Revision of the western African earthworm genus *Millsonia* (Octochaetidae: Oligochaeta) with notes on two new species of the genus *Agastrodrilus* (Octochaetidae) from Ghana

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Synopsis

The western African earthworm genus *Millsonia* Beddard, 1894 is revised. A table of diagnostic characters, descriptions and figures are provided for 27 species regarded as valid, of which 14 are described as new. Three taxa previously associated with the genus are excluded: *meridionalis* Omodeo, 1972 is transferred to *Dichogaster* Beddard, 1888 s.l. and *schlegeli* Horst, 1884 to *Benhamia* Michaelsen, 1889; *Dichogaster insignis* Michaelsen, 1922 is regarded as a species *incertae sedis*. Notes are also provided on the allied genus *Agastrodrilus* Omodeo & Vaillaud, 1967 with descriptions of two new species.

Introduction

Earthworms of the genus *Millsonia* inhabit the soils of the wet savannah and forest regions of western Africa from the Ivory Coast eastwards to Nigeria. Although the ranges partly overlap, the genus is replaced in the soils of the drier savannahs to the north and west by the allied *Benhamia;* both, however, are sympatric with their more widely distributed mutual relative, *Dichogaster*. Until comparatively recently only a few species of *Millsonia* were recognized, but following surveys in the Ivory Coast (Omodeo, 1958) and especially Ghana, the situation has changed radically. Collections were made in connection with the ecological surveys carried out by the laboratory at Lamto, Ivory Coast, while Miss M. Tazelaar collected earthworms around Kumasi, Ghana (Sims, 1965*a*). Even more recently, Professor J.J. Niles made further collections in the Kumasi region, then, in 1966, Dr J.D. Plisko Winkworth visited Ghana and sampled earthworm populations throughout the country. These latter series were eventually presented to the British Museum (Natural History) where they were found to contain so many new species of *Millsonia* that it became necessary to undertake a special study of the genus. The results of this investigation form the subject of the present report with the genus here recognized as comprising some 27 species of which 14 are described as new to science. Additionally, it emerges that the species occur in a wide range of habitats, spreading from the forests and wet savannahs into cultivation, i.e. from

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plantations to village fields, gardens and even to the Botanic Gardens at Aburi,Ghana. Two new species of the morphologically similar genus *Agastrodrilus* were also collected and are described later in the report.

Morphology

Size. Most species of *Millsonia* are large, a few being over 500 mm in length, and several having more than 500 body segments. However, some have small-sized individuals seldom exceeding 100 mm in length with fewer than 200 body segments.

Setae. Usually small and uniform in size and shape, not always to be seen anteriorly in mature individuals. (The ventral setae in the anterior region are considerably enlarged in species of the genus *Agastrodilus*.)

Dorsal pores. The first dorsal pore is variably located in a pre-clitellar furrow according to species. Its situation seems *not* to be correlated with the thickening, i.e. the muscularization, of the anterior septa (see below) that reflects the burrowing prowess of a species.

Clitellum. Chiefly saddle-shaped; present over at least segments *xiv–xvii*, commonly extending *xiii–xix*. The genital field, which is enclosed between the ventral borders of the clitellum, is highly variable in appearance, being characteristically developed for each species. The clitellum is often well developed in immature individuals (gonads poorly developed, seminal vesicles absent).

Male terminalia. Species of the genus form two assemblages according to the arrangement of the male and prostatic pores. Over half of the species have an acanthodriline arrangement (male pores paired *xviii*, prostatic pores paired *xvii* and *xix*), while the remainder have a microscolecine reduction with the male and prostatic pores paired only on segment *xvii*. The male pores are sometimes carried on porophores but mostly they are superficial and commonly discharge into paired genital pouches or perhaps a single median pouch. (The pouches are everted during copulation, and often during relaxing, killing and fixing when preserving specimens).

Spermathecal pores. In species with an acanthodriline arrangement of the male terminalia, the spermathecae occur in two segments, *vii* and *ix*, and consequently open into furrows 7/8/9. Among other species that have a microscolecine reduction of the male terminalia, there is only a single pair of spermathecae. Apart from two exceptions, *hemina* and *oracapensis*, that have the spermathecae opening into 7/8, the spermathecae open into furrow 8/9. The spermathecal pores are located the same distance apart as the male pores. The furrows into which they open are appropriately modified whenever the genital field is specialized, since the pores of the opposing systems of concopulants are closely applied during sperm transfer. Whenever the male pores open into deep, pit-like, genital pouches that are everted during copulation, the latter are accommodated by invaginations (*vestibula*, i.e. 'vestibules') that develop in the furrow in the vicinity of each spermathecal pore. The spermathecal pore is rarely single (median ventral only in *ditheca*), but a single mid-ventral vestibule may develop with maturity (as in *nigra*) although the pores within are paired (Sims, 1965*b*).

Female pores. Located on segment *xiv*, the female pores are usually paired near setal lines *a* or *b*, sometimes within *aa*; the pore is rarely single (mid-ventral in *ditheca* and *nilesi*).

Genital papillae. Papillate and transverse, glandular pads are common ventrally in the clitellar region and on nearby segments in fully adult individuals of most species. The papillae are mostly large with a single pair occurring on each segment, but occasionally they are small and irregularly scattered in discrete areas on the segments. Although papillae are usually arranged in discrete species-distinct patterns, there is considerable intraspecific variation in their development so that the full specific complement is seldom realized.

Septa. Interspecific differences in the thickening (muscularization) of the anterior septa are widespread, but even so they are not employed taxonomically. They do, however, signify that the included species have highly variably burrowing abilities and divergent life styles.

Gizzards. Two simple gizzards are present, and they are invariably separate. The anterior gizzard is in segment *v* and separated by septum 5/6 from the posterior gizzard in *vi*. They are usually uniform, but occasionally one is reduced being either smaller or less muscular, or exceptionally, vestigial as in *anomala*. (Both gizzards are reduced in *Agastrodrilus*.)

Calciferous glands. These are stalked, lamellate structures, paired dorso-laterally on the oesophagus in segments *xv*, *xvi*, *xvii*. Occasionally the anterior pair is reduced, e.g. *anomala*, *brevicingulata*, *centralis*.

Intestine. The last oesophageal segment is clearly *xvii* (i.e. the location of the posterior pair of (oesophageal) calciferous glands), in segment *xviii* the gut is transitional in structure since it begins to dilate while becoming thinner-walled so that in *xix* it forms the anterior end of the intestine. Apart from young juveniles, paired segmental caeca occur in 1 to 36 segments of the anterior intestine with the foremost pair located between segments *xxiv* and *xxx*. The number of caecal pairs is more or less constant for each species, but where there is a long series of caeca, the posterior pairs become progressively smaller until the posteriormost may be difficult to detect. The caeca are morphologically digitate and never saccular, thus the condition of the anterior intestine differs from the pouch-like shape present in contracted specimens of many western African species of *Dichogaster*.

Testes. Holandric, within paired testis sacs in segments *x* and *xi*.

Prostates. These may be paired in segments *xvii* and *xix* (acanthodriline arrangement) or in segment *xvii* only (miscroscolecine reduction). They may form a simple 'U' and be confined to a single segment of become highly convoluted and encroach into nearby segments. Ectally each gland becomes muscular to form a slender duct that leads to the exterior; generally the length of the duct varies according to the species.

Spermathecae. Invariably located in segments *viii* and/or *ix*. Spermathecae (usually paired) occur in both segments in species with an acanthodriline arrangement of the male terminalia but in species with a microscolecine reduction of the male terminalia, there is a single pair in only one segment. The species *ditheca* is exceptional in having only a single, unpaired, median ventral spermatheca in each of segments *viii* and *ix* (see above *Spermathecal pores*). About half of the species have simple, adiverticulate spermathecae. The spermathecae of most other species have one or two diverticula, mostly arising from the duct but occasionally on the ampulla; the diverticula are usually unilocular and only rarely multilocular.

Nephridia. Closed exonephric meronephridia are present on the parietes throughout most of the body; they are usually reduced or absent from the anterior, mainly pre-testicular, segments where they may occur on the septa. In the oesophageal segments the meronephrida tend to be diffuse, but in the intestinal segments they become more saccular and discrete with perhaps 10 to 12 forming a row along the equator of a segment, with each discharging directly to the exterior. Many species have an additional pair of open holonephridia in each intestinal segment. Each holonephridium consists of a long duct leading peripherally over the parietes to the dorsum from a ventral nephrostome opening in the preceding segment; the duct is looped and becomes convoluted before discharging to the exterior on the equator of the segment about setal distance *aa* from the mid-dorsal line. Terminal vesicle or bladder not seen, presumably absent from each holonephridium. The coiled portion of the holonephridial duct has subsidiary convolutions that possibly function as closed meronephridia. An additional specialization was reported in *M. anomala* by Omodeo

(1955); here the holonephridial ducts of each side communicate with a (paired) longitudinal canal on the parietes on both sides of the ventral nerve cord.

The discrete meronephric condition occurs in most species with numerous intestinal caeca (over ten pairs), whereas the combined meronephric and holonephric condition is present in the majority of species with fewer than ten pairs of intestinal caeca. This correlation between the presence of numerous pairs of intestinal caeca and the absence of holonephridia makes the causal factors seemingly physiological, i.e. species adaptations to their habitat niches. Among earthworms of the family Megascolecidae, the structure of the excretory system appears to be highly plastic with frequent partial or complete replacement of holonephridia by meronephridia, even among congeneric species. The occurrence of meronephridia does not therefore appear to represent a highly significant phylogenetic event, but instead a common phenomenon that may occur even within a minor radiation whenever it is advantageous for emergent groups to adjust to changing conditions or to exploit new niches. The incidence of both nephridial conditions among species of the genus *Millsonia* thus parallels comparable situations in the family Megascolecidae and, in doing so, casts doubts on the validity of the family Octochaetidae that is currently delineated from the family Acanthodrilidae with only holonephridia by having only meronephridia.

Taxonomy

The megascolecoid genus *Millsonia* was erected by Beddard (1894) for two non-perichaetine, meronephric species lacking penial setae but with paired male and prostatic pores combined on segment *xvii*, two gizzards, three pairs of calciferous glands and paired intestinal caeca. At that time, megascolecoid earthworms with a lumbricine arrangement of the setae and spermathecae in the pre-testicular segments were divided into the family Cryptodrilidae (male and prostatic pores paired on segment *xvii* or *xviii*) and the Acanthodrilidae (male pores paired on segment *xviii* and the prostatic pores paired on segments *xvii* and *xix*). Thus *Millsonia* was originally assigned to the family Cryptodrilidae to join, among others, its ally *Dichogaster* Beddard, 1888 (type species *D. damonis* Beddard, 1888 from Fiji having male pores on *xvii* with prostatic pores and further prostatic pores on *xviii* and *xix* but internally lacking intestinal caeca). When Michaelsen produced his monograph (1900), he considered the location and arrangement of the male terminalia to be relatively unimportant systematically and instead gave greater weighting to internal characters. Thus he united all of the meronephridial species of the Cryptodrilidae previously accommodated in *Dichogaster*, *Millsonia* and *Balanta* (the last was a related monotypic genus separated by Michaelsen in 1898 for a species with combined, paired male and prostatic pores on segment *xix*). Furthermore, they were placed with species of the genus *Benhamia* previously assigned to the family Acanthodrilidae to form a vast, heterogenous genus, *Dichogaster*, that accommodated all species with two gizzards and three pairs of calciferous glands. One result was that three species with an acanthodriline arrangement of the male terminalia and possessing intestinal caeca, *inermis* Michaelsen, *caecifera* Benham and *heteronephra* Michaelsen (all previously assigned to the genus *Benhamia*), were first brought together with *nigra* Beddard, the type species of *Millsonia* that has a microscolecine arrangement of the male terminalia (i.e. male and prostatic pores paired on segment *xvii* only).

During the next few decades, many new species were described in the genus *Dichogaster* to form what was clearly an heterogenous assemblage containing nearly two hundred nominal species. Eventually, Omodeo (1955) divided *Dichogaster s.l.* into six genera by separating the species on the number and location of the calciferous glands together with the occurrence of penial setae and intestinal caeca. The genus *Millsonia* was resurrected for the species without penial setae but, among other characters, possessing intestinal caeca. Subsequently, small-bodied species similar to *Millsonia*, but with enlarged ventral setae and rudimentary gizzards, were separated in the genus *Agastrodrilus* by Omodeo and Vaillaud, 1967 (see p. 309). This group of genera is now assigned to the family Octochaetidae *sensu* Gates (1959).

Genus *MILLSONIA* Beddard, 1894

Millsonia Beddard, 1894: 380; Beddard, 1895: 479; Omodeo, 1955: 218; Omodeo, 1958: 22 & 59.
Dichogaster (part): Michaelsen, 1900: 334; Stephenson, 1930: 851.

TYPE SPECIES. *Millsonia nigra* Beddard, 1894 (Omodeo, 1955, by subsequent designation).

DIAGNOSIS. Octochaetidae lacking penial setae with two simple, well-developed gizzards, the anterior gizzard in segment *v* and the posterior gizzard in *vi*; stalked, lamellate, calciferous glands paired on the oesophagus in segments *xv*, *xvi*, *xvii* (the anterior pair occasionally reduced); paired digitate caeca present in at least one, usually several adjacent segments, of the anterior region of the intestine; typhlosole present; setal couples *ab* and *cd* similar in size, small.

DISTRIBUTION. Ivory Coast, Ghana, Togo, Benin and Nigeria.

REMARKS. The genus is restricted to contain only species with two large, simple gizzards (never fused or partly fused gizzards) and lacking penial setae; thus species such as *schlegeli* Horst, 1884 and *meridionalis* Omodeo, 1973 with penial setae and fused gizzards are excluded. Examination of the types of *schlegeli* in the Rijksmuseum van Natuurlijke Historie, Leiden, reveals that Horst miscounted the segments and the species should be assigned to the genus *Benhamia* Michaelsen, 1889 (*sensu* Omodeo, 1955); this is clearly a taxon requiring a separate study (Michaelsen, 1914*a*). While *meridionalis* is seemingly a species of *Dichogaster* Beddard, 1888 (*sensu* Omodeo, 1955), a genus in which the anterior region of the intestine is commonly saccular in each segment (in contracted specimens this condition gives the appearance of the intestine being caecate).

On the other hand, the identity of *Dichogaster insignis* Michaelsen, 1922, known only from a single subadult collected at Juring on the Sulima River in eastern Sierra Leone, is problematic. Unlike *meridionalis* and *schlegeli*, this species from Juring possesses separate gizzards in *v* and *vi* and lacks penial setae, but intestinal caeca were not recorded by Michaelsen. (Examination of the unique holotype in the Rijksmuseum van Natuurlijke Historie, Leiden, does not resolve the question of the occurrence of intestinal caeca since the fore-gut has been removed and only the oesophageal portion has been separately retained in an included vial.) Unfortunately, comparisons with other species are made different because of the immaturity of the individual, with the clitellum, spermathecae and prostates being only poorly developed. Omodeo (1958: 59) assigned *insignis* to the genus *Millsonia* on the characters already noted, and also on the absence of diverticula from the spermathecae, a condition rarely encountered among western African octochaetids outside of the genus *Millsonia*. Examination during this current investigation of the holotype revealed additionally the absence of holonephridia, the occurrence of the female pores in setal line *a* and the lack of papillae and other external specializations; thus *insignis* would appear to resemble *M. centralis* from Central Ghana, a species with 14 pairs of intestinal caeca. However, to unite these two taxa would imply that Michaelsen either omitted to record or overlooked the presence of numerous intestinal caeca, clearly unacceptable requirements. In these circumstances, I propose to regard the taxon *Dichogaster insignis* Michaelsen, 1922 as a species *incertae sedis;* hopefully the acquisition of additional material from the type locality will, in time, help elucidate the problem of its generic identity. In any case, support for this decision is provided by distributional evidence as species of *Millsonia* have not been reported from Sierra Leone nor from the adjacent state of Liberia, the most westerly recorded so far coming from the Ivory Coast.

The comparative characters of the valid species currently included in the genus *Millsonia* are listed in Table 1.

Millsonia anomala Omodeo, 1955

(Figs 9D & 10D)

Millsonia anomala Omodeo, 1955: 219; Omodeo, 1958: 59; Sims, 1965*a*: 299.

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 in setal lines *bb*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores paired near *a* immediately within *aa*; small closely paired papillae present $\frac{2}{3}$*viii* and in furrows 13/14 and 14/15, single transverse pads present mid-ventrally *xxi–xxv*; nine pairs of intestinal caeca *xxvi–xxxiv*; holo- and meronephric.

Table 1 Distinguishing characters of species of the genus *Millsonia*

Male pores segment no.	Spermathecal Pores		Female pores setal line	1st dorsal pore furrow	Intestinal caeca no. pairs	Species	Notes
	Furrow(s)	Setal line					
Meronephridia only present (holonephridia absent)							
xvii	8/9	across *cd*	distance *ab* below *a*	8/9	**1**	*sokodeana*	
xvii	8/9	across *ab* within vestibulum	ventral, $\frac{1}{3}$ *aa* apart	4/5	**16**	*ashantiensis*	
xvii	8/9	*c*	*a*	4/5	**32**	*mima*	copulatory 'pouch' and spermathecal vestibulum absent
xvii	8/9	across *ab*(imm.) within vestibulum (adults)	distance *ab* below *a*	5/6	**32 (25–36)**	*nigra*	copulatory 'pouch' and spermathecal vestibulum present
xviii	7/8/9	*b*	ventral $\frac{1}{2}$ *aa* apart	10/11	**(3)4(5)**	*pumilia*	
xviii	7/8/9	*b*	distance *ab* below *a*	7/8	**5—6**	*riparia*	
xviii	7/8/9	across *ab*	mid-ventral (single)	5/6	**14(13—17)**	*nilesi*	
xviii	7/8/9	across *ab*	*a*	11/12	**14—16**	*pulvillaris*	external transverse pads papillose;anterior gizzard small
xviii	7/8/9	across *ab*	*a*	12/13	**13–16**	*guttata*	external transverse pads without papillae; gizzards of equal size

xviii	7/8/9	*a*	*a*	5/6	**14**	*centralis*	anterior calciferous glands (*xv*), reduced in size
xviii	7/8/9	*b*	distance $\frac{1}{2}$ *ab* below *a*	12/13	**(11–)14**	*inermis*	external transverse pads absent; gizzards of equal size
xviii	7/8/9	*a*	*a*	4/5	**24**	*caecifera*	
Holonephridia and meronephridia present							
xvii	7/8	*b*	within *ab*	6/7	**1**	*oracapensis*	body length + 100 mm
xvii	7/8	*b*	within *ab*	8/9	**2**	*hemina*	body length − 100 mm
xvii	8/9	*b*	distance *ab* below *a*	8/9	**2**	*nota*	
xvii	8/9	*b*	within *ab*	9/10	**4–5**	*hortensis*	
xvii	8/9	across *ab*	distance 2*ab* below *a*	9/10	**7**	*jadwigae*	
xvii	8/9	*a*	distance $\frac{1}{2}$ *ab* below *a*	11/12	**8**	*moderata*	
xvii	8/9	across *ab*	distance $1\frac{1}{2}$ *ab* below *a*	10/11	**9**	*cruciventris*	
xvii	8/9	across *ab*	ventral $\frac{1}{3}$ *aa* apart	10/11	**6–12**	*artesetosa*	setae ventral but approximately equidistance apart
xviii	7/8/9	*b*	within *ab*	7/8	**1(2)**	*brevicingulata*	
xviii	7/8/9	above *d*	distance *ab* below *a*	11/12	**6–9**	*heteronephra*	
xviii	7/8/9	*b*	ventral $\frac{1}{2}$ *aa* apart	6/7	**7**	*omodeoi*	spermathecal pores in furrows
xviii	7/8/9	across *ab*	ventral $\frac{1}{2}$ *aa* apart	10/11	**7–8**	*ghanensis*	spermathecal pores located anteriorly to the furrows
xviii	7/8/9	single median	single median	11/12	**8**	*ditheca*	
xviii	7/8/9	*b*	distance $\frac{1}{2}$ ab below *a*	5/6	**9**	*anomala*	anterior gizzard reduced in size
xviii	7/8/9	across *ab*	ventral closely paired	5/6	**19**	*lamtoiana*	

DESCRIPTION. *External characters.* Length 110–124 mm, diameter 5–6 mm. Segments 180–249, multiannulate. First dorsal pore 5/6. Citellum ($\frac{2}{3}$ *xiii*) *xiv–xix*, saddle-shaped extending ventrally to within setal lines *bc*. Male pores paired *xviii* discharging into paired seminal grooves joining the (paired) prostatic pores in *xvii* and *xix* where they are located between setal lines *ab*. Female pores paired slightly within setal lines *aa*. Spermathecal pores paired in furrows 7/8/9 in setal line *b*, the anterior pair being larger. Papillae closely paired on the posterior surface of the mid-ventrum of *viii* and by the mid-ventral line in furrows 13/14/15; a swollen transverse pad occurs between setal lines *aa* on each of segments *xxi–xxv*, the more posterior pads being less well defined.

Setae uniform, small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd =$ 14: 1·2 : 9 1 where $dd =$ three-quarters of the body circumference.

Internal characters First septum 4/5, septa 5/6/7 greatly thickened, septa 7/8/9/10 less so. The anterior gizzard is weakly developed, being little more than a slight thickening of the oesophageal wall, whereas the posterior gizzard is strongly muscularized; the anterior pair of calciferous glands is often reduced in size. Intestinal caeca, nine pairs, present *xxvi–xxxiv*. Prostates paired *xvii* and *xix*, tightly convoluted each with a slender muscular ectal duct. Spermathecae paired *viii* and *ix*, adiverticulate, the duct and ampulla of each are approximately the same length. Nephridia: meronephridia occur throughout the body, a pair of holonephridia are additionally present in each intestinal segment where their ducts unite with paired longitundinal canals lying one on each side of the ventral nerve cord.

TYPE LOCALITY. Gagnoa, southern Ivory Coast.

RECORDS. 4C Gagnoa (6°04′N, 5°55′W), southern Ivory Coast; Nov. 1954 (syntypes of *Millsonia anomala*), (see *Remarks* below).

DISTRIBUTION. Southern Ivory Coast.

REMARKS. The description and the text-figure are based on Omodeo (1955). See also the *Remarks* in the account of the morphologically similar species *M. omodeoi*.

Lavelle (1971) recorded that *M. anomala* constitutes a major part of the oligochaete fauna in the low-lying, wet areas of the Lamto savannah of the Ivory Coast where breeding occurs twice a year at the end of the rainy seasons. (For further ecological information see also: Lavelle, Douhalei & Sow, 1974; Lavelle & Meyer, 1976.)

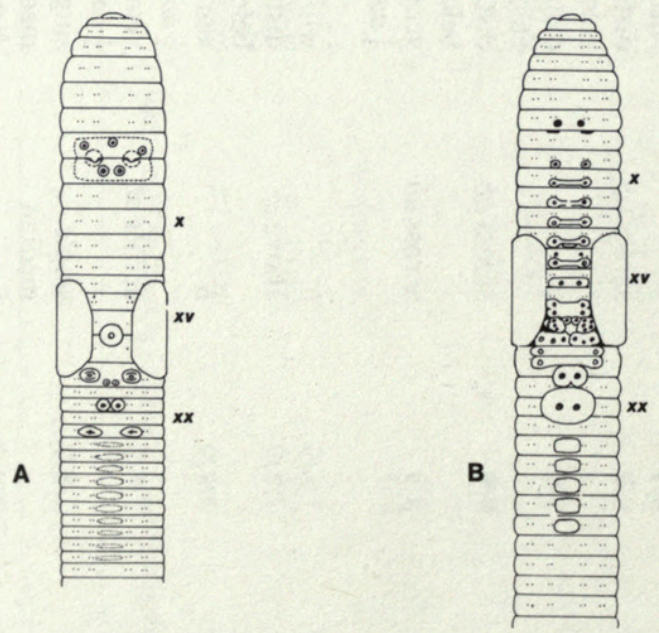

Fig. 1 *Millsonia* spp. with spermathecal pores in furrow 7/8; anterior region, ventral view (not to scale). (A)*oracapensis*; (B)*hemina*.

Millsonia artesetosa sp. nov.

(Figs 5F & 6F)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 in setal line *b*; combined male and prostatic pores paired on segment *xvii*; female pores paired $\frac{1}{3}$ *aa* apart within setal lines *aa* slightly anteriorly to the setal ring; papillae numerous, randomly arranged around the spermathecal and male pores, mid-ventral papillose pads may be present in furrows 13/14–15/16; setae widely paired approaching equidistance apart, ventral; intestinal caeca variable in number, six to twelve pairs beginning *xxix*, i.e. *xxix–xxxiv*, *xxxvii*, *xl*; holo- and meronephric.

DESCRIPTION. *External characters*. Length (aclitellate specimens 60–198 mm) clitellate specimens 186, 210 mm; diameter 5–8 mm. Segments 312–340, triannulate commonly with further subdivisions, especially anteriorly where external determination of the segments is often difficult. First dorsal pore in furrow 10/11, 11/12. Clitellum *xiii* ($\frac{1}{2}$ *xiii*)–($\frac{1}{2}$ *xvi*) *xvi*, saddle-shaped. Male pores combined with the paired prostatic pores *xvii*, inconspicuous in setal line *b* opening anteriorly in slight concavities on massive muscular paired pads (in the clitellate syntypes these pads form the lateral walls of an invaginated, single, median copulatory pouch); the muscular pads are papillose especially posteriorly when the papillae are more numerous. Female pores paired *xiv* within *aa* about $\frac{1}{3}$ *aa* apart, approximately equidistant from the other and the adjacent seta *a*; located slightly anteriorly to the setal ring. Spermathecal pores paired 8/9, inconspicuous by setal line *b* as slight depressions in paired, massive papillose pads than extend across most of the mid-ventral surfaces of *viii* and *ix*, often obliterating furrow 8/9. In addition to the papillae on the pads associated with the male and spermathecal pores, one syntype has midventral pads in furrows 13/14, 14/15 and 15/16 that carry between four and eight papillae. The mid-ventral surface of *circa xxiv–xxx* is somewhat raised and more heavily pigmented between *bb*.

Setae moderate to stout, widely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 2{\cdot}0 : 1{\cdot}2 : 1{\cdot}5 : 1{\cdot}0$, where *dd* = three-quarters of the body circumference.

Internal characters. Septa 4/5 and 5/6 strongly thickened, other anterior septa membranous. Gizzards large, strongly muscularized. Intestinal caeca of variable number 6–12 *xxix–xxxiv* to *xxix–xl*. Prostates, single pair *xvii*, highly convoluted filling most of *xviii* and *xix* with a long, muscular ectal region. Single pair of spermathecae in *ix*, with a stout duct and distinct ampulla; two diverticula present on the duct, the lateral diverticulum arises more ectally than the more highly convoluted medial diverticulum. Nephridia: meronephridia throughout the body and a single pair of holonephridia present in each intestinal segment.

TYPE LOCALITY. North Ejura, Ghana.

MATERIAL EXAMINED. 2C* 24A* Near the river, north of Ejura (7°23′n 1°15″W), central Ghana; coll. J.D. Plisko, date? BM(NH) 1984.4.1: 1–26 (syntypes of *Millsonia artesetosa*).

DISTRIBUTION. Known only from the type locality.

REMARKS. The near equidistant location of the setae on the ventral surface and the reduction in the number of strongly muscularized anterior septa may indicate that this is a weakly burrowing species; possibly it is a denizen of forest litter and crevices among tree roots.

Millsonia ashantiensis sp. nov.

(Figs 3C & 4C)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 in setal line *b* located within a shallow, single median pouch-like vestibule; combined male and prostatic pores paired on segment *xvii*, usually on prominent porophores; female pores paired in the setal ring about $\frac{1}{3}$ *aa* apart within setal lines *aa*; single mid-ventral papillose pads often in furrows (12/13), 13/14, 14/15, 15/16; 16 pairs of intestinal caeca beginning in *xxviii*; paired male copulatory pouches absent; meronephric only.

*C = clitellate (specimen), A = aclitellate (specimen).

DESCRIPTION. *External changes*. Length (aclitellate specimens 60–255 mm) clitellate specimens 211–330 mm; diameter (aclitellate specimens 2–5 mm) clitellate specimens 5–8 mm. Segments 400–517 (402 in juvenile 60 mm long); commonly triannulate. First dorsal pore 4/5 but very small, large dorsal pores beginning in furrow (11/12) 12/13, 13/14, (14/15). Clitellum $\frac{1}{2}$ *xiii—xvii*, saddle-shaped. Male pores paired combined with the prostatic pores within paired pouches; when the pouches are everted the pores are seen to be carried on large, crenulated porophores occupying most of the ventral surface of *xvii* and encroaching onto *xvi* and *xviii*. Female pores paired in the setal ring of *xiv* within *aa* about $\frac{1}{3}$ *aa* apart; in more mature specimens the body wall deepens locally to produce paired, medially curved longitudinal grooves or a single, short, transverse furrow linking the pores. Spermathecal pores paired 8/9 in setal lines *b*, in mature individuals they are located within a single, shallow, mid-ventral pouch-like vertibule. Oval papillose pads, single mid-ventral sometimes in each of furrows (12/13), 13/14, 14/15, 15/16; usually carrying two papillae. The body-wall on a few segments behind the clitellum usually glandular and raised at least between *bb* on *xviii* and *xix*.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Septa 4/5—11/12 strongly muscularized, 12/13 less so. Gizzards large, of equal size. Intestinal caeca 16 pairs, *xxviii–xliii*. Prostates paired, highly convoluted in *xvii–xix* with a slender muscular ectal portion. Single pair of spermathecae in *ix*, adiverticulate but mostly with nodular areas on the duct; the proximal portion of the duct is dilated and opens medially into a small chamber that communicates with the exterior, the distal portion of the duct gradually enlarges into a clavate ampullla. Nephridia: meronephridia only present.

TYPE LOCALITY. Ayeduasi, near Kumasi, Ghana.

MATERIAL EXAMINED. 7C Ayeduasi village, Kumasi (6°50′N, 1°35′W), Central Ghana; coll. I.K.B. Acheampong, ? date; BM(NH) 1968.2.32–39 (syntypes of *Millsonia ashantiensis*).
2C 3A 7juv. Bomsa village, Kumasi (6°50′N. 1°35′W), central Ghana; coll. J.J. Niles, ? date; (BM(NH) 1968.2.40–51.
1C Afrantwa, Ashanti (7°24′N. 1°57′W.), central Ghana; coll. J.J. Niles, ? date; BM(NH) 1968.2.52.

DISTRIBUTION. Central Ghana.

Millsonia brevicingulata sp. nov

(Figs 9E & 10E)

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 in setal line *b*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix* discharging on porophores, the posterior pair being reduced; female pores within *ab* slightly anterior to the setal ring; single mid-ventral papilla on *ix* by furrow 9/10, paired papilla on $\frac{2}{3}$*xii* by setal line *b*, on *xx* within *bc* and on *xxi*, *xxii* and *xxiii* within *aa*, single transverse mid-ventral pad present *xvi* and most of segments *xxiv–xxxv*; 1 pair (occasionally 2 pairs) of intestinal caeca *xxv* (*xxvi*);holo- and meronephric.

DESCRIPTION. *External characters*. Length 46–101 mm, diameter 2–3 mm. Segments 162–218; tetrannulate in the pre-clitellar region, triannulate in the post-clitellar region. First dorsal pore 7/8. Clitellum short, $\frac{2}{3}$*xiii–xviii*, saddle-shaped extending ventrally to below setal line *b*. Male pores paired *xviii* (not seen) discharging into paired seminal grooves passing between paired porophores on *xvii* and *xix* that carry the prostatic pores, each pair is joined by a raised transverse pad, the hinder porophores and pad in *xix* are reduced in size. Female pores paired slightly anteriorly to the setal ring in *xiv* lying between setal lines *ab* close to setal line *b*. Spermathecal pores paired, in furrows 7/8/9 in setal line *b* with a slight swelling of the ventral body wall immediately anterior to the pores. Single mid-ventral papilla usually present on *ix* close to furrow 9/10; paired papillae occur on $\frac{2}{3}$*xii* in setal line *b*, a raised transversely oval pad lies between the ventral margins of the clitellum on segmemt *xvi*, while further papillae are located on *xx* where they are widely paired between setal lines *bc* and closely paired on *xxi*, *xxii* and *xxiii* near to setal line *a*. Thereafter, a

series of low transversely oval pads are usually present within *aa* in the setal rings of some or all of the segments back to *xxxv*.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 7 : 1 : 5 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. First septum 4/5, septa 5/6–10/11 strongly thickened, 11/12 and 12/13 less so. Gizzards strongly muscularized, of equal size; in one syntype the anterior pair of calciferous glands is greatly reduced in size. One or sometimes two pairs of intestinal caeca present *xxv* (*xxvi*). Prostates paired *xvii* and *xix*, slender and highly convoluted with the hinder pair commonly reduced. Spermathecae paired *viii* and *ix*; ampulla globular to conical in shape merging into a stout duct that, at one-third of its length from the ventral parietes, carries a multilocular diverticulum of comparable length. Nephridia: one pair of holonephridia present in each of the clitellar and post-clitellar segments in addition to numerous discrete meronephridia that occur throughout the body.

TYPE LOCALITY. Kumasi, central Ghana.

MATERIAL EXAMINED. 4C 1A Grounds of the State School for Boys, Kumasi (6°50′N, 1°35′W.), central Ghana; Coll. J.J. Niles, 6 May 1966; BM(NH) 1968.2.1–5. (syntypes of *Millsonia brevicingulata*).
3C Forest, Pusu-Pusu, near Abuakwa, Asiakwa Reserve, East Akim (5°50′N. 1°10′W.), central Ghana; Coll. J.D. Plisko,? date; BM(NH) 1984.12.8–10.
1C Alluvium often flooded by the R. Volta, near Brong-Ahafo, north of Bui (8°10′N. 2°20′W.), northwestern Ghana; coll. J.D. Plisko, ? date; BM(NH)1984.12.16.
1C Botanical Gardens, Aburi (5°50′N. 0°11′W.), southern Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.12.17.
1C Savanna, Wango-Fitini, northern Ivory Coast; coll. P. Lavelle, ? date; BM(NH) 1971.22.113.

DISTRIBUTION. ? Northern Ivory Coast and Ghana.

REMARKS. The specimen from the northern Ivory Coast can be only provisionally assigned to this species due to its immaturity despite the presence of a clitellum; moreover, the diagnostic intestinal caeca, the gonads and seminal vesicles are also absent.

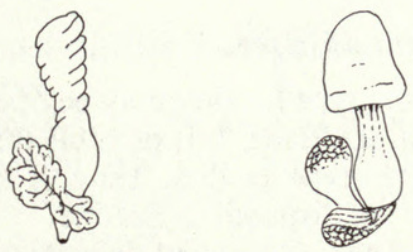

Fig. 2 Spermathecae (not to scale) of *Millsonia* spp. with spermathecal pores in furrow 7/8. (A)*oracapensis*; (B)*hemina*.

Millsonia caecifera (Benham, 1894)

(Figs 7H & 8H)

Benhamia coecifera (lapsus) Benham, 1894: 103; Reynolds & Cook, 1976: 88.
Benhamia caecifera Benham, 1894: 107; Beddard, 1900: 167.
Dichogaster caecifera: Michaelsen, 1900: 366.
Millsonia caecifera: Omodeo, 1958: 600; Sims, 1965*a*: 299.

DIAGNOSIS. Very large worm; spermathecal pores paired in furrows 7/8/9 in setal line *a*; male pores paired *xviii*, prostatic pores inconspicuous, paired *xvii* and *xix*; female pores paired *a* slightly anterior to the setal ring; numerous small papillae clustered over setal lines *ab* on *vii–xiii* and forming a pattern over *xvi–xxiii* within the ventral borders of the elongate clitellum; 24 pairs of intestinal caeca *xxix–lii*; meronephric only.

DESCRIPTION. *External characters*. Length 230 (aclitellate) — 510 mm (holotype), 800 mm (Beddard, 1900), diameter 11–12 mm but wider at the clitellum, up to 17 mm. Segments 310–359, predominantly biannulate with the anterior annulus large, bearing the setae. First dorsal pore 4/5. Clitellum long, *xiii–xxiii*, mostly saddle-shaped extending to setal line *d* by segment *xvi* or *xvii* to below *b* more posteriorly but more or less annular on segments *xiv* and *xv*. Male pores paired *xviii* (not seen) discharging into paired seminal grooves lying within setal lines *bc* that sub-terminally lead medially to the paired, inconspicuous prostatic pores located by setal line *a* on segments *xvii* and *xix*. Female pores paired close to setal line *a* slightly anterior to the setal ring. Spermathecal pores simple, paired in setal line *a* in furrows 7/8/9. Numerous small papillae present on segments *vii–xiii* occurring in paired clusters of two to six papillae mainly across setal lines *ab*; also numerous within the genital field and the ventral borders of the posterior clitellum where they form a distinctive pattern.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 6 : 1 : 5 : 1$ where $dd =$ three-quarters of the body circumference.

Internal characters. First septum 4/5, 4/5–8/9 delicate, 9/10–13/14 greatly thickened, 14/15 and 15/16 less so. Gizzards strongly muscularized, of equal size. Intestinal caeca 24 pairs present *xxix–lii*, the last six or so gradually diminishing in size. Prostates paired in *xvii* and *xix*; slender and moderately convoluted, ectally each with a pronounced delicate muscular duct. Spermathecae paired *viii* and *ix*; ampulla of each is simple and about the same length as the duct, the latter dilating near where it enters the parietes; the posterior spermathecae are slightly larger with a small digitate 'diverticulum' present on the duct. Meronephridia only present being diffuse on the anterior septa and discrete on the parietes of the clitellar and post-clitellar segments.

TYPE LOCALITY. Axim, coast of Ghana.

MATERIAL EXAMINED. *Previously recorded*. 1C Axim (4°51′N. 2°15′W.), coast of southwestern Ghana; coll. Captain Torry, ? date; BM(NH) 1894. 12.31.1 (holotype of *Benhamia caecifera*).
1C (fragments) 'Ashanti' (?vicinity of Kumasi, 6°50′N. 1°35′W.), central southern Ghana; coll. ? date?; BM(NH) 1904.10.5.657 (Beddard, 1900).
New records. 2A Near Kwadaso (6°42′N. 1°39′W), central Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.12.18–19.

DISTRIBUTION. (?) Southern and central Ghana.

REMARKS. The precise location of the type locality may be open to speculation, since subsequent records of the species are from central Ghana. It is possible that the only connection between the holotype and the currently recognized type locality, Axim, is that the town was either the place of residence of the collector or the port of dispatch to Europe.

The spelling of the name *caecifera* needs comment since Reynolds and Cook (1976) erroneously reverted to the original orthography which was merely a printer's error of transcription. In the original description, the spelling in the title and second paragraph, page 103, (also the 'running head' at the top of each alternate page) was inadvertently printed as '*cæcifera*' whereas the etymologically correct '*cæcifera*' appears on page 107. Clearly the former is in error so the first spelling of the name is not to be retained but that on page 107 should be employed instead (*International Code of Zoological Nomenclature* (3rd edition 1985), Article 32 (b) (i)). In any case there is a first reviser since Beddard (1900)* validated the name *caecifera* Article 24 (C). The author, Benham, a nineteenth-century graduate of Oxford University was, of necessity, well schooled in the classical languages and clearly would not have employed the stem '*coeci-*' in a Latin-derived scientific name to designate a 'caeca-bearing' species. It seems likely that the error arose where the author made use of ligature to join the vowels when writing his original description, subsequently the printer mis-read the '*a*' for an '*o*' in the hand-written manuscript, so '*æ*' was set instead of '*æ*'.

*Although Michaelsen (1900: 366) indicated that he was correcting the spelling, Beddard's action took priority since his paper was published in the February of 1900 whereas Michaelsen's monograph was not published until the October.

Due to their great size, individuals of this species must be particularly vulnerable to injury and liable to extinction in cultivation. The collection of specimens may prove increasingly difficult if not impossible in time, as more land is developed or ploughed for agriculture.

Millsonia centralis sp. nov.

(Figs 7E & 8D)

DIAGNOSIS. Spermathecal pores paired $\frac{2}{3}$ *vii* and $\frac{2}{3}$ *viii* in setal line *a*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores in or slightly above *a* anteriorly to the setal ring on *xiv*; paired papillae posteriorly to each spermathecal pore also one or two pairs between setal lines *bc* on segments *x*, *xi*, *xii*; genital field comprising two concavities, the anterior over segments *xv* and $\frac{1}{2}$ *xvi*, the posterior over segments *xvii*, *xviii*, *xix*, peripheral papillae common; 14 pairs of intestinal caeca *xxix–xlii*; only two pairs of calciferous glands in segments *xvi* and *xvii* (i.e. undeveloped in segment *xv*); meronephric only.

DESCRIPTION. *External characters.* Length 145–200 mm, diameter 4–6 mm. Segments 286–324, commonly regenerating after 75–80; strongly biannular. First dorsal pore 5/6. Clitellum *xii–xix*; saddle-shaped. Male pores paired in *xviii* discharge into paired seminal grooves passing between the (paired) prostatic pores of each side in *xvii* and *xix*; the latter being seen as low papillose porophores in the second of the two concavities that form the genital field, the first, i.e. the anterior concavity, has peripheral papillae and extends between furrow 14/15 and $\frac{1}{2}$ *xvi*. Female pores paired somewhat anteriorly to the setal ring in *xiv*, lying in or slightly above setal lines *a*. Spermathecal pores paired in the hinder regions of segments *vii* and *viii* by setal line *a*; two small papillae occur by the posterior border of each pore while a swollen, transversely oval area may surround each pair of pores. In addition to segmentally paired papillae located peripherally to the genital field, single or double pairs of papillae occur near the posterior furrows of segments *x*, *xi* and *xii* between setal lines *bc*; a single, mid-ventral papilla is sometimes present near the posterior furrow of segment *xix*.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd : = 4 : 1 : 4 : 1$ where $dd =$ two-thirds of the body circumference.

Internal characters. First septum 4/5, all the anterior septa are membranous until 10/11 and 11/12 which are strongly muscularized with 12/13 and 13/14 less so. Gizzards equal in size and moderately muscularized; only two pairs of calciferous glands seen, occurring in segments *xvi* and *xvii*, i.e. not seen in *xv*. Intestinal caeca present, 14 pairs *xxix–xlii*. Prostates, two pairs, *xvii* and *xix*, each highly convoluted with a slender, muscular portion ectally. Spermathecae paired in *viii* and *ix*, each has a short, stout duct swelling slightly ectally and an elongate, conical ampulla; adiverticulate. Meronephridia only present, being diffuse anteriorly and discrete in the intestinal region.

TYPE LOCALITY. Ayedusa, central Ghana.

MATERIAL EXAMINED. 15C 1A Ayedusa Village (6°40′n. 1°34′W.), central Ghana; coll. I.K.B. Acheampong, 24 Jun, 1967; BM(NH) 1968.2.90–105 (syntypes of *Millsonia centralis*).
1C Bekwaia, central Ghana; coll. J.J. Niles, ? date; BM(NH) 1968.2.106.
2C 1A 'Prempeh College', University of Science and Technology, Kumasi (6°50′N. 1°35′W.), central Ghana; coll. Mary Tazelaar, 21 Mar. 1956; BM(NH) 1984.5.130–132.
1C Under trees of a banana plantation, Kwadaso (6°42′N. 1°39′W.), central Ghana; coll. J.D. Plisko, 31 Mar. 1966: BM(NH) 1984.4.79.
1C Under citrous trees, Kwadaso (6°42′N. 1°10′W.), central Ghana; coll. J.D. Plisko, 7 Jun. 1966; BM(NH) 1984.4.78.
17C 8A Cocoa plantation, Bunso (6°12′N. 1°49′W.), south central Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.4.53–77.

DISTRIBUTION. Central Ghana.

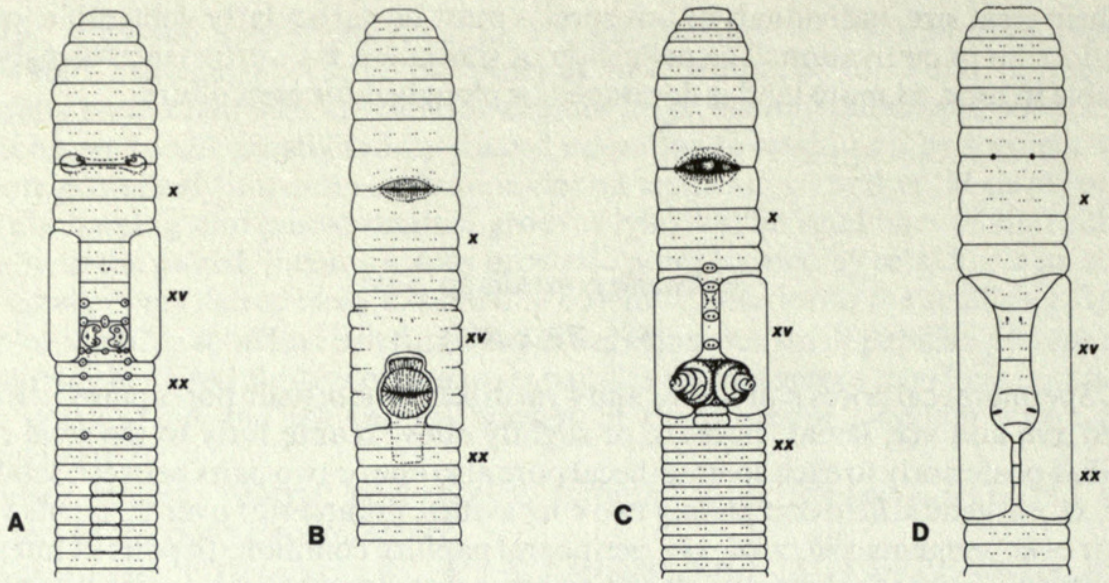

Fig. 3 *Millsonia* spp. with spermathecal pores in furrow 8/9, meronephridia only present (holonephridia absent); anterior region, ventral view (not to scale). (A)*sokodeana*, (B)*nigra*, (C)*ashantiensis* (male field everted); (D)*mima*.

REMARKS. Despite the incomplete expression of the generic characters, i.e. the absence of the anteriormost pair of calciferous glands from segment *xv* (a trend seen in *M. brevicingulata*), I propose to include this species within the genus *Millsonia* since it possesses separate gizzards in *v* and *vi*, and intestinal caeca.

Millsonia cruciventris sp. nov.

(Figs 5E & 6E)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 in setal lines *ab*; combined male and prostatic pores paired on segment *xvii* (genital field may be invaginated); female pores paired within *aa*, located slightly anteriorly to the setal ring about distance 1·5 *ab* below *a*; male gential field may be invaginated in mature individuals otherwise seen as four (two pairs) of papillose pads; nine pairs of intestinal caeca *xxviii–xxxvi*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 70(? regenerating)—151 mm, diameter 5–7 mm. Segments 189(? regenerating)—295; multiannualte, mostly tetrannulate but further subdivisions common anteriorly; caudal region (?) flattened. First dorsal pore 10/11. Clitellum *xiii–xvii*, saddle-shaped. Male and prostatic pores combined, paired *xvii*; in subadults they lie in setal line *ab* on a narrow, transverse, raised glandular strip that divides the genital field; another but longitudinal glandular strip bisects the transverse strip to form a cross (i.e. a plus sign, +) so causing the field to be composed of four papillose pads. These characters are not seen in mature adults as the genital field invaginates with the papillose pads forming the walls of a large pit-like, single mid-ventral male 'pore' over segments *xvi* and *xvii*. Female pores paired on *xiv* slightly anterior to the setal ring, located within setal lines *aa* about 2 *ab* apart (each about 1·5 *ab* below seta *a*); in mature adults when anterior setae are missing, the female pores are carried on a glandular rectangular pad. Spermathecal pores paired in furrow 8/9 across setal lines *ab*, the hinder annulus of *viii* and the anterior annulus of *ix* are swollen with several (usually one to four) papillae laterally to the spermathecal pores, i.e. in *bc*. Raised transverse pads often present below setal line *b* on up to eight post-clitellar segments, e.g. (*xxiii*) *xxiv–xxvii* (*xxx*).

Setae closely paired, ventral; seldom present in the pre-clitellar and clitellar regions; post-clitellar formula $aa : ab : bc : cd = 7 : 1 : 3 : 1$ where *dd* = three-quarters of the body circumference.

Internal characters. Septa 4/5–10/11 thickened. Gizzards strongly muscularized but disparate in size with the posterior gizzard twice the size of the anterior. Intestinal caeca nine pairs, *xxviii–xxxvi*. Prostates single pair, very long and convulated passing through several segments.

Single pair of seprmathecae in *ix*, with a long, stout duct and pronounced ampulla, lateral diverticulum on the duct poorly developed and may be overlooked. Nephridia: meronephridia present throughout the body with, in addition, paired holonephridia in the intestinal region.

TYPE LOCALITY. Ada Kanyanga, southeastern Ghana.

MATERIAL EXAMINED. 23C 2A Under tomato plants, Ada Kanyanga (5°55′N. 1°10′W.), S.E. Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.80–104. (syntypes of *Millsonia cruciventris*).
6C Cultivated field, Ada Koloidaw (5°40′N. 0°25′W.), S.E. Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.105–110.

DISTRIBUTION. Southeastern Ghana.

Millsonia ditheca Sims, 1965

(Figs 9F & 10F)

Millsonia ditheca Sims, 1965*a*: 296.

DIAGNOSIS. Spermathecal pores single, mid-ventral in furrows 7/8/9; male pores paired *xviii*, prostatic pores, inconspicuous, closely paired *xvii* and *xix*; female pore single, mid-ventral $\frac{1}{3}$ *xiv*; paired papillae mainly in setal line *b* in furrows 15/16/17 and *c* in furrow 19/20, occasionally in *a* on segment *viii* and within the genital field; eight pairs of intestinal caeca, *xxvii–xxxiv*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 128–154 mm, diameter 4·5–5 mm. Segments 264–342; tetrannulate in the pre-clitellar region, triannulate in the post-clitellar region. First dorsal pore (10/12) 11/12. Clitellum *xiii–xvii*, saddle-shaped extending ventrally nearly to setal line *d*. Male pores (not seen, *xviii*) discharge into paired grooves passing between inconspicuous, closely paired prostatic pores opening in setal line *a* on segments *xvii* and *xix*. Female pore single, mid-ventral $\frac{1}{3}$ *xiv*.Spermathecal pores single, mid-ventral in furrows 7/8/9, simple. Papillae closely paired in furrows 15/16/17 in setal line *b* and widely paired in furrow 19/20 in setal line **c**; adventitious papillae common ventrally on the spermathecal segments when sometimes paired in setal line *a*, similarly additional paired papillae often present on segments *xvii* and *xix* medially to the seminal grooves. Raised transverse ridges variably present on segments *xxi–xxii*, largest anteriorly, seldom extending beyond setal line *d*.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 7 : 1 : 4 : 1$ where $dd =$ three-quarters of the body circumference (in the pre-clitellar region the setae are more ventrally situated due to a reduction in setal distances *aa* and *bc*.).

Internal characters. Septa 4/5—10/11 thickened, 11/12 and 12/13 less so. Gizzards strongly muscularized and of equal size. Intestinal caeca, eight pairs present *xxvii–xxxiv*. Prostates paired *xvii* and *xix*, loosely coiled. Spermathecae single in *viii* and *ix*, adiverticulate with the ampulla and duct of about equal length. Nephridia, meronephridia present throughout the body in addition to a single pair of holonephridia in each intestinal segment.

TYPE LOCALITY. Tafo, southeastern Ghana.

MATERIAL EXAMINED. *Previously recorded*. 2C 19A Under cocoa trees, Tafo (6°15′N. 0°20′W.), southeastern Ghana; coll. M. Tazelaar, 26 Oct. 1955; BM(NH) 1964.2.170–188 & 227–232 (holotype and paratypes of *Millsonia ditheca*).
New records. 3C Under grass cuttings, Tafo (6°15′N. 0°20′W.), southeastern Ghana; coll. M. Tazelaar, 1956; BM(NH) 1964.2.233–235.

DISTRIBUTION. Tafo, southeastern Ghana.

Millsonia ghanensis Sims, 1965

(Figs 9C & 10C)

Millsonia ghanensis Sims, 1965*a*: 293.

DIAGNOSIS. Spermathecal pores paired $\frac{3}{4}$ *vii* and $\frac{3}{4}$ *viii* across setal lines *ab*; male pores paired *xviii*,

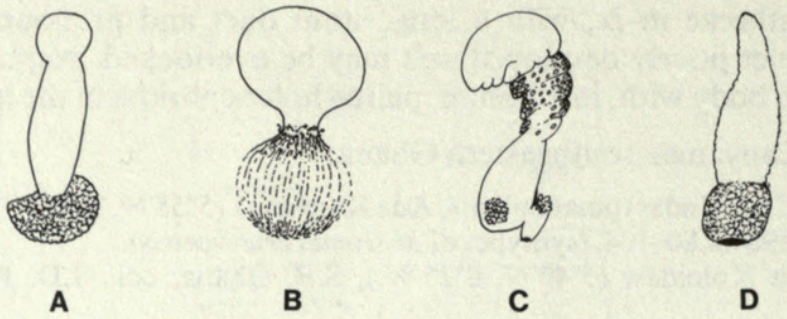

Fig. 4 Spermathecae (not to scale) of *Millsonia* spp. with spermathecal pores in furrow 8/9, meronephridia only present (holonephridia absent). (A)*sokodeana*; (B)*nigra*; (C)*ashantiensis*; (D)*mima*.

prostatic pores paired *xvii* and *xix*; female pores within *aa* nearly $\frac{1}{2}$ *aa* apart anteriorly to the setal ring; papillose pads single, mid-ventral in furrows 9/10–16/17, papillae commonly paired often single or multiple; seven or eight pairs of intestinal setae *xxvii–xxxiii* (*xxiv*); holo- and meronephric.

DESCRIPTION. *External characters*. Length 210–387 mm, diameter 5–9 mm. Segments 262–393, anteriorly commonly biannulate with further subdivision, post-clitellar region strongly triannulate. First dorsal pore 10/11. Clitellum *xiii–xix*, saddle-shaped. Male pores paired *xviii* discharging into paired seminal grooves passing between the (paired) prostatic pores of each side in *xvii* and *xix* (location of the pores difficult to determine). Female pores paired slightly anteriorly to the setal ring of segment *xiv* located within *aa* nearly $\frac{1}{2}$ *aa* apart. Spermathecal pores near the posterior furrows of segments *vii* and *viii*, seen as transverse slits with crenulated lips across setal lines *ab*. Single, mid-ventral papillose pads occur in the furrows between the spermathecal pores and the prostatic pores, i.e. 9/10–16/17; most carry a single pair of papillae, but in the holotype the papilla is single in the first and last and four papillae are present on the pad in furrow 15/16. Mid-ventral pads may be present on the segments immediately behind the clitellum, mostly restricted to below setal line *a* but the more anterior pads may be broader and extend perhaps to setal line *c*; sometimes carrying paired papillae (specimens from the Ivory Coast).

Setae closely paired, ventral; post-clitellar setal formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$, where *dd* = two-thirds of the body circumference.

Internal characters. Septa 5/6–12/13 strongly thickened, 13/14 less so. Gizzards strongly muscularized and of equal size. Intestinal caeca, seven and sometimes eight pairs present *xxvii–xxxiii* (*xxxiv*). Prostates paired *xvii* and *xix*, highly convoluted and impinging on adjacent segments, each with a slender muscular ectal region. Spermathecae paired *viii* and *ix*, simple, clavate; adiverticulate but the duct with flattened rugose 'wings'. Nephridia: a single pair of holonephridia are present in each intestinal segment in addition to meronephridia present throughout the body.

TYPE LOCALITY. Bunso, central Ghana.

MATERIAL EXAMINED. *Previously recorded*. 8A Tafo (6°15′N. 0°20′W.), Ghana; coll. M. Tazelaar; BM(NH) 1964.2.161–168.

2C 11A Mud at the side of the R. Wiwi (tributary of the R. Oda that flows into the R. Osin), near Kumasi (6°50′N. 1°35′W.), Ghana; coll. M. Tazelaar, 2 Mar. 1956 and 21 Mar. 1956; BM(NH) 1964.2.145–160 & 216–222.

29C 3A Riveside mud, Bunso (6°12′N. 1°49′W.), Ghana; coll. M. Tazelaar, 14 May 1954; BM(NH) 1964.2.26–46 (holotype and paratypes of *Millsonia ghanensis*) & 1964.2.206–215.

87A Riverside mud, Bunso (6°12′N. 1°49′W.), Ghana; coll. M. Tazellar, 22 Feb. 1951 & 21 Feb. 1952; BM(NH) 1964.2.47–103 & 114–144.

4C 2A Between Kili and Bunso (6°12N. 1°49′W.), Ghana; coll. M. Tazelaar, 21 Feb. 1952; BM(NH) 1964.2.104–113.

1C Apapam (6°10′N. 1°35′W.), Ghana; coll. M. Tazelaar; BM(NH) 1964.2.169.

New records. 2C Savannah with palmira palms (*Borassus*), Lamto, 60 km south of Topumodi (6°32′N. 5°10′W.), southern Ivory Coast; coll. P. Lavelle; BM(NH) 1971.22.70–71.

1A Rich brownish-grey soil, grazing land, Navrongo (10°51′N. 1°03′W.), northern Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.12.20.
1C Soil in cocoa plantation, Bunso (6°12′N. 1°49′W.), central Ghana; coll. J.D. Plisko, ? date; 1984.12.21.

DISTRIBUTION. Southern Ivory Coast and southern Ghana.

REMARKS. Subadult individuals may prove difficult to identify, see *Remarks* under *M. riparia*.

Millsonia guttata (Michaelsen, 1912)

(Figs 7D & 8C)

Dichogaster inermis guttata Michaelsen, 1912: 28.
Millsonia inermis guttata: Omodeo, 1955: 221.

DIAGNOSIS. Spermathecal pores paired in setal lines *ab* in furrows 7/8/9, but in mature individuals each pair commonly located within a shallow vestibule; male pores paired *xviii* and prostatic pores paired *xvii* and *xix* with the pores of each side discharging into a (paired) longitudinal seminal groove; when the genital field is everted numerous papillae may be seen, also paired spherical processes, on *xvii* and *xix*; female pores paired on *xiv* in setal line *a* slightly anteriorly to the setal ring; ventrally a few scattered papillae may be present; a raised glandular area develops in mature individuals below setal line *a* over several post-clitellar segments; setae closely paired, frequently absent from the anteriormost segments; usually 14 (13–16) pairs of intestinal caeca *xxx*-(*xlii*) *xliii* (*xliv*, *xlv*); meronephric only.

DESCRIPTION. *External characters*. Length 175–280 mm, diameter 5–9 mm. Segments 315–489, mainly triannulate. First dorsal pore 12/13 but may be occluded together with the dorsal pores of the clitellar region. Clitellum ($\frac{1}{2}$ *xii*) *xiii–xix*, saddle-shaped. Male pores paired *xviii* discharging into paired seminal grooves that join the paired prostatic pores in *xvii* and *xix*; the genital field is contained within a copulatory pouch extending from *xvii–xix* but with the aperture confined to *xviii*, however it may become everted during killing, fixing and preserving when its papillose condition and paired spherical processes in *xvii* and *xix* are revealed. Female pores paired in (or adjacent to) setal lines *a* slightly anteriorly to the setal ring; sometimes carried on a slightly raised oval to rectangular area extending laterally to above setal line *b* with a shallow transverse groove joining the pores. Sphermathecal pores paired in furrows 7/8/9 across setal lines *ab*; in mature specimens the furrows may deepen ventrally to form shallow vestibules when the hindermost annuli of *vii* and *viii* usually become raised and seemingly more highly glandular. Papillae, only a few commonly present, usually irregularly scattered but sometimes mid-ventral. Mid-ventral glandular pads may develop below seta *a* on ten or more post-clitellar segments, mainly *xxiv–xxxiii*.

Setae closely paired, ventral; mainly uniform but anteriorly the ventral setae may be somewhat stouter than the lateral setae, while in mature individuals the lateral and the anteriormost ventral setae may be absent from the pre-clitellar region; post-clitellar setal formula $aa : ab : bc : cd = 8 : 1 : 6 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Septa 4/5–11/12 strongly thickened, 12/13 backwards delicate. Gizzards strongly muscularized and of equal size. Intestinal caeca, 13–15 pairs, commonly 14 pairs, present *xxx*–(*xlii*) *xliii* (*xliv*, *xlv*). Prostates paired *xvii* and *xix*, highly convoluted each becoming muscular ectally. Spermathecae paired *viii* and *ix*, simple, digitiform; adiverticulate. Nephridia: only meronephridia present.

TYPE LOCALITY. Atakpame, Togo.

MATERIAL EXAMINED. *Previously recorded*. 2C Atakpame (7°34′N. 1°14′E.), Togo; coll. Stockhausen, Jun. 1910; Hamburg V. 3729 (syntypes of *Dichogaster inermis guttata*).
New records. 7C 2A Volta region, eastern Ghana; coll. K. El-Duweini, Mar. 1967; BM(NH) 1968.2.6–12.

OTHER RECORDS. 5C Man (7°31′N. 7°37′W.), western Ivory Coast; Oct./Nov. 1953/4, (Omodeo, 1955: 221).

DISTRIBUTION. Southern Ivory Coast, Ghana and Togo.

Millsonia hemina Sims, 1965

(Figs 1B & 2B)

Millsonia hemina Sims, 1965*a*: 291.

DIAGNOSIS. Spermathecal pores in furrow 7/8 in setal lines *b*; combined male and prostatic pores paired on segment *xvii*; female pores paired between setal lines *a* and *b* slightly anteriorly to the setal ring; papillae common in the pre-clitellar region and transverse pads between setae *aa* in six to twelve post-clitellar segments; two pairs of intestinal caeca *xxiv* or *xxv*, occasionally (?) more posteriorly to, perhaps, *xxvi* or *xxvii*; holo- and meronephric.

DESCRIPTION. *External characters*. length 36–89 mm, diameter 1·5–3·0 mm. Segments 128–189; mostly triannulate but becoming pentannulate in the pre-clitellar segments by the subdivision of the anterior annulus. First dorsal pore 8/9, 9/10. Clitellum (*xii*) $\frac{1}{2}$ *xiii*–$\frac{1}{2}$ *xvii* (*xvii*), saddle-shaped. Male pores paired *xvii*, united with the prostatic pores to form a short oblique slit from setal line *a*

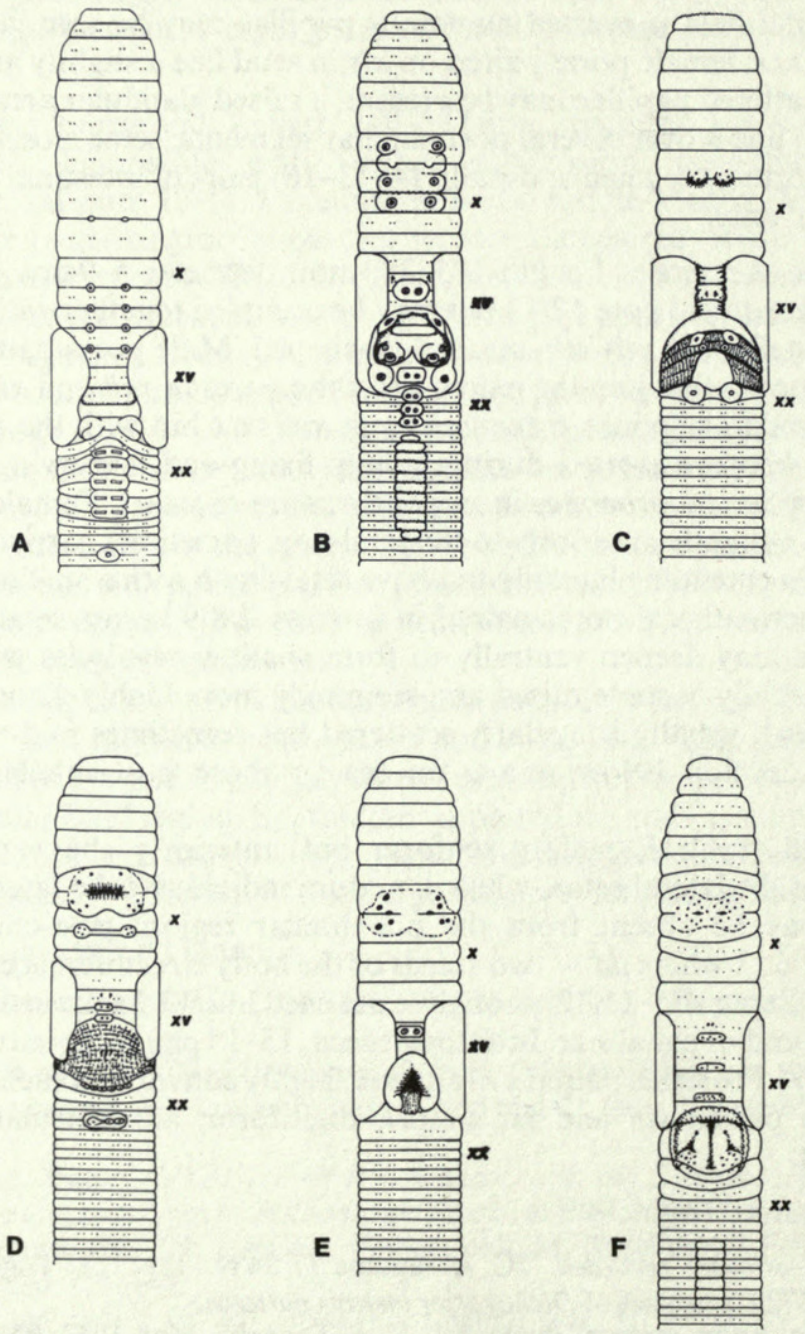

Fig. 5 *Millsonia* spp. with spermathecal pores in furrow 8/9, meronephridia and holonephridia present; anterior region, ventral view (not to scale). (A)*nota*; (B)*hortensis*; (C)*jadwigae*; (D)*moderata*; (E)*cruciventris*; (F)*artesetosa*.

crossing setal line *b* and carried on paired porophores usually encircled by several (four or five) small papillae or carried on a low transverse ridge. Female pores paired *xiv* midway between setal lines *ab* slightly anteriorly to the setal ring. Spermathecal pores paired 7/8 in setal line *b* but stretching more laterally in mature individuals. Papillae common in the pre-clitellar region near setae *ab* and sometimes joined on a low transverse ridge, occasionally papillae single on each segment, even mid-ventral; in the clitellar region paired papillae usually on *xvi* but more closely paired immediately behind the clitellum (*xviii*, *xix* and *xx*) and may be fused mid-ventrally. Ventral surface between setal lines *aa* raised to form transverse genital pads on at least segments *xxii–xxvi*, perhaps to *xx–xxxi*.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$ with *dd* approaching two-thirds the body circumference.

Internal characters. Septa 4/5–11/12 strongly thickened. Gizzards of equal size. Intestinal caeca, two pairs present, the first usually in segment *xxiv* with a second pair in *xxv*, occasionally located more posteriorly *xxvi* or *xxvii*, often the hinder pair is imperfectly developed. Prostates paired in *xvii* only, tubular, long and convoluted. One pair of spermathecae in *viii*; duct short with distal and lateral multilocular diverticula; ampulla simple, long and tubular. Nephridia; meronephridia present throughout the body with, in addition, a pair of holonephridia in each segment in the intestinal region.

TYPE LOCALITY. Apapam, southern Ghana.

MATERIAL EXAMINED. *Previously recorded*. 2C 4A Apapam (6°10′N. 1°35′W.), southern Ghana; coll. M.A. Tazelaar, ? date; BM(NH) 1964.2.20–25 (holotype and paratypes of *Millsonia hemina*).
New records. 5C 4A Kuntanasi, near Lake Bosumtwe (6°30′N. 1°25′W.), southern Ghana; coll. J.J. Niles, 8 Apr 1966; BM(NH) 1968.2.17–25.
3C Deep in mineral soil in rain forest with water pools nearby stream, Kade, Ghana; coll. M.J. Proszynscy 12 Jul. 1964; BM(NH) 1984.4.120–121.
2A Rubber plantation, Bunso (6°12′N. 1°49′W.), southern Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.118–119.
6C Cocoa plantation, Bunso, southern Ghana; coll. J.D. Plisko; date?; BM(NH) 1984.4.113–117.
2C Primary forest, Pusu-Pusu, Asiakwe Reserve, near East Akim (5°50′N. 1°10′W.), Abuakwe, southern Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.111–112.
6C Nyakrom, near Swedru on the road from Winely to Kpandu, Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.122–127.

DISTRIBUTION. Southern Ghana.

REMARKS. A variable species particularly in the presence of, and patterns formed by, the papillae both in the pre-clitellar region and in the genital field. Most specimens examined have paired papillae on the pre-clitellar segments together with discrete male porophores but sometimes the pre-clitellar papillae are single, even mid-ventral, and the male porophores are joined by a transverse ridge. These latter variants are present among the series from the Bosumtwe area. The location of the caeca can be difficult to determine depending on the fixation techniques employed by the collector, but it does seem that sometimes the caeca do occur more posteriorly, perhaps as far back as segment *xxvii*.

Millsonia heteronephra (Michaelsen, 1897)

(Figs 9A & 10A)

Benhamia heteronephra Michaelsen, 1897: 22.
Dichogaster heteronephra: Michaelsen, 1900: 365.
Millsonia heteronephra: Omodeo, 1955: 219; Omodeo, 1958: 59; Sims, 1965*a*: 299.

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 near the mid-lateral lines (i.e. above setal line *d*) each with a single antero-ventral papilla; male pores paired *xviii*, prostatic pores paired *xvii* and *xix* (in mature, preserved specimens the pores of each side are carried on laterally displaced swollen pads formed by the eversion of pouches on the left and right sides of the genital field); female pores paired at distance *ab* below setal line *a*, slightly anterior to the setal ring; paired

papillae in setal line *a* present in furrows 12/13–15/16; six or seven pairs of intestinal caeca *xxvi–xxxi* (*xxxii*); holo- and meronephric.

DESCRIPTION. *External characters*. Length 251–336 mm, diameter 6–9 mm. Segments 518–580 (? 600), multiannulate with a variable number of annuli anteriorly but triannulate behind the clitellum. First dorsal pore (10/11) 11/12. Clitellum (*xiii*) *xiv–xix* (*xx*), saddle-shaped extending ventrally to below setal line *c* but possibly to *a* anteriorly. Male pores paired *xviii*, in mature individuals they are located in genital pits or pouches that in preserved specimens may become everted; the pores can be seen above setal line *d* discharging into short lateral grooves that join paired longitudinal seminal grooves passing between inconspicuous paired prostatic pores in *xvii* and *xix*. Female pores paired *xiv*, located at distance *ab* below setal line *a* and slightly anterior to the setal ring. Spermathecal pores paired laterally above setal line *d* in furrows 7/8/9; in mature individuals tumid lips develop and a simple papilla appears antero-ventrally to each pore. Paired papillae present in setal line *a* in furrows 12/13–15/16. Raised transverse pads sometimes occur ventrally below setal line *b* on segments *xxi*, *xxii* and perhaps more.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 8 : 1 : 3 : 1$ where $dd =$ two-thirds of the body circumference.

Internal characters. Septa 5/6–10/11 very thick, 11/12 less so. Gizzards unequal with the hinder being slightly larger and more strongly muscularized. Intestinal caeca, six, usually seven pairs present *xxvi–*(*xxxi*) *xxxii*. Prostates paired *xvii* and *xix*, large and strongly convoluted, ectally with a long slender muscular region. Spermathecae paired *viii* and *ix* lying on the lateral parietes, ampulla and duct of about equal length; adiverticulate. Nephridia: one pair of holonephridia in each of the post-clitellar segments together with numerous meronephridia that also occur in the pre-clitellar and clitellar segments.

TYPE LOCALITY. Misahohe, Benim.

MATERIAL EXAMINED. *Previously recorded*. 1C (immature) 'Misahohe Station', Misahohe (6°59′N. 0°40′E.), Benim; coll. Ernst Baumann, 10 Nov. 1893; Hamburg V. 4520 (syntype of *Benhamia heteronephra*, other two syntypes originally reported, not found Zoologisches Institut und Zoologisches Museum, Universität Hamburg, September 1982).

New records. 2C (anterior fragments), 2A 1 juv. Maize plantation, Akoto Ambiente east of Bibiani (6°30′N. 2°08′W.), near the road from Kumasi, southern Ghana; coll. J.D. Plisko, 8 Jun. 1966; BM(NH) 1984.12.11–15.

DISTRIBUTION. Southern Benim and southern Ghana.

REMARKS. The outstanding feature of *M. heteronephra* is that the male genital field becomes grossly developed with the onset of sexual maturity when the male and prostatic pores are displaced laterally until the left and right sides of the field can be directly applied to the widely paired, laterally situated spermathecal pores of a partner during copulation. (The surviving syntype is immature and the male genital field is only poorly developed with the male and prostatic pores still located somewhat ventrally.)

There is a discrepancy between the morphologies of the specimens described above and Michaelsen's original description. In the specimens examined from Ghana, the location of the intestinal caeca can be established with certainty between the segments *xxvi–xxxi*, whereas Michaelsen recorded their presence in *xxxvi–xli*, i.e. ten segments more posteriorly. (Although he recorded six pairs of caeca, he stated that seven pairs were present and, in 1900, he commented that there may be one or two pairs more.) Unfortunately, the anterior intestine with the caeca has been removed from the surviving syntype so the discrepancy cannot be resolved.

However, I am of the opinion that on this occasion a *lapsus calami* occurred and that Michaelsen made a clerical error. His description, and the sole syntype, otherwise match closely the specimens from Akoto Ambiente. In any case, the location of the caeca recorded by Michaelsen would be far more posterior than is usual among other species where the caecal series commonly begins in or nearby segment *xxvi*. If new material should be discovered with caeca located as described by Michaelsen, then clearly the identity of the present series and the relationship with the new material will need careful appraisal.

Millsonia hortensis sp. nov.

(Figs 5B & 6B)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 in setal line *b*; combined male and prostatic pores paired on segment *xvii*; female pores paired between setal lines *a* and *b* anteriorly to the setal ring; papillae widely paired near to setal line *b* on segments *viii–x*, *xvi* and *xviii*, closely paired on a mid-ventral pad in each of furrows 14/15, 18/19 20/21, 21/22 and on segment *xviii*; four or five pairs of intestinal caeca (either or both the first and last pair may be greatly reduced in size) *xxvi–xxx*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 142–252 mm (88 mm regenerating), diameter 4–5 mm. Segments 212–272 (111 regenerating); triannulate, caudal region slightly swollen. First dorsal pore in furrow 9/10 or 10/11. Clitellum *xiii–xvii*, saddle-shaped. Male pores paired combined with the prostatic pores above setal line *b* on *xvii*, each is carried on a porophore and seen as a transverse slit with flap-like lips, the posterior lip in particular being more fully developed. Female pores paired on *xiv* where they are located anteriorly to the setal ring between setal lines *a* and *b*. Spermathecal pores paired in furrow 8/9 in setal line *b*. Papillae paired on segments *viii–x*, *xvi* and *xviii* nearby or slightly above setal line *b*, each on a raised circular glandular area; raised mid-ventral pads each with two, closely paired, papillae in furrows 14/15, 18/19, 20/21, 21/22 and on segment *xviii*. Mid-ventral surface heavily pigmented and glandular between setal lines *aa* over segments (*xxiii*, *xxiv*) *xxv–xxxii* (*xxxiii*).

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 6 : 1 : 4 : 1$ where $dd =$ two-thirds of the body circumference.

Internal characters. Septa 4/5–11/12 strongly muscularized. Gizzards highly muscular and of equal size. Four to five pairs of intestinal caeca present in *xxvi–xxx*, the first and/or the last pairs may be reduced in either diameter or length. Prostates, single pair highly convoluted lying mainly in *xviii* ectally with a muscular duct that passes forwards into the ventral parietes of *xvii*. Spermathecae paired in *ix*, duct long and stout with a large distal ampulla, diverticulum multiocular located midway along the duct; the duct may be convoluted or lead across the segment so that the ampulla of the right spermatheca may lie against the lateral parietes of the left side and *vice versa* the ampulla of the left spermatheca lie by the right parietes. Nephridia: meronephridia present throughout the body with a single pair of holonephridia additionally present in each segment throughout the intestinal region.

TYPE LOCALITY. Botanic Garden, Aburi, southern Ghana.

MATERIAL EXAMINED. 4C Botanic Garden, Aburi (5°50′N. 0°11′W.), southern Ghana; coll. J.D. Plisko, date? BM(NH) 1984.4.128–131 (syntypes of *Millsonia hortensis*).

DISTRIBUTION. Known only from the type locality.

Millsonia inermis (Michaelsen, 1892)

(Figs 7C & 8E)

Benhamia inermis Michaelsen, 1892: 209; Beddard, 1895:568.
Dichogaster inermis: Michaelsen, 1900: 366; Michaelsen, 1937: 501.
Dichogaster inermis typica Michaelsen, 1912: 28.
Millsonia inermis: Omodeo, 1958: 59; Sims, 1965*a*: 299.

DIAGNOSIS. Spermathecal pores paired by the posterior borders of segments *vii* and *viii* ('7/8/9'), in adults each pair opens into a median vestibule whereas in subadults they are superificial and located slightly above setal line *b*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix* within a deeply invaginated male field; female pores paired within *aa* about distance $\frac{1}{2}$ *ab* below *a* and somewhat anterior to the setal ring; paired papillae usually present slightly above setal line *b* by the posterior borders of segments *ix–xxiii*, in subadults additional paired papillae often medially to the spermathecal pores; usually 14 pairs of intestinal caeca present, occasionally less perhaps 11 pairs (*xxviii*, *xxix*) *xx–xl* (*xli*, *xlii*, *xliii*); meronephric only.

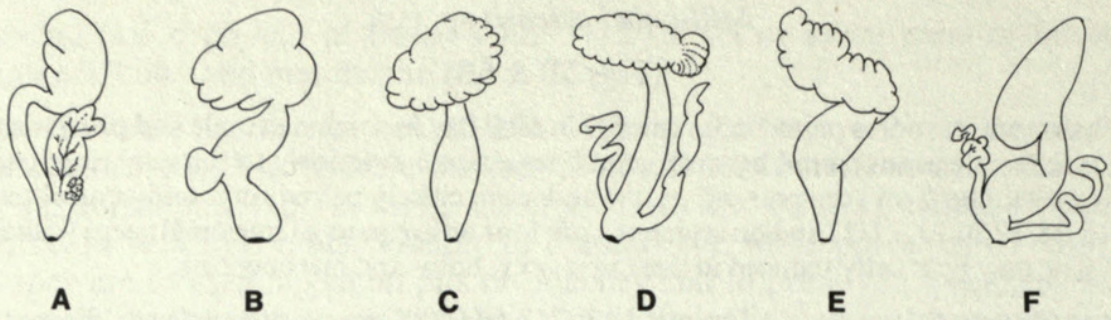

Fig. 6 Spermathecae (not to scale) of *Millsonia* spp. with spermathecal pores in furrow 8/9, meronephridia and holonephridia present. (A)*nota*; (B)*hortensis*; (C)*jadwigae*; (D)*moderata*; (E)*cruiciventris*; (F)*artesetosa*.

DESCRIPTION. *External characters*. Length 123–364, diameter 4–10 mm. Segments 365–384 (regenerating individuals common but 384 segments in one aclitellate, (?) juvenile 123 mm long), mainly triannulate but further subdivision common in the pre-clitellar region. First dorsal pore 12/13 (13/14) occasionally occluded in the clitellar region when the first dorsal pore occurs at the posterior border of the clitellum. Clitellum *xii–xix*, saddle-shaped. Male pores paired *xviii* discharging into paired seminal grooves joining the paired prostatic pores in *xvii* and *xix*; in fully mature specimens the seminal grooves are hidden within a deeply invaginated genital field but in subadults the grooves may be seen lying between setal lines *b* and *c*. The genital field is encircled by a raised rim with a single median anterior papilla and paired posterior papillae, within the invagination two pairs of papillae may often be seen lying medially to the seminal grooves. Female pores paired *xiv* within *aa* about distance $\frac{1}{2}$ *ab* from *a* located slightly anteriorly to the setal ring. Spermathecal pores paired in the hinder regions of segments *vii* and *viii* in the anterior walls of furrows 7/8/9 about distance *ab* above setal line *b*; two pairs of associated papillae commonly present on each of segments *vii* and *viii*, the first pair are located at the same level as the spermathecal pores but lie within *aa* while the second pair are adjacent but located more anteriorly and medially. Paired papillae usually present near the posterior borders of most of segments *ix–xxii* (except in the genital field) lying slightly above the setal line *b*, sometimes the papillae may be multiple.

Setae closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$ where $dd =$ two-thirds of the body circumference. Setae in the clitellar region often with the setal couples on raised genital tumescences.

Internal characters. Septa 4/5–11/12 greatly thickened, 12/13 and 13/14 less so. Gizzards strongly muscularized and of equal size. Intestinal caeca 14 pairs present sometimes fewer (11) located (*xxviii*, *xxix*) *xxx–xl* (*xli–xliii*), the posteriormost three pairs are commonly shorter and arise more laterally. Prostates paired *xvii* and *xix* highly convoluted with a slender muscular portion ectally; the hinder pair are commonly smaller than the anterior pair. Spermathecae paired *viii* and *ix*, basically digitiform but the distal part may be slightly dilated to form an ampulla-like swelling; adiverticulate. Nephridia: only meronephridia present.

TYPE LOCALITY. Adeli, Togo.

MATERIAL EXAMINED. *Previously recorded*. 1C Kete Krachi (7°47′N. 0°50′W.), eastern Ghana; coll. Mischlich, ? date; Hamburg V. 7639 (Michaelsen, 1912: 28).
2C Korle Bu, Accra (5°33′0°15′W.), southern Ghana; coll. S.F. Woodward, Jun 1934; BM(NH) 1935.2.8.1–2 (Michaelsen, 1937: 501).
New Records. 40C 6A Rich brownish-grey soil, pasture, Nvarongo (10°51′N. 1°03′W.), northern Ghana; coll. M.J. Proszynscy, 27, 28 Aug 1963; BM(NH) 1984.4.348–395.
5C 2A Near Bolgatanga (10°44′N. 0°53′W.), beside road to Bawku, northern Ghana; coll. M.J. Proszynscy, 19 Jun 1964 (at the beginning of the rainy season); BM(NH) 1984.4.132–138.
22C 11A Meadow of the Agricultural Station, Koissena Nankani, Nuwronga (10°10′N. 0°05′W.), northeastern Ghana; coll. J.D. Plisko, 24 Aug 1965; BM(NH) 1984.4.283–315.
5C Field of maize, South Mampressi, Wale-Wale (10°20′N. 0°45′W.), beside road from Tamale to Bolgatanga, northern Ghana; coll. J.D. Plisko, 23 Jul 1965; BM(NH) 1984.4.176–180.

20C 2A Field of maize adjoining road, south Mampressi, Wale-Wale (10°20′N. 0°45′W.), between Tamale and Bolgantangi, northern Ghana; coll. J.D. Plisko, 23 Aug 1965; BM(NH) 1984.4.189–210.
1C Agricultural Station, Ejura (7°23′N. 1°15′W.), west central Ghana; coll. J.D. Plisko, 16 Aug 1966; BM(NH) 1984.4.172.
1C 1A By the river, north of Ejura (7°23′N. 1°15′W.), west central Ghana; coll. J.D. Plisko 17 Aug 1966; BM(NH) 1984.4.153–154.
3C 4A Picked up from the road (a.m. and noon) during dry weather, Ejura (7°23′N. 1°15′W.), west central Ghana; coll. J.D. Plisko, 9 Nov 1966; BM(NH) 1984.4.341–347.
4C Field, Ejura (7°23′N. 1°15′W.), west central Ghana; coll. J.D. Plisko, Feb 1967; BM(NH) 1984.4.185–188.
2C Campus, 'Prempeh College' (= University of Science and Technology), Kumasi (6°50′N. 1°35′W.), central Ghana; coll. W. Bellfield, 16 Oct 1957; BM(NH) 1983.41.1–2.
2C 1A By the Abu River, Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.173–175.
1C Garden, Kpeve (6°40′N. 0°20′E.), Volta region, southeastern Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.181–182.
2C 1A Soil under oil palm trees, Kpeve (6°40′N. 0°20′E.), Volta region, southeastern Ghana; coll. J.D. Plisko, date ?: BM(NH) 1984.4.139–141.
4C 2A Roots of a plant beside a stream, Edward Han (6°24′N. 1°32′W.), central Ghana; coll. J.D. Plisko, 25 Aug. 1965; BM(NH) 1984.4.142–147.
1C Kpong (6°11′N. 0°09′E.), southeastern Ghana; coll. J.J. Niles, 18 Jul 1964; BM(NH) 1965.1.1.
6C 16A Pineapple plantation, Manjia, Krombo, Agor Kotea, Kpong (6°11′N. 0°09′E.), southeastern Ghana; coll. J.D. Plisko, date ?: BM(NH) 1984.4.241–262.
8C 13A In soil of flooded paddy fields, Sugar Products Corporation, Kpong, (6°11′N. 0°09′E.), southeastern Ghana; coll J.D. Plisko, date ?; BM(NH) 1984.4.220–240.
11C 9A Rice plantation, Sugar Products Corporation, Kpong (6°11′N. 0°09′E.), southeastern Ghana; coll. J.D. Plisko, date ? BM(NH) 1984. 4.263–282.
20C 5A Ditch beside sugar cane plantation, Kpong (6°11′N. 0°09′E.), southeastern Ghana; coll. J.D. Plisko, 4 Nov 1965; BM(NH) 1984.4.316–340.
2C 2A Soil under sugar cane, Kpong (6°11′N. 0°09′E.), southeastern Ghana; coll. J.D. Plisko, 18 May 1966; BM(NH) 1984.4.168–171.
2C Soil in bush near Somanya (5°55′N. 2°05′W.), southwestern Ghana; coll. J.D. Plisko, 31 Jul 1965; BM(NH) 1984.4.155–156.
2C 7A Sugar cane plantation Yilo Krobo, Osudoku, Somanya (5°55′N. 2°05′W.), southwestern Ghana; coll. J.D. Plisko, date ?: BM(NH) 1984.4.157–165.
5C Copse on the slope of Green Hill, Legon, near the road to Achimoto (5°35′N. 0°15′E.), southern Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.148–152.
2C Soil in the bush between Legon and Achimoto (5°35′N. 0°15′E.), southern Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.183–184.
1C 1A On the surface of the soil after heavy rain, Botanical Garden, Legon (5°33′N. 0°15′E.), southern Ghana; coll. J.D.Plisko, date ?: BM(NH) 1984.4.166–167.
9C Deep in black soil under long grass and trees, south of Legon near Accra (5°33′N. 0°15′W.), southern Ghana; coll. J.M. Proszynscy, 6 Jul 1963; BM(NH) 1984.4.211–219.

OTHER RECORDS. 1C 'Adeli, near Bismarckburg, Togo' (? = near Dutukpene (8°09′N. 0°31′E.), eastern Ghana); coll. Büttner, 20 Sept 1890; Berlin 2153 (holotype of *Benhamia inermis*).
1? 'Mangu District, Togo'; coll. Thierry, 15 Mar 1899 (Michaelsen, 1912: 28).
1? Sokode (8°59′N. 1°11′E.), Togo; coll. F. Schröder, Aug 1900 (Michaelsen, 1912: 28).

DISTRIBUTION. Ghana and Togo.

Millsonia jadwigae sp. nov

(Figs 5C & 6C)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 in setal lines *ab*; combined male and prostatic pores paired on segment *xvii* discharging through porophores each with an adjacent postero-medial papilla; female pores paired within *aa*, located slightly anteriorly to the setal ring and distance 2 *ab* below seta *a*; male genital field *not* invaginated with the pores partly enclosed anteriorly by a crescentic pad on segment *xvi* and a trapezoidal pad on *xviii*; seven pairs of intestinal caeca with sometimes a supernumerary pair *xxviii–xxxiv* (*xxxv*); holo- and meronephric.

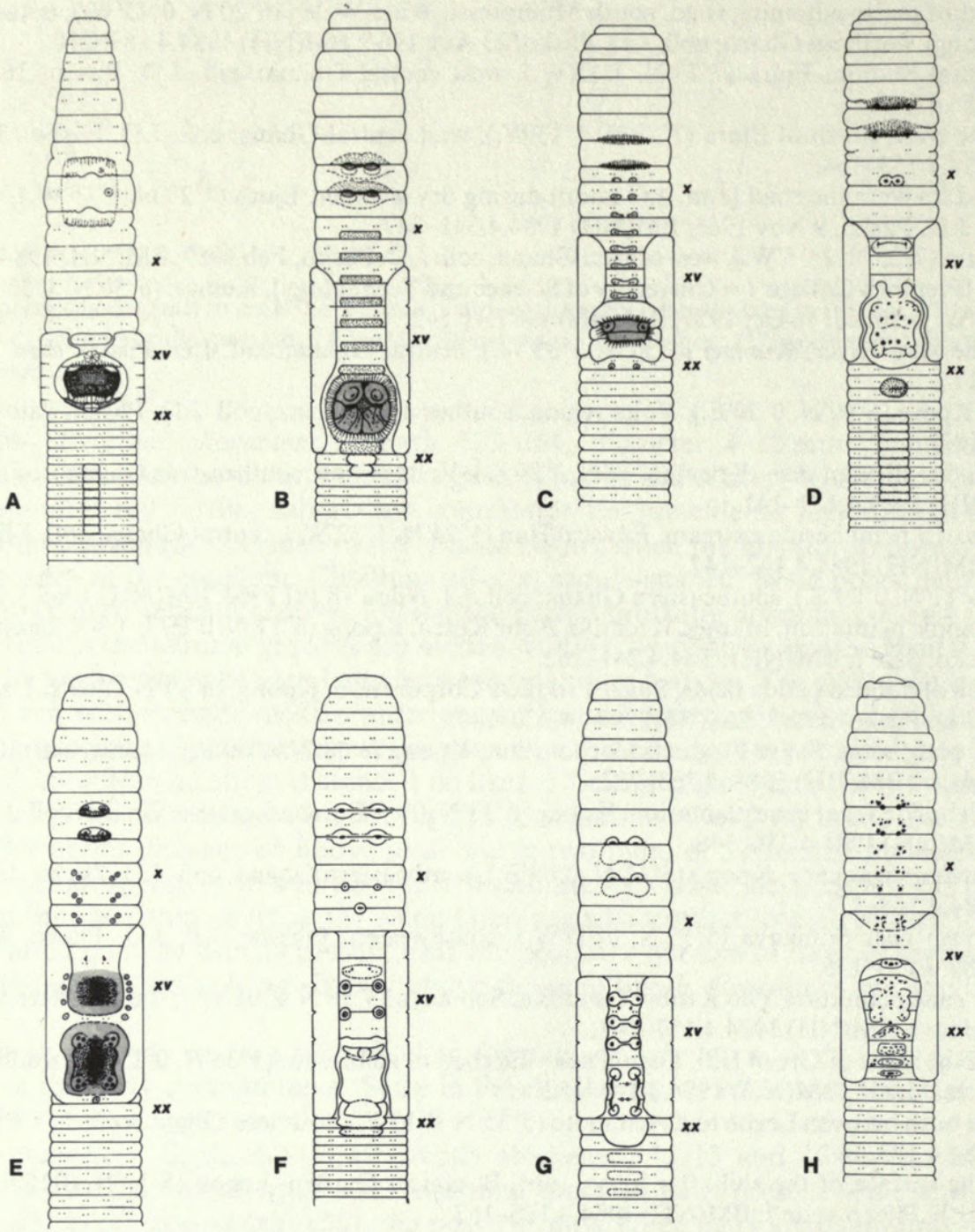

Fig. 7 *Millsonia* spp. with spermathecal pores in furrows 7/8/9 meronephridia only present (holonephridia absent); anterior region, ventral view (not to scale). (A)*nilesi*; (B)*pulvillaris*; (C)*inermis*; (D)*guttata*; (E)*centralis*; (F)*riparia*; (G)*pumilia*; (H) *caecifera*.

DESCRIPTION. *External characters*. Length 69–195 mm, diameter 5–7 mm. Segments 205–265, predominantly triannulate; caudal region commonly flattened or swollen. First dorsal pore in furrow 9/10. Clitellum *xiii*–$\frac{1}{2}$ *viii*, saddle-shaped. Male pores combined with the paired prostatic pores on *xvii*, each on a low porophore above setal line *b* and antero-lateral to a pair of small papillae. Female pores paired *xiv* within *aa* slightly anterior to the setal rin, 3*ab* apart, i.e. distance 2*ab* below setal line *a*. Spermathecal pores paired 8/9 across setal lines *ab*, commonly with paired papillae near the equators of segments *viii* and *ix* also often paired papillae in the anterior wall of furrow 8/9 obscuring the spermathecal pores. Genital field comprises the ventral region of segment *xvi* within the borders of the clitellum being raised into a crescentric pad, the anterior half of segment *xvii* with paired porophores (carrying the male and prostatic pores) and the posterior half with paired papillae slightly closer together than the porophores, the mid-ventral region of segment *xviii* is raised up into a trapezoidal pad while posteriorly segment *xix* is swollen with a pair of papillae

about the same distance apart as the porophores on *xviii*. Other post-clitellar genital markings occur as raised transverse pads between setal lines *aa* on segments (*xxiii*) *xxiv–xxx* (*xxxi*).

Setae closely paired, ventral, commonly absent from some or all of the pre-clitellar segments; post-clitellar formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$ where *dd* is three-quartersof the body circumference.

Internal characters. Septa 4/5–10/11 moderately thickened, septa 11/12 and 12/13 less so. Gizzards strongly muscularized but disparate in size with the posterior gizzard considerably larger. Intestinal caeca, 7, possibly 8, pairs present *xxviii–xxxiv* or *xxxv*, although the anterior cacea are clearly digitiform structures, they regress in size posteriorly and the hindermost may be difficult to discern. Prostates, single pair, long and convoluted occupying most of segments *xvii* and *xviii* with a long muscular ectal duct entering the parietes in *xvii*. Single pair of spermathecae in segment *ix*, each with a simple, long duct (diverticulum not seen) and a well-differentiated ampulla having a diameter several times greater than that of the duct. Nephridia: meronephridia present throughout the body; paired holonephridia additionally present in each segment of the intestinal region.

TYPE LOCALITY. Legon, (near the University of Legon), southeastern Ghana.

MATERIAL EXAMINED. 7A 6C Cultivated soil, near the University of Legon, Legon, S.E. Ghana; coll. J.D. Plisko, date ?: BM(NH) 1984.4.396–408 (syntypes of *Millsonia jadwigae*).
2C Expelled by heavy rain from soil under trees in the Botanical Garden Legon, S.E. Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.434–435.
1C 2A Green Hill, Legon, S.E. Ghana; coll. J.D.Plisko, 26 Jun. 1965; BM(NH) 1984.4.452–455.
20C 5A Cultivated soil in a small garden, 5 km ('3 mls') from Legon, S.E. Ghana; coll. J.D. Plisko, 16 Jul. 1965; BM(NH) 1984.4.409–433.
11C 1A Botanical Gardens, Aburi, S.E. Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.436–448.
3C Pasture with brownish-grey, rich soil, Nvaronga (10°51′N. 1°03′W.), northern Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.449–451.

DISTRIBUTION. Ghana.

REMARKS. This species is named in honour of Dr Jadwiga Danuta Plisko Winkworth, now of Durban, South Africa.

Millsonia lamtoiana Omodeo & Vaillaud, 1967

(Figs 9G & 10G)

Millsonia lamtoiana Omodeo & Vaillaud, 1967: 932.

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 over setal lines *ab*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores closely paired, midventral; double papillae on single, mid-ventral pads *xiv*, *xv*, *xvi* and (?) *xx*; 19 pairs of intestinal caeca *xxviii–xlvi*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 300 mm (415 mm Ghana), diameter 7–9 mm. Segments 293 (574 Ghana). First dorsal pore 5/6. Clitellum *xiii–xx*, saddle-shaped. Male pores paired *xviii* (not seen) discharging into paired seminal grooves that pass between paired porophores carrying the prostatic pores in setal lines *ab* of segments *xvii* and *xix*. Genital field depressed with three papillae lying obliquely laterally to the posterior porophores; becoming tessellated with maturity. Female pores closely paired by the mid-ventral line of segment *xiv*. Spermathecal pores paired across setal lines *ab* in furrows 7/8/9; as the worms mature so each furrow deepens by each pore to form at first shallow paired vestibules then later a deeper single transverse vestibule. Mid-ventral pads carrying paired papillae usually occur on the hinder surface of the segments by furrows (12/13) 13/14–15/16 and in furrows 21/22–25/26, small papillae sometimes present in furrow 19/20.

Setae very small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 6 : 1 : 5{\cdot}5 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Anterior septa greatly thickened back to 13/14. Gizzards large and highly muscularized. Intestinal caeca, 19 pairs present *xxviii–xlvi*. Prostates paired *xvii* and *xix*. Spermathecae paired *viii* and *ix*, the duct, of similar length to the ampulla, is adiverticulate and

globular in shape whereas (in the types) the ampulla bears a digitate diverticulum. Nephridia: meronephridia present throughout the body, additionally each post-clitellar segment contains a pair of holonephridia.

TYPE LOCALITY. Vicinity of Gpakobo and Singrobo, southeastern Ivory Coast.

MATERIAL EXAMINED. *New records*. 1C Maize plantation, Akoto Ambiente, east of Bibiani (6°30′N. 2°08′W.), near the road from Kumasi, central Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.12.22.

OTHER RECORDS. 3C Sandy soil in Savannah between Gpakobo and Singrobo (15 km SE of Lamto, 6°13′N. 5°02′W.), southeastern Ivory Coast; (syntypes of *Millsonia lamtoiana*,Station d'Ecologie Tropicale de Lamto).

DISTRIBUTION. Southeastern Ivory Coast and central Ghana.

REMARKS. The description and the text-figures are based on Omodeo and Vaillaud (1967).

Millsonia mima (Michaelsen, 1891)

(Figs 3D & 4D)

Dichogaster mimus Michaelsen, 1891: 212; Eisen, 1900: 226; Michaelsen, 1900: 367.
Millsonia mima: Michaelsen, 1895: 31.
Millsonia mimus (sic): Omodeo, 1958: 59; Sims, 1965*a*: 299.
Millsonia rubens Beddard, 1894: 382; Beddard, 1895: 480.

DIAGNOSIS. Spermathecal pores paired in furrow 8/9, superficial by setal line *c*; combined male and prostatic pores paired on segment *xvii*, superficial, simple, located above setal line *b*; female pores paired by setal line *a* slightly anteriorly to the setal ring of *xiv*; papillae absent; clitellum extending posteriorly to *xxi* or *xxii*; 32 pairs of intestinal caeca beginning in *xxviii*; paired copulatory pouches absent; meronephric only.

DESCRIPTION. *External characters*. Length 320, 400 mm, diameter 12, 13 mm. Segments 350, 363, mainly biannulate. First dorsal pore in furrow 4/5. Clitellum *xiii–xxi*, $\frac{1}{2}$ *xxii*, saddle-shaped. Male pores combined with the prostatic pores, paired *xvii*, simple, superificial, located above setal line *b*. Female pores paired *xiv* in or adjacent to setal lines *aa*, situated about distance *ab* anteriorly to the

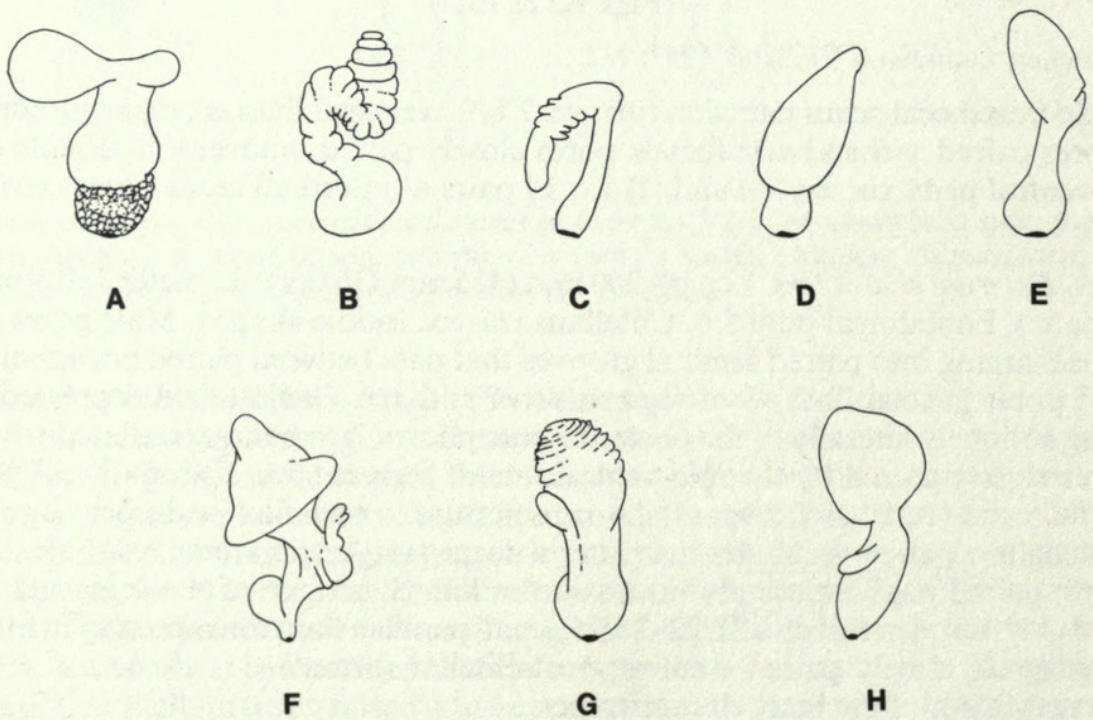

Fig. 8 Spermathecae (not to scale) of *Millsonia* spp. with spermathecal pores in furrows 7/8/9, meronephridia only present (holonephridia absent). (A)*nilesi*; (B) *pulvillaris*; (C) *guttata*; (D)*centralis*; (E)*inermis*; (F)*pumilia*; (G)*riparia*; (H)*caecifera*.

setal ring. Spermathecal pores superficial, simple paired 8/9 by setal line *c*. Papillae absent. Colour in life: pre-clitellar region violet grey, clitellum pale brown, post-clitellar region laterite (brick) red.

Setae closely paired, ventral; may be absent from the pre-clitellar region; post-clitellar formula *aa* : *ab* : *bc* : *cd* : = 6 : 1 : 4 : 1 where *dd* = three-quarters of the body circumference.

Internal characters. Septum 4/5 thickened, 5/6–8/9 delicate but 9/10 thickened with successive septa to 16/17 becoming progressively more membranous. Gizzards large, strongly muscularized. Intestinal caeca 32 pairs *xviii–lix*. Prostates single pair highly convoluted with ectally a long, coiled slender muscular portion entering the parietes in *xvii*. Single pair of spermathecae in *ix*, each with a slender ampulla leading from a stout adiverticulate duct with a verrucose basal area. Nephridia: meronephridia only present.

TYPE LOCALITY. 'Accra' Ghana. (This locality possibly denotes either the port of despatch to Europe or the address of the collector.)

MATERIAL EXAMINED. *Previously recorded.* 1C Accra, Ghana; Hungarian collection, ? date; Berlin 561 (holotype of *Dichogaster mimus*).
1C 'West Africa'; coll. A. Millson, ? date; BM(NH) 1904.10.5.546 (holotype of *Millsonia rubens*).

DISTRIBUTION. Ghana, possibly also Nigeria (? and Togo).

Millsonia moderata sp. nov.

(Figs 5D & 6D)

DIAGNOSIS. Spermathecal pores inconspicuous, paired in furrow 8/9 in setal line *a*; combined male and prostatic pores paired on segment *xvii*; female pores paired within *aa*, lying slightly anterior to the setal ring less than distance *ab* below *a*; paired spermathecal pores carried on a raised mid-ventral pad obliterating furrow 8/9 ventrally, paired small pads in the hinder region of *ix* and single mid-ventral pads present in furrows 14/15 and 15/16; setae small, usually absent anteriorly in mature individuals; eight pairs of intestinal caeca *xxvii–xxxiv*; holo- and meronephric.

DESCRIPTION. *External characters.* length 111–140 mm, diameter 5–6 mm. Segments 255–267, commonly triannulate tending towards a pentannulate condition anteriorly with the subdivision of the first and third annuli of the segments. First dorsal pore in furrow 11/12. Clitellum ($\frac{1}{2}$ *xii*) *xiii–xvi* ($\frac{1}{2}$ *xvii*), saddle-shaped. Male pores paired, combined with the prostatic pores on *xvii*, inconspicuous within setal lines *ab*; in mature individuals the mid-ventral surface of *xvii* may be invaginated to form a single copulatory pouch that, in preseved specimens, becomes evaginated and is seen as a raised glandular pad with posterior papillae. Female pores paired slightly anterior to the setal ring of *xiv* lying less than the distance *ab* below setal line *a*. Spermathecal pores inconspicuous, paired in furrow 8/9 in setal line *a*; the furrow is commonly obliterated mid-ventrally by a raised glandular trapezoidal to circular, papillose pad extending between $\frac{1}{2}$ *viii* and $\frac{1}{2}$ *xi* that carries the pores. Raised papillose pads commonly paired in the hinder region of segment *ix* by furrow 10/11 between setal lines, *cd* also a single, mid-ventral papillose pad often in each of furrows 14/15 and 15/16; other small papillose pads commonly in furrows (19/20) 20/21. Post-clitellar mid-ventral region often elevated and perhaps more heavily pigmented between setal lines *dd* chiefly over segments (*xxii*) *xxiv–xxxii* (*xxxiv*).

Setae small, closely paired and ventral; inconspicuous often absent from the pre-clitellar region. Setal formula *aa* : *ab* : *bc* : *cd* = 3 : 1·5 : 2 : 1 where *dd* is approximately one-fifth to one-quarter of the body circumference.

Internal characters. Only septum 5/6 is strongly muscular. Gizzards of equal size. Intestinal caeca, eight pairs *xxvii–xxxiv*. Prostates single pair, small, seldom extending beyond *xvii* and then only into the adjacent segments. Single pair of spermathecae in *ix*, each with a long, stout duct and bipartite ampulla; ectally the duct has a medial slender duct-like diverticulum and a lateral stouter but flattened diverticulum extending nearly to the level of the ampulla. Nephridia: meronephridia present throughout the body, also holonephridia in the intestinal region.

TYPE LOCALITY. Bozo-Akwamufie, Anom Akwam, eastern Ghana.

MATERIAL EXAMINED. 5C In the bush by the R. Volta at Boza Akwamufie, Anom Akwam, eastern Ghana; J.D. Plisko, date ?; BM(NH) 1984.4.479–483 (syntypes of *Millsonia moderata*).

DISTRIBUTION. Known only from the type locality.

Millsonia nigra Beddard, 1894

(Figs 3B & 4B)

Millsonia nigra Beddard, 1894: 384; Michaelsen, 1895: 31; Beddard, 1895: 480; Omodeo, 1958: 59; Sims, 1965*a*: 299; Sims, 1965*b*: 39; Omodeo, 1973: 17.
Dichogaster nigra: Eisen, 1900: 226; Michaelsen, 1900: 367; Cognetti, 1901: 2; Michaelsen, 1914*b*: 182.
Dichogaster eudrilina Cognetti, 1909: 1.
Millsonia eudrilina: Omodeo, 1958: 59; Sims, 1965*a*: 299.

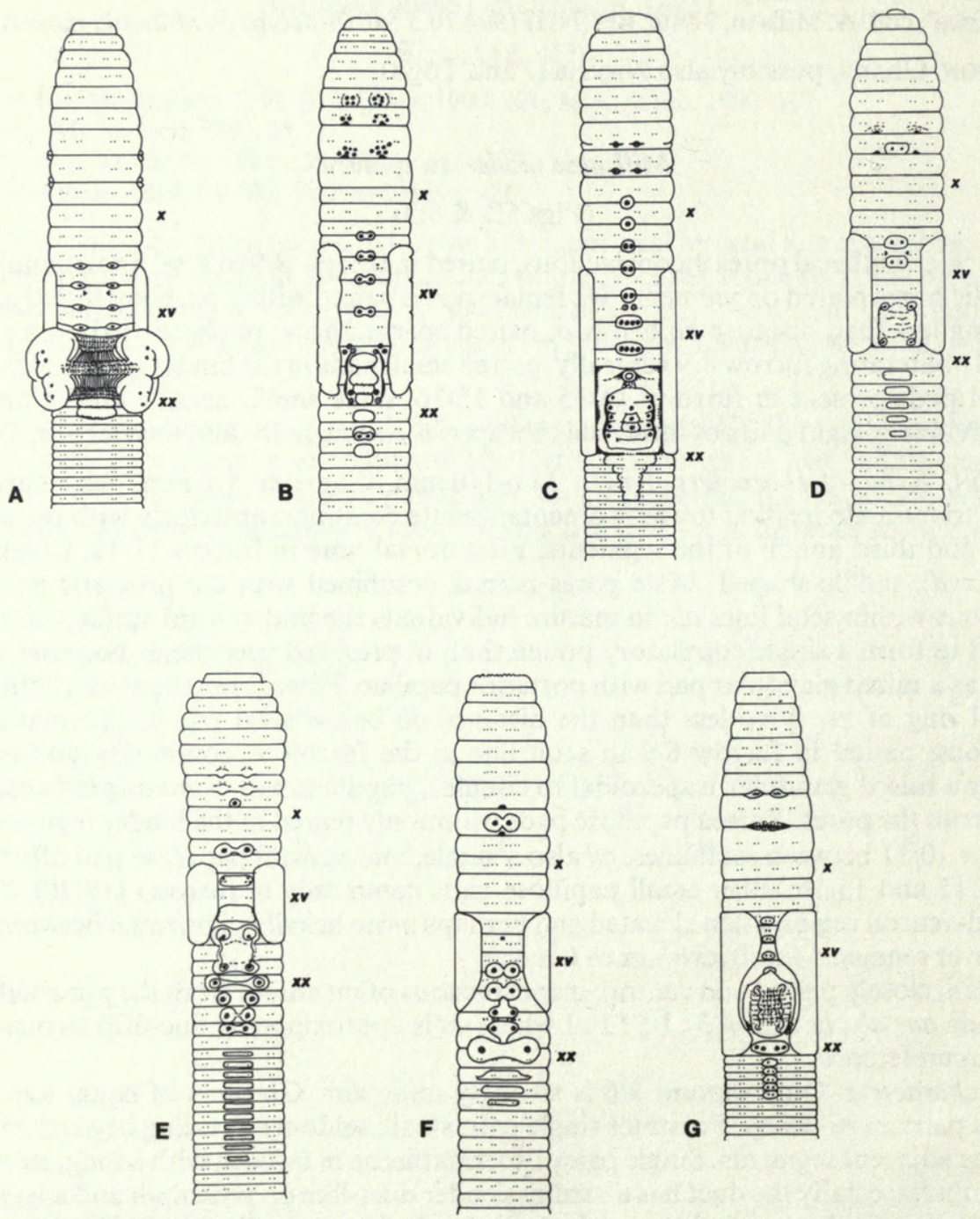

Fig. 9 *Millsonia* spp. with spermathecal pores in furrows 7/8/9, meronephridia and holonephridia present; anterior region, ventral view (not to scale). (A)*heteronephra* (male field everted); (B)*omodeoi*; (C)*ghanensis*; (D)*anomala*; (E)*brevicingulata*; (F)*ditheca*; (G)*lamtoiana*.

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 across setal lines *ab* but in adults located within a single median pouch-like vestibule; combined (paired) male and prostatic pores discharge within paired pouches with a common orifice opening *xvii*; female pores paired in the setal ring within *aa*; about distance *ab* below *a*; papillae absent; 32 (sometimes 25 to 36) pairs of intestinal caeca present; paired copulatory pouches present; meronephric only.

DESCRIPTION. *External character*. length 145–305 mm, diameter 13–14 mm. Segments 233–303, mainly triannulate but commonly tetrannulate in the pre-clitellar region. First dorsal pore in furrow 5/6. Clitellum $\frac{2}{3}$ *xiii–xviii*, anterior half annular but saddle-shaped by single male 'pore'. Male pores paired opening through paired copulatory pouches that discharge to the exterior through a large mid-ventral single orifice with striated glandular lips on *xvii* usually encroaching onto *xvi* and *xviii*. Female pores closely paired in the setal ring wihin *aa* located distance *ab* below *a*; they may lie in a pair of short, curving longitudinal striations or in a small, simple transverse groove. Spermathecal pores paired 8/9 across setal lines *ab* opening within a single mid–ventral pouch–like vestibule with crenulated lips that may extend between setal lines *cc*. Papillae absent.

Setae small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 5 : 1 : 4 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Septa 4/5–13/14 strongly muscularized, 14/15 less so. Gizzards large, of equal size. Intestinal caeca usually 32, rarely 25–36, pairs beginning *xxviii*. Prostates paired, highly convoluted in the pre-caecal segments of the anterior intestine from where they lead forward to enter the parietal wall of a massive pair of copulatory pouches in *xvii* that, with full maturity, extend into *xvi* and *xviii*. Single pair of spermathecae in *ix*, adiverticulate each with a large, simple ampulla joined by a short duct to a pouch in the parietal wall that opens to the exterior by way of the vestibule in furrow 8/9. Nephridia: only meronephridia present (Beddard, 1894: 385).

TYPE LOCALITY. Western Province, Nigeria.

MATERIAL EXAMINED. *Previously recorded*. 1A 'West Africa' (? Nigeria); coll. A. Millson, ? date; BM(NH) 1904.10.5.535 (holotype of *Millsonia nigra*).
1C Western Province, Nigeria; coll. G.A.E. Kitson, ? date; BM(NH) 1908 11.14.1. (holotype of *Dichogaster eudrilina*).
1C Ghana; coll. C.M. Ingoldby, ? date; BM(NH) 1932.5.4.13.
1C Yaba, Nigeria; coll. A.G. Taylor, ? date; BM(NH) 1937.9.20.1.
1C Ibadan, Nigeria; coll. D.S. Madge, ? date; BM(NH) 1965.23.1.
New records. 8A Under trees around Ibadan, Nigeria; coll. D.S. Madge, ? date; BM(NH) 1970.1.779–786.
1C Zoological Gardens, University of Ife, Ile-Ife, Oyo, Nigeria; coll. A.O. Segun, ? date; BM(NH) 1978.23.17.
11C 24A Land subject to flooding by the R. Volta, Brong-Ahafo region, north Bui (8°10′N. 2°20′W.), central Ghana; coll. J.D. Plisko, 14 Sept. 1965; BM(NH) 1984.4.484–519.

OTHER RECORDS. 1(?) 'Olokmejd', southern Nigeria; coll. F. Silvestri, ? date; (Michaelsen, 1914*b*; 182).
1C Kumasi, Ghana; coll. J.J. Niles, ? date; (Sims, 1965*b*: 43).

DISTRIBUTION. Ghana and Nigeria.

REMARKS. This species forms a couplet with the mainly Ghanian species *mima*, since the immature and (?) subadult individuals of *nigra* are also large worms with paired spermathecal and male pores and both species have meronephridial excretory systems. However, the adults of *nigra* are separable externally by having a large single mid-ventral male pore and a single spermathecal vestibulum, and internally by the presence of a pair of massive copulatory pouches, while the septum of the ovarian segment is muscularized and there are usually more intestinal caeca.

Millsonia nilesi sp.nov.

(Figs 7A & 8A)

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 across setal lines *ab*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix* within a single median copulatory pouch; female pore inconspicuous, single, mid-ventral in the setal ring on *xiv*; papillae commonly absent but occasionally on *xiv* where a raised pad extends to slightly beyond setal lines *bb* when the ventral setae may

be on genital tumescences; raised, glandular areas may also develop mid-ventrally over segments ½ *vii*-½ *ix* and between setal lines *aa* over segments *xxvi–xxxiii*; ventral setae slightly stouter than the lateral setae, setae closely paired; commonly 14 (sometimes 13–17) pairs of intestinal caeca (*xxvii*), *xxviii–xli*, (*xlii*, *xliii*); meronephric only.

DESCRIPTION. *External characters*. Length 90–182 mm, diameter 4–6 mm. Segments 142–198, mainly triannulate but further subdivision common especially in the pre-clitellar region. First dorsal pore 5/6. Clitellum *xiv–xix*, saddle-shaped. Male pores paired *xviii* (not seen externally) discharging into paired, longitudinal seminal grooves joining the (paired) prostatic pores in *xvii* and *xix*; the seminal grooves are located laterally in an invaginated genital field but, depending on the techniques employed to relax, kill, fix and preserve specimens, these may not be seen. The genital field is encircled by a raised glandular rim with an anterior and a posterior papilla, the field is invaginated with paired spherical to digitiform processes in *xvii* and *xix* usually partly lying under the external rim, other papillae may also occur. Female pore single, median ventral within the setal ring of *xiv*, usually inconspicuous but occasionally lying within a small transverse fold in the body wall. Spermathecal pores paired in furrows 7/8/9 lying across setal lines *ab*, the body-wall in their vicinity (from ½ *vii*–½ *ix* between setal lines *cc*) may sometimes be slightly raised also with one or two randomly arranged papillae. Apart from these papillae and those of the male field, there are no other papillae. Sometimes the ventral surface of *xiv* may be raised between the borders of the clitellum when the ventral setae may be carried by genital tumescence, while occasionally the ventral surface on *xxvi–xxxiii* between *aa* may also be raised slightly.

Setae closely paired, small, ventral couples slightly stouter than the lateral couples; post-clitellar formula $aa : ab : bc : cd = 4 : 1 : 4 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Septum 4/5 thickened, 5/6–8/9 membranous, 9/10–12/13 moderately thickened. Gizzards each with a proventricular-like anterior region and a highly muscular posterior region; both large and displaced posteriorly with the hinder gizzards lying within the parietes of *ix* and *x*. Intestinal caeca, 13–17 pairs present, usually 14 pairs full-size, (*xxvii*) *xxviii–xli* (*xlii*, *xliii*). Prostates paired *xvii* and *xix*, each is highly convoluted with slender muscular portion ectally. Spermathecae paired *viii* and *ix*, in mature individuals the basal region of the duct has a granular appearance while distally the ampulla becomes bipartite; adiverticulate. Nephridia: only meronephridia present.

TYPE LOCALITY. Suame, near Kumasi, central Ghana.

MATERIAL EXAMINED. 1C Kordie, 16 km from Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, 21 Feb. 1966; BM(NH) 1968.2.80.
2C Bouhou, 13 km from Kumasi (6°50′N. 1°35′W.) central Ghana; coll.J.J. Niles, 3 Feb. 1966; BM(NH) 1968.2.78–79.
3C Agyosa village, near Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, 16 Jun. 1966; BM(NH) 1968.2.72–74.
1C Korofrofrom, near Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, 20 Feb. 1966; BM(NH) 1968.2.81.
1C Almanj, Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, 4 Mar. 1966; BM(NH) 1968.2.75.
1C Palm-tree plantation, University of Science and Technology, Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, 12 Feb. 1966; BM(NH) 1968.2.77.
1A Campus, University of Science and Technology, Kumasi (6°50′N. 1°35′W.), central Ghana; coll. J.J. Niles, Jan. 1966; BM(NH) 1968.2.76.
1C 1A Tarkwa (6°44′N. 1°40′W.), central Ghana; coll. J.J. Niles, 30 Dec. 1965; BM(NH) 1968.2.82–83.
10C 8A Suame (6°43′N. 1°36′W.), north of Kumasi, central Ghana; coll. M.A. Dawood, 12 Nov. 1966; BM(NH) 1968.2.53–71 (syntypes of *Millsonia nilesi*).
2C Bush by Kwadaso (6°42′N. 1°39′W.), central Ghana; coll. J.D. Plisko, date ?; BM(NH) 1984.4.520–521.
1C By Lake Bosumtwe (6°30′N. 1°25′W.), central Ghana; coll. J.D. Plisko, 16 Dec. 1965; BM(NH) 1984.4.522.
2C 2A Abonn Village by Lake Bosumtwe (6°30′N. 1°25′W.), central Ghana; coll. J.J. Niles, 19 Apr. 1966; BM(NH) 1968.2.86–89.
2C Field of onions by Lake Bosumtwe (6°30′N. 1°25′W.), central Ghana; coll. J.J. Niles, 19 Apr. 1966; BM(NH) 1968.2.84–85.

DISTRIBUTION. Central Ghana.

REMARKS. The species is named in honour of Professor Joseph J. Niles of the University of the West Indies, Georgetown, Guyana, in recognition of his interest in the earthworms of the Kumasi area when he was a member of the staff at Prempeh College and later when that institution became the University of Science and Technology, Kumasi.

Millsonia nota sp. nov.

(Figs 5A & 6A)

DIAGNOSIS. Spermathecal pores in furrow 8/9 in setal line *b*; combined male and prostatic pores paired on segment *xvii*; female pores paired in the setal ring within setal lines *aa* about distance *ab* below *a*; paired papillae in furrows 10/11–13/14, mid-ventral rectangular pads in three or more successive furrows 19/20–23/24; two pairs of intestinal caeca *xxviii*, *xxix*, the anterior pair being smaller; holo- and meronephric.

DESCRIPTION. *External characters*. Length 56–72 mm, diameter 2–3 mm. Segments 179–210. First dorsal pore in furrow 8/9. Clitellum *xiii–xvii*, saddle-shaped. Male pores paired, combined with the prostatic pores on *xvii*, in *bc* about distance *ab* above *a*, located on paired porophores that are joined by a transverse ridge. Female pores paired in the setal ring on *xiv*, inconspicuous, they lie within *aa* about the distance *ab* below *a*. Spermathecal pores paired in furrow 8/9 in setal line *b*. Papillae paired in furrows 10/11/12/13/14 by setal line *b*; a single mid-ventral papilla is present in furrow 28/29 in one syntype. A transverse pad is formed from the anterior half of segment *xvi* (approaching the combined dimensions of the porophores and transverse ridge on segment *xvii*). Raised mid-ventral rectangular pads present in furrows 19/20/21/22, also perhaps 22/23/24, occupying all of the ventral surface between setal lines *bb*; each pad has a pair of slit-like transverse, pits; overall the area has a grill-like or gridiron appearance.

Setae small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 9 : 1{\cdot}5 : 5 : 1$ where *dd* = two-thirds of the body circumference.

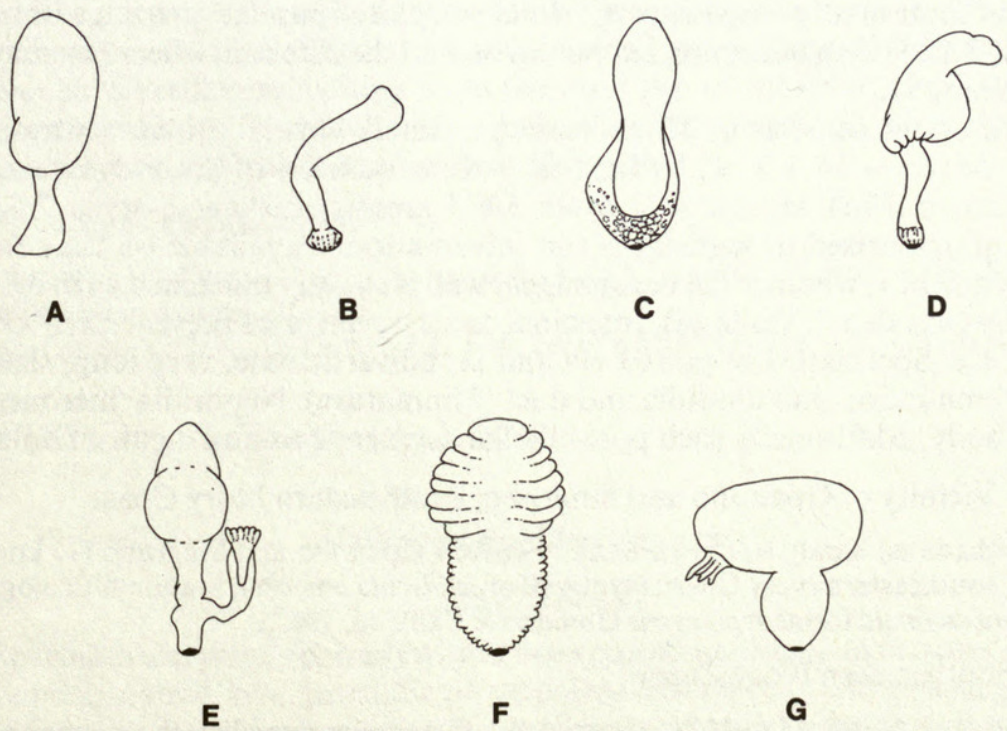

Fig. 10 Spermathecae (not to scale) of *Millsonia* spp. with spermathecal pores in furrows 7/8/9, meronephridia and holonephridia present. (A)*heteronephra*; (B)*omodeoi*; (C)*ghanensis*; (D)*anomala*; (E)*brevicingulata*; (F) *ditheca*; (G)*lamtoiana*.

Internal characters. Septa 4/5–10/11 thickened, 11/12, 12/13 less so. Gizzards strongly muscularized, of equal size. Two pairs of intestinal caeca present in *xxviii*, *xxix* with the anterior pair being small and inconspicuous. Prostates single pair, highly convoluted, lying mostly in *xviii*, ectally with a muscular duct that passes forwards into the ventral parietes of *xvii*. Spermathecae paired in *ix*, each with a long slender duct and distal ampulla, proximally there is a flattened dendritic, multilocular lateral diverticulum. Nephridia, two kinds present: meronephridia present on the parietes throughout the body and a single pair of holonephridia additionally present in each segment throughout the intestinal region.

TYPE LOCALITY. Akropong-Poana, southern Ghana.

MATERIAL EXAMINED. 2C 1A and 1A fragment (anterior region), Akropong-Poana ('New Gambia') at side of Kumasi-Dunkwas road (6°25′N. 1°40′E.), southern Ghana; coll. J.D. Plisko, date?; BM(NH) 1984.4.523–525 (syntypes of *Millsonia nota*).

DISTRIBUTION. Known only from the type locality.

Millsonia omodeoi sp. nov.

(Figs 9B & 10B)

Millsonia anomala nouvelle forme: Omodeo & Vaillaud, 1967: 929.

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 in setal line *b*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores paired in setal line *a*; numerous small, irregularly arranged papillae form clusters posteriorly on some or all of segments *vi–viii* over setal lines *ab*, paired papillae commonly present in furrows 10/11–22/23, possibly becoming segmental behind the clitellum to segment *xxv*; seven pairs of intestinal caeca *xxvi–xxxii*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 140–170 mm, diameter 4–5 mm. Segments 226–301, multiannulate. First dorsal pore 6/7. Clitellum ½*xiii–xviii*, saddle-shaped. Male pores paired *xviii* discharging into paired seminal grooves passing between the paired prostatic pores located between setal lines *ab* in *xvii* and *xix*; paired papillae often present in the genital field. Female pores paired in setal line *a*, slightly anterior to the setal ring. Spermathecal pores paired in furrows 7/8/9 in setal line *b*. Numerous papillae are irregularly arranged in clusters over setal lines *ab* on the hinder surfaces of some or all of segments *vi*, *vii* and *viii*; paired papillae present within setal lines *aa* in furrows 10/11–22/23 often becoming segmental behind the clitellum when they may extend back as far as to segment *xxv*.

Setae stated to be the same as in *M. anomala* (i.e. small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 14 : 1{\cdot}2 : 9 : 1$ where *dd* = three-quarters of the body circumference).

Internal characters. First septum 4/5, septa 5/6/7 greatly thickened, septa 7/8/9/10 less so. Gizzard highly muscularized in segment *vi* (no information is available on the condition of the oesophagus in segment *v*, whether the oesophageal wall is slightly thickened as in *M. anomala* was not made clear by Omodeo & Vaillaud). Intestinal caeca, seven pairs present *xxvi–xxxii*. Prostates paired *xvii* and *xix*. Spermathecae paired *viii* and *ix*, adiverticulate, very long, slenger, uniform without any differentiation into ampulla and duct (? immature). Nephridia: meronephridia occur throughout the body, additionally each post-clitellar segment contains a pair of holonephridia.

TYPE LOCALITY. Vicinity of Gpakobo and Singrobo, southeastern Ivory Coast.

RECORDS. 4C (? subadults) Sandy soil in savannah between Gpakobo and Singrobo (15 km SE of Lamto, 6°13′N. 5°02′W.), southeastern Ivory Coast; (syntypes of *Millsonia omodeoi*, Station d'Ecologie Tropicale de Lamto as *Millsonia anomala* forma *leptocystis* Omodeo & Vaillaud, 1967).

DISTRIBUTION. Southeastern Ivory Coast.

REMARKS. Omodeo & Vaillaud (1967) reported the four specimens listed above as representative of a new form of *Millsonia anomala* but I am of the opinion that, due to the magnitude of morphological divergence between this series and the seemingly sympatric types of *M. anomala*, the worms from Gpakobo/Singrobo represent a separate species. However, under Article 16 of the

International Code of Zoological Nomenclature (3rd edition 1985) a scientific name proposed with the term 'variety' or 'form' after 1960 is infrasubspecific and excluded from nomenclature, thus the epithet *leptocystis* proposed for the 'nouvelle forme' by Omodeo and Vaillaud is not an available name. It is necessary, therefore, to provide a name for this species which I do in honour of Professor P. Omodeo.

The two species *omodeoi* and *anomala* can be readily separated on their papillae patterns and, although *omodeoi* is a larger worm it possesses fewer intestinal caeca. The description and text-figure are based on Omodeo and Vaillaud (1967).

Millsonia oracapensis sp. nov.

(Figs 1A & 2A)

DIAGNOSIS. Spermathecal pores paired in furrow 7/8 in setal line *b*: combined male and prostatic pores paired on segment *xvii*; female pores paired between setal lines *a* and *b* slightly anteriorly to the setal ring; large, over 100 mm in length; anterior papillae confined to segments *vii* and *viii* and post-clitellar transverse pads present between setae *aa* on up to twelve segments; single pair of intestinal caeca *xxvii*; holo- and meronephric.

DESCRIPTION. *External characters*. Length 140–295 mm, diameter 5–6 mm. Segments 101 (? regenerating) –279; multiannulate (6–10 annuli) in the pre-clitellar region, mainly triannulate in post-clitellar region. First dorsal pore in furrow 6/7. Clitellum $\frac{1}{2}$ *xiii*–$\frac{1}{2}$ *xvii*, saddle-shaped. Male pores paired *xvii*, united with the prostatic pores in setal line *b* with associated papillae around the pore. Female pores paired *xiv* midway between setal lines *a* and *b* slightly anteriorly to the setal ring. Spermathecal pores paired 7/8 in setal line *b*. Papillae carried on segments *vii* and *viii* on a glandular area associated with the spermathecal pores; single large mid-ventral papilla usually occurs in furrow 15/16 while a pair of closely applied papillae lie within *aa* on *xix*. Raised transverse pads spread across the ventral surface between *aa* on segments (*xx*) *xxii*–*xxx* (*xxxii*).

Setae small, closely paired, ventral; post-clitellar setal formula $aa : ab : bc : cd =$ 6·0 : 1·25 : 3·5 : 1·0 where *dd* approaches two-thirds the body circumference.

Internal characters. Septa 4/5–11/12 strongly thickened. Gizzards large. Single pair of intestinal caeca located in segment *xxvii*. Prostates paired in *xvii*, long and convoluted (often passing through several segments) each with a long, slender, muscular ectal region. One pair of spermathecae present in segment *viii*; each spermatheca is divided into a duct and ampulla of similar length with a multiocular diverticulum issuing from the ectal end of the duct. Nephridia of two kinds; meronephridia throughout the body with a pair of holonephridia in each intestinal segment. Internally, the external large papillae have flask-like glands.

TYPE LOCALITY. Cape Coast, Ghana.

MATERIAL EXAMINED. 1C Cape Coast, Ghana; coll. K. El-Duweini 25 Feb. 1966; BM(NH) 1968.2.26 (holotype of *Millsonia oracapensis*).
3C Cape Coast, Ghana; coll. K. El-Duweini 25 Feb. 1966; BM(NH) 1968. 2.27–29 (paratypes of *Millsonia oracapensis*).

DISTRIBUTION. Known only from the type locality.

Millsonia pulvillaris sp. nov.

(Figs 7B & 8B)

DIAGNOSIS. Spermathecal pores (paired) within deep paired vestibules in furrows 7/8/9 across setal lines *ab*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix* within a single median copulatory pouch; female pores paired, inconspicuous slightly anterior to the setal ring on *xiv* lying in or slightly above setal line *a*; transverse papillose pads single or closely paired present mid-ventrally on the hinder parts of *vii*–*xvi*; setae small, closely paired; usually 14–16 pairs of intestinal caeca (*xxxvii*) *xxxviii*–*lii* (*liii*); meronephric only.

DESCRIPTION. *External characters*. Length 145–310 mm, 5–9 mm. Segments 328–410, triannulate tending towards pentannulate especially in the pre-clitellar region. First dorsal pore is located in furrow 11/12. Clitellum *xii–xix*, saddle-shaped. Male pores paired *xviii* discharge into a median copulatory pouch extending over the mid-ventrum of *xvii–xix*, also within the pouch are paired porophores in *xvii* and *xix* carrying the prostatic pores. Female pores paired in or slightly above setal line *a* of segment *xiv* where they are located a short distance anteriorly to the setal ring. Spermathecal pores paired in furrows 7/8/9 across setal lines *ab* where they are deep-set, each is located within a vestibule so that the two pairs are the same distance apart and of sufficient depth to accommodate the porophores bearing the prostatic pores. Single or closely paired papillose transverse pads extend to slightly beyond setal lines *bb* over the hinder regions of sements *vii*, *viii* (? *ix*), *x–xv*, (? *xvi*) and *xix*; the mid-ventral regions of segments *xx* and *xxi* may also be raised.

Setae closely paired, small, ventral; post-clitellar formula $aa : ab : bc : cd = 8 : 1 : 4 : 1$ where *dd* = two-thirds of the body circumference; setae are commonly absent from the more anterior of the pre-clitellar segments, especially the lateral couples.

Internal characters. Septa 4/5 onwards greatly muscularized but gradually decreasing in thickness until 12/13 which is similar to the unspecialized septa of the intestinal region. Gizzards greatly muscularized with the posterior gizzard about twice the size of the anterior gizzard. Intestinal caeca, 14–16 pairs present (*xxxvii*) *xxxviii–lii* (*liii*). Prostates paired *xvii* and *xix*, highly convoluted each with a long, slender muscular ectal portion. Spermathecae paired *viii* and *ix*, digitiform although often convuluted and frequently annulated, ectally each is dilated where it enters the vestibule; adiverticulate. Nephridia: only meronephridia present.

TYPE LOCALITY. Bole, northwestern Ghana.

MATERIAL EXAMINED. 8C 4A At the roadside by a cultivated field, Catholic mission, near Bole (9°0′N. 2°30′W.), northwestern Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.4.526–537. (syntypes of *Millsonia pulvillaris*).
2C 1A Flood level by a small river, Kwunchogaw, Tuenu (10°45′N. 2°0′W.), northern Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.4.538–540.
2C Roots of a plant beside a stream, Edward Han (6°24′N. 1°32′W.), central Ghana; coll. J.D.Plisko, 25 Aug. 1965; BM(NH) 1984.4.543–544.
2C On the surface of garden soil after rain, Somanya (5°55′N. 2°55′W.), southwestern Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.4.541–542.

DISTRIBUTION. Ghana.

Millsonia pumilia Sims, 1965

(Figs 7G & 8F)

Millsonia pumilia Sims, 1965*a*: 289.

DIAGNOSIS. Spermathecal pores paired 7/8/9 in setal line *b*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores paired distance *ab* below *a* slightly anterior to the setal ring; papillae paired in setal line *b* in furrows 13/14/15/16 also a single transverse trapezoidal pad commonly present mid-ventrally over *xx* and *xxi*; ventral setae often moderately enlarged in the clitellar region, otherwise setae small and uniform; four pairs of intestinal caeca *xxvii–xxx*; meronephric only.

DESCRIPTION. *External characters*. Length 94–120 mm, diameter 1–3 mm. Segments 193–242, tetrannulate. First dorsal pore (9/10), 10/11. Clitellum *xiii–xix*, saddle-shaped extending ventrally to above setal line *b*. Male pores (not seen) open into paired seminal grooves passing between the prostatic pores discharging from paired porophores in setal line *b* on segments *xvii* and *xix*. Female pores paired slightly anteriorly to the setal ring in *xiv* located at a distance of about *ab* below setal line *a*. Spermathecal pores paired in furrows 7/8/9 occurring in setal line *a* where the adjacent body wall is frequently swollen. Paired papillae present in furrows (10/11/12) 13/14/15/16 lying in setal line *b*; a raised trapezoidal area is seen mid-ventrally across segments *xx* and *xxi* of more mature individuals, also transverse pads often present on adjacent segments.

Setae usually small, closely paired, ventral, commonly uniform but ventral clitellar setae enlarged in fully mature individuals; post-clitellar formula $aa : ab : bc : cd = 6 : 1 : 4 : 1$ where dd = five-sevenths of the body circumference.

Internal characters. First septum 4/5, 4/5–10/11 stongly thickened, 11/12, 12/13 less so. Gizzards strongly muscularized, of equal size. Intestinal caeca, four pairs present *xxvii–xxx*, occasionally three or five on one side. Prostates paired *xvii* and *xix*, usually straight extending back perhaps to *xl*, or occasionally folded into one or two simple loops. Spermathecae paired *viii* and *ix*, the posterior pair being larger; duct ectally with a simple saccular diverticulum and entally with a pollux process, ampulla conical. Nephridia, only meronephridia present.

TYPE LOCALITY. Kumasi, central Ghana.

MATERIAL EXAMINED. *Previously recorded.* 5C Forest near Prempeh College (= University of Science and Technology), Kumasi, central southern Ghana; coll. M.A. Tazelaar, 21 March 1956; BM(NH) 1964.2.15–19 (holotype and paratypes of *Millsonia pumilia*).
New records. 2C Akropong Poanu (= 'New Gambia') (6°25′N. 1°40′E.), Amasie area, near the Kumasi-Dunkwa Road, central Ghana; coll. J.D. Plisko, ? date; BM(NH) 1984.4.545–546.
2 subadults 17 juvs Savanna, Wango-Fitini (near Bunkina Faso), northern Ivory Coast; coll. P. Lavelle, ? date; BM(NH) 1971.22.94–112.

DISTRIBUTION. (?) Northern Ivory Coast to central Ghana.

REMARKS. The specimens from the northern Ivory Coast, with poorly developed external characters due to immaturity, can only provisionally be assigned to this species.

Millsonia riparia sp. nov.

(Figs 7F & 8G)

DIAGNOSIS. Spermathecal pores paired in furrows 7/8/9 immediately above (adjacent to) setal line *b*; male pores paired *xviii*, prostatic pores paired *xvii* and *xix*; female pores paired distance *ab* below *a* slightly anteriorly to the setal ring; paired papillae near setal lines *b* present in furrows 14/15/16 sometimes also 10/11 with a single, mid-ventral papilla occasionally in 11/12; five or six pairs of intestinal caeca *xxvii–xxxi* (*xxxii*); meronephric only.

DESCRIPTION. *External characters*. Length 125–175 mm, diameter 4–6 mm. Segments 304–337, multiannulate but mainly tetrannulate in the post-clitellar region. First dorsal pore 7/8. Clitellum *xiii–xix*, saddle-shaped. Male pores paired *xviii* discharging into paired seminal grooves passing between the (paired) prostatic pores carried on porophores in segments *xvii* and *xix*; the mid-ventral area between the ventral borders of the clitellum in these segments being mostly smooth but depressed to form a sunken genital field. Female pores paired slightly anteriorly to the setal ring of segment *xiv*, located distance *ab* below setal line *a*; the ventral setae and the pores may be carried on a single transverse pad. Spermathecal pores located in furrows 7/8/9 adjacent to but immediately above setal line *b*, the walls of the furrows by the pores may be swollen to resemble porophores. Paired papillae are usually present in furrows 14/15/16 and sometimes in furrow 10/11 at about the same distance apart as the spermathecal pores; a single mid-ventral papilla is occasionally present in 11/12.

Setae closely paired, small, ventral; post-clitellar setal formula $aa : ab : bc : cd = 6 : 1 : 4 : 1$, where dd = two-thirds of the body circumference.

Internal characters. Septa 5/6–9/10 strongly thickened, 10/11 and 11/12 less so. Gizzards strongly muscularized and of equal size. Intestinal caeca, five sometimes six pairs present *xxvii–xxxi* (*xxxii*). Prostates paired *xvii* and *xix*, long and highly convoluted, impinging on adjacent segments; each with a slender muscular ectal region. Spermathecae paired *viii* and *ix*, each is clavate with a duct and an ampulla of about equal length; a small vestigial or incipient diverticulum may be seen laterally at the base of the ampulla of mature individuals. Nephridia: only meronephridia present.

TYPE–LOCALITY. Lake Bosumtwe area, southern central Ghana.

MATERIAL EXAMINED. 6A Campus, University of Science and Technology, Kumasi (6°50′1°35′W.), Ghana; coll. J.J. Niles; BM(NH) 1965.1.2–7.
C24 21A Various localities around Kumasi (6°50′N. 1°35′W.), Ghana; J.J. Niles; BM(NH) 1968.2.107–158.
4A Banks of the R. Wiwi (tributary of the R. Oda that flows into the R. Osin), near Kumasi (6°50′N. 1°35′W.), Ghana; coll. M. Tazelaar, 2 Mar. 1956; BM(NH) 1964.2.223–226.
1C 1A Suame (6°43′N. 1°57′W.), near Kumasi, Ghana; coll. J.J. Niles; BM(NH) 1968.2.159–160.
2C Cultivated field, Kwadaso (6°42′N. 1°39′W.), southern central Ghana; coll. J.D. Plisko, 1 Apr. 1966; BM(NH) 1984.12.6–7.
5C River bank, near Lake Bosumtwe (6°30′N. 1°25′W.), southern central Ghana; coll. J.D.Plisko, date? : BM(NH) 1984.12.1–5 (syntypes of *Millsonia riparia*).

DISTRIBUTION. Southern central Ghana.

REMARKS. This species is similar in size to *M. ghanensis*, and as the two species share the same damp habitat, subadult individuals can be confused. However, in addition to differences in the number of intestinal caeca, separation is made possible by the presence of indistinct traces of the paired ventral papillae in the clitellar region of *riparia* while the first dorsal pore is located more anteriorly.

Millsonia sokodeana (Michaelsen, 1912)

(Figs 3A & 4A)

Dichogaster sokodeana Michaelsen, 1912: 30.
Millsonia sokodeana: *Omodeo*, 1958: 59; Sims, 1965*a*: 299.

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 across setal lines *cd*; combined male and prostatic pores paired on segment *xvii*; female pores paired within setal lines *aa* slightly anterior to the setal ring about distance *ab* below *a*; paired papillae just above setal line *b* in furrows 15/16, 16/17, 17/18 (2 pairs), 18/19 and 19/20 while additional single, median ventral papillae are present in 16/17 and 17/18; one pair of intestinal caeca of unknown location; meronephric only.

DESCRIPTION. (Note. The unique holotype is dissected and incomplete, it is also in poor condition due to (past) maceration.)

External characters. Length ? (probably of only moderate length), diameter 4 mm. Segments? First dorsal pore (? 8/9), 9/10. Clitellum $\frac{1}{2}$ *xii–xix*, saddle-shaped. Male pores paired combined with the prostatic pores *xvii* in *b* in a shallow crescentic depression with a small papilla at both ends of the crescent. Female pores paired slightly anteriorly to the setal ring within *aa* at distance *ab* below *a*. Spermathecal pores paired in furrow 8/9 across setal lines *cd* each with two antero-medial papillae; pores joined by two low transverse ridges, one on each side of the furrow. Papillae paired slightly above setal line *b* in furrows 15/16, 16/17 and 17/18 (where there are an additional pair by *aa*), then 18/19 and 19/20; also a single median papilla in each of furrows 16/17 and 17/18. Raised mid-ventral rectangular pads occupy all of the ventral surface between setal lines *bb* on segments *xxvii–xxxi*.

Setae small, closely paired, ventral; post-clitellar formula $aa : ab : bc : cd = 6 : 1{\cdot}5 : 4 : 1$ where *dd* = two-thirds of the body circumference.

Internal characters. Septa 4/5–6/7 strongly muscularized, 7/8 and 8/9 less so. Gizzards small, of equal size. Single pair of intestinal caeca, location unknown. Prostates single pair, highly convoluted in (?) several intestinal segments each with a slender muscular duct ectally entering the parietes in *xvii*. Spermathecae paired in *ix*, each with a long duct and ectal multilocular diverticulum, ampulla small entally. Only meronephridia seen in the holotype.

MATERIAL EXAMINED. 1C (subadult) Sokode, Togo; coll. F. Schroder, 1910; ZIZM, Hamburg V. 7636 (holotype of *Dichogaster sokodeana*).

DISTRIBUTION. Known only from the type locality.

Notes on two new species of the genus *Agastrodrilus* (Octochaetidae) from Ghana

The genus *Agastrodrilus* was erected by Omodeo and Vaillaud (1967) to accommodate two new earthworms from the Ivory Coast that differed from species of the genus *Millsonia* in the reduced

sizes of the gizzards, an increase in the length of the clitellum and the large size of the ventral setae. Subsequently, Lavelle (1981) described a third species but with a clitellum extending over only segments *xiii–xix* (like the clitella of many species of *Millsonia*), but more importantly he reported predation on other small species of earthworms. He observed one individual feeding on *Stuhlmannia porifera* (Eudrilidae) by entwining itself around the worm and swallowing it head-first, like a boa constrictor consuming its prey. His observations led him to assess the adaptive significance of the characters of the genus. The reduction in the size and weak musculature of the gizzards and the absence of a typhlosole, he interpreted as adaptations to a carnivorous diet; while the large size of the ventral setae was regarded as important in the capture and retention of the prey. These three species were described from the wet savannahs of the Ivory Coast, but specimens which prove to represent two new species have been found from the forested country of southern Ghana among material of *Millsonia* reported above.

Genus ***AGASTRODRILUS*** Omodeo and Vaillaud, 1967

Agastrodrilus Omodeo & Vaillaud, 1967:925.

TYPE SPECIES. *Agastrodrilus opisthogynus* Omodeo and Vaillaud, 1967 (new designation).

DIAGNOSIS. Octochaetidae lacking penial setae; ventral setae (*ab*) large, at least in the pre-clitellar region; two simple rudimentary gizzards present in segments *v* and *vi*; lamellate calciferous glands paired on the oesophagus in segments *xv*, *xvi* and *xvii*; paired digitate intestinal caeca, one pair in each of several contiguous segments, present on the anterior intestine; typhlosole absent.

DISTRIBUTION. Ivory Coast and southern Ghana.

REMARKS. Members of this genus are remarkable not only because of their predatory behaviour but also morphologically in the case of three of the species since the locations of their reproductive systems and pores differ from those in other Octochaetidae. The two new species from Ghana described below are readily separable from the representatives of *Agastrodrilus* known from the Ivory Coast by, among other characters, the smaller number of intestinal caeca while *insolitus* sp.nov. also has the spermathecal pores situated in furrow 7/8 (see *Table 2*).

Table 2 Distinguishing characters of species of the genus *Agastrodrilus*

Prostatic pores Segment No./ Furrow	Spermathecal pores Furrow(s)	Female pores Segment No.	Intestinal caeca		Species
			No. pairs	Location	
xvii	8/9	*xiv*	8	*xxiv–xxxi*	*lavellei* sp. nov.
xvii	8/9	*xv*	19	*xlii–lx*	*opisthogynus* Omodeo & Vaillaud, 1967:926
xviii	7/8	*xiv*	5	*xxvi–xxx*	*insolitus* sp. nov.
24/25	8/9	*xxi*	24	*liv–lxxvii*	*multivesiculatus* Omodeo & Vaillaud, 1967:927
xvii + *xix*	7/8/9	*xiv* (by 14/15)	19	*xxii–xl*	*dominicae* Lavelle, 1981:254

Agastrodrilus insolitus sp. nov.

(Figs 11A & 12A)

DIAGNOSIS. Spermathecal pores paired in furrow 7/8 in setal line *b*; combined male and prostatic pores paired on segment *xviii* female pores paired *xiv* within seta lines *aa*, lying in the setal ring approximately distance *ab* from *a*; paired papillae on a single, transversely oval, mid-ventral pad

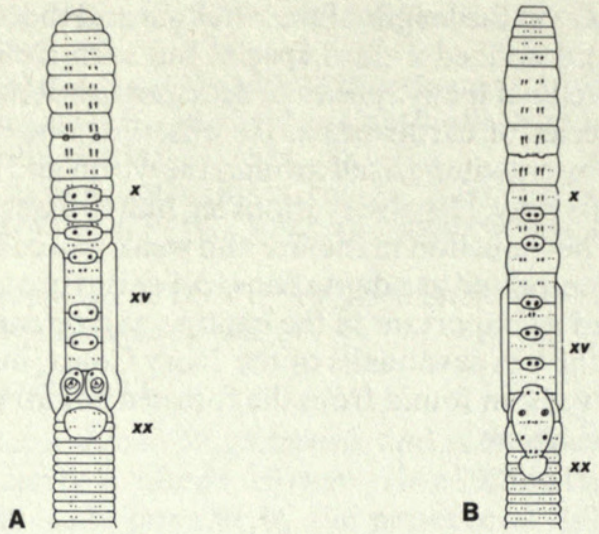

Fig. 11 *Agastrodrilus* spp. anterior region, ventral view (not to scale). (A)*insolitus*; (B)*lavellei*.

present in most furrows between the spermathecal and male pores; anteriorly setae *ab* greatly enlarged especially on segments *v*, *vi* and *vii*; five pairs of intestinal caeca *xxvi–xxx*; meronephric only.

DESCRIPTION. *External characters*. Length 71–110 mm, diameter 2·5–3·5 mm. Segments 126–249. First dorsal pore in furrow 9/10. Clitellum *xiii–*$\frac{1}{2}$ *xix*, saddle-shaped. Male pores paired united with the prostatic pores *xviii* slightly above setal line *b*, each located on a low porophore. Female pores paired in the setal ring of *xiv* within setal lines *aa*, each located about distance *ab* from *a* thus lying a little more than distance *ab* part. Spermathecal pores paired 7/8 in setal line *b*. Papillae paired in furrows 10/11–16/17 within *aa*, each pair on a raised oval pad extending above setal lines *b*; raised pads occasionally present within the ventral setae on segments *xx*, *xxi*.

Setae *ab* becoming progressively enlarged until long and stout on segments *v*, *vi*, *vii* and at the same time becoming more distant with the setal formula of $aa : ab : bc : cd = 5 : 4 : 7 : 1$ on *vii*, whereas setae *cd* on the same segments are small or absent; behind the clitellum setae small and uniform with the setal formula $aa : ab : bc : cd = 9 : 1 : 7 : 1$ where *dd* is three-quarters to three-fifths the body circumference.

Internal characters. Septa 4/5–9/10 strongly thickened, 10/11 and 11/12 less so. Gizzards small, weakly muscularized. Intestinal caeca five pairs *xxvi–xxx*. Prostates single pair, very long and convoluted passing through several segments, ectally becoming muscular and passing into the parietes in *xix*. Single pair of spermathecae discharging posteriorly in *vii*, each somewhat T-shaped. The duct, or lower, vertical limb of the 'T', is broad with a lateral diverticulum containing a system of branching ducts (more dendritic than racemose), while the ampulla representing the upper, horizontal portion of the 'T', has a long, main (medial) chamber and a small, subsidiary (lateral) chamber. Nephridia: meronephridia only present.

TYPE LOCALITY. Ada Kanyanga, southeastern Ghana.

MATERIAL EXAMINED. 18C Soil under tomato plants, Ada Kanyanga (5°55′N. 0°05′W.), S.E. Ghana; coll. J.D. Plisko, date? BM(NH) 1984.4.27–45 (syntypes of *Agastrodrilus insolitus*).
4C Cultivated field, Ada Koloidaw (5°40′N. 0°25′W.), S.E. Ghana; coll. J.D. Plisko, date? BM(NH) 1984.4.48–52.
2C By a ditch, sugar cane plantations, Kpong (6°11′N. 0°09′E.), S.E. Ghana; coll. J.D. Plisko, date? BM(NH) 1984.4.46–47.

DISTRIBUTION. S.E. Ghana.

Agastrodrilus lavellei sp. nov.

(Figs 11B & 12B)

DIAGNOSIS. Spermathecal pores paired in furrow 8/9 within setal lines *ab*; combined male and

Fig. 12 Spermathecae (not to scale) of *Agastrodrilus* spp. (A)*insolitus*; (B)*lavellei*.

prostatic pores paired *xvii*; female pores paired *xiv* slightly anteriorly to the setal ring within setal lines *aa* about $\frac{1}{3}$ *aa* apart; paired papillae on a single, transversely oval, mid-ventral pad in two pre-clitellar and a further two clitellar furrows; setae *ab* greatly enlarged in the pre-clitellar region, eight pairs of intestinal caeca *xxiv–xxxi*; meronephric only.

DESCRIPTION. *External characters*. Length 80–132 mm. diameter 2·5–3·0 mm. Segments 216–289, multiannulate in the pre-clitellar segments, (up to nine annuli per segment) commonly only tri-annulate in the post-clitellar segments. First dorsal pore (9/10) 10/11. Clitellum $\frac{1}{2}$ *xiii*–$\frac{1}{2}$ *xvii*, saddle-shaped. Male pores paired on *xvii* in setal line *b*. Female pores paired on *xiv* slightly anterior to the setal ring within setal lines *aa* about $\frac{1}{3}$ *aa* apart. Spermathecal pores paired in furrow 8/9 located between setal lines *ab*. Paired papillae immediately within setal lines *aa* in furrows 10/11, 11/12, 14/15 and 15/16, each pair on a raised, transversely oval pad lying ventrally between *bb*, other papillae in the genital field (16/17, 17/18, 18/19) are similarly located nearly *aa* apart but the furrows are obliterated and an additional pair occur at *bb* on *xviii*. The genital field is usually seen as a raised scutate, glandular area, but in older individuals it may become invaginated. A further raised, glandular pad may occur ventrally between setae *bb* on segment *xx* and sometimes encroach onto the adjacent segments.

Setae in the pre-clitellar segments somewhat widely paired where *ab* are long and stout with the setal formula on segment *ix* being $aa : ab : bc : cd = 3 : 2 : 3 : 1$; post-clitellar setae closely paired, small and uniform, setal formula $aa : ab : bc : cd = 6 : 1 : 4 : 1$ where *dd* approximates to two-thirds of the body circumference.

Internal characters. Septa 4/5–10/11 strongly thickened, 11/12 and 12/13 less so. Gizzards small, weakly muscularized. Intestinal caeca eight pairs located *xxiv–xxxi*. Prostates paired, tubular, long and convoluted extending through several segments, ectally with a long, muscular duct that enters the ventral parietes in *xvii*. Single pair of spermathecae in *ix* discharge anteriorly into furrow 8/9; proximally each has a rotund, globular duct bearing a small ectal multilocular diverticulum and distally there is a wrinkled, duct-like ampulla with a diameter about one-third that of the duct. Circular, flask-like pads are present in the parietal wall internally to the external papillae. Nephridia: meronephridia only present.

TYPE LOCALITY. Near Achimota, Ghana.

MATERIAL EXAMINED. 13C Bush near Achimota, S.E. Ghana; coll. J.D. Plisko, date? ; BM(NH) 1984.4.456–467 (syntypes of *Agastrodrilus lavallei)*.
4C Bush near Achimota, S.E. Ghana; coll. J.D. Plisko, date ? ; BM(NH) 1984.4.468–471.
5C 1A Green Hill, Legon, Achimota, S.E. Ghana; coll. J.D. Plisko 26 Jun 1965; BM(NH) 1984.4.473–478.
1C 'S.E. Ghana'; coll. J.D. Plisko, date ?; BM(NH) 1984.4.472.
1C Bodonya, New Achimota Village, S.E. Ghana; coll. J.J. Niles, date ?; BM(NH) 1968.2.30

DISTRIBUTION. Around Achimota (5°35′N. 0°15′E.), S.E. Ghana.

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References

Beddard, F.E. 1888. On certain points in the structure of *Urochaeta E.P. and Dichogaster* nov. gen. with further remarks on the nephridia of earthworms. *Quarterly Journal of Microscopical Science* **29:** 235–282.

—— 1894. On two new genera, comprising three new species, of earthworms from western tropical Africa. *Proceedings of the Zoological Society of London* **1894:** 379–390.

—— 1895. *A monograph of the order Oligochaeta* pp. i–vii, 1–769. Oxford: Clarendon Press.

—— 1900. On a species of earthworm from western tropical Africa, belonging to the genus *Benhamia*. *Proceedings of the Zoological Society of London* **1900:** 167–173.

Benham, W.B. 1894. On *Benhamia caecifera* n. sp., from the Gold Coast. *Quarterly Journal of Microscopical Science* (N.S.) **37:** (145) 103–112.

Cognetti de Martiis, L. 1909. Un nuovo *Dichogaster* Africano. *Bollettino del Musei di Zoologia ed Anatomia Comparata della R. Università di Torino* **24:** (599): 1–3.

Eisen, G. 1900. Researches in American Oligochaeta with especial reference to those of the Pacific coast and adjacent islands. *Proceedings of the California Academy of Sciences* Ser. 3 (Zoology) **2:** 85–276.

Gates, G.E. 1959. On a taxonomic puzzle and the classification of the earthworms. *Bulletin of the Museum of Comparative Zoology, Harvard* **121:** 229–261.

Horst, H. 1884. On two new species of the genus *Acanthodrilus* Perr. from Liberia. *Notes of the Leyden Museum* **6:** 103–107.

Lavelle, P. 1971. Recherches ecologiques dans la savane de Lamto (Côte d'Ivorie): production annuelle d'un ver de terre *Millsonia anomala* Omodeo. *La Terre et la Vie* **2–71:** 240–254.

—— 1981. Un ver de terre carnivore des savanes de la moyenne Côte d'Ivorie: *Agastrodrilus dominicae* nov. sp. (Oliogochètes–Megascolecidae). *Revue d'Ecologie et de Biologie du Sol* **18**(2): 253–258.

—— **Douhalei, N. & Sow, B.** 1974. Influence de l'humidité du sol sur la consommation et la croissance de *Millsonia anomala* (Oligochètes–Acanthodrilidae) dans la savane de Lamto (Côte-d'Ivorie). *Annales de l'Universitè d'Abidjan* Ser. E. (Ecologie) **7:** 305–314.

—— **& Meyer, J.A.** 1976. Les populations de *Millsonia anomala* (Acanthodrilidae–Oligochetes): structure, variations spatio–temporelles et production. Application d'une analyse multivariée (programme Coustel). *Revue d'Ecologie et de Biologie du Sol* **13** (4): 561–577.

Michaelsen, W. 1889. Oligochaeten des Naturhistorischen Museums in Hamburg, I. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten, Hamburg* **6:** 1–17.

—— 1891. Terricolen der Berliner Zoologischen Sammlung. I, Afrika. *Archiv für Naturgeschichte, Berlin* **57:** 205–228.

—— 1892. Terricolen der Berliner Zoologischen Sammlung. II. *Archiv für Naturgeschichte, Berlin* **58:** 209–261.

—— 1895. Zur Kenntnis der Oligochaeten. *Abhandlungen aus dem Gebiete der Naturwissenschaften herausgegeben vom Naturwissenschaftlichen Verein in Hamburg* **13**(2): 3–37.

—— 1897. Neue und wenig bekannte afrikanische Terricolen. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten, Hamburg* **14:** 1–71.

—— 1898. Ueber eine neue Gattung und vier neue Arten der Unterfamilie Benhamini. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten, Hamburg* **15:** 4–16.

—— 1900. Oligochaeta. *Das Tierreich* **10:** i–xxix, 1–575.

—— 1912. Oligochäten vom tropischen und sudlich-subtropischen Afrika, I. *Zoologica, Stuttgart* **67:** 1–32.

—— 1914*a*. Oligochäten vom tropischen Afrika. *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten, Hamburg* **31:** 81–127.

—— 1914*b*. Oligochäten aus dem tropischen Westafrika gessamlt von Prof. Dr. F. Silvestri. *Bollettino del Laboratorio di Zoologia Generale e Agraria della R. Scuola Superiore d'Agricoltura, Portici* **9:** 171–185.
—— 1922. Oligochäten aus dem Rijks Museum van Natuurlijke Historie zu Leiden. *Capita Zoologica* **1**(3): 1–68.
—— 1937. On a collection of African Oligochaeta in the British Museum. *Proceedings of the Zoological Society of London* Ser. B. **107:** 501–528.
Omodeo, P. 1955. Eudrilinae e Octochaetinae della Costa d'Avorio (Oligochaeta). *Memorie del Museo Civico di Storia naturale di Verona* **4**(1954): 213–229.
—— 1958. La réserve naturelle intégrale du Mont Nimba. I, Oligochètes. *Mémoires de l'Institut Français d'Afrique noire* **53:** 9–109.
—— 1973. Oligochètes de l'Angola. *Das publicaçoes culturais da Companhia de Diamentes de Angola* **87:** 13–58.
—— **& Vaillaud, M.** 1967. Les oligochètes de la savane de Gpakobo en Côte-d'Ivoire. *Bulletin de l'Institut Français d'Afrique noire*. Ser. A. **29**(3): 925–944.
Reynolds, J.W. & Cook, D.G. 1976. *Nomenclatura Oligochaetologica: a catalogue of names, descriptions and type specimens of the Oligochaeta*. pp. i–x, 1–217. Fredericton: University of New Brunswick.
Sims, R.W. 1965*a*. Acanthodrilidae and Eudrilidae (Oligochaeta) from Ghana. *Bulletin of the British Museum (Natural History)* (Zoology) **12**(8): 285–311.
—— 1965*b*. The identity of the western African earthworm *Millsonia nigra* Beddard, 1894 (synonym *Dichogaster eudrilina* Cognetti, 1909). *Journal of the West African Science Association* **10**(1): 39–44.
Stephenson, J. 1930. *The Oligochaeta*. pp. 1–978. Oxford. Clarendon Press.

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