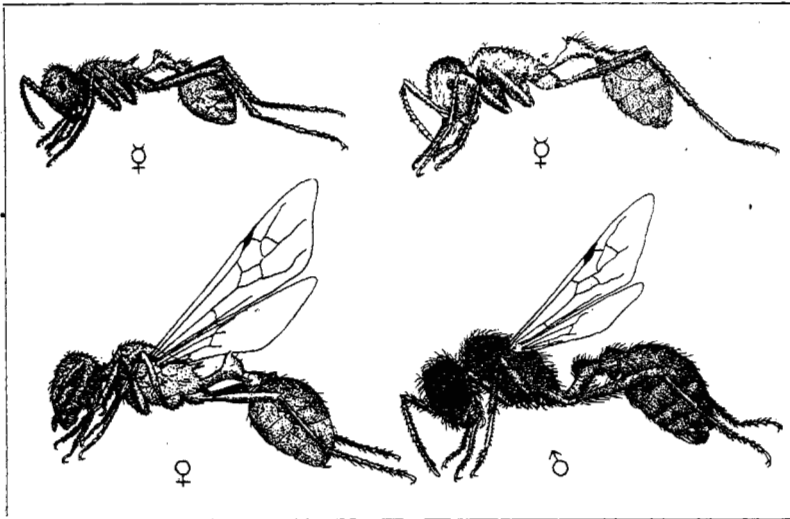

Kansas State Agricultural College Agricultural Experiment Station.

THE MOUND-BUILDING PRAIRIE ANT.



Two upper insects are workers; left lower is a fertile female or queen, and right lower is a male.

BY
T. J. HEADLEE AND G. A. DEAN.

MANHATTAN, KANSAS.
Published by the State; printed by the State Printer.
Topeka, 1908.

THE MOUND-BUILDING PRAIRIE ANT.

(*Pogonomyrmex occidentalis* Cresson).

T. J. HEADLEE and GEO. A. DEAN.*

SUMMARY.

1. *The mound-building prairie ants are distributed throughout western Kansas and over a large part of the western plains of the United States.*

2. *They live in large colonies in gravel-covered mounds, each located in a cleared circular space, and beneath these mounds in chambers and galleries that penetrate the earth as far as ten feet. These chambers and galleries serve them as store-rooms, nurseries, and workshops.*

3. *They have come to be considered injurious insects, not through a great increase in numbers, but rather through their close contact with man resulting from his conversion of the prairies into cultivated fields.*

4. *While it is true that they destroy a small per cent. of cultivated crops, their substantial claim to the title of injurious insects lies in the annoyance caused the farmer in cultivating and harvesting his crops and in the discomfort resulting from their efforts to protect their habitations when occupying public streets, sidewalks, much-used paths, dooryards, and corrals.*

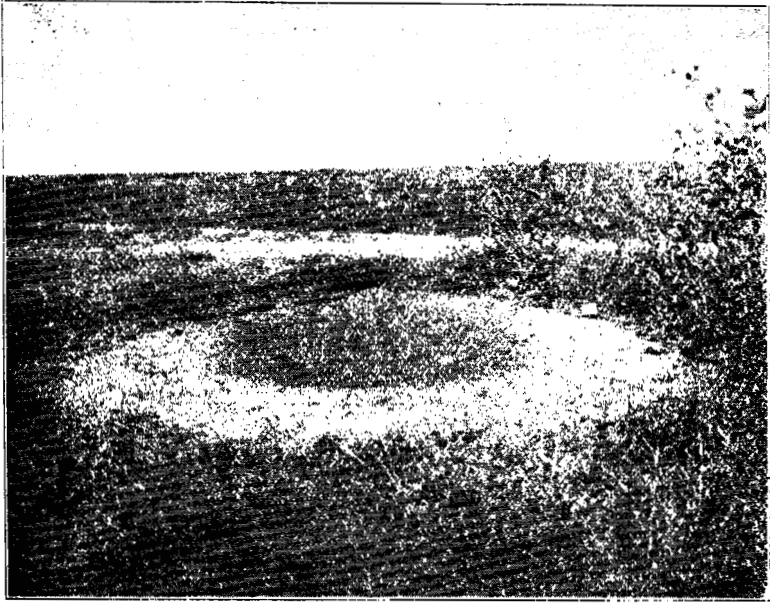
5. *They cling to their homes with such tenacity that to get rid of them the whole of the reproducing portion of the colony must be exterminated.*

6. *Large numbers of experiments have shown that thorough fumigation with carbon bisulfid is at once the easiest and most successful method of destroying them known at the present time.*

INTRODUCTION.

In crossing the prairies of central and western Kansas the traveler's attention is frequently drawn to the gravel-covered mounds that skirt the railways and wagon roads. Located in the center of cleared circular areas, they stand out prominently, breaking the grassy surface. These mounds dot the slopes of ravines, the banks of streams, and nooks and flats between

* The work upon which this bulletin is founded was independently planned and executed by Mr. Dean, who also made the photographs for illustrations.



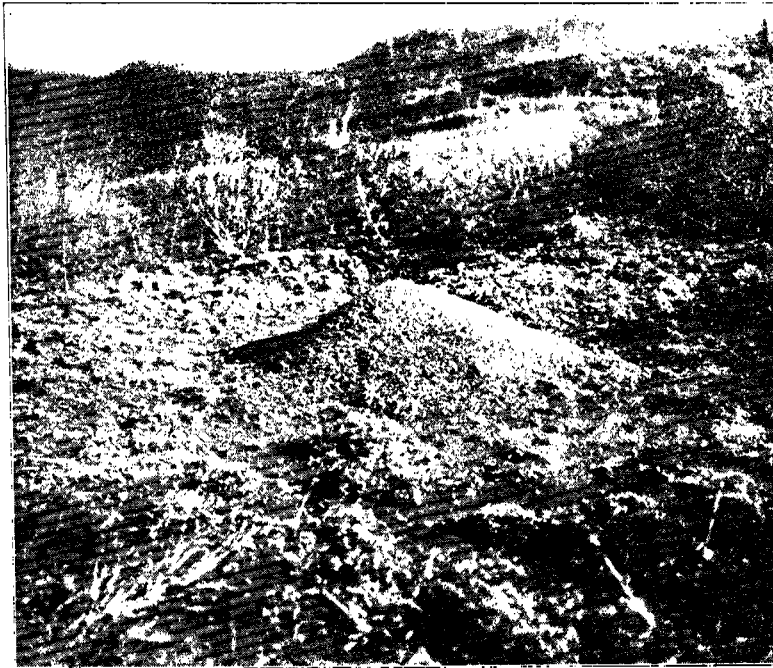
"Located in the center of cleared circular areas, they stand out prominently, breaking the grassy surface."

cliffs and ridges. They occur along traveled streets and sidewalks, in corrals, and in dooryards. They are present in fields of wheat and alfalfa, in spite of the plowing and disking. They possessed the prairie before the farmer came, and they remain in spite of his operations. The ant whose industry has made these mounds, with their clean-swept dooryards, clings tenaciously to the house which it has built and, so often as the roof is destroyed, laboriously rebuilds it.

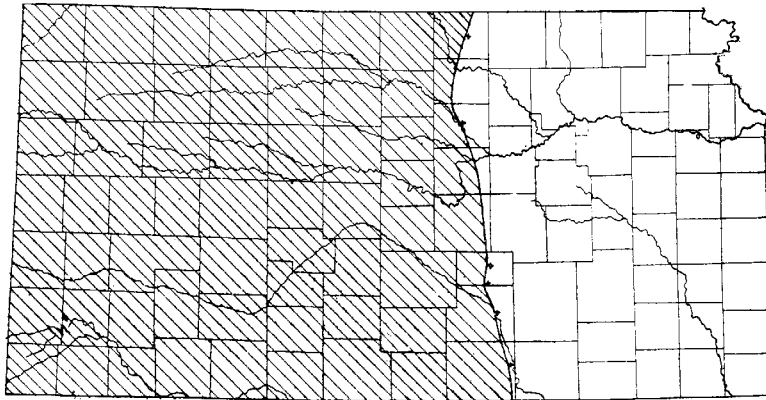
DISTRIBUTION.

These ants include a considerable portion of the western plains in their range. They occur throughout the northwestern part of Texas, a considerable part of New Mexico, Arizona, Utah and Wyoming, the western part of Oklahoma, Kansas and Nebraska, and the whole of Colorado.

In Kansas, they occur throughout the territory lying west of a line running through Belleville, in Republic county, down through Delphos and Minneapolis, in Ottawa county, Newton and Sedgwick, in Harvey county, Wichita, in Sedgwick county, and Oxford, in Sumner county. Their nests are small and very scarce along the eastern border but become larger and more



"These mounds dot the slopes of ravines."



"In Kansas, they occur throughout the territory lying west of a line running through Belleville, in Republic county, . . . and Oxford, in Sumner county."

plentiful westward. Throughout the western part of the state their mounds occur generally and vary in size within uniform limits.

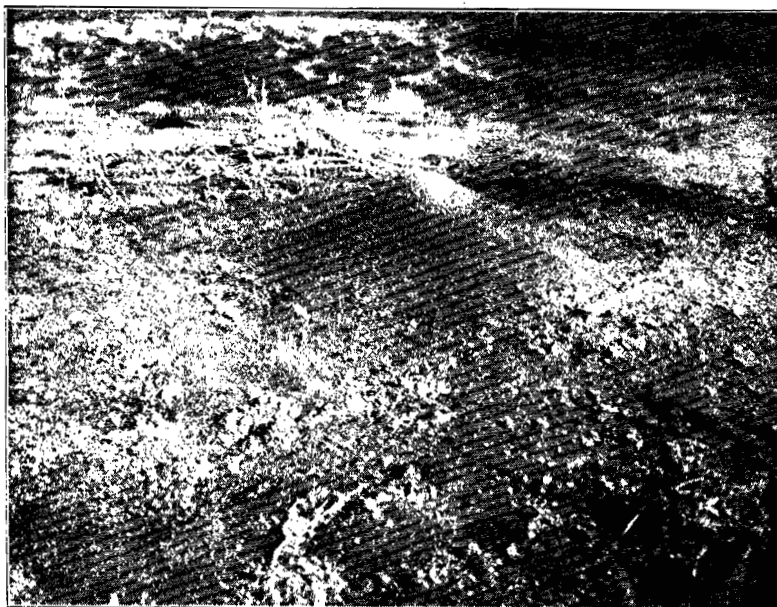
HABITS AND LIFE-HISTORY.

External features of the nest. Although some are perfect cones, the mounds usually have an elliptical base. They are of various sizes and heights, depending on the age, size and location of the colony. In prairie grass they average nine inches in height, in alfalfa four, and in wheat fields they are almost level with the general surface of the field. Yet where located on favorable soil and undisturbed they may reach fully twenty-four inches, and even in such cultivated fields as alfalfa, although there may be practically no mounds, there is always enough debris on the cleared space to indicate the former presence of good-sized ones. Generally, no amount of rough handling short of actual extermination seems sufficient to induce the ants to leave their homes, but in one instance a colony located in an alfalfa field had deserted the old site and was clearing the vegetation from a new spot a few feet distant.

Exterior measurements, in inches, of nests located in buffalo-grass and Russian thistles, Wallace county, Kansas.

NUMBER.	Height...	Long slope...	Short slope...	Major diameter at base..	Minor diameter at base..	Diameter of space.	Location of mound in cleared space.
1.....	13	27	24	44	40	126	Center.
2.....	11	24	24	42	36	90	Center.
3.....	12	36	24	66	44	168	Center.
4.....	9	20	20	39	39	132 x 108	West side.
5.....	8	36	22	66	43	144	West side.
6.....	10	24	24	48	36	108	Center.
7.....	16	46	34	78	78	144	Center.
8.....	9	28	16	45	36	120 x 96	Center.
9.....	9	24	24	44	44	180	Center.
10.....	8	15	15	24	24	132	Center.
11.....	9	23	18	44	36	90	Center.
12.....	9.5	27	27	48	48	132 x 144	Center.
13.....	11	22	22	52	34	132	Center.
14.....	11	30	20	51	40	120	Center.
15.....	9	29	17	48	36	144 x 84	Center.
16.....	9	27	17	48	38	120 x 96	One foot from edge.
17.....	9	21	21	41	41	114 x 96	West side.

The clearing surrounding the mound is usually circular and regular in form, but occasionally varies from this to elliptical. It is level, absolutely devoid of vegetation, and usually has the mound as its exact center. The size of the clearing depends upon the age and size of the colony and the nature of the surroundings. Those in buffalo-grass average nine feet in diameter and those in Russian thistles eleven feet. In alfalfa fields

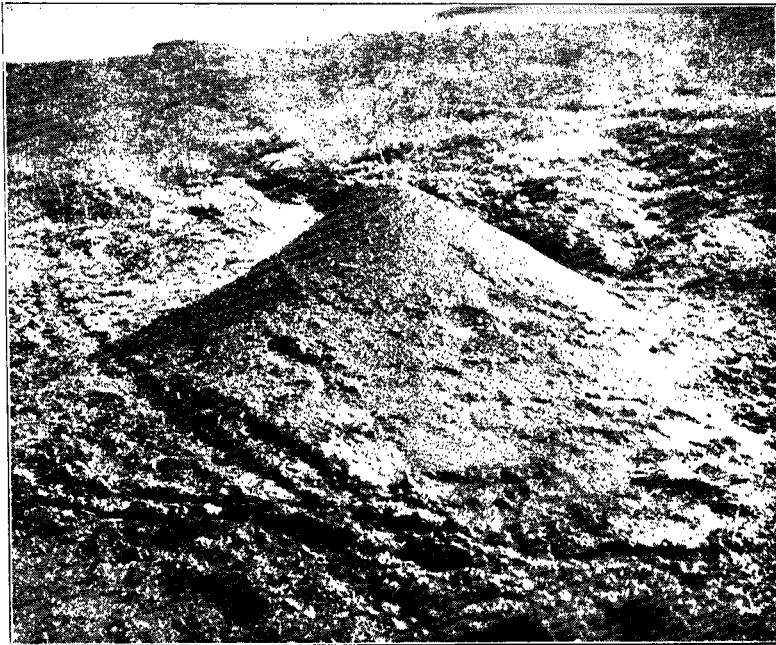


"They are of various sizes and heights, depending on the age, size and location of the colony."

they may measure as much as twenty feet, and the extreme limit of forty-five feet was found in a corral.

The ants cannot tolerate the presence of vegetation near their mounds and the workers clear it away by use of their well-adapted mandibles. They doubtless find that vegetation is an obstacle to their going and coming; that it affords concealment to their enemies; retains moisture after a rain, thus favoring the growth of injurious fungi; that its roots penetrate the chambers of their nests and, decaying, form passages for the entrance of water.

They cover the mound to a depth of from one-half to one inch with a layer of coarse particles selected from the surrounding material, making the slope nearly as steep as the nature of the substances will permit. Along the railways they use cinders, bits of coal, and ballast, and on the old town site of Wallace, Kan., they used bits of glass, mortar and small fragments of rusted iron, doubtless secured from houses that had been torn down. They supplement the supply of surrounding material with soil brought up from below.



“When located on favorable soil and undisturbed, they may reach fully twenty-four inches in height.”

Exterior measurements, in inches, of nests located in alfalfa field, Hays, Kan.

NUMBER.	Height...	Major diameter at base...	Minor diameter at base...	Diameter of space.	Location of mound in cleared space.
1.....	3	24	24	168	
2.....	18	12	12	120 x 108	Center.
3.....	4	16	12	132	Center.
4.....	4	14	13	138 x 120	Center.
5.....	2	26	24	168 x 156	Center.
6.....	5	24	24	170 x 144	West side.
7.....	3	10	10	60	Center.
8.....	3	20	18	180 x 156	Center.
9.....	7	7	6	36	Center.
10.....	3	24	11	168	Center.
11.....	4	16	16	144 x 120	West side.
12.....	5	30	26	186 x 168	Center.

The dexterity and ease with which the workers handle the pebbles wherewith they cover their homes is a source of constant interest and surprise. A worker will seize a pebble with outstretched mandibles and, with head elevated, holding it well to the front, carry it over the rough surface to the very top of the mound without once stopping to rest. In no case does one worker help another that happens to have undertaken too



“The ants cannot tolerate the presence of vegetation near their mounds.”



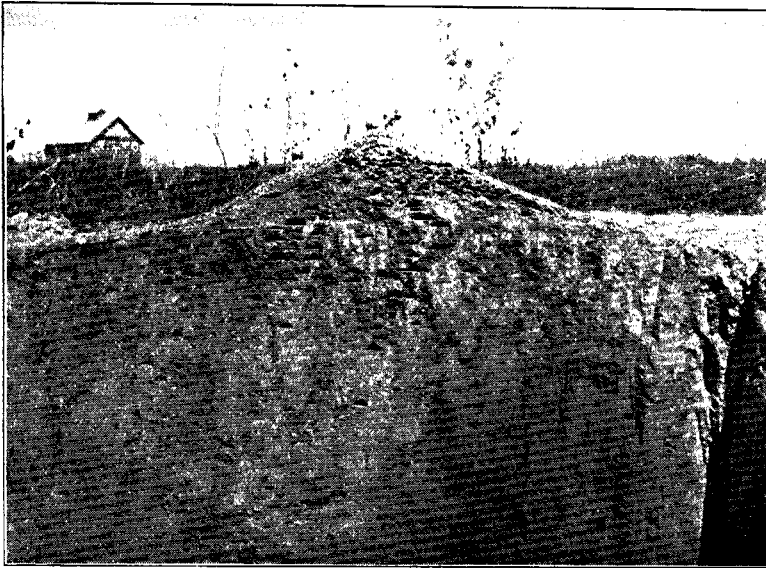
“These gateways are usually located about one-third the way up from base to summit of the mound.”

heavy a load. We have seen such individuals struggling vainly at the base while their comrades pass unconcernedly up and down all about them.

In many of the mounds the ants go and come through one opening, in others they have two or three such passageways, and in one exceptionally large mound the occupants had eight openings. These gateways are usually located about one-third the way up from the base to the summit of the mound. They commonly face the east, southeast and south, although so many may be found facing other directions that there is not much evidence of a determinate habit. They are funnel-shaped, with the broad end of the funnel directed outward and the small end into the galleries and chambers within. At night, or on the approach of a rain-storm, the openings are closed with material similar to that of which the mound-covering is composed. During the summer the ants begin to close them shortly before sunset and open them between eight and nine o'clock in the morning. So perfect is their workmanship that even close examination does not readily show where the openings have been. The force of workers that does the night closing is small, but when a storm is rapidly approaching, the number is greatly increased that the work may be quickly completed. In the morning, as soon as the gates are opened, the working force is out and busily engaged. It returns to the nest shortly before noon and remains inside until the hottest part of the day is past, then comes out and works until evening. On cool, cloudy days the midday return to the nest is omitted and the force continues in the field during the whole day. The morning and noon hours are probably employed in caring for and enlarging the interior of the nest.

Number, direction and position of openings.

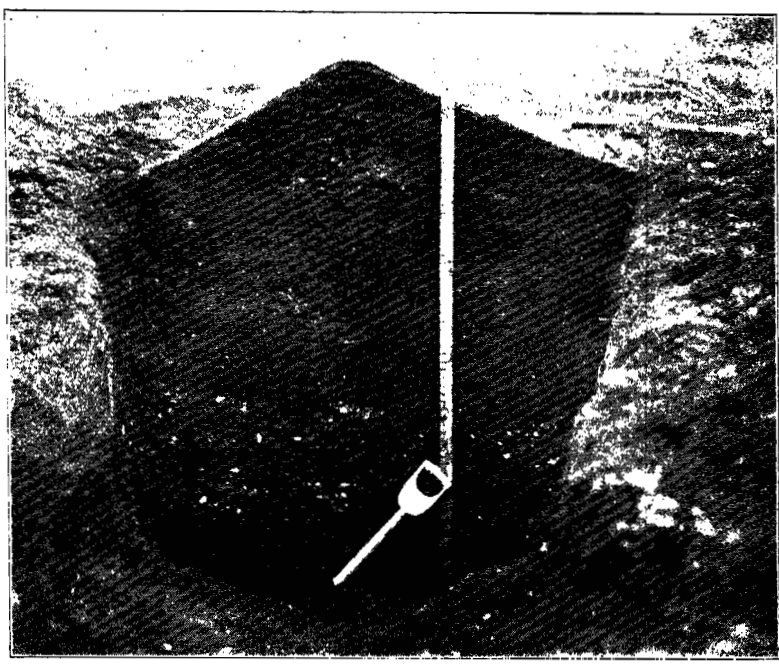
NUMBER.	No. of gates.	Direction.	Distance from base, in inches.
1	1	S.	12.
2	1	E.	11.
3	1	E.	8.
4	1	NE.	7.
5	5	N., E., SE., SW., S.	2, 3, 4, 3, 6.
6	3	SW., E., N.	6, 4, 5.
7	3	N., NW., SW., S.	8, 6, 14, 16.
8	3	S., SE., E., NE., S., W., SE.	16, 14, 12, 8, 2, 2, 2.
9	1	E.	13.
10	1	S.	5.
11	1	E.	8.
12	2	SE., SW.	6, 12.
13	2	NW., S.	7, 12.
14	2	N., SE.	6, 4.
15	1	SE.	8.
16	1	E.	9.
17	2	N., S.	6, 6.



"Except for an unbroken layer just beneath the gravelly surface, the whole mound is honeycombed with chambers and galleries."

Internal features of the nest. Beneath the gravelly coating the mound is composed of the local soil, mainly brought up from below, and so firmly cemented together that it forms a rain-proof roof. Except for an unbroken layer just beneath the gravelly surface, the whole mound is honeycombed with chambers and galleries. The ants by no means restrict themselves to their mound, but penetrate the soil directly beneath it to a great depth, sometimes as far as ten or more feet. The circular chambers, with their low-arched ceilings and level floors, vary from one to three inches in diameter and from one-half to one inch in height. The connecting galleries have a uniform diameter of about three-eighths of an inch and vary in length with the distance between chambers. Beyond the first three or four inches below the base of the mound the chambers decrease markedly in number and in proximity to one another. Sealed and unsealed storerooms filled with seeds occur throughout the nest; larvae, pupa, and young ants occupy many of the chambers, and adult members of the colony use the remainder for working and living rooms.

Social organization. The mound-building prairie ant shows three distinct classes of individuals—the queens (fertile fe-



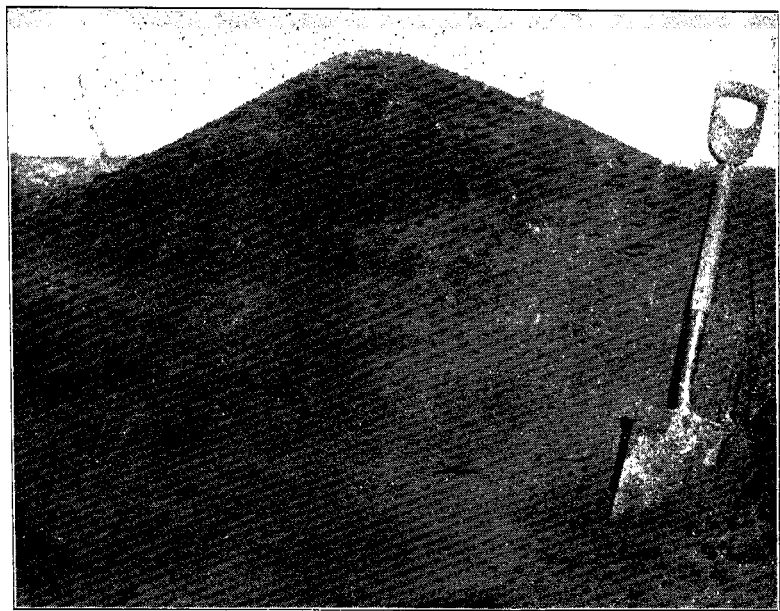
"The ants by no means restrict themselves to their mounds, but penetrate the soil directly beneath it to a great depth."

males), males, and workers (sterile females). Males and fertile females, which are about equal in number, form a comparatively small portion of the colony, while the workers in large nests seem almost numberless, there being at least 10,000.

The queen is about seven-sixteenths of an inch long, of uniform yellow-brown color, with one pair of small compound eyes and three very small ocelli. Her mandibles are large, black, and armed with seven teeth, and she is provided with a sting.

The male is about three-eighths of an inch long with head and thorax nearly black, abdomen brown and more pointed than that of the queen. His head is small and bears two large compound eyes and three ocelli, the middle one of which is much larger than the other two. He has no sting.

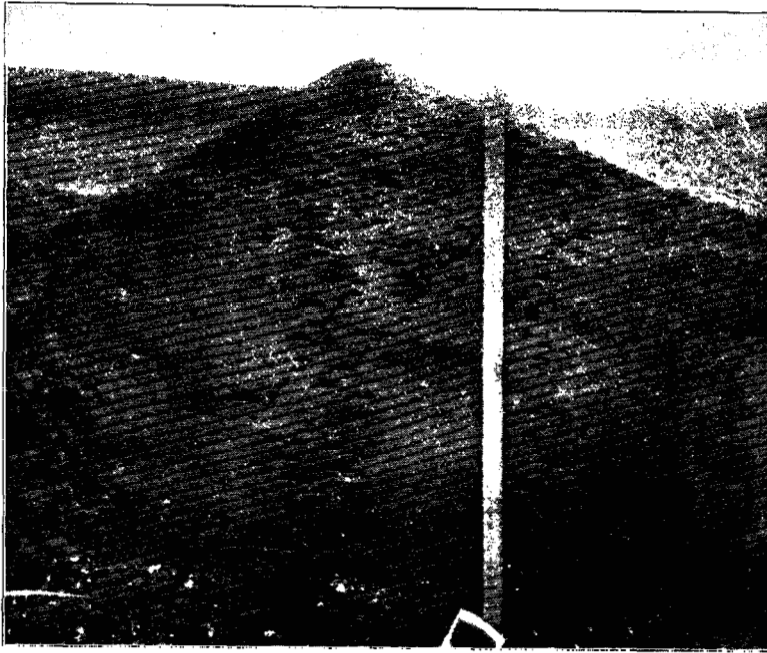
The workers vary in length from three-sixteenths to five sixteenths of an inch. The head is very large, two or three times the width of the prothorax. The mandibles are large, curved, and armed with seven teeth. They are well fitted for the tasks of seizing, cutting, crushing and sawing. The head



"The circular chambers with their low, arched ceilings and level floors vary from one to three inches in diameter and from one-half to one inch in height."

bears no ocelli and the compound eyes are small—about the size of those of the queen. The workers also are armed with stings. They vary in size from a large form known as the worker major to a smaller form known as the worker minor. Inasmuch as this distinction is based on characters all of which show such a clear intergrading that ten well-selected workers may be so arranged that the characters of the worker major gradually shade off into those of the worker minor, there is no good reason for distinguishing the two extremes of the series by special names. Not only are there no structural characters but there is no difference in function to justify such a distinction.

Disposition. Although these ants are larger than most species and have two of the most formidable weapons known among insects—large, pointed mandibles and most efficient stings—they are not quarrelsome, and fight only in self-defense. So peaceably inclined are they that other species of ants are allowed to come into their clearings and throw up their tiny crescent-shaped mounds of earth, and even to attack and chase



"The connecting galleries have a uniform diameter of about three-eighths of an inch, and vary in length with the distance between the chambers."

such thoughtless "mound-builders" as happen to pass too near them. Indeed, they carry this peaceful disposition to a point where they permit the common termite (*Termes flavipes*) and some species of ants to live with them in the chambers of their nests and to partake of their stored food.

Food. The workers gather seeds of various kinds and carry them into the nest. The hulls are torn off, carried out, and dumped at one side of the clearing, and the plump, sound seeds stored away in the underground granaries. These storerooms, packed with seeds of various kinds, may be found from an inch or two beneath the gravelly covering down to the lowest chambers, those beneath the frost line being larger and better filled. The seeds stored in the granaries are gathered from the surrounding vegetation, the kinds being limited only to such as are small enough for the ant to carry. The quantities of the different species depend largely on their accessibility.

The seeds of the pigweed (*Amaranthus blitoides*) and lambsquarters (*Chenopodium album*) were found abundantly in nearly all nests examined. The seeds of the prairie sun-

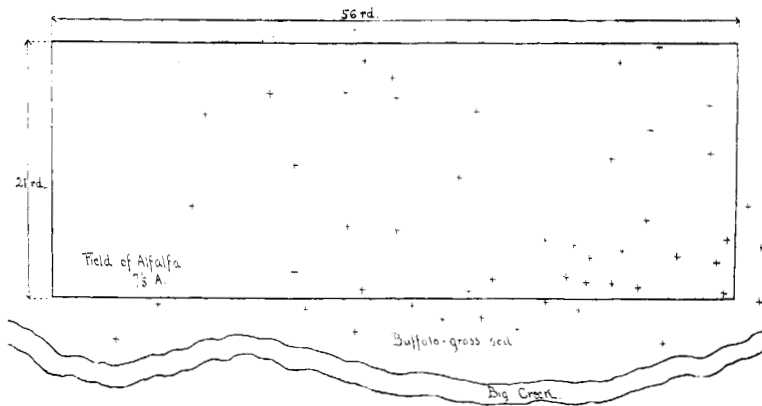
flower (*Helianthus petiolaris*) were common in several of the nests in western Kansas. The seeds of the green foxtail (*Chaetochloa viridis*), knotgrass or doorweed (*Polygonum aviculare*), lance-leaved sage (*Salvia lanceolata*), false dog-fennel or fetid marigold (*Boebera papposa*), and Lewis' wild flax (*Linum lewisii*) were all found in considerable quantities in nests near which these plants were growing. In cultivated fields the ants will store their cells with the seeds of millet or any other crop that may have seeds small enough for them to transport.

INJURY.

The ant colonies are usually too scattering materially to decrease the yield of any important crop. Even in alfalfa, where the damage occasions most complaint, they are chiefly troublesome as an obstacle to harvesting. In a seven and one-third acre field at Hays City, Kan., thirty-four colonies had cleared a space amounting to between one and two per cent. of the total area, and most of them had constructed mounds of sufficient size to compel the mowing-machine to pull around them. To attempt to mow through or over them would have choked the machinery and ruined the cutting-edge of the sickle. Should a driver have such trouble in passing over a mound it would be most unwise for him to stop and try to adjust his machinery, for such a disturbance would bring the ants forth in angry swarms, each individual eager to do her utmost to repel the invader. Every one that succeeded in getting on man or beast would seize clothing, hair, or skin between her mandibles, curve her abdomen downward, and deliver a thrust quite as painful in result as the sting of bumblebee or yellow-jacket.

Even if the mounds be leveled some days before the cutting, the difficulty is merely lessened, for the passage of the team and machine over the nest is sufficient to bring the ants out in readiness to attack when the intruder comes around again. To a less degree the same difficulty is experienced in raking and loading the hay.

In the dooryard the ants not only render the lawn unsightly with their mounds but unhesitatingly attack the careless child who walks over or plays about their nest. In trodden paths the passage of man or beast is sufficient to bring them out ready for any unfortunate that may follow soon after, and in corrals their determination to defend their rights is a source of annoyance to stock.



"In a seven and one-third acre field at Hays City, Kan., thirty-four colonies had cleared a space amounting to between one and two per cent. of the total area."

Although the work of the ants in alfalfa-fields has occasioned more complaint than has arisen from their presence anywhere else, there is nothing to indicate that they are especially fond of this plant, or that they have grown in numbers as the proportion of land devoted to its production has increased. They were in their present homes before alfalfa came, and they simply propose to remain there in spite of time and change.

REMEDIES.

Our study has shown no natural enemy of sufficient importance to warrant hope of material help from such a source, but has clearly indicated that artificial remedies must be employed to give relief.

In view of the tenacity with which the ants cling to their nests, it is clear that successful treatment requires the complete extermination of the reproducing members of the colony, and, as some of these are to be found in the lowest chambers, it is also plain that every ant in the nest must be killed. Any method of treatment is therefore successful only in so far as this end is attained.

Carbon bisulfid. Many methods have been given thorough trial, but fumigation with carbon bisulfid is the only one that can be labeled "successful" according to this test. Carbon bisulfid is evaporated under a practically air-tight vessel over one or more of the opened gateways of the mound. The vapor formed, being heavier than air, sinks downward through the burrows into the lowest parts of the nest and finally comes to

fill every chamber and passageway. Thus all the ants that are at home are suffocated. Many nests so treated were carefully opened to the lowest chambers and all the occupants found dead beyond possibility of doubt. Some nests were not opened until the next day after the fumigation and then not a living ant could be found. The following method of using carbon bisulfid has proven the easiest and most efficient tried. Start fumigation when gateways are open ; take a vessel, such as a galvanized-iron wash-tub, and place it bottom side up in such a manner as to cover the openings and as much of the mound as possible; if there are more openings than the tub will cover they should be closed by throwing some of the surrounding soil over them ; place under the tub, in a shallow pan or dish, near the opening, one to three ounces of carbon bisulfid, depending on the size of the nest; quickly pack soil around the edge of the tub, making it as nearly air-tight as possible; allow to stand thus for about fire hours. The experiments show that breaking open the mound before setting the fumigation is of no advantage, nor did the practice of pouring the fluid into the broken-up mound give any better results than that of evaporating it from a shallow pan.

The objections to this, the best method we know for destroying the ant colony, are mainly three. First, the method requires too much time ; second, workers absent from the nest when it is fumigated will escape destruction ; third, many of the mounds are too large to be covered by a tub. The enterprising farmer will find no difficulty in arranging his work so that he can fumigate six colonies per day with a very small expenditure of time. Two tubs may be used and the first fumigation set as soon as the ants open their gateways, the tubs removed and reset over other mounds on the way to his afternoon work, and again changed as he comes in from work in the evening. Each change requires only a few minutes. In answer to the second objection, it may be urged that it is only necessary to kill the fertile females and that they are in the nests at all times. If the scheme just suggested be followed, except on dull cloudy days, all the ants would be at home when each fumigation is started. Repeated experiments have shown that the tub need cover only a part of the openings, provided the others are stopped with soil, and that the results when the tub sat on one side of the mound were just as good as when it covered the entire cone.

Caution. Carbon bisulfid is about as explosive as gasoline, and should be used with equal care.

Useless methods. Several colonies were fumigated with hydrocyanic acid gas, using the same methods as those employed with carbon bisulfid, but the gas, being lighter than air, did not kill anything more than two feet down, and thus left many of the queens alive and reproducing.

Kerosene and gasoline were poured freely upon the mounds, some of which had been torn open, and the ants were killed to a depth of from six to ten inches. This method merely crippled the colony and was in no case sufficient to drive the ants away.

In some cases the mounds were opened and wet down with a liberal amount of carbon bisulfid, then covered with wet woolen blankets. In from ten to fifteen minutes the blankets were lifted and a torch applied. The explosion which followed did not, as was expected, blow the vapor far down into the chambers. This method is both useless and dangerous.

In a number of cases cans of one to two pints capacity were sunk into the mound until their open ends were on a level with the surface. They were then filled about one-third full of kerosene and the ants stirred up to the highest pitch of fury. They readily plunged into the kerosene. With the single exception of fumigation with carbon bisulfid, more ants were killed by this method than any other, the extreme total in one case reaching 1800. This, however, left about 400 still in the nest, and among them the reproducing females, so it, too, is an ineffective method.