The first troglobite scorpion from Israel and a new chactoid family (Arachnida: Scorpiones)

by Gershom Levy

Abstract. A new eyeless troglobite scorpion, *Akrav israchanani* n. sp., is described from inside karstic voids in Israel that form a completely isolated, old underground ecosystem with living populations of blind crustaceans and pseudoscorpions. The scorpions, of which no live specimen has yet been collected, prove to differ from all other scorpions and are placed in a new family, Akravidae. The possibility is addressed that the subterranean Akravidae are a relict of an old circum-tropical pattern of distribution that differs from the present temperate location of Israel.

Kurzfassung. Aus Israel wird ein neuer höhlenbewohnender Skorpion, *Akrav israchanani* n. sp., von karstischen Hohlräumen beschrieben, in denen ein völlig isoliertes, altes unterirdisches Ökosystem mit lebenden Populationen von blinden Crustaceen und Pseudoskorpionen existiert. Die Skorpione, von denen bisher noch kein lebendes Tier gesammelt werden konnte, unterscheiden sich von allen anderen Skorpionen und werden in eine neue Familie gestellt, die Akravidae. Es wird die Möglichkeit diskutiert, dass die unterirdisch lebenden Akraviden Relikt eines alten, die Tropen umfassenden Verbreitungsmusters sind, das sich von der gegenwärtigen Lage Israels in den gemäßigten Breiten unterscheidet.

Key words. Troglobite scorpion, karst fauna, subterranean fauna, new family, Israel, Middle East.

Introduction

The recent discovery (2006) of the Ayyalon Cave in Israel revealed a peculiar underground ecosystem. The completely isolated subterranean space is located in a quarry deep below a surface that precludes the permeability of water or organic matter from the outside. The space comprises galleries of winding passages and a large chamber with warm brackish groundwater with high H_2S levels (FRUMKIN & GVIRTZMAN 2006). The closed subterranean ecosystem depends basically on biomass production by chemoautotrophic sulfide oxidizing bacteria that are found there in great masses (DIMENTMAN et al. 2006). The troglobites discovered include living populations of various species of blind Crustacea, Collembola and Pseudoscorpiones. No live scorpions have as yet been detected, only their empty carcasses. These desiccated but not fossilized cuticular remains which retain their bright fluorescence under UV light were found firmly attached to rocks at various levels corresponding to the levels attained by the rise and fall of the underground water inside the voids. No traces of any of the scorpions' prey animals have yet been found. Could their disappearance have caused the presumed extinction of the scorpions? The internal contents of the scorpions' carcasses have been completely cleared out. This may have been carried out by mites, as the remains of an unidentified mite were found inside a dry carcass. Photographs were taken on spot of the scattered scorpions (Fig. 1). A few of the fragile remains were carefully scraped

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from the rocks, and drawings of the brittle, crumbled remnants have been carefully prepared.

The present distribution of the troglobite scorpions of the world is circum-tropical: Mexico, Greater Antilles, Ecuador, Brazil, Malaysia and Christmas Islands in the Indian Ocean (LOURENÇO et al. 2004). Their occurrence in Israel, not being tropical, is thus an exception. But the distribution of the subterranean crustaceans living in the Ayyalon Cave is considered to be a relict of the Later Miocene circum-tropical Tethys Ocean (POR 1986). Perhaps the troglobite scorpions deep down in Israel preserve the old constellation and are therefore in line with contemporary worldwide records. On the other hand, these troglobites may represent a detached subterranean fauna of its own, as postulated by POR (pers. comm.). Analysis of the carbon isotope composition of the scorpions' remains resulted in a value around -36‰ PDB, denoting diet sources that thrive in the atmosphere of an ecosystem that deviates markedly from values like -25 to -18‰ that are found in organic terrestrial organisms living in the common global atmosphere (E. BOARETTO, pers. comm.). Of significance is the fact that the Ayyalon Cave scorpions, described below, do not belong to any of the scorpion families of the region, namely: Buthidae, Scorpionidae and Diplocentridae (LEVY et al. 1973, LEVY & AMITAI 1980), and they also differ from all other scorpion families. Whether the scorpions found alongside the crustaceans belong to similarly ancient ancestral populations or occupied the area at a later period, becoming secluded thereafter in a unique subterranean ecosystem, is debatable.

Akrav n. gen.

Type species. *Akrav israchanani* n. sp.

Diagnosis. Eyeless troglobite. Chelicerae without serrula on ventral edge. Fine elongated fingers of pedipalpi equipped with a nearly contiguous median row of denticles, a straight parallel row on their basal half, and inner and outer accessory denticles. Trichobothria ib-it positioned on fixed finger; series V1-V4 extending to entire length of palm with little or no angling at the V2 juncture. Patella (tibia *auct.*) with all three ventral trichobothria positioned on ventral surface, and femur with trichobothrium d located slightly proximal to trichobothrium i. Metasomal segments longer than wide and bearing ventral carinae.

Etymology. The generic name is a noun in apposition, taken from the Biblical Hebrew word for scorpion. The gender is masculine.

Akrav israchanani n. sp.
(Figs 2–17)

Type-material. Holotype and paratypes from Ayyalon Cave, southern coastal plain, Israel, leg. Israel NA'AMAN, April 2006; only dry, very brittle, cuticular remains of the hollow carcasses are known. All are deposited in the Collections of the Hebrew University of Jerusalem, Israel (HUJsc. 2673, holotype; 2674-2679, paratypes).

Diagnosis. As for the genus.

Description. Medium-sized troglobite about 50 mm in body length. Brown coloured, completely eyeless without any lenticel remnants. Carapace encircled by fine raised edges; anterior margin notched by a moderate concavity, and a narrow, deep median groove running along posterior part; carinae absent (Fig. 2). Sternum pentagonal, longer than wide, with angular anterior margin and posteriorly with a narrow depression flanked by slightly

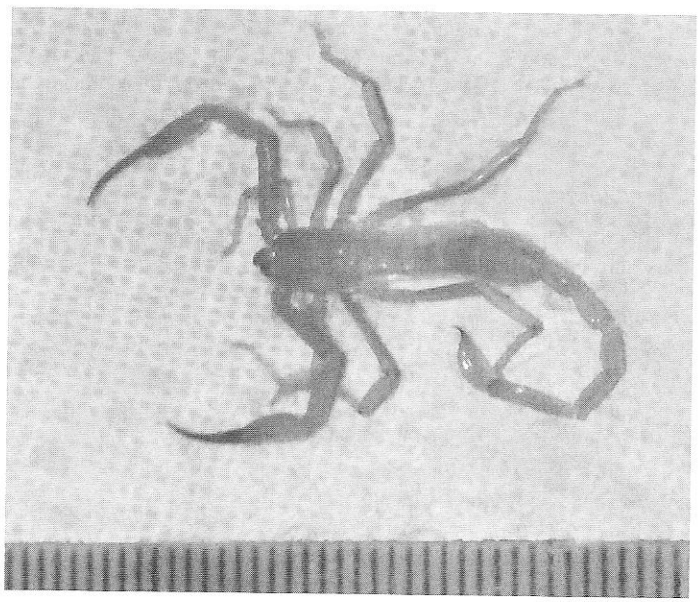
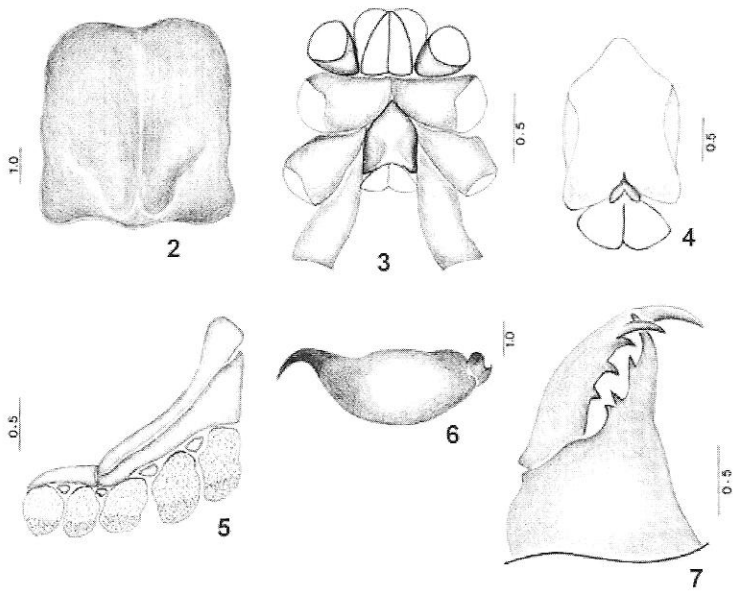


Fig. 1. Desiccated scorpion remains on rock inside the Ayyalon Cave. Photograph by Israel NA'AMAN. Ruler with cm/mm scale bars.

distended sides (Fig. 3; type-2 of SOLEGLAD & FET 2003a). Internal bifurcated process projecting from posterior median edge of sternum (Fig. 4). Genital opercula fused along median indentation (Figs 3-4). Tergites of mesosoma without carinae. Spiracle slits on sternites slightly crescent-shaped. Pectines consisting of basal dilated, long anterior marginal and middle lamellae, a terminal piece, four distinct fulcra, and five relatively large teeth (Fig. 5). Ventral surface of anterior two-thirds of each pectinal tooth covered by short setae, and posterior third perforated by fine dense pores. Metasomal segments longer than wide and bearing, in part, low tuberculated carinae or carina-like embossments. Segment V bearing a pair of ventro-lateral carinae and a single, partly indicated, ventro-median (axial) carina. Stinger without subaculear tubercle (Fig. 6). Chelicerae with a fixed finger armed with two separate basal-most teeth, and a movable finger with five teeth and smooth dorsal and ventral edges without comb-like serrula (Fig. 7). Pedipalpi with trichobothriotaxy conforming to type C pattern (Figs 8-14; see also diagnosis of genus). Long, slender, slightly bent fingers of pedipalpi terminating with curved tips (Figs. 12-14). Fingers with a median row of denticles arranged in a straight contiguous line, partly broken up on distal part into a few groups, and basal half armed with two straight parallel rows of denticles. Inner and outer denticles distributed alongside median row (Fig. 15). Legs bearing two sclerotic basitarsal (pedal) spurs: a dilated white retrolateral spur and a brown spine-like prolateral spur (Figs. 16-17). Tarsi bearing paired ventral setae.

Etymology. The specific name is a combination, derived from Israel, *terra typica* for the type species, and from patronyms in honour of the collector Israel Na'aman and of Dr Chanan DIMENTMAN for his investigations undertaken in the Ayyalon Cave ecosystem and for his unstinting help in the pursuit of scorpions from the subterranean voids and galleries.



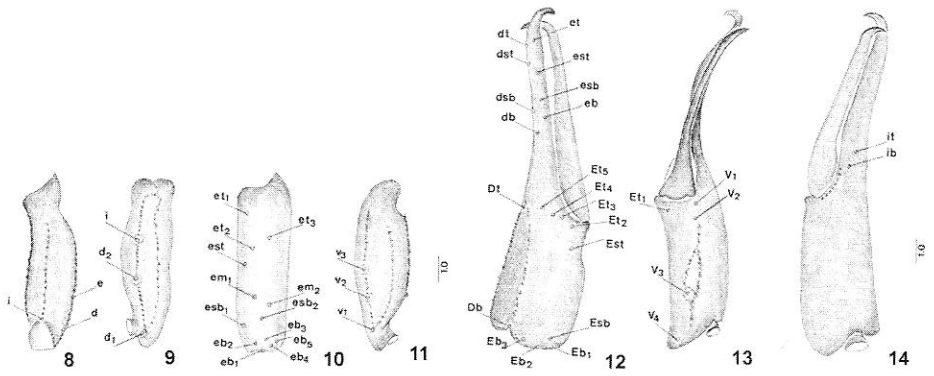
Figs. 2-7. 2. Eyeless carapace, dorsal view; 3. Coxosternum, ventral view; 4. Sternum and genital opercula, inner (dorsal) view; 5. Pecten, ventral view; 6. Stinger, lateral view; 7. Left chelicera, dorsal view. Scales in mm.

Akravidae n. fam.

Diagnosis. Pedipalpi with type C trichobothrial pattern; orthobothriotaxy. Sternum pentagonal. Slits of spiracles crescent-shaped. Fingers of chelicerae smooth, without serrula on ventral surface; movable finger with one subdistal denticle; median and basal denticles of fixed finger not conjoined on a common trunk. Pectines equipped with fulcra and only with a few large teeth. Tibial spur absent. Basitarsi with two distinct pedal spurs. Tarsi bearing paired ventral setae without a median row of spinules. Metasomal segment V with single ventromedian carina. Stinger without subaculear tubercle.

Remarks

The combined characters of the above diagnosis distinguish the Akravidae from all other scorpions. The fundamental C type orthobothriotaxic pattern, the pentagonal sternum, the chelicerae lacking a serrula, and the tarsi with pairs of setae and no spinules, place the new family among the Chactoid scorpion families rather than in the Scorpionoidea as discussed by PRENDINI (2000) or in any of the other superfamilies. Eyeless Chactoid scorpions, epigean and troglobites, are currently placed in the New World family Superstitioniidae (SOLEGLAD & FET 2003b); the nearly eyeless, Pyrenean, and often transposed *Belisarius*, that differs markedly from all other congeners by its trichobothrial configuration, is placed at present in the Chactidae. *Belisarius* and all Superstitioniidae, unlike Akravidae, have a distinct serrula on the chelicerae. The Superstitioniidae, with the exception of *Alacran* which



Figs. 8-14. 8. Right femur of pedipalp, dorsal view. Right patella of pedipalp: 9. Dorsal view; 10. External view; 11. Ventral view. Right chela of pedipalp:12. Dorsal view; 13. Ventral view; 14. Mesal view. Scales in mm.

displays neobothriotaxy, also have two ventral trichobothria on the patella of the pedipalpi rather than three as in Akravidae; the third 'ventral' trichobothrium in Superstitioniidae is located on the external surface of the patella ("emigrated" as of VACHON 1974). The crescent-shaped spiracle slits unlike the circular stigmata of the Superstitioniidae, and the peculiar basitarsal retrolateral spur of the Akravidae rather than the ordinary-shaped retrolateral spurs present only in *Superstitionia* and *Troglotayosicus*, place the Akravidae further apart from the Superstitioniidae. The trichobothrial alignment on the Akravidae pedipalpi differs distinctly from the configuration found in all the Chactoid families (VACHON 1974, LOURENÇO 1998, SOLEGLAD & FET 2003b).

The presumption that the Ayyalon Cave scorpions are extinct derives from the endless, fruitless quests with intensive use of UV lights for a live or at least a recently dead specimen. Nevertheless, a similar secluded subterranean ecosystem that sustains a live population of these scorpions may still exist somewhere along the same stratum that houses the Ayyalon underground spaces.

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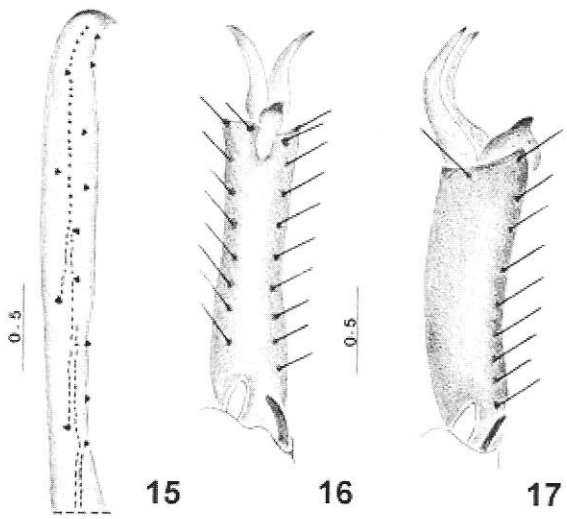

Figs. 15-17. 15. Tip of movable finger of pedipalp chela, inner view; detail. Tarsus: 16. Ventral view; 17. Lateral view. Scales in mm.

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