

DIPLOCARDIA VARIVESICULA, A NEW MEGASCOLECID
EARTHWORM FROM INDIANA^{1, 2}
(OLIGOCHAETA)

W. R. MURCHIE

University of Michigan Flint College

ABSTRACT

A new quadrithecate diplocardian earthworm, *Diplocardia varivesicula*, is described from southern Indiana. The species shares some attributes with *Diplocardia invecta* and *D. koebeli*, both of which are known only from Mexico. The new species differs from known species in position of the seminal vesicles, variability of spermathecal pores, setal sculpturing, pattern of genital tumescences, and distribution.

The twenty-one earthworms used in this description were collected April 12, 1965, north of Boonesville, Warwick County, Indiana. The holotype has been deposited in the United States National Museum, U.S.N.M. Catalogue Number 33415.

Diplocardia varivesicula sp. n.

Unpigmented, clitellum flesh-colored (formalin preservation). Size, 66 to 94 mm by 1.0 to 1.8 mm with averages of 78.3 by 1.47 mm, length and width respectively (fourteen mature specimens). Somite numbers from 118 to 152, average 141. Worm diminishing in diameter anterior to v, posterior region only slightly swollen. Prostomium pro-epilobic, small. Annulations: I-V, simple; VI-VII, triannulate; secondary annulations weak posterior to VII; absent in clitellar region. Setal formula: aa: ab: bc: cd = 10:3:15:4 (segment XXIII). First dorsal pore: begin normally in 10/11, occasionally in 9/10 or 11/12. Clitellum; cingulum, XII-XVII, weakly developed. Tubercula pubertatis absent. Glandular tumescences of VIII and IX causing general enlargement of the entire ventral area of those segments; triangular area on XVI and XVII, with apex at mid-ventral 15/16, extending posteriorly to 17/18; individual circular swellings usually midventral on 17/18, posterior XX, at the ends of the seminal gutters on XVIII and XX, and in a row of 2-4 smaller tumescences lateral to seminal gutters in XVIII-XX. Spermathecal pores two pair, location variable, occupying any position, or combination of positions in ab of VIII and IX. Female pores paired on XIV antero-median to a-a, on slightly raised, oval glandular area. Male pores on anterior quarter of XIX, on outer side of seminal gutter. Male field flat; anterior, posterior, and lateral areas papillose. Seminal gutters in 1/2 XVIII-1/2 XX, curved, with concavity lateral, margins weakly glandular. Prostatic setae a and b of XVIII and XX very small, about 0.4×0.013 mm in length and width respectively; extreme tip variously twisted or bent with a few shallow sculptured pits. Spermathecal setae of VIII and IX small, modified, nearly straight to slightly curved, with few pits on distal third of shaft, length and width about 0.3 by 0.012 mm respectively, tip simple. Somatic seta (x) without sculpturing, 0.2 by 0.017 mm in length and width. Nephridiopores in setal line d, on anterior edge of somite.

Pharyngeal gland masses small, end in IV. Gizzards V and VI. Esophagus VII-XIII, straight, no diverticula; internal walls with papillae, often in rows resembling short ridges. Calciferous gland weakly developed in XIV-XV; lamellae free at inner edges, low (at most one-fifth diameter of gut in XVI), and about 24 in number. Intestine begins in XVIII. Typhlosole begins in XX; low, simple, ends ca. LXVII. Near segment LXX and continuing posteriorly, intestinal wall is ridged internally by 6-10 longitudinally disposed ciliated folds. Septa 7/8 and 8/9 thickened; 6/7 and 9/10 somewhat thickened; 10/11 and 11/12 very slightly thickened. Dorsal vessel single; last hearts in XII; lateral esophageal joins esophagus in XIII. Meganephridial, avascular.

Testes two pair, X and XI; small, flat, manicate, from ventro-anterior wall of segment.

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Male funnels compact, with some iridescence, near ventro-median line. Sperm duct on parietal wall just lateral to setal line *b*; ducts contiguous, joining in parietes of XIX; atrium absent.

Prostate glands two pair, somewhat variable in form, generally elongate, passing through several adjacent segments; duct loosely coiled to nearly straight, about one-fourth length of glandular part and one-fifth diameter of same. Prostatic setae and follicles not discernable internally; seta on ectal wall of prostatic duct and within the parietal wall. Seminal vesicles two or three pair, anterior 9/10, posterior 10/11 and 11/12, appearing in IX, XI, and XII or in XI and XII only; vesicles of XII largest. Ovaries one pair in XIII, compact, multiple strands of ova. Ovisac present, dorso-median to funnel from 13/14. Ovarian funnel simple auriculate, small. Oviduct short and direct, opening in XIV. Spermathecae two pair; in VIII and IX, ampulla swollen and cap-like over ental portion of enlarged duct; duct about equal to ampulla in length, narrowing ectally; diverticulum from anterior side of mid-duct, shortly stalked, dorso-ventrally oblong, somewhat acinous. Spermathecal setae follicles small, slightly more obvious than those of normal setae. Spermathecal duct enters parietal wall near or anterior to follicles, then passes anteriorly or posteriorly within wall.

Of the known diplocardians, *D. varivesicula* would appear most closely related to *D. invecta* Gates 1955. That species is known only from the type collection, consisting of nine specimens, made at a plant quarantine interception at Hidalgo, Texas, on May 27, 1954. For *D. invecta*, precise information is lacking on the size and configuration of the prostatic and spermathecal setae, the overall form of the spermatheca, and the number of lamellae in the calciferous gland. It is difficult, therefore, to determine how close *invecta* and *varivesicula* may be. While complete reliance on genital tumescences as a suitable basis of separation of diplocardians is not desirable, there is a substantial constancy in infra-specific patterns of these epidermal structures. Segments VIII and IX are swollen ventrally in *varivesicula*; no such development is mentioned for *invecta*. For the male field, *varivesicula* has distinctly median tumescences on 17/18 or on XVIII and on the posterior half of XI. Laterally placed series appear in one or two rows, in varying amounts and number, from XVIII through anterior XXI, lateral to the seminal gutter. Normally two pair are located on XIX (Fig. 1-A). The median triangular area of XVI-XVII (mid-ventral) is not strongly developed in all specimens at hand, but is constant and distinct enough to be considered as important external feature.

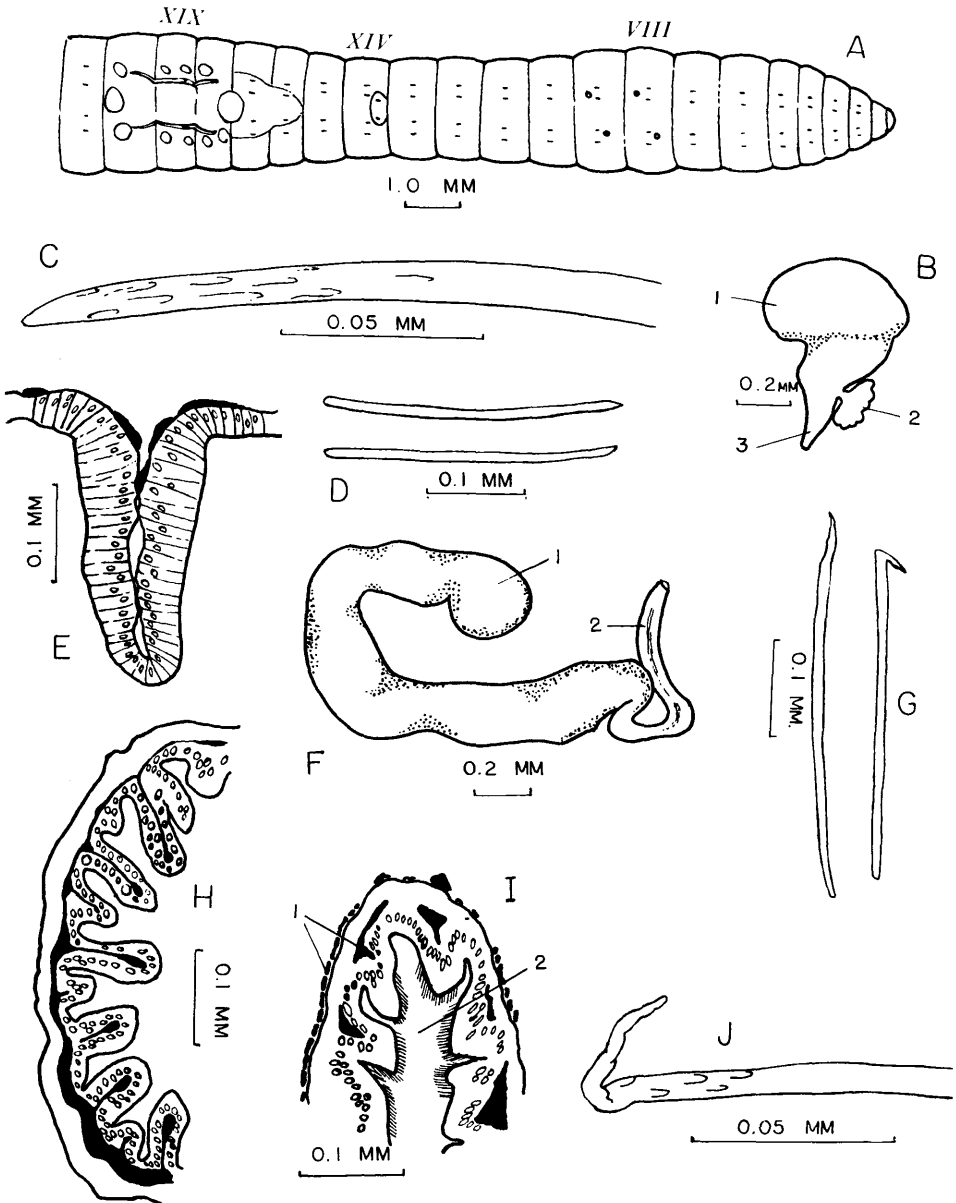
The spermathecal pores in *varivesicula* are highly variable in position. Among twelve specimens available for comparison on this feature, no two individuals showed the same pattern. The variability is illustrated by the example represented in figure 1-A. Internally, the spermathecal duct enters the body wall near or slightly anterior to *ab*, passing anteriorly or posteriorly within the tissue of the wall.

Another variation of note is the position of the seminal vesicles. In one instance, vesicles were present in IX, XI, and XII; more commonly, they occur in XI and XII, with the latter pair the larger. This condition obtains for *Diplocardia koebeli* Eisen 1900, another Mexican species of the genus.

Prostatic setae and spermathecal setae are quite small and all of them modified. The prostatic setae are difficult to isolate and to remove in the whole condition. The distal portion of these setae vary even between members of a pair (*a* and *b*). The tip is variously folded, or twisted, as though a plastic material had been hardened prior to shaping. A few very shallow pits can be seen near the tip (Fig. 1-J). The spermathecal setae are distinctly modified, but are very thin and small. The tip shows a few shallow pits to the extent of about 4-5 rows.

The calciferous gland is quite simple, consisting of very low folds in XIV and XV. These lamellae (fig. 1-H) are not joined internally. Vascularization of the esophageal wall in this region is substantial.

The prostate gland and the spermathecae show no unusual structural features.



A. Diagram of ventral view of *D. varivesicula*.
 B. Spermatheca of IX. 1. Ampulla. 2. Diverticulum. 3. Duct.
 C. Distal part of spermathecal seta.
 D. Spermathecal setae *a* and *b* of IX.
 E. Typhlosole, ca. XXIII, in cross section.
 F. Prostate gland of XVIII. 1. Glandular segment. 2. Duct.
 G. Prostatic setae *a* and *b* of XVIII.
 H. Calciferous gland of XV in cross section.
 I. Cross section of intestine of LXX. 1. Blood sinus. 2. Lumen of gut.
 J. Distal section of prostatic setae of XVIII.

The ampulla of a spermatheca is swollen, nearly ovoid, and has a tendency to fit over the upper portion of the duct like a cap. The duct is broad, and the ental section may be so swollen as to make it appear that the ampulla is actually an elongate, constricted device. Posterior to LXV, the digestive tract shows an interesting modification internally in the presence of a series of rather obvious ridges. Traces of longitudinal "ribbing" have been seen in the posterior wall of *D. verrucosa*, but there the effect is not to extend the internal wall of the gut as is the case with *varivesicula* (fig. 1-I). The cells are ciliated; the folds are strongly reminiscent of the gut lumen immediately posterior to the calciferous gland. This gastral folding cannot presently be considered as an important taxonomic character, but it does underscore the very considerable functional and structural plasticity of many earthworm systems.

The similarity, in certain details, to two diplocardian species (*invecta* and *koebeli*) known from Mexico, cannot presently be accorded much significance. The genus is as yet too poorly known to warrant any evaluations of close phylogenetic ties based upon a few characters in combination.

Little can be said about the life history of this species. The specimens were collected from an open, grassy field, of southwest exposure. The soil is yellow clay loam, fairly well drained, with a heavy stand of grass and low herbs. Some areas of the field were quite wet, suggesting a seepage zone, a condition perhaps limited to the spring months.

REFERENCES

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Gates, G. E. 1955. Notes on Several Species of the Earthworm Genus *Diplocardia* Garman 1888. Mus. Comp. Zool. (Harvard) Bull. 113(3): 229-259.
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