135
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NEW GENUS AND SPECIES OF SPINOTHECIDAE (COLLEMBOLA) FROM CAVES OF ARGENTINA

by

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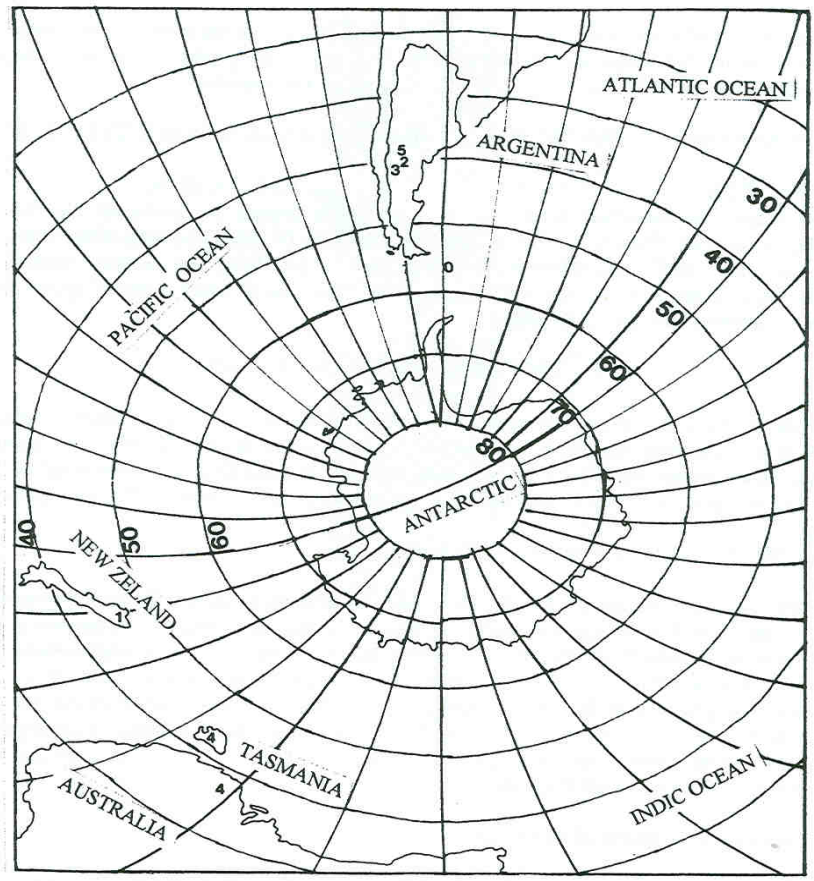
I - INTRODUCTION

Some species of Collembola that are found in caves have been considered as troglomorphics. Most important features for cave life in them are the absence of eyes and pigment, and foot complex structures associated with water surface locomotion; there can also have an elongation of antennae, feet and furcula and development of sensory structures on antennae.

The new species described here was cited by JUBERTHIE, TRAJANO and LIPPS (1991) as Arrhopalitidae, from Cueva del León in the Province of Neuquén, Argentina. This cave is found in an important karstic area with gypsum about 40 m deep and several small ponds and one lake.



Map. 1 - Distribution of the species of Spinothecidae. 1 = *Spinotheca magnasetaceae*; 2 = *Spinotheca cyaneae*; 3 = *Spinotheca patagonica*; 4 = *Adelphoderia regina*; 5 = *Troglospinotheca refsgaardiorum* n. gen., n. sp.

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As this was the first record of the family from a cave at the Patagonia and we were unable to locate the specimens, we collected more for the morphological study and description of this new species which would represent the most Southern record of the genus (37° L. South). Now we know that specimens belong to a new genus and a new species, and that it looks like *Arrhopalites* for a number of characteristics that are similar, just because convergence evolution to cave life. This is the first really troglomorphic Collembola species from caves of Argentina, and completely eyesless.

The family Spinothecidae, whom this new genus and species belongs to, was represented only by two genera: *Spinotheca* Stach, 1956, with three described species and the monospecific *Adelphoderia* Greenslade, 1982. The five species, known up to date, are known to live only in cold regions South to the 30° L. South (Map 1) in the Holantartic Region (RAPOPORT, 1971). The new genus is the first member of the family to be known from caves.

The first species, *S. magnasetaceae* was described by SALMON (1946) from New Zealand under the genus *Sphyrotheca*. STACH (1956) created the genus *Spinotheca* for the inclusion of this species. Afterwards, DELAMARE DEBOUTTEVILLE erected the subfamily Spinothecinae (1961), and in collaboration with MASSOUD (1963) published *Spinotheca patagonica* from Argentina. Later, NAJT (1971) described the third species in the genus, from the Province of Neuquén, Argentina. GREENSLADE (1982), in her excellent revision of the family, described the genus *Adelphoderia* and the species *A. regina*.

The members of Spinothecidae live on litter forest of *Nothofagus dombeyi* in South America and *Nothofagus conninghamii* in South Australia, Tasmania and New Zealand. Only *Spinotheca cyanea* is known to live on mosses and the new taxa here described from caves of Patagonia. They show a typical holantartic distribution.

II - MATERIAL AND METHODS

Specimens were collected with a small brush and preserved in alcohol 96%. They were mounted under cover in Hoyer's solution. Drawings were made with the aid of a drawing tube. Notation of the setae was taken from PALACIOS-VARGAS and ZEPPELINI (1995), as used in *Arrhropalites*.

III - DIAGNOSE OF THE SPINOTHECIDAE DELAMARE DEBOUTTEVILLE, 1961

A diagnosis of the family (modified from GREENSLADE, 1982) would be:

Globular shape; no modified antennae of males, neck organs exclusive in the family, no distinct segmentation thorax; trichobothria A, B, C and D present; antenna IV subsegmented, distal subsegment with one long sensorial sensillum; ocelli reduced or lacking; tibiotarsal tenent hairs not clavate; ventral tube with short smooth extrusive sacs, rami of tenaculum with basal appendage; one or more external spines and dens; mucro elongate, toothed; females with anal appendage.

IV - *TROGLOSPINOTHECA* GEN. NOV.

Thin neck organs; no eyes; no spines on head; antenna IV with 8 subsegments; one pair of neosminthuroid seta; trochanter with 4, 6, 6 setae accordingly, coxae II and III with oval organ; claw without tunica; mucronal setae absent; dens with spines, anal segment without spines or expanded setae in female. A comparison of the two previous genera and the new one is presented in table 1. The new genus is close relate with *Spinotheca*.

Type species. *Troglospinotheca refsgaardiorum* sp. nov.

Discussion. The neck organs of *Troglospinotheca* are thin, more similar to *Spinotheca* than to *Adelphoderia*. Ant. IV with only 8 subsegments while in the other genera 9 and 11 respectively; abdomen with neosminthuroid seta as in *Spinotheca*; unguis without tunica, which exists only in *Adelphoderia*; the presence of 9 spines on dens is more similar to *Spinotheca*. When comparing the three genera (Tabl. 1) it is easy to see the similarities of the new genus with *Spinotheca* and the big differences with *Adelphoderia*. Characters, that are autopomorphies in *Troglospinotheca*, are: total reduction of eyes, reduction of antennal subsegments on Ant. IV and development of dental spines. The synapomorphies that are shared with *Spinotheca* are the lack of mucronal setae and the presence of a neosminthuroid setae.

Tabl. 1 - Comparison among the genera of Spinothecidae.

Genus/character	Eyes #	Ant. IV Subsegms.	Neosmin. Seta	Mucroseta	Vertex Seta	Dens Spines
Adelphoderia	4+4	11	-	+	spine	1
Spinotheca	3+3	9	+	-	simple	8
Troglospinotheca	0	8	+	-	simple	9

V - *TROGLOSPINOTHECA REFSGAARDIORUM* SP. NOV. (Fig. 1-17)

Diagnosis. Distinctive characters are: complete lack of eyes, presence of two thick sensilla on apex of Ant. IV, dental ventral formula 3,3,1,1,1,...1. Lack of trochanteral organ of trochanteral spine and presence of one pair of neosminthuroid setae on Abd. IV.

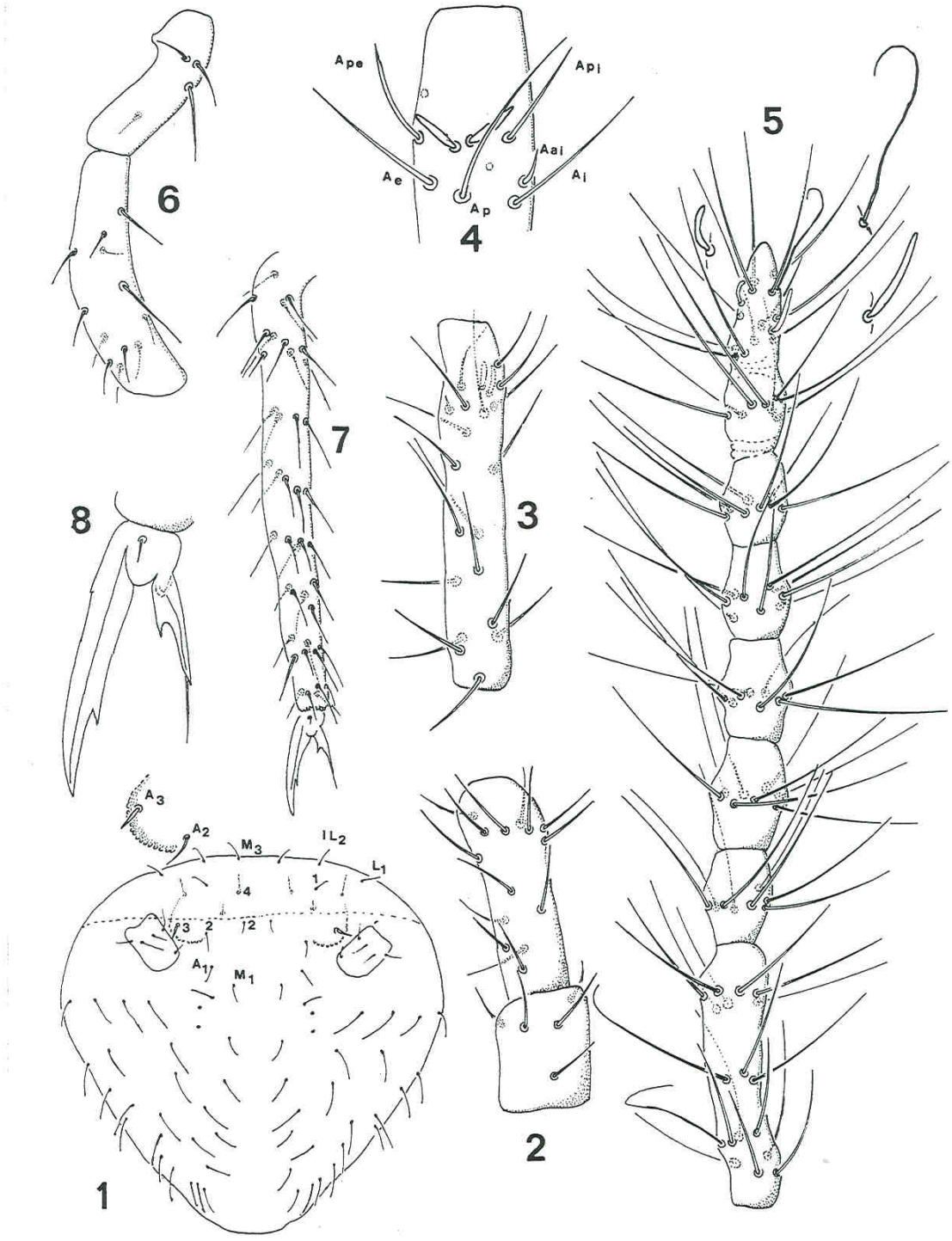

Fig. 1 to 8 - *Troglospinotheca refsgaardiorum* gen. nv., sp. nov. 1 = Chaetotaxy of the head, with magnification of ocular area in upper left; 2 = Ant. I and II; 3 = Ant. III; 4 = Magnification of the sensory structures of the apical segment; 5 = Ant. IV; 6 = Trochanter and femur from leg I; 7 = tibiotarsus I; 8 = Foot complex of leg I.

Description. Body clothed with thin and short setae (12 µm), in the fore part of the abdomen, and relatively long setae (45 µm), a little longer than unguis III at the posterior part.

Head only with thin and short setae (12 µm) only the ocular regions has one thicker seta (Fig. 1). No spine-like setae on series L and IL. No eyes or any pigment at all. Thin neck organ (Fig. 17).

Antennae about 1.8 times head. Ant. I; II; III; IV = 1; 1.8; 3.1; 8.0. Ant. IV 2.7 times as long as III, clearly subdivided into 8 subsegments (Fig. 5). The longest setae of segment 3 times as long as its diameter. Subsegment 1 with three verticils of setae, subsegments 7 and 8 with weak separation. On subsegment 8, there is

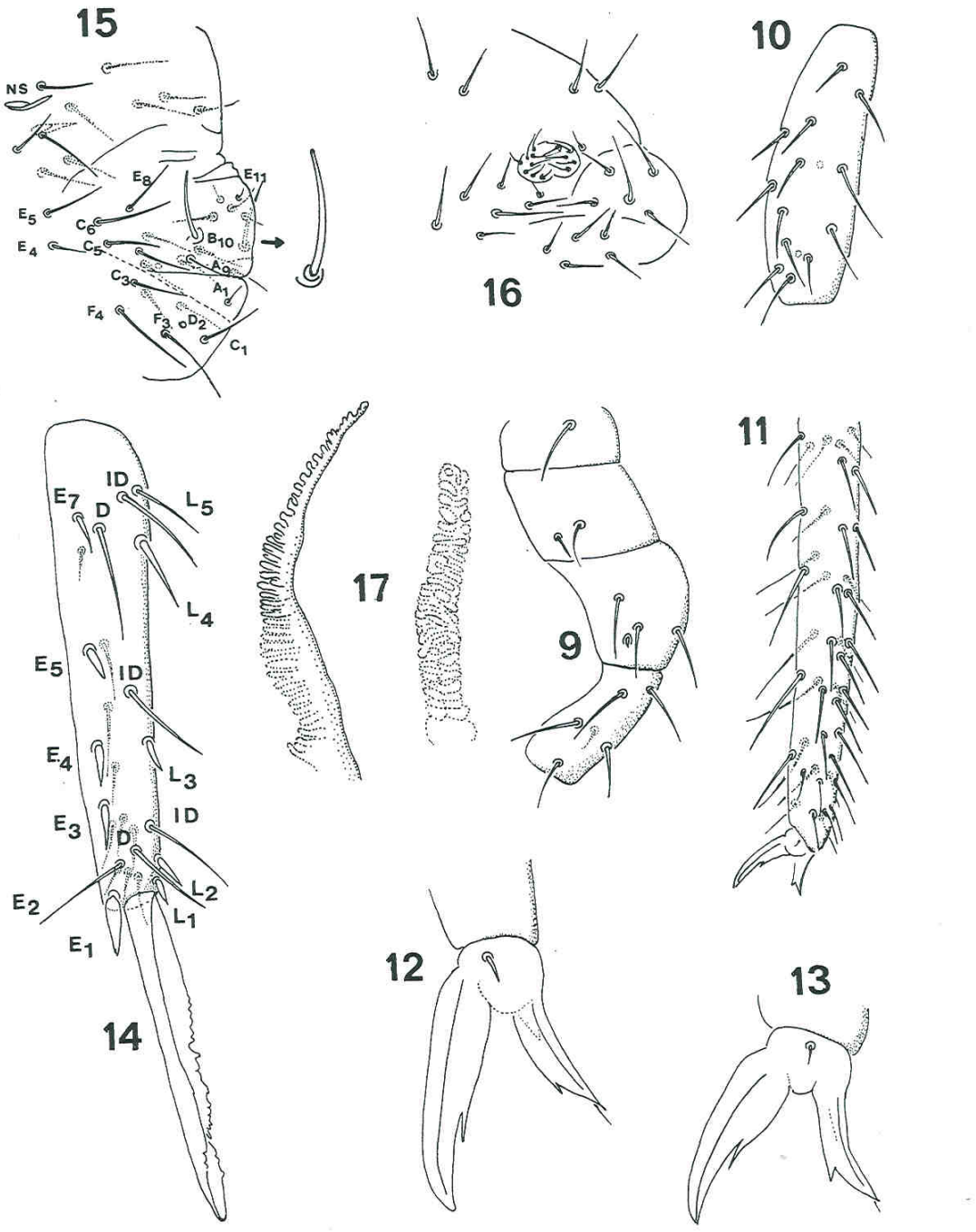

Fig. 9 to 17 - *Troglospinotheca refsgaardiorum* gen. nov., sp. nov. 9 = Precoxae, coxa and trochanter III; 10 = Femur III; 11 = Tibiotarsus III; 12 = Foot complex of leg II; 13 = foot complex of leg III; 14 = Dens and mucro in dorsal view; 15 = Genital area of female, with magnification of anal spine, lateral view; 16 = Genital area of male, ventral view; 17 = Neck organ; left, lateral view; right, dorsal view.

one curving subapical setae and two thick sensilla, one is about two times the length of the other (Fig. 5). Ant. III without basal swelling, with 16 setae (Fig. 3), and the sense organ with two long straight sense rods in separate alveoli, *Ape* short and acuminate, and *Api* are as long as normal setae and *Aai* is spine like (Fig. 4). Ant. II with 14 setae, Ant. I with 5 setae (Fig. 2).

Trochanter of leg I with 4 setae, femur with 11 setae, one of them very long (Fig. 6), tibiotarsus with 8 verticils of setae (Fig. 7). All the ungues with inner tooth on the distal half of ventral lamella; first unguis thinner and longer than the others (Fig. 8). Tunica absent. First empodial appendage with a corner tooth, apical filament long but not exceeding the unguis tip (Fig. 8). Empodial appendages on legs II and III are thick and short (Fig. 12, 13) with a tooth on the distal part, and a small filament on the leg III, precoxa I and II with one and two setae, coxa with an "oval organ" and three setae, trochanter with 6 setae (Fig. 9). Femur with 15 setae (Fig. 10). Tibiotarsus with 8 verticils of setae (Fig. 11).

Ventral tube with 1 + 1 apical setae and 5 posterior setae. Corpus of tenaculum with two setolae, ramus with 3 teeth and one basal appendix. Manubrium with 5 + 5 dorsal smooth setae.

Dens long and thin, about 1.4 times as long as the mucro (Fig. 14), with very heavy spine-like setae; dorsal surface bearing six E setae, with E1, E3-E5 strongly spine-like, E6 is missing and E7 is setiform. Three spin-like "L" setae, and L4 and L5 are setiform; the id3 is present (Fig. 13). Ventral surface of dens with 3,3,1,1,1... 1 setae mucro narrow, elongate with about 25 small and irregular serrations on external edge, the inner edge almost smooth (Fig. 14).

Female anal valve chaetotaxy as in Fig. 15, subanal appendages setiform, thick, smooth and inserted in an clear papilla. Male with 13 eugenital setae (Fig. 16). Length of body of adult specimens (n=5) = 750 µm (range 640-900 µm). Abd. IV with a pair of neosminthuroid setae (Fig. 15).

Variation. One specimen had 6 setae on Ant. I. The Ant. IV have 8 subsegments, but one specimen had the basal subsegment weakly subdivided, making a total of 9 subsegments. Some specimens show a small vesicle at the base of Ant. II.

Type Material. Holotype female, 1 paratype female and one male will be kept at author's Institution, one paratype will be sent to each of the following Museums: Museo Rivadavia, Buenos Aires Argentina and Museum of Natural History of Paris, France.

Type Locality. ARGENTINA: Neuquén: Picunches, Cueva del León. On the surface of a small pond, 8-II-1997, J. Palacios and H. Refsgaard Cols.

Discussion. *T. refsgaardiorum* sp. nov. is only comparable with *Spinotheca cyanea* (described also from Neuquén Province), from which it differs clearly by the absence of eyes and pigment and the chaetotaxy of dens. They share several characters as the presence of neosminthuroid seta, lack of mucronal seta and lack of spine-like seta on vertex of head.

Several troglomorphic features are displayed in *T. refsgaardiorum* sp. nov., such as the total absence of eyes and pigment, foot complex structures and elongation of antenna, legs and furcula. The presence of two big sensilla on Ant. IV seems to be a plesiomorphy as there are also found in the species of *Spinotheca* and *Adelphoderia*. The presence of 10 ventral setae on dens seems to be an apomorphy, as the genus *Adelphoderia*, (with 4 + 4 eyes and pigment) has 16 dental setae.

Ventral chaetotaxy (number and position of the setae) of dens of Spinothecidae are constant at species level, the following formulae (and total in parenthesis) have been found for the species: *S. magnasetaceae* 3,2,1, 1,1,...1 (9); *S. patagonica* 3,2,2,1,1,1,1 (11); *A. regina*: 3,3,3,2,2,1,1,1 (16); *S. cyaneae* 3,2,1,1...1 (8); *T. refsgaardiorum* 3, 3,1,1,1...1 (10).

This is the first species of Spinothecidae with troglomorphic features and represents a clear example of convergence evolution. Species of *Arrhopalites* also show reduction of eyes, lack of pigmentation and elongation of antennae. Specimens of *Troglospinotheca*, at first sight, can be mistaken as a member of Arrhopalitidae, but they belong to a small primitive family distributed only in the southern of the world which, thanks to their morphology due to cave life (v. gr. lack of eyes and pigment, elongation of appendages), it has a convergence evolution with Arrhopalitidae.

No attempt has been done before to give a notation system to the chaetotaxy of the member of Spinothecidae, so I have used provisionally that of *Arrhopalites* (PALACIOS-VARGAS & ZEPPELINI, 1995). Only a revision of the genera, under the study of new characters and modern methodology will allow to differentiate the filogenetical groups, and create a more natural separation of the genera in the family.

Etymology. This species is dedicated to Dora and Héctor Refsgaard (Asociación Grupo Antropo-Paleonto Espeleológico) from Malargüe, Argentina, for their help on this biospeleological project.

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ABSTRACT

A new genus and species of the family Spinothecidae (Collembola) are described and illustrated: *Troglospinotheca refsgaardiorum*. Specimens are from one cave of South Argentina and are characterized by the complete lack of pigment and eyes.

RÉSUMÉ

Un nouveau genre, *Troglospintheca*, et une nouvelle espèce, *T. refsgaardiorum*, de la famille Spinothecidae (Collembola) sont décrits et dessinés. Les exemplaires proviennent de la Cueva del León, Province de Neuquén, Argentine, et sont caractérisés par l'absence de pigment et des yeux.

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