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A FOSSIL WHIPSCORPION FROM THE LOWER CRETACEOUS OF BRAZIL

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ABSTRACT. A new fossil whipscorpion (Arachnida, Uropygi, Thelyphonida) is described from the Lower Cretaceous (Aptian) of the Crato Member of the Santana Formation, Ceará Province, Brazil. This specimen is the first record of a Mesozoic thelyphonid, but it is too poorly preserved to be assigned to a family with any confidence. It is named *Mesoproctus rowlandi* new genus and species.

Fossil whipscorpions are rare and are currently known only from the Pennsylvanian of Europe and North America (Brauckmann & Koch 1983; Dunlop & Horrocks 1996). These very ancient forms nonetheless resemble living whipscorpions and can even be referred to modern families, making thelyphonids strong candidates for the title of "living fossils". This paper describes the first Cretaceous whipscorpion, which is particularly significant given the rarity of all arachnids during the Mesozoic (Selden 1993). The Cretaceous Santana Formation already boasts insects (Grimaldi & Maisey 1990), solifuges (Selden & Shear 1996) and spiders (P. Selden pers. comm.). This new specimen adds to the terrestrial arthropod fauna from this locality.

METHODS

The new specimen was obtained from the Ulster Museum (UM), No. K28006. The specimen was studied under a stereomicroscope and Fig. 2 was prepared using a camera lucida. Preserved specimens of the extant whipscorpion *Mastigoproctus* Pocock 1894 were examined for comparative purposes in conjunction with Carboniferous fossil whipscorpions from the collections of the British Museum (Natural History) (BMNH). All measurements are given in mm.

Geological setting.—The new fossil comes from the Crato Member of the Santana Formation, NE Brazil which is dated at Lower Cretaceous (Aptian) in age (Maisey 1990), corresponding to about 110 Mya. The geological setting of the Crato Member has been discussed by Maisey (1990) and Martill (1993). The locality is interpreted as a lacustrine deposit with deposition in both the margins and the center of a lake. Evaporitic structures and the types of pollen and macrofossils found indicate an arid, open sabkha-like environment, i.e., a dry salt-flat close to the margins of a lake. Fossils of plants, insects, fish, frogs, pterosaurs and even feathers having been recorded from the Crato Member. Arachnids are also present, including the solifuge, *Cratosolpuga* Selden 1996, undescribed scorpions (Grimaldi & Maisey 1990) and undescribed mygalomorph and araneomorph spiders (P. Selden pers. comm.). Selden & Shear (1996) cited an opilionid as coming from this locality. This citation may refer to another UM specimen seen by the author, which in fact appears to be a long-legged spider, possibly a pholcid.

Morphological interpretation.—The specimen is preserved on a slab about 13 cm × 16 cm as a part only in a finely laminated, yellowish matrix. Small, pale plant fragments are scattered across the slab. The specimen (Figs. 1, 2) stands out from the matrix and is slightly three-dimensional and brown in color with patches of darker mineralization especially evident on the prosoma and legs. These Crato Member arthropods are preserved as a mineral replacement of the original tissues by goethite (iron oxide hydroxide) (Grimaldi & Maisey 1990; Selden & Shear 1996). The preservation is not as good as that documented in Selden & Shear's (1996) solifuges, where details of carapace morphology and setae on the appendages are evident.

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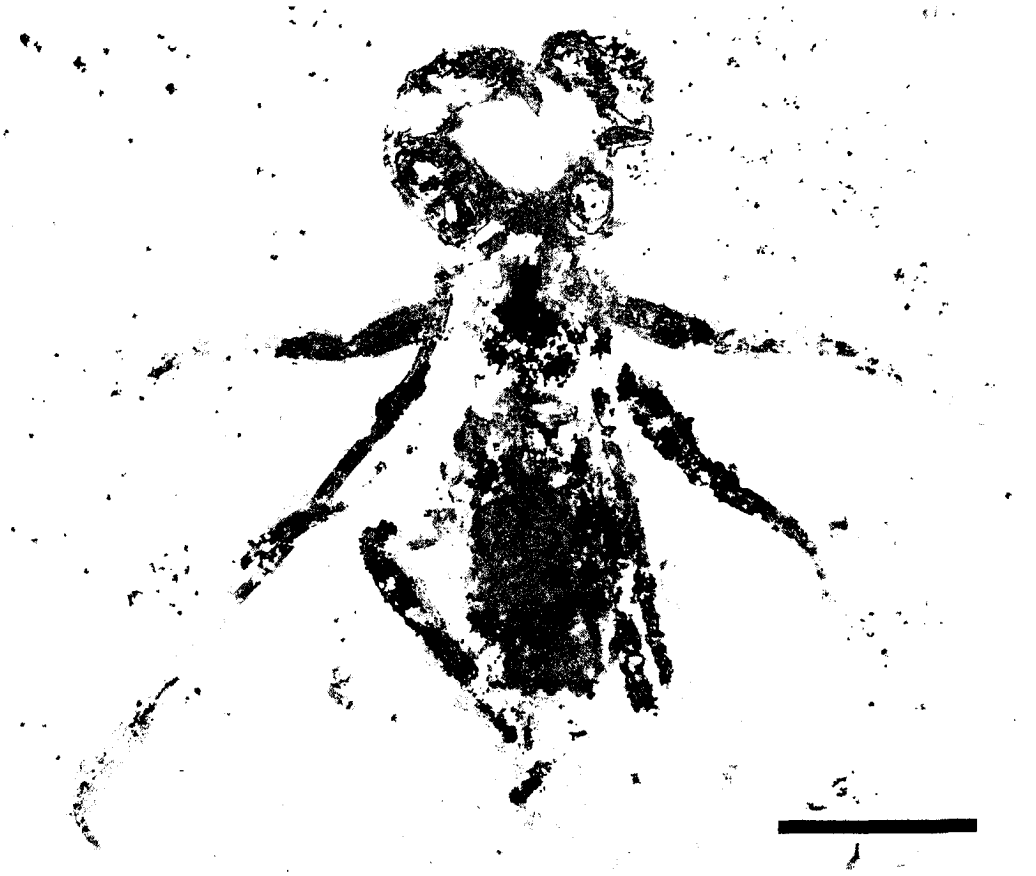

Figure 1.—***Mesoproctus rowlandi*** new genus and species. A whipscorpion (Arachnida: Thelyphonida) from the Lower Cretaceous Crato Formation of Brazil. Scale = 1 cm.

The specimen is evidently a thelyphonid since it resembles living whipscorpions (e.g., Millot 1949) by possessing large, well developed, subraptorial pedipalps, narrow, elongate legs with divided tarsi and leg I being characteristically antenniform. These tarsal divisions are obscure in the specimen but can be seen in left legs I–II. The characteristic flagellum, or "whip" is not preserved; extensive preparation posterior to the specimen, before its deposition in the museum, failed to locate this structure. The specimen is too large, about 2.5 cm in body length, to belong to the related order Schizomida (micro-whipscorpions) and the pedipalps in this fossil would have articulated in a horizontal plane, whereas they articulate vertically in schizomids (Millot 1949). Both the prosoma and opisthosoma are too elongate for this specimen to belong to the remaining order with large subraptorial pedipalps, the Amblypygi (whipspiders), wherein the two body somata tend to be rounder.

Though displaying few morphological details, the legs are preserved laterally, and are held in approximately the same position in life (Millot 1949). Legs I are folded back and directed posteriorly. They are also overlain by the posterior legs and since it might be expected that leg I would be drawn back dorsally above the other legs, this suggests that the specimen is essentially a ventral view. Such a condition would occur when the animal foraged to its side. No details of the sternites and coxosternal region can be distinguished. The opisthosoma ends abruptly and does not narrow into a characteristic pygidium (Millot 1949), which suggests that the terminal end of the opisthosoma and its flagellum have been lost.

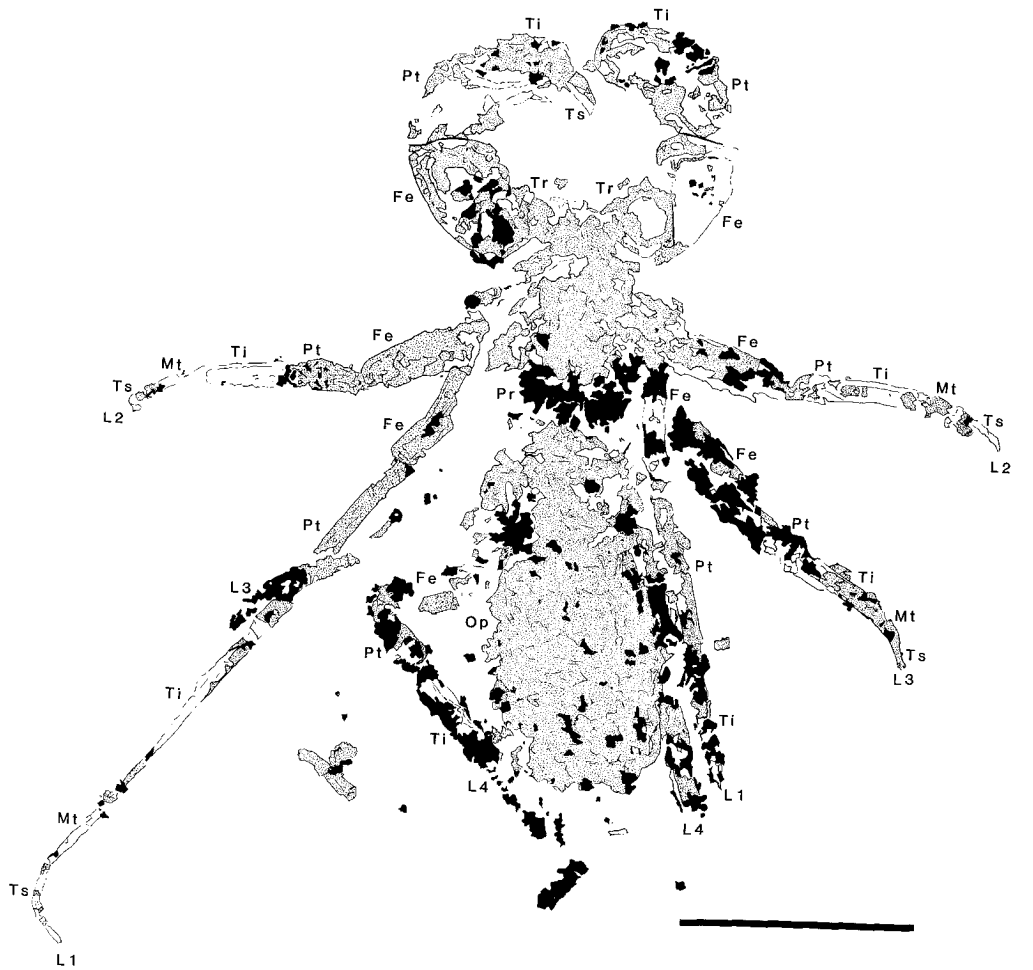

Figure 2.—Camera lucida drawing of the specimen of ***Mesoproctus rowlandi*** new genus and species shown in Fig. 1. Pr = prosoma, Op = opisthosoma, Pp = pedipalps, L = leg (with number), Fe = femur, Pt = patella, Ti = tibia, Mt = metatarsus, Ts = tarsus. Black = areas of dark mineralization, stipple = areas of lighter, brown mineralization, white = areas composed of background matrix. Scale = 1 cm.

DISCUSSION

This new specimen is the first record of a Mesozoic whipscorpion. However older, Carboniferous, records are referable to extant families (e.g., Dunlop & Horrocks 1996) and predict their occurrence from the late Palaeozoic to the Recent. The occurrence of this specimen in Brazil is consistent with the distribution of living whipscorpions, which are found in Africa (rarely), eastern and southeastern Asia, North America up to the southern United States, and northeastern South America, including Brazil (Rowland & Cooke 1973). Grimaldi & Maisey (1990) noted a number of xerophilic Crato Member insect taxa, while Selden & Shear (1996) suggested that their solifuges supported the interpretation of an arid palaeoenvironment. Extant solifuges primarily occur in deserts. Extant whipscorpions are nocturnal predators, typically inhabiting humid, tropical regions, living in leaf litter, under stones or in burrows. However, at least some extant whipscorpions, of which *Mastigoproctus* from the USA is perhaps the best studied, live in arid environments (Crawford & Cloudsley-Thompson 1971), similar to the interpreted environment for the Crato Member. A fossil whipscorpion from an arid palaeoenvironment therefore is not surprising.

Crawford & Cloudsley-Thompson (1971)

noted that *Mastigoproctus* is not physiologically well adapted for desiccation resistance and spends much of its time during dry seasons in deep burrows, only emerging after rain. These authors suggested that whipscorpions are essentially tropical creatures, some of which have become adapted to arid conditions by obtaining moisture from food and by using their sensitive antenniform legs to detect moist, non-horizontal substrates into which they burrow readily and so avoid desiccation. The oldest, Carboniferous, whipscorpions occur in tropical coal swamps. *Mesoproctus* from the more arid Crato Member suggests that this behavioral ability, as opposed to a physiological ability, to avoid desiccation was developed by at least the Lower Cretaceous.

SYSTEMATIC PALAEONTOLOGY

Order Thelyphonida Cambridge 1872

Remarks.—I follow Shultz (1990) and Dunlop & Horrocks (1996) in recognizing a taxon Uropygi containing two orders, Thelyphonida and Schizomida. Rowland & Cooke (1973) split the Thelyphonida into two families, Thelyphonidae and Hypoctonidae, differentiated by carapace keels in the former family which are absent in the latter family. This division is not adopted by all authors. Since the carapace is not preserved in the fossil it is not possible to refer this specimen to either family, both of which have been recorded among the Recent thelyphonid fauna of Brazil (Rowland & Cooke 1973).

Genus ***Mesoproctus*** new genus

Etymology.—*Meso* from its Mesozoic age and *proctus* from the fossil's overall similarity to the extant genus *Mastigoproctus* which also inhabits arid environments.

Type.—*Mesoproctus rowlandi* new species.

Remarks.—Due to the lack of preserved detail in this specimen it is difficult to diagnose *Mesoproctus* from either Carboniferous or Recent thelyphonids on anything other than its Mesozoic age. The pedipalps are quite robust in *Mesoproctus,* but in isolation this is a poor diagnostic character.

Mesoproctus rowlandi new species
Figs. 1, 2

Etymology.—Named in honor of J. Mark Rowland for his work on whipscorpion systematics and fossil palpigrades and his assistance with this paper.

Type.—Holotype and only specimen. UM No. K28006. From the Lower Cretaceous (Aptian) of the Crato Member of the Santana Formation, Araripe Plateau, Ceará Province, NE Brazil.

Diagnosis.—See remarks above.

Description.—Part only showing specimen in dorso-ventral compression. Length 23.5, prosoma with length 11.0, maximum width 6.8, opisthosoma with maximum length 12.5, maximum width 8.5. Flagellum and posterior end of opisthosoma missing. Carapace morphology, eyes, coxosternal region and opisthosomal segmentation not preserved. Pedipalps and legs generally complete with leg I on both sides folded back and directed posteriorly. All legs preserved laterally with femora II-IV distinctly robust. Pedipalps large and robust. Left pedipalp complete with podomere lengths: trochanter 2.5, femur 4.9, patella 2.6, tibia 4.9 and tarsus 8.5. Right pedipalp lacks tarsus. Left leg I elongate, slender and complete with podomere lengths: femur 6.7, patella 8.9, tibia 9.2, metatarsus 4.0, tarsus 3.0. Tibia and metatarsus ornamented with groove running the length of the podomere. Right leg I with only femur, patella and part of tibia preserved. Left leg II complete with podomere lengths: femur 5.7, patella 2.2, tibia 4.5, metatarsus 1.2, and tarsus 1.3. Right leg II with only femur, patella and part of tibia preserved. Left leg III only preserved as fragment overlying leg I, right leg III complete with podomere lengths: femur 6.0, patella 2.0, tibia 3.8, metatarsus, 1.2 and tarsus 1.5. Leg IV incomplete, only proximal podomeres of left leg IV preserved with podomere lengths: femur 7.0, patella 2.5 and tibia 4.9.

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