

A NEW EARTHWORM FROM TEXAS BELONGING TO THE
GENUS DIPLOCARDIA.

By FRANK SMITH,

Of the University of Illinois, Urbana.

The genus *Diplocardia* includes a considerable number of species already described, and presumably an even larger number yet to be made known. They constitute a group of indigenous species, apparently limited to North America, which exhibit an unusual range of variation in the position of the spermiducal pores. The ordinary position of these pores in the nearly related groups is on the eighteenth somite. In the majority of species of *Diplocardia* they are on the nineteenth somite; in one species, at least, they are on somite 20; and in still another one, *D. keyesi*, they are on somite 21. This last-named species was based on one specimen obtained by Eisen in Lower California and originally described (Eisen, 1896) under the name *Aleodrillus keyesi*.

The writer recently received from Dr. C. V. Piper of the Bureau of Plant Industry at Washington, D. C., two specimens of a closely allied form, which had been collected in Texas, and which represent a variety of *D. keyesi*. As a matter of convenience in making comparisons, a brief summary of the distinguishing characters of the type form of the species from a later paper of Eisen (1900) will be first presented; this will be followed by a similar summary of important characters of the new variety; and then a more extended description and comparison will be undertaken.

This paper forms No. 245 of the series of contributions from the zoological laboratory of the University of Illinois.

DIPLOCARDIA (ALEODRILLUS) KEYESI (Eisen).

Definition.—Color, flesh, marbled violet, no pigment. Size, 70 mm. by 5 mm. Somites 150. Prostomium divides somite I about one-half. Dorsal pores, the most anterior one, VIII/IX. Spermiducal pores in XXI. Spermathecal pores, two pairs, in VIII and IX, in front of setae *ab*. Prostate pores in XX and XXII. Oviducal pores

in front of setae *a*. Setae all ventral; *a-b* slightly larger than *c-d*; *a-a* larger than *b-c*. No sculpture. Penial setae, none. Spermathecal setae not differentiated. Clitellum ringlike anteriorly, posteriorly saddle shaped. Genital zone not distinct; two parallel grooves in $\frac{1}{2}$ XX— $\frac{1}{2}$ XXII; groove almost straight, with a knob at each apex; concavity turned ventrally. Esophagus without calcic concretions. Gizzards in V and VI. Sacculated intestine in XV. Dorsal vessel single, not covered with chloragogen cells. Hearts in X, XI, XII with large pulsating divisions; no chloragogen cells. Nephridia, meganephridia, no coelomic mantle. Testes in X and XI. Sperm-funnels in X and XI. Sperm-ducts, which join at XII/XIII in a common muscular sheath; fuse in XX/XXI. Sperm-sacs, one pair preseptal in IX, one pair postseptal in XII. Sperm-masses in X and XI. Oviducts in XIV. Prostates confined to one somite each; small, tubular, thicker at apex. Spermathecae, two pairs in VIII and IX; distal end knoblike; the duct is very slender and long, with a minute wartlike and ear-shaped diverticle situated about the middle.

Septal formula.—

$\overline{\text{VI/VII}}$, $\overline{\text{VII/VIII}}$, $\overline{\text{VIII/IX}}$, $\overline{\text{IX/X}}$, $\overline{\text{X/XI}}$

DIPLOCARDIA KEYESI TEXENSIS, new variety.

Length, 80 mm. Diameter (maximum), slightly less than 2 mm. Somites, 139–146. Color, pale; no obvious pigment. Clitellum, 13–20; thin on midventral strip. Genital papillae, transverse band between oviducal pores. Setae, anteriorly, *aa*: *ab*: *bc*: *cd*=7:2:6:2 $\frac{1}{2}$; near somite 25=6:2:6:2; ventral setae absent on 21 and slightly modified on 20 and 22. Dorsal pore, most anterior, 9/10 or 10/11. Nephridiopores, dorsad of setae *d*; first in 2. Spermiducal pores, $\frac{1}{4}$ 21; in seta line *b*. Prostate gland pores, 20 and 22; with ventral setae. Oviducal pores, anterior part 14; slightly mesad of seta line *a*. Spermathecal pores, near anterior margins 8 and 9; nearly in seta line *a*. Septa, 7/8 and 8/9 strongly thickened; 6/7 and 9/10 less strongly thickened. Gizzards in 5 and 6. Expanded intestine, begins in 19. Dorsal vessel single. Hearts, dorso-intestinal in 10–12; dorsal hearts in 7–9. Nephridia, paired; first in 2. Spermaries and spermiducal funnels, paired in 10 and 11. Sperm ducts of either side fuse in 21 near their openings. Prostate glands, paired in 20 and 22. Sperm sacs, paired in 9 and 12. Ovaries and oviducal funnels, paired in 13. Ovisacs, paired in 14. Spermathecae, paired in 8 and 9; small diverticula attached at junction of ducts and sacs.

Two specimens collected at Chillicothe, Texas, in Bermuda grass sod.

Holotype.—Cat. No. 19116, U.S.N.M. *Paratype*.—In collection of the writer.

Sagittal sections were made of one-half of the anterior 24 somites of the specimen having the clitellum best developed, and this specimen was used as the type of the new variety. Transverse sections were made of the anterior 25 somites of the other specimen which is designated as the paratype. The general condition of the reproductive organs of both worms indicate that they had passed the climax of a state of sexual activity and that the reproductive organs are not at a stage of maximum development. The new form agrees in several important characters with *Diplocardia keyesi*, described by Eisen (1896) from a specimen collected in Lower California. Since there is agreement between the new form and Eisen's species in most characters which usually serve as a basis for distinguishing between species in this genus, it seems preferable to treat the new form as a variety of the species mentioned.

Eisen's original description included many details concerning some of the organs and was accompanied by numerous illustrations. The same species was later described more briefly (Eisen 1899) in a paper which dealt in a preliminary way with all of the species of *Diplocardia* known at the time, and which included descriptions of some new species of that genus. In the following year Eisen (1900) published a more extensive paper which contained descriptions of the known species of *Diplocardia* and of still another new species. There are several discrepancies between some of the statements made in the original description of *D. keyesi* and those made in the two later papers. Although no statement with reference to it is made in either of the later papers, it is probable that some of the changes were intended to correct errors made in the original description. In other instances it is by no means clear which of the differing statements is more nearly correct.

EXTERNAL CHARACTERS.

The two Texas worms are similar in size, about 80 mm. in length, and have a maximum diameter of slightly less than 2 mm. The type specimen has 139 somites and the paratype 146. (Eisen's specimen is stated in all three papers to be 70 mm. by 5 mm. Figure 66 of his first paper is described as of natural size, and is about 85 by 3 mm. In the first paper the number of somites is given as 80 and in the other two papers as 150.) The worms preserved in alcohol are pale and without obvious pigment in the body wall. The formula $aa:ab:bc:cd=7:2:6:2\frac{1}{2}$ indicates the relative setal distances of a considerable number of anterior somites and is based on averages of several measurements. In the vicinity of somite 25 the formula $aa:ab:bc:cd=6:2:6:2$ is more nearly accurate. (A similar formula

based on Eisen's first paper would be $aa:ab:bc:cd=7:3:6:4$. In his last two papers he writes "*a-b* slightly larger than *c-d*." Ventral setae are lacking on 21; and those of 20 and 22, related to the prostatic gland pores, differ but slightly from those of other somites, being somewhat straighter. The ventral setae of the spermathecal somites are not modified in character, as are those of several other species of the genus. Similar statements are made by Eisen concerning *D. keyesi*.

The clitellum on the dorsal side includes all of 13-20 and a part of 12. Ventrally it extends from $\frac{1}{3}13$ - $\frac{1}{2}20$, but thins out on a narrow median strip. A transverse glandular thickening extends across this median area between the oviducal pores. Eisen describes and figures two longitudinal grooves connecting the prostatic gland pores of the corresponding sides. No such grooves are present in the specimens of the new form, but the absence is probably due to the sexually nonactive condition. Such grooves are present at the time of sexual activity in most known species of the genus. The first dorsal pore is at the anterior margin of 10 in the type, and in 11 of the paratype. The nephridiopores are near the anterior margins of the somites. Those of the most anterior pair are in the second somite and are dorsad of seta line *d* by a distance at least twice as great as *cd*, the distance between the setae of the dorsal bundle. Several of those in the clitellar somites are dorsad of seta line *d* by a distance nearly as great as *cd*, or even greater. The majority of those of the anterior 25 somites are but slightly dorsad of seta line *d*. The nephridiopores of somites posterior to 25 have not been studied. The spermiducal pores are on the ventral side of 21; are scarcely one-fourth of the length of the somite from the anterior margin; and are nearly in seta line *b*. The prostatic gland pores are in close relation to seta *b* of somites 20 and 22. Eisen describes and figures the spermiducal pores of *D. keyesi* as opening midway of the length of 21 and midway between the corresponding prostatic gland pores. In the new variety the distance from the spermiducal pore to the anterior gland pore of the same side is scarcely one-half as great as that to the posterior pore. The oviducal pores are on the anterior part of 14 and slightly mesad of seta line *a*. The spermathecal pores are near the anterior margins of 8 and 9 and nearly in seta line *a*.

INTERNAL CHARACTERS.

Septa 7/8 and 8/9 are most strongly developed and are about as thick as the body wall. Septa 6/7 and 9/10 are also thickened, but not as much as the two first mentioned. Septum 5/6 is normally developed and extends to the body wall, and so also does an extremely thin but perfectly evident septum 4/5 which is the most anterior

one. In *D. keyesi* Eisen describes 7/8, 8/9, and 9/10 as much thicker than the body wall; 5/6 is said to not join the body wall, but is described and figured as forming a sort of sac including the pharyngeal region of the esophagus. He found no trace of a septum anterior to 5/6.

Two well-developed gizzards are present in 5 and 6. The pharyngeal region and the esophagus as far back as 13 are not noticeably different from those of other species. The walls have an extensive blood supply in 9–13 through numerous branches of the supra-intestinal vessel. The walls of 14 and 15 are also highly vascular. They have several connections with the dorsal vessel and have a few low longitudinal folds of the epithelial layer. In the type specimen there is a considerable dilation of these two somites, but not in the paratype. The contracted part of the esophagus beginning with 16 has no such extensive blood supply as has the part anterior to it, and has a diameter only about one-third as great as that in 19, where the expanded intestine begins. The walls of the latter have an extensive blood supply. Eisen makes no reference to the place of the beginning of the widened intestinal part in his original description of *D. keyesi*, but a figure in that paper conforms with the brief statement in each of the two later papers—"sacculated intestine in XV." Eisen states that no typhlosole is present in that species, but the new form has one that is perfectly obvious.

The dorsal and supra-intestinal vessels in a few somites of the type specimen are not included in the piece that was sectioned, but there is nothing to indicate that the character and relations of these vessels and of the hearts in the type specimen differs from those found in the paratype. The dorsal vessel has not been found to be double in any part of its course. The supra-intestinal vessel is a definite, distinct trunk from the middle of the ninth to the middle of the thirteenth somite. The "hearts" of 10 to 12 are much larger than the others, and are of the dorso-intestinal type, regularly found in the genus, while those of 7 to 9 are of the dorsal type. In his description of *D. keyesi*, Eisen writes simply of vessels in 7–12 connecting the dorsal and ventral vessels, and states that those of 10, 11, and 12 are larger and of "the form of so-called hearts." At the time that he wrote it had not been noticed that the posterior pairs of hearts in *Diplocardia* are of the dorso-intestinal type.

The nephridia are meganephric and the first pair is in the second somite. The nephridial ducts with nephridiopores, but slightly dorsad of seta line *d* have a course which is slightly ventrad and posteriad through the layer of circular muscle fibers in the body wall to a level of seta line *d*, and then through the layer of longitudinal muscle fibers to the coelome. Their course in this latter layer is between the two bands of fibers which further posteriad separate and extend on

either side of the *d* setae. The ducts of the second somite and of the clitellar somites which have the more dorsally placed nephridiopores pass through the longitudinal muscle layer at a level considerably dorsad of seta line *d*.

The reproductive organs in most respects are similar to those already known in the genus. Paired spermaries and spermiducal funnels have the usual positions and relations in 10 and 11. The sperm ducts of either side are in close proximity in their course posteriad, but fusion into one duct does not take place until they have reached 21, on which they open to the exterior. The prostate glands are paired in 20 and 22, a position known heretofore only in *D. keyesi*. The glands are relatively small and each occupies but a small space in one somite. The duct is rather short and the lumen is very definite. It has a diameter $\frac{1}{4}$ to $\frac{1}{3}$ as great as that of the gland itself. Sperm sacs are paired in 9 and 12. Ovaries and oviducal funnels are paired in 13, and the paired oviducts have a fairly direct course to their outlets on the next following somite. A pair of ovisacs in 14 have their communications with 13 through openings dorsad of the oviducal funnels and near the esophagus. Paired spermathecae in each of somites 8 and 9 are of relatively small size, due in part to the fact that the worms were not sexually active when collected. Minute diverticula are attached at the junction of the short sacs with the ducts. In *D. keyesi* the ducts are relatively much longer and the diverticula are attached to them approximately midway of their length. Eisen (1900, fig. 136) figures the length of the duct as about three times that of the sac, while in the new form the lengths of the duct and of the sac are approximately equal.

LITERATURE CITED.

EISEN, GUSTAV

- 1896. Pacific coast Oligochaeta II. Mem. California Acad. Sci., vol. 2, pp. 123-198, pls. 46-57.
- 1899. Notes on North American earthworms of the genus *Diplocardia*. Zool. Bull., vol. 2, pp. 161-172.
- 1900. Researches in American Oligochaeta, with especial reference to those of the Pacific coast and adjacent islands. Proc. California Acad. Sci., ser. 3, vol. 2, pp. 85-276, pls. 5-14.

