

***Megascolex (Promegascolex) mekongianus* Cognetti, 1922 - its extent, ecology and allocation to *Amyntas* (Clitellata/Oligochaeta: Megascolecidae)**

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Abstract. Cognetti (1922) miscounted segments of his *Megascolex (Promegascolex) mekongianus* and, believing the gizzard in 7 was intermediate between *Megascolex*, with gizzard in 5, and *Pheretima*, with gizzard after 7/8, he proposed the subgenus *Promegascolex*. Next, Gates (1934: 260) redescribed the immature, poorly preserved and abnormal type as *Pheretima mekongiana*. However, Sims & Easton (1972: 223) listed it as *species incertae sedis*, excluded it from their *Pheretima*-group of genera and postulated its gizzard was “clearly in segment 5”. The latter authors also mistook the River Mekong, “Annam” type locality as “Vietnam”. Recently collected material from the River Mekong in Laos is herein described that complies with the corrected type description allowing new designation as *Amyntas mekongianus* comb. nov. Moreover, *A. fluvialis* (Gates, 1939) from the Mekong in Thailand is found to be a synonym, although *Metaphire fluvialoides* (Huynh Thi Kim Hoi, 1998) comb. nov. from Central Highlands of Vietnam remains separate. Reallocation of the type species adds *Promegascolex* as syn. nov. to *Amyntas* and its generic diagnosis is amended from Sims & Easton (1972: 211) to permit: Clitellum annular, 14-16, rarely beginning on 13, sometimes extending into 17 (e.g. in *A. mekongianus*). The slender length and annulations of current specimens: measuring up to 2,900 mm with more than 500 segments, are near the maxima recorded for any earthworm; comparisons are given with “giants” in various families from other regions of the World. Brief comments are made on diversity and ecology of the River Mekong locality.

INTRODUCTION

Sims and Easton (1972) provided a numerical revision of all 746 nominal species names of pheretimoids (*Pheretima* auct.) then known, they did not discriminate between valid taxa and synonyms. Subsequently taxa have been greatly increased and updated checklists provided by Blakemore (2004, 2005, 2006) now catalogue approximately 920 valid names, with several *nomen nudum* and synonyms included as appropriate. Under a heading “*Species incertae sedis*”, Sims & Easton (1972: 223) had detailed *Megascolex (Promegascolex) mekongianus* and suggested elevating the subgenus to generic status. As part of

continuing revisions of this taxonomic group, this earthworm species is revisited.

The original Italian description in full by Cognetti (1922) is:

“*Megascolex (Promegascolex) mekongianus* n. subgen. n. sp.

Un esemplare ancora sprovvisto di clitello e mediocremente conservato.

Caratteri esterni. - Lunghezza 1 metro, diametro massimo (al 5o segmento) mm. 8, minimo (alla coda) mm. 4. Segmenti 370. Colore grigio, più scuro sul dorso. Prostomio mal distinto. Corona setigera di ciascun segmento un po' sporgente, in special modo nei tratti medio e posteriore del corpo; nel tratto anteriore i segmenti sono più allungati. Setole in corona continua, tranne al 2o segmento ove si contano soltanto 46 setole a cagione d'una larga interruzione

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ventrale (fig. 4). Nei segmenti che seguono, fino al 25o, se ne contano circa 100 (93o al 17o). La forma delle setole è quasi rettilinea, il nodulo è spostato verso l'apice (fig. 5); lunghezza μ 400 circa, spessore μ 20. Primo poro dorsale all'intersegmento 10/11. Clitello non ancora sviluppato.

Pori maschili al 17o segmento, su tubercoli (peni) abbracciati ognuno da una intumescenza più estesa lateralmente che medialmente. Fra le due intumescenze si contano 10 setole (fig. 6). L'intervallo fra i pori maschili equivale a circa 1/6 del perimetro segmentale. Apertura delle spermateche quattro paia, in forma di brevi fessure trasverse, a labbra un po' tumide, distribuite negli intersegmenti 4/5 5/6 6/7 7/8, allineate con i pori maschili. Mancano papille genitali e setole copulatrici.

Caratteri interni. - Disseptimenti 3/4 a 7/8 tutti molto ispessite e imbutiformi, 8/9 assente, 9/10 e seguenti sottili. Congolo nervoso nel 2o segmento. Ventriglio muscoloso al 7o, poco robusto, ma con spesso rivestimento cuticolare interno. L'intestino p.d. comincia al 14o segmento ed è provvisto di un paio di ciechi digitiformi semplici, estesi nei segmenti 26-21o. Ghiandole calcifere assenti. Nefridi diffusi. Nella regione media e posterior del corpo sono evidentissimi gli organi fagocitari segmentali ai lati vaso dorsale; gli organi corrispondenti nei segmenti 4-7o sono voluminosi, espansi contro il dissepimento anteriore e infestati da gran numero di cisti di Gregarine. Un paio di capsule seminali al 10o sporgente in parte nell' 11o, un secondo paio di capsule nell'11o sporgenti in parte nel 12o; le due capsule di ciascun paio non comunicano fra di loro nè c'è comunicazione fra le capsule del primo e quelle del secondon paio (1).

Ciascuna capsula si continua all'indietro con un grosso cacco seminale a superfice leggermente mamillare, compresso contro l'esofago; il primo paio di sacchi è contenuto nell'11o segmento, il secondo paio, più voluminoso, è contenuto nel 12' (fig. 8). Le prostate, contenute nel 17o segmento, hanno una porzione ghiandolare subreniforme a margine inciso; e un canale muscoloso a parete robusta, piegato ad ansa. I vasi deferenti s'insinuano nel punto di unione del canale con la porzione ghiandolare (fig. 7). Le spermateche sono in numero di quattro paia, distribuite nei segmenti 5o (due paia), 6o, e 7o; il volume decresce leggermente dal primo all'ultimo paio. In ogni spermateca si distingue una porzione prossimale sacciforme ampiamente comunicante con un canale più breve della porzione suddetta; al poro esterno confluisce assieme al canale un diverticolo foggiate a clava, lungo quasi come l'intera spermateca (fig. 9). Habitat: Ban Leum sul Fiume Mekong, Annam; raccogliitore il Sig. Dott. MALCOLM SMITH.

L'esemplare sopra descritto ha indubbiamente strettissime affinità col gen. *Megascolex*, ma la posizione eccezionale dei pori maschili al 17o segmento non permette di annoverarlo tra le specie di quel genere finora note. L'esame di un solo esemplare della species in discorso può destare il sospetto ch'esso sia anomalo nella disposizione dei pori maschili, tuttavia non credo sia da escludere a priori la presenza, in senso alla subfam. *Megascolecinae*, di forme dotate normal-

mente di pori maschili al 17o segmento: nella vicina subfam. *Acanthodrilinae* (sic) i pori maschili possono essere appunto al 18o segmento o al 17o. Pertanto ho considerato la nuova species quale tipo di un nuovo sottogenere: ulteriori studi di materiale proveniente dall' Annam potranno dimostrare l'opportunità o meno di conservare il sottogenere *Promegascolex*, o quanto meno la necessità di una lieve modificazione nella diagnosi della subfam. *Megascolecinae* relativa alla posizione dei pori maschili."

An approximate translation of Cognetti (1922) is:

"*Megascolex (Promegascolex) mekongianus* n. subgen. n. sp.

A specimen unprovided with a clitellum and with mediocre conservation.

External characters. - Length 1 meter, the maximum diameter (at 5th segment) 8 mm, minimum (towards the tail) 4 mm. Segments: 370. Colour gray, darker on the back. Prostomium poorly distinguished. Setal ring of each segment protrudes in a special way especially in the mid and hind body; in the anterior they are slightly larger; they are in a continuous circle except in the 2nd segment where only 46 setae are recognized with a wide ventral interruption (fig. 4). In the segments that follow, until the 25th, they number approximately 100 (e.g. 93 on the 17th segment). In shape the setae are nearly rectilinear, the nodule is moved towards the apex (fig. 5); length approximately 400 μ , thickness 20 μ . First dorsal pore in 10/11. Clitellum not developed. Male pores on 17th segment, on tubercles (penises) extending more laterally than medially. Between the two intumescences are 10 setae (fig. 6). The interval between the male pores is equivalent to approximately 1/6 of the perimeter. Spermathecal openings are four pairs, in short transverse fissures, with slightly protruding lips in 4/5-7/8 aligned with the male pores. Genital papillae and copulatory setae are lacking.

Internal characters. - Septa 3/4 to 7/8 greatly thickened and funnel-shaped, 8/9 absent, 9/10 and following thin. Cerebral ganglion encircles segment 2. Gizzard muscular in the 7th segment, moderately sturdy, but with covering of inner cuticles. Intestine begins in 14th segment and is provided with a pair of simple digitiform caecae extending from 26-21. Calciferous glands absent.

Nephridia diffuse. Obvious in the mid and posterior regions of the body are segmental phagocytic organs on each side of the dorsal vessel; the corresponding organs in segments 4-7 are more voluminous, expanded against the anterior septum and infested with a great number of Gregarine cysts. A pair of seminal vesicles in the 10th and partly in the 11th segments; a second pair in 11 and partly in 12, each pair independent (fig. 8). The prostates are contained in the 17th segment with one glandular portion (racemose) and a muscular duct folded to exit joined by the vasa deferentia (fig. 7). The spermathecae number four, distributed in segments 5 (two pairs), 6, and 7; their volume decreases gradually from the first to ultimate pair. Each spermatheca with a sacciform proximal portion wide and communicating via a short channel to the external pore where it meets the duct of a clavate diverticulum (fig. 9). Habitat: Ban Leum on the River Mekong, Annam; collector Dr. MALCOLM SMITH.”

MATERIALS AND METHODS

The following redescription allowing augmentation of the original description is based on new material with collection details given below and follows the procedures, format and system of classification presented in Blakemore (2000; 2002; 2005), complying with ICZN (1999). Voucher specimens are held in the Soil Ecology Research Group (SERG) at Yokohama National University.

TAXONOMIC RESULTS

Megascolecidae Rosa, 1891 sensu Blakemore (2000a, 2000b).

Amyntas mekongianus (Cognetti, 1922). **comb. nov.**

Megascolex (Promegascolex) mekongianus Cognetti de Martiis, 1922: 3 (figs. 4-8); Sims & Easton, 1972: 223 [et *mekongiana* (laps.): Sims & Easton, 1972: 244 “*Species incertae sedis*”]; Reynolds & Cook, 1976: 135. Type locality: Ban Leum on the River Mekong; collected by Dr. Malcolm Smith. Holotype Natural History Museum, London BMNH: 1921:7:30:4. Poorly preserved, acitellate subadult with “the internal organs of the anterior end rather messed about as a result of the previous dissection” (Gates, 1934), possibly also heavily in-

fectured with gregarines; labelled “*Megascolex (Promegascolex) mekongianus*. 1921.7.30.4 (Type). R. Mekong (Ban Leum) Annam. Pres. Dr. Malcolm Smith.” Specimen re-inspected by Gates (1934: 260) [and Sims & Easton (1972)?], not re-inspected here due to its stated poor condition.

Pheretima mekongiana: Gates, 1934: 260.

Pheretima fluvialis Gates, 1939: 89; Gates, 1972: 186, 215 (where he notes its similarity to *A. juliani*); Thai & Samphon, 1989: 62 Tabl. 2 (paper in Vietnamese). **Syn. nov.** [Type locality Chiengsen Kao, Thailand, in mud on bank of the Mekong River (ca. 20°15" N, 99°85" E). Types in U.S. National Museum, (#20564): described as three batches of 5 juveniles, one juvenile, and 3 partially clitellate plus 4 clitellate specimens (total 13) all collected from mud on bank of Mekhong (sic) River, Chiengsen Kao [also spelt “Chiang Saen”, “Chieng Saen Kao”, or “Chieng-sen-kae”], collected 15-16th January, 1937 by H. G. Deignan. [Ornithologist Herbert Girton Deignan (1906-1968) was an authority on the birds of Thailand (Deignan, 1945) who on the same trip also collected fish that are deposited in the Smithsonian Institution. Ecological information of the region can be found: http://www.arcbc.org.ph/arcbcweb/wetlands/thailand/tha_chisaebas.htm (December, 2004)]. [Non *Pheretima fluvialoides* Huynh Thi Kim (H.T.K.) Hoi, 1998: 10, figs 1-5. From Dak Lak, Central Highlands of Vietnam].

Amyntas fluvialis: Sims & Easton, 1972: 235, 242 [*A. diffringens* (= *A. corticis*) species-group]; Reynolds & Cook 1976: 102.

Locality Note: The locality was given as “Ban Leum on Mekong River, Annam” by Cognetti and, because Annam = Central Vietnam, as “from Vietnam” by Sims & Easton (1972: 223). In the current revision the actual Mekong River type-locality is uncertain but, as argued in the Discussion below, is probably in Thailand or Laos, and not in Vietnam.

Taxonomic Note: The following description is based upon Cognetti's original (in italics to which a segmental count of one must be added), on Gates' (1934) reinspection of the type, Gates' (1939) *Pheretima fluvialis*, the account in Sims & Easton (1972) and, especially, from recently collected material that is in better condition than the type.

Diagnosis: *Amyntas* with four pairs of spermathecal pores ca. 0.2 body circumference apart in furrows 5/6/7/8/9. Male pores paired superficial ca. 0.2 circumference apart on flat porophores on 18. Genital markings absent. Clitellum impinging on segment 17. Oesophageal gizzard weak in 8.

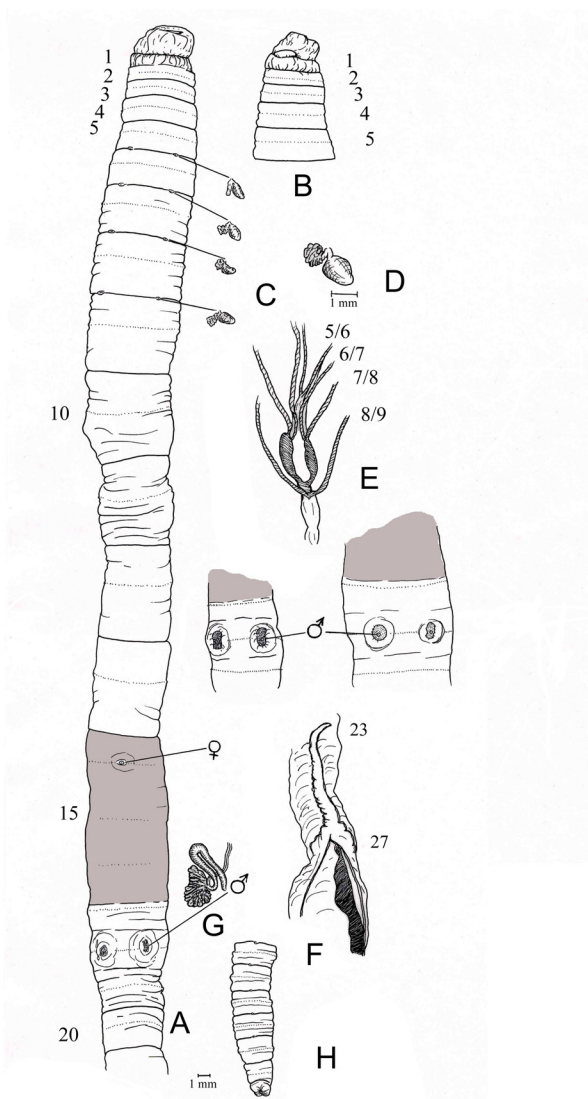


Figure 1. *Amynthus mekongianus* (Cognetti, 1922). A = anterior ventrum of medium sized Laos specimen, as sketched, dissected and described by the senior author; figure also shows B = dorsal view of prostomium, C = spermathecae *in situ* (with D = an enlargement of that from 9ths), E = a section of septa and gizzard in segment 8, F = intestinal caeca with incision to reveal dorsal typhlosole, G = prostate gland in 18 ducting to male pore with ental vasa deferentia, and H = dorsal view of ultimate posterior segments. Male pores of smallest and largest specimens from the current sample are shown for comparison. Clitella are shaded and all scale bars are 1mm.

Intestinal caeca simple originating in 27. Length up to 2,900 mm. Septum 8/9 present and muscular.

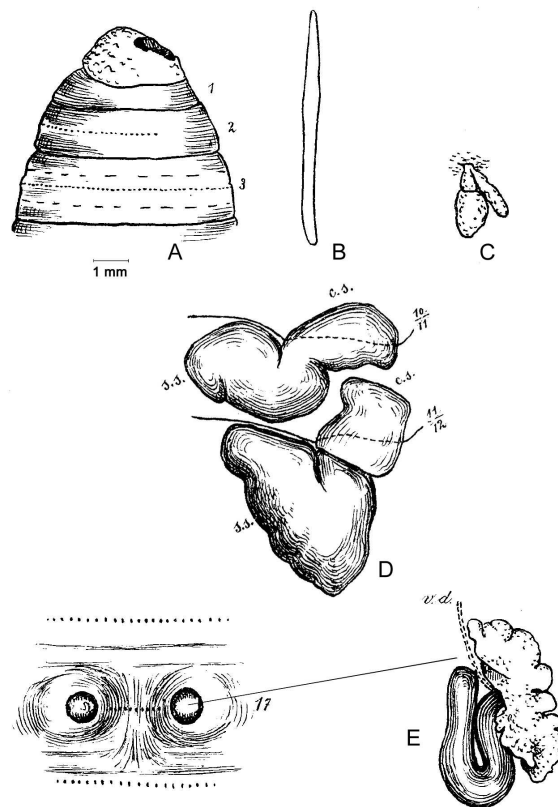


Figure 2. Original figures of *Megascolex (Promegascolex) mekongianus* after Cognetti (1922, figs 5-9) showing: A - deformed anterior (segments miscounted), B - one seta (approx. 400µ X 20µ), C - a spermatheca, D - seminal vesicles in 11 and 12, E - prostates in "17" (=18ths) ducting to male field in "17" (=18). Scales obviously vary, but an approximate scale for the anterior is added.

Spermathecal diverticula zig-zaged, each enveloped in thick sheath.

Distribution and habitats: Mud or sand of banks of the Mekong River.

Current specimens inspected: Six matures and one sub-adult, all clitellate, from banks of the Mekong River, 16 km upstream of Vientiane, Laos; collected and preserved in formalin collected in two batches on 19th December 1998, and 5th March, 2001 by Mr. Koiwaya and Tomoko Uchida of YNU. Details of specimens are: the smallest 690



Figures 3, 4. Photographs by Tomoko Uchida of colleagues re-collecting Mekong elongate specimens 16 km upstream from Vientiane, Laos on 5/V/2001 - showing typical habitats (and castings on the mud?).

mm with 305 segments (dissected and sketched), the largest 1,920 mm with 477 segments (male field sketched), a mature length 1,780 mm with 508 segments (this specimen fully dissected and figured here, it has segments 243, 300 and 306 fused and merged with adjacent segments), another mature was 1,430 mm long with 361 segments.

Body: Elongate and cylindrical. Lengths; 1,000 mm (Cognetti); 365-555 mm (Gates 1939); 690-1,920 mm (current preserved specimens), to 2,900 mm when collected from the field (Koiwaya, 1999). Widths: 4-8 mm (Cognetti); 6-8 mm (Gates 1939); 5.5-10.0 mm (current).

Segments: 370 (Cognetti); not recorded (Gates); 361-508 or as many as 580 (current); much secondary annulation and setal rings most prominent in hind segments.

Colour: Gray, darker on the back (Cognetti); dark greyish or brownish grey (Gates 1939); current specimens grey with darker brown clitellum, but alcohol in their jar has brownish tinge suggesting there is some colour leaching.

Behaviour: Limicolous (mud dwelling). No iridescence was noted in sperm funnels nor spermathecal diverticula of clitellate specimens (Gates

1939 and current), thus the species possibly has seasonal reproduction (with breeding season including January-March) or it may be incipiently parthenogenetic.

Cocoons: Information not available.

Prostomium: Poorly distinguished (Cognetti), perhaps because anterior segments were damaged or deleted in his specimen; not noted by Gates; small pro-epilobous (current).

First dorsal pore: 10/11 (Cognetti); 12/13 (Gates and current).

Setae: “Setal ring of each segment protrudes in a special way especially in the mid and hind body; in the anterior they are slightly larger; they are in a continuous circle except in the 2nd segment where only 46 setae are recognized with a wide ventral interruption (fig. 4). In the segments that follow, until the 25th, they number approximately 100 (e.g. 93 on the 17th segment). In shape the setae are nearly rectilinear, the nodule is moved towards the apex (fig. 5); length approximately 400μ , thickness 20μ ” (Cognetti); mostly 99-118 per segment (Gates 1939); numerous, ca. 100 small black setae in continuous ring in each segment except peristomium and periproct (current).

Nephropores: Not found.

Clitellum: Not developed (Cognetti); annular in 14-16 and just into 17 with dorsal pores obscured (Gates, 1939); from 14 almost to setal arc of 17, some ventral setae visible (current).

Male pores: "Male pores on 17th segment, on tubercles (penises) extending more laterally than medially. Between the two intumescences are 10 setae (fig. 6). The interval between the male pores is equivalent to approximately 1/6 of the perimeter" (Cognetti); or as "short transverse slits on 17 each male pore towards lateral margin of a fairly large disc that is apparently retractile into the parietes. Just lateral to each male-pore disc there is a rather crescentic but deeply bowed groove, the concave side of the groove facing midventrally" (Gates, 1934). Similar in current specimens but superficial on 18 about 0.2 circumference apart with 10 or so setae between pores. Some variation in male pores allows either circular or hour-glass shaped low, flat porophores with actual male pores at centres; sometimes with a lateral bowed lines (seen on both sides in one specimens or on either rhs or lhs in two other specimens). Similarly, Gates (1939: 93) describes the pores as "tiny transverse slits on centres of disc-shaped porophores (that can be slightly retracted and covered by lid-like lateral flaps?)."

Female pores: Not mentioned by Cognetti; single on 13 (Gates 1934); not mentioned by Gates (1939); but as usual on 14 in current specimens.

Spermathecal pores: Four pairs in 4/5/6/7/8 in line with male pores (Cognetti and Gates, 1934); in 5/6/7/8/9 ca. 0.2 circumference apart (Gates, 1939 and current).

Genital markings: None (all descriptions).

Septa: 3/4 to 7/8 greatly thickened and funnel-shaped, 8/9 absent, 9/10 and following thin (Cognetti); 4/5-8/9 thickened and extending posteriorly, 9/10 aborted, 10/11 thin, 11/12 is thin with web-like fibres on either side, following septa are all thin (Gates 1939 and current).

Dorsal blood vessel: Single (Gates 1939 and current).

Vascularization and hearts: Not mentioned by Cognetti; in current specimens hearts are in 10lhs only, and large, paired in 11-13 with complex capillary systems, plus in 5,6-8 are blood-glands with

lateral vessels. Although these large blood glands have many tubercles, it is not possible to say whether they are parasitic gregarine cysts as per Cognetti who has them in 4-7, or acinous masses (i.e., with several small sacs) as per Gates (1939) who has them in 4-9 and gives much detail on other blood vessels: e.g. he notes that the heart in 9 is single and may be on either the left or right side and in 10 the hearts are replaced by looping vessels and that the last pair of hearts is in 13.

Gizzard: "muscular in the 7th segment, moderately sturdy, but with covering of inner cuticles" (Cognetti); weakly muscular to vestigial in 8 between septa 7/8 and 8/9 that extend backwards (Gates 1939 and current).

Calciferous glands: Oesophageal pouches absent.

Intestine origin (caeca, typhlosole): "In 14 with simple paired, digitiform caeca in 26-21" (Cognetti); in 15 with elongate paired caeca in 27-23 simple but with slightly incised posterior edge in older specimens; a dark (vascularized) deeply lamellar typhlosole develops from 25, 26 (Gates 1939 and current) plus Gates says the typhlosole ends about segment 150.

Nephridia: "Diffuse" (Cognetti); meroic, tubules numerous especially obvious on anterior septa and blood vessels, e.g. in segment 5; absent from spermathecal ducts (current).

Testis/sperm funnels: Testis not mentioned but "A pair of seminal vesicles in the 10th and partly in the 11th segments; a second pair in 11 and partly in 12, each pair independent" (Cognetti); in current specimens testis and funnels in combined sacs paired in both 10 and 11, with seminal vesicles in 11 and, a larger pair in 12. Gates (1939) describes a similar holandric arrangement in his specimens. Vasa deferentia (sperm ducts) can be traced back to the junctions of the prostatic ducts and glands.

Ovaries: Not discovered by Cognetti nor reported by Gates; small and difficult to see in current specimens paired in 13 with funnels passing to 14, as would be expected.

Prostates: "contained in the 17th segment with one glandular portion (racemose) and a muscular duct folded to exit and joined by the vasa deferentia" (Cognetti); ditto but in segment 18 in

current specimens with U-shaped duct as also described by Gates (1939). Copulatory pouches absent. *Spermathecae*: “distributed in segments 5 (two pairs), 6, and 7; their volume decreases gradually from the first to ultimate pair. Each spermatheca with a sacciform proximal portion wide and communicating via a short channel to the external pore where it meets the duct of a clavate diverticulum” (Cognetti); in current specimens in 6 (2 pairs), and paired in 7-9, diverticula flattened with irregular outline. Gates (1939) describes the diverticula as shortly zigzag looped, surrounded by a layer of tissue, which conceals the looping. It was not possible to tease out the diverticula in current specimens although the looping was visible through the membranous sacs. Spermathecal ducts free of nephridia.

Gut contents: Fine silty soil in current specimens; Gates (1939) describes gut as filled with sand in one of his specimens.

Ecology: Description and photographs of specimens collected from Mekong by Mr Satoshi Koiwaya (published in No. 9 Earthworm Newsletter, 1999 report; Japan January, 1999 edited by Dr S. Matsumoto in Japanese), in summary, says: “During research in Laos, stories of an earthworm greater than 1 m length in the banks of the River Mekong were told by the father of a friend from Vientiane. On 19th December 1998 there was the chance to collect worms. They produce copious surface casts and the worms were collected from the mud but were easier to obtain from below the water at depth of 40 cms. The worms easily exceeded 2 m when extended or held between 3 people. The maximum recorded was 2.9 m. Preserved specimens were donated to Dr Tomoko Uchida at Yokohama National University for study.” These were the specimens newly described here by the senior author.

DISCUSSION

Systematics

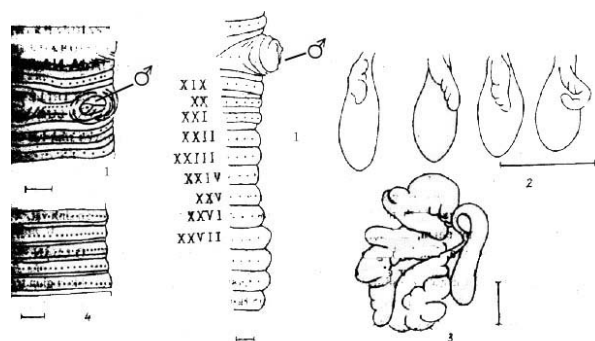
It now seems obvious that a count of one needs to be added to Cognetti’s description and, when this is done, *mekongianus* is seen to belong to the genus *Amyntas* where in normal specimens female pores and male pores are reasonably expected to be in 14

and 18, respectively, the gizzard behind 7/8, and intestinal caeca near 27. After inspection of the poorly preserved, damaged (and immature) type, Gates (1934: 260) thought that Cognetti’s description was of an abnormal specimen of a “*Pheretima*”. However, Sims & Easton (1972: 223) conjectured that Cognetti miscounted the segments externally where segments “2 and 3 having either fused or one of them suppressed”, yet for some reason they postulated the gizzard is “clearly in segment 5” so they provisionally retained it as *species incertae sedis* in Cognetti’s subgenus *Promegascolex* of genus *Megascolex*.

From inspection of new material here, it now seems most likely that Cognetti’s specimen was abnormal or mutilated and thus placement of his species, as with *A. fluvialis*, in the prior genus *Amyntas* as defined by Sims & Easton (1972) is warranted. From this new material and the descriptions in Cognetti’s original and in both Gates’ accounts, the male pores are classed as ‘superficial’ thereby qualifying for inclusion in *Amyntas*, albeit Gates (1934) said for *mekongianus* that the type has “a fairly large disc that is apparently retractile” and for his *fluvialis* he notes “Presumably the porophore can be slightly depressed” [*Italics added*]. In the current specimens some variability is permissible in the arrangement of the male pores that are, nevertheless, clearly superficial (cf. *Metaphire fluvialoides*). Gates’ (1939) *P. fluvialis* differs inconsequentially from the corrected account of Cognetti’s species so is placed in synonymy while also offering slight augmentation of the original description due to the more usual nature of his material compared to Cognetti’s. Gates (1939) thought his *fluvialis* similar to *Amyntas juliani* (Perrier, 1875) from Ho Chi Minh City (Saigon), Vietnam that, however, has large genital markings in line with male pores in 17, 19-20 or 22. Despite his earlier redescription, the possibility that his new species was similar to *mekongianus* appears to have escaped Gates’ attention.

Metaphire fluvialoides (Hoi, 1998) (Fig. 5) from Dak Lak province in the Central Highlands of Vietnam, although sharing general characteris-

tics (e.g. four pairs of spermathecae in 5/6-8/9; lack of genital markings, simple intestinal caeca), is maintained separately as it differs in size (125-180 mm by 4-6 mm), has only 130 segments, 34-89 setae per segment, mostly clavate spermathecal diverticula, and is distinct in having ventral region of 19-27 thick and pigmented (a preservation artefact?). Because the original figures (Fig. 5) show the male pores to be slightly everted, it is assumed that in the usual state they are somewhat pouched, and therefore possibly qualify it for *Metaphire* inclusion.



Hình 5: Loài giun đất mới *Pheretima fluviatoides* sp. nov.

Figure 5. *Metaphire fluviatoides* (Hoi, 1998: fig. 1) original figures showing 1 = male pores from ventral and lateral views, 2 = spermathecae, 3 = prostate, 4 = thick and pigmented ventral region of 19-27 (not clearly marked). Scale bars all different but = 1 mm.

Comparisons of Body Size with “Giant Earthworms” from around the World

The slender length of current specimens, measuring up to 2,900 mm with more than 500 segments are at the maxima recorded for any earthworm and, because of this, perhaps few complete specimens of *A. mekongianus* had hitherto been obtained hence earlier descriptions may have been based on truncated specimens, or those yet to obtain their full extent and segmental totals. Biometric data suggest a correlation between body length and number of segments, implying that segments are added with maturity.

Accounts of large earthworm species are provided by Stephenson (1930), Blakemore (2002: 13), and by Tsai et al. (2004). Family Moniligast-

ridae: *Drawida nilamburensis* (Bourne, 1894) and *Drawida grandis* (Bourne, 1887) from India which may be as much as 760 and 1,080 mm, respectively, the latter species burrowing to depths of 3 m (Julka 1988: 33). Sumatran *Hastirogaster houteni* (Horst, 1897), previously in genus *Eupolygaster*, has size range of 1100-1500 mm (Gates 1972: 243).

The South African family Microchaetidae has a group of sometimes ‘gigantic’ species all to about 1 m or more long (Plisko 1999) including *Microchaetus microchaetus* (Rapp, 1849) which has a length of 1,800 mm by 16-18 mm wide with 792 segments. The type species of Acanthodrilidae *sensu* Blakemore (2000a, 2000b) is *Acanthodrilus ungulatus* Perrier, 1872 from New Caledonia that reaches sizes up to 700 mm by 10mm with more than 200 segments, but most other members of the family are small sized.

In family Glossoscolecidae: South American ‘giants’ are: *Thamnodrilus gigas* (Perrier, 1872: 50), 1,160 mm; *Rhinodrilus horsti* (Beddard, 1892: 117), 860 mm; *Glossoscolex paucisetis* Michaelsen, 1900: 445, 673 mm; and *Glossoscolex giganteus* (Leuckart, 1835/6: 764) [syns. *G. maximus* Leuckart, 1841: 104, *Titanus brasiliensis* Perrier, 1872: 57, *T. gigas* Perrier, 1881: 218] that measured 1,270 mm by 15 mm or more width, and 550 segments that was said by Leuckart to possibly extend up to 8 or 9 ft (ca. 2,743 mm) in life (Beddard 1895: 644). Stephenson (1930) stated that *Rhinodrilus fafner* Michaelsen, 1917, which measures when extended 2,100 mm in length and 24 mm in diameter, rates with *Megascolides australis* as probably one of the largest of all earthworms. *Martiodrilus (Cordilleroscolex) beddardi* (Cognetti, 1904), *M. (C.) crassus* (Rosa, 1895), *M. (C.) iserni* (Rosa, 1895), *M. (C.) columbianus* (Michaelsen, 1900), and *M. (C.) olivaceus* and *M. (?) panamensis* both by James (1990) are all about 400-800 mm by 16-25 mm. Other ‘giants’ are the recently described Ecuadorian *M. (C.) ischuros* Zicsi, 1990: 370 that exceeds 1,000 mm by 40-50 mm in life [cf. *M. crassus* (Rosa, 1895: 151) that also reaches these dimensions - see Zicsi & Csuzdi (1997)]; and the Amazonian *Andiorrhinus (Andiorrhinus) kuru* Moreno

and Paoletti, 2004 with a length of 500 mm (living specimens measure up to 1,100–1,300 mm) and diameter 20–30 mm, with 342 segments and mass 122.5 g for the holotype. This latter species is used as a local food resource (Moreno & Paoletti 2004) as are other species documented by the same authors.

In the family Megascolecidae sensu Blakemore (2000a, 2000b) the Australian *Megascolides australis* McCoy, 1878 from southern Victoria as originally recorded with a size of 1,230 mm, or a little over 4ft, but specimens attaining lengths of about 7ft 2in (2,184 mm) have been measured that each weighed 400–450 g with 300–500 body segments (Spencer 1888). There are unconfirmed reports of specimens being “stretched” to 13ft (3,960 mm), however, the average size is about 1,000 mm long by 20 mm wide and average weight of 210 g (but highest just under 400 g) according to Dr Beverley Van Praagh of the Museum of Victoria who studies the biology and ecology of this worm (e.g. Van Praagh 1992). *Notoscolex grandis* Fletcher, 1886 from Burrawang, NSW measures 760–1,060 mm long by 11 mm wide; it was recently rediscovered near there by one of the current authors (Blakemore 2001), and Victorian *Notoscolex hulmei* (Spencer, 1892) is up to 1,200 mm long. Several other Australian natives in the genera *Digaster*, *Heteroporodrilus*, *Fletcherodrilus* and *Diporochaeta* have species in the range 600–1,500 mm (see Blakemore 1994; 1997; 2000a). The largest known species from Tasmania is *Vesiculodrilus tasmanianus* (Fletcher, 1887) as redescribed by Blakemore (2000b) at over 610 mm and while this is much shorter than sizes attained by *Megascolides australis*, these two species are of equivalent width. Specimens of *V. tasmanianus* dug during forest trail building operations were found at about 1–1.5 m depth, but some burrows descended to 5 m (Blakemore 2000b).

The lumbricine megascolecid *Tonoscolex birmanicus* Gates, 1926 from Pyin U Lwin or Pyin-Oo-Lwin (formerly Maymyo) in the northern Shan States of Myanmar (Burma) is over 600 mm long by 10–15 mm and up to 7ft or 10ft

(=2,130–3,050 mm) long in some reports - this species builds large tower-like casts, similar to those described and figured by Darwin (1881: figs. 3, 4), that may be 25 cm tall and weigh about 4lb (1.8 kg) according to Gates (1972: 227). From Karala State, India, *Megascolex konkanensis longus* Stephenson, 1915 is 345–570 mm long by only 3–4 mm with ca. 400–550 segments. New Zealand’s *Celeriella gigantea* (Benham, 1906) may measure 990 mm when preserved, but 1,300–1,400 mm when alive and extended, with a width of 11 mm and ca. 450 segments (Lee 1959: 344). North American *Driloleirus americanus* (Smith, 1897) from eastern Washington and *D. macelfreshi* (Smith, 1937) from Oregon each grow up to “3 feet” long, or roughly one meter. A recently described Taiwan species, *Metaphire taiwanensis* Tsai et al., 2003 was 637–860 mm long by 16–17 mm wide with 185–228 segments and weight of 101–121 g.

Other ‘giant’ pheretimoids, i.e., *Pheretima* auct. species, the group to which *A. mekongianus* belongs, are usually in the range 555–700 mm with less than 300 segments (Tsai et al. 2004: 883) with the previous maximum of just over 700 mm long by 24 mm wide with 184 segments for *Metaphire magna* (Chen, 1938) from Hainan. Similarly large are *Metaphire musica* (Horst, 1883) and *Metaphire longa* (Michaelsen, 1892) from Java and Sumatra that are 370–570 mm by 10–48 mm. *Metapheretima jochana* (Cognetti, 1911) from New Guinea is up to 600 mm long, 10 mm wide with 600 segments and as many as 200 setae per segment and, despite being smaller, the sympatric *M. sentanensis* (Cognetti, 1911) also has 300 setae per segment (Easton 1979: 88, 114). Cosmopolitan *Polypheretima elongata* (Perrier, 1872) had a reported range of up to 360 mm long (Easton 1979: 52) but the largest specimen in a series of Queensland studies reached >450 mm in life with mass 8 g (Blakemore 1994; 2002).

Distribution Range

At the time of publication of Cognetti's paper, the historic region of central Vietnam called Annam had been integrated into the French “Union of

Indochina” since 1887 and Laos was included as a protectorate in 1893. The Truong Son ridge (Annamese Cordillera) separates north and central Annam from Laos and the Mekong on the west; the ridge then swings south-eastward and runs along the coast of southern Annam, which includes plateaux stretching to the borders of Cambodia and Cochin China (South Vietnam). Thus it is unlikely that the type locality is in the current People's Republic of Vietnam where the Mekong only occurs in the south, it is more likely that the site is in Laos PDR or Thailand, possibly near to Vientiane.

Type-locality was given as “Ban Leum on Mekong River, Annam” by Cognetti and, because Annam = Central Vietnam, as “from Vietnam” by Sims & Easton (1972: 223). Yet, while there is a similar sounding “Ban Leum” in northern Vietnam (DMS 21°49'60 N, 103°52'0 E), it is a great distance from the Mekong River and unlikely to be the source. In Laos, however, there are “Ban Leum” (19°34'24"N, 103°5'21"E) and “Ban Leu” (18°98"N, 103°5"E) in Xiang Khoang Province, famous as the “Plain of Jars” at the northern end of the Annamese Cordillera, also nearby are “Ban Leum Gnai”, “Ban Leum Noy” and “Ban Leum-U” (15°6"N, 106°28"E), but all are similarly far from the Mekong. Yet another “Ban Leum”, possibly meaning “Village in the hollow” is in Muang District, Udon Thani, Thailand closer to the Laasian capital Vientiane (17°96"N, 102°6"E) that is on the Mekong. In these regions there are also half-a-dozen places named “Ban Len”.

In the Lao/Siamese and upland Vietnamese dialects the term “Ban” can mean village - hence “Leum's Village”, but often the names of smaller villages disappear as they merge or are spelt in a variety of ways after romanization to French and/or English. In these dialects “ban leum” can also translate as “[I] forget the place” so, although the actual Mekong River type-locality is uncertain; it is probably in Thailand or Laos, and not in Vietnam.

Geography and Ecology of Mekong River Habitat

The riverine habitat of the current species (*A. mekongianus*) is the Mekong that, flowing over 4,200 km, is the third largest river system in Asia after the Yangtze in China and the Ganges in India. This river originates in Tibet and China's Qinghai Province, passes through Yunnan province, next forming the border between Myanmar (Burma) and Laos then most of the border between Laos and Thailand. It enters Cambodia at Khone waterfall, drains Tonle Sap lake seasonally, and slows its pace in the nine arms of the low-lying Mekong delta in southern Vietnam before finally discharging into the South China Sea. This catchment is home to some 250 million people and approximately 70 million rely on the Mekong River for their transport and livelihood, according to the Mekong River Commission (<http://www.mrcmekong.org>). Earthworms are nutritious, are used as bait for fishing and domestic pigs forage for them along the riverbanks (pers. obs.). However, the extent to which this particular worm species is utilized, or endangered, locally is unknown. There would appear to be few natural barriers to migration of worms along the sedimentary embankments over much of the huge Mekong basin, although various proposals to build and extend 50 or more hydroelectric dams along the rivers and catchments, such as the Nam-Ngum and Ban-Koum dams in Laos, will affect flow and sedimentation.

Species Associations

Gates (1930: 355) said “Practically nothing is known about the earthworms of Siam (= Thailand)”, and the situation has changed little to this day although further surveys along the Mekong and other river systems would be expected to yield many new species and to increase ecological information about the 27-30 taxa or so that are reported from Thailand (Gates 1939; 1972; Blakemore 2005). Less is known of

Laosian earthworms although their nematode parasites are reported e.g. by Spiridonov (1994) from the guts of several “*Pheretima*” spp hosts in the Mekong region of Laos such as *Homungella mekongianum* Spiridonov, 1994 (non *Pharyngonema mekongianum* Pierantoni, 1923) that was found inside *Amyntas juliani* (Perrier, 1875) collected in October, 1987 from near the river Pon, Sepon that, although in Laos, is some distance from the Mekong proper (S. Spiridonov pers. obs.). Some other pheretimoid species known from the Mekong River include *Amyntas gibbosus* (Thai and Samphon, 1990) **comb. nov.**, *Metaphire luongphabanganus* (Thai and Samphon, 1990) **comb. nov.**, ?*Metaphire packhansensis* (Thai and Samphon, 1990) **comb. nov.** and ?*Pheretima choana* Thai and Samphon, 1988 all from Laos, and *Amyntas polychaetiferus* (Thai, 1984) **comb. nov.** from the Mekong Delta of S. Vietnam. Despite some general similarities, these species are only about 150 mm long or less and considerably shorter than *A. mekongianus*. In a Vietnamese paper, Thai & Samphon (1989: 75) also list *Metaphire posthuma*, *Amyntas juliani*, *A. samphoni*, *A. unicipeniferus*, and possibly *M. peguana* and *M. bahli* from the “tide area of Mekong River”.

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