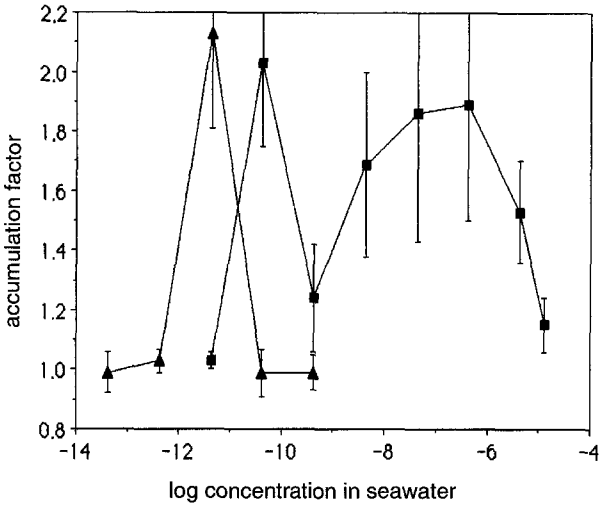

Fig. 2. Sensitivity curve for 10-fold concentration intervals. On the abscissa, molar pheromone concentration is given as the geometric mean of the limiting concentrations in seawater on the surface of the solvent droplets. Each plotted value corresponds to the arithmetic mean from five assays, data from two independent experimental series (■, ▲) are shown

omone complexes [7]. It is known from movement studies that *Laminaria* spermatozoids show reorientation reactions when perceiving decreasing attractant concentrations and do adapt to constant stimulation [5]. It should be kept in mind, however, that the response and the response range observed in an assay reflect the behavior of a large population of cells. It is not possible to draw conclusions for a single cell, even though a clonal culture was used.

The threshold concentration for pheromone-induced spermatozoid release in *Laminaria digitata* has been determined as 5×10^{-11} *M* [4], which is clearly higher than the threshold for chemotaxis at 1.4×10^{-12} *M*. In *Desmarestia aculeata*, the threshold concentration for attraction by its pheromone, desmarestene, has been found at 2.8×10^{-11} *M*, lower than the threshold for release which is 9×10^{-11} *M* [9]. Thus, it is ensured that spermatozoids of both species should be able to sense the attractant gradient once released from antheridia by the pheromone signal.

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Mealybug-carrying by Swarming Queens of a Southeast Asian Bamboo-inhabiting Ant

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Many ant species attend phloem-sucking Homoptera, especially coccoids and aphidoids, to harvest their honeydew, often in turn providing them with protection and thus forming with them a mutually beneficial relationship called trophobiosis. While worker ants of various genera transport their homopterans to new feeding sites (e.g. [1 – 4]), the next step in the co-adaptation, the carrying-along of trophobionts by colony-founding queens, has been secured only for *Acropyga* (Formicinae), a genus of subterranean ants tending root pseudococcids [5 – 7]. Queens of *Plagiolepis* reported to be carrying pseudococcids [8] were later identified as *Acropyga palaearctica* (Buschinger, pers. comm.) and a report of coccoid-carrying by swarming queens of an ant only tentatively identified as *Cladomyrma* [9] could not be confirmed by our own extensive studies on that genus [10, 11]. We report here on the discovery of pseudococcid-carrying by swarming queens in an ant very different from *Acropyga*, both systematically and ecologically: a bamboo-inhabiting *Tetraponera* sp. ("*Te*") (Pseudomyrmecinae), an undescribed species, near *T. attenuata* F. Smith, which has been assigned the

code name *T.* sp. PSW-80 by Dr. P. S. Ward, University of California at Davis, who is preparing a revision of the genus.

The large, shiny black *Te* (workers ca. 10 mm long) was detected by D. K. during a study on the arthropod succession in bamboo internodes on the Malay Peninsula. It is the third ant species known to be specialized on nesting in bamboo [4]. At the main study site, the Ulu Gombak Field Studies Centre of the University of Malaya, the ants were found in internodes of the large bamboo, *Gigantochloa scortechinii* Gamble 1896 (up to 25 m high and 12 cm diameter), which they entered through small holes (ca. 2×3 mm) usually bored by pyralid caterpillars. They were always associated with mealybugs of an unidentified *Chaetococcus* sp. (Pseudococcidae).

We established several *Te* colonies in our laboratory, keeping them in Fluon®-lined plastic containers partially covered with glass panes. Plastic Petri dishes and film vials, both with plaster-of-Paris bottoms and small entrance holes, served as nest sites. The *Te* workers transported not only the brood but also the red *Chaetococcus* crawlers (the dispersing first-instar nymphs) into these laboratory nests, where some of them survived for over 6 weeks. Soon we made an exciting discovery: Alate *Te* queens exhibiting swarming behavior during the morning hours were carrying one or two crawlers in their mandibles while running about and tyring to fly away (Fig. 1) (observed during five swarming events in two colonies). Judging from the pre-swarming spatial distribution of queens and crawlers in different nests of one polydomous colony, at least some queens must have collected the mealybugs from nests other than their own. We confined nine swarming queens carrying a total of 15 crawlers in small vials. Seven of the queens continued to hold the crawlers for hours, dropping the last one only after more than 32 h. Inspected under a stereo microscope after their release, the pseudococcids appeared unhurt except for a reversible moderate lateral compression from the grip of the mandibles in most cases. Thirteen out of the 15 moved their legs or antennae when touched, showing they were alive.

The laboratory findings on pseudococcid-carrying by swarming *Te* queens have been confirmed by field observations of D.K. and A.S., all during sunny weather. Usually there is no noticeable outside activity on *Te*-inhabited bamboo stalks. But on 2. 10. 1991 at ca. 1030 h large numbers of *Te* workers were milling about on several inhabited bamboo culms. An alate queen was running up one culm with a red object in her mandibles. Collected for closer inspection she proved to be holding two small *Chaetococcus* nymphs (Fig. 1b). Another swarming event was witnessed on 23. 10. 1991 at 1200 h, when five alate queens, all of them carrying crawlers, emerged from the small entrance holes and ran up the bamboo culm. Two of them, carrying one and two crawlers, respectively, were collected. The others flew off at a height of 3 – 4 m. One alate queen with two crawlers was detected after it had dispersed from its colony on the morning of 12. 2. 1992. It was walking on the upper part of a culm just felled in a bamboo clump not inhabited by *Te*, ca. 7 m from the nearest inhabited clump.

By carrying pseudococcids along on her mating flight, the *Te* queen secures herself a honeydew supply as soon as she finds a suitable bamboo internode. Unlike queens of other arboreal ants (e.g., [10 – 12]), she enters a preformed nest site and therefore does not need to gnaw an opening or a cavity, an activity that would be incompatible with the holding of trophobionts between the mandibles. The occurrence of pseudococcid-carrying in colony-founding queens of ants as different as *Te* and *Acropyga* proves that the trait developed independently at least two times in the Formicidae.

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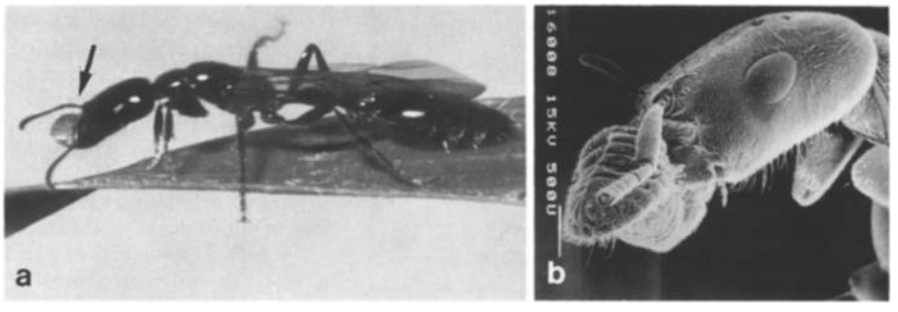

Fig. 1. *Tetraponera* PSW-80 queens holding *Chaetococcus* crawlers between the mandibles. a) Swarming laboratory queen (length ca. 14 mm) with two crawlers held venter to venter. b) Head view of field-collected queen with two crawlers (SEM photo by B. Ruppel)

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