	206
Wyoming	34

PLAGUE INFECTION IN FLEAS AND LICE FROM GROUND SQUIRRELS IN SUBLETTE COUNTY, WYO.

Under date of August 5, 1938, Senior Surgeon C. R. Eskey reported plague infection found in a pool of 42 fleas and 4 lice from 18 ground squirrels, *C. elegans*, shot July 25, 2 miles south of Cora, Sublette County, Wyo.

PLAGUE INFECTION IN GROUND SQUIRRELS AND IN FLEAS, LICE, AND TICKS FROM GROUND SQUIRRELS IN LINCOLN COUNTY, WYO.

Under date of July 5, 1938, Senior Surgeon C. R. Eskey reported plague infection in Lincoln County, Wyo., as follows:

In specimens collected 6 to 8 miles northeast of Cokesville: In tissue from 2 *C. armatus*, proved separately, shot July 9, and from 1 *C. armatus* shot July 22; in a pool of 41 fleas from 1 *C. armatus*, and a pool of 29 lice and 3 ticks from 2 *C. Armatus* shot July 9.

In specimens collected July 20 and 21 in the vicinity of Hamsford: In a pool of 129 fleas from 39 *C. armatus;* in a pool of 147 fleas from 74 *C. armatus;* and in a pool of 101 fleas from 49 *C. armatus.*

WEEKLY REPORTS FROM CITIES

City reports for week ended Aug. 6, 1938

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

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	99	35	12	514	296	291	4	369	92	1,320	----
Current week [1]	85	33	17	441	275	230	8	304	40	1,860	----
Maine:											
Portland	1	----	0	7	0	0	0	2	0	2	23
New Hampshire:											
Concord	2	----	0	0	0	0	0	1	0	0	7
Manchester	0	----	0	0	3	0	0	0	0	0	27
Nashua	0	----	0	0	0	0	0	0	0	1	10
Vermont:											
Barre	0	----	0	4	0	2	0	0	0	0	4
Burlington	0	----	0	0	0	0	0	0	0	1	10
Rutland	0	----	0	0	0	0	0	0	0	0	4
Massachusetts:											
Boston	0	----	0	23	2	11	0	8	0	10	198
Fall River	0	----	0	1	3	1	0	0	0	1	28
Springfield	0	----	0	5	0	0	0	0	0	17	25
Worcester	0	----	0	0	2	0	0	1	0	3	40
Rhode Island:											
Pawtucket	1	----	0	0	0	0	0	0	0	0	12
Providence	0	----	0	0	3	2	0	3	1	14	57
Connecticut:											
Bridgeport	0	----	0	2	1	0	0	1	1	2	21
Hartford	1	1	0	1	3	0	0	1	2	1	36
New Haven	0	1	0	1	0	1	0	1	1	16	45
New York:											
Buffalo	0	----	0	1	8	4	0	3	0	39	111
New York	13	1	2	89	57	21	0	69	5	289	1,329
Rochester	0	----	1	10	0	0	0	3	1	4	61
Syracuse	0	----	0	18	1	0	0	1	0	17	35
New Jersey:											
Camden	0	----	0	0	3	0	0	1	0	4	27
Newark	4	----	0	0	5	6	0	2	0	58	95
Trenton	0	----	0	0	1	0	0	1	2	15	28
Pennsylvania:											
Philadelphia	5	1	1	5	7	5	0	17	5	98	397
Pittsburgh	3	1	1	4	5	8	0	6	0	30	123
Reading	0	----	0	0	0	0	0	0	0	3	28
Scranton	0	----	----	1	----	0	0	----	1	6	----
Ohio:											
Cincinnati	2	----	0	0	2	8	0	6	0	11	91
Cleveland	0	3	0	8	6	17	0	6	0	79	166
Columbus	3	1	1	1	8	4	0	1	0	7	57
Toledo	0	----	0	0	4	0	0	3	0	21	69
Indiana:											
Anderson	0	----	0	0	1	0	0	0	0	2	10
Fort Wayne	----	----	----	----	----	----	----	----	----	----	----
Indianapolis	0	----	0	0	3	4	0	0	1	1	92
Muncie	0	----	0	0	0	1	2	0	0	0	10
South Bend	0	----	0	0	1	0	0	0	1	1	14
Terre Haute	0	----	0	0	0	1	0	0	0	0	19
Illinois:											
Alton	0	----	0	0	0	0	0	0	0	0	11
Chicago	8	2	1	12	18	39	0	32	2	346	605
Elgin	0	----	0	0	1	0	0	0	0	3	9
Moline	1	----	0	0	0	1	0	0	0	1	10
Springfield	0	----	0	0	2	0	0	0	0	1	16
Michigan:											
Detroit	7	----	0	6	2	14	0	15	1	254	223
Flint	0	----	0	2	3	4	0	1	0	3	29
Grand Rapids	1	----	0	10	0	6	0	1	0	4	27
Wisconsin:											
Kenosha	0	----	0	0	0	0	0	0	0	14	14
Madison	0	----	0	6	0	0	0	0	0	3	11
Milwaukee	0	1	1	5	1	5	0	1	0	158	97
Racine	0	----	0	0	0	0	0	0	0	33	18
Superior	0	----	0	2	0	1	0	0	0	10	13

[1] Figures for Ft. Wayne, Ind., and Salt Lake City, Utah, estimated; reports not received.

City reports for week ended Aug. 6, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Minnesota:											
Duluth	0	------	0	5	0	1	0	0	0	19	20
Minneapolis	0	------	0	7	2	4	0	1	0	4	76
St. Paul	0	------	0	6	2	1	0	4	0	8	64
Iowa:											
Cedar Rapids	0	------	--------	0	-------	0	0	-------	0	0	--------
Davenport	0	------	--------	0	-------	0	0	-------	0	0	--------
Des Moines	0	------	0	0	0	2	6	0	0	0	33
Sioux City	0	------	--------	11	-------	0	0	-------	0	11	--------
Waterloo	1	------	--------	0	-------	0	0	-------	1	3	--------
Missouri:											
Kansas City	0	1	0	1	5	4	0	5	0	5	93
St. Joseph	1	------	0	0	0	1	0	0	0	0	24
St. Louis	2	------	0	5	0	7	0	5	1	1	158
North Dakota:											
Fargo	0	------	0	1	1	0	0	0	0	1	9
Grand Forks	0	------	0	1	-------	1	0	-------	0	0	--------
Minot	0	------	0	6	-------	0	0	-------	0	0	--------
South Dakota:											
Aberdeen	0	------	0	1	-------	0	0	-------	0	0	--------
Sioux Falls	0	------	0	0	0	0	0	0	0	0	10
Nebraska:											
Lincoln	0	------	0	1	-------	1	0	-------	0	7	--------
Omaha	0	------	0	1	3	0	0	0	0	0	49
Kansas:											
Lawrence	0	------	0	0	0	0	0	0	0	0	1
Topeka	0	------	0	1	1	2	0	0	0	18	9
Wichita	0	------	0	3	1	2	0	1	0	0	24
Delaware:											
Wilmington	0	------	0	0	5	0	0	2	0	1	34
Maryland:											
Baltimore	3	1	1	7	10	2	0	12	1	31	212
Cumberland	0	------	0	0	1	0	0	1	0	0	17
Frederick	0	------	0	0	0	0	0	0	0	0	1
Dist. of Col.:											
Washington	4	------	0	5	12	1	0	10	0	10	145
Virginia:											
Lynchburg	1	------	0	0	0	1	0	0	0	3	6
Norfolk	0	------	0	0	0	1	-------	1	1	0	21
Richmond	0	------	0	3	1	0	0	1	3	0	47
Roanoke	1	------	0	0	0	0	0	0	0	3	12
West Virginia:											
Charleston	0	------	0	0	3	0	0	1	1	0	39
Huntington	-------	------	-------	-------	-------	-------	-------	-------	-------	-------	-------
Wheeling	0	------	0	1	0	0	0	1	0	3	16
North Carolina:											
Gastonia	0	------	--------	3	-------	0	0	-------	0	0	--------
Raleigh	0	------	0	0	0	0	0	0	0	6	8
Wilmington	0	------	0	0	2	0	0	0	0	4	13
Winston-Salem	0	------	0	9	0	0	0	2	0	6	18
South Carolina:											
Charleston	0	2	0	0	1	0	0	0	0	0	21
Florence	0	------	0	1	2	0	0	0	0	0	11
Greenville	1	------	0	4	0	0	0	0	0	3	6
Georgia:											
Atlanta	2	1	0	1	3	7	0	4	0	10	84
Brunswick	0	------	0	0	1	0	0	0	0	0	2
Savannah	0	------	0	0	1	0	0	1	1	0	18
Florida:											
Miami	0	------	0	0	0	1	0	2	1	2	26
Tampa	1	------	0	1	0	0	0	1	0	0	17
Kentucky:											
Ashland	0	------	--------	0	-------	0	0	-------	0	0	--------
Covington	0	------	0	1	0	0	0	1	0	1	12
Lexington	1	------	0	1	3	0	0	1	4	1	24
Louisville	2	------	0	3	2	3	0	1	1	10	62
Tennessee:											
Knoxville	1	------	2	0	0	1	0	0	2	3	23
Memphis	0	------	0	1	1	0	0	2	1	3	53
Nashville	0	------	0	1	4	1	0	2	0	1	49
Alabama:											
Birmingham	0	3	2	3	3	0	0	7	0	4	80
Mobile	0	------	0	0	1	0	0	1	0	0	21
Montgomery	0	------	--------	0	-------	0	0	-------	0	1	--------
Arkansas:											
Forth Smith	0	------	--------	0	-------	0	0	-------	1	3	--------
Little Rock	0	------	--------	0	4	1	0	2	0	0	--------

City reports for week ended Aug. 6, 1938—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Louisiana:											
Lake Charles	0	------	0	0	1	0	0	0	0	0	5
New Orleans	1	7	2	0	14	1	0	8	1	48	154
Shreveport	0	------	0	0	2	0	0	3	0	0	30
Oklahoma:											
Oklahoma City	0	------	0	0	3	3	0	3	0	2	33
Tulsa	0	------	--------	0	-------	0	0	-------	1	4	--------
Texas:											
Dallas	0	1	1	1	0	4	0	2	0	8	56
Fort Worth	0	------	0	1	0	0	0	0	1	4	27
Galveston	1	------	0	0	0	2	0	2	0	0	20
Houston	0	------	1	0	9	1	0	8	3	1	95
San Antonio	1	------	0	1	3	0	0	5	3	0	50
Montana:											
Billings	0	------	0	0	0	0	0	0	0	4	8
Great Falls	0	------	0	1	1	0	0	0	0	6	4
Helena	0	------	0	0	0	0	0	0	0	1	3
Missoula	0	------	0	0	0	0	0	0	0	0	3
Idaho:											
Boise	0	------	0	0	1	0	0	0	0	0	6
Colorado:											
Colorado Springs	0	------	0	0	1	1	0	2	0	7	15
Denver	11	------	0	2	7	3	0	3	0	13	83
Pueblo	0	------	0	0	0	1	0	0	0	3	6
New Mexico:											
Albuquerque	0	------	0	0	2	1	0	5	0	0	18
Utah:											
Salt Lake City	-------	------	--------	-------	-------	-------	-------	-------	-------	--------	--------
Washington:											
Seattle	0	------	0	1	3	1	0	1	0	13	91
Spokane	0	------	0	3	1	1	0	0	1	2	24
Tacoma	0	------	0	0	2	1	1	0	0	1	30
Oregon:											
Portland	0	------	0	1	3	2	0	2	0	3	51
Salem	0	2	--------	0	-------	1	0	-------	0	1	--------
California:											
Los Angeles	8	5	2	16	9	12	6	14	0	46	209
Sacramento	0	------	0	9	3	0	1	1	0	6	21
San Francisco	0	------	0	3	2	0	0	7	1	15	163

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Rhode Island:				District of Columbia:			
Providence	0	0	1	Washington	0	0	2
New York:				Virginia:			
Buffalo	3	1	0	Norfolk	1	0	0
New York	3	1	3	Tennessee:			
New Jersey:				Memphis	0	1	0
Newark	0	0	1	Alabama:			
Pennsylvania:				Birmingham	0	1	1
Pittsburgh	0	0	1	Louisiana:			
Illinois:				Shreveport	2	2	0
Chicago	1	0	1	Texas:			
Michigan:				Houston	1	0	0
Detroit	0	0	2	California:			
Minnesota:				San Francisco	0	1	0
Minneapolis	0	0	1				
St. Paul	0	0	1				

Encephalitis, epidemic or lethargic.—Cases: Cumberland, 1; Sacramento, 1.
Pellagra.—Cases: Charleston, S. C., 1; Atlanta, 11; Savannah, 2; Birmingham, 1; New Orleans, 1.
Typhus fever.—Cases: New York, 1; Atlanta, 1; Savannah, 2; Fort Worth, 1; Houston, 1; San Antonio, 2.

FOREIGN AND INSULAR

CANADA

Provinces—Communicable diseases—2 weeks ended July 16, 1938.—During the 2 weeks ended July 16, 1938, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Disease	Prince Edward Island	Nova Scotia [1]	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis				1	2				2	5
Chickenpox		12	3	34	321	129	105	20	106	730
Diphtheria		8	3	90	8	6	4	5		124
Dysentery							1		10	11
Erysipelas				8	5	3	2	2	2	22
Influenza		11		3	3				1	18
Measles		41	1	111	910	5	3	5	9	1,085
Mumps		11			41	15	2	16	2	87
Paratyphoid fever									1	1
Pneumonia					54				9	63
Poliomyelitis		1		4	6	6		1	1	19
Scarlet fever		23	9	79	93	23	10	25	31	293
Smallpox								1		1
Trachoma							5		1	6
Tuberculosis	3	20	32	110	59	7	27	2	42	302
Typhoid fever		2	2	20	6	2	2	1	1	36
Undulant fever				2	2					4
Whooping cough		28		137	317	20	6	1	58	567

[1] For 2 weeks ended July 20, 1938.

ITALY

Communicable diseases—4 weeks ended May 22, 1938.—During the 4 weeks ended May 22, 1938, cases of certain communicable diseases were reported in Italy as follows:

Disease	Apr. 25–May 1	May 2–8	May 9–15	May 16–22
Anthrax	13	11	12	9
Cerebrospinal meningitis	40	33	44	29
Chickenpox	454	436	434	610
Diphtheria	479	462	441	449
Dysentery	31	14	17	34
Hookworm disease	22	20	29	59
Lethargic encephalitis	2	1	2	
Measles	3,770	3,817	3,656	3,514
Mumps	315	308	263	316
Paratyphoid fever	41	45	55	41
Pellagra	16	68	58	56
Poliomyelitis	15	17	19	10
Puerperal fever	44	26	30	25
Scarlet fever	338	289	314	316
Typhoid fever	224	230	226	215
Undulant fever	159	159	189	165
Whooping cough	582	535	500	529

JAMAICA

Communicable diseases—4 weeks ended August 6, 1938.—During the 4 weeks ended August 6, 1938, cases of certain communicable diseases were reported in Kingston, Jamaica, and in the island outside of Kingston, as follows:

Disease	Kingston	Other localities	Disease	Kingston	Other localities
Anthrax		1	Leprosy		3
Chickenpox	2	9	Pneumonia		1
Diphtheria	6	5	Puerperal sepsis		2
Dysentery	16	1	Tuberculosis	56	87
Erysipelas		2	Typhoid fever	10	27

PANAMA CANAL ZONE

Notifiable diseases—April–June 1938.—During the months of April, May, and June 1938, certain notifiable diseases, including imported cases, were reported in the Panama Canal Zone and terminal cities as follows:

Disease	April		May		June	
	Cases	Deaths	Cases	Deaths	Cases	Deaths
Chickenpox	33		25		12	
Diphtheria	10		6		6	
Dysentery (amoebic)	12	2	9	1	25	3
Dysentery (bacillary)	7	2	1	1	8	4
Leprosy	1	1		1	2	1
Malaria	76	8	179	3	146	4
Measles	24		42		18	
Meningococcus meningitis		1			1	1
Mumps	6	1			1	
Pneumonia		24		17		13
Scarlet fever	1					
Tuberculosis		32				34
Typhoid fever			1		1	1
Typhus fever	1					
Whooping cough	[1] 2	1	[1] 2			

[1] Canal Zone only.

SWEDEN

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

Disease	Cases	Disease	Cases
Cerebrospinal meningitis	2	Poliomyelitis	[1] 39
Diphtheria	5	Scarlet fever	2,689
Dysentery	3	Syphilis	28
Epidemic encephalitis	4	Typhoid fever	4
Gonorrhea	960	Undulant fever	13
Paratyphoid fever	36	Weil's disease	1

[1] Includes only paralytic cases.

YUGOSLAVIA

Communicable diseases—4 weeks ended July 17, 1938.—During the 4 weeks ended July 17, 1938, certain communicable diseases were reported in Yugoslavia as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Anthrax	73	6	Paratyphoid fever	34	--
Cerebrospinal meningitis	30	10	Poliomyelitis	4	--
Diphtheria and croup	278	20	Scarlet fever	158	--
Dysentery	65	5	Sepsis	6	1
Erysipelas	140	3	Tetanus	57	26
Favus	7	--	Typhoid fever	181	19
Leprosy	2	--	Typhus fever	29	2
Lethargic encephalitis	2	1	Weil's disease	1	1

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

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

CHOLERA

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

Place		Dec. 26, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	Week ended— May 1938 7	May 1938 14	May 1938 21	May 1938 28	June 1938 4	June 1938 11	June 1938 18	June 1938 25	July 1938 2	July 1938 9	July 1938 16	July 1938 23	July 1938 30
Afghanistan.[1]																		
China:																		
Canton	C												2	2	2	2	5	5
	D														3	1		1
Hankow	C								2	1	6		17	35				
Hong Kong	C	2							2	2	9	2	9	25	43	60	48	26
	D	1							1	1	6			14	32	53	33	26
Kwangtung Province	C													6,267				
	D													1,858				
Macao	C											16	33	76	273	121	63	24
Shanghai	C	3						2	18	13	84	66	319	301	225	901	505	121
Swatow [2]	C				1			4	13	13	40	500	157	300	150	56	8	4
Tientsin	C																2	
Dutch East Indies: Macassar	C				[3] 1													
India	C	9,330	6,718	12,561	22,930	6,962	8,009	10,064	11,663	13,195	14,499	11,936						
	D	4,602	3,493	5,818	10,939	3,450	4,140	5,092	6,042	6,593	6,952	5,924						
Allahabad	C			4	8	8	1	1	2	2	1		2	7	2	2	1	6
Assam	C	262	143	298	938	162	129	186	190	248	395	319	232	169	141	85	71	
	D	141	80	138	469	93	58	83	106	122	172	159	122	93	80	55	36	
Bassein	C			1	4			2	1	1		1	2					
Bombay Presidency	C	10	4	14	52	2		11	9	16	52	20	66		155			
	D	7	2	9	38			6	3	4	34	9	34		67			
Bombay	C					[4] 1					1							
Calcutta	C	122	226	574	634	96	113	125	102	122	84	73	64	41	40	32	15	16
Cawnpore	C				1		6	7	2	13	40	28	7	3	22	66	67	44
	D				1			2	4	5	12	12	4	2	2	16	19	10
Central Provinces and Berar	C	40	56	213	4,039	1,098	1,097	1,538	1,907	2,528	1,954	1,259	1,137	1,034	1,959	2,825	3,648	4,961
Chittagong	C		1	1	5	1	1			1				[4] 1	1			
Delhi	C				29	17	6	10	41	42	8	10	4	3	1	7	3	
Howrah	C				344		66		71		52	42	33					

Jodhpur	C						3											
Madras Presidency	C	3,914	957	705	1,575	348	232	136	86		238	385	546					
	D	1,804	466	376	730	150	96	72	34		99	168	208					
Madras	C	120	16	3	9		1			1			1		1		1	1
	D	29	6	2	4								1					
Northwest Frontier Province	C				1	17	56	122	89	60	171	161	163	149	86	72	73	39
Orissa Province	C	77	82	102	169	88	197	87	53	57	99	116	60	57	45	78	29	
Gopalpur	C										5							
Punjab	C				1,090	577	476	537	729	202	153	150	168	112	149	84	134	63
Rangoon	C	2		1				1				1						
Sind State	C				2	2	2	6	47	87	89		66					
Larkana	C				[1] 1													
Vizagapatam	C		1															
India (French):																		
Chandernagor Territory	C	7	10	9	27					1	3	1	6					
Karikal Province	C	1	4	8														
Pondichery Province	C	3		35	6								2					
Yanaon	C													1				
India (Portuguese): Noroli	C			7														
Indochina (French):																		
Annam Province	C	63	338	13	451	213	85	198	119	162	158	225	153	117	86	137	293	290
Tonkin Province	C	59	55	55	1,043	543	542	386	188	375	305	519	184	177	107	63	62	42
Haiphong	C				1													
Hanoi	C	3		17	175	48	58	55	32	35	11	20	16	3	11	12	6	2
Japan:																		
Fukuoka Prefecture—Wakamatsu	C																	2
Okayama Prefecture	C																5	3
	D																4	
Siam	C		3															

On vessels:

S. S. *Ranee* at Calcutta from Port Said and Blyth	1 case	Dec. 31, 1937
S. S. *Karoa* at Rangoon from Calcutta	1 case	Mar. 21, 1938
S. S. *Tsushima Maru* at Calcutta from Japan	1 case	Apr. 16, 1938

On vessels—Continued.

S. S. *Mandasor* at Calcutta	1 case	Apr.	18, 1938
S. S. *Tak Sang* at Hong Kong from Shanghai and Swatow	1 case	June	5, 1938
S. S. *Kikukawa Maru* at Fukuoka from Shanghai	57 cases	July	28, 1938

[1] Cholera reported present early in June in South Afghanistan, Afghanistan.
[2] Under date of June 7, 1938, the American Consul at Swatow reported approximately 200 cases of cholera with 50 deaths, in Swatow, China, for the period May 29–June 6, 1938.
[3] El Tor strain.
[4] Imported.
[5] Suspected.

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

PLAGUE[1]

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

Place		Dec. 26, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	Week ended— May 1938 7	May 1938 14	May 1938 21	May 1938 28	June 1938 4	June 1938 11	June 1938 18	June 1938 25	July 1938 2	July 1938 9	July 1938 16	July 1938 23	July 1938 30
Argentina. (See table below.)																		
Belgian Congo	C			4	4			3			1	1		1	1		1	
Bolivia:																		
Chuquisaca Department	C	2	35		3													
Sucre	C	1																
Santa Cruz Department	C		[2]1	[2]1						9	1							
Tarija Department	C	54	3								52		[2]44					
Brazil. (See table below.)																		
British East Africa:																		
Kenya	C		4	1	4		9	1							5	2		
Uganda	C	39	24	14	7	2	7	2	6	2	6		11	9	15	13		
	D	39	24	14	7	2	6	2	6	2	6		9	11	15	13		
Ceylon:																		
Colombo	C	1	2	1	1	2	1	1		1								
	D	1	2			2	2	1		1								
Plague-infected rats				5	2	3			1			1						1
China.[4]																		
Dutch East Indies:																		
Java and Madura	C	297	306	238	204	33	42											
	D	296	301	235	205	33	41											
Pasoeroean (vicinity of)	C	2	3		1													
Ecuador:																		
Chimborazo Province—Chimbo	C			10														
Colimes	C	1																
Guayaquil	C	4	5	5	11	1	1								1			
	D	2	2	4	8		1											
Plague-infected rats			3	2		1												
Egypt:																		
Asyut Province	C	1			[2]1	1	2	3	1			1						
Beheira Province	C																	
Gharbiya Province	C	1																

Hawaii Territory:[5] Plague-infected rats:																		
Hawaii Island—Hamakua District:																		
Hamakua Mill Sector		1	2															
Kukaiau					2													
Paauhau Sector		8	3	3	6			2										
Pohakea Sector					1													
Maui Island:																		
Makawao District—Omaopio.[5]																		
Walluku District—Puunene	D	1																
India	C	1,968	3,482	3,883	2,294	100	67	22	29	16	24	9						
	D	965	1,582	2,026	1,164	78	111	24	11	8	8	8						
Allahabad	C	1		1	1													
Bassein	C	2	2	1	1	1			3	1			1	1	2			1
Bombay Presidency	C	24	7	47	58	1			5	3	5	3			3			
	D	13	2	28	30				2	2	2	5			1			
Central Provinces and Berar	C	486	838	1,306	821	19	21		2		1							
Madras Presidency	C	330	157	69	70	12	7	3	2		16	16	19					
	D	174	69	36	26	8	5	1	1		6	11	7					
Mandalay	C	43		121														
	D	41		115														
Punjab	C			1														
Rangoon	C		3	4	1							1		2		1		
	D		3	2	1							1		2		1		
Plague infected rats				1														
Iraq: Baghdad—Plague-infected rats		1																
Madagascar. (See table below.)																		
Niger Territory. (See table below.)																		
Peru. (See table below.)																		
Senegal: M'Bour subdivision	C											1						
Tunisia: Tunis: Plague-infected rats			1	1										2				
Union of South Africa	C	[3] 1	13	7	[3] 4	[3] 3		[3] 18		[3] 7		1		[3] 3				
Cape Province—Port Elizabeth	C				8					1		1		2	1			
	D				11													
United States:[6]																		
California:[6]																		
Fresno County [7]—Plague-infected fleas.																		
San Bernardino County—																		
Plague-infected fleas.																		
Plague-infected squirrels													1				5	
Santa Cruz County [7]—																		
Plague-infected fleas.																		
Plague-infected ground squirrels					1													

[1] Including plague in the United States and its possessions.
[2] Pneumonic.
[3] For 2 weeks.
[4] Information dated May 9, 1938, states that an outbreak of bubonic plague has occurred in Kochow District, and on Hainan Island, China.
[5] During the week ended Nov. 20, 1937, plague infection was proved in 10 rats by mass inoculation in Omaopio, Makawao District, Maui Island, Hawaii Territory.

Footnotes 6 and 7, see page 1549.

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

PLAGUE—Continued

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

Place	Dec. 26, 1937–Jan. 20, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	Week ended— May 1938: 7	14	21	28	June 1938: 4	11	18	25	July 1938: 2	9	16	23	30
United States—Continued.																	
Idaho:[6]																	
Bannock County—																	
Plague-infected fleas and lice.																	
Plague-infected squirrels								1	3								
Bear Lake County—																	
Plague-infected fleas.																	
Plague-infected squirrel								1									
Montana:[6]																	
Beaverhead County—																	
Plague-infected fleas.																	
Plague-infected squirrels										5		2					
Gallatin County—Plague-infected fleas.																	
Nevada:[6] Clark County—Plague-infected fleas.																	
Oregon:[6]																	
Baker County—																	
Plague-infected fleas.																	
Plague-infected ground squirrels				2													
Grant County—																	
Plague-infected fleas, lice, and tick.																	
Plague-infected ground squirrel							1										
Utah:[6]																	
Kane County—Plague-infected fleas.																	
Rich County—Plague-infected fleas.																	
Wasatch County—Plague-infected squirrels													1				
Washington:[6]																	
Adams County:																	
Plague-infected fleas and lice.																	
Plague-infected ground squirrels			1														
Lincoln County—Plague-infected ground squirrels				2													

Wyoming: [6]																						
Lincoln County: [7]																						
Plague-infected fleas.																						
Plague-infected squirrels																			8	1	5	
Sublette County—Plague-infected fleas.																						
Uinta County:																						
Plague-infected fleas.																						
Plague-infected squirrel																	1					
S. S. *Ville de Tamatave* at Beirut	C				1																	

Place		January 1938	February 1938	March 1938	April 1938	May 1938	June 1938
Argentina: Salta Province	C						4
Brazil: [8]							
Ceara State	C			2	6		
	D			1	3		
Parahyba State	C		1	3			
	D		1	1			
Pernambuco State. [8]							
Madagascar (central region)	C	69	70	57	29	16	5
	D	65	56	55	26	13	5
Niger Territory	C			26			
Peru	C	7	10	7	3	1	
Lambayeque Department	C	1	2				
Libertad Department	C		1	2	2		
Lima Department	C	6	7	5	1	1	

[6] Plague infection proved in insect hosts as follows: *California*—Fresno County, June 15–July 14, 1938; San Bernardino County, June 1–July 22, 1938; Santa Cruz County, Feb. 3–May 18, 1938; *Idaho*—Bannock County, May 21–June 3, 1938; Bear Lake County, May 25–July 15, 1938; *Montana*—Beaverhead County, June 1–24, 1938; Gallatin County, May 24–25, 1938; *Nevada*—Clark County, Apr. 14–22, 1938; *Oregon*—Baker County, Apr. 23–May 2, 1938; Grant County, May 12–21, 1938; *Utah*—Kane County, May 20, 1938; Rich County, July 1–2, 1938; *Washington*—Adams County, Mar. 7–30, 1938; *Wyoming*—Lincoln County, July 6–21, 1938; Sublette County, July 25, 1938; Uinta County, June 27–July 18, 1938.

[7] Pooled tissue from plague-infected squirrels has been reported as follows: Fresno County, Calif., May 27, 1938, Santa Cruz County, Calif., Apr. 13, 1938; Lincoln County, Wyo., July 8, 1938.

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

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

SMALLPOX

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

Place		Dec. 26, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	Week ended— May 1938 7	14	21	28	June 1938 4	11	18	25	July 1938 2	9	16	23	30
Algeria:																		
Algiers Department	C				1	1						1						
Constantine Department	C		1			1					1							
Southern Territories	C				1													
Angola. (See table below.)																		
Belgian Congo. (See table below.)																		
Bolivia. (See table below.)																		
Brazil (see also table below):																		
Bahia (alastrim)	C																	
Porto Alegre	D					1	1											
British East Africa: Tanganyika	C	1	190		205					48			36	70		24		
Canada:																		
Alberta	C	2	3	[1]8	9							[1]12				[1]1		
British Columbia	C	[1]1	1					1										
Manitoba	C									[1]8		[1]8		[1]10				
Nova Scotia—Halifax	C			3														
Saskatchewan	C	[1]1	13											[1]11				
China:																		
Canton	C	33	79	98	46	1												
Dairen	C		1	1	2			1		1	1							
Hankow	C	2	3	1	16	2	8	4	1	3		16	5	6				
Hong Kong	C	255	641	766	514	34	26	21	9	12	9	3	1	1	1	1	2	
	D	107	502	639	590	38	25	20	10	10		8	1			1	2	
Macao	C		2		8			1										
Shanghai	C	7	10	9	12	2	5	1	5	2	3	2	1	1			6	
Swatow	C				[2]1		1		1									
Tientsin	C											1						
Chosen. (See table below.)																		
Colombia:																		
Barranquilla	D				1													
Cartagena	D									1				1				
Dahomey	C							119										
Dutch East Indies: Batavia	C					3			1									
Ecuador: Guayaquil	C	4	1		1													
Egypt:																		
Alexandria	C							1										
Port Said	C		3	6	9													

Eritrea	C	8	7	14	1		1												
Great Britain: England and Wales—																			
Kent County—Gravesend	C			3		1	1				1								
Lancaster County—Wigan	C																	2	
Leighton Buzzard	C			2															
Port of London	C			1															
Greece. (See table below.)																			
Guatemala. (See table below.)																			
Honduras: Tela	C						1		1										
India	C	9,248	10,096	12,752	16,692	3,399	2,719	2,649	3,234	1,794	1,451	1,224							
	D	2,645	2,467	2,991	3,575	782	736	778	969	477	431	313							
Allahabad	C	1			2														
Assam	C	95	90	147	224	31	65	43	54	48	39	48	28	15	25	18	15		
Bassein	C	1			1	1		1	1								1		
Bombay Presidency	C	1,130	2,392	3,412	3,569	595	391	443	291	272	137	179	238		151				
	D	316	674	735	620	111	87	84	55	55	35	36	44		22				
Bombay	C	690	950	874	508	61	38	27	33	22	13	9	13	5	7	11	6	8	
	D	350	545	491	300	43	23	22	20	13	11	9	5	6	5	7	4	6	
Calcutta	C	235	431	848	768	113	80	76	67	52	42	45	26	22	16	14	16	18	
	D	177	273	565	574	86	68	66	53	44	33	40	25	9	15	9	12	9	
Cawnpore	C	14	18	13	31	5	3	1	1			1	1						
Central Provinces and Berar	C	51	230	249	507	98	93	22	127	102	58	45	55	37	43	32	25	7	
Chittagong	C	3	1	4	1				1										
Delhi	C	9	13	11	26	10	11	6	5	1	3	1	3					1	
Howrah	C				61		1		22		13	20	17						
Jodhpur	C								1	1									
Karachi	C	18	12	17	21		2		3	4									
Madras Presidency	C	899	684	765	699	111	78	72	129		48	90	90						
	D	172	129	125	208	21	13	21	20		15	11	18						
Madras	C	359	248	249	241	43	38	27	30	47	16	24	39	37	47	33	35	33	
Negapatam	C		6	8	11	2	1												
Northwest Frontier Province	C	748	160	155	86	43	23	36	133	9	45	10	18	28	22	5	21	19	
Orissa Province	C	831	940	1,291	936	175	156	134	239	142	146	74	125	102	90	59	106		
Punjab	C	1,641	952	836	553	109	33	42	29	14	7	15	8	7	17	2	10	5	
Rangoon	C	66	42	77	23	8	1	2	1	2	2	13	4				2		
Sind State	C	643	483	522	844	169	192		130	92	84	77	47	62	29	25	48	3	
Vizagapatam	C			2	2														
India (French):																			
Chandernagor Territory	C			2	2	2	1		1	1	1								
Karikal Province	C			1															
Indochina (French) (see also table below):																			
Tonkin Province	C	135	707	675	905	123	122		87	85	35		36		26	19	11	32	
Haiphong	C	169	148	45	30	1	2			1									
Hanoi	C	5	15	16	46	2	3		1	4									
Saigon-Cholon	C	1	1	1	2		1		1						2		3		
Tourane	C					1													
Iran	C	4	6	2	2														
Iraq	C	13	8		11														
Baghdad	C		1						1										
Basra Province	C			1															
Ivory Coast. (See table below.)																			

[1] For 2 weeks.

[2] Imported.

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

SMALLPOX—Continued

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

Place		Dec. 26, 1937–Jan. 20, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Mar. 27–Apr. 30, 1938	Week ended— May 1938 7	14	21	28	June 1938 4	11	18	25	July 1938 2	9	16	23	30
Japan:																		
Kobe	C												1					
Saga Prefecture	C				1													
Mexico (see also table below):																		
Chihuahua	C			1														
Durango	D		2	2	1													
Mexico, D. F.	C	2	3	2	6	1	2	5	3	6		2						
Monterrey	C	5	1		2		2				1		4					
Saltillo	D										1							
San Luis Potosi	D						2			1								
Torreon	C	7																
	D	4	2															
Morocco. (See table below.)																		
Nigeria	C	104	57	1,224	253	294			[3] 111		[1] 83		[1] 47					
Lagos	C			3	4		1					1	1					
Niger Territory. (See table below.)																		
Northern Rhodesia	C															9		
Nyasaland	C	3																
Portugal (see also table below): Lisbon	C	4	4	12	1	2	2	1				3	3	1			4	2
Salvador. (See table below.)																		
Senegal. (See table below.)																		
Siam	C	76	26	84	3	1				1								
Sierra Leone	C		4	5	23			[1] 6				1						
Southern Rhodesia	C	13	21	7	28	4	8	27					70					
Straits Settlements: Singapore	C	1			1													
Sudan (Anglo-Egyptian)	C	282	63	58	59	6	3	7	3	4			4			1		
Tunisia: Tunis	C										3							
Union of South Africa. (See table below.)																		
Venezuela (see also table below): Puerto Cabello.[4]																		

[1] For 2 weeks.
[3] For 3 weeks.
[4] A report dated Feb. 10, 1938, states that 16 cases of smallpox were reported in Puerto Cabello: information dated Feb. 21, 1938, states that 4,000 cases of smallpox (alastrim) were reported in Barquisimeto, Lara State, Venezuela, and that smallpox is present from Barquisimeto to Valencia and Maracay.

On vessels:

S. S. *Anhui* at Singapore from Hong Kong	1 case	Jan.	19, 1938
S. S. *Rizwani* at Kamaran	1 case	Jan.	19, 1938
S. S. *Tai Seun Hong* at Sandakan from Hong Kong	1 case	Jan.	23, 1938
S. S. *Sulzang* at Penang from Hong Kong and Singapore	1 case	Jan.	26, 1938
S. S. *Hong Siang* at Singapore from Amoy, Swatow, and Hong Kong	1 case	Jan.	26, 1938
S. S. *Trave* at Singapore from Hong Kong	1 case	Jan.	27, 1938
S. S. *Muinam* at Singapore from Hong Kong	1 case	Jan.	29, 1938
S. S. *Tatsuta Maru* at Honolulu	1 case	Feb.	4, 1938
S. S. *Circassia* at Aden from Bombay	1 case	Feb.	16, 1938
S. S. *Chantala* at Akyab from Chittagong	1 case	Feb.	18, 1938
S. S. *Empress of Japan* at Honolulu	1 case	Feb.	21, 1938
S. S. *Tilawa* at Singapore from Hong Kong	1 case	Feb.	21, 1938
S. S. *Seringa* at Calcutta from Port Said	1 case	Feb.	24, 1938
S. S. *Yuen Sang* at Singapore from Hong Kong	1 case	Feb.	28, 1938
S. S. *Cathay* at London	1 case	Mar.	4, 1938
S. S. *City of Auckland* at Halifax from Calcutta	1 case	Mar.	5, 1938
S. S. *Kaisar-I-Hind* at Yokohama from Hong Kong	3 cases	Mar.	6–7, 1938
S. S. *Van Heutsz* at Singapore from Amoy, Swatow, and Hong Kong	1 case	Mar.	9, 1938
S. S. *Hai Hing* at Singapore from Amoy, Swatow, and Holhow	1 case	Mar.	9, 1938

On vessels—Continued.

S. S. *Netuka Maru* at Moji from Dairen	1 case	Mar.	11, 1938
S. S. *Norviken* at Singapore from Hong Kong and Swatow	1 case	Mar.	13, 1938
S. S. *Kum Sang* at Singapore from Kobe, Amoy, and Hong Kong	1 case	Mar.	16, 1938
S. S. *Haruna Maru* at Kobe from Hong Kong	1 case	Mar.	16, 1938
S. S. *Hinsang* at Sandakan from Hong Kong	2 cases	Mar.	22–24, 1938
S. S. *Kiturin Maru* at Moji from Dairen	1 case	Mar.	31, 1938
S. S. *Sirdhana* at Singapore from Kobe, Amoy, and Hong Kong	1 case	Apr.	1, 1938
S. S. *Prosper* at Singapore from Hong Kong and Swatow	2 cases	Apr.	3, 1938
S. S. *Straithaird* at Fremantle	2 cases	Apr.	7, 1938
S. S. *Shirala* at Singapore from Japan	1 case	Apr.	14, 1938
S. S. *Hosang* at Singapore from Hong Kong	3 cases	Apr.	15, 1938
S. S. *Cremer* at Singapore from Amoy, Swatow, and Hong Kong	1 case	Apr.	19, 1938
S. S. *Jean Laborde* at Singapore from Kobe, Shanghai, Hong Kong, and Saigon	1 case	Apr.	21, 1938
S. S. *Sandviken* at Singapore from Hong Kong	1 case	Apr.	29, 1938
S. S. *Hinsang* at Sandakan from Hong Kong	1 case	May	18, 1938
S. S. *Forth Bank* at Niigata from Vancouver	1 case	May	28, 1938
S. S. *Ellenga* at Rangoon from Calcutta	1 case	July	19, 1938

Place		January 1938	February 1938	March 1938	April 1938	May 1938	June 1938
Angola	C	19	29	-------	86	13	-------
Belgian Congo	C	251	336	-------	252	251	-------
Bolivia:							
Cochabamba Department	C	-------	[1]4	-------	1	5	4
La Paz Department	C	-------	[1]11	9	12	6	5
Oruro Department	C	-------	-------	-------	1	1	-------
Potosi Department	C	-------	[1]5	2	4	1	4
Santa Cruz Department	C	-------	[1]5	-------	1	1	1
Tarija Department	C	-------	-------	1	-------	1	-------
Brazil (see also table above)	C	4	4	-------	-------	-------	-------
Chosen	C	-------	-------	-------	5	8	-------
Greece: Salonika	C	10	1	7	-------	2	-------
Guatemala	C	-------	-------	-------	1	3	4
Indochina (French) (see also table above)	C	694	864	1,258	1,237	-------	511
	D	188	189	237	161	-------	90
Ivory Coast	C	-------	48	23	-------	-------	-------
Mexico (see also table above):							
Chiapas State	C	-------	1	1	-------	-------	-------
Chihuahua State	C	-------	-------	1	-------	-------	-------

Place		January 1938	February 1938	March 1938	April 1938	May 1938	June 1938
Mexico—Continued.							
Hidalgo State	C	-------	-------	1	-------	-------	-------
Mexico State	C	-------	1	-------	-------	-------	-------
Mexico, D. F.	C	8	4	6	-------	-------	-------
Puebla State	C	-------	-------	1	-------	-------	-------
Queretaro State	C	-------	4	6	-------	-------	-------
San Luis Potosi State	C	-------	-------	1	-------	-------	-------
Tamaulipas State	C	-------	-------	4	-------	-------	-------
Morocco	C	-------	-------	-------	4	-------	3
Niger Territory	C	-------	31	53	-------	-------	-------
Portugal (see also table above)	C	62	13	-------	-------	46	-------
	D	2	-------	-------	-------	3	-------
Salvador	C	16	2	-------	-------	-------	-------
Senegal	C	-------	42	103	-------	-------	-------
Union of South Africa:							
Cape Province	C	-------	-------	-------	-------	-------	-------
Transvaal	C	-------	-------	-------	110	-------	-------
Venezuela	D	-------	-------	-------	-------	8	5

[1] For January and February.

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

TYPHUS FEVER

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

Place		Dec. 26, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Week ended— April 1938					May 1938				June 1938				July 1938		
					2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16
Algeria:																				
Algiers Department	C	24	29	77	16	13	4	6	4	14	7	9	4	27	16	6	4	1	5	3
Algiers	C		9	3				1	2	5		1	1				4			
Constantine Department	C	117	98	142	65	33	25	24	16	54	35	43	47	59	23	53	37	16	1	8
Bone	C	2	2							1					1		25			1
Constantine	C	1	38	33	20			5		34	23	37			5				1	1
Philippeville	C		2							1										
Oran Department	C	5	13	7	1	3	6		24	10	3	3	1	10	2		6	3	3	
Southern Territory	C	1	17	13	2				4	1										
Australia: Brisbane	C	1		1																
Basutoland	C		1																	
Bolivia. (See table below.)																				
British East Africa: Kenya	C	1						1	4		10									
Bulgaria	C	24	2			1	1													
Chile	C	85	11	42	8	11	14	14	4	5	6	6	9							
Concepcion Province	C			9	1	5	5	5		1	1									
Linares Province	C	2	2																	
Malleco Province	C			6	1				1		1	1								
Nuble Province	C	13	10	8			1		1			3	7							
Santiago Province	C	59	33	30	4	3	6	3	1	1		1								
Valparaiso	C	6	2	3	1				1	1	1			2	1	3		2		1
China (see also table below):																				
Dairen	C								2				1	1	2		3			
Hankow	C	1	1				1			2										
Harbin	C	1																		
Hong Kong	C											[1]1								
Shanghai	C	1		26	58	27	28	58	65		94	64	96	103	65		46		35	27
Tientsin	C	1		1	1							1								
Chosen (see table below.)																				
Colombia: Barranquilla	D																	1		
Czechoslovakia. (See table below.)																				
Dutch East Indies: Sumatra. (See table below.)																				

Egypt:																				
Alexandria	C	1	2	11	2	1	4	2	-----	2	1	8	3	2	2	1	-----	1	1	-----
Aswan Province	C	-----	8	16	-----	2	-----	-----	14	13	-----	-----	11	-----	2	2	-----	-----	-----	-----
Asyut Province	C	1	-----	-----	-----	1	-----	-----	-----	1	-----	-----	11	-----	1	-----	-----	2	-----	-----
Beheira Province	C	9	10	33	7	12	-----	-----	59	50	-----	-----	41	-----	39	15	-----	2	-----	-----
Cairo	C	3	2	13	2	4	6	7	1	6	2	4	2	11	3	5	5	2	1	2
Dakahliya Province	C	1	49	27	7	5	-----	-----	2	3	-----	-----	7	-----	2	8	-----	16	-----	-----
Gharbiya Province	C	3	14	5	14	8	-----	-----	21	14	-----	-----	12	-----	3	20	-----	4	-----	-----
Girga Province	C	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	4	-----	-----	-----	-----	-----	-----	-----
Giza Province	C	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	15	-----	-----
Kalyubiya Province	C	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	7	-----	-----
Minufiya Province	C	3	13	4	2	14	-----	-----	41	33	-----	-----	16	-----	9	24	-----	14	-----	-----
Minya Province	C	-----	5	11	2	-----	-----	-----	2	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Port Said	C	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	1	-----	-----	-----	-----	-----	-----	-----	-----
Qena Province	C	1	-----	25	38	45	-----	-----	26	28	-----	-----	4	-----	1	-----	-----	-----	-----	-----
Sharkiya Province	C	-----	7	12	-----	-----	-----	-----	1	8	-----	-----	1	-----	5	3	-----	5	-----	-----
Provinces	C	61	177	262	80	102	120	148	176	165	214	161	147	146	86	85	97	65	42	42
Greece. (See table below.)																				
Guatemala. (See table below.)																				
Hawaii Territory: Honolulu	C	2	1	1	-----	-----	-----	-----	-----	1	-----	1	1	1	1	-----	-----	1	2	-----
Hungary	C	-----	-----	-----	-----	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Iran	C	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Teheran	C	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Iraq: Baghdad Province	C	-----	-----	-----	-----	-----	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Latvia. (See table below.)																				
Lithuania. (See table below.)																				
Mexico (see also table below):																				
Mexico, D. F	C	13	12	18	11	14	10	4	1	-----	2	1	2	2	2	2	1	-----	-----	-----
Saltillo	D	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
San Luis Potosi	D	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Tecamachalco	C	7	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Torreon	C	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Morocco (see also table below)	C	743	783	1,316	206	199	243	198	165	162	175	176	171	169	170	166	71	66	56	39
Casablanca	C	79	173	213	24	-----	35	19	13	10	77	18	8	9	3	15	7	7	5	1
Palestine:																				
Haifa	C	4	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----	1	2	-----	-----	-----	-----	-----
Jaffa	C	5	3	3	-----	-----	-----	2	-----	2	-----	1	1	1	-----	-----	1	-----	-----	1
Panama Canal Zone. (See table below.)																				
Poland	C	396	431	689	130	145	125	108	144	100	136	100	88	97	67	44	59	64	67	33
	D	30	23	38	3	4	7	8	8	3	7	4	1	3	4	2	3	5	4	-----
Portugal. (See table below.)																				
Rumania. (See table below.)																				
Sierra Leone: Freetown	C	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----	-----	-----	-----	-----	-----
Straits Settlements: Singapore	C	2	1	-----	-----	1	-----	-----	-----	-----	-----	-----	-----	-----	-----	1	-----	2	-----	-----
Syria: Deir-ez-Zor	C	-----	10	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Trans-Jordan	C	-----	2	3	1	1	-----	2	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Tunisia:																				
Tunis	C	2	4	7	1	1	3	2	5	5	2	6	-----	3	6	6	-----	6	1	2
Provinces	C	284	211	261	57	63	-----	25	72	45	38	94	78	93	103	77	76	55	54	52

[1] Imported.

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

TYPHUS FEVER—Continued

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

Place		Dec. 26, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb 27–Mar 26, 1938	Week ended—															
					April 1938					May 1938				June 1938				July 1938		
					2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16
Turkey. (See table below.)																				
Union of South Africa. (See table below.)																				
Yugoslavia: Belgrade	C		1																	
On vessels:																				
S. S. *Blackhill* at Philippeville	C	1																		
S. S. *Empress of Japan* at Yokohama	C					1														

Place		January 1938	February 1938	March 1938	April 1938	May 1938	June 1938
Bolivia:							
Cochabamba Department	C					4	
La Paz Department	C		[1]18	5	12	17	8
Oruro Department	C		[1]9	3	3	8	6
Potosi Department	C		[1]5	8	5		4
China: Manchuria—Harbin	C	3	1	5	4	9	
Chosen	C				87	55	
Czechoslovakia	C		2	2	12		
Dutch East Indies: Sumatra	C		[1]33				
Greece	C	3	3	6			
Guatemala	C	3		1	40	2	11
Latvia	C			3			
Lithuania	C	12	8	49	20	25	3
Mexico (see also table above):							
Aguascalientes State	C	13					
Coahuila State	C		1				
Hidalgo State	C			6			
Jalisco State	C			1			
Mexico State	C	8	7	6			
Mexico D. F	C	27	16	26			

Place		January 1938	February 1938	March 1938	April 1938	May 1938	June 1938
Mexico—Continued:							
Mexico City	D	5	4				
Oaxaca State	C	1					
Puebla State	C			6			
Queretaro State	C		5	5			
San Luis Potosi State	C	5	2	5			
Tlaxcala State	D			1			
Morocco (see also table above)	C	638	1,118	1,545	1,474	1,264	
Panama Canal Zone	C				1		
Portugal	C	2	17				
Rumania	C	470	510	533	257	222	
Turkey	C	96	43	48	73		
Istanbul	C	3	10	1	3	3	6
Union of South Africa:							
Cape Province	C	37	43	49	36	4	
Port Elizabeth	C	2	1	3	1		
Natal	C		4		1		
Orange Free State	C	30	24	2	6	2	
Transvaal	C	12	4	4	7	3	

[1] For January and February.

[1] Tropical typhus fever.

YELLOW FEVER

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

Place		Dec. 27, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Week ended—																
					April 1938					May 1938				June 1938				July 1938				
					2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30
Belgian Congo:																						
Saratumba	C			[1] 1																		
Zongo	C		[1] 7	[1] 4																		
	D		4	1																		
Brazil: [2]																						
Amazonas State	D											1										
Federal District	D		1	1																		
Minas Geraes State	D	16	68	55	1	2	2			3	2	3		1		1	1					
Para State	D	1																				
Rio de Janeiro State	D	6	10	37	4	2	1	1		1	1	1										
Santa Catherina State	D		1	9	1		8	3	4													
Sao Paulo State	C		P																			
	D	19	1	2	1		1															
Colombia:																						
Cundinamarca Department	D	1	2	1								2		2			1					
Santander Department	D					1		1														
Dahomey: Allada	C																		1			
French Equatorial Africa:																						
Bangui	D	1																				
Gabon—Koula Moutou	C																	[1] 1				
Gambia: Georgetown	C	[1] 1																				
Gold Coast	C	[3] 9						[1] 1		1	[1] 1						3		1			2
	D							[1] 1														1
Keta	C	1						[1] 1			1											

[1] Suspected.
[2] See also reports of yellow fever in Brazil in preceding issues of the PUBLIC HEALTH REPORTS.
[3] Includes 1 suspceted case.

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

YELLOW FEVER—Continued

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

Place		Dec. 27, 1937–Jan. 29, 1938	Jan. 30–Feb. 26, 1938	Feb. 27–Mar. 26, 1938	Week ended—																
					April 1938					May 1938				June 1938				July 1938				
					2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30
Ivory Coast:																						
Abidjan	C		[3]2																			
Agboville	C			[1]1																		
Anyama	C	1																				
Bognoa	C																		[1]1			
Grand Bassam	C			2																		
Spao Plantations (near Bingerville)	C			2																		
Nigeria [4]	C	[3]3											2									
	D	2																				
Senegal	C		[1]1																			
Dakar	C		[1]1																			
Diourbel	D						1				[1]1											
Sierra Leone: Kailahun	C																					
Sudan (French)	C	1																				
San	C	1																				
Segou Circle—Kokry	C																[1]1					

[1] Suspected.
[3] Includes 1 suspected case.
[4] During the week ended Aug. 6, 1938, 1 suspected case of yellow fever with 1 death was reported in Kaduna, Nigeria.