

RESULTS OF COOPERATIVE STATE-FEDERAL TYPHUS CONTROL PROGRAMS

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Murine typhus fever in North America is a rickettsial disease of domestic rats which is transmitted in some manner from rat to rat, and from rats to human beings by the oriental rat flea. It is not often fatal but is so severe that patients generally complain of experiencing the worst headache that they ever have known. "The most serious aspect of this disease is the long period of physical non-effectiveness associated with it. While the acute phase is generally concluded within twelve to fifteen days, the patient is so depleted that he is rarely able to leave his bed for another week. It is a month or two more before he can return to work and even then he is apt to be nervous and depressed for some time. All told, the non-productiveness of its victims usually extends over two or three months" (1).

This disease long has been known to occur in the Southeastern and Gulf Coast States, but it was not until 1926 that it was recognized as probably rat-borne. In that year Dr. Kenneth Maxcy suggested that "a reservoir exists other than in man, and that this reservoir is in rodents, probably rats or mice, from which the disease is occasionally transmitted to man" (2, 3). Dr. Maxcy suspected that fleas, mites, and possibly ticks might transmit the disease.

Some experimental studies suggested by Dr. Maxcy, and designed to test this theory, were already in progress in the hygienic laboratory of the Public Health Service when Dr. Maxcy's report was published. When several cases of typhus occurred in Baltimore in the fall of 1930, northern and oriental rat fleas were obtained from rats and their nests in the vicinity, ground up, and injected into guinea pigs and rabbits. These animals became sick with murine typhus. Other experiments further confirmed the transmitting powers of the oriental rat flea (4, 5, 6, 7).

Feces of oriental rat fleas, infected with murine typhus organisms by feeding on infected rats,

later were crushed and rubbed into scratches on the skin of guinea pigs. The guinea pigs contracted murine typhus fever (8). Similar experiments indicated that, in the laboratory, the northern rat flea and the dog flea also could transmit typhus (9, 10).

The workers failed in repeated attempts to transmit typhus by the bite of infected fleas (7, 10). Cat fleas apparently transmit typhus under special conditions when near infected rats.

As a result of this work and that of others, evidence was quite conclusive that fleas, at least, were transmitters of murine typhus from rats to human beings, most likely by way of their feces.

Studies comparing the distribution of murine typhus in both rats and man revealed that it occurred almost invariably in those sections of the country where oriental rat flea populations were at once large and widespread and that it was uncommon where those fleas were uncommon. Furthermore, it was acquired almost invariably in buildings where oriental rat fleas were numerous and at those times of the year when they were numerous. It was rare or nonexistent where those fleas were scarce or absent even though other ectoparasites might be quite abundant.

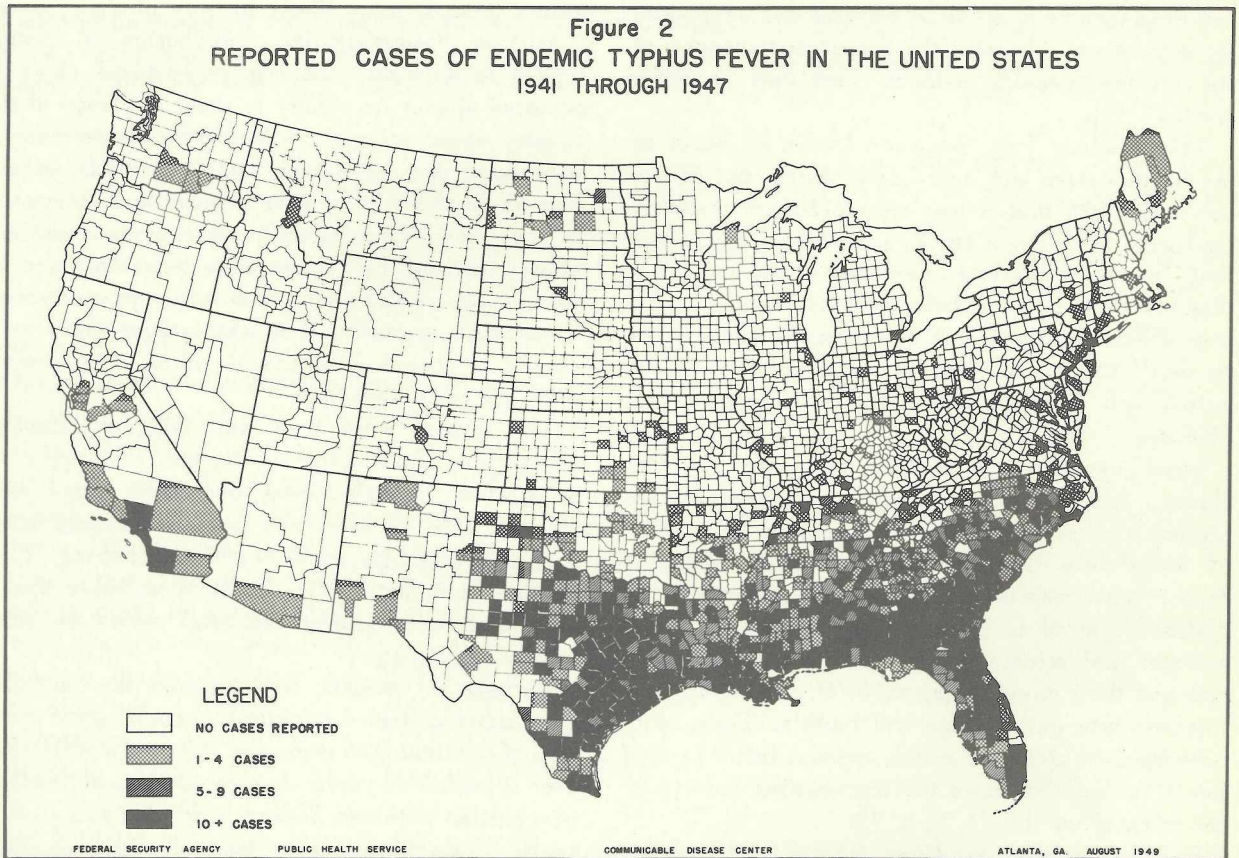
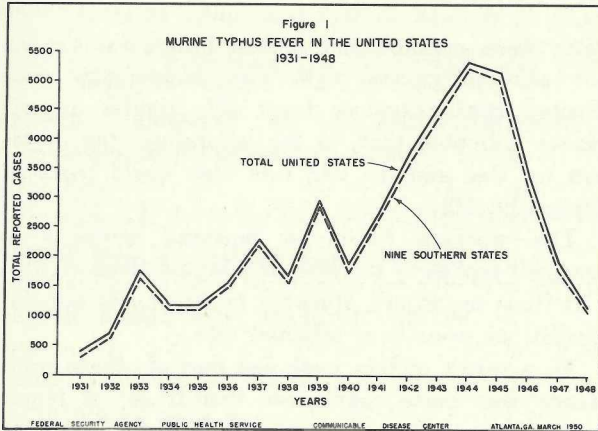
The ground work thus was laid for effective recognition and control of typhus. Following its recognition in 1926, more and more cases were reported until, in 1944, the total for the year stood at 5,213 (fig. 1), most of them occurring in 10 Southeastern States (fig. 2). It is probable that if all cases were known the total would be much larger.

Perhaps of greater concern was the fact that the number of cases occurring annually gave every sign of continuing to increase. Prospects were that, over a period of years at such rate, most families in counties with the highest infection rates eventually might have one or more members or close friends affected.

Health authorities were not willing to let this happen. As soon as it was known that domestic rats and their fleas were the reservoirs of the disease, rat-poisoning campaigns, clean-up campaigns, and ratproofing programs were intensified in order to suppress the number of cases. WPA rat-poisoning campaigns also were aimed at suppression of the disease, with possibly some favorable results (fig. 1, 1934 and 1935).

It is difficult to judge the results of such programs over state-wide areas, although the good effects were apparent on a local scale where ratproofing of certain buildings and subsequent elimination of rats, forestalled occurrence of further cases of them alone. Their effectiveness was further obscured by the fact that, following the discovery of the identity of murine typhus and means of diagnosing it, some of the apparent rise was due simply to an increase in knowledge concerning it with consequent increased reporting. Without a doubt, the poisoning and ratproofing programs did prevent the occurrence of many cases, but they could not be practiced on a wide enough scale to prevent a continued increase. Some more rapid and effective method of control was necessary.

Since DDT was effective in controlling many kinds of insects, and since ecological, experimental, and epidemiological work had shown conclusively that the oriental rat flea is a transmitter, members of the Communicable Disease Center (11, 12) initiated field studies in the early part of 1944 and 1945 to determine the effect of DDT on rat ectoparasites as a means of controlling endemic



typhus fever and to develop equipment for the application of the insecticide. A powder consisting of 10 percent DDT and 90 percent pyrophyllite was distributed along runways and blown into burrows of the rats.

Spectacular and consistent control of the oriental rat flea resulted from this field experiment in 11 establishments. In San Antonio, marked reduction of human typhus was obtained (11). The results were so good that plans were made for extension of experimental applications through aid to State and local health departments in the typhus zone of the United States to determine to what extent reduction of flea populations would reduce the number of human typhus cases. On July 1, 1945, an expanded program was inaugurated through assistance to State health departments in recruiting and training personnel and in conducting promotional activities (13). A few dusting projects were established in July, and more were added rapidly, so that by March 1946, a full program was in operation. Dusting projects were operated by 122 of the highest typhus-reporting counties in nine States during 1946 and have continued on a diminishing scale with the reduction in number of typhus cases.

Results in reduction of human typhus cases were marked. Even though most dusting projects were begun so late in 1945 that one could not expect maximum effectiveness, the number of typhus cases occurring in counties with such projects dropped about 10 percent from the number that had occurred during the preceding year. On the other hand, in counties without such dusting projects, the number of cases actually rose slightly.

By the end of 1946, the drop was more marked; in counties in which dusting was done, the number of cases dropped to about half the number that had occurred in 1944, whereas in the undusted counties the drop was only one-fourth. The favorable decline has continued to date.

Observations were made concurrently on methods of improving the timing of applications. Dustings were adjusted in such a way as to anticipate the seasonal rise of flea populations and to space the dustings so as to take maximum advantage of the residual effect of DDT in suppressing the flea populations and the disease among the rats. Whereas during 1945 and 1946 premises were dusted two, three, and even four times in most States, the number of dustings in succeeding years was reduced to one per year or one in alternate years, or even less frequently.

Results varied with the number of years succeeding the initial dusting. Whereas the number of reported cases in counties with organized cooperative dusting programs in the typhus States in which no dusting was done dropped only about one-half by the end of 1948 (as compared with the number of cases that occurred in the same counties in 1944), the number of cases in counties in which dusting was done during 2 years (1945 and 1946) dropped by more than three-fourths. Even when dusting was done during only 1 year (1947), the drop by the end of 1948 was nearly as great (cases in 1948 compared with those in 1946).

Increasingly also, advantage was taken of the long-term control, to do "pin-point" dusting. Instead of relying on the original wide coverage of affected counties, increasing attention was given to dusting only in premises in which the occurrence of human typhus, large oriental rat flea populations, or heavy rat infestations indicated that dusting was needed. Reliance was placed in past applications, in surveillance, and certain rat-control measures to prevent recurrence of human cases in many of the premises formerly productive of typhus.

Generally speaking, the typhus problem from the viewpoint of control of fleas and rats has four phases, dependent on whether or not it is acquired in the following locations:

Artificially heated premises

Urban business establishments

Urban residences

Rural residences

Unheated premises

Rural farm buildings

Applications of dust, followed by control measures for the rats, are made after appraisal of the nature of the typhus problem, and appraisal of effectiveness of dusting being done in those types of premises that gave signs of being troublesome. In this way, it is possible to reduce the number of typhus cases almost 100 percent in certain counties. This frequently is done more easily in the northernmost of the States in which typhus is common, because the cases generally are acquired in a relatively few premises which are heated artificially. It is more difficult in the more southern areas because the numbers of infested fleas are distributed more widely, cases occurring in unheated as well as heated buildings.

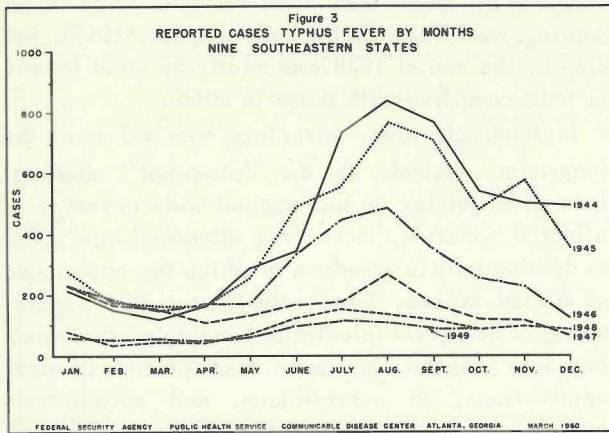
Whereas the greatest number of reported typhus cases originally occurred during August and

amounted to more than 800 during 1944, the peak has been reduced to less than one hundred – and during the peak month which is now July (fig. 3).

In the meantime, permanent control measures aimed at suppression of domestic rat populations were continued in the hope that the more-or-less temporary relief, achieved by destruction of the fleas, might be prolonged by suppression of rat

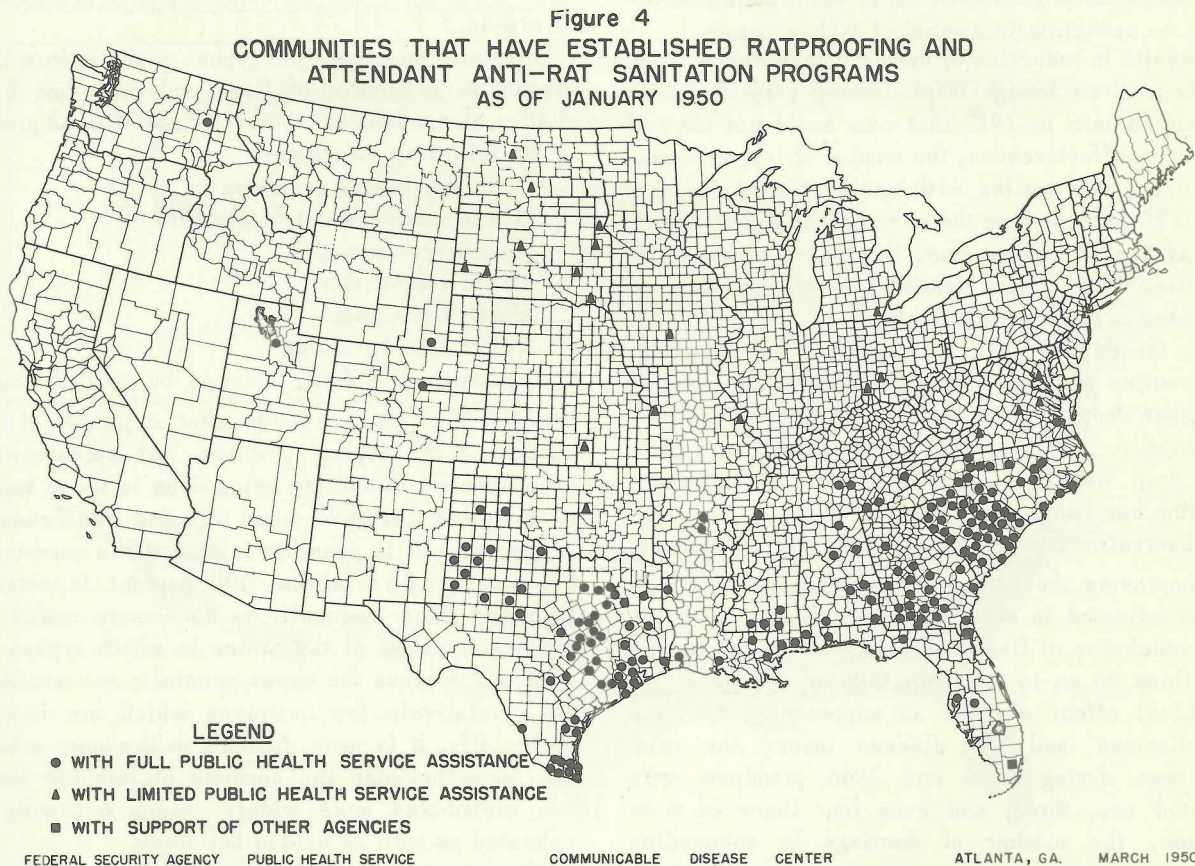
populations. Ratproofing and back-lot and alley-sanitation programs were carried to many new communities. Forty-eight cities and towns had ratproofing and attendant antirat projects in operation during 1949. One hundred and twenty-one had completed their programs and were maintaining both the proofing and back-lot and alley sanitation under guidance and assistance of the Public Health Service and the State health services through cooperative programs (fig. 4).

This program also has proved instrumental in reducing the danger of occurrence of plague among domestic rats in mid-Texas, where plague occurs among native wild rodents, as well as in reducing the number of cases of murine typhus during the years since initiation of the program.



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EFFECTIVENESS OF DDT DUSTING IN CONTROLLING RAT ECTOPARASITES AND TYPHUS INFECTION IN RATS

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The effectiveness of DDT dusting operations in reducing the hazard of transmission of murine typhus to man is measured by two methods: (1) the reduction in rat ectoparasites and (2) the reduction in typhus infection in rats. The effect of this work in reducing human typhus can be measured of course only in the reduction occasioned in the number of reported human cases. Reduction in rat ectoparasites usually takes place within 1 or 2 days after dusting, whereas a year or more may elapse before the full import of the reduction in human typhus is apparent. Typhus in this country is a disease of rats which man acquires by accident. During the period 1945-49 approximately 18 percent of all rats tested proved positive for typhus. During these

same years, an average of 2,485 human cases was reported per year in the nine Southeastern States (including and south of North Carolina and Tennessee, plus Louisiana and Texas), for an over-all average case rate of 92 per 10,000 or 0.009 percent. Thus it is observed that typhus is approximately 2,000 times more prevalent in rats than in man. This comparison is justified if one considers that rats probably live only about 1 year in nature and that most infections therefore are more or less recent. Since infection rates in rats are so much higher, they are considered to be much more significant statistically in measuring present typhus reduction and also in indicating probable future typhus incidence in man.