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The Control of Carpenter Ants in Telephone Poles

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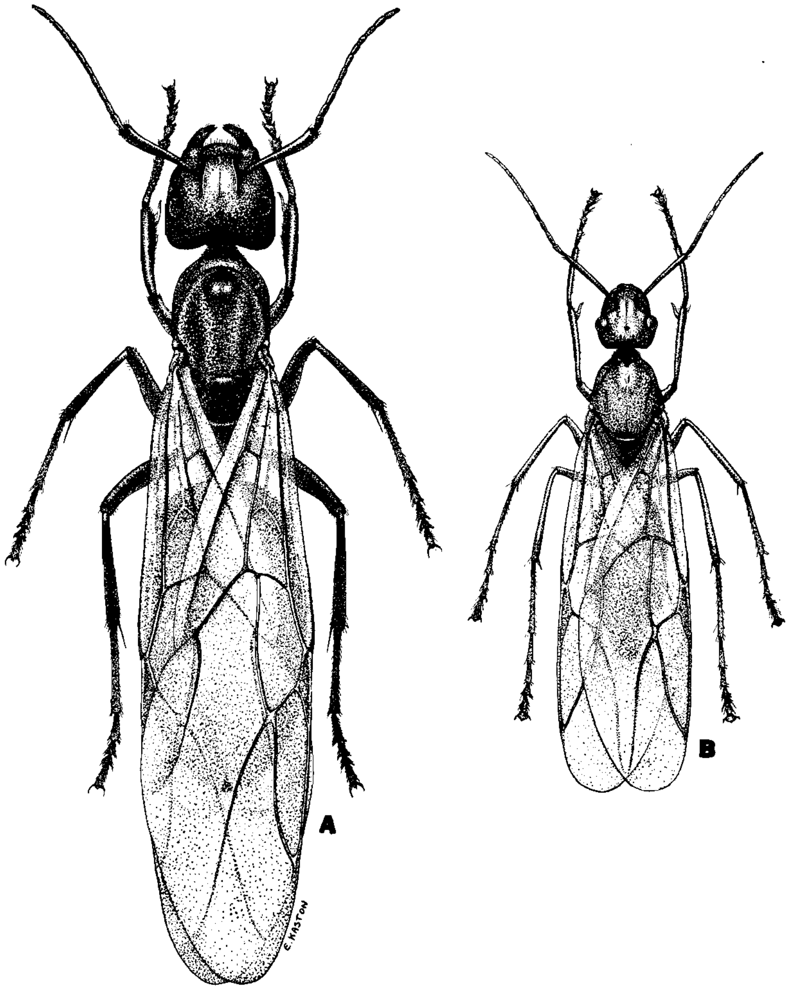

FIGURE 89. A: adult winged female. B: adult winged male. Both enlarged 5 times.

THE CONTROL OF CARPENTER ANTS IN TELEPHONE POLES

R. B. FRIEND AND A. B. CARLSON[1]

IN ORDER to furnish safe, proper and adequate service, all pole-using companies in Connecticut are required to make periodic inspections at such intervals as will insure proper maintenance. The pole plant of the Southern New England Telephone Company consists of some 300,000 poles, about one-third of which are inspected each year. During the course of these inspections many poles have been found which were infested with ants. For many years little or no attention was paid to such timber except for marking the poles for replacement where the shell thickness was below that permitted by standard specifications. As the extent of the damage caused by these insects increased, it became apparent that something should be done to control this ant activity. It was felt that if the interior of ant-infested poles could be treated with some chemical materials which would destroy the colonies, it might be possible to prolong the physical life of these poles. Work was started in 1933 and continued through 1937 by Messrs. Carlson, Nicholas and Osmond of the Southern New England Telephone Company's staff and Friend of the Connecticut Agricultural Experiment Station.[2] A number of ant-infested telephone poles were treated with various chemicals. The construction crews of the telephone company pulled out and cut open the poles at the time of examination.

Our investigations have been concerned with ant injury to chestnut poles only. In spite of the decline in the abundance of chestnut trees in North America during the last 30 years due to blight, about 54 percent of the poles now in use (January 1, 1936) by the Southern New England Telephone Company are native chestnut and another 18 percent are southern chestnut (Table 1). There is practically no difference in quality of wood between native and southern poles. About half of the total number of chestnut poles now standing have been butt-treated with creosote and the other half have not been treated. These poles have been in the ground for 8 to 51 years (set 1885 to 1928).

TABLE 1. POLES IN USE JANUARY 1, 1936

Type	Number
Native chestnut, not treated	98,381
Native chestnut, butt-treated—creosote	51,472
Southern chestnut, butt-treated—creosote	51,329
Southern pine, full treatment—creosote	57,974
Southern pine, zinc-meta-arsenite treatment	592
Western red cedar, butt-treated—creosote	17,930
Total	277,678

[1] Southern New England Telephone Co., New Haven.

[2] The authors are indebted to Mrs. Elizabeth Kaston for the drawings and to Mr. B. H. Walden and Dr. R. P. Marshall for the photographs used to illustrate this paper.

The butt-treated and untreated chestnut poles are apparently equally susceptible to ant injury, and no attempt has been made to separate the two groups in the course of this work.

Although our investigations have been limited to the poles in use by one

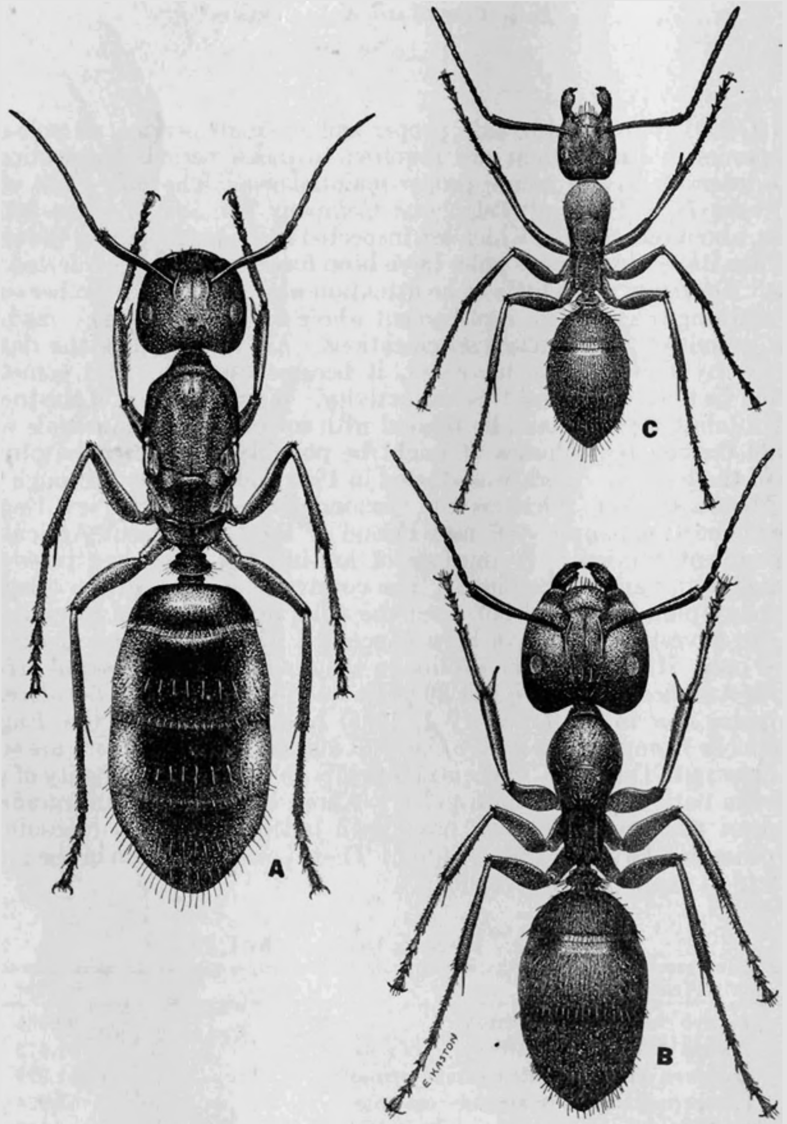

FIGURE 90. A: de-alated queen. B: major worker. C: minor worker. All enlarged 5 times.

company, there is good reason to believe that the same general conditions of ant attack prevail throughout New England where chestnut poles are commonly used. Many of these have been set in recent years and should

remain in service a long time barring unusual deterioration. There are also thousands of eastern white cedar and western red cedar poles, both untreated and butt-treated, in use in New England, but we have no information on the extent to which they are attacked by ants. Within the last decade southern pine poles, pressure-treated with creosote the entire length, have come into wide use in parts of New England. The effect of deterioration factors on these in this region remains to be seen. The consumption of poles of various types for the year 1930 by 35 pole-using companies in New England is shown in Table 2, taken from Garrett (1932).

TABLE 2. CONSUMPTION OF UNTREATED AND TREATED POLES BY 35 NEW ENGLAND POLE-USING COMPANIES IN 1930

Type	Number
New England chestnut	
Untreated	3,168
Surface-treated	2,979
Open-tank-treated[1]	...
Southern chestnut	
Untreated	4,860
Surface-treated	578
Open-tank-treated[1]	52,527
Eastern white cedar	
Untreated	11,575
Surface-treated	306
Open-tank-treated[1]	16,069
Western red cedar	
Untreated	505
Surface-treated	...
Open-tank-treated[1]	23,145
Southern pine	
Untreated	...
Pressure-treated	
Creosote	13,238
Montan wax-creosote	5,242
Zinc meta-arsenite	3,373

[1] Butt-treated

About 10 percent of the poles replaced each year by the Southern New England Telephone Company have been rejected because of ant cavities (see Table 3). Practically all of these are chestnut. As is to be expected ant attack is more commonly found in rural districts than in cities. About 90 percent of the poles replaced because of ant damage are in rural areas and about 10 percent in urban areas. About 75 percent of all poles in use are in rural areas.

TABLE 3. POLES (ALL TYPES) ATTACKED BY ANTS

Year	No. of Poles Inspected	Poles rejected Total	Ant injury only[1]
			%
1933	70,200	11,000	9.1
1934	94,500	15,200	10.21
1935	98,400	11,500	11.36

[1] These poles may have had some decay, but they were rejected primarily because of ant injury.

Aside from the effect ant injury may have on the maintenance of an efficiently operated system, the expense of replacing poles is an important factor. The approximate cost of replacement is $30 to $35 per pole.

FIGURE 91. Left: carpenter ant colony in telephone pole in winter. The arrow indicates the ground level. The section is about 2 feet long. Right: longitudinal section of a treated pole. The dark stain is due to creosote injected at the level indicated by the arrow. The section is about 4 feet long.

ANT INJURY TO POLES

The black carpenter ant, *Camponotus herculeanus pennsylvanicus* DeGeer (Figures 89 and 90), is the only species commonly present in poles in Connecticut. A small species of ant, *Crematogaster lineolata* Say, is sometimes found in poles but its galleries are small and it causes no significant injury. The subterranean termite, *Reticulitermes flavipes* Kollar, has been found in a few poles but the injury caused by it has been relatively insignificant to date.

The carpenter ant is well known for its habit of excavating extensive galleries in wood, both in living trees and in timber in use (Graham 1918, 1929; Snyder 1927). The ants do not utilize wood for food, but the galleries form a home for the colony (Figure 91). Although the galleries probably originate in a decayed spot, a deep check, a knot-hole, or some similar

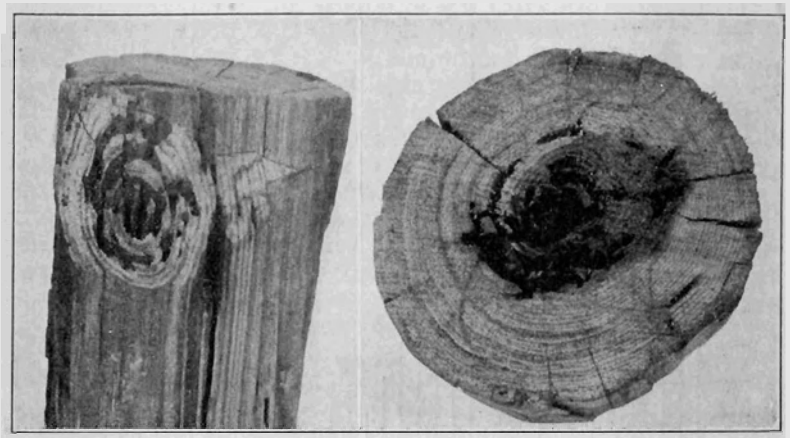

FIGURE 92. Left: section cut at an angle through the laminated part of a carpenter ant cavity in a telephone pole. Right: cross section through a treated ant cavity below the level at which the creosote was applied. The dark stain is due to creosote.

defect, after the colony attains some size the sound wood is extensively excavated. Decayed wood is completely removed, but in sound timber the ants appear to concentrate on the spring wood of the annual ring, although the summer wood is often extensively gnawed away. The result of this in chestnut poles is a typical cavity consisting of three parts. The lower section, where there was originally some decay, has a more or less completely hollow center surrounded by peripheral laminae (Figure 91). Above this is a zone of concentric thin laminae of sound wood (Figures 91 and 92). Extending up from this zone are small galleries which presumably represent a zone of active excavation. The two lower parts constitute the main cavity. Members of an active colony are more numerous in the middle and upper sections and in the periphery of the lower section. The original defect in a pole which permits the establishment of a colony may not be serious, but the later activities of the colony may weaken the pole to such an extent that failure occurs.

The ant-infested poles are generally injured more by the radial than by the longitudinal extent of the cavities. The length of the main cavity and the extent of galleries of small diameter above it are of importance, however, because they indicate the vitality of the colony present and may affect the possibilities of eradicating it. Whereas the main cavity in poles examined was usually two to four feet in length, galleries of small diameter often extended some distance beyond this. The length of the ant galleries, including small offshoots from the main cavity, in 35 poles, is shown in Figure 93. This does not indicate the total amount of excavating that an ant colony can accomplish. Just how rapidly an ant

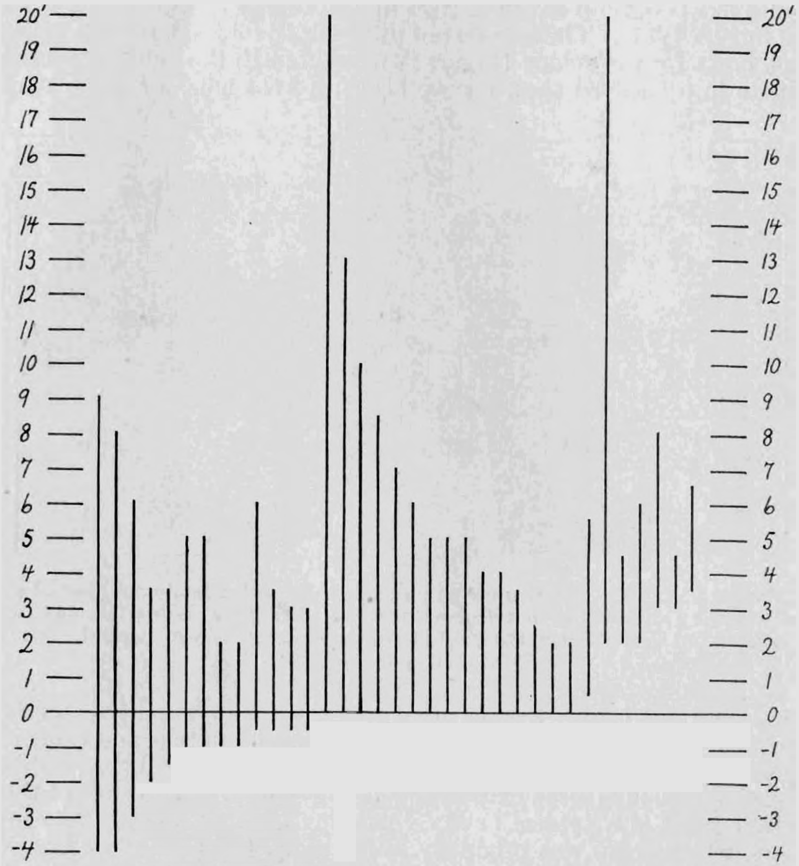

FIGURE 93. Length and position of carpenter ant cavities in 35 telephone poles. Each vertical line represents the extent of one cavity. The figures on each side represent distance in feet from the ground level (horizontal line).

gallery enlarges during the first two years of the life of a colony is not known, but very little excavating is accomplished from the establishment of a colony in late summer until activity is resumed the following spring. According to the conception of Pricer (1908), the peak of vitality of a carpenter ant colony is reached with the production of winged adults. The presence of winged adults in the majority of poles examined and the size of the cavities found indicate that in most cases the maximum rate

of gallery extension by the ants had been reached. However, excavation can be extensive after the production of winged adults begins, as was shown by a colony kept in the laboratory for a few months. The observations of Graham (1918) show that in white cedar trees in Minnesota the cavities do not usually extend above six feet from the ground, and that ants are responsible for a loss of two feet, on the average, from the butt of the living tree, in addition to the loss by heart rot. The ants had been present in the trees examined by Graham an indefinite length of time and yet the galleries were apparently no more extensive than those found in the poles with which we are concerned. Although the system of pole inspection precludes the discovery of ant cavities which are too high to be found by a man standing on the ground, such cavities are rare, and the diagram shown in Figure 93 is in all probability truly representative.

As shown in Figure 93, although the majority of galleries did not extend over six feet above the ground, a few extended much further, two going to about the top of the pole (20 feet in the figure). Sound poles under excess load usually break at the ground line or slightly above it. As indicated in Figure 93, the cavities in the great majority of poles extend from the ground line or a point below it up to two feet or more above ground level. The ants excavate the pole where the greatest strength is needed. There is no correlation between the age of the pole or the presence or absence of butt treatment with creosote and the size of the cavity produced by ants. This is to be expected in view of the frequent inspection of the poles and their condition. Any pole which is so weakened at the time of inspection that failure is likely to occur within three years is marked for replacement. Therefore it is impossible, under these circumstances, to determine either the life of an ant colony in a pole or the maximum possible extent of the galleries.

Whether or not an infested pole is marked for replacement by the inspector depends on the thickness of the shell. Although this thickness varies according to the circumference of the pole necessary to carry the load, generally speaking a hollow pole should have a sound shell at least two inches thick in order to remain in use. For example: A hollow pole 20 inches in circumference with a sound shell two inches in minimum thickness is equivalent to a solid pole 19 inches in circumference, and if the sound shell is 2.5 inches in minimum thickness, the hollow pole is equivalent to the solid pole; a hollow pole 40 inches in circumference with a sound shell two inches in minimum thickness is equivalent to a solid pole 36 inches in circumference, and if the sound shell is five inches in minimum thickness it is equivalent to the solid pole. This shell must be good wood, exclusive of both inside and outside decay. The inspector rejects all poles which, in his opinion, will not safely carry the load for three years. The average life of poles set between 1919 and 1923 was approximately 14.5 years.

METHODS OF TREATMENT

The object in treating the ant-infested poles was to eliminate the ant colony and prevent further deterioration due to this agent. The eradication of the colony could presumably be accomplished by injecting a lethal or repellent material into the cavity or by poisoning the ants with a bait placed where it would be readily accessible to them. There is apparently no practical method of treating a standing pole externally to prevent infestation by ants. The general procedure was to treat the pole and several months later to pull it out of the ground and split it open for examination. Only those poles reported to be infested with ants were included in these tests.

It is essential to determine the presence or absence of ants in a pole and the extent of the cavity. This is accomplished by sounding the pole with the head of a hatchet and then making a trial boring at the point where the top of the cavity is assumed to be. A skilled operator can determine the limits of a cavity very closely by sounding if the cavity is within four inches of the surface. The jar of the hatchet disturbs the ants so that they become excited and run about rapidly. Usually many ants come out of the cavity to the surface of the pole. By placing his ear against the outside of the pole, the operator can hear the ants rushing about within. In making the trial boring, the laminae in the cavity can be detected. This can

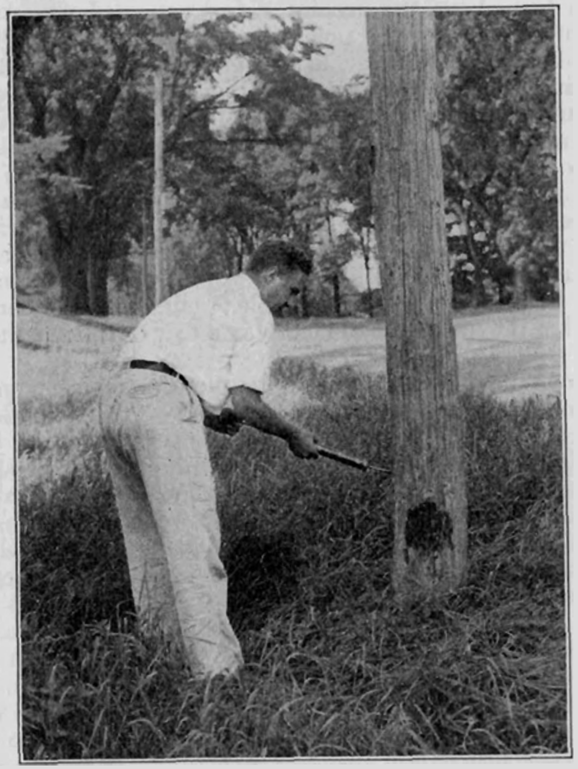

FIGURE 94. Method of injecting materials into poles with an "oil-gun".

also be determined by inserting a hooked probe into the hole bored. The material used in treatment must be injected into the top of the main cavity through this hole if the treatment is to be successful (Figure 91). In the course of these experiments we had no difficulty in determining the proper point for injecting the materials used.

Early in the investigations the materials were poured into the cavities by means of a funnel attached to a copper tube which was inserted in a

hole about 3/8 inch in diameter bored in the pole. This was found to be unsatisfactory, and in all later work a modified "oil-gun", such as used by automobile mechanics, was used to inject liquids. The flexible metal tube attached to the gun was about a foot in length and terminated in a conical tip. The gun was filled by dipping the tip into the liquid and drawing back the piston. The tip was then inserted into the ant cavity through the hole bored in the side of the pole, and the liquid forcibly injected (Figure 94). It was found essential to bore the hole all the way through the top of the ant cavity and to insert the tip of the gun only a short distance beyond the sound shell. An excellent distribution of the material throughout the galleries resulted (Figures 91 and 92). The hole should be plugged with a dowel after treatment.

The condition of the poles affects the efficiency of the treatment. Some internal decay is usually present at the bottom of those infested with ants. The sides of the poles frequently have deep checks which in some cases extend into the cavity. Knot-holes are also of common occurrence. It is obvious that an airtight ant cavity does not exist, for the ants must have a means of entrance and exit. Any fumigant will leak out to some extent. The temperature of the cavity has been found to be within three degrees centigrade of that of the surrounding air (shade) at the time of treatment.

EARLY EXPERIMENTS

The first series of seven poles, located in Branford and North Branford, Conn., was treated between October 16 and November 1, 1933, with fumigants. The temperature of the cavities was between 20° and 23° C. except for one which had a temperature of 16° C. The cavities varied from 2 to 10 feet in length with shell thicknesses of 2 to 4 inches. The poles were 11 to 13 inches in diameter at the base. The material was poured into the cavity through a hole in the side of the pole, no attempt being made to bore this hole into the top of the cavity. Four poles were treated with one pint each of a solution of one pound of paradichlorobenzene in two quarts of gasoline. One pole was treated with two fluid ounces of carbon disulfide. Two poles were treated with one-fourth ounce each of calcium cyanide ["Cyanogas A" powder containing 40% - 50% $Ca(CN_2)$]. All the poles were examined between April 24 and May 25, 1934.

None of the materials used produced good results. Live ants were abundant at the time of examination in all poles but two, both of these having been treated with the paradichlorobenzene solution. The failure of these fumigants may have been due to the chambered nature of the cavities, the presence of deep checks and knot-holes in the poles, and the application of materials in the middle instead of the top of the cavities.

A second series of eight poles, located in New Haven, Conn., was treated July 8, 1934. The air (shade) temperature was 29° to 30° C. and the cavity temperatures one to three degrees lower. The cavities varied from 2 to 7.5 feet in length with shell thicknesses of 1 to 3 inches. The poles were of about the same diameter as those treated in 1933, and the method of treatment was the same. Two poles each received one-fourth pound of paradichlorobenzene dissolved in one pound of carbon disulfide. One pole received one-fourth pound of naphthalene dissolved in one pound of carbon disulfide. Two poles each received 50 c.c. of the following mixture: honey 75 c.c., water 25 c.c., sodium arsenite 1 gram. Two poles each received 50 c.c. of a similar mixture with tartar emetic substituted for sodium arsenite. One pole received 21 c.c. of a commercial ant poison ("Antrol") containing 0.18 percent sodium arsenite. The poles were pulled out and examined October 11 and 25, 1934.

The solutions of paradichlorobenzene and naphthalene were fairly effective, three live workers being found in one pole, six in another, and none in the third. In this last pole, however, *Crematogaster lineolata* was apparently the only ant present, so not much significance can be attached to it. Dead individuals of *Camponotus* were abundant in one of the other two poles and few in the remaining one. None of the poison baits was effective, a thriving colony being present at the time of examination in each pole so treated. There is a possibility that the ants did not feed on the materials.

A third series of 10 poles, located in the vicinity of New Haven, Conn., was treated November 8, 1934. In view of the failure to secure definite results with many of the materials previously used and the obvious disadvantages of using carbon disulfide in any quantity in such an operation, in treating this third series of poles, substances which were considered repellent as well as toxic were employed, and an attempt was made to inject a quantity large enough to penetrate throughout the ant galleries. All materials were injected with an "oil-gun" in the manner previously described. Most of the cavities were 2 to 6 feet in length, the two exceptions being one cavity 10 feet long and one 20 feet long. The shell thicknesses were from 2 to 4 inches, and the poles were 10 to 16 inches in diameter at the base. The amount of material injected into any one cavity depended somewhat on its size and on the material itself. No cavity received less than one pint or more than two, except in the case of decahydronaphthalene. Two cavities were treated with creosote[1] and two with carbolineum creosote. Both of these materials are commonly used as wood preservatives. One cavity was treated with a "refined"[2] creosote, a commercial product advocated for use where the stain of ordinary creosote is not desired and where the wood is to be painted. This "refined" creosote contained, according to chemical analysis at the Connecticut Agricultural Experiment Station, 85 percent gasoline. One pole was treated with a mixture of equal parts ordinary creosote and "refined" creosote. One cavity received orthodichlorobenzene, one decahydronaphthalene (one-half pint), and two steam-distilled pine oil. The poles were pulled out and examined May 27 and 28, 1935.

The creosote treatment killed a large number of ants in each pole treated, but by no means all in the colony. One of the cavities was 10 feet in length, and the live ants were at its ends. The presence of creosote in parts of the cavity did not expell all the ants. The pole treated with "refined" creosote had a few live ants in a high, small gallery above the main cavity. Most of the members of the colony were dead. One of the poles treated with carbolineum creosote contained a thriving colony in the cavity, the other contained only dead ants in the cavity. In the pole treated with a mixture of "refined" and ordinary creosote all the ants were dead. The cavity of the pole treated with orthodichlorobenzene contained an abundance of live ants in galleries at the level of the boring through which the material was injected. Many dead ants were present in the bottom. This cavity was six feet long and the injection was made near its center. The pole treated with decahydronaphthalene contained many dead ants at the bottom of the cavity and an abundance of live ants at the top. The material had been injected into the center. One of the poles treated with pine oil showed an abundance of dead ants in the cavity and a few alive 10 feet above the ground line. The cavity in this pole was 20 feet long. The other pole, with a cavity six feet long, showed no dead ants but a thriving colony. Both poles received one pint of pine oil in the treatment.

[1] American Wood Preservers Association Grade I was used in all experiments.

[2] The term "refined" is used merely to distinguish this material from the creosote commonly employed in wood preservation. The material does not contain this term in its trade name.

The results of these treatments were significant in several respects. Creosote killed ants with which it came into contact, and the ants tended to keep out of those parts of the cavity where the creosote had been absorbed into the walls. The "refined" creosote appeared more effective than the ordinary creosote, and a mixture of equal parts of the two was very effective. This may have been due to the volatile nature of the constituents. Injection of the material into the top of the cavity in sufficient quantity to penetrate all the galleries seemed essential to success. The presence of winged adults in some treated poles at the time of examination indicated that there had been at least a fair survival during winter in these poles in spite of the treatment.

1935 EXPERIMENTS

A fourth series of 34 poles, located in Litchfield and Goshen, Conn., was treated September 11 and 12, 1935, and two other untreated poles were used to check the results. Three materials were used: (1) carbolineum creosote; (2) a mixture of equal parts "refined" and ordinary coal tar creosote; (3) a commercial ant bait (Lethelin) containing one percent thallium sulfate as the toxic agent. This poison bait has given excellent results in the control of the carpenter ant in buildings. The creosote compounds were injected into the tops of the cavities, or as nearly so as could be estimated, with an "oil-gun". The bait was placed either in a hole bored into the cavity or outside near the base of the pole. In June, 1936, 24 of these poles were pulled out and opened for examination. Twelve others were inspected in place at this time. These latter were reserved for more complete examination in the future.

In Table 4 the data on 24 poles are given. The pole diameters were taken at the ground line or within a foot or two above it. The length of the cavity is the total length, both above and below ground level. The extent of the cavity above ground is indicated in all poles treated with creosote compounds, except pole number 1832, by the height of bore, this being presumably the top of the cavity or close to it. Pole number 1832 had a cavity 13 feet long, and the boring was made as high as could be reached from the ground. The shell thickness is the minimum found on examination. The figures given under height of bore for the thallium sulfate treated poles indicate, as noted above, the height above ground at which the bait was placed, either within the pole or on the outside of it. In some cases the holes in which the bait was placed were plugged with a dowel, in others the hole was left open.

The carbolineum creosote treatment was successful. Of the 14 poles treated with the "refined" creosote mixture, only three were failures. Pole number 1829 had a very long cavity and was not bored, the liquid being poured in through knot-holes. This method of treatment is not

TABLE 4. POLES TREATED SEPTEMBER 11-12, 1935. LITCHFIELD AND GOSHEN, CONN.

Pole No.	Treatment		Effect of Treatment	Pole Diameter (inches)	Length of Cavity (feet)	Shell Thickness (inches)	Height of Bore (feet)
557	carbolineum creosote	1 pt.	Dead ants abundant; 5 or 6 live workers present.	12	5.0		4.5
616	"refined" creosote mixture	1 "	Dead ants abundant, none alive.	10	3.5		
2097	"	1 "	Dead ants abundant, none alive.	9	5.0		4.5
1829	"	2 "	Dead ants abundant below bore, live workers, pupae, and larvae abundant above bore; much fresh "sawdust".	10	8.5	2.5	4.0,5.0,7.0[1]
1832	"	1 "	Dead ants abundant, live workers and larvae abundant in upper 3 feet of cavity.	10	13.0	1.0	7.0
1833	"	2 "	Dead ants abundant, none alive.	11	4.0	2.5	3.0, 3.5[2]
1843	"	2.5 "	Many dead ants, none alive.	10	5.0	1.0	3.0
2459	"	1 "	Dead ants common, none alive.	11	1.5	1.5	4.5
2460	"	1.5 "	Dead ants abundant, none alive.	10	2.5	0.5	2.5
2471	"	1 "	Dead ants abundant, none alive.	9	6.0	1.5	4.0, 5.0[2]
1960	"	1 "	Dead ants abundant, 1 live worker and 1 live female present.	9	5.5		3.0

[1] Equal parts at each height in knot-holes, not bored.

[2] Equal parts in each of the two borings.

* The terms "abundant", "common", and "many" are rather vague, but it was not possible to count the ants found alive in the poles. They indicate the relative abundance of ants in decreasing order. "Abundant" signifies most of the colony were alive, and "many" signifies approximately 10 percent of the colony were alive. The same terms are used with this significance in Table 5.

TABLE 4. POLES TREATED SEPTEMBER 11-12, 1935. LITCHFIELD AND GOSHEN, CONN. (CONTINUED)

Pole No.	Treatment		Effect of Treatment	Pole Diameter (inches)	Length of Cavity (feet)	Shell Thickness (inches)	Height of Bore (feet)
1930	"refined" creosote mixture	1 pt.	Dead ants abundant, none alive.	12	7.5	1.0	6.0
1955	"	1 "	Dead ants abundant, none alive.	10	3.0		2.0
1927		1 "	Dead ants abundant, some live workers and very few live larvae present.	11	7.0		7.0
1923	"	1 "	Dead ants abundant, none alive.	10	2.0	1.5	
543	thallium sulfate bait	14 gms.	Dead ants abundant, 3 live workers present.	10	3.0		2.0
617	" " "	10 "	Dead ants abundant, many live workers and larvae.	10	6.0		
622	" " "	10 "	Dead ants abundant, none alive.	10	3.5		0.8
646	" " "	10 "	Dead ants abundant, several live females (less than 1% of total ants), no live workers.	10	9.0		0.8
2114	" " "	12 "	Dead ants numerous; live workers, cocoons and larvae abundant; 1 live male.	8	3.5	1.0	ground level,
1495	" " "	12 "	A few dead ants present, none alive. Very few ants observed at time of treatment.	10	2.0	3.0	ground level, 0.5, 1.0[3]
2408	" " "	24 "	Many dead ants, none alive.	11	12.0	1.0	ground level, 0.3[3]
2497	" " "	24 "	Many dead ants, none alive.	12	18.0	0.5	ground level, 0.4[3]
2084	No treatment		Thriving colony of workers and larvae.		6.0		

[3] Equal parts at each height.

TABLE 5. POLES TREATED JULY 9, 1937. VICINITY OF NEW HAVEN, CONN.

Pole No.	Treatment		Effect of Treatment	Pole Diameter (inches)	Length of Cavity (feet)
12	"refined" creosote-creosote mixture[1]	1 pint	Dead ants abundant, none alive.	10	3.0
774	gasoline-creosote mixture[2]	2 pints	Dead ants abundant, none alive.	11	5.0
3470	gasoline-creosote mixture	1 pint	Dead ants abundant, none alive.	11	2.4
583	"refined" creosote undiluted	1 pint	Both dead and live ants abundant.	11	3.0
576	"refined" creosote undiluted	1.5 pints	Both dead and live ants abundant.	14	4.5
1522	gasoline	1 pint	Live ants abundant.	10	1.5
435	creosote undiluted	1 pint	Both dead and live ants abundant.	12	6.5
437	creosote undiluted	1 pint	Both dead and live ants abundant.	12	2.0
786	"refined" creosote-gasoline mixture[3]	1 pint	Dead ants abundant, none alive.	10	5.0

[1] Refined creosote 50%, creosote 50%, by volume.
[2] Creosote 50%, gasoline 50%, " "
[3] Refined creosote 50%, gasoline 50%, " "

efficient, even for smaller cavities. Pole number 1832 had a cavity extending 13 feet above the ground line, and the cavity was too large for successful treatment. Pole number 1927 had a cavity extending seven feet above the ground line and an insufficient quantity of material was injected. The treatment with the "refined" creosote mixture is considered successful. Only one pole was treated with carbolineum creosote, and the efficiency of this is still questioned because of previous results.

Of the eight poles treated with thallium sulfate bait, two were failures; a third (number 646) was possibly a success as the only live ants found were adult winged females and these were relatively few in number; the fourth (number 1495) was questionable because of the small size of the colony; the other four poles were successes. If a sufficient quantity of this bait is used and protected from outside influences, better results might be obtained. The untreated pole contained a thriving colony of workers and larvae.

Ten of the remaining 12 poles were pulled out and examined in September, 1937, the other two having been previously removed during reconstruction of the line. Four of these poles had each been treated with 12 grams of thallium sulfate bait and five had each received the "refined" creosote mixture, four having been treated with one pint each and one (the smallest cavity) with one-half pint. One pole was not treated and served as a check. The smallest cavity in a treated pole was 8 inches long; the others were between 2.5 and 3.5 feet in length. All poles contained carpenter ants at the time of treatment. In every case the treatment was successful, no living carpenter ants being found in any pole. In three of the poles colonies of *Crematogaster lineolata* were found, but this is of no significance. All three poles had been treated with the ant bait. A thriving colony of workers and larvae was present in the untreated pole.

1937 EXPERIMENTS

In view of the fact that the "refined" creosote contained, by analysis, about 85 percent gasoline, ordinary automobile gasoline[1] should be as effective a diluent for creosote. A small number of poles were treated July 9, 1937, to test this. The poles were pulled out and examined September 17 and 21, 1937. The data are given in Table 5.

The treatment with the so-called "refined" creosote mixed with an equal volume of either ordinary coal tar creosote or gasoline was successful in each case. One other pole (not included in Table 5) treated with a "refined" creosote-creosote mixture was not pulled out but examined in place by sounding and by blowing smoke into the cavity. No indication of live ants was obtained. The treatment with undiluted "refined" creosote failed in the two cases tried. In both poles dead worker ants and pupae were abundant, but living workers and larvae were abundant at the base of the cavities. Apparently enough individuals in the lower lateral galleries escaped the effect of the material to permit the colony to survive. In each case there were many small living larvae, so the queen was not killed. The reason for failure does not lie in the nature of the material but probably in the type of cavity and the amount of material used. In both poles the main cavity was not extensively hollowed out and the

[1] The gasoline used in these experiments is sold under the trade name of "Benzoline".

lateral galleries at the base were unusually isolated. The injection of more material doubtless would have exterminated the ants. Cavities of this type have not been commonly found.

The treatment with the gasoline-creosote mixture was successful in both cases. Dead worker ants and pupae were abundant, and no live ants were found.

The other two materials, undiluted gasoline and undiluted creosote, did not produce good results. The pole treated with gasoline contained a thriving colony of workers, pupae, and larvae. The two poles treated with creosote contained dead worker ants and pupae in abundance but a large number of living ants were also present.

Two poles containing ant colonies were not treated July 9. When examined in September, both contained living ants.

The results attained in 1937 substantiate those attained in 1936, although a small number of poles were treated. A mixture of equal parts by volume of either gasoline and creosote or "refined" creosote and creosote exterminated the ant colonies.

CONCLUSIONS

It is quite evident from the results attained that a suitable chemical injected forcibly into the top of an ant cavity in a sufficient quantity will eliminate the ant colony from the pole. In these experiments coal tar creosote diluted with an equal volume of either "refined" creosote or gasoline was efficient. This mixture is easily obtained and handled and is not expensive. Further experiments might well refine or change the method, but the physical difficulty of experimenting with telephone poles limits the work of this nature that can be accomplished in any reasonable length of time. Seventy poles were used in these tests.

Creosote and gasoline are both powerful contact insecticides and the mixture undoubtedly possesses repellent and fumigant properties. Undiluted creosote does not seem to disperse well enough throughout the ant galleries. Gasoline alone volatilizes very rapidly and seems to be taken up rapidly by the dry wood. The mixture of equal volumes of the two disperses very well throughout the galleries of the ants. The fact that dead ants are found in galleries where no stain of creosote is visible indicates that the fumigant properties of the mixture are of some importance. The repellent properties are quite obvious, as the ants rush frantically out of a pole that is being treated.

Although poison baits have been successfully used in controlling carpenter ants under certain conditions, there are obvious objections to using such poisons in this work. Aside from the difficulties of preparing and handling poisons, it does not appear advisable to use them where their ultimate disposition is unknown. The few trials made with a thallium sulfate bait indicated a certain effectiveness, but the creosote mixtures are more effective and easily handled. The sodium arsenite solutions used were ineffective.

The failure of the highly volatile fumigants used in the earlier trials makes their practical value under the conditions very questionable.

From a practical standpoint there is a limit to the size of ant cavities which can be treated successfully. If the cavity extends over seven feet above the ground level the results of treatment are questionable. Moreover, the thickness of sound shell in such cavities is very likely to be below minimum requirements. These long cavities are also very likely to have long narrow galleries extending high into the pole and not subject to treatment. Generally speaking, any pole containing an ant cavity which extends over seven feet above the ground line should not be treated but should be replaced.

The amount of material to be injected depends mainly on the size of the cavity. It is the opinion of the authors, based on an examination of the poles treated, that not less than one pint should be injected into a cavity four feet or less in length, and not less than two pints into cavities between four and seven feet in length. The success or failure of the treatment depends on the skill of the operator.

Whether or not a treated pole will become re-infested with ants in the future has not been determined. No re-infestation has taken place in successfully treated poles within two years of the time of treatment. The presence of creosote in the walls of the cavity would tend to repel ants. If a new colony should become established, it would not become large enough to cause serious injury to the pole within two years of the time of establishment, which would be three years after treatment. Poles are inspected every three years, and such an inspection would detect the ant colony in time to avoid much injury.

The observations on infested poles lead the authors to believe that an inspection every three years is sufficient to detect ant colonies in chestnut poles before the injury due to the ants will cause a pole to fail.

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