The activation of transcription machinery of the liver following whole-body X-irradiation does not seem to be due to the effect of irradiation directly on the liver itself, but possibly arises as a result of adrenal mechanisms[4-6]. Our results have further indicated that irradiation of liver nuclei in vitro does not enhance or decrease RNA polymerisation capacities (M.N. Subba Rao, M.S. Netrawali and D.S. Pradhan unpublished observation). As seen in table 4 in vitro irradiation of liver nuclei likewise does not change the permeability of nuclei to nucleoside triphosphates, even at the doses as high as 5000 R. This would mean that the increased permeability of nuclei to ^{3}H-UTP could also have arisen from indirect mechanisms.

It has been shown that the increase in the ability of liver nuclei from irradiated rats to synthesis RNA in vivo could be mediated through glucocorticosteroids known to be released in greater amounts after whole-body radiation exposure probably through hypothalamus-pituitary-adrenal axes[8-11]. The whole-body radiation-induced changes in permeability of liver nuclei could hence be conceived as the consequences of increased release of glucocorticosteroids. Our results showing that irradiation in vitro fails to elicit changes in permeability of nuclei seem to support this contention. Indeed, a study reported by Sekeris and coworkers seems to suggest that cortisol added in vitro may change permeability of liver nuclei to iodoacetic acid[12].

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Slavery in the subfamily Dolichoderinae (F. Formicidae) and its ecological consequences

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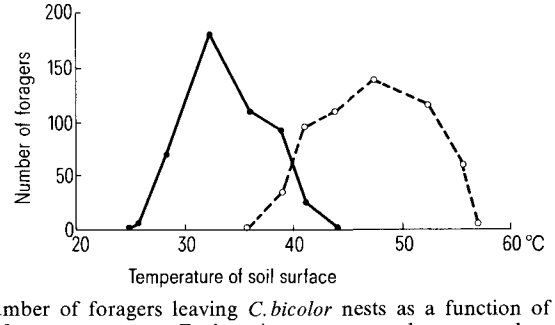
Summary. Evidence of slave-making habits in 2 species of the subfamily Dolichoderinae has been found in arid habitats of western North America. The enslaved species are of the subfamilies Myrmicinae and Formicinae. In previously reported cases of slavery in ants, both the slave-making and enslaved species are of the subfamily Formicinae. In the 2 new cases of slavery reported here, presence of slaves of another species in a colony significantly increases the breadth of diet and/or the range of temperatures at which the colony forages.

Certain species of ants are known to capture pupae from the nests of other ant species, return them to their own nests, and allow them to emerge as workers. In known cases of slavery, both the slave-makers and the enslaved species are within the subfamily Formicinae. In my studies of the ecology of ants, I have observed 2 possible cases of slavery: in both, the slave-making species is in the subfamily Dolichoderinae. The enslaved species are of different subfamilies, Myrmicinae in one case and Formicinae in the other. The present study describes the evidence for slavery in this new subfamily and the ecological changes resulting from the inferred slavery systems.

The 1st case of slavery reported here is that of *Conomyrma bicolor* using workers of *Myrmecocystus kennedyi* as slaves. The colonies were observed in the Mojave Desert of southwestern United States, at an elevation of 825 m. While taking ecological measurements on what were believed to be compound nests of the 2 species, I observed slave raids by foragers of *C. bicolor* on colonies of *M. kennedyi*. These raids developed in several of the 'compound' nests at about 16.30 h on the afternoons of 19–23 July. The soil surface temperature at this time was 37 °C; the ambient temperature 32.6 °C. Initially, *C. bicolor* workers began to emerge from their nests in unusually large numbers and to mill around the nest entrance for about 30 min. About 300 workers per colony were present and all foraging ceased. Workers of each colony then formed into a loose column and traveled up to 10 m from their nest to enter the nest of *M. kennedyi*. The *M. kennedyi* workers gave little resistance and soon thereafter, *C. bicolor* workers began to return to their own nest, each carrying a pupa. This continued until sunset each day, at which time the soil surface temperature was around 29 °C and the ambient temperature 27 °C. During the latter part of the raid, *M. kennedyi* workers were seen leaving their raided nests, some carrying pupae.

The 2nd case of slavery was observed at a study site located in sagebrush habitat (elevation 1524 m) in the Great Basin Desert of western United States (Arizona). On the mornings of 27–30 June, workers of *Conomyrma insana* colonies were seen to travel in loose columns to the nests of



Number of foragers leaving *C. bicolor* nests as a function of soil surface temperature. Each point represents the mean observed, during a 10-min interval, for 4 colonies. Solid line represents *C. bicolor* foragers; dashed line represents *M. kennedyi* foragers.

Crematogaster emeryana, and to later emerge carrying pupae which were then transported back to their own nests. The formation of the raid was similar to that observed in the Mojave Desert, except fewer workers were involved (around 70 per colony). At the peak of the raids, I estimated about 22 pupae were returned to each *C. insana* nest every 10 min. The raids began at 07.00 h and continued until around 09.15 h. Soil surface temperatures during this period ranged from 21.5 to 32.5 °C.

The foragers of both *C. bicolor* and *C. insana* normally search independently for food items. Formation of columns therefore involved a considerable departure from their normal foraging behavior. In both species, the raiding column appeared to move directly to the nest which was raided. The mechanism by which this was accomplished (e.g., memory from previous raids, chemical trails, or scouts) was not discovered.

Ecological characteristics. C. bicolor and *M. kennedyi* were found to be quite similar in nest site location. Nests of both species were abundant in sunny areas where the soil was composed of fine-grained sand. Daily foraging activities of 4 colonies of *C. bicolor,* in which slaves were present, were observed and the number of foragers of each species leaving the nest recorded. Although individuals of the 2 species closely resemble each other in size and color, they can easily be distinguished by their movement patterns while foraging.

Dietary estimates, based on the types of food collected by 80 foragers of each species, indicate that the 2 species collect similar foods. Nectar was collected by 95% of the *C. bicolor* foragers and by 96% of the *M. kennedyi* foragers. The remainder of the diet, for both species, consisted of seeds and insects.

The soil surface temperatures, and therefore times of day[1], at which foragers of these 2 species were active were so different they scarcely overlapped (figure). By having *M. kennedyi* foragers in the colony, *C. bicolor* increased its foraging activity from a temperature range covering 14° (26–40 °C) to a range covering 31° (26–57 °C). With a greater range of temperatures utilized, colonies with slaves are able to forage for longer periods each day during the spring and summer months when nectar is abundant.

Dietary estimates for the 2 species without slaves and for *C. insana* colonies with *C. emeryana* slaves present

Species	Seeds (%)	Insects (%)	Nectar (%)
C. emeryana	10	0	90
C. insana			
(without slaves)	55	45	0
(with slaves)	44	36	20

The 2 species at the Arizona site were ecologically quite different. *C. insana* nests were located in open areas, away from shrubs, whereas *C. emeryana* nests were located in the base of cholla cactus plants. Foragers of *C. insana* actively collected insects and seeds at soil surface temperatures between 20 and 41 °C, whereas foragers of *C. emeryana* collected seeds on the ground at temperatures between 14.5 and 49 °C, and gathered nectar from cholla cactus buds and flowers when soil surface temperatures ranged between 14.5 and 62 °C.

The presence of *C. emeryana* slaves within the nests of *C. insana* produced a considerable increase in the breadth of diet (table). Without slaves, *C. insana* foragers collected seeds and insects; with slaves, nectar was added to the diet.

The position of the nests of *C. insana* limited the potential gain in foraging times by having *C. emeryana* as slaves. *C. emeryana* foraged at soil surface temperatures up to 62 °C by moving directly from their nest in the base of the cholla cactus up to the top of the plant. Thus, although the soil surface temperatures were often as high as 62 °C, foragers on the cactus seldom experienced temperatures greater than 40 °C. The *C. emeryana* foragers present in the *C. insana* nests, however, could not avoid the direct heat by moving directly up a cholla cactus, thus ceased foraging when temperatures reached 49 °C. Nevertheless, the presence of *C. emeryana* slaves increased the foraging temperature range of *C. insana* from 21° (20–41 °C) without slaves to 34.5° (14.5–49 °C) with slaves. Further studies are required in order to establish with certainty the existence of slave-making in these 2 species of *Conomyrma.*

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Effect of dibutyryl cyclic AMP and analogs on the rate of contractions of myocytes in culture

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Summary. ^{2}O, ^{6}N-butyryl, 3′, 5′-cyclic monophosphate (dibu cAMP) when added to fetal rat heart cells in culture inhibits myocyte contraction. This inhibition is 100, 84 and 51% complete when the dibu cAMP concentration used is 2, 0.2 and 0.02 mM, respectively. The potency of dibu cAMP derivatives in myocyte contraction inhibition follows the order, dibu cAMP > ^{6}N-bu cAMP > ^{2}O-bu cAMP = AMP > butyrate. The inhibition caused by the first three chemicals is greater than 70%.

The dissociation of heart cells (for example, by degradative enzymes) causes the disintegration of myofibrils with a concomitant appearance of contractile activity[2–4]. We have shown that this contractile activity correlates well with the intracellular microtuble organization[5]. High concentrations of ^{2}O, ^{6}N-butyryl, 3′, 5′-cyclic monophosphate (dibu cAMP) inhibits myocyte contractions with a concomitant alignement of microtubles in a longitudinal array[5]. The process is reversed by colchicine. Here we report that the dibu cAMP effect is concentration-dependent and that of the various derivatives tested only ^{6}N-bu cAMP replaces dibu cAMP.

Methods. Primary myocyte cultures from 19-day-old rat embryos were grown on glass cover slips[6]. The treatment with various chemicals and the monitoring of the rate of myocyte contractions were performed as described previously[5].

Results and discussion. As shown in the table, dibu cAMP at 2 mM concentration inhibits myocyte contraction almost totally. At $^{1}/_{10}$ this concentration of dibu cAMP, the contraction of myocytes is reduced by about 80%. 3 of the 8 cultures treated with 0.2 mM dibu cAMP stopped beating altogether. A further reduction in the concentration of dibu