An Indian Ant's Novel Method for Obtaining Water

Mark W. Moffett, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

Desert animals obtain and conserve water in a variety of ways (Hadley 1979). Dew and fog are two commonly exploited sources (Broza 1979, Hamilton and Seeley 1976, Seeley and Hamilton 1976). I here report the ingenious harvesting of substantial quantities of dew by *Diacamma rugosum*, a common and conspicuous ant in open fields in and around the city of Bangalore in southern India (Karnataka state). My observations were made between January and March of 1982 in a large, open field on the campus of the Indian Institute of Science. (W. L. Brown suspects that these may represent not *D. rugosum* but another, closely related species. Voucher specimens of the ants used in this study have been deposited in the Museum of Comparative Zoology at Harvard University.)

The dry season in Bangalore extends from mid-November to mid-April. During the period of this study there was no recorded rainfall in Bangalore, while daytime temperatures often surpassed 30°C. This is not unusual. Thus water is an extremely scarce resource during the dry season. One source of water available at this time is the light dew which often forms in the early morning hours (Raman et al. 1973). However,

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Figure 1. Diacamma rugosum *worker drinking dew from feathers.*

the droplets are usually rare and very scattered. Because dew is usually available only for one to three hours each morning, the time required to search for individual droplets severely limits the amount of water that can be collected. Any means of reducing the search time would increase the yield.

The nest entrances of *D. rugosum* are often built up into cones of hard clay soil and are easily recognized, even from a distance, by a peculiar assortment of objects surrounding the large entrance holes. These are almost entirely feathers and dead ants. In most cases at least 95% of the dead ants are *Leptogenys processionalis* workers, although the remains of other large ants are usually present also.

A common property of feathers and dead ants is that relatively large quantities of moisture condense on them. Even on mornings when no dew is evident elsewhere, moisture is usually available for an hour or more on the feathers and ant remains.

On days when dew is present, most *D. rugosum* workers departing from the nest spend two to 15 minutes drinking from the droplets (Figure 1). Indeed, the value of the feathers and dead ants as a water source is apparent in that other ants, most commonly *Tetramorium smithi, Meranoplus bicolor,* and *Monomorium* sp., often take advantage of the bountiful water supplies of *D. rugosum,* accumulating in large numbers around nest entrances to drink from the droplets. These ants are small enough to go unnoticed by the *Diacamma.*

About 90% of the *Diacamma* workers drink from the feathers, which accumulate the largest quantities of dew. The dead ants could actually be serving other, as yet unrecognized, functions. However, if the feathers are removed, workers drink dew from the dead ants in greater numbers. Possibly the dead ants provide the primary source of water where feathers are rare or unavailable.

D. rugosum workers are not predators on live ants. Foragers quickly retreat whenever they come upon a foraging column of *L. processionalis* ants, and are occasionally pursued and captured by these aggressive predatory ants if they do not move fast enough. Foragers also either avoided or ignored single workers of *L. processionalis* or other species when these were dropped on their entrance mound, although severely wounded individuals were sometimes briefly antennated.

The poor condition of most ant remains carried to nest entrances by *D. rugosum* foragers indicates that this species is scavenging for the remains of dead ants rather than hunting live individuals. Indeed, both fresh and old *L. processionalis* remains dropped with tweezers in front of foraging *Diacamma* workers are frequently seized and carried to the nest. In one experiment I killed *L. processionalis* workers in alcohol, dried them overnight, and marked them each with a spot of enamel paint. At 0900, 100 of these corpses were scattered in the area between 1 and 2 m around each of five nest entrances. *Diacamma* foragers began to find and carry the marked corpses within 10 minutes, and 24 hours

later the number of marked ants at the entrances varied from 21 to 69.

D. rugosum workers also readily take the dead of ants other than *L. processionalis*, although corpses smaller than about one fourth the length of a *Diacamma* worker are usually ignored. Dead *D. rugosum* workers are an exception: Although substantial dew accumulates on the dead of *D. rugosum* (and occasionally even on live individuals), these are never deposited at nest entrances. Instead, perhaps for purposes of sanitation, *Diacamma* workers carry their dead 3 to 15 m away from the nest entrances and drop them. The predominance of *L. processionalis* remains around the entrances is simply a reflection of the abundance of these ants in the same habitat, as well as the high mortality suffered by this species during its massive raids, and the durability of the heavily sclerotized corpses.

Feathers dropped in front of foragers are likewise carried to the nest entrances. Community roosts of the Indian House Crow *(Corvus splendens)* occur in trees bordering many fields (including the study area), assuring a steady supply of preened feathers and down to colonies in these areas. However, even where no such obvious source of feathers is available, some feathers can usually be found around nest entrances. This suggests that the *Diacamma* are gradually accumulating feathers over a long period (as is presumably also true for the dead ants).

Refuse, such as the discarded remnants of prey items, is also present around nest entrances. This material does not accumulate substantial dew. Consequently, unlike feathers and ant corpses, refuse is not carried back to an entrance once displaced.

I was unable to discover any additional functions for the feathers and dead ants. These objects make nest entrances very conspicuous, but are not used as orientation cues: Foragers return just as quickly and directly to their nests after the feathers and ants are removed. Nor do the objects attract animals on which *Diacamma* prey. *D. rugosum* is a predator on a variety of small invertebrates, but the great majority of its prey is taken several meters (up to 10 to 20 m) from a nest entrance.

Foragers are not simply responding to the presence of dew when they collect dead ants and feathers, because these are taken to the nest and deposited there even when there is no dew on them. However, by selectively collecting these objects, workers are in essence foraging for water indirectly. Because dead ants and feathers are relatively hygroscopic, the behavior of the ants ultimately results in the virtual elimination of the search time required to locate droplets of dew. This is because the distribution of the droplets is changed from highly dispersed to strongly clumped. Feathers and dead ants presumably have a long life span, so that the cost to the ants in maintaining a large collection of them should be very low.

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A Horned Cretaceous Carnosaur from Patagonia

José F. Bonaparte, Head, Division of Paleontology, Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina.

A virtually complete, articulated skeleton of a new genus and new species of Carnosauria, *Carnotaurus sastrei*, was recently collected from Cretaceous strata in northern Patagonia, Argentina.

The skeleton was discovered on the Estancia Pocho Sastre at Bajada Moreno in the Telsen Department of Chubut. The geology of the area is not well known. Here the carnosaur-bearing beds are referred to as the continental Gorro Frigio Formation of Albian age, which is overlain by Late Cretaceous marine strata containing plesiosaurs.

The carnosaur skeleton was embedded in a large hematite concretion. Weathering affected only a segment of the tail, both feet, and the lower half of the tibiae and fibulae. The remainder of the skeleton was extremely well-articulated. The skull and forelimbs have several distinctive and significant anatomical features that suggest an evolutionary lineage different from those recorded in the Northern Hemisphere.

Systematic Paleontology

Order	SAURISCHIA
Suborder	THEROPODA
Infraorder	CARNOSAURIA
Family	Abelisauridae (Bonaparte and Novas, in press)
	Carnotaurus new genus
Type species	*Carnotaurus sastrei* new species

Holotype

An almost complete skeleton, MACN-CH 894, lacking only the distal