Vol. 75, pp. 137–144 30 March 1962

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

MISCELLANEA MEGADRILOGICA. V–VI[1]

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V. On Some Instances of Supposed Variation in the Night Crawler, *Lumbricus terrestris* L.

Segment number in 817 specimens (hereinafter referred to as the B series), obtained from biological supply houses (Bragg, 1955), was 114–204. The clitellum in 640 of the worms comprised 4–8 segments and began with xxvii (1 specimen), xxviii (1), xxix (2), xxx (11), xxxi (161), xxxii (409), xxxiii (49), xxxiv (4), xxxvi (1), xxxvii (1).

Species of *Lumbricus* are distinguishable from each other almost only by location of the clitellum and of the tubercula pubertatis though number of segments (Evans, 1946) and soma size supposedly have some taxonomic value. *L. terrestris*, as usually defined (*cf.* Smith, 1917, p. 179 or Cernosvitov and Evans, 1947, p. 29), has a clitellum of six or seven segments on xxxi or xxxii–xxxvii. Moreover, the clitellum in other American species of *Lumbricus*, as hitherto diagnosed, extends only through six or seven segments. The data for the B series accordingly are so inconsistent with lumbricid taxonomy as to require confirmation or correction. A letter (18 January 1956) to the author and a note (16 April 1956) to the editor of the trade journal published by the major supplier explained the situation and mentioned the desirability of further investigation of the supposedly divergent worms or study of others of a similar sort. Unfortunately, the original worms had been discarded and, so far as is known, no effort was made to secure further information or material.

Meanwhile, the literature has been reviewed by the present author and segments of juvenile and adult night crawlers from various parts of the country have been counted. Further con-

[1] From research supported by the National Science Foundation.

sideration of segment number in the species is left for a future communication but no good reasons have been found for believing that "normal" specimens of *L. terrestris* have more than 164 segments or that the clitellum of "normal" individuals varies markedly from the commonly accepted norms for the species. Although "Any specimens with lost segments or regenerating segments were discarded" (Bragg, 1955) it is likely that night crawlers with fewer than 125 segments (*cf.* Evans, 1946) really were amputees.

Intercalation of one to several extra segments in an anterior portion of the body (Gates, 1956–1958) is not uncommon in lumbricids. Occasionally the insertions are numerous and more extensively distributed through the body. One night crawler with 175 metameres on the right side and 196 on the left side recently (Gates, 1956) was described. The aberrant nature of all such worms that have been studied was shown by wrong locations of fixed-position organs such as the obvious male tumescences) and/or by abnormalities in metamerism. Although abnormality in the B series usually would be suspected Bragg stated (*in litt.* 9 February 1956) that he "was careful to reject from the data any counts on worms which were in any way abnormal as to somites." The splitting of somites during embryogenesis that is responsible for the above-mentioned abnormalities presumably could be confined to the region behind xviii where fixed-position organs are lacking. Regularization, after somite fission, presumably could be so perfect that no evidence for the developmental aberrations would be recognizable in the adults but such eventualities are unlikely even in a single individual (*cf.* Gates, 1956–1958) and seem incredible for a much larger number of worms.

In the B series, 570 specimens now seem likely to have been night crawlers and normal insofar as the clitellum is concerned. If abnormality of embryonic origin, amputation and regeneration are to be excluded from consideration, seventy worms or more than one-ninth of the series now must be assumed to have belonged to taxa other than *L. terrestris* in spite of the fact that Bragg (1955) "never found reason to question the identification of the animals."

Four species of *Lumbricus* are known from North America. The clitellum of *L. castaneus* and *rubellus* does begin with xxvi, xxvii, or xxviii but each of those species is so much smaller than *L. terrestris* as to be unlikely to be given to American students for dissection[2] or to be mistaken for the night crawler. *L. festivus* does have a clitellum beginning with xxxiii or xxxiv as in 53 of the B series. That species was reported from North America (eastern provinces of Canada) in 1902 (Stafford) but the record has not been confirmed. Though larger than *L. castaneus* and *rubellus, L. festivus* is not known to reach night crawler size. Other American lumbricids belong to five genera three of which hardly seem to need mention in the present connection. The clitellum of *Allolobophora turgida* occasionally begins with xxix but this species is small, unpigmented and unlikely to be mistaken for *L. terrestris.* The clitellum always begins with xxix in *Octolasium cyaneum,* as it does in two specimens of the B series, and with xxx in *O. lacteum,* as in 11 of the B series, but these species are smaller than *L. terrestris* and readily distinguished by the lack of pigment as well as by the prostomium. Only two of the exotic lumbricids, both pigmented, now seem at all likely to be confused with *L. terrestris.* The smaller of these, *Allolobophora trapezoides,* has a clitellum of 7–8 segments that may extend anteriorly into xxvi. A markedly aberrant specimen, originally referred to *A. caliginosa* (Gates, 1956a), has 210 (+ ?) segments though the maximum for normal individuals in the United States seems to be 170. The larger species, *A. longa,* may have as many as 220 segments and has a clitellum of 8–9 segments beginning, as in two of the B series, with xxvii or xxviii. Both species easily are distinguishable from *L. terrestris* by the color and by the prostomium. The anterior end of the clitellum in all endemic lumbricids is in front of xxxi. Such data as were provided for the B series are insufficient to warrant further comment on specific identity of the seventy divergent earthworms.

No normal earthworm of any family in North America is

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[2] The writer was recently requested to advise on the possibility of providing giant earthworms for dissection by students in this country. My reply mentioned the fact that beginning students in other countries seem to have no difficulty with dissection of earthworms that are smaller than the night crawler.

known to have a clitellum beginning with or behind xxxv, as in two of the B series. For those specimens, the only alternative explanations now remaining would seem to be mistakes in segment counting (even though counts were checked for accuracy and questionable counts were eliminated) or presence of unknown species.

Whether abnormality, amputation, misidentification or unknown species were involved in the B series, information as to various unrecorded characteristics of the divergent specimens would have been of considerable interest and worthy of publication. Accordingly, there is no disagreement with Bragg's conclusion as to possibilities of research on animals used in teaching.

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VI. Reproduction in a Tropical Earthworm.

The glossoscolecid *Pontoscolex corethrurus* (Müller, 1856), originally from tropical America and now domiciled in the United States (Gates, 1954, p. 222), may prove to be the most widely established of all the earthworms that have been transported around the world by man. Possibly no other megadrile has occasioned so much disagreement as to its morphology and reproduction. Some of the confusion with

regard to structure, due to misinterpretation of divergence from normal megadrile organization, has been resolved (Gates, 1943) though some anatomical relationships still need accurate characterization. Basically involved in other contradictions is an assumption that reproduction is sexual and biparental as was long thought to be characteristic of all megadriles.

Sperm usually have been lacking on male funnels and in spermathecae of most breeding (indicated by clitellar tumescence) individuals that were collected by or for the author in different seasons of the year and from many widely separated regions. Tabulated data will be presented, circumstances permitting, in a subsequent communication. Spermatophores never were seen on many thousand specimens identified during the last thirty years and are not mentioned in the literature. Absence of spermathecal and spermatophoral sperm in breeding worms shows that copulation either was ineffective or had not taken place. In such circumstances, fertilization is possible only if a worm matures its own sperm. Testes, however, often remain juvenile or even rudimentary, sometimes so much so as to be unrecognizable in dissection. If, then, cross fertilization is impossible because sperm are not received in copulation and self fertilization is impossible because of male sterility, reproduction must be parthenogenetic. Further evidence in support of that method of reproduction is provided by the small size, rudimentary state or even absence of seminal vesicles (especially significant in a genus where by definition those organs are required to be unusually long and to extend through a number of segments), the small size of the male funnels or the translucence of larger but abnormally delicate funnels, retention of spermathecae in a juvenile condition throughout the entire breeding season, occasional presence of ova in gonads that should be testes, attenuated male gonoducts (without functional male pores). Such conditions have been found during the breeding season in taxa that have been proven by cytological studies to be male sterile. Elsewhere, similar conditions are known, in the breeding season, only from individuals or taxa in which male sterility or parthenogenesis is anticipated or suspected.

Very rarely in *P. corethrurus* sparse maturation of sperm

has been demonstrated by flecks or spots of iridescence on male funnels possibly of nearly normal size. Such worms, however, usually do not copulate as can be deduced from the almost uniform emptiness of spermathecae during the breeding period. Only in four (of the six) spermathecae of a single individual was coagulum with spermatozoal iridescence found. Even there the coagulum was so little as to occupy only a small portion of the space available in the ampullae. Maturation of sperm is not incompatible with parthenogenesis which may be optional as in *Dendrobaena rubida* or obligatory as in the anarsenosomphic morph of *Pheretima anomala* because the sperm, even if normal, are unable (Gates, 1956) to pass out of a closed system (comprising testis sacs and male gonoducts) without openings to the exterior.

Furthermore, examination of many specimens of *P. corethrurus* has provided evidence for a belief, even though normally sexual morphs have not been seen, that tubercula pubertatis, genital setae, supraparietal TP and GS glands are disappearing or already have disappeared in various strains just as in parthenogenetic morphs of certain lumbricids. Male gonoducts of *P. corethrurus* sometimes attenuate or otherwise terminate without acquiring functional openings to the exterior, again just as happens in parthenogenetic morphs of lumbricids and of the megascolecid genus *Pheretima.*

The protandry, consecutive hermaphroditism, dioecism, masculine and feminine phases postulated by previous authors to explain conditions in their material of *P. corethrurus* are absent, at least in later stages of its postparthenogenetic evolution of polymorphism. As in other megadrile species for which separate sexes were reported, the supposed females are parthenogenetic and there is no male sex. Megadrile oligochaetes certainly seem to be characterized by an inherent inability to become dioecious.

Possibility or probability of parthenogenesis now can be recognized in favorable circumstances and when only pickled specimens too poorly preserved for cytological studies are available. This is especially important in oligochaete taxonomy as ignorance of the morphological changes appearing after

establishment of that method of reproduction has been responsible for needless erection of species and perhaps occasionally even of genera. Some of those morphological changes are considered in recent contributions (Gates, 1954–1958). Other postparthenogenetic modifications of anatomy are to be considered in subsequent publications.

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