

ERRATA.

Page 12, lines 16 and 17, for *one* hundred read *three* hundred and for *one thousand* read *six hundred*.

Page 17, line 2, dele first letter in the line.

Page 168, line 12, page 177, lines 13 and 14, and page 271, line 10, for *Lemna trisulca* read *Spirodela polyrhiza*.

Page 209, line 2 of foot-note, after *but* insert *represents*.

Page 256, line 7, and page 266, line 19: *snowi* n. s. has been shown to be *hieroglyphica*, ♂.

Page 257, insert as line 8 as follows: -ken to the office produced young in ten days. The

Page 272, line 13, for *P. biguttatus* read *Pompilus biguttatus*.

Page 278, Plate V., 16, after *view* insert as follows: *a*, mentum; *b*, labial rudiment; *c*, maxillary palpi; *d*, maxilla; *e*, labrum; *f*, antenna; *g*, eye; *h*, mandible.

Page 286, line 11, drop initial *the* one line.

Page 386, line 1, for *Comstocki* read *Comstock*.

Page 399, line 17, for *specimens* read *specimen*.

Page 411, line 10, for *Michaelson* read *Michaelsen*.

Page 441, line 3 from bottom, for *66* read *68*.

Page 445, line 10 from bottom, for *57* read *58*.

Page 466, line 1 from bottom, for *Cypria* read *Cypris*.

ARTICLE VIII.—*Notes on Species of North American Oligochæta.* BY FRANK SMITH.

A number of species of Oligochæta have been collected during the present year (1895) at Havana, Ill., in connection with the work of the University of Illinois Biological Experiment Station. It seems best to give a preliminary account of some of them at this time, although a more complete description, with plates, is in preparation. In this account is included some recently obtained information upon *Enchytræus (Halodrilus) littoralis* Verrill.

Diplocardia (Geodrilus) singularis Ude.

In the months of April and May there were found at Havana, Ill., many sexually mature earthworms which are probably identical with *Geodrilus singularis*, described by Ude (14, p. 69)* from specimens collected at Danville, Ill. Michaelsen (8, p. 190) has recently shown that a close scrutiny of Ude's description makes it likely that the pores of the prostate glands are upon somites XVIII and XX instead of upon XVII and XIX, and that the male pore is upon XIX, and a letter recently received from Ude confirms the correctness of Michaelsen's assumption. The Havana specimens correspond to the description of *G. singularis* as thus amended, except in minor characters to be mentioned later.

The poor state of preservation of Ude's specimens made a satisfactory account of the reproductive organs impossible. In having three pairs of spermathecæ in VII, VIII, and IX, *Diplocardia singularis* agrees with *D. communis* Garman, and differs from the three remaining

*Here and throughout this paper the full-face parenthetical figures refer to the bibliographical list which follows it.

species of the genus thus far described, while it agrees with all but *D. verrucosa* Ude, (15) in the presence of prostate glands opening upon XVIII and XX. The prostate-gland pores are connected on each side by a longitudinal groove. The male pores are upon the anterior part of XIX. The clitellum is nearly as thick upon the ventral part of the somites as upon the dorsal, except upon XVII and XVIII. A pair of genital papillæ is situated upon the posterior part of XVII or the anterior part of XVIII, and a second pair occurs upon XX or XXI, the position of both pairs being variable.

The testes and ovaries and the funnels of the sperm ducts are present in the usual number and situation, and the sperm sacs agree in number and arrangement with those of the other species of the genus. The dorsal vessel is single. The nephridia of the first pair are very small and open upon II. The position of the first dorsal pore is not uniform, being in some specimens in the anterior part of IX and in others in the anterior part of X. In the other species of the genus I have found it in the anterior part of XI, where it is stated by Ude to occur in *D. singularis*. The penial setæ of the specimens studied by me are long and slender, but have a slight double curve instead of the form figured by Ude (14, Fig. 18). The ventral setæ are absent upon XIX, as they are in some of the other species. The anterior end of worm is dark-colored upon the dorsal surface, as in *D. eiseni* Mich. and in *D. riparia*.

Diplocardia riparia Smith.

Since writing a previous paper (12) in which I described the above species and compared it in some particulars with *Diplocardia* (*Geodrillus*) *eiseni* Michaelsen (8, p. 184), I have received, through the kindness of a friend in Florida, forty-one living specimens of *D. eiseni* which were collected last June from the banks of Lake Eola in that state. A comparative study of these worms and

of the *D. riparia* from Havana shows clearly that they belong to distinct species; but it is necessary to revise somewhat the list of differences as given on p. 148 of my earlier paper (12).

The two species agree in the presence of a pair of very small nephridia opening upon II, and also in the position of the first dorsal pore, which is in the anterior part of XI.

The principal characters which distinguish the species are as follows: (1) The spermathecal pores are posterior to the setæ in *D. eiseni*, while they are anterior to the setæ in *D. riparia*; (2) the ventral setæ of VIII and IX in *D. eiseni* are modified and accompanied by glandular structures, while in *D. riparia* they are not; (3) the ventral setæ of XIX are one or both present on each side of the somite in *D. eiseni*, but both are lacking in *D. riparia*; (4) the quadrangular glandular area upon the ventral part of XVIII—XX described by Michaelsen in *D. eiseni* is quite conspicuous in that species, but is not noticeable in *D. riparia*; and (5) the two species are very different as regards size. On this latter point I may say that the specimens of *D. eiseni* received by me were quite uniform in size, and that none of them had a length of more than 150 mm. when alive and fully extended, the diameter of the anterior part being only 2 mm. and that of the other regions still smaller. Michaelsen, on the other hand, gives 160 mm. as the length of one of his specimens and 3-3.5 mm. as the diameter, but this seems to have been exceptional, since he states that "andere Stücke sind beträchtlich kleiner." Ordinary specimens of *D. riparia* are 220-250 mm. in length when fully extended, and 3 mm. in diameter. By comparing average specimens of each species I find the ratio between the weights of individuals of *D. riparia* and of those of *D. eiseni* to be more than 5:1.

Fridericia agilis n. sp.

Numerous specimens of an enchytræid worm belonging to the genus *Fridericia* were found at Havana, Ill., associated with the different species of *Diplocardia*. They were sexually mature in April and May.

The length of well-extended living specimens is 25-30 mm. and the number of somites is 57-66 in the specimens examined, the average number being 62.

The setæ are straight, with the exception of a slight curvature of the proximal end, the usual number in each bundle being two, although sometimes one or even two additional may be present in a few of the bundles. Occasional specimens are found in which between the ordinary setæ of a pair a second pair of very slender ones is present, the diameter of the latter being one half that of the former, or even less. In such specimens this arrangement of setæ prevails posterior to the clitellum as well as anterior to it. A head pore is present between the prostomium and peristomium, and the first dorsal pore is in VII. The clitellum is on XII and XIII.

The posterior margin of the brain is quite convex, while its anterior margin is slightly concave. Its length is one and a half times its greatest width, and the posterior part is a little wider than the anterior. The salivary glands are large and very much branched, and open into the alimentary tract between its lateral and ventral walls in somite III. Septal glands occur in IV, V, and VI. The anteseptal part of each of the nephridia equals the postseptal part in size. The duct of the former is convoluted, and the terminal duct arises from the posterior end of the postseptal part and opens in front of the ventral setæ. The dorsal vessel arises in XIX. The spermathecae communicate with the alimentary tract, each of them having about nine well-developed diverticula, which are hollow and somewhat unequal. The duct, which is about three times the length of the pouch, is slender, cylindrical, and without glands, except

a few scattering cells at the external opening. The length of the funnel of the sperm duct is about twice its diameter, and the duct itself is very slender, much coiled, and confined to XII.

F. agilis is distinguished from the other species of the genus, except *F. bisetosa* and the two species recently described by Nusbaum (10), by the number of setæ in each bundle, and it is distinguished from these by the form of the brain and by other characters. The spermathecæ are more nearly like those of *F. oligosetosa*, but the dissimilarity in the number of somites and of septal glands, together with the differences in the nephridia, in the duct of the spermathecæ, and in the brain, clearly distinguish the two species.*

Enchytræus (Halodrilus) littoralis Verrill.

Verrill's description of this species (20, p. 623) contains no account of the reproductive organs, and consequently its relation to other Oligochæta has been quite uncertain. Vejdovsky (18, p. 45) placed it with the Tubificidæ, while Vaillant (16, p. 292), Michaelsen (7, p. 50), and Beddard (1, p. 312) have considered it as an enchytræid. As a number of specimens, many of which were sexually mature, were obtained by me at Wood's Holl, Mass., in August of the present year (1895), I am able to extend the description somewhat. I think there is no doubt that these specimens belong to Verrill's species, since they correspond very closely to his description and were extremely abundant in precisely the same sort of situation in which he found his, namely, in dead seaweed and under stones near high-water mark, those under

* Since the above description was written, an account of four new species of *Fridericia* from the vicinity of Philadelphia has been received from Mr. J. Percy Moore (Proc. Acad. Nat. Sci. Phil., 1895, p. 341). Of these *F. longa* is quite similar to *F. agilis* in several characters. The arrangement of the setæ is somewhat different in the two species, and the number of diverticula of the spermathecæ is somewhat greater in *F. agilis* than in *F. longa*, but the most obvious difference is in the character of the salivary glands. Other differences may appear when more is known of the nephridia, the dorsal vessel, and the reproductive organs of the latter species.

stones and in the sand being, as a general rule, much smaller than those in the seaweed.

The living animals are sufficiently transparent to enable one to determine many facts concerning their structure, and such observations have been supplemented by dissections and by the study of both longitudinal and transverse serial sections, which show the general anatomy to be that characteristic of the Enchytræidæ. The length of the larger specimens is approximately 25 mm. and the diameter .5 mm. to 1 mm. The average number of somites in several specimens taken at random is 59, the minimum and maximum numbers noticed being respectively 53 and 69. The setæ are somewhat hooked at the proximal end, but are otherwise straight or sometimes slightly curved. The most frequent number of setæ in a bundle is three. There are often four present in the bundles of the anterior region, and sometimes even six, but in the latter case they are in two sets of three each, as though a second set had been formed before the first one had been lost. In the bundles of the posterior region there are frequently but two setæ present. The clitellum is on XII and XIII. I found no dorsal pores.

The length of the brain is one and a half to one and three-fourths times its width, the ratio varying with the state of contraction. Its sides are nearly parallel, the anterior margin being slightly concave, and the posterior slightly convex or straight. A careful examination of this organ in several living specimens shows that the posterior margin is not concave, and that its convex or straight appearance is not due to the peritoneal cells, as suggested by Michaelsen (7, p. 36) in the case of *E. vejdvovskyi*. Two long tubular unbranched salivary glands open into the alimentary tract upon its dorsal surface, behind the pharynx, and extend into IV, having a somewhat contorted course. Three pairs of septal glands occur in IV-VI, but those of V and VI are one

or both so constricted and contorted that there appear to be two pairs in each somite. I think that there is not the slightest doubt that these glands, together with the spermathecae, are the structures mentioned by Verrill as the caecal lobes of the alimentary tract, situated just behind the pharynx. There are certainly no extensive diverticula like those of some species of *Henlea*. The septal glands nearly surround the oesophagus, and this fact, together with the actual communication of the spermathecae with the oesophagus, would make it quite natural to assume that they were all thus connected if one should study living specimens only. The gland cells surrounding the oesophagus in VII and VIII are higher than those of the next following somites, and this fact probably explains Verrill's statement that the so-called caecal lobes "are followed by a large two-lobed portion, beyond which the intestine is constricted."

The dorsal vessel arises behind the clitellum, in XVII. The arrangement of the blood vessels in the anterior somites is the same as that described and figured by Michaelsen (6, p. 26; Taf. II., Fig. 2) for "*Enchytraeus Möbii*." The blood is colorless. The anteseptal part of each nephridium is small and forms the funnel only. The terminal duct arises from the posterior end of the post-septal part, and opens in front of the ventral setae. The spermathecae are without diverticula. The duct is of about the same length as the pouch, and is closely beset with glands throughout its length. The length of the funnel of the sperm duct is several times its diameter. The duct itself usually extends to XVII or XVIII in a tolerably straight course, and then, making a short, abrupt turn, retraces its course, the second part lying close beside the first, and communicating with a small prostate gland in XII. As one traces the duct from the funnel, the diameter is nearly uniform until just after the turn, where it is nearly doubled, the size being again uniform until a point is reached about one third of the

distance from the prostate gland to the turn. From this point the diameter gradually diminishes, and before reaching the prostate, becomes smaller than in any other part of the duct. The diameter of the widest part of the duct is one fifth that of the entire worm in that region, and three times the diameter of its own lumen.

In specimens that have passed the period of sexual activity the sperm duct becomes reduced in size, more convoluted, and extends backward a shorter distance.

Enchytræus littoralis is evidently very closely related to *E. vejdvovskyi* Eisen (3, p. 25) and *E. humicultor* Vejdovsky (17, p. 57). The chief difference would seem to be in the sperm duct, which in *E. littoralis* extends back as far as XVIII, but which at the height of sexual activity is entirely free from the numerous flexures described by Eisen (3, Fig. 19h), Michaelsen (6, p. 39; and 7, p. 37), and Ude (13, p. 86) as existing in *E. vejdvovskyi* and *E. humicultor*. Specimens of *E. littoralis* are frequently found in which the sperm duct passes from one side of the body to the other once or sometimes twice, but it is without sharp turns except at the point farthest back, where its course is reversed. The somewhat abrupt increase in the diameter, already described, is also very characteristic. The brain is similar in form to that of *E. vejdvovskyi* as figured by Eisen (3, Fig. 19f), though less concave in front and less convex behind. In view of the above facts it seems reasonable to question the advisability of regarding the differences between the European and American forms as more than varietal. Verrill's name has priority, of course, in the event of its being necessary to unite the species from the two continents under one name.

Thinodrilus inconstans, n. g. et n. sp.

At various times since April 1894 specimens of a species belonging to the Lumbriculidæ have been collected from the east shore of Quiver Lake, at Havana. They

are sometimes found in the algæ, sometimes in the mud at the bottom of the lake, and sometimes on the shore above the level of the water, under rubbish which is kept moist by the springs constantly flowing from the bank. Among specimens collected last February from a situation like that last described, one individual was found that was sexually active, with others that had been in that condition recently enough to be of use in gaining a knowledge of the sexual organs.

The worms are 30-60 mm. in length and .6-.8 mm. in diameter. The number of somites is usually 150-200, and sometimes even greater. The setæ are in four rows of bundles with two setæ in each. They are .15-.2 mm. in length, with bifid extremities, and have the same form as those of *Lumbriculus variegatus* Grube as figured by Vejdovsky (18, Taf. XII, Fig. 27). The length of the prostomium in alcoholic specimens is about equal to that of the first three somites taken together, and its width is almost as great as the diameter of the first somite. The width is nearly uniform for the greater part of the length, and the extremity is bluntly rounded. The brain is quite similar to that of *L. variegatus* Grube as figured by Ratzel (11, Pl. XLII., Fig. 10), if I understand his figure, but not if Beddard's interpretation (1, p. 212) be correct. A comparison of Ratzel's figure 10 with figures 12 and 13 of the same plate makes it quite evident that the supraœsophageal ganglia are represented by Ratzel in a position the reverse of the normal one, so that what is described by Beddard as the anterior part is really the posterior part, and *vice versa*. In the brain of *Thinodrilus inconstans* the masses of cells are upon the posterior part, and are not united by a narrow layer of cells as represented in *Lumbriculus variegatus*, although such a layer is present upon the outer surface of the brain, and if no sections were made might be supposed to connect the two masses. The median part of the brain, which connects the two lateral

divisions, is composed entirely of fibers with the exception of a few cells in the dorsal part. Groups of cells are situated respectively in front of and behind the point of union of the commissures with the ventral chain. The pharynx extends through II—V and is followed by the œsophagus in VI and VII, and in VIII by the intestine, which, as indicated by the chloragogue cells, commences in that somite. The septal glands are large in IV—VI, and slightly developed in III.

Beginning with the eleventh somite, paired appendages of the dorsal vessel with several cæcal branches are present. Nephridia are contained in the same somites with the gonads at the time of maturity of the latter. No especial modification of the epidermis to form a clitellum has been noticed. Albumen glands are wanting. Two pairs of testes are present in IX and X and two pairs of ovaries in XI and XII. The male pores were determined with certainty in but three specimens, in two of which the pores were upon X and in the other upon XI. The atria are similar in form and in the structure of the walls to those of *L. variegatus* as described by Hesse (4, p. 358) and by Vejdovsky (19, p. 81). Whether or not a definite penis is developed I am unable to state. The funnels of the sperm ducts are borne upon the posterior walls of IX and X. The sperm ducts have not yet been followed throughout their entire course. A pair of elongated sperm sacs communicate with X and extend backward for a varying number of somites, in some cases as far as XX. Well-developed spermathecae were found in but one specimen, and in that did not contain spermatozoa. There are five pairs in XI—XV, with their pores dorsad to the ventral setae and situated similarly to those of *L. variegatus*. In another example vestiges of these organs were present in XI—XV, while the specimen having male pores upon XI had traces of spermathecae in XII—XVI. The oviducts are short and open at the

posterior margin of their somites XI, XII. In all the specimens examined gonads were present in IX—XII.

No attempt will be made at present to distinguish fully between generic and specific characters. The characters of the setæ and of the branches of the dorsal vessel distinguish *Thinodrilus inconstans* from other Lumbriculidæ except *Lumbriculus*, while the number and position of the various reproductive organs distinguish it from that genus. Its relation to *Lumbriculus limosus* Leidy (5, p. 49) cannot be determined until more is known of that species. It seems probable enough that they may belong to the same genus, though I do not think that they are identical if the setæ of *L. limosus* are correctly figured by Leidy (5, Pl. 2, Fig. 16), since the distal portion is much more curved in his figure, and the point of abrupt change in diameter is considerably nearer the distal end than in the setæ of *Thinodrilus inconstans*. Also, the number of cæcal appendages of the dorsal vessel is greater than I have noticed in the latter species. In spite of these differences, however, there is a possibility that the forms may prove to be identical.

The genus *Diplocardia* apparently contains five distinct species, and is distributed over an area extending from Florida at least half way across the continent. *Sparganophilus* has several species and at least as wide a distribution. Benham (2, p. 175) suggests that the occurrence of *S. tamesis* in England is due to its importation, presumably from America, which seems highly probable, especially as Moore (9, p. 473) reports the occurrence of that species near Philadelphia. *Bimastos* is very distinct from the European Lumbriculidæ. In view of the above facts, the distinctness of the Palæarctic and Neartic regions as shown by the earthworm fauna would seem greater than has previously been supposed.

I take this opportunity to express my gratitude to Prof. E. L. Mark, of Harvard University, through whose

kindness I have been permitted to work during the past summer in the laboratory and library of the Museum of Comparative Zoölogy, and especially to Prof. S. A. Forbes, of the University of Illinois, whose continued encouragement and assistance have enabled me to carry on my study of this interesting group of animals.

Champaign, Dec. 12, 1895.

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