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## Control of Norway Rats With Residual Rodenticide Warfarin

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The discovery by Dr. Karl Paul Link and his associates (1, 2) of the chemical now called warfarin<sup>1</sup> and their recognition of its rodenticidal properties (3) provided a completely new practical approach<sup>2</sup> to rodent control. The new material differs from all previously used successful rodenticides in two respects: it kills effectively only when consumed repeatedly and it produces no acquired bait refusal or bait shyness in the rodents being poisoned.

This paper reports several laboratory and field tests aimed at evaluating the usefulness for public health of this new approach to chemical rodent control. The evaluation has not been completed by any means, but one method of using warfarin for the control of Norway rats has been tested and found effective, and the over-all cost of the method has been explored.

All of the tests were done at Savannah, Ga., where the classical studies of murine typhus were conducted by Maxcy many years earlier (4, 5, 6). Some of the field tests were done in the very heart of the old typhus focus, and some were done in stores in which the rodenticides, 1080 or ANTU, had recently been used by experienced personnel with only partial success. The control of rats under these conditions is obviously significant for public health.

### Materials and Methods

The rats used for laboratory tests were adult male and female albino and wild Norway rats. The wild rats were hand caught from

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<sup>1</sup> Chemically, the compound is 3-( $\alpha$ -phenyl- $\beta$ -acetyloethyl)-4-hydroxycoumarin or 3-( $\alpha$ -acetylbenzyl)-4-hydroxycoumarin. Both names have been approved by Chemical Abstracts but the latter is the one currently in use. During its trial period the compound was known as compound 42 or W.A.R.F.-42. It was called "42" because it stood 42d in a table in one of the original publications (1). The initials "W.A.R.F." and the first letters of the name, warfarin, stand for the Wisconsin Alumni Research Foundation which owns the patent (No. 2,427,578-9 September 16, 1947).

<sup>2</sup> The approach with Dicumarol was similar but impractical. See discussion in the body of this paper.

garbage dumps and were held for at least 1 week in the laboratory before being placed in tests. During this interval unhealthy or otherwise abnormal rats were discarded. During the test period rats were individually caged in Army Medical School type cages and supplied with an adequate amount of food and water.

The compound for stomach tube tests was suspended in vegetable oil at different concentrations so that the oil could be administered to rats at the rate of 0.005 cc. per gram of body weight.

The dry poisoned baits were prepared by mixing the appropriate amount of warfarin<sup>3</sup> into the bait with an ordinary kitchen-type electric food mixer. In preparing baits containing low poison concentrations, the poison, an amount of cornstarch 100 times the weight of the poison, and, finally, enough meal to make up the total quantity of bait were weighed out separately in advance. The poison and cornstarch were thoroughly mixed. A volume of meal approximately equal to that of the poisoned bait was then added and mixed, and this procedure was continued until all the meal had been used up. Each separate mixing required at least 15 to 20 minutes. Coarse, yellow, germ-free corn meal of a quality suitable for cooking was used as a bait for warfarin in all of the field and some of the laboratory tests. Ground Purina laboratory chow was used as a poisoned bait in other laboratory tests and in all the simulated field tests. The yellow corn meal has proved to be, in this area, the best accepted, readily available, moderately priced bait material. It is also a good semi-permanent bait, one with good keeping quality, and one which is not likely to be carried from the bait station uneaten. Whole meal is slightly preferable, but the degerminated meal that can easily be obtained from grocery stores is quite satisfactory.

The poisoned baits were offered in the laboratory to the rats along with a choice of a poison-free bait. Thus, none of the rats were forced to take poison in order to eat. The poisoned and poison-free baits were offered in separate nonspillable food cups which were attached side by side to the rear of the cage floor. The baits were weighed daily or every other day and the consumption of each bait computed.

The poisoned meal was dispensed in the field in small glass bowls of approximately 300 cc. capacity. In places where there was any danger of the meal being picked up by children or knocked about by workmen so that it could contaminate other food, a simple station was used as a protective cover for the poisoned meal (fig. 1). The station was constructed of  $\frac{3}{4}$ -inch lumber and  $\frac{1}{2}$ -inch mesh hardware cloth. A hole  $2\frac{1}{2}$  inches by 4 inches at each end of the station served as an opening for rats to enter and leave the station. The station was screwed to the floor or wall. The size opening used was necessary

<sup>3</sup> The warfarin employed in these studies was supplied through the kindness of the Wisconsin Alumni Research Foundation. It was the pure enolic form and not the 0.5 percent dilution in starch which is currently available.

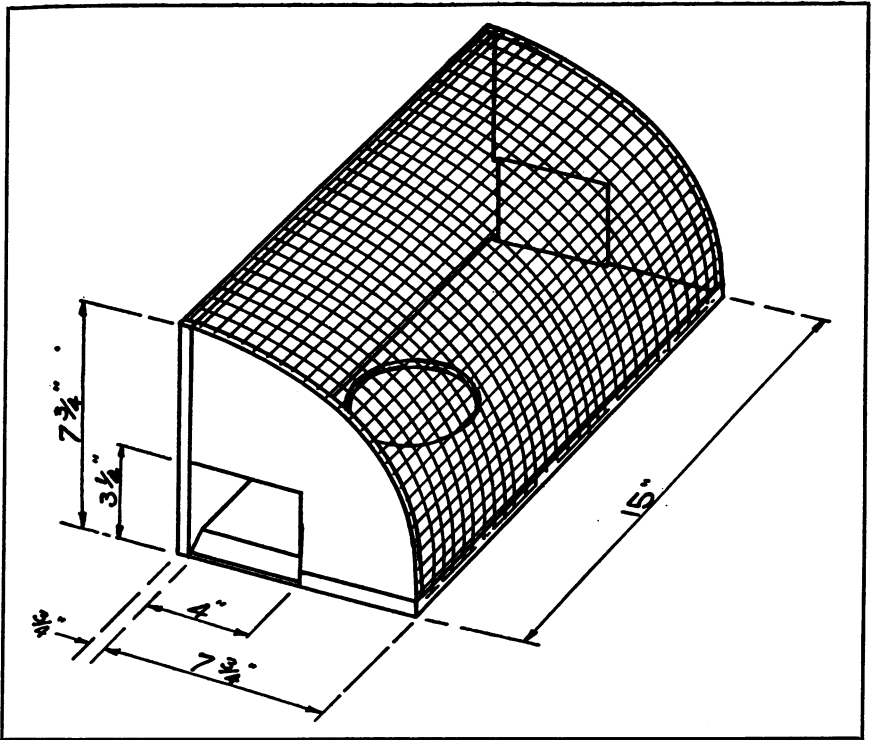


Figure 1. Poison bait station of the type used in field tests with warfarin. The  $\frac{1}{2}$ -inch hardware cloth was secured to a frame of  $\frac{3}{4}$ -inch lumber. The diameter of the hole in the bottom which secured the bait cup in position was  $4\frac{1}{2}$  inches.

in order to remove the bait dish for cleaning out molded or otherwise contaminated baits. Refilling was done through the hardware cloth without removing the dish.

Simulated field tests with wild Norway rats were conducted in four wooden, barracks-type buildings measuring about 20 by 100 feet which were ratproofed and supplied with ample harborage, consisting of boxes, paper, and other rubbish. Each building was artificially infested with rats (including immature rats in two buildings) at least 6 weeks before the tests were started. Before and during the test period the rats were maintained with liberal supplies of corn meal and wheat shorts as well as water. In the tests, poisoned ground Purina laboratory chow bait was placed in open bowls at eight points in each building in a manner similar to field control methods. At the end of each test, the harborage was removed piece by piece and every living and dead rat accounted for.

In field tests, estimates of the extent of rat infestation before and after poisoning were based on observations of live rats, damage to merchandise, tracking dust tests, and recovery of dead rats. No

establishment was considered rat-free until tracking tests revealed an absence of rats for at least a week.

Field tests were conducted in rat-infested business establishments. In some instances a few mice as well as Norway rats were present; there was no evidence of roof rats. The occupants of these places complained of severe rat damage to merchandise. In many cases live rats were seen during the day. The establishments fell into three general groups:

(a) Two complete city blocks in the center of the business district, surrounded by paved streets, and containing stores devoted almost exclusively to food handling. This is one of the classical foci of murine typhus.

(b) Fifteen grocery and other food handling stores located almost entirely in slums.

(c) One stockyard and abattoir, one grocery store, and one airport outside of town and isolated from other foci of rat infestation.

At the time these studies were made it was not considered desirable to use warfarin in homes.

So far as could be observed, or learned from others, ratproofing had never been attempted except in the two city blocks (group a). These had been ratproofed in 1940 almost 10 years before the present study was begun. The work had fallen into such disrepair that no real ratproofing could be said to exist. Block No. 1 consisted of very old, three-story buildings with dirt floor basements chiefly used for storage. Block No. 2 consisted of the City Market Building which, for the purpose of this study, was divided into seven establishments on the basis of the type of business conducted in each particular section. The main floor was treated as one establishment since the floor is generally open except for a large refrigerator at each end. The basement was divided into large sections in such a way that one business place was separated from another by solid brick walls. There were, however, passages which rats could use to get from one section to another, and the concrete floor was imperfect in places so that rats were able to burrow beneath it.

## Results

### *Toxicity of Warfarin to White Rats in Stomach Tube Test*

Warfarin was administered by stomach tube to white rats fed *ad libitum* on Purina laboratory chow, a diet sufficient in vitamin K to maintain rats well under normal laboratory or field conditions. It was realized that animals on such a diet would be somewhat less susceptible to the toxic action of warfarin than rats on an inferior diet and that vegetable oil used as a diluent might have further antidotal action. However, the test was designed to compare the effect of war-

farin upon rats, when given daily, with its effect upon them when administered every other day for a specific number of doses under conditions of normal diet. The test was also designed to show the degree of mortality which warfarin in various multiple doses will produce.

One series of tests consisted of administering single doses of 3.0, 2.0, 1.0, 0.50, 0.25, and 0.125 mg. of warfarin per kilogram of body weight, daily for 5 consecutive days. Another series of tests consisted of administering the poison to rats in single doses of 5.0, 3.0, 2.0, 1.0, 0.75, and 0.50 mg./kg. every other day until a total of five doses was administered. Tests at critical dosage levels were repeated as a check.

The results of these stomach tube tests, presented in table 1, indicate that, under the conditions of the experiment, warfarin is capable of killing 90 percent or more of rats in 2 to 12 days when given at a total dosage of 5 mg./kg. and it is, at critical dosage levels, slightly less effective when the separate doses are given on alternate days rather than on successive days. A total dosage of 2.5 mg./kg. killed but one of the 10 rats tested although it caused symptoms of intoxication in 7 of them. Undoubtedly, lower concentrations would have killed rats more effectively if the doses had been repeated more than five times.

The results of these stomach tube tests may have been somewhat prejudiced as shown by the pathology of the animals which died (see below). Even so, if a total dosage of 5 mg./kg., to be consumed over

Table 1. Mortality among 21 groups of 9 or 10 white rats each given stomach tube administrations of warfarin in vegetable oil until death or until a maximum of five doses were given. The rats were maintained on Purina laboratory chow during the test.

Frequency of administration	Single dose (mg./kg.)	Mortality			Survival time (days)*
		After 3 doses only	After 4 doses or less	After 5 doses or less	
Daily.....	3.0	2/10	5/10	10/10	3-6
	2.0	1/10	3/10	9/10	3-6
	1.0	0/10	3/10	10/10	4-12
		1/10	5/10	8/10	2-7
	.5	0/10	0/10	7/10	5-8
		0/10	1/10	4/10	4-6
	.25	0/10	0/10	2/10	7
		0/10	1/10	3/10	3-7
	.125	0/9	0/9	0/9	-----
		0/10	0/10	0/10	-----
Every other day.....	5.0	4/9	8/9	9/9	2-8
	3.0	6/10	9/10	10/10	4-8
		8/10	9/10	9/10	3-7
	2.0	4/10	5/10	9/10	6-10
		4/10	5/10	8/10	3-13
	1.0	3/10	6/10	8/10	5-11
		3/10	3/10	6/10	5-13
	.75	0/10	1/10	1/10	7
		2/10	2/10	4/10	6-13
	.5	0/10	0/10	0/10	-----
0/10		1/10	**1/10	7	

\*Includes only rats which died.

\*\*Rat pregnant, extensive hemorrhage in left horn around placenta.

a period of 5 days, be hypothetically considered the minimum requirement for efficient poisoning, then it is clear that a 200 gm. rat would have to eat different quantities of poisoned bait daily depending on the concentration of the poison in the bait. These relationships are shown in table 2. They suggest that concentrations of poison in bait as low as 0.10 or even 0.05 mg./gm. might be effective for field use since it is reasonable to assume that commensal rats might be enticed into taking roughly 11 or even 22 percent of their food in the form of poison bait.

Table 2. Amount of poisoned bait of different concentrations necessary to provide 1 mg. of poison per kilogram of body weight daily to a 200-gm. rat. The percentage of the total daily food intake is also given based on an average intake of 17.5 gm. of food per 200-gm. rat per day. Actually such rats consume 12 to 20 gm. of dry food per day.

Concentration of poison in bait	Amount of bait required daily to give 1 mg. of poison	
mg./gm.	gm.	Percent of total food
1.0	0.2	1
.5	.4	2
.25	.8	5
.10	2.0	11
.05	4.0	22

### Poisoned Bait Acceptance by Wild Norway Rats in Laboratory Tests

Groups of 10 wild rats each were offered the compound at dosage levels of 1.0, 0.5, 0.3, 0.2, and 0.1 milligrams per gram of bait. The test continued until the death of all rats in each group. Results are shown in table 3. All the rats died within 9 days after feeding started. None died before the third day of feeding and all offered bait at 0.1, 0.2, and 1.0 mg./gm. died within 1 week of testing. It would seem that dosages higher than 0.1 mg./gm. have no advantage. With the exception of the group offered the 0.5 mg./gm. concentration, each group took, on the average, slightly less poisoned bait than poison-free

Table 3. Mortality among five groups of 9 or 10 wild Norway rats offered warfarin in ground Purina laboratory chow until death. A choice of the same food without poison was also offered.

Body weight (gm.)		Warfarin in poisoned bait (mg./gm.)	Food consumption per rat (gm.)				Mortality		Survival time (days)
Range	Mean		Poisoned		Poison-free		First week	Total	
			Range	Mean	Range	Mean			
162-258.....	201	1.0	3.0-27.0	14.8	15.5-33.0	22.6	9/9	9/9	4-6
150-354.....	244	.5	17.5-63.0	35.0	2.5-115.0	26.0	8/10	10/10	3-8
223-378.....	304	.3	4.0-28.0	17.5	26.0-92.5	47.9	9/10	10/10	5-9
160-446.....	252	.2	5.5-47.5	20.1	17.0-59.5	43.2	10/10	10/10	4-7
155-288.....	205	.1	6.5-26.0	17.6	7.5-50.5	20.8	10/10	10/10	3-7

food of the same kind; this is inconclusive evidence that wild Norway rats detect warfarin in bait and show a slight primary bait refusal. What is more to the point, the test gave no indication of acquired bait refusal or bait shyness since there was no indication that any of the rats decreased their consumption of poisoned bait more rapidly than their consumption of poison-free food (see table 4). There was, of course, an absolute decrease in the amount of both kinds of food taken as poisoning progressed, but the amount of poison taken was sufficient to cause death.

Table 4. *Bait consumption of wild Norway rats in the face of progressive warfarin poisoning when offered poisoned and poison-free ground Purina chow. The rats are the same as those shown in table 3.*

Warfarin in poisoned bait (mg./gm.)	Day	Food consumption per rat (gm.)				Number rats alive
		Poisoned		Poison-free		
		Range	Mean	Range	Mean	
1.0	1 and 2	3.0-21.0	8.1	3.5-25.0	15.8	10
	3 and 4	0 -12.0	5.1	0 -14.0	7.3	10
	5	0	0	0	0	7
	6	0	0	0	0	1
	1	1.0-20.0	8.3	0 -19.0	2.6	10
	2	7.5-19.5	13.0	0 -18.5	6.1	10
	3	2.5-20.0	9.9	0 -20.0	7.6	10
	4	0 -17.5	5.7	0 -20.0	5.2	10
0.5	5	0 - 5.0	.7	0 -20.0	2.2	10
	6	0	0	2.0-18.5	3.4	6
	7	0	0	0	0	4
	8	0	0	0	0	2
	1 and 2	0 -26.0	11.4	23.0-30.0	24.7	10
	3 and 4	0 -35.0	9.5	0 -41.0	21.6	10
	5 and 6	0	0	0	0	5
	7 and 8	0	0	0 - 6.5	6.5	1
0.2	1 and 2	0 -45.5	10.5	0 -52.0	18.2	10
	3, 4, and 5	0 -38.0	11.3	0 -36.0	15.8	10
	6 and 7	0 - 2.5	6.7	0 - 8.0	2.0	6
	1	2.0-16.0	7.4	0 -15.0	6.7	10
	2	3.0-11.5	6.0	0 - 9.5	5.0	10
0.1	3	0 - 4.0	1.6	0 -12.0	4.2	10
	4	0 - 6.0	2.2	0 -12.0	3.5	9
	5	0 - 4.0	1.0	0 -3.5	1.1	7
	6	0	0	0	0	4
	7	0	0	0	0	2

### *Survival of Albino Norway Rats in Relation to Poison Dosage*

Dosages of 0.05, 0.025, 0.0125, 0.00625, and 0.003125 of warfarin per gram of bait were tested against groups of 10 white rats each. Each rat was offered poison in corn meal bait and a choice of poison-free ground Purina laboratory chow. A study of table 5 and figure 2 shows that none of the rats survived longer than 2 weeks except those offered dosages of 0.00625 and 0.003125 mg./gm. Poisoning was discontinued in the group receiving 0.00625 mg./gm. of bait at the end of 2 weeks and one animal survived until the 18th day. It showed typical pathology at autopsy. Eight rats died during a 40-day exposure to the 0.003125 mg./gm. dosage. However, one rat succumbing on the 20th day, died of pneumonia, although subcu-

Table 5. *Mortality among white rats fed warfarin-poisoned corn meal at various dosages. Rats were offered a choice of poison-free laboratory chow. Rats in the first four groups were offered poison for 2 weeks or until death; rats in the last group were offered poison for 40 days or until death. The greater bait consumption of the last two groups corresponds to their longer survival.*

Warfarin (mg./gm.)	Weight of rats (gm.)		Total poisoned bait consumed per rat (gm.)		Total warfarin consumed per rat (mg.)		Poison-free bait consumed per rat (gm.)		Mortality	Survival time (days)*	
	Range	Mean	Range	Mean	Range	Mean	Range	Mean		Range	Mean
0.05-----	203-376	227	39.0- 66.0	57.1	1.95-3.30	2.85	0.0-91.0	23.2	10/10	5-14	7
0.025-----	205-308	223	44.0- 98.5	65.4	1.10-2.46	1.64	4.5-43.0	16.9	10/10	6-10	7
0.0125-----	200-376	244	34.0- 89.0	64.9	.43-1.11	.81	2.5-55.0	23.2	10/10	6-13	9
0.00625-----	183-325	240	59.5-152.0	110.9	.37-.95	.69	5.0-57.0	28.0	10/10	8-18	12
0.003125-----	240-406	318	94.5-338.5	210.8	.28-1.02	.63	15.0-94.5	51.5	8/10	10-32	21

\*Based on rats which died.

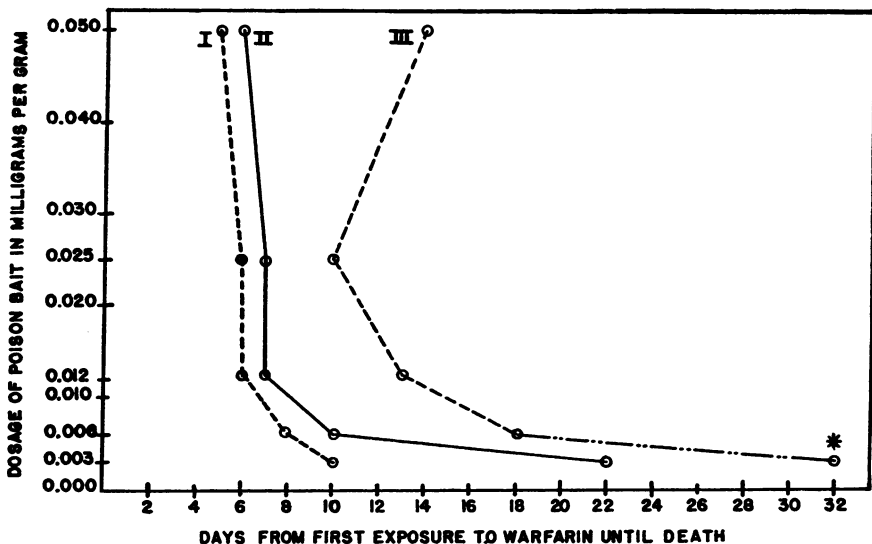


Figure 2. Survival time in days of white rats fed warfarin at various dosage levels in yellow corn meal as well as a choice of poison-free ground Purina laboratory chow. All rats were fed until death or for a maximum of 14 days except those offered poisoned bait at the 0.003125 mg./gm. level where the maximum was extended to 40 days. Curve I represents the survival time of the first, curve II the fifth, and curve III the last rat dying in each group. The point marked with an asterisk is based on the eighth and last animal which died in its group of 10.

taneous hemorrhage was noted in the head. The two remaining rats in this group survived, although at the end of 40 days one showed external signs of poisoning. With a bait concentration of 0.025 mg./gm. or higher, there appeared to be no important difference in the survival time of rats; at lower concentrations the survival time gradually increased (fig. 2). This must be interpreted in the light of the fact that in these tests the acceptance of ground laboratory chow was poor and the acceptance of poisoned corn meal bait corre-



spondingly high. The rats took 71 to 81 percent of their total diet in the form of poisoned bait. Obviously, such a rate of bait consumption could not be expected regularly in the field. One might, then, expect a gradual increase in the survival time of rats in the field if baits containing less than 0.05 mg. of poison per gram of food were used. However, if time were not a factor, it is conceivable that dosages even lower than 0.05 mg./gm. might be effective. Such doses would be somewhat cheaper and present slightly less hazard. The results emphasize that if rats do show a very light primary bait refusal because they detect warfarin (a point which has not been established), then this can be more than compensated by offering the poison in a more acceptable bait.

It is interesting to note that those rats which were offered a concentration of 0.00625 mg./gm. for 14 days all died, having consumed a total of 1.82 to 3.90 mg./kg., an average of only 0.69 mg. of poison per rat or 2.87 mg. of poison per kilogram of body weight.

### *Simulated Field Tests With Wild Norway Rats*

Because rats decompose so rapidly in warm weather, warfarin was exposed to wild rats in barracks-type buildings only for a maximum of 7 days. The results with concentrations of 1.0, 0.1, and 0.05 mg. of warfarin per gram of ground laboratory chow are shown in table 6. Satisfactory kills (85 to 100 percent) were obtained at all the dosages tested. By comparison, similar tests with other poisons produced the following range of mortality: ANTU 50 to 80 percent, thallium sulfate 72 to 94 percent. Three buildings were used in the ANTU tests and 10 buildings were used in the thallium sulfate experiments; these poisons were exposed overnight in the usual manner. Simulated field tests appeared to confirm the indication of laboratory studies that warfarin would be an effective rodenticide against Norway rats under field conditions at a concentration at least as low as 0.05 mg./kg. This was particularly true since the baiting period was too short for optimum results and the ground laboratory chow is not so acceptable as corn meal, the bait used in field studies.

Table 6. *Mortality among wild Norway rats living in a simulated natural habitat and fed on corn meal and wheat shorts when offered warfarin in ground Purina laboratory chow*

Building No.	Amount warfarin in bait (mg./gm.)	Number days bait in building	Number of rats		Percent mortality
			Total	Dead	
1.....	1.0	6	107	107	100.0
2.....	1.0	5	61	52	85.2
3.....	.1	7	25	24	96.0
4.....	.05	7	19	18	94.7

## Field Tests

Actual field tests with warfarin were begun in the summer of 1949 before the complete results of the laboratory and simulated field tests became available. For that reason, tests were started with high concentrations of the poison (1.0 and 0.5 mg./gm.). Later, as evidence accumulated on the potency of the compound, the concentration was lowered to 0.1 and then 0.05 mg./gm.

Ten of the places tested had been poisoned one or more times by a municipal typhus control unit or by pest control operators within the 12-week period preceding tests with warfarin. Sodium fluoroacetate and ANTU had been used in different establishments as shown in table 7.

Table 7. *Recovery of dead rats from establishments poisoned with rodenticides other than warfarin within 12 weeks before poisoning with warfarin*

Kind	Poison		Establishment No.	Number of rats recovered
	How used	Shortest time in weeks to nearest week before use of warfarin		
1080	Permanent stations.....	1	1	8
	Permanent stations.....	1	4	10
	Permanent stations*	1	9	( <sup>1</sup> )
	Overnight 2 times**	4	11	100
	Overnight 4 times**	4	13	118
	Overnight once.....	11	14	10
	Overnight once.....	11	15	3
	Overnight 5 times**	5	16	156
	Permanent stations*	1	20	( <sup>1</sup> )
ANTU in solid bait.....	Exposed for 3 days.....	3	34	120

\*1080 not properly protected.

\*\*Not consecutive nights.

<sup>1</sup> Not known.

Tests were discontinued in establishments 6, 7, and 9. However, wherever possible, warfarin is being maintained in stores and warehouses indefinitely to evaluate it as a residual rodenticide. The results of tests with warfarin extending over a maximum of 284 days are outlined in table 8.

Rat infestation was, in general, controlled within 2 to 3 weeks at all of the dosage levels tested. There was no apparent advantage in the other concentrations over the 0.05 mg./gm. level as regards speed of kill or other factors. In many cases, tracking tests indicated the presence of a few rats for one or more weeks after the occupants had declared that injury to merchandise had stopped. However, the rat populations were gradually brought under control at rates which varied with the difficulty of the local situation. In 4 of the 31 places studied rats were never eliminated at any time. This was probably due in two instances to continual reinfestation from outside; in one instance to baiting problems; and in one instance to poor cooperation on the part

of the occupant of the premises and consequent discontinuance of the test. After control was achieved, some of the establishments would

Table 8. Results of field tests against Norway rats with warfarin in yellow corn meal

Treatment with warfarin					Establishment			
mg./gm. of bait	Duration days	Number dead recovered			Number bait placements	No.	Type	Remarks
		During		Total				
		First week	First 2 weeks					
0.1†-----	284	3	13	27	11	*1	Poultry abattoir.	Initial infestation moderate. Failed to achieve control with permanent 1080 bait stations in place 63 days. No further rat damage after 1 month.
	245	15	27	40	6	*2	Grocery store..	Initial infestation heavy. Generalized odor detected 2d week. 36 rats recovered 1st month. No rat damage after 2 weeks.
	240	*6+1	*16+2	*19+3	9	*3	Small animal hospital.	Initial infestation moderate. No rat damage after 2 weeks; 19 dead rats recovered during 1st month.
	242	0	7	7	6	*4	Pastry bakery.	Initial infestation light. Failed to get control with permanent 1080 bait stations in place 42 days. No rat damage after 3 weeks.
	270	0	*0+2	*0+4	5	*5	Grocery store..	Initial infestation light. No rat damage in store or in residence above store after 3 weeks.
	29	*1+3	*2+4	*2+4	6	6	Grocery store..	Initial infestation light. No signs of rats or mice after 2 weeks. Bait stations removed on 26th day.
	28	0	*6+2	*6+2	7	7	Airport hangar	Initial infestation moderate. No signs of rats or mice after 2 weeks. Bait stations removed on 28th day.
	204	0	0	*0+1	7	8	Drug store....	Initial infestation light. Manager failed to achieve control with other poisons. Infestation eliminated 4 weeks after starting use of warfarin.
	92	0	2	*2+4	5	9	Grocery store..	Initial infestation moderate. Exterminator using 1080 failed to achieve control. Damage reduced first 2 weeks with warfarin but never eliminated.
	190	7	8	*13+1	37	11	Poultry abattoir.	Block No. 1.—Initial infestation heavy especially in No. 16. No rat damage after 2 weeks. Tracking test indicated a very light rat infestation still present in establishment 16. See discussion.
		1	*1+1	*1+1	7	12	Wholesale produce.	
		*6+1	*7+1	*8+1	17	13	Peanut roasters.	
		7	14	14	17	14	Wholesale produce.	
		0	0	1	3	15	Furniture store.	
		45	*68+1	*86+1	23	16	Poultry abattoir.	
		13	42	70	22	17	Main floor meat and vegetable mkt.	
	181	0	*3+2	*3+2	7	18	Poultry abattoir.	Block No. 2.—Initial infestation heavy. Establishments combined constitute Savannah City Market, which is surrounded on all sides by paved streets. Establishments all rat-free at end of 2 weeks except Nos. 17 and 20 where rats were harboring in refrigerator insulation and feeding on inside. Market rat-free after 1 month except for occasional rat on main floor revealed by tracking tests. See discussion.
1		1	1	5	19	Basket and crate storage.		
1		*3+1	*4+1	18	20	Wholesale meat mkt.		
27		31	31	19	22	Wholesale produce.		
0		*0+1	*0+1	5	23	Basket and crate storage.		

See footnotes at end of table.

Table 8. Results of field tests against Norway rats with warfarin in yellow corn meal.—  
Continued.

Treatment with warfarin					Establishment				
mg./gm. of bait	Duration days	Number dead recovered			Number bait placements	No.	Type	Remarks	
		During		Total					
		First week	First 2 weeks						
0.05	137	3	10	17	6	25	Grocery store.	Initial infestation moderate. Rat damage ceased after 3 weeks. Rat-free after 6 weeks.	
	137	1	*7+1	*9+1	10	26	Grocery store.	Same as for establishment No. 25. Initial infestation light. No signs of rats since 2d week.	
	137	0	*4+1	*4+1	6	27	Fish market....		
	134	3	*4+1	*6+1	10	28	Grocery store.	Initial infestation moderate. No rat damage after 2d week. Occasional signs of rats revealed by tracking tests.	
	150	*0+1	*5+1	*5+2	6	29	Grocery store.	Initial infestation light. Signs of only one rat after 2d week. Damage ceased. Rat-free at end of 3 months.	
	147	1	*1+?	*1+? 3 mice	7	30	Grocery store.	Initial infestation light. Manager saw live rats in store during daylight before use of warfarin. No signs of rats after 2d week. Very few mice. Generalized odor during 2d week.	
	141	{	0	0	0	3	31	Grocery store.	Initial infestation light. Rats previously damaging goods severely. No signs of rats after 2 weeks. Generalized odor.
	0		1	1	6	32	Grocery store.		
	120	25	113	267	53	34	Stock yards and meat packing plant.	Initial infestation heavy. 120 rats recovered following use of ANTU 3 weeks previously. Rats practically eliminated from stockyards within 1 month after starting use of warfarin. Very few signs of rats around abattoir after 3 months. 146 rats recovered during 1st month. See text.	

\*Additional dead rats indicated by odor.

†Establishments 1 and 2 treated with 1.0 mg./gm. and establishments 3, 4, and 5 treated with 0.5 mg./gm. dose level up until time blocks 1 and 2 were poisoned.

remain rat-free for a month or longer. When there was reinfestation by rats or mice, they were eliminated before any apparent damage was done to merchandise. That reinfestation was, in fact, the cause of reappearance of rats was indicated in some instances by the fact that occupants of residences near treated establishments reported that their places were gradually disinfested of rats over a much longer period than that necessary for the initial control in the treated store. In other instances, workmen reported seeing rats enter the treated areas from buildings or blocks where no poison had been placed.

Rats were controlled successfully in eight places and unsuccessfully in one additional place where 1080 had previously been used without achieving complete control.

Actually, the kill produced by 1080 had in most cases been satisfactory, but enough rats had been left alive to damage merchandise and, of course, breed back the colony. Under these circumstances

warfarin proved useful in reducing the rat population to insignificant numbers during the entire test period and in eliminating damage to merchandise.

Rats were also controlled in a combined abattoir and stockyard (No. 34) where control by ANTU had been tried. One hundred and twenty rats were recovered after the use of ANTU, and 267 more were eventually taken after the use of warfarin. This place presented special difficulties, for there were few locations where protected bait stations could be put. Further, the rats not only occupied the yards and abattoir proper but also lived in various drainage ditches into the banks of which they burrowed. They emerged to feed on the abundant refuse available in the surrounding fields where it was not considered safe to make bait placements.

Special baiting problems were encountered in certain large walk-in refrigerators located in stores Nos. 17 and 20. Rats were harboring in the insulation and had free access to abundant and varied food in the refrigerators. For an entirely unexplained reason, these rats began to take poisoned bait only after it had been in place about 2 weeks. Control was achieved during the following month in spite of imperfect bait acceptance.

#### *Effect of Feeding Warfarin-Poisoned Rats to Cats*

A stray cat had made its home in one place where warfarin was to be used at the rate of 0.1 mg./gm. Permission was obtained to poison it. It was not confined or molested in any way, but it died during the first week after apparently eating part of several sick or dead rats. Autopsy revealed the cat was pregnant. Rat skin, hair, and bone were in the stomach, and the pathology of the cat was entirely typical of warfarin poisoning.

A laboratory study was made of the hazard of warfarin to cats. A group of adult Norway rats were fed the compound in corn meal at a dosage of 0.1 mg./gm. until they became sick. Each was fed on the poisoned bait alone for a minimum of three days. The following three tests were conducted using adult cats: First, two cats, both female, were starved for 24 hours and then each was fed a sick live rat. No evidence of injury was ever detected in these cats. Second, a male cat was offered a sick live rat each day for 8 days. The rats offered on the sixth and eighth days were not eaten. The cat died on the eighth day after eating six rats. Autopsy findings revealed that death was due to the effects of warfarin. Third, a female cat was offered two sick live rats each day for 5 days. On the first day, neither rat was eaten; on the second day, one rat was eaten; and on the fourth and fifth days, both were eaten. After consuming a total of five rats, the cat survived apparently unaffected.

Dr. Link (?) has shown that secondary poisoning depends largely on warfarin still contained in the alimentary tract of poisoned rats and not on warfarin in their tissues. This, however, has little bearing on the hazard of secondary poisoning under operating conditions.

### *Pathology*

Warfarin acts by inhibiting the formation of prothrombin and by causing capillary damage. Rats and other animals exhibit pallor and weakness as they become poisoned by it. Subcutaneous hemorrhage and/or swelling due to hematoma may become visible externally especially on the appendages. Oral or rectal bleeding occurs but not in all rats. Appetite remains disproportionately good, although it does decrease. There are no convulsions or other seizures. The appearance of animals and the blood findings suggest that death is caused by shock. Most rats poisoned by warfarin lose weight. Losses up to 23 percent have been observed. Rats which survive more than a week commonly show all or most of their weight loss in the last several days. An occasional rat gains slightly. The two white rats which were fed a concentration of 0.003215 mg./gm. and survived did not lose weight, although one did show pallor of the feet and ears.

Twenty-nine white rats that died after taking poisoned baits in the laboratory and 35 wild rats that were killed in the field were autopsied as well as 61 white rats that died after stomach tube tests. At autopsy, all but 14 of these 125 rats showed one or more lesions characteristic of anticoagulant poisoning and sufficient to account for death.

Those in which pathology was recognized and which died after voluntarily ingesting baits showed either general pallor of all the organs and the musculature, and/or muscular or intramuscular or subcutaneous or intestinal hemorrhage. Less frequent were hemorrhages of the genital organs and retroperitoneal pelvic and lumbar region, and small circumscribed hemorrhages of the lungs. Hemorrhage of the brain was rare, and bleeding into the peritoneal cavity was not observed. Subcutaneous hemorrhage was more frequently observed in wild rats, but whether this was due to the rougher conditions of their lives or was a matter of chance was not clear.

The group of rats that received poison by stomach tube differed in that 23 of the 61 showed hemorrhage in the neck region and/or the mediastinum. This bleeding was clearly periesophageal and usually ended sharply at the point about midway of the chest and beyond which the stomach tube had not passed. There was rarely any extension of the hemorrhage into the chest cavity and in most cases there was no indication that bleeding into the lumen of the esophagus had occurred. Often the loose tissue of the neck or the entire thymus

gland was permeated by the blood which, characteristically, was not completely clotted and not organized. In spite of the frequency of this periesophageal lesion there was no clear evidence that rats died faster or more surely because of the procedure. In fact, death was caused by lower dosages when the poison was given by a different method. The experience does emphasize that the hemorrhage tends to start at a point of very minor trauma, for the procedure was done by an experienced operator and by a technique that causes no apparent injury or inconvenience to normal rats which do not receive warfarin.

No greater incidence or speed of poisoning was noted generally for males or females in any of the tests. Pregnant females appeared to be slightly more susceptible than nonpregnant females. No age differential was observed.

### Discussion

All of the poisons, new and old, previously available for the control of commensal rats and mice have two characteristics in common: (1) They kill when given in single doses of appropriate strength; (2) they cause, to a greater or lesser extent, an acquired bait refusal (bait shyness) in animals which happen to take a small dose so that they are only sublethally poisoned. This characteristic often makes it impossible to eradicate a colony of rats with poison bait even when several poisons and baits are resorted to in series—a common practice among pest control operators. Many of the poisons previously available also share a third characteristic: they are about equally dangerous to man and domestic animals that happen to take a single dose, as they are dangerous to rats. Unfortunately, the safer of the quick-acting poisons also tend to be the least effective for rat control.

Because of these characteristics, many efforts in the past have been directed toward: (1) discovering more toxic substances of such bland taste that rats would seldom fail to take a lethal dose the first time they encountered the poison, or (2) discovering materials to disguise the taste of the poison or attractants to induce rats to take more bait or to take it more surely, or (3) discovering more effective techniques of prebaiting, or (4) combining emetics with the poison in order to make it less hazardous, especially to man. None of these efforts have been strikingly successful.

Some of these considerations led O'Connor (8) to state the requirements for an ideal rat poison. These requirements, somewhat modified, are as follows: (1) The poison must be surely effective when incorporated into baits in such small quantity that its presence is not detected to an interfering degree. (2) Finished baits containing the poison must not excite bait shyness in any way and the necessity of prebaiting must, thereby, be avoided. (3) The manner of death must be such that surviving individuals will not become suspicious of its

cause, but will remain on the premises and eat freely of the bait until they themselves die. (4) The poison, in the concentration used for control, must be specific for the species to be destroyed unless its use can be made safe for man and domestic animals by some other means.

O'Connor, in stating his requirements, had in mind Dicumarol,<sup>4</sup> which he studied as a rodenticide.<sup>5</sup> However, the requirements remain and the first three appear to be fulfilled by warfarin. The fourth requirement appears to be better satisfied by warfarin than by the effective single-dose rodenticides presently available. Just what hazard it will present will depend on the dosage at which it is used and the method of its distribution. The present investigation indicates that warfarin may be effectively used under field conditions against Norway rats at a bait concentration of 0.05 mg./gm. (0.005 percent). This concentration is considerably lower than those actually field-tested and reported by other investigators (10, 11). Clearly, the hazard is somewhat reduced by the use of lower concentrations. This problem of hazard is discussed below in connection with the cost of operations.

Although rats in this study died in places where they could not be reached and odors were detected, it was not considered that these odors were more frequent or stronger than those expected from the extensive use of any other rodenticide.

The keeping quality of the bait under field conditions appeared to be limited only by the corn meal. Mold in warm, damp weather interferes with the acceptability of such bait, but there was no indication of a loss of toxicity of the poison.

No difficulty whatever was encountered in getting rats to enter bait stations, although they were made of new lumber. In other tests not reported here, there has been difficulty in getting rats to enter bait stations containing baffles so constructed that there was no direct path through the station.

There appears to be no reason why people generally as well as pest control specialists should not learn to use warfarin successfully; but if it is used in the pattern established for the older, quick-acting rodenticides, it obviously would fail.

Bait placements must be serviced frequently during the early period when rats are taking quantities of bait, and later, dead rats must be removed. Even so, the service time does not appear excessive when compared with the results achieved.

The cost of bait was estimated on the basis of the current price of warfarin formulations (\$2.15 per pound of 0.5 percent warfarin

<sup>4</sup> 3,3-Methylene bis(4-hydroxycoumarin).

<sup>5</sup> O'Connor reported considerable success. However, tests at this laboratory gave so little indication that Dicumarol was an effective rodenticide that the matter was dropped and no report made. Differences in results may have been based on differences in diet. The marked effect of diet and especially of vitamin K on intoxication by Dicumarol has been noted (9).



formulation) and yellow corn meal of cooking grade (\$4.05 per 100-pound bag) to be \$8.25 per 100 pounds. Bait stations were estimated at \$1.30 each, using current costs of labor and new materials. Satisfactory bait cups or bowls may be made by cutting off discarded motor-oil cans at a height of 2 inches. A can manufacturer has estimated the cost of a suitable can at \$67.03 per 1,000.

In the two complete (but small) city blocks reported in this paper, 189 bait placements were made of which 138 were in bait stations. A total of 72.2 pounds of finished bait, costing \$5.95, was used during the first 3 weeks. (Much smaller quantities were used thereafter.) By contrast, the bait stations cost \$127.40. If specially manufactured bait cups had been used, they would have cost \$12.66, making a total of \$146.01 for the two blocks or an average of \$11.23 for each of the 13 establishments. The finished bait for each of these heavily infested places cost \$0.46.

In 21 other establishments at various locations within the city, 50 pounds of bait, 125 bait cups, and 95 bait stations were used at a total cost of \$127.63 without specially manufactured bait cups. The cost per establishment was \$6.08 of which \$0.20 went for bait.

From these estimates it is clear that the use of warfarin in corn meal is an economically feasible way of controlling rats if only a few or no bait stations are required. However, if many such stations are required and if they must be bought or made from new materials at the usual wage rates, then the costs mount rapidly. Even so, bait stations are durable equipment, and it might be feasible for those permanently interested in rat control to acquire them. In this introductory study, bait stations were used wherever there was any chance that a domestic animal or a child or other irresponsible person might reach a bait placement. It is possible that safety might have been guaranteed at a much lower cost. That is a matter to be determined after further experience. There is no doubt that warfarin is highly toxic when taken in repeated doses. There also seems little doubt that it presents far less hazard when taken in the largest single dose which could be consumed at the concentration suitable for finished bait.<sup>6</sup>

From the standpoint of cost, as well as in other ways, warfarin appears admirably suited for the control of rats on ships. Here the crew can be informed of the use of the poison, the bait colored, the placements marked "POISON" and few, if any, bait stations used.

Warfarin could also be used economically on farms and around private residences where completely satisfactory bait stations could be improvised from scrap lumber at nominal cost. An 8- or 10-inch

<sup>6</sup> Most rats (all tested so far) resist a single dosage of warfarin at the rate of 50 mg./kg. To obtain this dosage, a 150-pound man would have to eat 3.5 kg. or 7.7 pounds of corn-meal bait containing warfarin at the rate of 0.1 mg./gm.

board 2 or 3 feet long can form a station if leaned against a wall at about a 45° angle and nailed to the floor and wall to form a tunnel.

If it can be used economically, warfarin should prove a valuable weapon for permanent rat control even where ratproofing is not practical. Although DDT has contributed much to the control of typhus fever through its action on rat fleas, it is possible that warfarin properly used in connection with good sanitation may become a most potent weapon for the control of typhus and plague, as well as those rat-borne diseases not transmitted by fleas.

### Summary and Conclusions

1. Warfarin provides a completely new workable approach to rodent control. It is not "just another rodenticide," but its exact role will have to be decided by further experience.

2. Because it does not cause acquired bait refusal (bait shyness), the compound is self-prebaiting and may be used as a residual rodenticide.

3. All rats tested withstood a single dose of warfarin at the rate of 50 mg./kg. Ninety percent or more of rats given the compound by stomach tube for 5 consecutive days were killed by a total dosage of 5 mg./kg. or above. Warfarin was slightly less effective when given on alternate days. All of 10 rats offered poisoned bait at a concentration of 0.00625 mg./gm., along with poison-free food, for 14 days were killed; they took an average total of 2.87 mg./kg.

4. Field trials against Norway rats, including some tests in an old focus of murine typhus and in places where 1080 and ANTU had previously been used without complete effectiveness were successful even with concentrations of 0.05 mg./gm. of bait (0.005 percent). Yellow corn meal proved an effective bait.

5. Secondary poisoning may occur if cats (and presumably dogs) eat several warfarin-poisoned rats over a period of days.

6. Warfarin produces a typical pathology that can be recognized with almost complete certainty in something over 85 percent of rats killed by it.

7. The cost and other limiting factors in the use of warfarin are discussed.

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# Industrial Sickness Absenteeism

Males and Females, 1949, and Males, First and Second Quarters,  
1950

By W. M. GAFAFER, D. Sc.\*

This report, one of a continuing series, presents data on sickness absenteeism among 225,000 male and female employees during 1949 and earlier years, and among males during the first and second quarters of 1950. Data for the series are derived from periodic reports of industrial sick benefit organizations comprising mutual benefit associations, group health insurance plans, and company relief departments. The data are limited to sickness and non-industrial injuries causing absence from work for more than 1 week. Quarterly reports covering the experience of male employees in 1949 have appeared (1, 2). The last report for females was for the year 1948 (1).

## Males and Females, 1949 and Earlier Years

*Year, 1949.* Table 1 presents frequency rates by cause for male and female workers during 1949 and 1948, and for the 10-year period 1940-49. During the year 1949, all sickness and nonindustrial injuries resulted in annual frequency rates of 95.5 absences per 1,000 males and 254.5 absences per 1,000 females. These numbers are equivalent to an average for the year of one absence of 8 days or longer for every 10 male workers and a corresponding absence for every 4 female workers.

Among males, the 1949 rate is some 9 percent below the corresponding frequency for 1948, and more than 15 percent below the 10-year frequency of 115.7. Among females, on the other hand, the 1948 and 1949 rates are similar in magnitude, both rates being more than 15 percent above the frequency recorded for the 10-year period.

For both males and females, the group of nonrespiratory-nondigestive diseases accounts for more absences in 1949 than any other broad cause group, constituting about 40 percent of the absences for each sex. Among males, the rates for specific causes in this group, and for the group as a whole, appear relatively stable in the three time periods covered. Among females, each of the rates, with one or two minor exceptions, recorded in 1949 for specific nonrespiratory-

\*From Division of Industrial Hygiene, Public Health Service.

Table 1. Annual number of absences per 1,000 persons on account of sickness and nonindustrial injuries disabling for 8 consecutive calendar days or longer, by cause; experience of male and female employees in various industries, 1949, 1948, and 1940-49, inclusive<sup>1</sup>

Cause <sup>2</sup>	Annual number of absences per 1,000 persons beginning in specified period					
	Males			Females		
	1949	1940-49 <sup>3</sup>	1948	1949	1940-49 <sup>3</sup>	1948
Sickness and nonindustrial injuries .....	95.5	115.7	104.5	254.5	218.8	257.2
Percent of female rate .....	38	53	41			
Percent of male rate .....				866	189	246
Nonindustrial injuries (160-195) .....	10.9	12.0	12.1	18.5	15.7	19.7
Sickness .....	84.6	103.7	92.4	236.0	203.1	237.5
Respiratory diseases .....	27.0	43.6	32.4	98.2	89.5	104.5
Tuberculosis of respiratory system (13) .....	.7	.7	.6	.9	.6	.4
Influenza, grippe (33) .....	8.0	17.7	10.4	24.6	31.6	31.9
Bronchitis, acute and chronic (106) .....	4.4	6.9	5.9	12.1	10.4	13.0
Pneumonia, all forms (107-109) .....	4.0	4.9	4.3	5.5	3.1	4.4
Diseases of pharynx and tonsils (115b, 115c) .....	3.4	5.0	3.6	15.9	15.6	17.6
Other respiratory diseases (104, 105, 110-114) .....	6.5	8.4	7.6	39.2	28.2	37.2
Digestive diseases .....	16.8	17.3	17.4	27.9	29.6	31.1
Diseases of stomach except cancer (117, 118) .....	5.3	5.4	5.7	3.6	3.1	4.1
Diarrhea and enteritis (120) .....	2.1	2.1	2.2	6.9	5.3	6.8
Appendicitis (121) .....	3.5	4.2	3.6	7.8	12.7	9.6
Hernia (122a) .....	2.7	2.3	2.5	.5	.6	1.4
Other digestive diseases (115a, 115d, 116, 122b-129) .....	3.2	3.3	3.4	9.1	7.9	9.2
Nonrespiratory-nondigestive diseases .....	38.5	39.4	39.7	105.3	79.1	97.0
Infectious and parasitic diseases (1-12, 14-24, 26-29, 31, 32, 34-44) <sup>4</sup> .....	2.2	2.5	2.6	9.2	5.3	5.9
Cancer, all sites (45-55) .....	.8	.6	.6	.8	.5	.7
Rheumatism, acute and chronic (58, 59) .....	3.8	4.5	4.1	5.2	4.2	5.0
Neurasthenia and the like (part of 84d) .....	1.6	1.8	1.8	11.1	10.6	11.0
Neuralgia, neuritis, sciatica (87b) .....	2.0	2.6	2.3	3.8	2.8	2.7
Other diseases of nervous system (80-85, 87, except part of 84d and 87b) .....	1.8	1.6	1.6	3.0	1.7	2.1
Diseases of heart (90-95) .....	4.4	3.9	4.3	3.0	2.2	1.9
Diseases of arteries and high blood pressure (96-99, 102) .....	2.0	1.9	2.1	1.4	1.2	1.4
Other diseases of circulatory system (100, 101, 103) .....	3.8	3.7	3.9	8.0	5.3	6.3
Nephritis, acute and chronic (130-132) .....	.4	.4	.3	.6	.4	.5
Other diseases of genitourinary system (133-139) .....	3.3	3.0	3.2	26.5	17.7	25.9
Diseases of skin (151-153) .....	3.1	3.3	3.5	5.6	5.2	6.1
Diseases of organs of movement except diseases of joints (156b) .....	2.8	3.3	3.2	7.5	5.0	6.8
All other diseases (56, 57, 60-79, 88, 89, 154, 155, 156a, 157, 162) .....	6.5	6.3	6.2	19.6	17.0	20.7
Ill-defined and unknown causes (200) .....	2.3	3.4	2.9	4.6	4.9	4.9
Average number of persons .....	210,494	2,427,654	218,419	15,116	217,472	20,728

<sup>1</sup> Industrial injuries and venereal diseases are not included.

<sup>2</sup> Numbers in parentheses are disease title numbers from International List of Causes of Death, 1939.

<sup>3</sup> Average of the 10 annual rates.

<sup>4</sup> Exclusive of influenza and grippe, respiratory tuberculosis, and venereal diseases.

nondigestive causes exceeds the corresponding rate for 1948. The 1948 rates, in turn, are generally higher than rates for the 10-year period.

*Frequency of Sickness Absenteeism, 1940-49.* Figures 1 and 2 present graphically the frequency rates for the broad cause groups, 1940-49. Notable sex differences will be observed in the variation of the rates with time. Thus, among males the frequency of all sickness and nonindustrial injuries shows a marked hump during the years 1943-45, preceded by relatively slight increases in 1941 and 1942,

and followed by decreasing rates in 1946-49; the rates for 1940 and 1949 are approximately the same (96 absences per 1,000 males). Among females, on the other hand, the rate for all causes rises from 153 absences per 1,000 females in 1940 to 258 absences per 1,000 fe-

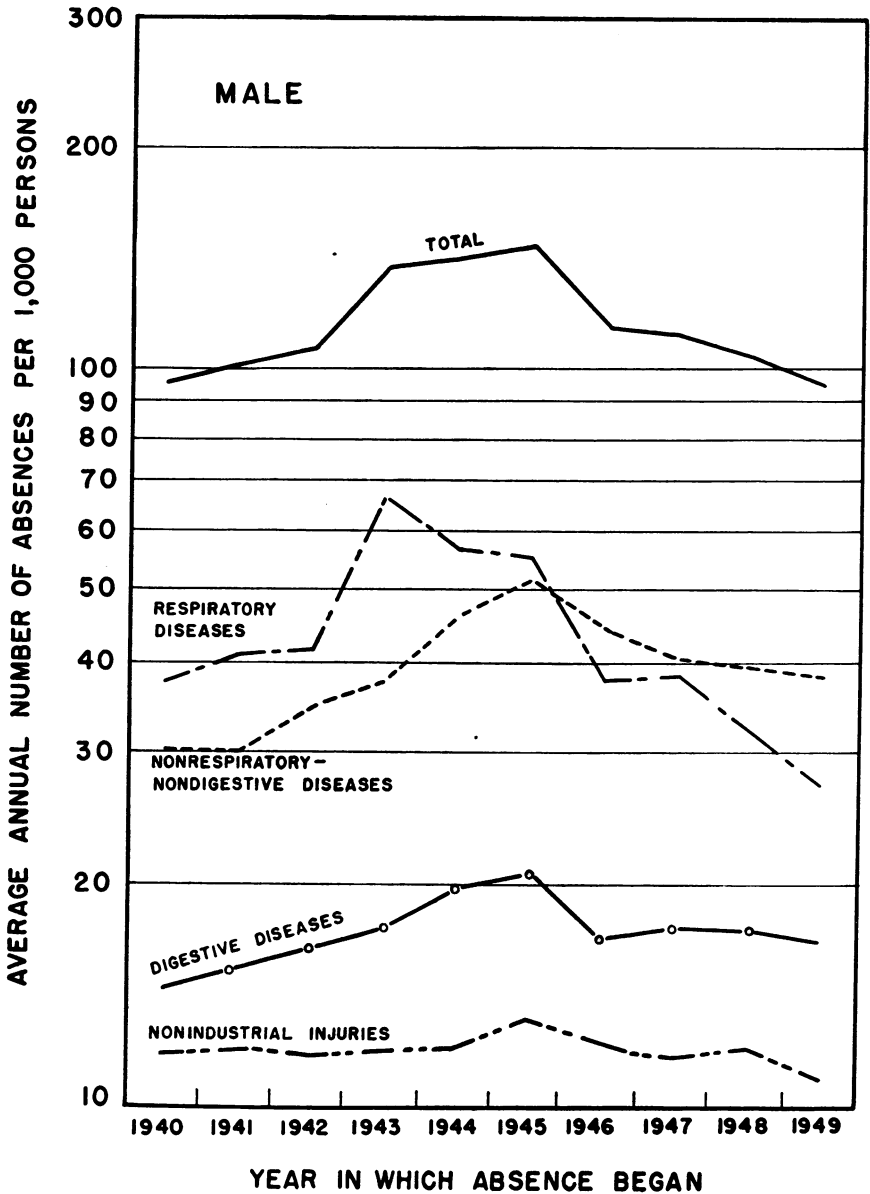


Figure 1. Annual number of absences per 1,000 persons on account of sickness and nonindustrial injuries lasting more than 1 week; experience of male employees in various industries, 1940-49, inclusive. (Logarithmic vertical scale.)

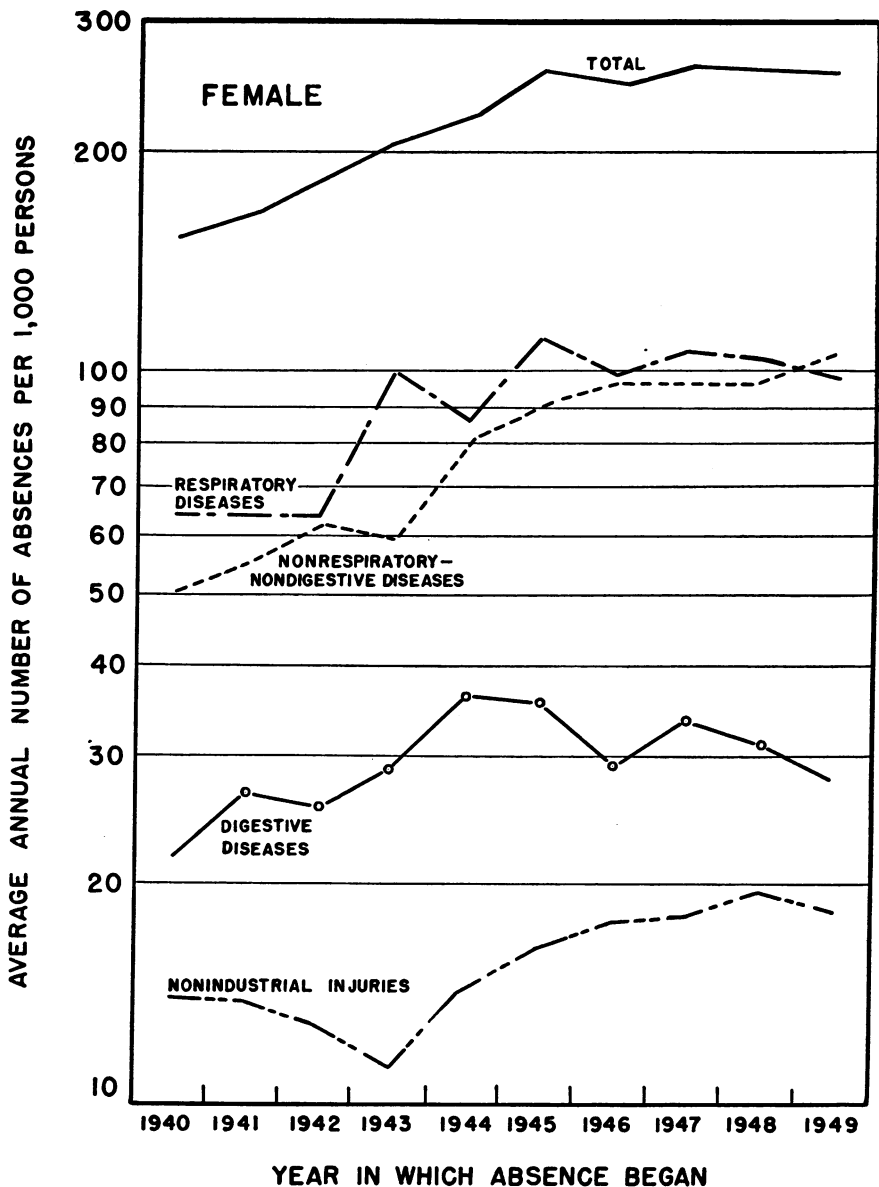


Figure 2. Annual number of absences per 1,000 persons on account of sickness and nonindustrial injuries lasting more than 1 week; experience of female employees in various industries, 1940-49, inclusive. (Logarithmic vertical scale.)

males in 1945, an increase of over 65 percent. The rates remain at this high level throughout the years, 1946-49.

Respiratory diseases among males exhibit a hump in 1943-45 which is more marked than the corresponding one observed in the frequency of all causes; moreover, the respiratory rates for 1946-49 exhibit a relatively rapid decrease, the rate for 1949 (27 per 1,000 males) being

almost 30 percent below the corresponding rate for 1940 (38 absences per 1,000 males). Digestive and nonrespiratory-nondigestive diseases among males reveal an increasing trend during the years 1940-45. They decrease in 1946 and tend to remain relatively stable in 1947-49. Attention is directed to the contribution made by each of the three disease groups to the total rate. After 1943 the increases in the non-respiratory-nondigestive and digestive groups are sufficiently high to dampen the effect on the total rate of the decreasing respiratory group. This pattern is not evident in the instance of the females.

Among females, both respiratory and nonrespiratory-nondigestive diseases show marked increases in frequency over the 10 years. In the years 1946-49, each of these two cause groups accounts for an

Table 2. *Number of absences per 1,000 males (annual basis) on account of sickness and nonindustrial injuries disabling for 8 consecutive calendar days or longer, by cause; experience of male employees in various industries, first and second quarters of 1950*<sup>1</sup>

Cause <sup>2</sup>	Number of absences per 1,000 males (annual basis) beginning in specified period						
	Second quarter		First quarter		First half		
	1950	1949	1950	1949	1950	1949	1945-49
Sickness and nonindustrial injuries.....	118.2	93.2	128.7	117.3	123.4	105.2	125.5
Nonindustrial injuries (169-195).....	14.5	10.2	11.4	11.8	12.9	11.0	12.4
Sickness.....	103.7	83.0	117.3	105.5	110.5	94.2	113.1
Respiratory diseases.....	35.4	24.9	52.9	40.6	44.2	32.8	46.1
Tuberculosis of respiratory system (13).....	6	.8	5	.6	.5	.7	.7
Influenza, grippé (33).....	11.9	6.7	20.3	14.4	16.1	10.6	17.9
Bronchitis, acute and chronic (106).....	6.1	4.4	8.4	6.1	7.3	5.2	7.3
Pneumonia, all forms (107-109).....	5.4	3.8	7.9	5.5	6.7	4.7	5.2
Diseases of pharynx and tonsils (115b, 115c).....	3.6	3.4	3.3	5.1	3.4	4.3	5.0
Other respiratory diseases (104, 105, 110-114).....	7.8	5.8	12.5	8.9	10.2	7.3	10.0
Digestive diseases.....	19.9	17.1	17.8	18.6	18.8	17.8	18.1
Diseases of stomach, except cancer (117, 118).....	5.4	5.3	5.7	5.9	5.5	5.6	5.9
Diarrhea and enteritis (120).....	2.7	1.9	2.7	2.4	2.7	2.1	2.2
Appendicitis (121).....	4.2	3.8	3.1	4.0	3.6	3.9	3.7
Hernia (122a).....	3.3	2.7	2.6	2.7	3.0	2.7	2.8
Other digestive diseases (115a, 115d, 116, 122b-129).....	4.3	3.4	3.7	3.6	4.0	3.5	3.5
Nonrespiratory-nondigestive diseases.....	44.3	38.6	43.1	43.8	43.7	41.2	44.9
Infectious and parasitic diseases (1-12, 14-24, 26-29, 31, 32, 34-44) <sup>3</sup> .....	3.1	2.7	3.7	3.0	3.4	2.9	3.2
Rheumatism, acute and chronic (58, 59).....	3.6	4.3	3.7	4.6	3.7	4.4	5.3
Neurasthenia and the like (part of 84d).....	1.5	1.7	1.3	1.9	1.4	1.8	2.0
Neuralgia, neuritis, sciatica (87b).....	2.2	2.2	2.0	2.3	2.1	2.3	2.9
Other diseases of nervous system (80-85, 87, except part of 84d and 87b).....	2.1	1.6	2.3	2.0	2.2	1.8	1.9
Diseases of heart and arteries, and nephritis (90-99, 102, 130-132).....	7.7	6.7	8.1	7.8	7.9	7.2	7.8
Other diseases of genitourinary system (133-138).....	4.4	3.2	3.9	3.2	4.2	3.2	3.2
Diseases of skin (151-153).....	3.0	2.8	2.9	3.3	2.9	3.1	3.3
Diseases of organs of movement, except diseases of joints (156b).....	3.3	2.3	2.9	3.2	3.1	2.7	3.4
All other diseases (45-57, 60-79, 88, 89, 100, 101, 103, 154, 155, 156a, 157, 162).....	13.4	11.1	12.3	12.5	12.8	11.8	11.9
Ill-defined and unknown causes (200).....	4.1	2.4	3.5	2.5	3.8	2.4	4.0
Average number of males.....	155,227	199,308	160,248	201,310	157,821	200,309	1,012,232

<sup>1</sup> Industrial injuries and venereal diseases are not included.

<sup>2</sup> Numbers in parentheses are disease title numbers from International List of Causes of Death, 1939.

<sup>3</sup> Exclusive of influenza and grippé, respiratory tuberculosis, and venereal diseases.



average of one absence for every 10 female workers, representing an increase of 50 percent in the frequency of respiratory diseases, and a doubling of the frequency of nonrespiratory-nondigestive diseases when compared with corresponding rates for 1940.

It is difficult to evaluate the contribution of various factors in the war and postwar periods to the observed time changes in frequency of disability. Data on a number of factors, such as the changing composition of the employed population, are not available. Moreover, a number of psychological factors are not susceptible to quantitative measurement. Nevertheless, the striking increases in frequency of disability among females together with the persistence of relatively high rates for nonrespiratory-nondigestive diseases among males (reflecting principally the circulatory diseases), reemphasize the importance of adult health problems in the field of industrial health.

### **Males,<sup>1</sup> First and Second Quarters, 1950**

Male frequency rates by cause are given in table 2 for the first and second quarters of 1950 and 1949. Attention is directed to the increased frequency of respiratory diseases recorded for each quarter of 1950 when compared with the corresponding quarter of 1949. However, rates for the first half of 1950 exhibit remarkably little difference from corresponding rates for the first half of the 5-year period, 1945-49.

#### **REFERENCES**

- (1) Gafafer, W. M.: Industrial sickness absenteeism. Males and females, 1948, and males, first and second quarters, 1949. Pub. Health Rep. 64: 1350-1352 (1949).
- (2) Gafafer, W. M.: Sickness absenteeism among industrial workers, third and fourth quarters of 1949. Pub. Health Rep. 65: 810-811 (1950).

# Incidence of Disease

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

## UNITED STATES

### Reports from States for Week Ended November 4, 1950

A total of 1,089 new cases of acute poliomyelitis was reported during the current week, which was 17 percent less than the previous week when 1,315 cases were reported. The corresponding figure for 1949 was 879 cases.

The cumulative total (27,783) cases of poliomyelitis for the current "disease" year was well below that for the corresponding total (38,108) for last year. The cumulative total (28,914) for the calendar year is also well below (39,029) for the corresponding period last year.

Seven of 9 geographic divisions showed decreases in the incidence of poliomyelitis compared with the previous week ranging from 2 cases in the New England States to 128 cases in the East North Central

#### Comparative Data For Cases of Specified Reportable Diseases: United States

[Numbers after diseases are International List numbers, 1948 revision]

Disease	Total for week ended—		5-year median, 1945-49	Seasonal low week	Cumulative total since seasonal low week		5-year median, 1944-45 through 1948-49	Cumulative total for calendar year—		5-year median, 1945-49
	Nov. 4 1950	Nov. 5 1949			1949-50	1948-49		1950	1949	
Anthrax (062)-----		1	(1)	(1)	(1)	(1)	(1)	40	45	(1)
Diphtheria (055)-----	171	227	331	27th	1,877	2,675	3,512	5,005	6,443	9,809
Acute infectious encephalitis (082)-----	25	15	13	(1)	(1)	(1)	(1)	841	678	560
Influenza (480-483)-----	1,944	1,648	1,648	30th	16,314	12,463	13,233	262,573	88,330	156,201
Measles (085)-----	1,315	834	1,261	35th	7,120	5,277	7,018	295,291	593,795	582,393
Meningococcal meningitis (057.0)-----	41	76	55	37th	408	401	401	3,207	2,917	2,977
Pneumonia (490-493)-----	1,169	1,176	-----	(1)	(1)	(1)	(1)	69,921	66,114	-----
Acute poliomyelitis (080)-----	1,089	879	564	11th	27,783	38,108	22,474	28,914	39,021	22,941
Rocky Mountain spotted fever (104)-----		2	3	(1)	(1)	(1)	(1)	445	551	538
Scarlet fever (050)-----	892	988	1,468	32d	6,207	6,568	8,507	46,377	64,234	70,223
Smallpox (084)-----	2		-----	35th	3	3	5	29	44	152
Tularemia (059)-----	11	11	11	(1)	(1)	(1)	(1)	778	971	820
Typhoid and paratyphoid fever (040, 041) <sup>1</sup> -----	71	46	79	11th	2,542	2,996	2,996	3,051	3,484	3,484
Whooping cough (056)-----	1,673	1,560	1,742	39th	7,582	7,153	7,925	104,777	53,755	83,800

<sup>1</sup> Not computed.

<sup>2</sup> Deductions: Michigan, weeks ended Oct. 7 and 28, 1 case each; New Mexico, weeks ended Mar. 4, May 13, and Sept. 9, 1 case each.

<sup>3</sup> Including cases reported as salmonellosis.

States. There was no change in the number of cases in the South Atlantic States, and the Mountain States showed an increase from 24 to 34 cases. Only New York State and Michigan reported 100 or more cases.

The total number of cases of diphtheria reported for the current week was 171 compared with 150 for the previous week and 227 for the corresponding week last year. There were 55 cases of typhoid fever reported for the current week compared with 35 for the corresponding week last year. The number of whooping-cough cases was 1,673 compared with 1,560 for the corresponding week last year. The cumulative total of 7,582 cases for the "disease" year is 6 percent above that (7,153) for the corresponding period of last year.

One case of smallpox was reported in Ohio and 1 in Missouri.

### ***Deaths During Week Ended November 4, 1950***

	<i>Week ended Nov. 4, 1950</i>	<i>Corresponding week, 1949</i>
Data for 94 large cities of the United States:		
Total deaths.....	9, 099	9, 160
Median for 3 prior years.....	9, 031	-----
Total deaths, first 44 weeks of year.....	402, 839	402, 741
Deaths under 1 year of age.....	664	635
Median for 3 prior years.....	670	-----
Deaths under 1 year of age, first 44 weeks of year.....	27, 338	28, 755
Data from industrial insurance companies:		
Policies in force.....	69, 627, 901	70, 079, 429
Number of death claims.....	12, 655	11, 990
Death claims per 1,000 policies in force, annual rate.....	9. 5	8. 9
Death claims per 1,000 policies, first 44 weeks of year, annual rate.....	9. 2	9. 2

**Reported Cases of Selected Communicable Diseases: United States, Week  
Ended November 4, 1950**

[Numbers under diseases are International List numbers, 1948 revision]

Area	Diphtheria	Encephalitis, infectious	Influenza	Measles	Menigitis, meningococcal	Pneumonia	Polio-myelitis
	(055)	(082)	(480-483)	(085)	(057.0)	(490-493)	(080)
<b>United States</b> .....	<b>171</b>	<b>25</b>	<b>1,944</b>	<b>1,315</b>	<b>41</b>	<b>1,100</b>	<b>1,080</b>
<b>New England</b> .....	<b>2</b>			<b>50</b>	<b>1</b>	<b>18</b>	<b>43</b>
Maine .....						7	2
New Hampshire .....							
Vermont .....	1						1
Massachusetts .....	1			39	1		26
Rhode Island .....				6		3	4
Connecticut .....				5		8	10
<b>Middle Atlantic</b> .....	<b>10</b>	<b>3</b>	<b>1</b>	<b>264</b>	<b>11</b>	<b>302</b>	<b>232</b>
New York .....	3	3	11	87	8		157
New Jersey .....	3			51	2		23
Pennsylvania .....	4			126	1		46
<b>East North Central</b> .....	<b>6</b>	<b>1</b>	<b>30</b>	<b>246</b>	<b>7</b>	<b>107</b>	<b>303</b>
Ohio .....	4		2	95	3		74
Indiana .....				8		1	29
Illinois .....	1	1		76	3		63
Michigan .....	1			53			44
Wisconsin .....			28	114	1		37
<b>West North Central</b> .....	<b>2</b>	<b>3</b>	<b>24</b>	<b>123</b>	<b>3</b>	<b>120</b>	<b>122</b>
Minnesota .....	1	2		3		6	38
Iowa .....				2		1	31
Missouri .....	1		4	92	2		15
North Dakota .....		1	4	11		104	1
South Dakota .....				12			3
Nebraska .....			16	1			13
Kansas .....				2	1	7	21
<b>South Atlantic</b> .....	<b>63</b>		<b>450</b>	<b>89</b>	<b>4</b>	<b>246</b>	<b>144</b>
Delaware .....	1			6			1
Maryland .....	1		1	3		17	40
District of Columbia .....			1	2		24	4
Virginia .....	2		236	7	1	24	18
West Virginia .....	3		191	53		24	10
North Carolina .....	32			9	1		15
South Carolina .....	6		24			11	6
Georgia .....	14		6	5	2	129	16
Florida .....	4			4		17	34
<b>East South Central</b> .....	<b>37</b>	<b>1</b>	<b>18</b>	<b>74</b>	<b>3</b>	<b>29</b>	<b>40</b>
Kentucky .....	5		2	56	1	5	12
Tennessee .....	4		11	9	1		5
Alabama .....	21		3	2	1		10
Mississippi .....	7	1		7		14	18
<b>West South Central</b> .....	<b>41</b>	<b>6</b>	<b>1,301</b>	<b>91</b>	<b>6</b>	<b>245</b>	<b>60</b>
Arkansas .....	10	1	77	21		30	4
Louisiana .....	2			4		19	8
Oklahoma .....	3	1	48	2	2	27	13
Texas .....	26	4	1,176	64	4	189	35
<b>Mountain</b> .....	<b>5</b>		<b>92</b>	<b>121</b>	<b>1</b>	<b>51</b>	<b>34</b>
Montana .....	1			6			2
Idaho .....			16	11		8	4
Wyoming .....							1
Colorado .....			8	47	1	34	7
New Mexico .....				26		3	3
Arizona .....	4		64	1		6	16
Utah .....				30			1
Nevada .....							
<b>Pacific</b> .....	<b>5</b>	<b>11</b>	<b>18</b>	<b>157</b>	<b>5</b>	<b>22</b>	<b>111</b>
Washington .....			5	46	2		27
Oregon .....	1		9	6	1	5	23
California .....	4	11	4	105	2	17	61
Alaska .....						3	3
Hawaii .....	1		88	1			

1 New York City only.

**Reported Cases of Selected Communicable Diseases: United States, Week  
Ended November 4, 1950—Continued**

[Numbers under diseases are International List numbers, 1948 revision]

Area	Rocky Mountain spotted fever (104)	Scarlet fever (050)	Smallpox (084)	Tularemia (059)	Typhoid and paratyphoid fever <sup>1</sup> (040, 041)	Whooping cough (056)	Rabies in animals
<b>United States</b> .....		<b>892</b>	<b>2</b>	<b>11</b>	<b>71</b>	<b>1,673</b>	<b>96</b>
<b>New England</b> .....		<b>65</b>			<b>1</b>	<b>261</b>	
Maine.....						22	
New Hampshire.....		2				2	
Vermont.....		2				51	
Massachusetts.....		54			1	61	
Rhode Island.....						40	
Connecticut.....		7				25	
<b>Middle Atlantic</b> .....		<b>197</b>			<b>13</b>	<b>235</b>	<b>14</b>
New York.....		150			8	112	13
New Jersey.....		15			2	68	
Pennsylvania.....		42			3	55	1
<b>East North Central</b> .....		<b>215</b>	<b>1</b>	<b>1</b>	<b>16</b>	<b>397</b>	<b>8</b>
Ohio.....		84	1		12	74	2
Indiana.....		14				16	
Illinois.....		35			1	32	2
Michigan.....		82		1	3	138	4
Wisconsin.....						137	
<b>West North Central</b> .....		<b>45</b>	<b>1</b>		<b>1</b>	<b>136</b>	<b>6</b>
Minnesota.....		11				20	
Iowa.....		8				55	5
Missouri.....			1		1	16	
North Dakota.....						19	
South Dakota.....						6	
Nebraska.....		7				1	
Kansas.....		19				19	1
<b>South Atlantic</b> .....		<b>154</b>		<b>4</b>	<b>11</b>	<b>267</b>	<b>29</b>
Delaware.....		2			1	1	
Maryland.....		10				17	
District of Columbia.....		4				4	
Virginia.....		19		2	2	93	
West Virginia.....		19			4	48	2
North Carolina.....		72		1	2	67	
South Carolina.....		8				8	11
Georgia.....		11			2	10	7
Florida.....		9		1		19	
<b>East South Central</b> .....		<b>117</b>			<b>2</b>	<b>71</b>	<b>15</b>
Kentucky.....		61				42	2
Tennessee.....		30				5	6
Alabama.....		21			1	24	4
Mississippi.....		5			1		3
<b>West South Central</b> .....		<b>59</b>		<b>5</b>	<b>15</b>	<b>236</b>	<b>32</b>
Arkansas.....		5		2		29	2
Louisiana.....		1			2	32	
Oklahoma.....		7		1	1	15	1
Texas.....		37		2	12	160	29
<b>Mountain</b> .....		<b>33</b>		<b>1</b>	<b>8</b>	<b>69</b>	
Montana.....		6			1	14	
Idaho.....		2			1	6	
Wyoming.....		3					
Colorado.....		8				8	
New Mexico.....		1			4	1	
Arizona.....		7			2	29	
Utah.....		6		1		2	
Nevada.....							
<b>Pacific</b> .....		<b>106</b>			<b>4</b>	<b>70</b>	<b>1</b>
Washington.....		28			1	19	
Oregon.....		7				11	
California.....		71			3	40	1
Alaska.....							
Hawaii.....		3					

<sup>1</sup> Including cases reported as salmonellosis.

<sup>2</sup> Including cases reported as streptococcal sore throat.

*Rabies in man:* North Carolina 1 case.

# FOREIGN REPORTS

## CANADA

*Reported Cases of Certain Diseases—Week Ended Oct. 21, 1950*

Disease	Newfoundland	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Brucellosis.....					1	1	1		1	4	8
Chickenpox.....			56		198	212	25	87	82	92	752
Diphtheria.....					7	2					9
Dysentery, bacillary.....					10	1	5			3	19
German measles.....				1	2	51		4	6	7	73
Influenza.....			26				3			4	33
Measles.....			14		83	192	19	39	4	104	455
Meningitis, meningococcal.....			1		1	2					4
Mumps.....			11		82	150	16	69	98	95	521
Poliomyelitis.....						6	1	1	6		14
Scarlet fever.....	3		2		34	51	5	14	42	28	179
Tuberculosis (all forms).....	3		5	17	120	34	37	10	4	44	274
Typhoid and paratyphoid fever.....				2	11					5	18
Veneral diseases:											
Gonorrhoea.....	4		7	4	61	62	39	31	46	85	339
Syphilis.....	2			7	38	20	1	7	4	14	93
Primary.....				1	4	3		2			10
Secondary.....					2	3					5
Other syphilis.....	2			6	32	14	1	5	4	14	78
Whooping cough.....			3	15	86	155	21	2	4	20	306

## MADAGASCAR

*Reported Cases of Certain Diseases and Deaths—September 1950*

Disease	Aliens		Natives	
	Cases	Deaths	Cases	Deaths
Bilharziasis.....	3		35	
Diphtheria.....	2		4	1
Dysentery:				
Amebic.....	3		148	3
Bacillary.....			75	3
Erysipelas.....			12	
Influenza.....	83	1	3,777	35
Leprosy.....			29	
Malaria.....	205		22,651	87
Measles.....	23		94	
Meningitis, meningococcal.....	1	1	8	4
Mumps.....	3		69	
Plague.....			4	4
Pneumonia (all forms).....	8	1	1,083	121
Puerperal infection.....			2	
Relapsing fever.....			1	
Trachoma.....			1	
Tuberculosis, respiratory.....	10	2	76	10
Typhoid fever.....	1		1	
Whooping cough.....	2		229	6

# WORLD DISTRIBUTION OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

The following tables are not complete or final for the list of countries included or for the figures given. Since many of the figures are from weekly reports, the accumulated totals are for approximate dates.

## CHOLERA

(Cases)

Place	January-August 1950	September 1950	October 1950—week ended—			
			7	14	21	28
<b>ASIA</b>						
Burma.....	415	52	3			
Akyab.....	2					
Bassein.....	3					
Kyaokpya.....	1	1				
Maubin.....	3					
Moulmein.....		1				
Pegu.....	1					
Bangoon.....	6					
Toungoo.....	7	1				
India.....	99,253	15,754	1,765			
Ahmedabad.....	8	2				
Allahabad.....	3					
Bombay.....	<sup>1</sup> 419	10	1			
Calcutta.....	<sup>2</sup> 8,895	162	17	19	28	41
Cawnpore.....	1					
Cocanada.....	2					
Cuddalore.....	31	5	1			3
Lucknow.....	12					
Madras.....	<sup>2</sup> 22	243	248	173	110	89
Masulipatam.....	47					
Nagpur.....	31	29	6	5		
Negapatam.....	88	10				
New Delhi.....	117	8				
Port Blair (Andaman Islands).....	<sup>2</sup> 2					
Tellicherry.....	27					
Tiruchirappali.....	1					
Trichinopoly.....	1					
Tuticorin.....	25	1				
India (French).....	1,071	81	8	2		
Karikal.....	382	8	4	1		
Pondicherry.....	689	73	4	1		
India (Portuguese).....	17					
Indochina.....	19	1				
Cambodia.....	5					
Viet Nam.....	14	1				
Giadinh.....	3					
Rachgia.....	1					
Saigon.....		1				
Pakistan.....	23,160	578	100	103		
Chittagong.....	186					
Dacca.....	191	1				

<sup>1</sup> Preliminary figures. <sup>2</sup> Includes imported cases. <sup>3</sup> Imported.

## PLAGUE

(Cases)

AFRICA						
Belgian Congo.....	28	1		1		2
Costermansville Province.....	<sup>1</sup> 14			<sup>1</sup> 1		
Stanleyville Province.....	14	<sup>1</sup> 1				<sup>2</sup> 2
Madagascar.....	52	4		8		
Rhodesia, Northern.....	2					
Union of South Africa.....	11					
Orange Free State.....	8					
Transvaal Province.....	1					
Johannesburg.....	<sup>2</sup> 1					

<sup>1</sup> Includes 9 cases of pneumonic plague.

<sup>2</sup> Pneumonic plague.

<sup>3</sup> Includes 1 case of pneumonic plague.

<sup>4</sup> Oct. 7-19, 1950.

<sup>5</sup> Oct. 1-10, 1950.

PLAGUE—Continued

Place	January-August 1950	September 1950	October 1950—week ended—			
			7	14	21	28
ASIA						
Burma.....	6 236	4	2			
Bassein.....	1					
Bhamo.....	6 4					
Henzada.....	15					
Kyaiklat.....	34					
Minha.....	2					
Moulmein.....	6 3					
Myaungmya.....	5					
Myingyan.....	2					
Pegu.....	4	7 1				
Pyapon.....	3					
Rangoon.....	6 8					
Yenangyaung.....	58					
China:						
Chekiang Province.....	6 37					
Wenchow.....	6 4					
Fukien Province.....	945					
Amoy.....	10					
Kwangsi Province.....	6 63					
Kwangtung Province.....	622					
India.....	37,265	10 1,214	10 50			
Allahabad.....	7 19					
Bombay.....	6 5					
Calcutta.....	6 3					
Cawnpore.....	18					
Lucknow.....	6 9			1		
Indochina:						
Annam.....	83	3	2	2	1	
Phanthiet.....	79	3	2	2	1	
Cambodia.....	11 46					
Pnompenh.....	3					
Cochinchina.....	26					
Saigon.....	1					
Laos.....	2					
Indonesia:						
Java.....	399	15	1	3		
Bandoeng.....	3					
Djakarta.....	6 3					
Jogjakarta.....	213	15	1	3		
Pakistan.....	1					
Karachi.....	7 1					
Thailand.....	56					
SOUTH AMERICA						
Brazil.....	18					
Alagoas State.....	3					
Bahia State.....	9					
Ceara State.....	2					
Pernambuco State.....	4					
Sao Paulo State: Santos.....			7 1			
Ecuador.....	28					
Chimborazo Province.....	4					
El Oro Province.....	4					
Loja Province.....	20					
Peru.....	78					
Ancash Department.....	3					
Lambayeque Department.....	2					
Libertad Department.....	1					
Lima Department.....	5					
Piura Department.....	7					
Venezuela.....	5					
Miranda State.....	5					

- 6 Includes imported cases.
- 7 Imported.
- 8 Includes 4 cases of pneumonic plague.
- 9 Deaths.
- 10 Preliminary figures.
- 11 Includes suspected cases.



SMALLPOX

(Cases)

Place	January-August 1950	September 1950	October 1950—week ended—			
			7	14	21	28
<b>AFRICA</b>						
Algeria.....	97	3				
Angola.....	270					
Bechuanaland.....	77					
Belgian Congo.....	2,826	791	150	119		
British East Africa:						
Kenya.....	10					
Nyassaland.....	1,248	8				
Tanganyika.....	3,447	404				
Uganda.....	3					
Cameroon (British).....	408	10				
Cameroon (French).....	93	1		* 22		
Dahomey.....	280	66		* 1	* 42	
Egypt.....	* 4					
Eritrea.....	1					
Ethiopia.....	30					
French Equatorial Africa.....	449	5				
French Guinea.....	12					
French West Africa: Haute Volta.....	205	3				
Gambia.....	5					
Gold Coast.....	223	6				
Ivory Coast.....	613	36		* 3		
Libya.....	2					
Mauritania.....	1					
Morocco (French).....	10					
Mozambique.....	207	38				
Nigeria.....	14,767	463				
Niger Territory.....	1,069	23		* 10		
Rhodesia:						
Northern.....	4	1				
Southern.....	544					
Senegal.....	2					
Sierra Leone.....	31					
Sudan (Anglo-Egyptian).....	74		1			
Sudan (French).....	179	37		* 9		
Togo (French).....	72	30			* 3	
Tunisia.....	1					
Union of South Africa.....	632	5				
<b>ASIA</b>						
Afghanistan.....	308					
Arabia.....	333	* 3				
Bahrain Islands: Bahrein.....	36					
Kambaran Island: Kamaran.....		* 2				
Burma.....	14,993	4	3			
Ceylon.....	* 2					
China.....	750	4	2			
India.....	118,001	4,500	238			
India (French).....	242	125	20	35		
India (Portuguese).....	90	3				
Indochina.....	362	3	1			
Indonesia:						
Borneo.....	635	144	8			
Java.....	6,352	864	78	65		
Sumatra.....	344	1	1			
Iran.....	234	5				
Iraq.....	* 144	* 16	1	* 9	1	
Israel.....	16					
Japan.....	6					
Korea (Republic of).....	1,331					
Lebanon.....	2					
Netherlands New Guinea.....	3					
Pakistan.....	15,255	202				
Palestine.....	95					
Straits Settlements:						
Singapore.....	* 2					
Syria.....	15					
Thailand.....	460					
Transjordan.....	35					
Turkey (See Turkey in Europe.)						
United Nations Relief and Works Agency for Palestine Refugees.....	15					

See footnotes at end of table.

**SMALLPOX—Continued**

Place	January August 1950	Septem- ber 1950	October 1950—week ended—			
			7	14	21	28
<b>EUROPE</b>						
Great Britain:						
England: Liverpool.....	1					
Scotland: Glasgow.....	21					
Greece.....	15					
Athens.....	1					
Piraeus.....	1					
Xylokastron.....	1					
Portugal.....	1					
Spain: Canary Islands.....	1					
Turkey.....	15	1				
<b>NORTH AMERICA</b>						
Guatemala.....	5					
Mexico.....	506					
<b>SOUTH AMERICA</b>						
Argentina.....	517					
Brazil.....	79	18	1			
Chile.....	3,581	7				
Colombia.....	573	13	5	2		
Ecuador.....	117	18				
Paraguay.....	4					
Peru.....	2,315					
Venezuela.....	1,216					
<b>OCEANIA</b>						
Australia: Freemantle.....	1					

1 Corrected figure. 2 Oct. 1-10, 1950. 3 Oct. 11-20, 1950.  
 † Including imported cases. \* Imported. † Aug. 13 to Sept. 16.

**TYPHUS FEVER \***

(Cases; P=Present)

<b>AFRICA</b>					
Algeria.....	106	2			
Basutoland.....	24				
Belgian Congo.....	183	5	2		
British East Africa:					
Kenya.....	23				
Mombasa.....	3				
Uganda.....	2				
Egypt.....	86	3	1		
Eritrea.....	20	9	1	2	
Ethiopia.....	683				
French Equatorial Africa.....	5				
Gold Coast.....	9				
Libya:					
Cyrenaica.....	27				
Tripolitania.....	70				
Madagascar.....	12				
Morocco (French).....	8	1			
Morocco (International Zone).....	1				
Morocco (Spanish Zone).....	6				
Mozambique.....	3				
Nigeria.....	1				
Rhodesia, Southern.....	17				
Sierra Leone.....	5				
Sudan (Anglo-Egyptian).....	4			1	
Tunisia.....	54	5			
Union of South Africa.....	76	P			
<b>ASIA</b>					
Afghanistan.....	1,292	5			
Burma.....	115				
China.....	120				
India.....	276	7			
India (Portuguese).....	30	9			
Indochina.....	33	1	2		
Indonesia:					
Java.....	6				
Sumatra.....	1				
Iran.....	176				

See footnotes at end of table.

**TYPHUS FEVER—Continued**

Place	January-August 1950	September 1950	October 1950—week ended—			
			7	14	21	28
<b>ASIA—continued</b>						
Iraq.....	128	1				
Japan.....	1 927					
Korea (Republic of).....	2 1,183					
Lebanon.....	2					
Netherlands New Guinea.....	2					
Pakistan.....	97	1				
Palestine.....	5					
Straits Settlements: Singapore.....	1 6	2				
Syria.....	1 37	2				
Transjordan.....	27	4				
Turkey (see Turkey in Europe).						
United Nations Relief and Works Agency for Palestine Refugees.....	4					
<b>EUROPE</b>						
France.....	1					
Germany (British Zone).....	1 2					
Germany (French Zone).....	2					
Germany (United States Zone).....	2					
Great Britain:						
England: Liverpool.....	2 1					
Island of Malta 2	26	10				
Greece.....	28					
Hungary.....	4					
Italy.....	47					
Sicily.....	36					
Poland.....	37					
Portugal.....	2					
Spain.....	28	15				
Turkey.....	4 149	11	3	4	12	2
Yugoslavia.....	247					
<b>NORTH AMERICA</b>						
Costa Rica 2	15		2			
Guatemala.....	29					
Jamaica 2	27	2				
Mexico 1	321	14	2			
Panama Canal Zone 2	3					
Puerto Rico 2	16	3				
<b>SOUTH AMERICA</b>						
Argentina.....	2					
Chile.....	107	17		3	1	
Colombia.....	480	12	6			
Curacao.....	2 1					
Ecuador.....	205	6				
Peru.....	943					
Venezuela.....	114					
<b>OCEANIA</b>						
Australia 2	99	9				
Hawaii Territory 2	4 6					

\* Reports from some areas are probably murine type, while others include both murine and louse-borne types.

1 Includes murine type. Murine. 2 Imported. 4 Corrected figure.

**YELLOW FEVER**

(C—cases; D—deaths)

<b>AFRICA</b>					
Belgian Congo.....	D	1			
Stanleyville Province.....	D	1			
French Equatorial Africa.....	C	11			
Port Gentil.....	C	11			
Gold Coast.....	C	12			
Accra.....	D	2		12	
Ankobra Ferry.....	D	1			
Bogoso.....	C	11			
Kade.....	C	1			
Oda Area:					
Akwatia.....	C	27			
Atankama.....	C	1			

See footnotes at end of table.

**YELLOW FEVER—Continued**

Place	January-August 1950	September 1950	October 1950—week ended—			
			7	14	21	28
<b>AFRICA—continued</b>						
Nigeria.....D	2					
Calabar.....D	1					
Ibadan.....D	1					
Sierra Leone.....C	2					
Koinadugu District.....C	2					
<b>NORTH AMERICA</b>						
Panama:						
Colon.....D	1					
<b>SOUTH AMERICA</b>						
Bolivia.....C	867					
Chuquisaca Department.....C	850					
La Paz Department.....C	17					
Brazil.....D	2					
Bahia State.....D	1					
Ipiau.....D	1					
Maranhao State.....D	1					
Collinas.....D	1					
Colombia.....D	4					
Magdalena Department.....D	1					
Los Angeles, Rio de Oro.....D	1					
Putumayo Commissary.....D	3					
Mocoa Locality.....D	3					
Santander Department.....D	1					
Ocana.....D	1					
Peru.....D	4					
Cuzco Department.....D	2					
Quincemil.....D	2					
Huanuco Department.....D	1				1	
Tingo Maria.....D	1				1	
Junin Department.....D	1					
San Ramon.....D	1					
San Martin Department.....D	2					
Juanjui.....D	1					
Lamas.....D	1					
Venezuela:						
Bolivar State.....D				2		

<sup>1</sup> Suspected. <sup>2</sup> Includes suspected cases. <sup>3</sup> Imported. <sup>4</sup> Estimated number of cases reported in an outbreak in Asero Province Jan. 1—Mar. 14, 1950. <sup>5</sup> Outbreak in North and South Yungas Provinces. <sup>6</sup> Date of report, Oct. 23, 1950. <sup>7</sup> In jungle areas 124 miles apart. Exact localities not stated.

**Case of Human Rabies in West Virginia**

Dr. N. H. Dyer, State Director of Health of West Virginia, has reported a case of human rabies. The victim was a 4-year-old boy who was severely bitten about the face and head on July 7, 1950. Prophylactic treatment was given immediately, 16 doses being administered. First symptoms appeared on July 22, and death occurred two days later.

Diagnosis of rabies in the biting dog was confirmed by the State Hygienic Laboratory. Microscopic examination and animal inoculation of brain tissue in two laboratories confirmed the diagnosis of rabies in the boy.