U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1668

The RED HARVESTER ANT AND HOW TO SUBDUE IT

THE RED HARVESTER ANT causes both loss and annoyance in many parts of the Southwest.

These large ants rob the farmer of a considerable quantity of seeds, which they store away for food, and cause even more loss by denuding of vegetation large areas around the nest. They also both bite and sting on slight provocation.

This bulletin describes the various forms and manner of life of these ants, and the structure of their underground nests. It tells some of the best methods for getting rid of their colonies and shows the futility of some of the measures that are frequently recommended. It also emphasizes the necessity of very thorough and continuous treatment in order to attain success.

Washington, D. C. Issued August, 1931

THE RED HARVESTER ANT AND HOW TO SUBDUE IT

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WHERE THE ANTS ARE FOUND

THE RED HARVESTER ANT, *Pogonomyrmex barbatus* F. Smith,[1] is an insect that causes considerable losses in cultivated fields and orchards in the Southwestern States. The circular, bare areas (title illustration and fig. 5), often as much as 25 or even 35 feet in diameter, cleared of vegetation by colonies of these ants, stand out prominently in alfalfa or grain fields in this part of the country. Not only is this ant destructive to cultivated crops, but it is also a great annoyance around dooryards and is especially troublesome when in city lawns. In such locations the ant is a nuisance not only because of its harvesting activities, but also because it has the unpleasant habit of inflicting painful stings, as almost all residents of a district where this ant occurs can testify.

Because of its peculiar habits this ant is extremely hard to control. As the ants work to a great depth beneath the surface of the ground, the expense of control is rendered rather high, and at times, as discussed later in this bulletin, very uncertain.

It is found at the lower altitudes in Texas, New Mexico, Arizona, and California as well as in old Mexico. The colonies are naturally much more numerous in cultivated areas than on the surrounding

[1] There are many varieties of this species, but this popular discussion applies in a general way to all of them. This ant may be distinguished from the mound-building prairie ant, *Pogonomyrmex occidentalis* Cresson, by the absence of a mound at the main opening in the center of the circular cleared area known as the "colony" or "hill." The mound-building prairie ant occurs in the higher altitudes and colder districts throughout approximately the same territory over which the red harvester ant is distributed. The habits of the colony, their methods of feeding, and the means of control are practically the same for both species. The mound-building ant apparently developed this habit of constructing a mound at the entrance of its nest to obtain a greater benefit from the rays of the sun during the cooler periods of its active season. This mound could also be considered as a sun parlor for the development of the growing ants.

desert where food would be scarce, and are much more numerous in some localities than in others. One field may be literally dotted with colonies, and an adjoining field may contain only an occasional nest. An inspection of eight acres at Tempe, Ariz., revealed the presence of 265 colonies, each colony surrounded by a cleared area five feet or more in diameter. This is an average of over 33 colonies per acre.

LOSSES CAUSED BY THE ANTS

The greatest loss caused by these ants is the result of land wasted in their barren areas and runways. A 20-acre field will often have the equivalent of 100 average-size colonies with cleared circles 12 feet in diameter. Such a field would contain a little more than one-quarter of an acre of wasted land. The loss in dollars and cents on this quarter acre would depend on the kind of crop grown. In a field producing with four cuttings five tons of alfalfa hay per acre the loss, at $10 a ton, would be $12.50. On the other hand, a 20-acre field in short-staple cotton yielding three-fourths of a bale, or 375 pounds, per acre and selling at 18 cents per pound would show a loss of $16.87 per year because of the lost quarter acre.

When the colonies are located in a field that is being planted to citrus, dates, grapes, or other high-priced fruit products, the ants often destroy many trees or shrubs, and the loss thus occasioned sometimes is many dollars per acre. Under these conditions the owner can afford to spend considerable money and time in controlling this insect.

The ants also cause a direct loss to seed crops by collecting seeds for storage. In the case of small seeds, such as alfalfa, this loss may be considerable. If the seed is selling at 17 cents a pound, 100 colonies on 20 acres of alfalfa land consuming 1 pound of seed per colony, which would be a fair average, would cause a loss of $17. The loss which the ants occasion in the fields of other cereal crops depends upon the size of the seed being grown. In the case of the larger kinds of seeds the loss is not so great because the ants prefer the smaller kinds.

A loss not so easily measured is that caused by the ants in collecting freshly sown seed. This loss is especially heavy in newly seeded alfalfa fields where the gathering of seeds results in a thin stand for several seasons in the vicinity of the colonies. Where the larger grains are sown, the loss would not be so great. Nests have been found, however, whose chambers contained considerable quantities of oats collected from recently planted fields.

ANNOYANCE TO PERSONS AND ANIMALS

Much annoyance is caused by colonies located close to dwellings, public buildings, dooryards, and corrals. The presence of the ants about the yards and grounds of dwellings makes the use of these places for pleasure or recreation almost impossible. The ants, running promiscuously about these places, invariably get on people, and if molested may bite or sting or both. Because of this pugnacious habit small children can not be left alone out of doors where the ants are present. Livestock may also be greatly annoyed by these pests. Dairy cows may exhibit numerous swellings, especially on the udder, as the result of stings. Such attacks often reduce milk production.

DESCRIPTION OF THE STAGES

In its life cycle the ant passes through four stages (fig. 1), the egg, the larva, the pupa, and the adult or full-grown ant.

THE EGG

The eggs, which are laid by the queen in the chambers of the colony, are about half the size of a pinhead. They are longer than wide, are shaped like capsules, and are iridescent milky white. They are usually found clustered together, but because of their small size and the fact that they are present only in the underground chambers of the colony, they are very seldom seen.

THE LARVA

The larvae or grubs (fig. 1, D), which hatch from the eggs, also remain in the chambers of the colony. They are cream colored and are shaped like crooknecked squashes, the smaller crooked portion ending in a very small head. The length of the full-grown larva, not including the portion turned back, is about one-fourth of an inch.

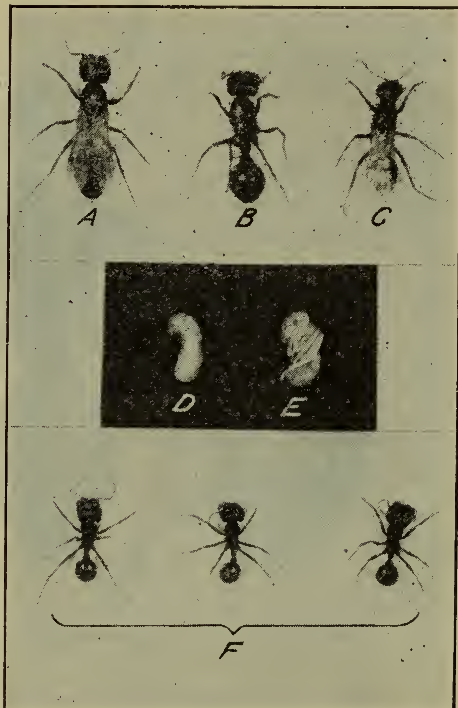

FIGURE 1.—Forms and stages of the red harvester ant: A, Winged female; B, queen; C, male; D, larva or grub; E, pupa; F, workers. All are about one-half larger than natural size

THE PUPA

The pupae (fig. 1, E) are about the same size as the adults but are a pale cream color and have the legs and feelers or antennae folded on the underside.

These three immature stages remain hidden in the chambers of the nest and are seldom seen except when the ants, as sometimes, are observed carrying the larvae or pupae to a new location. The pupae are then often mistaken for the eggs.

THE ADULT

There are four different forms of the adult ant; these are winged females (fig. 1, A, and fig. 2), queens (fig. 1, B), males (fig. 1, C), and workers (sterile females) (fig. 1, F, and fig. 3). The workers are the reddish-brown ants seen in large numbers hurrying to and from the colony in search of food. They range in length from a fourth to a half inch. These ants are well known for their pugnacious habits and painful stings. The winged males and females are the sexually mature individuals which emerge from the colony during swarming time to mate and establish new colonies. The females are larger than either the workers or males and may be distinguished from the latter by their slightly darker, more robust bodies, and larger heads. The males do not possess stings. The queen is merely a mated female that has discarded her wings and has established a colony.

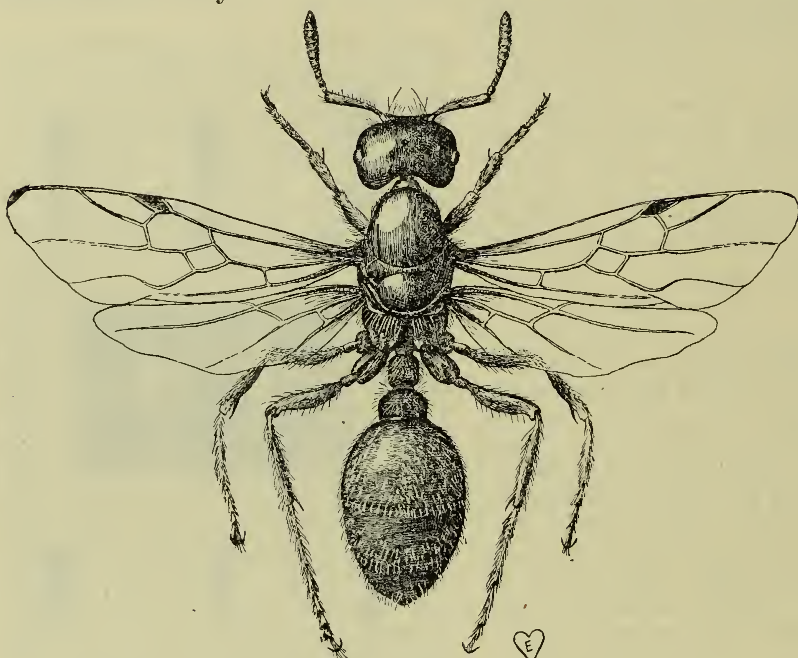

FIGURE 2.—The red harvester ant: Winged female, 5 times natural size

HABITS OF THE ANTS

The red harvester ants are social insects which live together as a colony. The colony consists of one queen and innumerable workers, together with eggs, larvae, and pupae. The winged males and females appear only at certain times of the year. Like other ants, the workers are very strong, being able to carry objects several times their own size. The workers are quite vicious when molested, but go busily about their tasks when left undisturbed. It is only when something interferes with their activities that they become hostile. The colony stubbornly resists interference, and the pugnacious habits of its members have caused them to be known as among the most ferocious of all American ants. When molested, they not only turn to give battle but actually run about in search of the intruder. When once they have set their powerful jaws in an object there is no way to remove them without tearing the head from the rest of the body, and even then the jaws may remain locked.

A possibly more effective weapon for defense is the sting. This needlelike appendage at the end of the abdomen can be thrust into the enemy and a poison injected. This poison is irritating to animals and causes considerable pain and swelling to human beings, especially to those of a susceptible nature.

STRUCTURE OF AN ANT NEST

The nests of the red harvester ant are readily recognized by the well defined, flat, barren, circular area on the surface of the ground, from which the vegetation has been removed. An examination of approximately 300 colonies in an 80-acre field at Tempe, Ariz.,

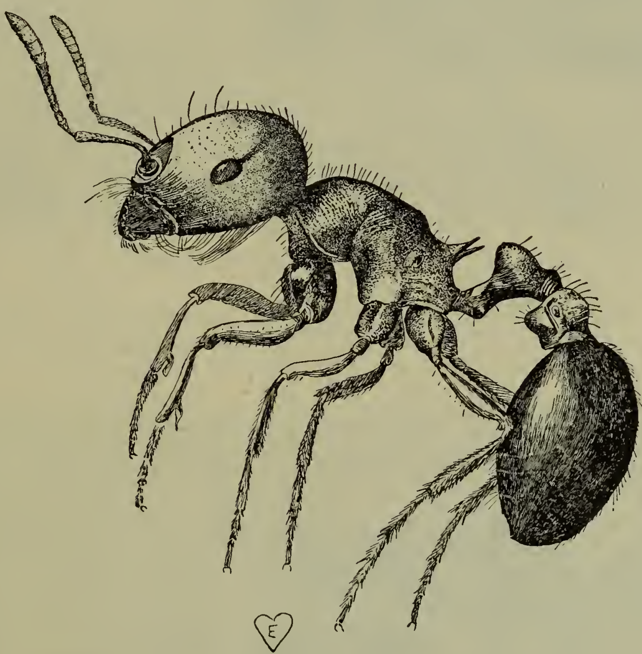

FIGURE 3.—The red harvester ant: Worker, 12 times natural size

showed the average diameter of the cleared area, or disk, to be 12 feet, though they range from 3 to 35 feet in diameter.

The entrance into the nest is an opening which is usually located at about the center of the disk. Frequently, especially when the colony has been disturbed by cultivation, more than one entrance hole is found. This entrance, which joins the network of tunnels and chambers underground, is normally from one-fourth to one-half inch in diameter.

Radiating from the cleared area on the surface are usually one or more pathways leading into the surrounding vegetation. These pathways are from 1 to 4 inches in width and range in length up to 200 feet; where they adjoin the nest they are as barren as the cleared disk, but gradually become less distinct toward the farther end, where they eventually disappear among the vegetation. The paths serve to make travel easier and faster between the nest and the area that is being harvested by the workers.

The nest (figs. 4 and 7) is a series of subterranean tunnels and chambers. The tunnels are pathways, about one-fourth of an inch in diameter, leading in and out of the nest and from one chamber to another. They extend downward at different locations (fig. 7), each with its separate series of chambers. The chambers are rooms or shelves that are scattered throughout the tunneled area. They are flat-bottomed, but each has a dome-shaped ceiling. They range in size from those that are one-fourth inch wide and one-half inch long to those that are 8 to 10 inches wide and a foot long, the larger ones usually being lower down. Stores may be found in any of the rooms, but those near the surface of the ground are used at times as nurseries in which to rear the young. The larger compartments in the lower half of the nest serve as hibernating quarters for most of the ants during the winter.

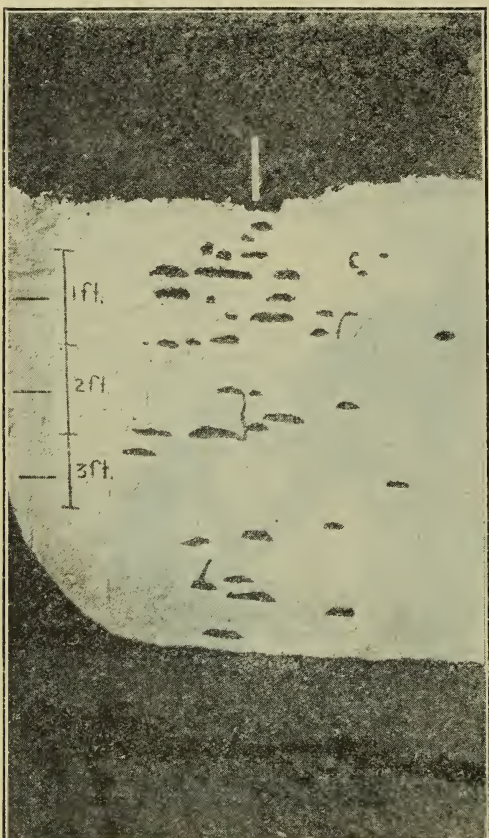

FIGURE 4.—Vertical cross section of an ant nest, showing the location and distribution of the chambers and a few of the connecting tunnels. The side of the excavated pit has been whitewashed so that the chambers will show more plainly. Note that these lie generally below the main entrance to the nest (marked by a stake). Such a colony can be destroyed by pouring 4 ounces of carbon disulphide down the main entrance

Several nests were excavated during the study of this ant. A nest of average size, or one having a cleared area 12 feet in diameter, was excavated at Tempe, Ariz., by the junior writer in 1929. This nest contained 436 chambers, over half of which were within a foot of the surface of the ground. The tunneled area was 7 feet in diameter and extended to a depth of 15 feet, which was 1 foot above the water table. A total of 12,358 ants were counted.

Another nest having a cleared area of the same size was excavated in 1928. This went to a depth of only 7 feet, at which point hardpan was encountered. This nest is shown in Figures 5, 6, and 7.

The type of soil affects the general arrangement of the tunneling. If the soil is porous, such as a sandy loam, for a considerable depth so that the nest can be extended downward uninterruptedly, the general shape of the tunneled area is that of a cone, usually from

8 to 10 feet in depth, with the apex or small end at the bottom. The ants are often checked by a hard layer of soil, which must approach the hardness of hardpan before it can stop these determined insects.

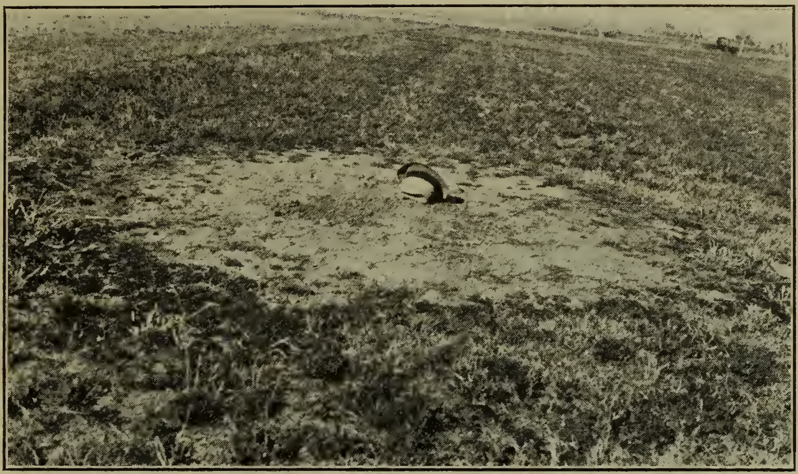

FIGURE 5.—The barren area, 12 feet in diameter, over a typical ant nest. The location of the vertical tunnels found on excavating this nest are shown in Figure 7

In this case the tendency is for the nest to spread laterally. A high-water table that interferes with the downward movement of the ants has the same spreading effect on the nest as a layer of hard earth.

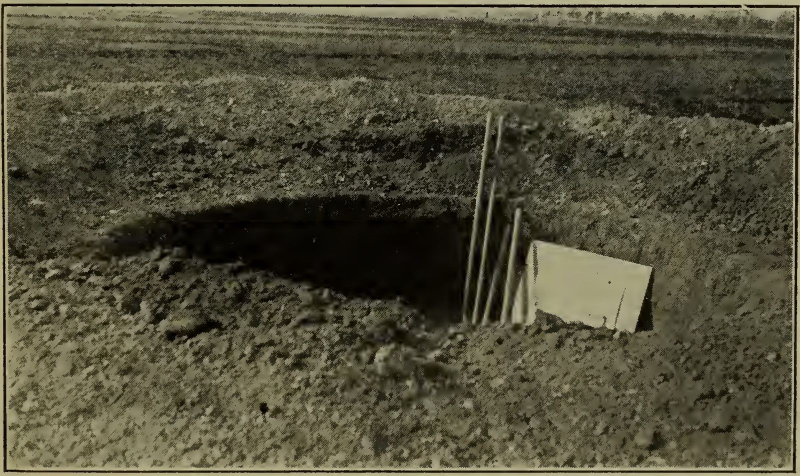

FIGURE 6.—Excavating an ant nest. This is the same nest as is shown in Figure 5. After removing each 6-inch layer of earth the locations of the exposed vertical tunnels were marked on a circle on the paper attached to the board. These circles, representing the excavated ring, with the tunnels indicated are shown in Figure 7. About 10,000 ants were found inhabiting this nest

This is noticeable along ditch banks, where the water stops tunneling activity. In this case the nest exhibits a tendency to be narrow and to extend along the bank.

ACTIVITIES OF THE COLONY

A new ant colony is established by a mated or fertile female, after the emergence of the winged forms at swarming time. The percentage of ant colonies that become successfully established is extremely small when compared to the number of virgin females that issue from an individual ant colony, as explained hereafter.

SWARMING

Swarming is the term used to designate the emergence and mating of the winged males and females. In southern Arizona this activity

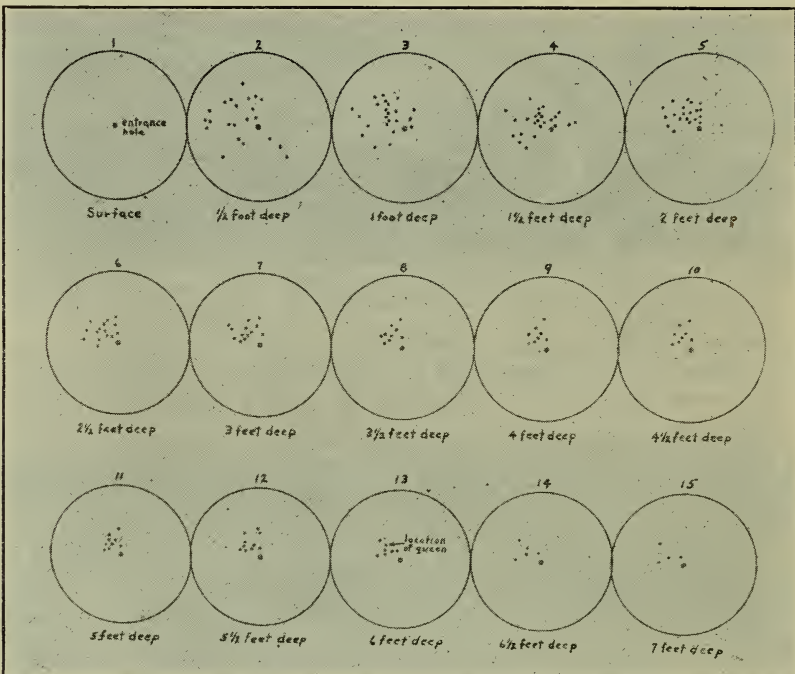

FIGURE 7.—Locations of the vertical tunnels in the nest shown in Figures 5 and 6: Each circle represents a cross section of the nest at 6 inches below the preceding circle. The nest was excavated to a depth of 7 feet. The queen was found 6 feet below the surface, as indicated in circle No. 13. Circle No. 2, the cross section exposed on removing the first 6-inch layer of soil, shows the holes which were treated with carbon disulphide before the nest was excavated further

takes place usually in August and September, although it may occur at any time from June to October. It frequently takes place after a shower in the afternoon and is ordinarily completed the same day on which it is started.

Mating occurs soon after the winged forms emerge from the nest. Males and females may be seen by the hundreds gathered around the entrance hole, or climbing upon grass, sticks, rocks, or any other object projecting into the air, in their efforts to fly away. The act of mating generally takes place while the males and females are in flight.

During the swarming period male ants may be found congregated in large numbers on elevations in the vicinity of the colonies. The winged males often form a mass on the tops of low mountains or buttes or even on the tops of high buildings. Toward the end of the swarming period hundreds of dead males may be found piled up to such an extent that they may be scooped up with the hands. (Fig. 8.) The congregation of the winged forms at elevated points during swarming time is probably related to mating. Those males which are unable to mate soon after emerging from the nest alight on the higher places of vantage to wait for the virgin females to alight or pass by. Most of these males die soon after alighting because of their weakened condition after flying for considerable distances.

ESTABLISHMENT OF THE COLONY

The male dies soon after mating, but the mated female establishes a new colony. She removes her wings either by pulling them off with

FIGURE 8.—Piles of dead male ants collected in the pockets of a rocky hill some 300 feet higher than the surrounding desert. The arrows point to the heaps of dead ants

her mouth parts and legs or by rubbing against rocks, grass, sticks, etc. After removing her wings she immediately begins digging into the ground. She first excavates a hole about 10 inches deep, and then she usually constructs from one to four small dome-shaped chambers branching off from this. When this work is completed, the young queen plugs up the entrance hole with the last bit of dirt excavated. She then deposits a cluster of about 50 eggs which eventually become the first workers of the new colony. These eggs and the resulting larvae and pupae are necessarily taken care of by the young queen. She carries the eggs from one chamber to another so that they receive the proper temperature and moisture for hatching. When the eggs hatch she feeds the larvae a secretion which is derived from the fatty tissue of her own body. These larvae, after passing through the pupal or resting stage, develop into workers. These first workers, owing to the fact that they are reared on the limited amount of food from the queen's body, are small as compared with those that follow. The colony once established, the queen spends the rest of her life within the tunnels and chambers, shunning the bright light of the outside world. The queen mates only once during her lifetime.

The percentage of females which are able to establish new colonies that are strong enough to survive is exceedingly small. After a period of heavy swarming in the fall of 1928, an estimate of the number of queens which were attempting to establish new colonies on an 80-acre alfalfa field at Tempe, Ariz., showed that there were about 80,000, or 1,000 per acre. Observations made in the same field during 1929 failed to reveal any new colonies although a few probably survived. Several factors are responsible for this great mortality of females at swarming time. Many are eaten by birds, toads, etc. Undoubtedly a certain percentage fail to mate in their hasty flight. Thousands are unquestionably lost in their attempts to find suitable places in which to establish colonies. Probably the greatest factor in reducing the number of successful females is the lack of vitality sufficient to establish a colony that can survive adverse climatic conditions over the winter. The flooding of fields in irrigated districts or the occurrence of heavy rains also greatly hinders their attempts to colonize.

COLONY DEVELOPMENT

The new colony having been established by the young queen, the dirt with which she had plugged the entrance hole is removed by the workers matured from the first batch of eggs. In case the colony has been established in early summer the nest is opened up soon thereafter, but where swarming has occurred in late summer or early fall the new nest is not opened up until the following spring. In this last case a much larger percentage of the new colonies fail to survive the winter owing to lack of stored food. The small ants enlarge the nest by extending its tunnels and constructing new chambers. Food in the form of seeds is harvested and stored in some of the chambers, and the new colony becomes the scene of much activity.

When the first of the workers issue in the newly formed nest the queen again starts egg laying and limits her activity thereafter solely to this function. The workers, beside doing the work of expanding the colony, bringing in food, removing refuse from the chambers, and guarding against the intrusion of any undesirable visitors, also care for the eggs, larvae, and pupae, as well as actually feed the queen. The activities of the colony thus becomes specialized to the extent that the queen lays the eggs, while the work is carried on entirely by the workers.

The barren circular area (cover illustration and fig. 5), commonly called an "ant hill," surrounding the entrance hole of the colony is the result of the activity of the ants in cutting down any vegetation which attempts to grow there. The size of this circle depends on the tunneled area underneath the surface of the ground. The presence of vegetation on the surface would shade the colony, thereby increasing the amount of moisture within the nest, and moist chambers are not suitable as storage rooms since moisture is conducive to seed germination. Sprouted seeds are not desired as food by the ants and are accordingly carried out of their galleries to the edge of the cleared area on the surface of the ground, and there they are dumped. At the same time, by preventing the rays of the sun from reaching it, vegetation would reduce the temperature to an undesirable degree, thus making the chambers unsatisfactory as nurseries for the immature stages of the ant.

After the colony once becomes established, there is a gradual increase in its size for a few years until it reaches maximum development. The queen continues to lay eggs which produce an ever-increasing number of workers. The number of the chambers is increased, and their size is enlarged, as is the cleared area on the surface of the ground. Colonies ordinarily survive for several years. One colony has been under observation by the senior writer at Tempe, Ariz., for 19 years and is still active, and it appears that it

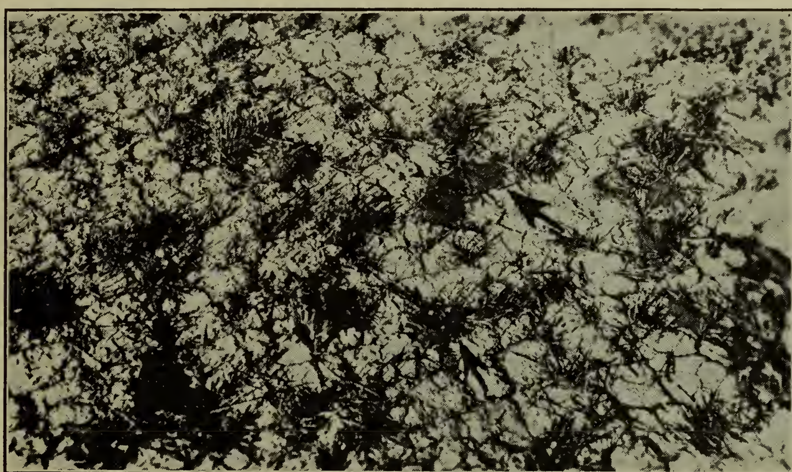

FIGURE 9.—Small piles of earth thrown out by new queens in their futile attempts to start new nests. No less than 12 different queens had made such attempts in this 3 by 4 foot area where only one colony could possibly have survived. Two of the piles of earth are indicated by arrows

may continue indefinitely unless some external condition arises to destroy it.

LOCATION OF NEW COLONIES

New colonies are most easily established in fields having a porous soil or along ditch banks, where the soil is easily excavated. Where the soil is hard or rocky, the females are unable to penetrate to the desired depth, and failure is certain. An examination of an alfalfa field (fig. 9) revealed the presence of 50 unsuccessful new workings of young queens in an area of 60 square feet. Although the females may fly for considerable distances, it has been observed that by far the greater number of new colonies are established within a radius of a few hundred feet from the old colony.

FOOD AND FOOD STORAGE

The common name of the red harvester ant is derived from the ant's habit of going out into the field surrounding the nest and harvesting the seeds which are its principal food. (Fig. 10.)

Apparently any seed which can be carried is taken, and the variety largely depends upon the vegetation found nearest the colony. A number of different kinds of seeds have been found stored in the colony chambers, such as alfalfa, bur clover, Johnson grass, oats, wheat, Bermuda grass, wild sunflower, and mesquite beans. Such products as bran or rolled oats, when within reach of the ants, are often carried in by the workers. All food materials are stored in the chambers. This stored material is not confined to any particular part of the nest, but may be found in chambers scattered throughout. It is undoubtedly moved about from chamber to chamber as the space is needed for other colony activities. In the fall, when seeds are most numerous, a majority of the chambers may be found to be largely filled with stores. This habit of food storage is one that makes control more difficult and perplexing. An ant colony when treated with some substance may immediately become quiet, the entrance tunnel being closed up and the ants living on these stores for months at a time. As it shows no outside activity, one is led to believe that the colony is dead, but it may suddenly resume its workings and become as lively as ever.

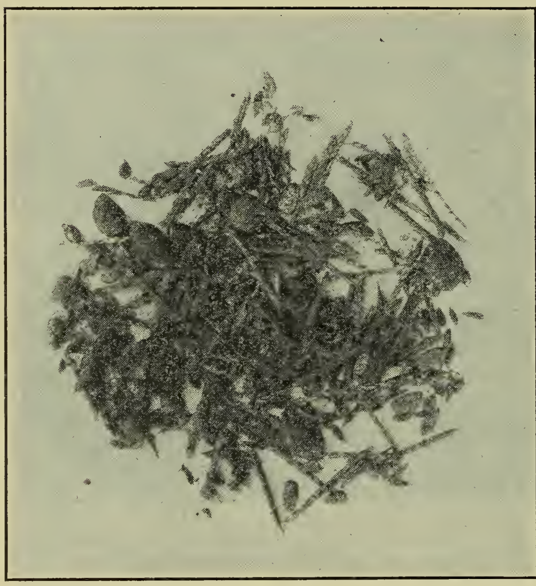

FIGURE 10.—Seeds of various plants found in the storage chambers of the red harvester ant. Among these are the seeds of Johnson and Bermuda grasses and alfalfa, and the beans from a mesquite tree. Although the ants prefer small seeds, the presence of the mesquite beans proves that these ants can transport large objects when the occasion demands. Natural size

DRESS PROTECTION AGAINST ANTS

The bites and stings of these ants affect some people more severely than others. In no case, however, is it a pleasure to be the recipient of an attack by these determined insects. While working among them, it is advisable to dress in such a way as to prevent their gaining entrance into the clothing and subsequently biting and stinging.

Rubber boots (fig. 11) serve as an excellent protection. The ants can not readily climb up the smooth sides and usually fall back to the ground soon after getting on the boot. Knee boots are much easier to work in and are just as much protection as hip boots, provided they have a really smooth surface.

Knee-high shoes with the trouser legs tucked inside afford considerable protection. The ants can occasionally ascend a shoe, especially where it is laced, so it is advisable to keep one eye, so to speak, on the footwear. Shoes that lace tightly so that the laced edges are drawn closely together are more desirable.

Any method which fastens the trousers tightly about the ankle, such as the wearing of leggins or tying the bottom of the trousers, is better than taking no precautions at all. It will be found necessary, regardless of the kind of protective measures taken, to stamp the feet on the ground at regular intervals to dislodge any ants that have started to climb the legs.

CONTROL MEASURES

The control of these ants, as has been previously mentioned, is extremely difficult. This is due to their tenacious habits and to the fact that their colonies are so well organized and their nest constructed so deep beneath the surface of the ground. It is, therefore, necessary first to determine and fix firmly in mind the general structure and extensiveness of the individual nest that is to be treated. The method of treatment must then be taken into consideration and the conditions under which it is to be applied. The degree of control obtained when using any given material is often deceiving, as previously explained (p. 12). Treatments applied in the fall of the year, about the time cold weather sets in, may cause the colony to enter a stage of hibernation which will continue until the following spring. Though this result will save much winter feed and consequently reduce the total yearly damage, it may not result in the final destruction of the colony. In this case, unless one digs down into the tunneled area of the nest, it is impossible to determine until the following spring whether or not the ant colony has been killed.

Figure 11.—When working around the red harvester ants, it is essential to take some measures to prevent their gaining access to the clothing. Rubber boots, such as are worn by this man, are a very satisfactory protection

Several materials give favorable control of the red harvester ant under certain conditions, whereas many others that from time to time have been recommended as remedies for this annoying pest have not been found to be permanently effective. No treatment which does not kill the queen will result in the permanent destruction of the colony. The queen, being the egg-laying machine, will soon replace the workers that are killed, and in time the colony will again be as strong as ever. On the other hand, a treatment which destroys the queen and a majority of the workers at a time of the year when there are no young in the colony in the form of eggs, larvae, or pupae, will effect a complete control, as the few remaining workers will eventually die and there will be no young ants left to continue the colony.

MEASURES AND MATERIALS RECOMMENDED

There are two substances which, when properly applied, give a higher percentage of control than any of the many other methods tried. These are carbon disulphide and London purple.

CARBON DISULPHIDE

Carbon disulphide is a colorless liquid which can be purchased at drug stores and seed houses, at prices ranging from 1 to 2 cents an ounce. When purchased in 5-gallon or larger quantities, it can be obtained at reduced prices. About 4 ounces of carbon disulphide is necessary for each application in treating a colony. The cost, therefore, not including labor, amounts to about 4 cents per nest as a minimum. Four fluid ounces of carbon disulphide is the amount recommended for destroying a colony of average size. A colony showing unusual strength and size should be treated with more than 4 ounces, but experiments have shown that for an average-sized nest this quantity will give about the same results as quantities up to a pint.

Carbon disulphide is very inflammable and explosive. It should be handled with great care, with assurance that no fire in any form is close by. A container of this material should never be opened in a closed room where there is little air in circulation as its fumes are deadly to human beings as well as to ants. When not in use, carbon disulphide should be kept well sealed and in a cool place. If handled deliberately and carefully, there is no danger connected with its use.

Carbon disulphide is best applied during either the early spring or the late fall of the year, while the ants are still actively working. The treatment should be made either in the early morning hours or late in the evening when practically all of the ants are within the colony, since if it is made in the middle of the day, during the time that the ants are out foraging, those not in the nest will escape death, and in case any eggs in the nest are not destroyed, the ants would rear a new queen. Carbon disulphide should not be used in the middle of the summer as it volatilizes too quickly in hot weather and would diffuse into the air currents and its effect be lost. It is advisable to apply this material when the ground is in a moist condition since this assists in the diffusion of the gas downward. The fumes or gas given off by it, being heavier than air, flow down through all of the tunnels of a colony and this makes it the ideal material for killing these destructive pests.

The thing to be aimed at for successfully controlling an ant colony is to apply the carbon disulphide in such a way as to allow the fumes to drain downward through the entire colony. Three methods of applying this material have been found to be successful. The first of these calls for the removal of a layer of dirt about 6 inches deep and from 2 to 3 feet in diameter, depending on the size of the colony, immediately around the main opening to the nest, and the pouring of the liquid down the several tunnels that will then appear as small holes about the diameter of a lead pencil. The second and simplest method is to pour the liquid directly into the entrance hole or holes.

The third method is to place the liquid in a shallow pan or dish beneath a tub that has been inverted over the main entrance to the nest. The edges of the tub should be pressed close to the ground, but it is not necessary to close the opening to the nest after making the application.

Of these three methods, the first, that of removing several inches of the top soil before applying the liquid, is the most certain to be effective with one treatment. If this is properly done, and at the right time, nearly all of the ants will be killed by the first application. It is advisable in these treatments to remove the surface soil one day and make the application the following day. This gives the ants a chance, during the interval, to clean out any soil particles that may have dropped into the tunnels. The majority of the downward tunnels leading directly to the various portions of the nest should be found and given a share of the dose, for only in this way can a complete fumigation result. The only objection to this method is that it requires more labor than the others, and the operator will need to be dressed as recommended in the section on Dress Protection Against Ants, in order to protect himself from these disagreeable pests. One will be better repaid, however, for the time and pains required to make one application by this method, than by using either of the other less certain methods, especially in the case of colonies in orchards where the crop to be protected is of high acreage value, or near the house where a large colony is extremely disagreeable.

The second method, that of pouring the carbon disulphide down the entrance hole or holes, is often quite successful when care is taken to pour the material slowly down the hole into the nest and then stamp the hole shut with the heel of the shoe. The colonies should be examined after a few weeks and the application repeated on any that were not killed. This method is not so successful as the one previously described because of the fact that the main opening to the colony may not be immediately above the center of the nest, and, the down tunnels being to one side, the fumes lodge in the network of tunnels and chambers near the surface of the ground before reaching the tunnels leading directly downward into the lower portion of the nest; or the fumes may drain into one part of the nest, leaving the other part free from them so that a great many of the workers and possibly the queen may escape uninjured. If the soil is quite shallow and there is a hardpan only a few feet beneath the surface, this method is usually fairly successful.

The third method, that of placing the desired dose of carbon disulphide in a shallow dish under a large inverted tub, is one that can be used quite generally around dooryards or residences. A galvanized washtub serves this purpose admirably. A pan of the liquid should be placed under the tub, and moist earth or mud should be plastered around the edges of the tub, so that the fumes can not escape but will be forced to go down into the nest. There is the same objection to this method as to the preceding in that a portion of the colony may escape by not being located immediately beneath the main opening.

LONDON PURPLE

The control of the red harvester ant by the use of London purple, though not so successful in destroying colonies, is in reality much cheaper than destroying them by the carbon disulphide method as it involves no apparatus and comparatively little labor. If thoroughly and correctly applied, it will give satisfactory results. London purple is a poisonous finely divided purple powder which is a by-product of the aniline-dye industry. In the past there was considerable variation in the proportion of arsenic, which is the poisonous agent of the compound, with a resulting uncertainty in

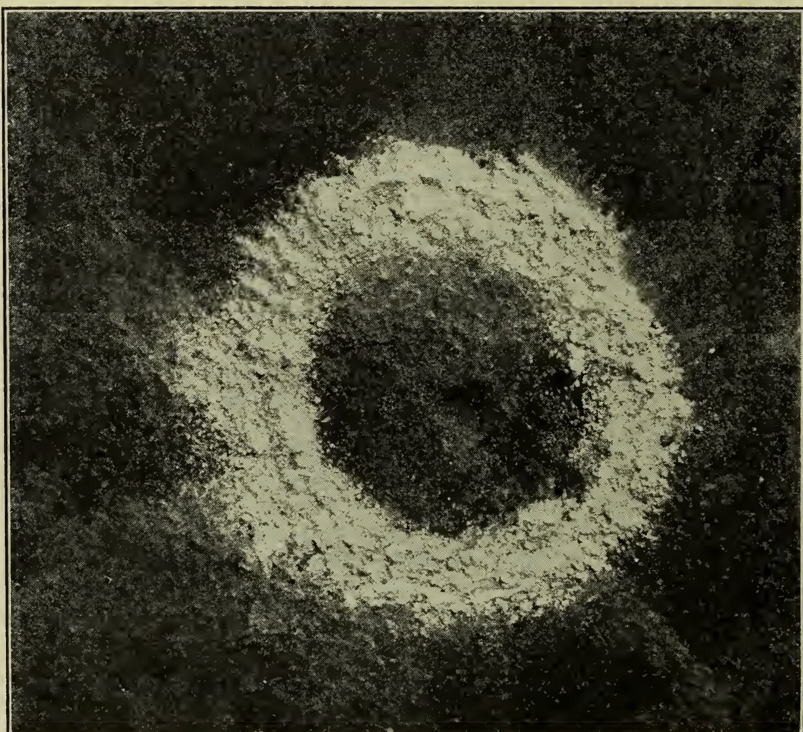

FIGURE 12.—A ring of London purple properly applied around the entrance to an ant nest. This ring should have a band of the poison that is 1½ inches wide, with the inside edge of the circle not more than 2 inches from the hole or entrance to the nest

its effectiveness. Within the last few years, however, this fault has been largely corrected. This poison is readily obtained in any locality at drug stores or seed houses. The material is a stomach poison, killing the ants when taken internally with their food. Death is not rapid, and results will not be noticed until two or three days after the material has been applied, at which time live ants may be noticed carrying the first dead ants to the outside rim of the cleared area over the nest.

London purple is most effective and should be used during the period of greatest activity of the ants. In late spring or at any time during the summer is the best time to apply it. During this period the ants are replenishing their depleted stores, and the poison is readily carried to the food supply. About one-half ounce of the poison should be applied in a circular band around the entrance hole or holes to the nest. This band should be not wider than 1½ inches and the circle made by it should be about 4 inches in diameter. The band must be unbroken, so that it will be impossible for the ants to go in and out of the colony without going through the London purple. One-half ounce of material will make a very shallow ring.

FIGURE 13.—A ring of London purple improperly applied around the entrance to an ant nest. When the poison is placed too far from the opening it is often shaken off by the ants before they enter their nest

The powder should be applied as shown in Figure 12 and not as shown in Figures 13 and 14. The use of London purple is often unsuccessful because of the failure to apply it properly. If the band is too far away (fig. 13) the ants will knock too much of the London purple off of their feet and bodies between the ring and the opening to the hill. If the material is placed directly at the opening (fig. 14), they will often not go through it but will make a new opening to the nest. If too much purple is applied and the band is too deep they will hesitate to walk across it and instead may open up a new hole, just as they would if the main entrance were plugged with the London purple.

In order for this poison to be successful, the application should be repeated at least three times, and as many more times afterwards as seems necessary on those colonies not controlled by the first three applications. The second and third applications should be made at intervals of from 10 to 12 days. This is necessary because when the poison is carried into the colony it does not kill the eggs or pupae. Consequently, even taking it for granted that all of the workers and the queen were killed by the first application, the pupae upon changing to adults will take care of the larvae hatch-

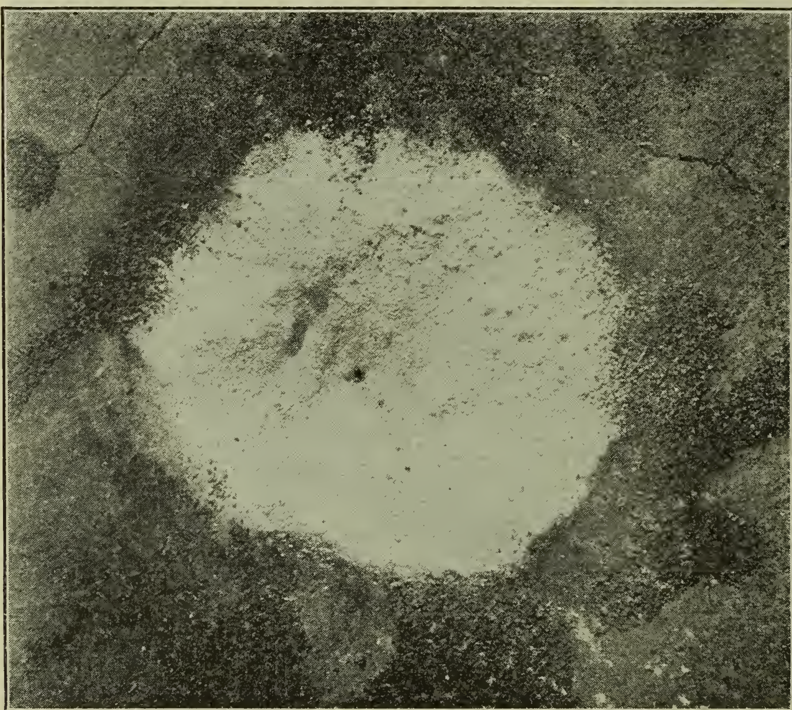

FIGURE 14.—London purple placed directly around the entrance to an ant nest. This is bad practice as it causes ants to dig a new entrance, and the poison is wasted

ing from the eggs and rear a new queen, and the colony will be continued and will soon build up to its old-time strength. By making the second and third applications, the adults developing from the pupae and the larvae hatching from the eggs laid by the old queen will also be killed, and the colony should be destroyed.

Only a portion of the colonies will be actually destroyed by these three treatments, and the process will have to be repeated from time to time and from year to year. The ant colonies can be successfully controlled, however, at a minimum of expense by this method. An 80-acre ranch, which contained 518 hills at the beginning of a 3-year experiment, contained only 160 active hills at the end of this period, and these were small and caused little damage. The entire expense in labor and material of the treatments, 13 in number, on these 80 acres amounted to $78.77, or 98 cents per acre for the three years. The material alone cost $35.47.

It may frequently happen that soon after applying a ring of London purple to an ant colony a sudden summer rain may fall and wash away the material. In this case, of course, it becomes necessary to repeat the application.

As London purple is an arsenical poison it should be handled carefully, and no empty cartons should be left lying in fields where livestock are present or around door yards where children might pick them up.

MEASURES FOUND PARTLY SATISFACTORY

Several methods of treating the red harvester ant are occasionally used which may serve the purpose of temporarily retarding their activities. None of these methods, however, will destroy the colonies, but because of the tendency of a colony to become inactive when treated in the summer or to go into hibernation when treated in the late fall, an inexperienced person may often be deceived into believing that the colony has been destroyed.

ETHYLENE CHLORIDE

Ethylene chloride, which is a colorless liquid very closely resembling carbon disulphide, will control ants in much the same manner. The material is applied in the same way under similar conditions, but it does not vaporize quite as rapidly as carbon disulphide and therefore does not show the same effectiveness in cool weather. Ethylene chloride, being more costly and difficult to obtain, as well as not being quite so effective, should not ordinarily be substituted for carbon disulphide.

TRAPPING

"Jugging" is a term used to designate a method of trapping the ants in which a jug, bottle, jar, or similar vessel, is buried close to the entrance hole with the mouth level with the ground. Many of the ants will fall into this, and the number of workers may be reduced to a point where they will cease to be an annoyance, especially where the colony is close to a dwelling, but it is by no means a method which will always destroy a colony.

CYANIDES

Calcium cyanide and sodium cyanide, especially the former, which is a commercial product used to kill insects, are quite commonly used to destroy ant colonies. Either may be purchased in powder, granular, flake, or lump form. These materials are quite different in their methods of releasing the deadly hydrocyanic acid gas. Calcium cyanide releases the gas quite rapidly when exposed to the atmosphere, whereas sodium cyanide absorbs moisture and gradually dissolves, giving off the gas much more slowly. Though unlike in this respect, their action when applied to an ant nest is quite similar, and they are therefore discussed together. Hydrocyanic acid gas is very deadly to ants as well as other animals and human beings, but owing to the fact that the gas is lighter than air it will not sink down into the colony more than a few inches beyond the point of application, and even though hundreds of dead ants are noticed at the entrance to the nest, complete control is not obtained. When it is desirable to check the activities of the ants for a short period of time, it may be done by placing a few ounces of calcium cyanide around the entrance hole or by making a solution of sodium cyanide and pouring it down the hole. The ants which pass near will be quickly killed by the fumes, and colony operations will be suspended for a week or more. In extensive tests with both sodium cyanide and calcium cyanide applied in many ways and under different conditions these substances failed to destroy any colonies completely.

Cyanide in any form should not be handled, nor should the container be opened in a closed room, and great care should be taken not to get even the smallest particle into the mouth or eyes as it is a dangerous and deadly poison. Animals or children should not be permitted to come in contact with it. Keep the container closed securely.

PARIS GREEN

Paris green may be used in the same way as London purple, by placing it around the entrance hole. The killing agent contained in it is also arsenic, and when the Paris green is tracked into the colony and mixed with the food many ants are killed. In some instances Paris green seems to have given results similar to London purple, but it has not generally proved so satisfactory, and it is doubtful if it should ever be substituted for this poison.

USELESS MEASURES OFTEN SUGGESTED

Several ineffective measures are often suggested or used as a possible means of control. These attempts at control are usually the result of insufficient knowledge of the structure of the nest and conditions affecting treatments.

Flooding, especially in irrigated districts, is occasionally tried as a means of combating the ants. Colonies that are flooded will temporarily discontinue activity on the outside of the nest, but will eventually become as active as ever.

Occasionally attempts are made to destroy ant nests by mechanical means. Some of these are plowing the surface soil, stamping entrance holes shut, filling dirt over the colony, and dynamiting. These practices have very little value and merely result in lost time and effort.

Oils, such as coal oil, gasoline, and lubricating oils, poured into the entrance hole of a colony are of no avail because they do not flow far enough into the colony to be effective.

Poisoned baits appear to be useless against this ant. Rather than carry the bait into the colony, the workers carry it to the edge of the cleared area on the surface and dump it.

INEFFECTIVE CHEMICALS

Nitro-benzol, a yellow, poisonous liquid, has no effect on the colonies of the red harvester ant.

Tartar emetic is a deadly poisonous substance, but it is ineffective because of the impossibility of getting the ants to take it internally.

Paradichlorobenzene is a material somewhat resembling table salt in appearance and commonly used as an insecticide and repellent. It has no value whatever against the ants. It produces a poisonous gas, but this gas does not penetrate the nests.

Lead arsenate and white arsenic are poisonous substances, which when applied in the same manner as London purple, have not proved effective.

SUMMARY OF RECOMMENDED CONTROL MEASURES

Carbon disulphide poured into the various tunnels, after a 6-inch layer of the topsoil has been removed, destroys a colony most quickly and thoroughly. The treatment should be applied in the spring or fall of the year and never at midday. The same chemical poured directly into the entrance hole frequently gives good results, but it is often necessary to repeat the treatment.

The application of London purple in a ring around the entrance hole is a cheap method of control and gives good results when used over a sufficient period of time. A season or two, or possibly longer, may be necessary to rid a field of the ant colonies present. It should always be applied when the ants are active, preferably during the late spring or summer.

Calcium cyanide sprinkled about the entrance hole serves to suspend the activity of the ants for a period of about a week or more. A second application continues the inactivity of the colony for a longer period.

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U. S. GOVERNMENT PRINTING OFFICE: 1931

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