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## Further Observations on *Pseudomyrmex apache* (Hymenoptera, Formicidae)

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The purpose of this note is to call attention to the high mortality that occurred in the population of *Pseudomyrmex apache* Creighton in the vicinity of Portal, Arizona, during the winter of 1961–1962. There is reason to believe that at least a third of the colonies of this ant, in an area extending from Paradise to Portal and thence to the Southwestern Research Station, froze to death during January, 1962. If to these are added the colonies that lost a large percentage of their members, about half of the *apache* population was affected. During the winter and early spring of 1962 the writer collected 20 colonies of *apache* in the area outlined above. Table 1 gives the data for each of these colonies. In brief, seven of these colonies contained no living individuals; in two, only the queen and a few workers were alive; and in one, about a fifth of the workers and most of the brood had been killed. During past years the writer has taken 75 colonies of *apache*, many of them in the mountains of southeastern Arizona, but until 1962 no dead colonies had ever been encountered. It seemed clear that the death of the colonies was a result of a cold snap of unprecedented severity which occurred in the Portal area during the period from January 9 to January 12, 1962.

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TABLE 1  
SUMMARY OF COLONIES OF *Pseudomyrmex apache* TAKEN NEAR PORTAL,  
ARIZONA, IN THE WINTER AND EARLY SPRING OF 1962

Station, Elevation, Date	No. of Nests Taken	Nest Site ( <i>Quercus</i> )	Condition of Colonies
Portal, 4800 feet			
January 30	1	<i>Q. arizonica</i>	All alive
February 2	1	<i>Q. arizonica</i>	All alive
February 12	1	<i>Q. emoryi</i>	All alive
February 12	1	<i>Q. grisea</i>	All alive
Paradise, 5600 feet			
February 15	2	<i>Q. oblongifolia</i>	All dead
February 24	1	<i>Q. oblongifolia</i>	All dead
Silver Creek, 5300 feet			
February 28	2	<i>Q. oblongifolia</i>	All dead
Idlewild Camp, 5000 feet			
March 15	1	<i>Q. emoryi</i>	All alive
Southwestern Research Station, 5500 feet			
March 17	1	<i>Q. grisea</i>	All dead
March 17	2	<i>Q. grisea</i>	Majority dead <sup>a</sup>
March 25	3	<i>Q. grisea</i>	All alive
Mouth of South Fork Canyon, 5100 feet			
March 22	1	<i>Q. emoryi</i>	All alive
March 26	1	<i>Q. emoryi</i>	All alive
March 29	1	<i>Q. emoryi</i>	All alive
April 4	1	<i>Q. arizonica</i>	Majority alive <sup>a</sup>

<sup>a</sup> In each of these colonies the queen had survived; hence it is probable that the colony would have recovered.

Since the duration of freezing temperatures during this period was important, the data secured at the Painted Canyon Weather Station (Southwestern Research Station) and carried in the Arizona Section of Climatological Data (January, 1962, vol. 66, no. 1) were consulted. A transcription of their figures is given here:

DATE	MAXIMUM	MINIMUM
January 9	59° F.	25° F.
January 10	49° F.	8° F.
January 11	25° F.	—11° F.
January 12	40° F.	3° F.

On the basis of these figures, it appears that there was only one day, January 11, on which the temperature remained below freezing during the entire 24-hour period. The writer's field notes made at this time

disagree with such a view. On the afternoon of January 9 there was a sudden drop in temperature, and during January 10, when snow fell, and January 11 the temperature remained well below freezing. The records from which the Weather Bureau secured the minima and maxima presented above are at the Southwestern Research Station. A study of these, particularly the thermographic chart, soon resolved the discrepancy. At the Painted Canyon Weather Station readings are taken each day at 6.00 P.M. Each 24-hour period thus consists of the last six hours of one day and the first 18 hours of the following day. On most calendar days the maximum temperature occurs around noon and the minimum temperature during the night. For this reason it is seldom that confusion results from the fact that the 24-hour period between readings is not a calendar day. But on January 9 the reading at 6.00 P.M. was the highest for the ensuing 24 hours; hence it was given as the maximum for the calendar day of January 10 in the Weather Bureau's publication. The thermographic record shows that after 6.00 P.M. on January 9 the temperature continued to fall and dropped below 32° F. at 8.00 P.M. Thereafter it remained below freezing for 63 hours. The maximum on the calendar day of January 10 was 17° F., which was reached at 10.00 A.M.

The above discussion has been necessary to establish the fact that during January, 1962, a most unusual climatic condition occurred in an area where the temperature rarely remains below freezing for as long as 12 hours. This does not imply that low temperatures are uncommon during the winter months. On the contrary, night temperatures at the Southwestern Research Station are often well below 32° F. during the winter months. But this nighttime cold is ordinarily of short duration, for with daybreak the temperature begins to rise, and after sunrise it climbs rapidly. By noon on most days the temperature is 60° F. or more. Thus winter survival in the Portal area demands either that the organism must have an inherent resistance to freezing or, if it lacks this, it must have habits that will furnish it protection during the periods of nighttime cold. But in most winters the freezing periods are brief; hence it does not follow that the ability to survive them presupposes an ability to survive a protracted period of freezing weather. If such a period lasted long enough to nullify the protection, the death of the organism would be certain. The destruction of many of the colonies of *apache* in the Portal area in January, 1962, appears to illustrate this very clearly.

The response of *apache* to cold weather is of particular interest, since it is a member of a genus the main representation of which occurs in the American tropics. Although a few species of *Pseudomyrmex* have ranges that extend from the tropics into temperate areas, *apache* enjoys the dis-

tion of a range that lies entirely north of the tropics. On this basis one might defend the view that the distribution of *apache* is the result of an unusual ability to withstand cold, but in 1954 the writer published data (Psyche, vol. 61, no. 1, p. 13) to show that the distribution of *apache* is more probably the result of an inability to tolerate excessive moisture. It seems likely that *apache* survives in the colder parts of its range not because of an unusual ability to resist low temperature but because of its nesting habits. When *apache* was described in 1952 the writer pointed out (Psyche, vol. 59, no. 4, p. 141) that it customarily nests in good-sized branches or the trunk of a tree. It was noted that this nesting behavior differs from that of the species of *Pseudomyrmex* that live in the southeastern United States, for the latter usually nest in twigs or plant stems of small diameter. Although no attempt was made to explain this difference, it now seems possible to do so. It is certain that the insulating qualities of the branches in which *apache* lives protect the ants against lethal cold. These branches ordinarily have a diameter of 4 cm. or more and consist of hard, dry wood (usually oak). Since the passages used by the ants are deep inside the branch, the ants cannot be affected by the outside temperature until the wooden walls of the nest have cooled to that temperature. The thicker the walls the longer it takes to cool them to a lethal temperature. If the ants live in large branches and the cold is of brief duration, they could "tolerate" very low temperatures because there would not have been time enough for the cold to chill the branch to a lethal point. If the branch were subsequently warmed before the next chilling occurred, the process could go on indefinitely, with no damage to the ants. But a very different result might be produced if the branch were not warmed between periods of nighttime chill. The cold would then penetrate deeper and deeper into the branch, and the temperature of the nest passages would ultimately drop to a level that would be lethal to the ants within them. Such appears to have happened to many of the colonies in the Portal area during early January in 1962. It would be interesting to know on which of the cold nights the colonies were killed. The obvious explanation would make the night of January 10-11, with its minimum of  $-11^{\circ}$  F., the fatal one. But it is equally possible and, in the writer's opinion, more probable, that the damage was done on the night of January 11-12 when the temperature plunged to  $3^{\circ}$  F. after 48 hours during which the nests had been subjected to freezing temperatures.