

*DIPLOCARDIA GATESI*, A NEW EARTHWORM  
FROM NORTH CAROLINA<sup>1</sup>

(OLIGOCHAETA: MEGASCOLECIDAE)

W. R. MURCHIE

*University of Michigan Flint College, Flint, Michigan*

ABSTRACT

A new species of earthworm, *Diplocardia gatesi* is described from the southern mountainous regions of the eastern United States. This earthworm is morphologically similar to *D. udei*; with minute prostatic setae, hastate spermathecal setae, quadrithecate condition, and dorsal vessel single anteriorly. The internal calciferous gland lamellae are free. It differs from *udei* in the structure of the spermathecae and the structure and arrangement of the male field.

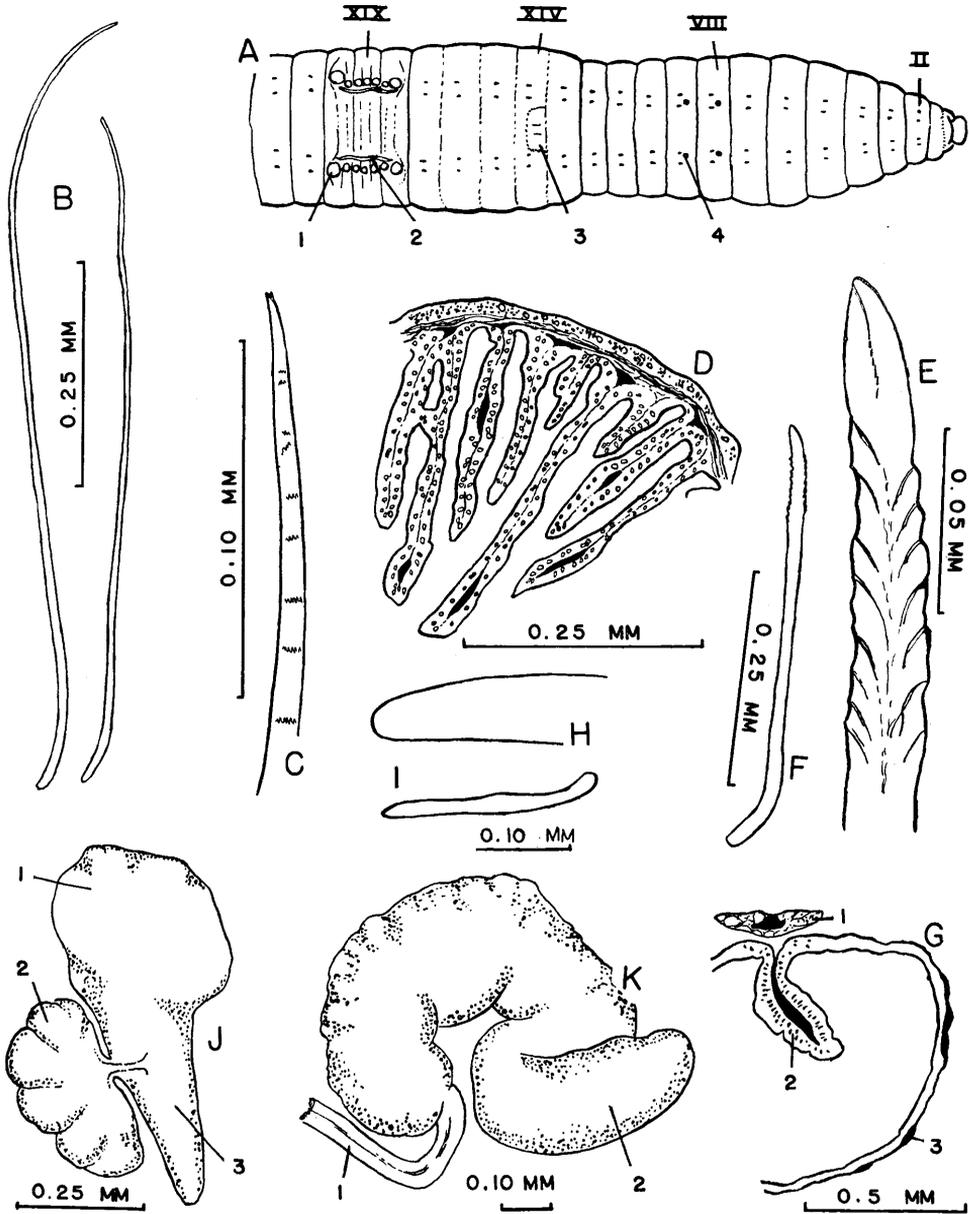
Specimens upon which this description is based were collected at French Creek, 5.5 miles north of Lake Toxaway, on Route number 281, Transylvania County, North Carolina. Two collections have been taken from this site, the first on 11 November, 1962; the second on 2 April, 1964. The holotype has been selected from the 1964 collection and deposited in the United States National Museum, U.S.N.M. Catalogue number 30994.

***Diplocardia gatesi* sp. n.**

*Diplocardia udei* Eisen 1899. Gates, G. E. 1955. Notes on several species of the earthworm genus *Diplocardia* Garman 1888. Bull. Mus. Comp. Zool. Harvard. 113(3): 229-259.

Unpigmented, clitellum pale buff-colored (formalin preservation). Size 73 to 100 mm by 1.5 to 2.7 mm, with averages of 83 by 2.0 mm for length and width respectively (13 specimens). Somite number: 96, 138, 145, 148, 150, 153, 154, 157, 158, 160, 161, 163, 168; average 150. Form elongate, widest in segments V-VII and in clitellar region, tapering anterior to V. Prostomium tanylobic or appearing so. Supernumerary annulations in preclitellar zone weak except VI and VII which are triannulate; postclitellar region multiannulate. Setal formula; *aa: ab: bc: cd=10: 2: 7: 3* (segment XXIII). First dorsal pore in 10/11. Clitellum XIII-XVII; of cingulum type, as thick ventrally as dorsally, with anterior and posterior margins sharply delineated above and below. Tubercula pubertatis absent. Glandular tumescences very weak in *ab* of VIII and IX; present in XVIII-XX, as a row of small circular papillae along outer edge of seminal gutter, from 2 to 3 per segment. Spermathecal pores two pair, immediately presetal in VIII and IX, slightly lateral to *a*. Female pores, paired, antero-

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EXPLANATION OF FIGURE I

- A. Diagram of ventral view of *D. galesi*.—1. Glandular tumescence of XX. 2. Seminal groove. 3. Glandular area surrounding oviducal pores. 4. Spermathecal pore of IX.
- B. Prostatic setae of XVIII. C. Distal portion of prostatic seta.
- D. Portion of calciferous gland; cross section. E. Distal portion of spermathecal seta IX.
- F. Spermathecal seta of IX.
- G. Cross section of intestine of XXII.—1. Dorsal vessel. 2. Typhlosole. 3. Blood sinus.
- H. Tip of somatic seta of X. I. Somatic seta of X.
- J. Spermatheca of IX.—1. Ampulla. 2. Diverticulum. 3. Duct.
- K. Prostate gland of XX. 1. Muscular duct. 2. Distal part of gland.

median on XIII; female field quadrangular, flattish area on anterior part of XIII. Male pores on anterior quarter of XIX, in seminal grooves. Male field flattish; seminal grooves sinuous, from  $\frac{1}{2}$  XVIII- $\frac{1}{2}$ -XIX, in *ab*, lips slightly raised. Prostatic setae *a* and *b* are modified, slightly dissimilar, elongate, thin, with very fine transverse striae on distal end; length ca. 0.74-0.84 mm, longer seta somewhat more curved distally. Spermathecal setae *a* and *b* modified, rather straight, hastate, with series (8-10 rows) of distinct teeth on distal one-sixth of setal shaft; length ca. 0.5 mm. Somatic setae without sculpturing, length ca. 0.25 mm. Nephridiopores on anterior edge of somite, in setal line *d*.

Pharyngeal gland masses ending in IV. Esophagus straight, without diverticula; widest in XIV and XV, narrowing in XVI and terminal at 16/17. Calciferous gland development of free lamellae—XIV through XV; about 44 lamellae, internal lamellar edges not connected. Gizzard in V and VI, large. Typhlosole begins abruptly in XIX, and diminishes in height rather rapidly in segments L through LV; simple fold, about one-half inner diameter of gut. Septa 8/9 and 9/10 thickened; 7/8 and 10/11 somewhat thickened. Dorsal vessel single anteriorly; some intrasegmental doubling may occur from XC posteriorly. Last hearts in XII. Meganephridial, avesculate.

Testes two pair, in X and XI; large, flattish, manicate. Male funnels prominent, folded, with strong iridescence. Sperm ducts without post-septal looping, extending posteriorly on coelomic wall of parietes at or slightly above setal line *b*; contiguous, joining within wall of XIX. Prostate glands two pair, in XVIII and XX; folded, compact, confined mostly to one segment or passing through posterior septa into XIX and XXI respectively; duct narrow, about one quarter to one third as long as gland proper. Seminal vesicles large, acinous, in IX and XII, from 9/10 and 11/12. Ovaries one pair in XIII; large, flattish, with ova in several strands. Ovarian funnels rather simple, auriculate, oviduct direct, opening in XIV. Ovisacs present in XIV from 13/14. Seminal receptacles two pair in VIII and IX; with cordate ampulla, diverticulum large, multi-lobed, opening into anterior wall of duct at about the mid-point of the duct; duct as long as ampulla, rather stout, narrowing toward ectal end. Prostatic setal follicles contiguous, on anterior surface of prostatic duct; confined to one segment. Spermathecal setal follicles large, posterior to spermathecal duct.

This species bears some resemblance to *Diplocardia udei* Eisen and, inasmuch as the types of that species have been presumed lost due to earthquake and fire, we have only the descriptions and drawings of Eisen (1899-1900) for comparison. Professor G. E. Gates (1955) has given a very precise description of some earthworms collected near Highlands, North Carolina, which he believed represented *D. udei*. He pointed out several important differences between his Highland material and the description of *udei*, but accepted potential variability of that species as possibly great enough to include his specimens. Variation is indeed common among diplocardians, even when all individuals are drawn from one population. I have had the opportunity of examining earthworms which fit the description of *udei* very closely; this fact, as well as a critical study of Eisen's description and figures, clearly indicate that Gates' Highlands and my Lake Toxaway worms represent a new, previously undescribed species which I designate *Diplocardia gatesi* in honor of Professor G. E. Gates.

The male field of *D. gatesi* is markedly different from *udei*. The seminal grooves of *udei* are set very close in XVIII-XX, much closer in fact than the normal intersetal distance *aa*. In *gatesi* (fig. 1-A) this male field is not narrowed, the seminal groove being in line with setal line *a*. In *D. udei*, Eisen described *tubercula pubertatis*; these are actually heavy glandular edges which surround the seminal grooves, especially on the outer edges. These edges are very heavy. By contrast, the papillae in *gatesi* are small, forming a line from XVIII-XX. In contrast to the described condition in *udei*, the clitellar margins of *gatesi* are quite sharp; posteriorly, the boundary is 17/18, and is not different above or below. The spermathecal setae of VIII and IX (sometimes called *copulatory setae*) are generally similar in *udei* and *gatesi*, but both of these are in turn similar to *D.*

*bivesiculata* Murchie (1961) with regard to this structure. The spermathecal setae in *gatesi* (fig. 1-E, F) are somewhat straighter than the equivalent setae in *udei*. The prostatic setae (penial setae) are longer in *gatesi* than in *udei*, and the ectal portion is slightly bifid rather than hooked (fig. 1-B, C).

The spermathecal diverticulum is in no way similar in these two species. In *udei*, the diverticulum is essentially intramural, forming a swollen region in the ectal half of the spermathecal duct; *gatesi*, on the other hand, has a large extramural structure (fig. 1-J), arising from the mid-duct on its anterior surface.

The typhlosole begins and ends with almost dramatic suddenness in *D. gatesi*. Commonly, the typhlosolar ends are not sharply limited, but increase or diminish in height gradually; in *gatesi*, this change in height occurs rapidly within a few segments.

Doubling of the dorsal vessel is, at best, very slight in each of the segments involved and is confined to the intra-segmental region of a varying number of segments posterior to XC.

The high internal folds of segments XIV and XV can be considered as calciferous-gland-like; the folds are not joined mesially (fig. 1-D), but the form and relationships of the lamellae are no different than would obtain if they did so join. Whether Frank Smith's "series" of stages in development (or regression?) (1924) in the calciferous gland complex is valid, is an undecided point as yet.

Ecologically, *Diplocardia gatesi*, as presently known, is an inhabitant of peaty mountain soils, associated with rhododendron, oak, and pine forest areas. My specimens were collected from the moist soil along the sides of a shaded ravine, within 35 miles of those seen by Gates, and from a nearly identical soil-vegetation complex. We know nothing of the specific habitat from which *D. udei* was collected, but certainly, "Raleigh, North Carolina, U.S.A." would include no habitats similar to those near Highlands or Lake Toxaway, North Carolina.

Precise data are unavailable on the life history of *D. gatesi*; strong iridescence of the sperm funnels and in the spermathecal diverticulum would indicate possible biparental reproduction. In this connection, Gates has written (1955):

"Reproduction obviously is sexual (biparental) and ovaries usually appear to be mature. Cocoon deposition in July and August may be expected in the Highlands locality if there is adequate moisture."

I believe the potential reproductive period is likely to include any period between April and November, at least in the mountainous areas of western North Carolina.

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#### REFERENCES

- Eisen, G.** 1899. Notes on North American earthworms of the genus *Diplocardia*. Zool. Bull. 2(4): 161-172.  
 ———. 1900. Researches in American Oligochaeta with special reference to those of the Pacific Coast and adjacent islands. Calif. Acad. Sci. Proc. (3rd Ser.) 2: 85-276.  
**Gates, G. E.** 1955. Notes on several species of the earthworm genus *Diplocardia* Garman, 1888. Mus. Comp. Zool. (Harvard) Bull. 113(3): 229-259.  
**Murchie, W. R.** 1961. A new species of *Diplocardia* from Florida (Oligochaeta: Megascolecidae). Ohio J. Sci. 61(3): 175-177.  
**Smith, F.** 1924. The calciferous glands of Lumbricidae and *Diplocardia*. Ill. Biol. Monog. 10(1): 1-76.