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The external structural detail of the protrusions on the cephalothorax of male *Argyrodes antipodiana* (Theridiidae)

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Summary

Male *Argyrodes antipodiana* secrete a substance onto cephalothoracic protrusions ("knobs"). The substance apparently seeps out at the bases of hairs situated on the knobs, then proceeds to cover the hairs. The role of the substance during copulation and its effect on the female is discussed.

Introduction

Argyrodes is a large, cosmopolitan genus of spiders, many species of which are known to live as kleptoparasites on the webs of other, larger spiders (Kullmann, 1959; Vollrath, 1976, 1979 a, b, 1984). Males of many species within this genus are striking in appearance: they have two protruding knobs on the dorsal surface of their cephalothorax (Exline & Levi, 1962). In a recent study of *Argyrodes antipodiana* (O. P.-Cambridge, 1880) from New Zealand, it was observed that during copulation females pressed their chelicerae between the males' two protuberances ("knobs") (Whitehouse, in prep.), a behaviour also noted by Bristowe (1941, 1958) in a linyphiid, *Hypomma bituberculatum* (Wider), which also has cephalothoracic protuberances. Legendre & Lopez (1974, 1975) and Lopez & Emerit (1981) found a set of glands (the "clypeal glands") within the knobs of other species of *Argyrodes*, but they had no evidence of secretions from the glands on the surface of the knobs.

In this paper scanning electron micrographs will be presented which reveal the surface structure of the knobs of *Argyrodes antipodiana,* and thus will add to the understanding of the role of the knobs during courtship.

Materials and Methods

Spiders were collected from Te Aroha (North Island, New Zealand) and were housed in spider cages according to procedures described elsewhere (Jackson & Hallas, 1987) in a room under controlled temperature (20-25°C) and light (LD12:12) regimes.

Prior to being examined under a scanning electron microscope (S.E.M.), spiders were prepared in one of two ways. Spiders were either "untreated", which meant they were killed (using CO_2) and examined immediately; or "treated", which meant they were killed (using ethanol) and then put through a series of fixing solutions including ethanol and amyl acetate before being freeze-dried.

Results

Males had two distinctive knobs on their cephalothorax (Fig. 1): a smaller, anterior knob, which was covered with hairs, and a larger, posterior knob, which was only sparsely covered with hairs. The majority of the hairs on the anterior knob angled backwards towards the 'groove' between the two knobs (Fig. 1).

Untreated males had a distinctive layer of a substance which extended up the hairs on the anterior knob (Fig. 2). There was, however, no evidence of this substance on treated males (Fig. 3). Additionally the hairs of treated males appeared to be grooved (Fig. 4), and the pit from which the hair arises (Fig. 3) was not visible on untreated males.

Discussion

Evidently males of *A. antipodiana* secrete a substance from their anterior cephalothoracic knobs. This substance is, presumably, derived from clypeal glands of the type described by Legendre & Lopez (1974, 1975) for *A. gibbosus* (Lucas, 1846) although histological studies of *A. antipodiana* are needed to confirm this. The substance appears to be secreted from the base of the hairs, and the grooves on the hairs probably assist in the dispersal of the substance along the hairs.

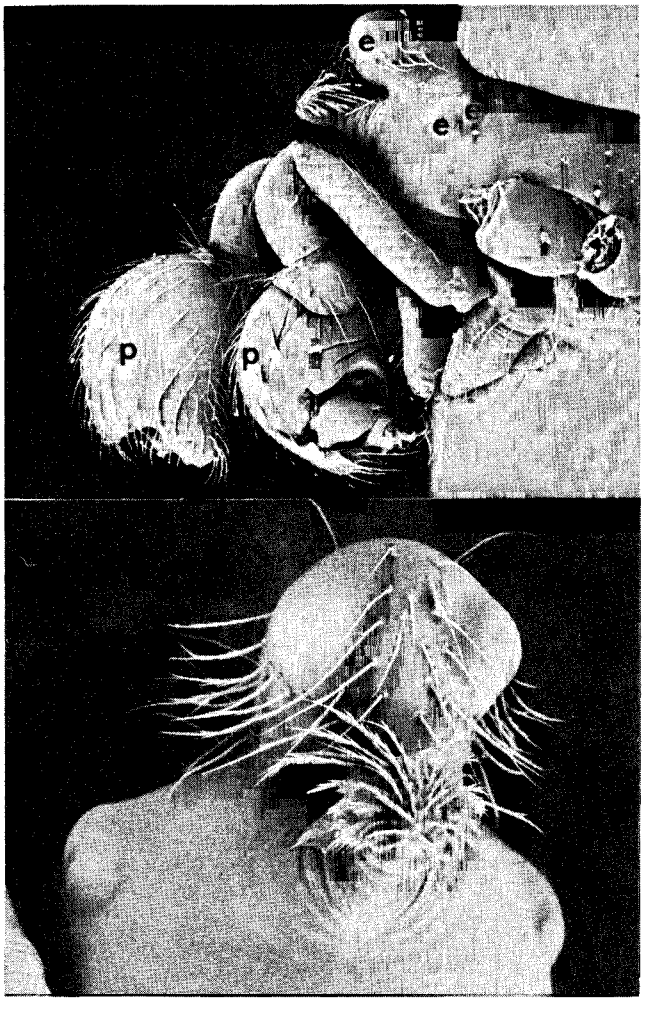

Fig. 1: (Above) Lateral view of male cephalothorax showing the position of the knobs. e = eyes, p = palps.
(Below) Closer anterior view of male knobs showing that the anterior knob is densely covered in hairs while the posterior knob is more sparsely covered in longer, finer, hairs. The creases around the base of the anterior knob suggest that it may be movable.

Pairs of *A. antipodiana* copulated repeatedly and frequently during male-female interactions, which often continued for over 5 hours (Whitehouse, in prep.). To copulate, the spiders approached each other face to face, each spider grasped the tarsi of the opposing legs I and II of the partner, then moved these legs laterally while the female located, with her palps, the groove between the male's knobs (Fig. 5). She applied her chelicerae and possibly labium and maxillae to the groove during copulation. Even when not copulating, the male-female pair often adopted a similar posture, but with the palp and epigynum not engaged and with the female's palps resting in the groove. As the female *A. antipodiana* was apparently close to or actually touching the substance secreted by the male, the substance may be a pheromone. As the females did not appear to move their mouthparts, and often their mouths did not touch the male, the substance may not have been consumed. Instead, it may have evaporated from the hairs and acted on the external chemotactic (i.e., olfactory) receptors of the female, especially as the concentration of any airborne substance would probably be great in the space between the two knobs where the hairs were concentrated.

Interestingly, the cephalic substance seems to be secreted by males who are not courting at the time. (The males examined in this study were simply taken from their webs. They were not courting at the time.) Using the terminology of Smith (1977), the substance on the males of *A. antipodiana* would seem to be a chemical "badge" (i.e., a specialised static property of a spider's morphology which is used in communication).

Exactly how the substance might affect the female is not known. Perhaps it serves to pacify her, making her less aggressive or predatory during copulation, but observations of behavioural sequences during male-female interactions do not support this supposition. If the substance has a pacifying effect, the female would presumably become less likely to attack the male as the interaction proceeded, yet the opposite was observed (Whitehouse, in prep.).

Perhaps the role of the substance is more one of arousal than pacification. The males of certain species of insects (Thornhill & Alcock, 1983) and salamanders (Arnold, 1977) are known to secrete substances that are mouthed by females during courtship and mating. These have been called "aphrodisiacs", implying an arousal effect. Arousal may be relevant to spiders as changes are known to occur in positioning of parts of

Fig. 2: (Above) Close-up of an untreated male's knobs showing substance on the anterior knob (arrowed).
(Below) Close-up of hairs on anterior knob. Note substance occurring between the hairs and extending up the hairs.

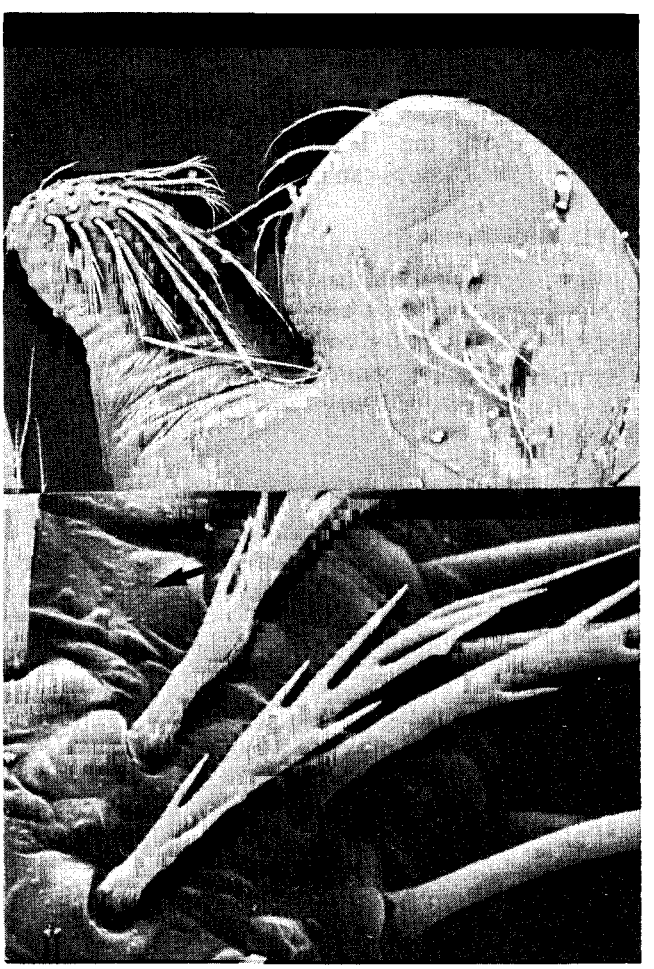

Fig. 3: (Above) Close-up of a treated male's knobs showing no substance on anterior knob (compare with Fig. 2 (above)). Note the pits at the base of the hairs.
(Below) Close-up of hairs on anterior knob (compare with Fig. 2 (below)). Here the pit at the base of the hairs is more obvious. The material arrowed is probably residual substance not removed by the treatment.

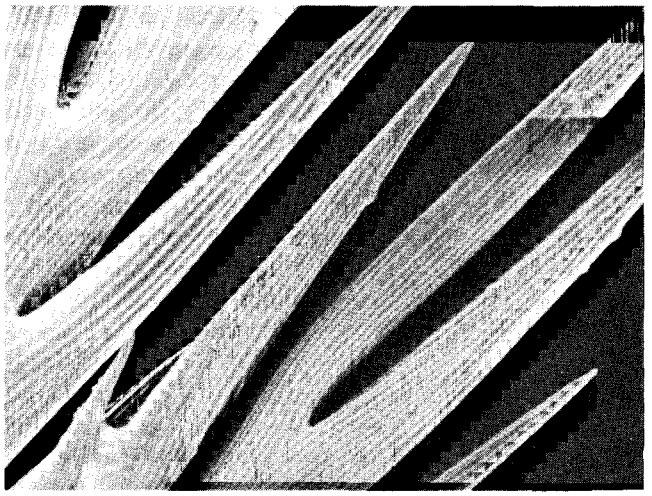

Fig. 4: High magnification of treated hairs on the anterior knob showing ridges and channels. These were covered by the substance (and therefore not visible) on untreated hairs.

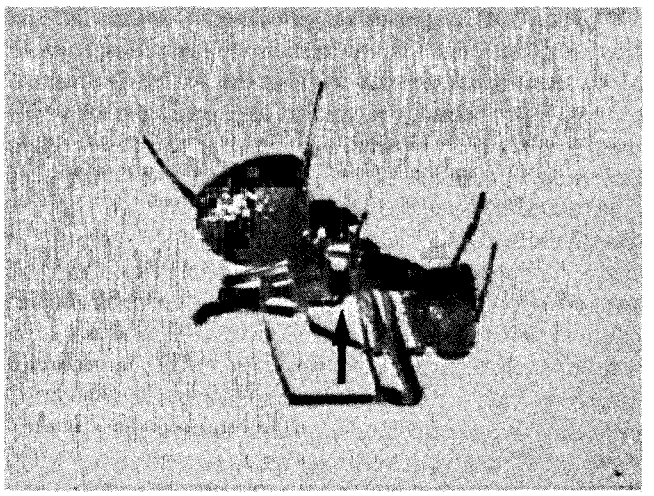

Fig. 5: Copulating pair of *A. antipodiana*. The female is on the left. Her chelicerae are between the male's knobs (arrowed), while her palps rest behind the knobs. Body length of female: *c.* 3 mm.

the female genitalia during courtship in some araneid spiders (Robinson, 1982) and Blest & Pomeroy (1978) observed that the epigynal region appears to swell during courtship in *Mynoglenes* Simon, 1905 (Araneae: Linyphiidae). *Mynoglenes* also has clypeal glands (Blest & Taylor, 1977), but in these spiders, unlike *A. gibbosus* (Legendre & Lopez, 1975), the clypeal glands occur in both sexes rather than just in the male. Thus work is needed to ascertain the effect of the substance on the female before the bizarre cephalothoracic knobs can be completely understood.

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