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IDENTIFICATION OF WISCONSIN TUBIFICIDAE

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INTRODUCTION

Oligochaete worms of the family Tubificidae are a common and frequently abundant component of the freshwater benthos. Nevertheless, there exists very little ecological knowledge concerning most species, and we do not even have an adequate inventory of the fauna for most regions of North America. This unfortunate situation is apparently the result of a widespread notion that tubificids are difficult to identify to the species level. This was true, for older keys often required examination of serial sections, or dissection of specimens, and failed to include many species which we now know to be common. However, taxonomic studies by R. O. Brinkhurst during the 1960's resulted in the production of keys (Brinkhurst 1965, 1968; Brinkhurst and Jamieson 1971) which make possible the identification of specimens mounted whole on microscope slides.

Thus while most older publications dealing with Tubificidae have been primarily systematic in content, there has been a recent increase in studies concerned with natural history, ecology, and pollution tolerance of tubificid species. A key to Wisconsin tubificids was constructed and is presented here in an attempt to stimulate more studies of this sort in the lakes and streams of Wisconsin. Although several keys to North American Tubificidae have been published in the past decade, this one should prove valuable to workers in Wisconsin for several reasons: those currently available include many species unlikely to occur in Wisconsin (Brinkhurst 1965; Brinkhurst et al. 1968; Brinkhurst & Jamieson 1971), fail to include a few species now known to occur in the waters of the state, are unnecessarily unwieldy for a restricted area since they do not proceed directly to the species level (Brinkhurst and Jamieson 1971), have had only a very limited distribution (Brinkhurst et al. 1968, Hiltunen 1970, 1973), or use terminology or nomenclature inconsistent with that in the recent world monograph of Brinkhurst and Jamieson (1971).

The Wisconsin key presented here proceeds directly to the species level and includes only those species known from the inland waters of Wisconsin (Howmiller 1974). It should thus simplify, as much as possible, the identification of tubificids collected in the state. While the localities from which tubificids have been examined are few in number, they represent a considerable range of environmental conditions (Howmiller 1974). We have reason to expect, therefore, that the present list includes most of the tubificid species which will be frequently encountered in collections from Wisconsin. Nomenclature used here agrees with that in Brinkhurst and Jamieson (1971). An exception is noted following the key, in footnote c.

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The Wisconsin key will, of course, present some difficulties when one comes across species not yet known from the state. In such a case, it will be necessary to consult the treatise of Brinkhurst and Jamieson (1971) or one of Brinkhurst's earlier keys.

PREPARATION OF SPECIMENS

The key is meant for identification of worms mounted whole on microscope slides. Magnification of up to 440X is required and higher magnification is occasionally convenient. Amman's lactophenol 20 g carbolic acid [phenol crystals], 16 ml lactic acid, 20 ml distilled water, and 31 ml glycerol, a small amount of anline blue may be added, Turtox CMC, or a mixture of the two are suitable mountants. Amman's lactophenol seems to clear specimens more quickly but CMC allows more freedom in handling of slides since it hardens. A mixture allows one to exploit the best features of the two.

CHARACTERISTICS USED IN IDENTIFICATION

Tubificid oligochaetes typically bear setae arranged in four bundles, two dorso-lateral and two ventro-lateral, on each segment except the first (Fig. 1a, 1b). The form of the setae provides the most valuable features for identification of most species. Most tubificids have setae which are bifid (two-toothed) distally, though the sizes and arrangement of the teeth vary greatly between species (Figs. 4-11). Many species have pectinate setae (Figs. 12-19), hair setae (e.g. Fig. 23), or both, in dorsal bundles. Other unusual shapes occur and are often highly characteristic of the species which bear them (e.g. Figs. 20-22, 24).

Unfortunately, many tubificid species cannot be identified using characteristics of the somatic setae alone. This category includes 10 of the 17 species in this key and some of the most commonly occurring species. Identification of these species requires sexually mature specimens for the examination of genital structures.

Some species have setae on the ventral side of one or two segments (X-XI) reduced in number and specially modified for reproductive purposes. Where somatic setae are not sufficiently distinctive, these penial (e.g. Fig. 25) or spermathecal (e.g. Figs. 27-28) setae provide characteristics which are valuable for identification.

Variously shaped penis sheathes (Figs. 29-40), generally borne on segment X or XI, are used in the identification of mature specimens of some species.

Collections often include large numbers of unidentifiable immature worms. Most workers separate these into two groups based on the presence or absence of hair setae. When sufficient numbers of mature individuals have been identified from a given habitat, it is often possible to come to a reasonable conclusion concerning the specific identity of the immatures with hairs, those without hairs, or both.

PROVISIONAL TAXONOMIC KEY TO TUBIFICIDAE

KNOWN FROM THE INLAND WATERS OF WISCONSIN

1 Posterior segments of worm bearing prominent gill filaments (Fig. 2) . . . . . *Branchiura sowerbyi*

1' No gill filaments on posterior segments. 2

2 Hair setae present in anterior dorsal bundles. 3

2' Hair setae absent. 10

3 Body wall bearing papillae in two rows on each segment; row of large papillae in line with the setae, row of smaller papillae in between (Fig. 3) . . . . . *Peloscolex multisetosus* . . . 4

3' No papillae, body wall naked 5

4 Posterior ventral setae with distal tooth as short or shorter than the proximal tooth (Fig. 9). . . . . .*Peloscolex multisetosus multisetosus*

4' Posterior ventral setae with distal tooth longer than the proximal tooth (Fig. 10). . . . . *Peloscolex multisetosus longidentus*

5 Dorsal bundles behind segment VII with hair setae and oar-shaped setae (Fig. 24), no pectinate setae. . . . . *Aulodrilus pigueti*. . . .

5' No oar-shaped setae, anterior dorsal bundles containing pectinate setae. 6

6 Pectinate setae with reduced distal tooth and only one or two intermediate teeth which are about the same size as the distal tooth (Fig. 17, 18). . . . . .*Aulodrilus pluriseta*

6' Pectinate setae having both lateral teeth considerably larger than the intermediate teeth (Fig. 13-16). 7

7 Mature specimens bearing modified genital setae. .*Potamothrix hammoniensis*[a]

7' No specialized gential setae; mature specimens with cuticular penis sheathes (Fig. 29-31). 8

8 Penis sheathes short, tub shaped (Fig. 29) . . . *Tubifex tubifex* . . . .

8' Penis sheathes elongate, tapering distally 9

9 Penis sheathes narrowly conical but with a broad base, distal end pointed, opening lateral (Fig. 30). . . . . *Tubifex kessleri americanus* . .

9' Penis sheathes conical (often wrinkled in whole mounts); opening lateral, oblique or terminal (Fig. 31). . . . . *Ilyodrilus templetoni*

10 Anterior setae simple or with distal tooth much reduced (Fig. 20), posterior dorsal setae broadly palmate (Fig. 19) . .*Aulodrilus americanus*

10' Anterior setae distinctly bifid, no palmate setae. 11

11 Anterior ventral setae with distal tooth much thicker and longer than the proximal and set at nearly a right angle to the shaft (Fig. 6), mature specimens with penis sheathes as in Fig. 39. . Limnodrilus udekemianus

11' Anterior ventral setae with distal tooth as thin or thinner than the proximal and shorter, equal, or only slightly longer than the proximal tooth. 12

12 Dorsal setae of median and posterior segments broadly flattened just below teeth (Fig. 21, 22), anterior dorsal and ventral setae with distal tooth much thinner and shorter than the proximal (Fig. 11) . . . . . Aulodrilus limnobius . .

12' No broadly flattened setae in dorsal bundles, anterior dorsal and ventral setae with the distal tooth at the least only slightly thinner and shorter than the proximal 13

13 Mature specimens bearing modified genital setae in the region of segment X; these spermathecal setae relatively large and board (Fig. 27); may also have fleshy penis with accessory penial setae (Fig. 25, 26) on segment XI . . . . . Potamothrix moldaviensis

13' No specialized genital setae; mature specimens with cuticular penis sheathes in the region of segment XI 14

14 Fully mature specimens with penis sheathes at least thirty times as long as width at base 15

14' Fully mature specimens with penis sheathes no longer than fifteen times width at base. 16

15 Penis sheathes with thick two-layered walls, narrowing and the walls becoming thinner abruptly just below the head, head of penis sheath triangular, not bilaterally symetrical (Fig. 36) . . . . . Limnodrilus cervix[b] . .

15' Penis sheathes with thin walls, the sheath not narrowing abruptly near the head, head of sheath pear shaped and bilaterally symetrical. . . . . (Fig. 37). . . . . Limnodrilus claparedeianus[b]

16 Penis sheathes relatively long, 300-900 μ when fully developed 17

16' Penis sheathes short, 200-300 μ when fully developed 18

17 Head of penis sheath a hood turned at a sharp angle to the shaft (Fig. 32, 33). . . . . Limnodrilus hoffmeisteri

17' Head of penis sheath a broad plate which is slightly upturned at one point (Fig. 34, 35). . . . . .Limnodrilus spiralis[c]

18 Anterior ventral setae with distal tooth much longer and thicker than the proximal and set at nearly a right angle to the shaft (Fig. 6), penis sheathes as in Fig. 39 . . . . . Limnodrilus udekemianus

18' Anterior ventral setae with distal tooth at most slightly longer and typically somewhat thinner than the proximal (Fig. 4, 5), penis sheathes as in Fig. 40. . . . . Limnodrilus profundicola

Footnotes Concerning Taxonomic Problems

[a]Potamothrix hammoniensis, P. bavaricus and P. bedoti would all key out to this point. These are morphologically very similar and one or more of them occur in Wisconsin. Howmiller (1974) reported P. hammoniensis from Lake Geneva but the report was based upon few specimens and some judgment was involved in the identification. As mentioned by Brinkhurst and Jamieson (1971) there is considerable variation in form of spermathecal setae within this species. Potamothrix hammoniensis has been reported only twice before from North America (Brinkhurst 1965, 1968; Howmiller and Beeton 1970). Potamothrix bavaricus has been more frequently found but Timm (1972) feels that all records should be referred to P. (as Euilyodrilus) bedoti. Timm (1970, 1972) and Hrabe (1967) distinguish between P. bavaricus and P. bedoti on the basis of differences in placement and form of the spermathecal setae. Brinkhurst (1965) believes that bedoti was established on the basis of unusual specimens of bavaricus and thus considers bedoti a synonym of the latter (Brinkhurst and Jamieson 1971). Michael Loden (pers. comm. 1974) refers to specimens in his collections from Lake Koshkonong as P. bavaricus/bedoti reflecting this taxonomic uncertainty.

[b]In many North American collections, it is difficult to distinguish between Limnodrilus cervix and L. claparedeianus on the basis of penis sheath morphology (Figs. 36, 37). Specimens with sheaths intermediate in form (Fig. 38) are often more common than those considered characteristic of either of the two species. It would seem that, in these cases, they do not form separate populations and recognition of this may be given by reporting the intermediates as Limnodrilus cervix-claparedeianus (Howmiller and Beeton 1970).

[c]Brinkhurst (1965) and Brinkhurst and Jamieson (1971) consider Limnodrilus spiralis a variant of L. hoffmeisteri and treat the name as a synonym. I continue to recognize L. spiralis because, in addition to being morphologically distinct, some evidence suggests that it may also be ecologically different from typical L. hoffmeisteri (Howmiller 1974).

It has been said that "a species is what a good taxonomist calls a species", but taxonomic judgments are eventually tested against ecological knowledge, "For where is the species that has no ecological reality?" (Brinkhurst and Jamieson 1971). The point here is that the field biologist or ecologist contemplating work with the tubificids should not be dismayed by these minor taxonomic problems. Without the ecological knowledge he can contribute, the taxonomists will be unable to provide the final solutions to these problems.

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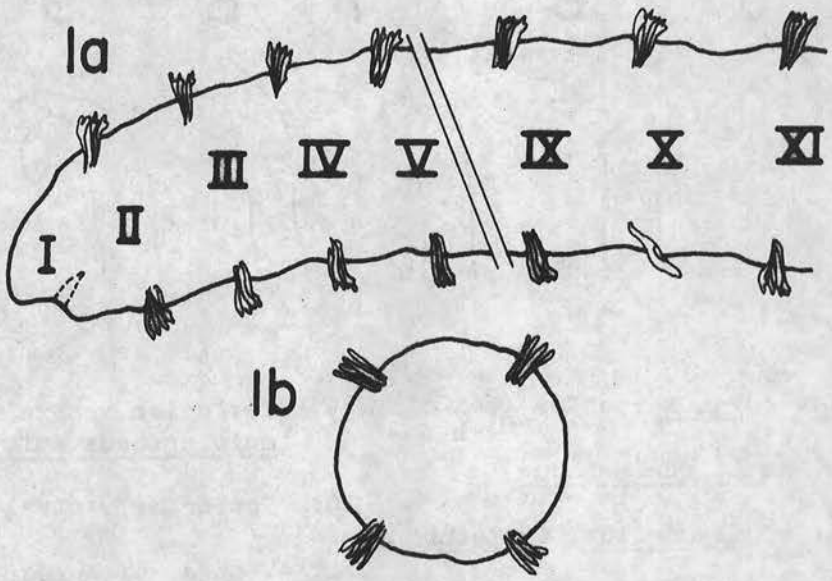
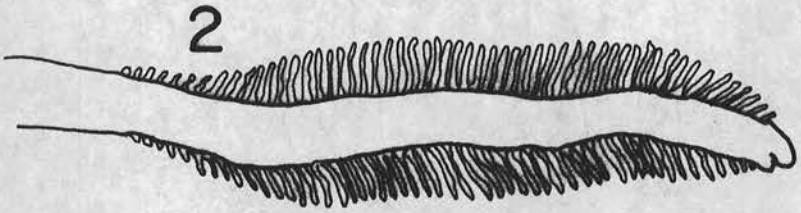
FIGURES

(Drawings are not all to same scale)

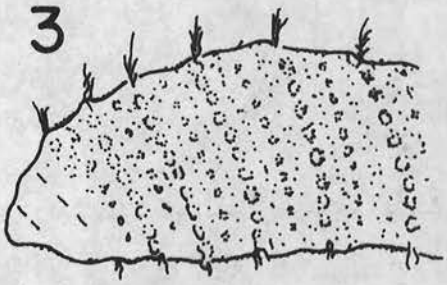


1a. Longitudinal side view of a generalized tubificid showing method of numbering segments. Setae are borne on all segments except the first (I).

1b. Cross sectional view of generalized tubificid showing dorso-lateral and ventro-lateral bundles of setae.

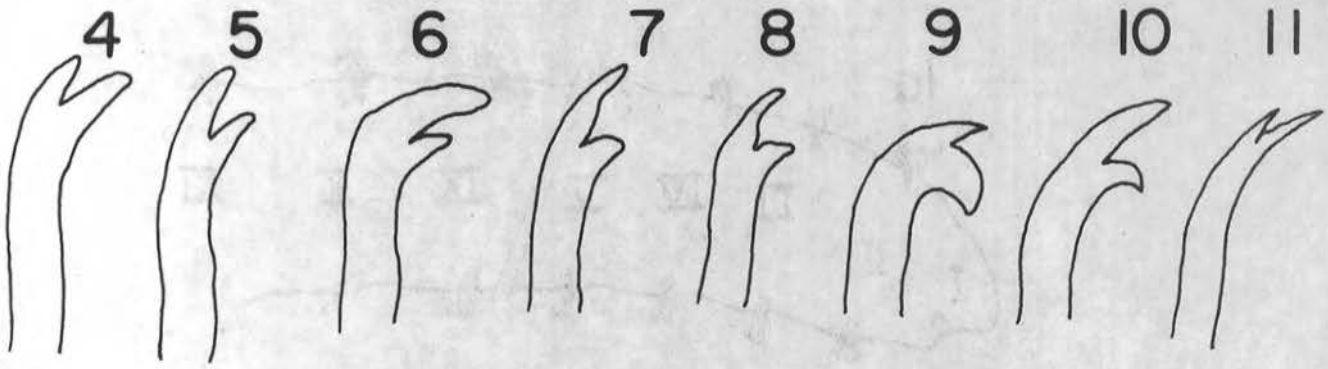


Posterior end of Branchiura sowerbyi showing dorsal and ventral gills.



Anterior end of Peloscolex multisetosus showing characteristic papillation of body wall.

Various bifid setae



4, 5. as of many Limnodrilus species

6. Anterior ventral of L. udekemianus

7. Anterior ventral of Ilyodrilus templetoni

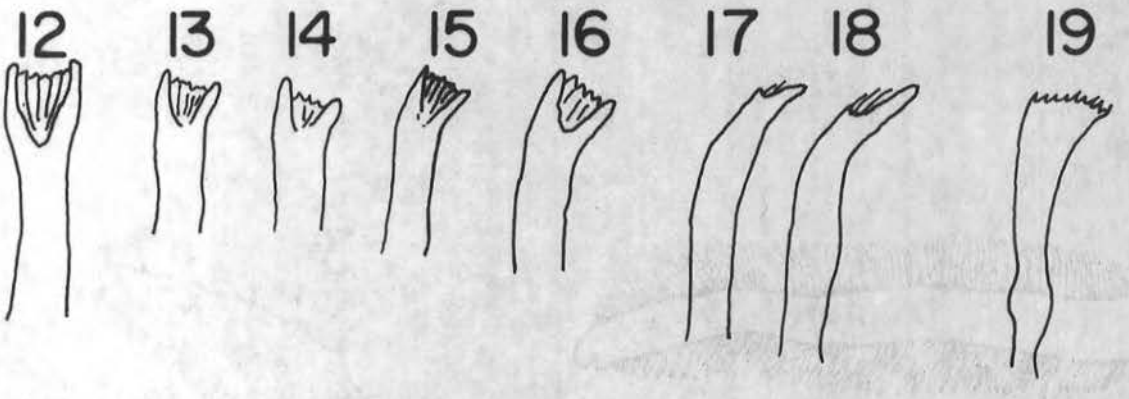
8. Anterior ventral of Tubifex tubifex

9. Posterior ventral of Peloscolex multisetosus multisetosus

10. Posterior ventral of P. m. longidentus

11. Ventral of Aulodrilus limnobius

Various pectinate setae



12. Peloscolex multisetosus

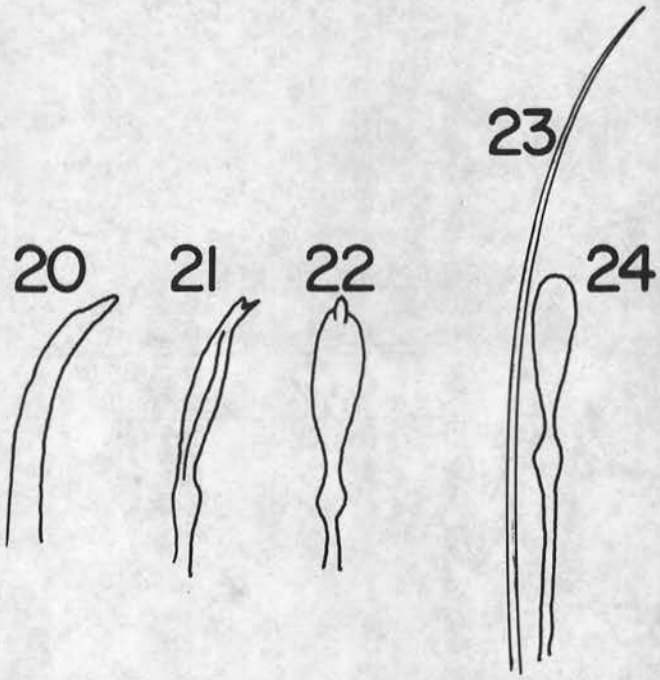
13, 14. Tubifex tubifex

15. Ilyodrilus templetoni

16. Potamothrix hammoniensis

17, 18. Aulodrilus pluriseta

19. A. americanus

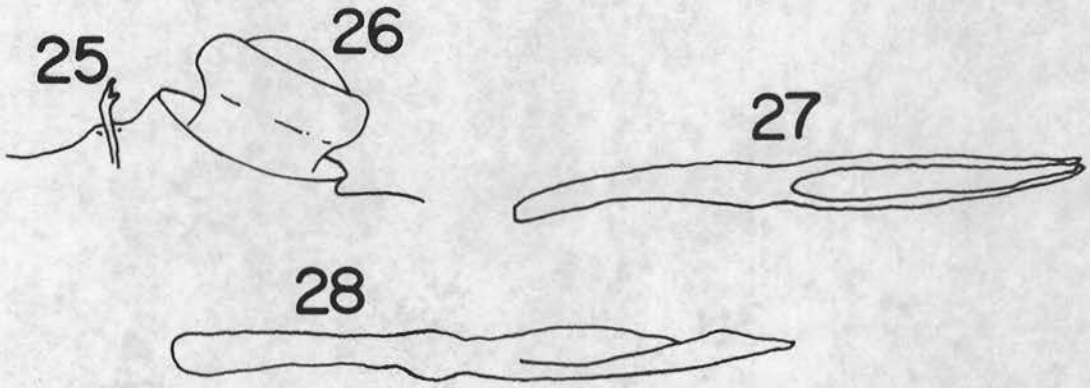


20. Simple anterior seta of A. americanus

21, 22. Lateral and facial view of flattened dorsal setae of A. limnobius

23, 24. Hair and dorsal "oar-shaped" setae of A. pigueti

Genital structures

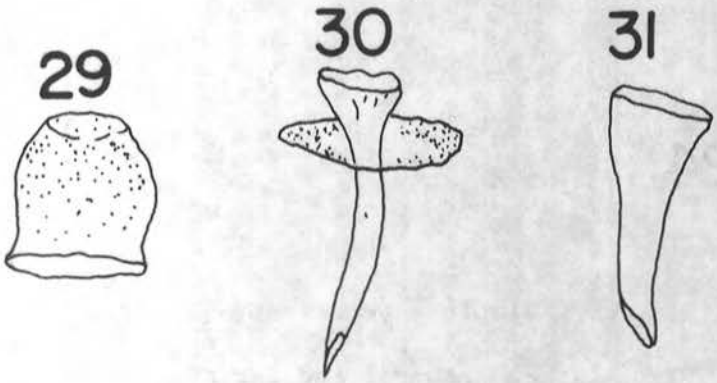


25, 26. Penial seta and penis of Potamothrix moldaviensis

27. Spermathecal seta of P. moldaviensis

28. Spermathecal seta of P. hammoniensis

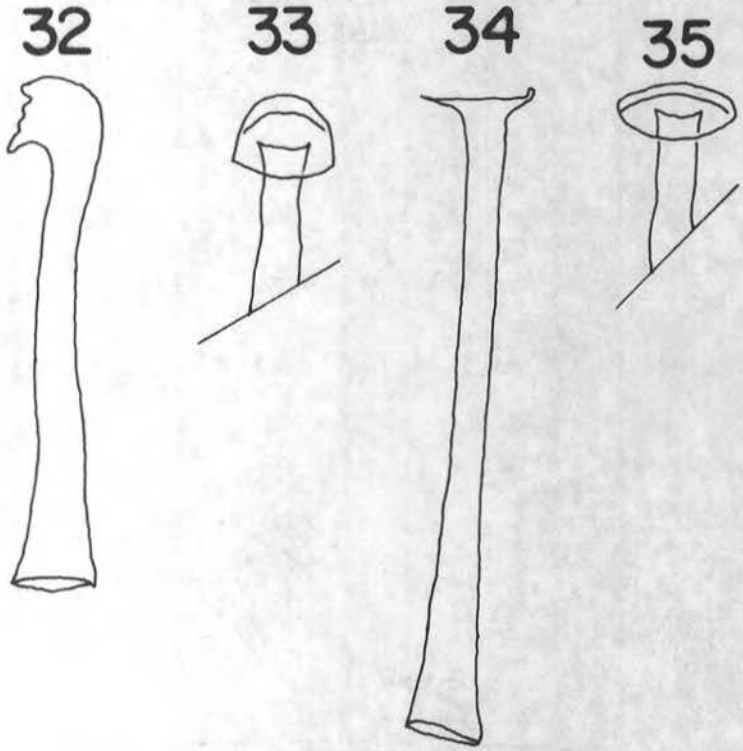
Penis sheaths of various species



29. Tubifex tubifex

30. Tubifex kessleri americanus

31. Ilyodrilus templetoni



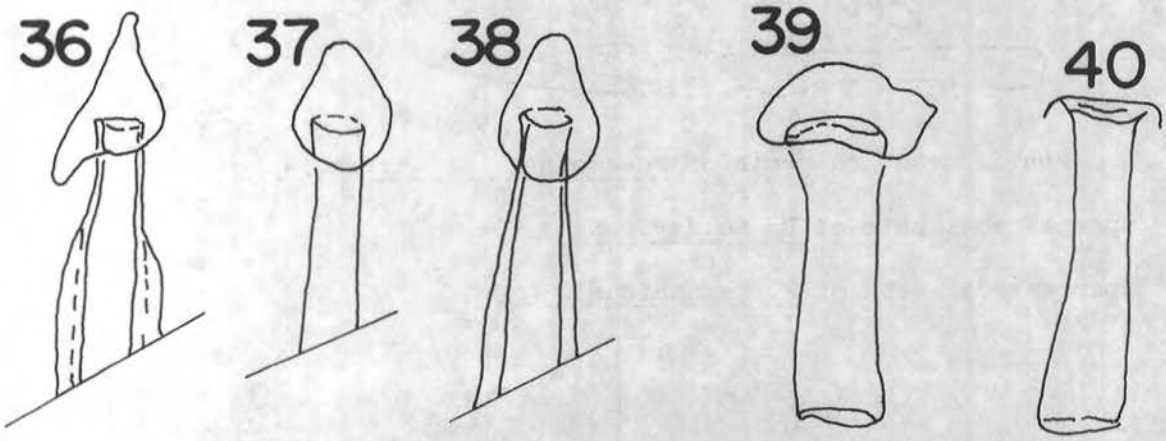
32, 33. Limnodrilus hoffmeisteri

34, 35. L. spiralis

36. L. cervix

37. L. claparedeianus

38. A form intermediate between 36 and 37

39. L. udekemianus

40. L. profundicola