THE
PEARCE-
SELLARDS *Series*

NUMBER 30

A DASYLEPTID FROM THE PERMIAN OF KANSAS, *LEPIDODASYPUS SHAROVI* N. GEN., N. SP. (INSECTA: THYSANURA: MONURA)

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1978

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A DASYLEPTID FROM THE PERMIAN OF KANSAS, *LEPIDODASYPUS SHAROVI* N. GEN., N. SP. (INSECTA: THYSANURA: MONURA)[1]

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ABSTRACT

Lepidodasypus sharovi n. gen., n. sp. is distinguished from previously described species of *Dasyleptus* by the fine vestiture of scales and hairs, by the heavier pigmentation of the tergites, and by the shorter first maxillary palpi. Preservation of the unique type specimen shows well the presence of segmented abdominal legs, and their posterior specialization to form an ovipositor of ovigerous legs. This is the first record of a dasyleptid monuran from North America and is the oldest representative of the order Thysanura on this continent.

INTRODUCTION

While examining specimens in the Dunbar collection of Kansas Permian Insects in Yale Peabody Museum of Natural History, the author found a specimen of a *Dasyleptus*-like insect among material that had been labeled by R. J. Tillyard as "nymph of cockroach." As *Dasyleptus* figures prominently in recent discussions (Tiegs and Manton 1958; Sharov 1966) of the early evolution of insects, as this specimen shows structures of the ventral abdomen more clearly than does most previously known material, and as the family has previously not been known from North America, this specimen is described here. Comparison of this specimen with material from the Permian of the USSR (Kuznetsk Basin) shows differences of generic importance. Unfortunately, the description of *D. lucasi,* the type of the genus, is not detailed enough for clear comparison with this older species from the Stephanian of France (Commentry).

Lepidodasypus new genus
(Type species: *L. sharovi* n. sp.)

This genus includes *Machilis*-like insects characterized by segmentation of the abdominal parapodia or styli-like legs, and the shortness and five-segmentation of the thoracic legs which bear a prominent single terminal claw and lack a clearly differentiated functional knee. The antennae are apparently short, the compound eyes are large and form most of the posterior part of the head. The labrum is strong and is articulated with

[1]Accepted for publication November 23, 1977.

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the clypeus. The mouthparts, although poorly preserved, appear to include chewing mandibles and maxillae, and five-to possibly seven-segmented maxillary palpi. The labium bears a robust postmentum which covers the posterior lateroventral corner of the head. The cardo is smaller than the postmentum, and lies anterior to it, against the ocular region of the acron. The prothoracic tergum is smaller than the other body terga, and is not expanded anteriorly over the head. Except for an abrupt increase in size of the thoracic legs, the thorax is differentiated from the abdomen only by gradient shift in characters, beginning in the anterior abdomen. The terga are divided into lateral paired tergites by the mid-dorsal suture. The thoracic leg consists of claw, tarsus, tibia, femur, and trochanter, which articulate basally against at least two obscure lateral coxites, which are plates of the body wall. The articulatory condyle of the leg appears to be lateral, with the trochanter directed toward the ventral midline. The femuro-trochanteral articulation is acute, with the femur and the remainder of the leg directed laterally. The simple kneeless conical leg is of a kind that has been associated with aquatic life in such scorpions as *Palaeophonus* (Silurian). In small arthropods under five millimeters in length, however, this leg form is found in many terrestrial groups of crawling gait, such as the Pauropoda, Pselaphognatha, Protura, and some mites. Hence *Lepidodasypus* need not have been aquatic. The presence of hairs and scales strongly suggests a terrestrial habit. An ovipositor is present and is formed by specialization of the abdominal legs (stylets) seven and eight to form ovigerous legs, and by appendages of the ninth and probably tenth abdominal segments. The homology of these latter two segmental appendages is not definitely known, for although the analogous structures in modern Thysanura are formed from homologues of exsertile vesicles, in the *Dasyleptidae* they are apparently leg (styli) homologues, for no abdominal legs are known on abdominal segments nine and ten in any specimens of *Dasyleptus* or *Lepidodasypus.* Spiracles are present on the pleural membrane on at least the first eight abdominal segments and on the metathorax. From impressions and maculae (muscle scars), the body musculature and the thoracic musculature appear to pass from abdominal configuration to thoracic configuration by a gradient change across the first abdominal segment. Maculae of the trunk tergites, the sites of muscle attachment, lie in three prominent longitudinal series. Dorsal maculae occur on the thoracic terga and on the first two abdominal terga, and are largest on the metanotum. Dorsolateral maculae lie in a line which curves laterally on the first and second abdominal terga, to enter the thorax. The dorsolateral maculae of the pronotum are minute or absent. Lateral maculae border the abdominal terga, are largest in the first, second, and third abdominal segments and reniform on the thoracic terga. The terga, legs, and maxillary palpi are clothed with a vestiture of articulated hairs and scales, those of the legs being very fine. *Dasyleptus lucasi* Brongniart, 1885, the type species of that genus, from the Stephanian A (Upper Carboniferous) of Commentry, Allier, France, was briefly described without figure. Brongniart's type material was

apparently used by Handlirsch for his figure (1908) of this insect, but this material has not been described since. Sharov was of the opinion (pers. comm. 1967) that the presence of scales and the more fully segmented abdominal legs (styli) are characters sufficient for generic distinction of the American species. Analogous characters are of generic significance in some modern Thysanura.

Lepidodasypus sharovi new species

HOLOTYPE: Figs. 1, 2, 3; YPM 28152, originally bearing a typewritten "i" paper tag, and thus part of the Tillyard loan. The reverse portion of this specimen was not found in the collection at Yale and presumably was lost at the collecting site.
TYPE LOCALITY: Kansas, Dickinson County, three miles south, one-half mile east of Elmo at "Insect Hill." This is the locality "Banner City" discovered to contain plants by Charles Sterling before 1900, and to contain insects by E. H. Sellards in 1902. This specimen was collected by Carl Dunbar in 1921.
TYPE HORIZON: Sumner Group, Wellington Formation, Carleton Limestone Member of R. C. Moore (1936), Elmo Limestone of C. O. Dunbar (1924).
AGE: Permian, late Artinskian (medial Leonardian) Epoch; about 260 Ma.

This specimen consists of the head and first 11 body segments, fragmentary appendages including parts of the antennae, first maxillary palpi, thoracic legs one to three and abdominal legs (styli) one to eight. It is preserved as the internal aspect of the left side, cuticle and residual membrane on white clay-rich limestone. The head is badly crushed, the terga are split along the mid-dorsal suture, and most of the twelfth and thirteenth trunk terga are missing, as is also the caudal region.

Description

This species differs from *Dasyleptus brogniarti* Sharov, 1957, in the more heavily pigmented tergites, in the broadening of some of the body hairs to form scales, and in the relatively shorter first maxillary palpi, the three distal segments of which when taken together, are shorter than the combined length of head and thoracic terga.

The holotype is an adult female. It is of machiliform shape, with a poorly differentiated thorax, robust head, prominent maxillary palpi, short but segmented abdominal legs, and paired abdominal coxosternites. The body length without the caudal filament is by extrapolative reconstruction, about five millimeters. The body was apparently higher than wide, and was probably less than one millimeter high before lateral crushing. The trunk terga are more heavily sclerotized than the remainder of the integument, and are

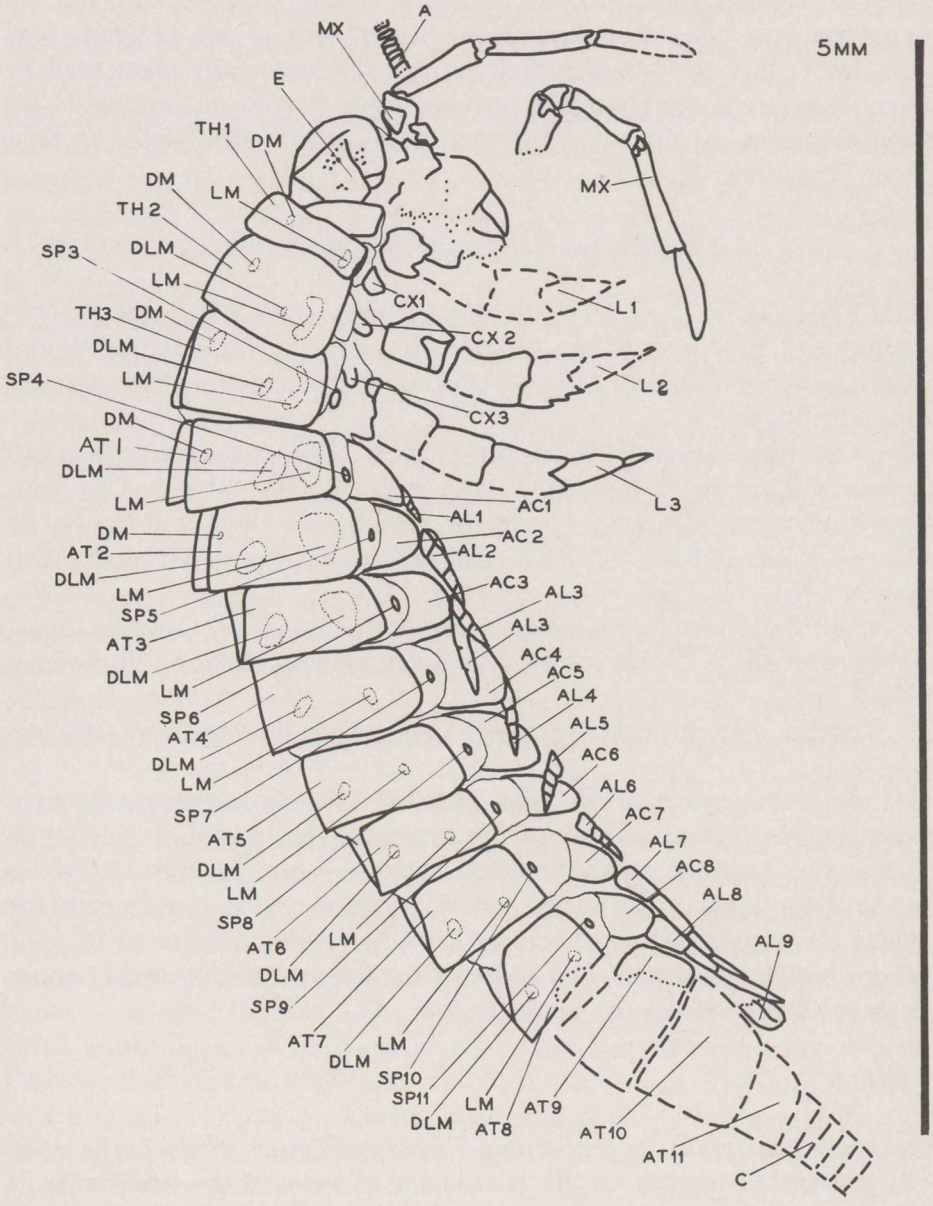

Fig. 1.—*Lepidodasypus sharovi* n. gen., n. sp., interpretive drawing of the holotype. A - antenna, AC1 to AC8 - abdominal coxosternites 1 to 8, AL1 to AL6 - abdominal legs or styli 1 to 6, AL7 & AL8 - first and second ovigerous legs, AL9 - valve of ovipositor, AT1 to AT9 - abdominal terga 1 to 9, AT10 & AT11 - presumed location of abdominal tergites 10 and 11, C - presumed location of caudal filament, CX1 to CX3 - prothoracic, mesothoracic, and metathoracic coxites, DLM - dorsolateral macula, DM - dorsal macula, E - compound eye, L1 to L3 - thoracic legs, LM - lateral macula, MX - first maxilla, SP3 - metathoracic spiracle, SP4 to SP11 - abdominal spiracles of abdominal segments 1 to 8, TH1 to TH3 - thoracic terga, the pronotum, mesonotum, and metanotum.

well pigmented. The terga and first maxillary palpi are clothed with flat hairs, some of which are expanded distally to form narrow scales.

The head is robust, with prominent, small-faceted compound eyes which occupy the dorsal half of the head. Seven anelli of the antennal flagellum are preserved near its base, and each bears, on the ventral side, a small fixed spine. The clypeus is arched and subtends a prominent labrum. The premandibular appendage (postantennal palp) cannot be recognized and the mandibles are poorly preserved but do bear a strongly denticulate molarium. The first maxilla is crushed, with its gnathal elements not clearly identifiable. The first maxillary palpi are more than five, probably as much as seven-segmented. The basal three segments are crushed in the right palp and the basal two segments are missing in the left palp. The distal three segments are elongate and are covered with a vestiture of very regularly inserted articulate hairs and narrow scales. These decrease in size apically and in places are rubbed off. The distal segment is terminated by a minute claw or hair tuft. The mid segment is short and forms the prominent knee of the appendage. The distal of the three basal segments is also clothed with articulated hairs which are robust in the dorsal apical region; the two basal segments are apparently bald. Details of the stipes cannot be made out but the cardo is small and lies against the eye, anterior to the postmentum. Details of the second maxillae are obscured by the trochanter of the first leg, but a prementum is visible apically. The tergal element of the segment, the postmentum, forms the posterior ventrolateral cover of the head, below and behind the lower part of the compound eye.

The first three trunk segments are little differentiated from the other body segments, chiefly by the larger size of the legs. The legs are simple-conical and are laterally directed. To close the trochanteral articulatory cavity, the legs must have been acutely flexed off the trochanter. The trochanter articulates laterally against at least two coxal sclerites. The metanotum is the largest tergum and the pronotum is the smallest of the trunk terga. The pronotum is not expanded anteriorly to cover the side of the head.

The abdomen is widest at its fourth segment, from which it tapers in width, gently anteriorly and posteriorly. The abdominal terga are separated by the mid-dorsal suture into lateral plates. The first abdominal legs are minute, with only three segments visible. The second abdominal legs are clearly four-segmented and are the largest of the anterior abdominal appendages. Leg length decreases from the second to the sixth abdominal appendage. The seventh abdominal leg is four-segmented, narrow, and is attenuated so that the apical segment lies under the presumed tenth abdominal segment. The eighth abdominal leg is clearly three-segmented, the apical segment being more heavily sclerotized, attenuated and blade-like. The reduced segment number is probably derived from a fusion of two primary distal segments, suggesting specialization toward its homologue, the "ventral" valve of pterygote insects. The ovigerous function of the homologues of the styli has been reported for machilids by Delany (1959) and Sharov (1966).

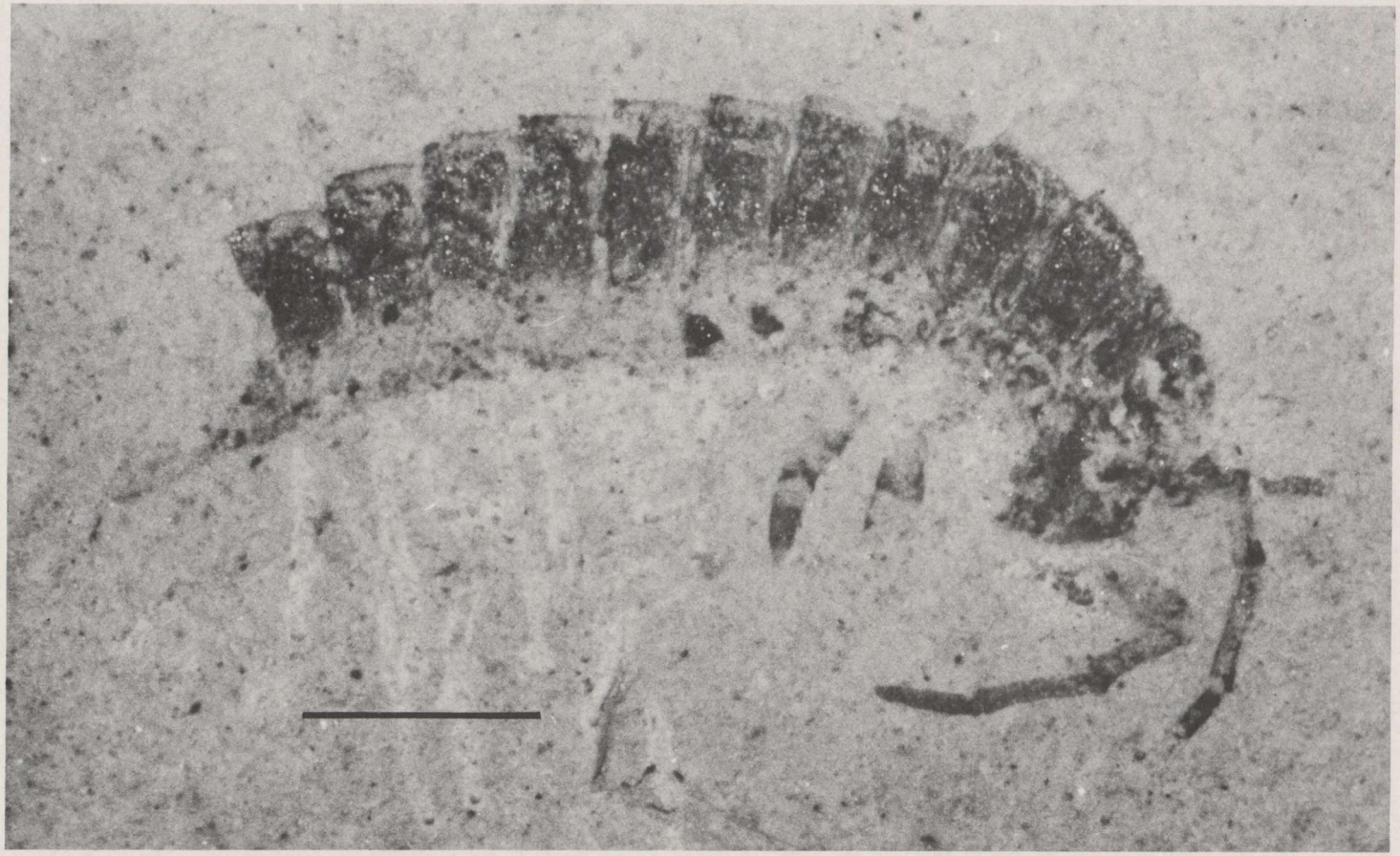

Fig. 2.—*Lepidodasypus sharovi* n. gen., n. sp., holotype YPM 28152, internal aspect of left side, photographed dry, with vertical illumination, 50 mm objective, 30 second exposure on Panatomic-X 35 mm film. Bar scale is one mm.

The presumed ninth abdominal appendage is a posteriorly directed spatula, with a longitudinal groove in its ventral half. This appears to be merely a groove in a simple plate rather than a suture between valvae of the ninth (dorsal part) and eighth (ventral part) abdominal segments as suggested by Sharov (pers. comm. 1967). Of course, this structure may have originated

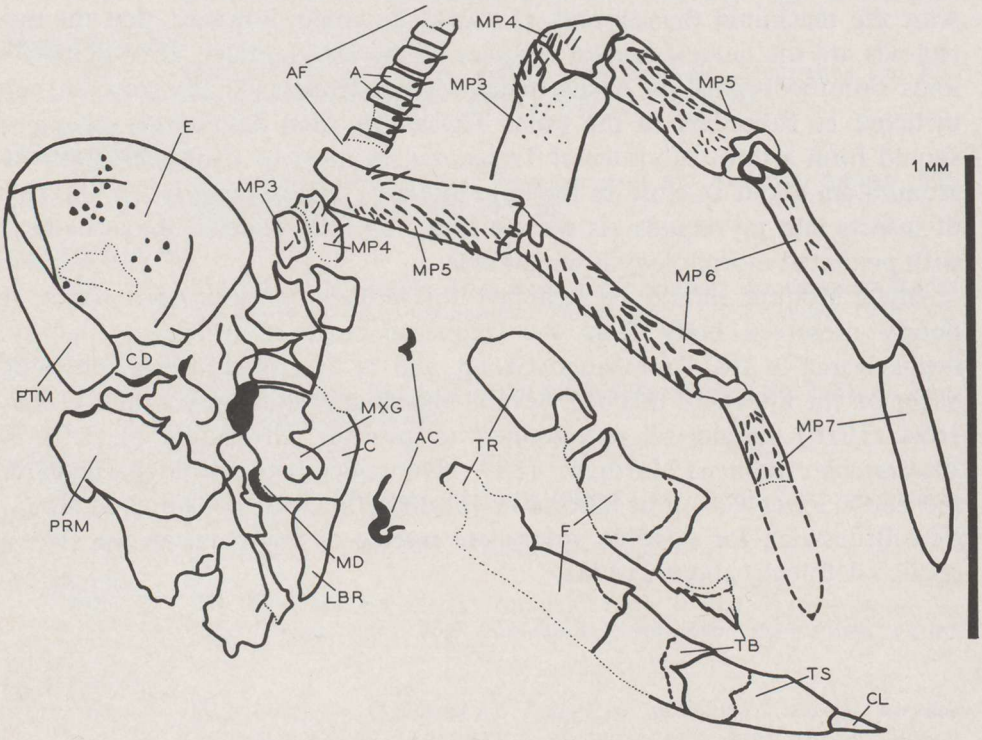

Fig. 3.—*Lepidodasypus sharovi* n. gen., n. sp., interpretive drawing of head and legs of holotype. A - anellus, AC - articulatory condyle of the leg, AF - antennal flagellum, C - clypeus, CD - cardo, CL - claw, E - compound eye, F - femur, LBR - labrum, MD - mandible, MP3 - third segment of maxillary palp, MP4 - fourth segment of maxillary palp, the functional knee of this appendage, MP5 to MP7 - fifth to seventh segments of maxillary palp, MXG - gnathal element of first maxilla, PRM - prementum, PTM - postmentum, TB - tibia, TR - trochanter, TS - tarsus.

as two such valvae, and have subsequently fused. The ninth abdominal appendage may represent the external or "dorsal" valve of an ovipositor. This development of the posterior abdominal legs and the extension of the ninth abdominal tergite pleurally, suggests that the structure so formed is an ovipositor, and that the specimen is a mature female. The abdominal coxosternites are largest at abdominal segment four, from which they taper in size both anteriorly and posteriorly. The spiracles are largest on the metathorax, and decrease in size posteriorly, and are set in the pleural membrane.

Discussion

Sharov (1957) proposed a new order, Monura, for the genus *Dasyleptus.* This action has been questioned by other specialists of apterous insects

(Tuxen 1960, Wygodzinsky pers. comm. 1967) who suggest that *Dasyleptus* is probably a machiloid thysanuran. Others would remove the group entirely from the insects. The segmented abdominal legs, as pointed out by Sharov (1966) and confirmed here, the lack of tarsal subsegmentation, the weak differentiation of the thorax, and the lack of segmentation of the ovipositor, clearly remove *Dasyleptus* and *Lepidodasypus* from immediate relationship with the machiloid thysanurans. It should be noted, however, that the machiloids are the nearest known relatives of the Dasyleptidae. If both machiloids (Microcoryphia or Archaeognatha) and lepismoids (Zygentoma) are included as suborders of the order Thysanura, then dasyleptids (Monura) should form a third suborder of Thysanura. In most of their characters the Monura are about as close to the hypothetical "protosymphyla" or ancestor of insects and myriapods, as we are likely to find. Indeed, the agreement with predicted morphology is remarkable.

Other Monura should be searched for in Pennsylvanian-aged rocks. A poorly preserved body from the Duquesne Shale of Allegheny County, Pennsylvania in the Conemaugh Group, will be described in a forthcoming paper on the insects of this bed. Several insects described by Matthew (1889, 1894, 1910) should be re-examined as possible Thysanura, particularly *Archaescolex corneus* Matthew, 1889. New collections should be made in the Little River Group at Matthew's locality, the Fern Ledges at St. John, New Brunswick for possible apterygote insects of Riversdalean age (Westphalian A Epoch) about 314 Ma.

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