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Further observations of blunt-hooked raillietiellids (Pentastomida: Cephalobaenida) from lizards with descriptions of three new species

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Summary

Our earlier revisions of the taxonomy of blunt-hooked raillietiellid pentastomids infecting small lizards recognized six, mostly well characterized, species. Three of these, *Raillietiella mabuiae, R. maculatus* and *R. hemidactyli,* are re-examined in this study: an additional diagnostic character, the form of the male copulatory spicule, confirms the status of these species. Another, morphologically very similar species, *Travassostulida freitasi* from a South American skink, was ascribed to a new genus *Travassostulida* by Motta & Gomes (1968). We show that there is no justification for this separation and the species is renamed *R. freitasi* n. comb. Other South and Central American blunt-hooked species from geckos are indistinguishable from certain African and South East Asian forms — these may be new species but because their hosts have been disseminated through commerce we have left them unnamed: more specimens are required before their status can be confirmed. Three new species are described; *R. scincoides* infects an Australian skink, *R. monarchus* infects a South East Asian gecko and *R. maculilabris* comes from an African skink. Appropriate combinations of hook size, annulus number and the form of the male copulatory spicule form the principal diagnostic criteria by which these species can be recognized. The taxon now embraces ten species of blunt-hooked raillietiellids and is the second largest within the genus *Raillietiella.*

Introduction

A recent revision of the taxonomy of certain blunt-hooked cephalobaenid pentastomids belonging to the genus *Raillietiella* Sambon, 1910 and infecting small lizards, recognized five species: the single African species *R. mabuiae* Heymons, 1922 and four species from South East Asia and the Philippines, namely, *R. gehyrae* Bovien, 1927, *R. hemidactyli* Hett, 1934, *R. maculatus* Rao & Hiregaudar, 1959 and *R. frenatus* Ali, Riley & Self, 1981 (Ali *et al.*, 1981). Note though, that *R. maculatus* was not examined in this study and was only considered valid if the annulus count, originally recorded as 30 by Rao & Hiregaudar, was genuine (Ali *et al.*, 1981).

Subsequently, another species, *R. affinis* Bovien, 1927 from a Javanese tokay (*Gekko gecko*), was also found to be blunt-hooked although, unaccountably, this fact was not recorded in the type description (Ali, Riley & Self, 1982a). According to Awachie (1974), this species also infects the Nigerian house gecko *Hemidactylus brookii angulatus* but Ali *et al.* (1982a) consider it more likely that the parasite was misidentified, and Awachie's species may, in fact, be new.

Only one species belonging to this taxon has been recorded from the Americas; Self & Diaz

(1961) recovered so-called *R. hemidactyli* from a gecko *Hemidactylus mabouia,* taken in Puerto Rico. They further speculated that this species, which hitherto had not been recorded from the Western Hemisphere, had probably been introduced from Africa. This may be true (Schmidt & Inger, 1957) but in any event Ali *et al.* (1981) thought it probable that the parasite had been misidentified.

Another morphologically very similar species, *Travassostulida freitasi* from a skink, *Mabuya punctata,* taken from an island off the coast of Brazil, was ascribed to the new genus *Travassostulida* by Motta & Gomes (1968) but the diagnostic criteria upon which this new genus was based had already been used by Hett (1934) to establish the subgenus *Heymonsia.* However, it is important to record that Hetts' subgenus has not gained acceptance and it does not appear in any recent revisions of pentastomid classification (see Fain, 1961; Nicoli, 1963; Self, 1969).

A section of this paper is devoted to the taxonomy of the (above) South and Central American species and is based, in part, on material featured in the original descriptions. The remainder of the paper is devoted to morphologically similar species from other zoogeographical areas which we either chose not to include in our earlier taxonomic revisions (Ali *et al.,* 1981, 1982a) or that we have only recently acquired.

Three new species are described and one is renamed. The taxon, which now embraces ten well characterized species of blunt-hooked raillietiellids and, is the second largest within the genus *Raillietiella.*

Materials and methods

The material is derived from the collection of Dr J.T. Self supplemented with specimens from a number of diverse sources. Most are preserved in 70% alcohol and are now deposited in the American Museum of Natural History (AMNH) or the British Museum (Natural History) (BM(NH)): any exceptions are indicated below.

American species

(i) *Raillietiella* sp. from *Hemidactylus brookii* taken at Rio Pedras, Puerto Rico. AMNH Reg. No. 485, 486, 488 and 489.

(ii) *Raillietiella* sp. from *H. mabouia* taken at Rio Pedras, Puerto Rico. AMNH Reg. No. 502. This is the species originally identified as *R. hemidactyli* by Self & Diaz (1961).

(iii) *R. freitasi* n.comb. from a skink *Mabuya punctata* taken on the Island of Fernando de Noronha, Brazil. The specimens were originally ascribed to a new genus, *Travassostulida,* by Motta & Gomes (1968) and comprise a paratype series (loaned from the Coleção Helmintologica do Instituto Oswaldo Cruz, Brazil). All are preserved in formalin.

African species

(iv) *Raillietiella* sp. from a house gecko *H. brookii* from Ondo State, Nigeria. (BM(NH) Reg. No. 1981.5.120.1–2).

(v) *R. maculilabris* n.sp. from a skink *M. maculilabris* taken in Dar es Salaam, Tanzania. (BM(NH) Reg. No. 1982.9.20.5–9).

(vi) *R. maculilabris* n.sp. from a skink *M. striata* taken in Dar es Salaam, Tanzania. These specimens were earlier identified as *R. hemidactyli* by Hirji (1980). (BM(NH) Reg. No. 1982.9.20.10).

(vii) *R. mabuiae* Heymons, 1922 from *M. sulcata* taken in Namibia (formerly German South West Africa) — one syntype specimen, loaned from the Zoologisches Museum, Berlin. (Reg. No. ZMB 17167).

South East Asian and Philippine species

(viii) *R. monarchus* n.sp. from the Monarch gecko (*Gecko monarchus*) from Kuala Lumpur, Malaysia (BM(NH) 1981.9.20.1–4), and Lan Yü Island, Taiwan (AMNH Reg. No. 503).

(ix) *R. maculatus* Rao & Hiregaudar, 1959 from *M. carinata,* India. (AMNH Reg. Nos. 492–5, 527.1).

(x) *R. hemidactyli* from *Calotes versicolor,* India. A single male specimen previously identified by

Heymons (1939) as *R. geckonis*. (BM(NH) Reg. No. 1939.3.14.21).

Australian species

(xi) *R. scincoides* n.sp. from the Blue-tongued skink *Tiliqua scincoides*, collected near the Murray River, South Australia (AMNH Reg. No. 471.1–6).

The gross morphology of blunt-hooked raillietiellids and the techniques for counting annuli and measuring hooks have been covered in earlier publications (Ali *et al.*, 1981), as has the use of the male copulatory spicule (Ali *et al.*, 1982a, b, c 1984).

In the analysis of hook dimensions only fully mature, probably patent, females were used. Maturity was assessed from the ratio of eggs containing fully developed, hooked primary larvae to undeveloped eggs, as outlined in Ali *et al.* (1982c) and Ali & Riley (1983).

Results

Species

(i) *Raillietiella* sp. from the geckos *Hemidactylus brookii, H. mabouia* from Puerto Rico and *H. brookii* from Nigeria (Table I, Figs. 2B, D, 4).

The characteristics of this assemblage are summarized in Table I and, on the basis of these few criteria, the species appears indistinguishable from *R. frenatus* (see Ali *et al.*, 1981; Ali & Riley, 1983). Mature females are 7–12 mm in length ($\bar{x} = 10$), possess 23–27 annuli ($\bar{x} = 26$) and contain 39–45% ($\bar{x} = 41$) fully developed eggs.

The male copulatory spicule (Fig. 2B) is a broadly rounded club-shaped structure with a finely etched base and again it is not possible definitely to distinguish this from the spicule of *R. frenatus* although it is slightly bigger: spicule dimensions (from the specimen indicated by an asterisk in Table I) are 430 μm long by 80 μm across the base (*contra* 335 by 63 μm in *R. frenatus* (Ali & Riley, 1983)).

The specimens from Nigerian geckos (*H. brookii*) (Table I) are again quite remarkably similar to those mentioned above in all respects. The base of the male copulatory spicule is 75 μm wide (specimen indicated [b] in Table I).

(ii) *Raillietiella maculilabris* n.sp. from *Mabuya maculilabris* and *M. striata*, Dar es Salaam, Tanzania (Table II, Figs. 1D, 4).

Holotype female: 10 mm long, 25 annuli (BM(NH) Reg. No. 1982.9.20.5).

The remainder of the specimens constitute a paratype series and their principal characteristics are summarized in Table II. Mature females, 7.5–10 mm long, contain about 25% fully developed eggs in the uterus. Even immature females, 4.0–4.4 mm in length with 24–27 annuli possess very bluntly rounded posterior hooks (in other species hooks are far more pointed at this stage) and adult specimens of both sexes have extremely thick, blunt hooks (Fig. 1D). Mature female hook dimensions, plotted in Figure 4 form a cluster group which does not overlap with similar values derived from other African species.

The male copulatory spicule (Fig. 1D), differs from that of *R. mabuiae* (see below) in that the base is rounded and it does not possess the more heavily chitinized projection of the base towards the inner curvature of the spicule (compare with Fig. 1A)

(iii) *R. mabuiae* Heymons, 1922 from *Mabuya sulcata* taken in Namibia (ZMB Reg. No. 17167) (Fig. 1A).

The poorly preserved paratype male (cursorily examined in Ali *et al.*, 1981) was re-examined in order to ascertain its relationship to the other African species described herein.

The specimen is 2.8 mm long, 0.5 mm wide, but its condition renders an annulus count impossible. Although the seminal vesicle was empty the copulatory spicule was fully formed (Fig. 1A). The latter structure, dissected from one side of the specimen, forms the only useful diagnostic criterion that can be gleaned from the type series. It measures 475 μm long and 140 μm across the base. Thus, apart from being bigger than in the above African species, the base carries an obvious knobbly projection directed towards the inner curvature of the spicule (Fig. 1A) and it therefore closely resembles

Table I. The principal characteristics of blunt-hooked *Raillietiella* sp. recovered from geckos

Host	Locality	Sex	Museum registration number	No. examined	Body length (mm)	No. of annuli	Hook size (μm)			
							Anterior		Posterior	
							AB	BC	AB	BC
Hemidactylus brookii	Puerto Rico	♀	AMNH: 485 (part)	3	7.5–9 (8.2)	23–26 (25)	–	–	336–366 (353)	445–474 (461)
		♀	AMNH: 486 (part)	1	4[a]	27	69	119	168	217
				6	8.1–11.4 (10.6)	–	119–148 (134)	168–217 (201)	346–356 (349)	435–494 (464)
		♀	AMNH: 488	3	9.5–11	24–26	–	–	336–375	445–454
		♀	AMNH: 489 (part)	1	12	27	–	–	375	454
		♂	AMNH: 486 (part)	3	2.8[a]	–	45–50 (48)	68–80 (73)	78–83 (80)	138–145 (140)
				4[b]	3.4–4.1 (3.8)	21	60–70 (66)	105–118 (110)	120–140 (130)	175–225 (193)
		♂	AMNH: 485 (part)	1	–	–	–	–	138	207
		♂	AMNH: 489 (part)	1	4.0	20	–	–	–	–
H. mabouia	Puerto Rico	♀	AMNH: 502	1	7.5	27	–	–	346	474
H. brookii	Nigeria	♀	BM (NH) 1981.5.20.1-2 (part)	4	7–11 (9.7)	26	109–119 (114)	207–227 (217)	346–356 (351)	464–504 (484)
		♂	BM (NH) 1981.5.20.1-2 (part)	3[b]	3	20–21	60	118	128	212

[a] immature

[b] see **Results:** *Species* (i)

Table II. The principal characteristics of three new species of blunt-hooked *Raillietiella* spp. (means in parentheses)

Raillietiella sp.	Host	Locality	Museum reg. no.	Sex	No. examined	Body length (mm)	No. of annuli	Hook size (μm)			
								Anterior		Posterior	
								AB	BC	AB	BC
R. monarchus n. sp.	*Gecko monarchus*	Kuala Lumpur, Malaysia	BM (NH) 1982.9.20.1-4	♀	1	4.5[a]	27	79	158	158	247
				♀	4	6–8.5 (7.5)	28–30 (29)	99–118 (109)	207–217 (212)	227–267 (247)	356–385 (375)
				♂	3	5–5.5 (5.3)	25–27 (26)	89	148–158 (153)	128–139 (135)	217–227 (224)
		Taiwan	AMNH 503	♂	1	4	–	79	138	128	198
R. maculilabris n. sp.	*Mabuya maculilabris*	Dar es Salaam, Tanzania	BM (NH) 1982.9.20.5-9	♀	1	4[a]	24	–	–	138	247
				♀	3	7.5–10 (8.5)	24–28 (25.3)	99–109 (104)	198–207 (202)	316–326 (321)	415–455 (435)
				♀	2	4.2[a] & 4.4[a]	27	63 & 69 (66)	143 & 148 (146)	148 & 158 (153)	247 & 257 (252)
				♀	3	11–11.5 (11.3)	24	119	207	306	415–435 (425)
				♂	2	4.0	21	63	125	119	207
	M. striata	Dar es Salaam, Tanzania	BM (NH) 1982.9.20.10	♀	4	8–9 (8.3)	26	99–107 (102)	198	306–326 (316)	385–395 (390)
				♂	1	2.9	–	68	97	109	177
R. scincoides n. sp.	*Tiliqua scincoides*	Murray River, Australia	AMNH 471.1-6	♀	3	15.5–20.5 (18.2)	33	99–109 (104)	198–217 (208)	247–277 (262)	385
				♂	3	4.5–6 (5.2)	c23	70–79 (75)	138–148 (143)	119–128 (124)	198–217 (203)

[a] immature

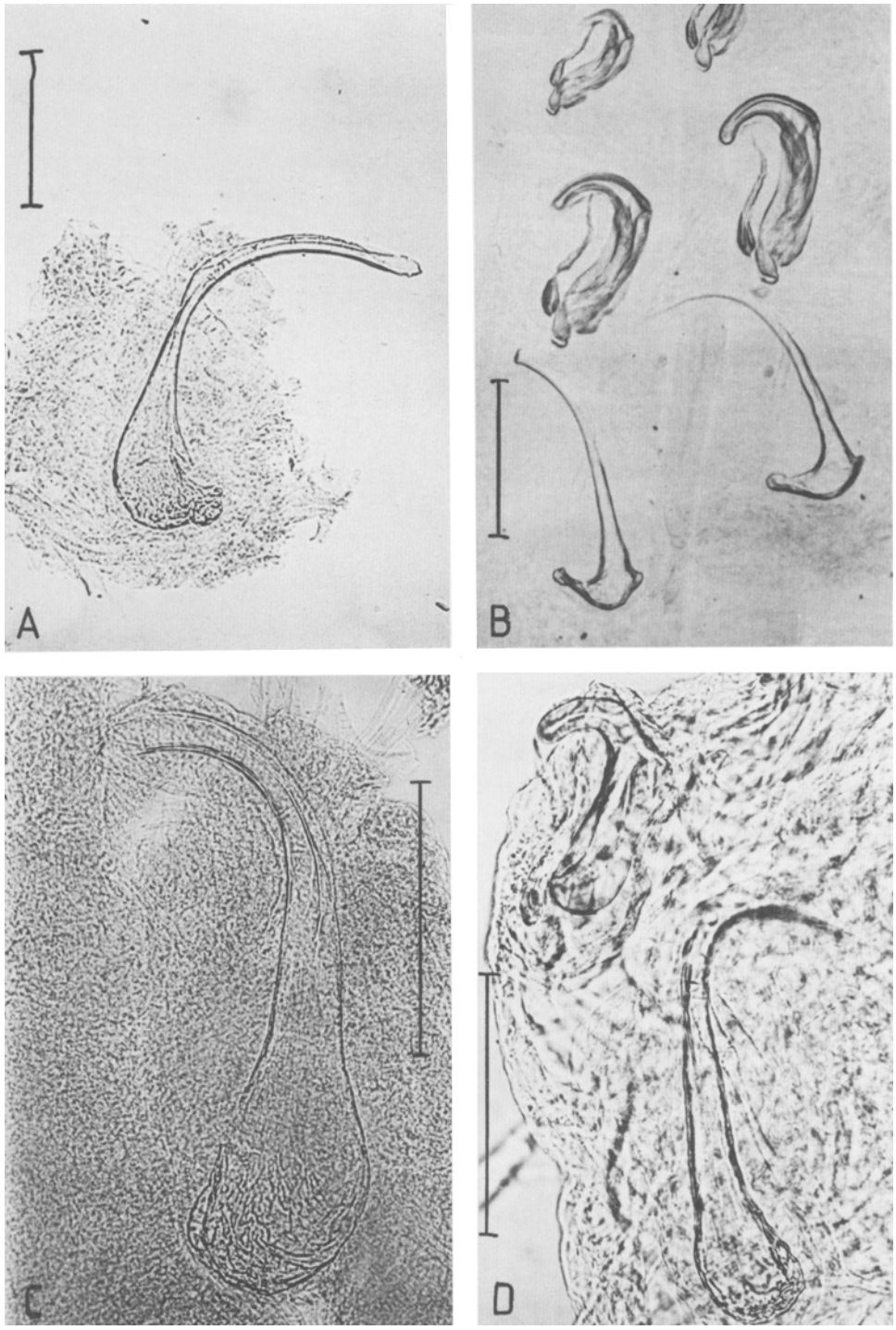

Fig. 1. The male copulatory spicules of blunt-hooked *Raillietiella:* A, *R. mabuiae,* syntype male; the knob-like extension of the inner surface of the base is clearly visible; B, *R. monarchus* n.sp. the knob-like rounded tip of the posterior hook is visible as is the distinctive base of the spicule: it is strongly hooked and carries a small projection on the outer surface; C, *R. maculatus.* The rounded club end to the spicule is very obvious; D, *R. maculilabris* n. sp. The spicule is very similar to (C) above but the very thick blunt-tipped blade of the posterior hook is one of the diagnostic characters of this species. (Scale bars = 200 μm).

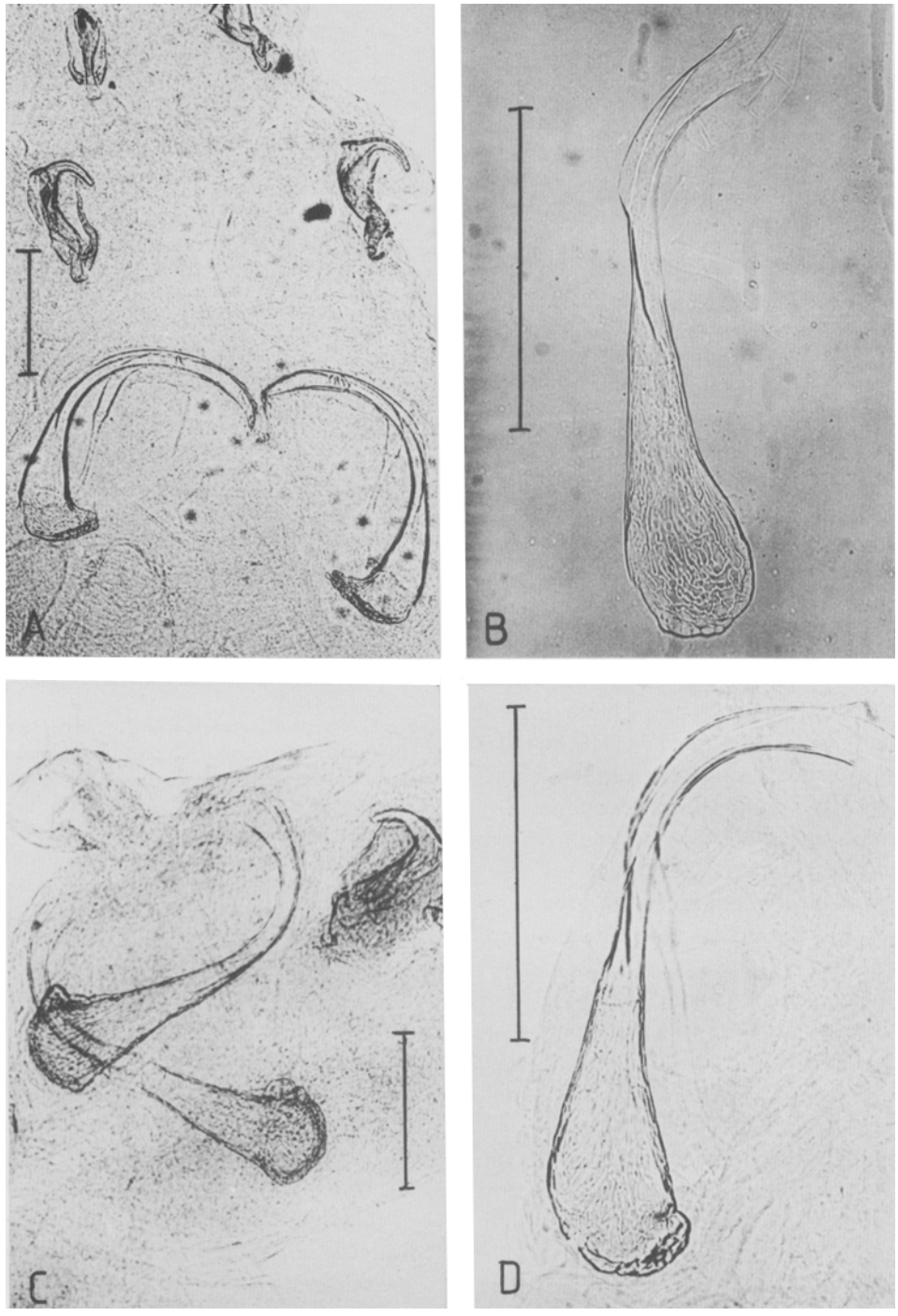

Fig. 2. The male copulatory spicules of: A, *R. scincoides* n.sp; the spicule is curved along most of its length; B, *Raillietiella* sp. from *Hemidactylus brookii* taken in Puerto Rico. The base of the spicule is uniformly rounded; C, *R. hemidactyli* from *Calotes versicolor* – the angular outside edge of the spicule base is a consistent feature; D, *Raillietiella* sp. from *Hemidactylus brookii* in Nigeria. The spicule base is thickened on its inner side but otherwise it is very close to (B). (Scale bars = 200 μm).

the '*R. gehyrae*' of Pence & Canaris (1973) from a Kenyan skink *Mabuya homalocephala* which Ali *et al.* (1981) considered to be *R. mabuiae*. The male posterior hook, measured on the specimen while pressed under a coverslip was AB 148, BC 207 μm.

A mature (?) female hook, remeasured from Pence & Canaris' (1973) diagram, is close to *R. maculilabris* n.sp. (Fig. 4)

(iv) *R. freitasi* (Motta & Gomes, 1968) n.comb.

This species, described earlier as *Travassostulida freitasi* by Motta & Gomes 1968, is a typical blunt-hooked raillietiellid and we have no hesitation in renaming it *R. freitasi* (Motta & Gomes, 1968) n.comb.

Two female specimens are 5 and 8 mm long with 23 and 25 annuli (considerably fewer than the 60 annuli recorded in the type description!) Both females are immature and the posterior hooks of the largest female measure AB 296, BC 345 and are therefore, as expected, much smaller than most other blunt-hooked raillietiellids. However, mature (?) female hook dimensions, which have been recalculated from Motta & Gomes' (1968) original diagram are presented in (Table IV). The fact that it infects an indigenous South American skink (i.e., it has not been desseminated through commerce — see the Discussion) is the only important feature that distinguishes this species at present.

The 3.5 mm male is immature — its copulatory spicule is not fully formed — and its annuli are uncountable.

(v) *R. monarchus* n.sp. (Table II, Figs. 1B, 4).

Host: Gecko monarchus, Kuala Lumpur, Malaysia and Taiwan.

Holotype female: 8.5 mm long, 30 annuli (BM(NH) Reg. No. 1982.9.20.2).

The remaining specimens constitute a paratype series and their characteristics are summarized in Table II. Mature females contain about 30% fully developed eggs.

The posterior hook of the mature male (AMNH 503) carries a rounded knob-like tip (Fig. 1B) which is 15 μm in diameter and the copulatory spicule is equally highly distinctive. The base is a flattened dish-like structure which is strongly hooked (Fig. 1B). It measures 330 μm in length by 135 μm across the base.

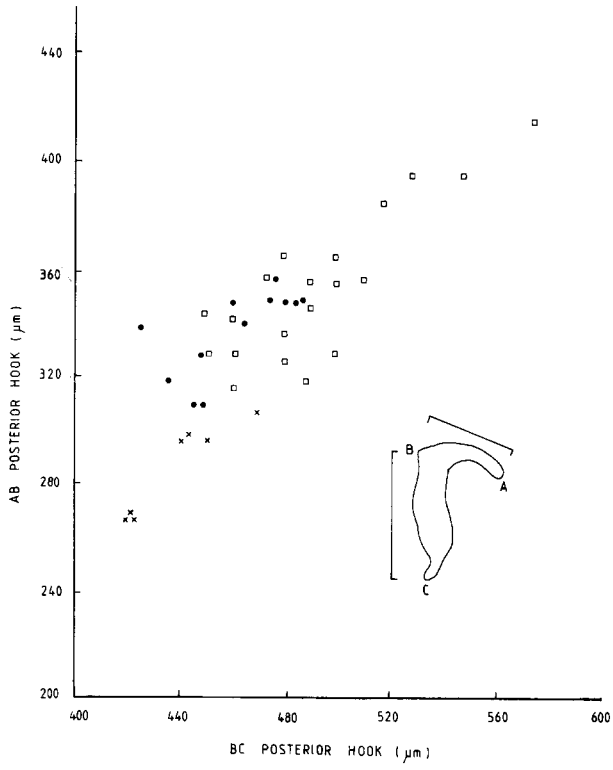

Fig. 3. A graph of mature female hook dimensions, shank length (BC) and blade length (AB), plotted against each other for three closely related South East Asian blunt-hooked raillietiellids: *R. frenatus* (□) *R. maculatus* (●) and *R. hemidactyli* (×). Note that *R. maculatus* occupies an intermediate position and although its hooks overlap with those of *R. frenatus* they are generally smaller (data for *R. frenatus* and *R. hemidactyli* taken from Ali *et al.*, 1981).

(vi) *R. hemidactyli* Hett, 1934 (Figs. 2C, 3)

Host: Calotes versicolor, India.

The taxonomy of this species has been reviewed earlier (see Ali *et al.*, 1981) and the only additional character considered here concerns the form of the male copulatory spicule (Fig. 2C). It differs from all other blunt-hooked species in that the outer face of the club-end is distinctly angular — it neither projects nor is rounded. Its measurements are 460 μm in length, 140 μm in width.

(vii) *R. maculatus* Rao & Hiregaudar, 1959 (Table III, Figs. 1C, 3)

In our earlier revision of blunt-hooked species (Ali *et al.*, 1981) we examined a few slide-mounted individuals of this species (and thus we had no information about annulus number) and found that

its hook dimensions were very similar to *R. frenatus*.

The present examination of 28 alcohol-preserved females has confirmed that although there is an overlap of hook dimensions there is a tendency for *R. frenatus* hooks to be bigger and the cluster groups have different shapes (Table III, Fig. 3).

However, *R. maculatus* females are larger (≤17.5 mm), possess more annuli (28–31, $\bar{x} = 29.4$ *contra* $\bar{x} = 25$ in *R. frenatus*) which confirms Rao & Hiregaudars' original claim of 30. Thus on most counts the species is distinguishable from *R. frenatus* but it is close to *R. hemidactyli* in terms of over-all hook size and annulus number (see Ali *et al.*, 1981). However, in this case cluster groups of hook dimensions, though close, do not overlap: the hooks of *R. hemidactyli* are smaller than those of *R. maculatus* (Fig. 3).

Males of *R. maculatus*, known from just two badly flattened, slide-mounted specimens have bluntly rounded hooks and the copulatory spicule, which is also bluntly rounded, contrasts with the more angular spicule of *R. hemidactyli* (compare Figs. 1C and 2C): it measures 430 μm long by 120 μm wide.

(viii) *R. scincoides* n.sp. (Table II, Figs. 2A, 4)

Host: Tiliqua scincoides, Murray River, South Australia.

Holotype female: 20.5 mm long, 2 mm wide, with 33 annuli (AMNH Reg. No. 471.1).

Genital pore situated between annuli 1 and 2.

The remaining two slide-mounted paratype specimens are 15.5 and 18.5 mm long and contain 36 and 42% fully developed eggs.

The male copulatory spicule (observed from slide-mounted specimens (AMNH Reg. No. 471.5–6) is strongly and uniformly curved and measures 445 μm in length and 148 μm across the base. Hook dimensions are close to *R. monarchus* (Table II, Fig. 4).

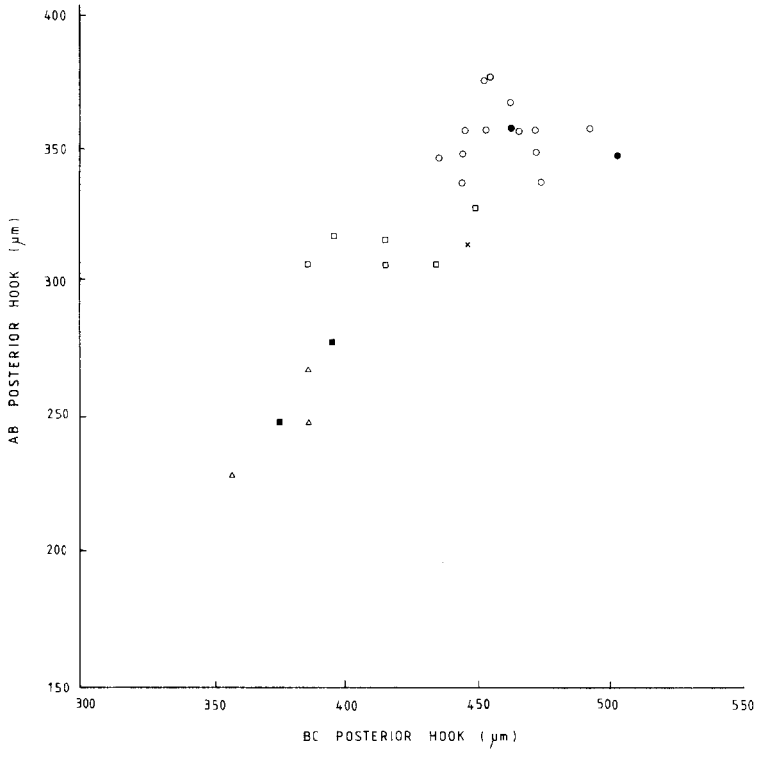

Fig. 4. The hook dimensions (plotted as in Fig. 3) for *Raillietiella* sp. from *H. brookii* (Nigeria) (●) and Puerto Rico (○) form a discrete cluster group which is separate from *R. maculilabris* n.sp. (□) and *R. mubuiae?* (×) from *Mabuya homalocephala*. The hooks of *R. scincoides* (■) and *R. monarchus* (△) are much smaller than these species.

Table III. The principal characteristics of *R. maculatus* from *Mabuya carinata* taken in India (means in parentheses)

Sex	AMNH reg. no.	No. examined	Body length (mm)	No. of annuli	Hook size (μm)			
					Anterior		Posterior	
					AB	BC	AB	BC
♀	492	3	12.5–16 (14)	30	–	227	346	484–520 (502)
♀	493	9	10–15 (12.1)	28–30 (29)	121	202 & 208 (205)	306–346 (336)	455–487 (447)
♀	494	2	9 & 12[a]	–	100 & 129 (115)	176 & 222 (199)	316 & 326 (321)	435 & 425 (430)
		8	12–17.5 (15.1)	29–30	–	–	306–356 (336)	445–475 (464)
♀	495	6	12.5–15.5 (14.1)	28–31 (29)	–	–	306 & 346 (326)	446 & 474 (460)
♂	527.1–2	2	Fragmented (slide mounted)	–	69	119 & 128 (124)	148	217 & 237 (227)

[a] immature

Discussion

Appropriate combinations of relatively few diagnostic characters, notably body-length, hook size, annulus number and the form and size of the male copulatory spicule, can reliably distinguish ten species of blunt-hooked raillietiellids (Ali *et al.*, 1981, 1982a): their characteristics are summarized in Table IV.

At least two species are known from Africa. The type description of *R. mabuiae* Heymons, 1922 is based on an immature female and its swollen caudal lobes, previously thought to be an important specific character, are most probably fixation artefacts (Ali *et al.*, 1981). Raillietiellid specimens recovered from another African skink, *Mabuya homalocephala* were mistakenly described as *R. gehyrae* by Pence & Canaris (1973). The annulus number of the specimens is close to *R. mabuiae* (Table IV), and since it came from another skink, Ali *et al.* (1981) postulated that it was most probably *R. mabuiae*. We have since realised the potential of the male copulatory spicule in specific diagnosis, and our present re-examination of Heymons (1922) original syntype male has shown that the morphology of the spicule is indeed very similar to that of Pence & Canaris' specimens: the knob-like extension of the base sets these specimens apart from other blunt-hooked raillietiellids. However Pence & Canaris (1973) record spicule length as 600–850 μm ($\bar{x} = 680$); our recalculated male hook length (BC) (from their Fig. 8) is 250 μm, and body length is 5.2–6.9 mm (Table IV). All of these dimensions are much greater than in Heymons' male syntype specimen and yet fully-formed spicules are characteristic only of mature, final instar males (Ali & Riley, 1983). On present evidence then, we conclude that these African species are very closely related, infect skinks, are geographically separated and possibly constitute more than one species: clearly more specimens are required before this can be confirmed.

R. maculilabris n.sp., another African skink parasite, is quite distinct from *R. mabuiae:* it has fewer annuli, much thicker, blunter hooks (in both sexes) and the male copulatory spicule lacks the knob-like extension. The remaining 'African' species from a Nigerian gecko, which we have left unnamed, is virtually indistinguishable from *R. frenatus* (see Ali *et al.*, 1981) and from specimens recovered from Puerto Rican Geckos (Table I). The principal reason for our indecision as to the true identity of these 'species' stems from the fact that the host species may have been disseminated through commerce (Self & Diaz, 1961). *Hemidactylus mabuiae,* the common house gecko of Africa has been spread, by boat, to many South Pacific Islands and to the West Indies, and *H. frenatus* (one of the hosts of *R. frenatus* (Ali *et al.*, 1981; Ali & Riley, 1983)) has been spread to Africa, Guam, Madagascar and Australia (Schmidt & Inger, 1957). Since the intermediate hosts of these parasites are insects (Ali & Riley, 1983) and, under certain circumstances *R. frenatus* can mature normally in gecko hosts that are not naturally infected (Lim & Yong, 1977; Ali & Riley, 1983) it is entirely possible that *R. frenatus* has been disseminated with its gecko host. Only critical life-cycle studies of these species will resolve this dilemma.

The South American species *R. freitasi* n.comb. infects an indigenous skink and therefore differences in host and geography are important reasons for considering this species are distinct. Also its hook dimensions are smaller than most of the other species (Table IV).

Some of the six South East Asian and Philippine species may, at first sight, seem difficult to differentiate. *R. gehyrae* is easily recognized by its small hooks, distinctive shape and low annulus number (Ali *et al.*, 1981; Ali & Riley, 1983). *R. affinis* and *R. monarchus* n.sp. also have comparatively small hooks (Ali *et al.*, 1982a; Table IV) but two other criteria, annulus number and the form of the copulatory spicule, separate these species: both spicules have very strongly hooked bases with the hook directed towards the inner curve of the spicule but an extra projection on the opposite side of the base characterizes *R. monarchus* (Fig. 1B). The remaining three species have spicules with more rounded bases but *R. frenatus* has fewer annuli and larger hooks than *R. hemidactyli* and *R. maculatus.* The last two though, which seem quite closely related, can be differentiated by small, but consistent, differences in the shape of the spicule base (compare

Table IV. A summary of the principal characteristics of blunt-hooked *Raillietiella*. The measurements refer to mature males and females except where indicated *

Species	Females				Males			Host	Locality	Source
	Length ($\bar{x}$) + range	Annulus number ($\bar{x}$) + range	Posterior hook ($\bar{x}$) + range		Length ($\bar{x}$) + range	Annulus number ($\bar{x}$) + range	Spicule size ($\bar{x}$ length and width) and shape			
			AB	BC						
R. gehyrae	(8) 6.3–9.5	21–22	(175) 145–198	(257) 213–296	(5) 3.4–6.4	18–19	315 and 80 (strongly hooked base)	*Gehyra mutilata*	Java and Malaysia	Ali *et al.*, 1981 Ali & Riley, 1983
R. frenatus	(10) 6.3–12	(25) 23–27	(350) 346–402	(492) 484–494	(3.6) 2.5–4.5	18–19	335 and 65 rounded base, thickened on inner surface	*Hemidactylus frenatus* *Cosymbotus platyurus* *Gehyra mutilata*	South East Asia	Ali *et al.*, 1981 Ali & Riley, 1983
R. hemidactyli	(20) 17–23	28–30	(287) 265–304	(444) 421–470	5–6	23	490 and 140 'angular' base, slight projection on inner surface	*Calotes versicolor*	India, Burma, Pakistan	Ali *et al.*, 1981
R. maculatus	(14) 12–17.5	(29) 28–31	(336) 306–356	(475) 445–520	?	?	430 and 120 club-shaped, rounded base	*Mabuya carinata*	India	Rao & Hiregaudar, 1959
R. monarchus n.sp.	(7.5) 6–8.5	(29) 28–30	(247) 227–267	(375) 356–385	5.3 (5–5.5)	25 & 27	330 and 135 strongly hooked base, projections on both sides	*Gecko monarchus*	Malaysia, Taiwan	–

R. affinis	<8.8	(24) 23–26	247	335	<5.7	(19) 18–21	360 and 125 strongly hooked base	*Gekko gecko*	Java, Indonesia	Ali *et al.*, 1982a
R. freitasi n.comb.	8.5–14.7	23–25	304[a]	400[a]	3.1–5.9	–	–	*Mabuya punctata*	Is. of Fernando de Noronha, Brazil	Motta & Gomes, 1968
R. maculilabris n.sp.	(10) 7.5–11.5	(25) 24–28	(320) 306–326	(430) 415–455	4.0	21	430 and 80 club-shaped, rounded base	*Mabuya maculilabris M. striata*	Tanzania	–
R. mabuiae	8*	30	–	–	3	–	475 and 140 [both have knob-like projection from inner surface of base]	*Mabuya sulcata*	South west Africa	Heymons, 1922 Ali *et al.*, 1981
?	(17.8) 15–21.8	28–32	288a	400a	(5.9) 5.2–6.9	21–23	680 and 140	*Mabuya homolo-cephala*	Kenya	Pence & Canaris, 1973 Ali *et al.*, 1981
R. scincoides n.sp.	(18.2) 15.5–20.5	33	262 (247–277)	385	(5.2) 4.5–6	c23	445 and 132 hooked base, strongly curved shaft	*Tiliqua scincoides*	South Australia	–

[a] recalculated from original description

Figs. 1C and 2C) and differences in hook size. Furthermore *R. hemidactyli* parasitizes an agamid lizard and *R. maculatus* a skink.

The remaining species *R. scincoides* n.sp., the only blunt-hooked species from Australia, has more annuli than any of the other related species and the male spicules are strongly curved over most of their length (Fig. 2A): in related forms normally only the distal half of the shaft is curved (Figs. 1 and 2).

The taxon now embraces ten well characterized species of blunt-hooked raillietiellids with the prospect of more to follow once more specimens become available.

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