A REDESCRIPTION OF *RADFORDILAELAPS MERIDIONALIS* ZUMPT, 1950, WITH A NEW DESCRIPTION OF THE PROTONYMPH AND A DISCUSSION ON THE INTRASPECIFIC VARIATION OF THE SPECIES.

BY

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From Mr. P. J. GELDENHUYS, of the Medical Ecology Centre, we received a collection of ectoparasites collected from various small mammals. Amongst these specimens were some mites collected from several localities in Bechuanaland found on *Pedestes capensis* Forster (= *P. cafer* (Pallas)). Although they were identified as *Radfordilaelaps meridionalis* Zumpt, it was found that they did not comply wholly with the description given by ZUMPT (1950). With our specimens, the setae on the genital plate varied mainly between five and eight, while ZUMPT figured three. Checking against the holotype and paratypes, we found that the same variation occurred as seen in our specimens. The original material was very much cleared and compressed so that accurate discernment of the number of setae proved difficult, especially as the setal arrangement lacked symmetry. This remarkable lack of symmetry in both shape of genital plate and the position of the setae and the need for a more comprehensive description based on recent taxonomic features motivated the publication of this paper. The following figures and descriptions are based on the specimens from Bechuanaland.

Female (figs. 1, 2, 3, 4).

The deutosternum bears six rows of denticles, each row consisting of two to four fine denticles. Their size varies within each respective row and from row to row, but it is generally inversely proportional to the number of teeth per row. The chelae consist of one fixed digit and one larger movable digit, the two tips coinciding, but the movable digit being inserted somewhat distally. The fixed digit (*f.d.*) measures 67 μ while the movable one (*m.d.*) is 90 μ in length (variation of 2.5 μ either way). Both the fixed and movable digits are strongly curved anteriorly, overlapping each other when closed. Each is strongly bidentate although the fixed digit may bear a small tooth between the first prominent tooth and the anterior, curved tip. The external face of the fixed digit bears, one sixth of the way from the tip, a small, inflated *pilus dentilus* (*p. dent.*). The terminal end of the fixed digit is defined by a lyriform fissure (*d.l. fiss.*), (EVANS & TILL, 1965), which originates dorsally and extends to the lateral surface (fig. 1). Immediately posterior to the lyriform fissure is the dorsal seta (*d.s.*), being somewhat smaller than the *pilus dentilus*, but quite stout. A lateral fissure (*lat. fiss.*) is present immediately below and posterior to the acetabulum of the movable digit. The Arthrodial process (*arth. pr.*) is spiral or coronet in structure, bearing subequal filaments.

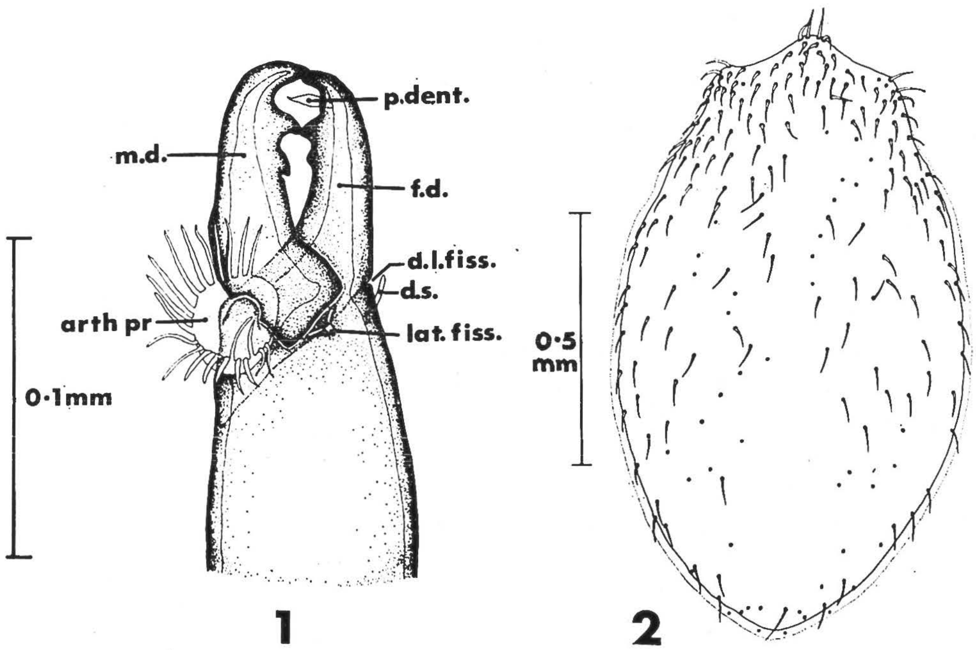

FIG. 1-2 : *Radfordilaelaps meridionalis* Zumpt.
1. — Female chela. 2. — Dorsal shield of female.

The capitulum bears one pair of setae (*c.s.*) while there are three pairs of setae on the hypostome. The ratio of the setal lengths of hyp. 1. : hyp. 2.: hyp. 3.: c.s. are 2:1:3:2 (chaetotaxal designation according to EVANS & TILL, 1965). The hypostomal process is quite distinctive, pilose, and having an inner serrated border with two lateral brushes of club-shaped filaments.

The dorsal shield is eliptical in shape, with a pair of prominent 'shoulders' at the anterior tip (fig. 2). The maximum width varies from 646 μ to 720 μ, occurring slightly more than one third from the posterior tip. The median length of the dorsal shield varies from 1102 μ to 1205 μ, a difference of 103 μ (1.129 mm to 1.80 mm was recorded by ZUMPT, 1950). DL/DW shows a great deal of variation, being

1.49-1.84. The setal arrangement on the dorsal shield tends to form a hypertrichous condition at the anterior end to perhaps what could be considered as holotrichy posteriorly. The setae are slightly stouter anteriorly but are simple throughout except the terminal pair which is barbed. As in the deuto-and protonymph, the shield exhibits a 'rosette' pattern of lighter chitinisation in the anterior medial, mediolateral and posterior medial regions. In these areas, an underlying granulation can be seen, which is obscured by transversely running reticulation elsewhere. A relatively broad hyaline margin or border can be seen surrounding the shieldproper, and bearing a regular row of simple setae. It cannot be discerned anteriorly owing to the strong curving of the shield just posterior to the shoulders.

TABLE 1.

Idiosomal shield measurements of ten females of *Radfordilaelaps meridionalis* Zumpt (in μ units).

Shield Measurements	1	2	3	4	5	6	7	8	9	10	Variation	Difference
DL	1144	1188	1048	1192	*1102*	1192	1155	1191	*1205*	1075	1102-1205	(103)
DW	686	*646*	706	698	*720*	713	705	675	*720*	706	646-720	(74)
DL/DW	1.67	*1.84*	*1.49*	1.71	1.53	1.67	1.64	1.77	1.67	*1.49*	1.49-1.84	
SL	160	162	172	162	*154*	162	169	162	*177*	167	154-177	(23)
SW	252	218	269	272	*215*	*265*	250	250	264	250	215-265	(50)
SL/SW	.64	*.84*	.64	*.60*	.72	.61	.68	.65	.67	.67	.60-.84	
GL	377	*443*	412	397	382	397	*353*	360	426	362	353-443	(90)
GFL	136	*197*	140	143	*119*	139	160	122	156	*119*	119-197	(78)
AL	180	*152*	164	175	*183*	167	160	160	180	163	152-183	(31)
AW	128	123	*121*	124	*121*	136	*121*	128	*137*	124	121-137	(16)
AL/AW	1.4	1.24	1.36	1.41	*1.51*	*1.23*	1.32	1.24	1.32	1.31	1.23-1.51	

The sternal shield is roughly one and a half times as broad as long, being strongly reticulate and demarcated anteriorly from the likewise reticulate presternal area (fig. 3). Placed in a medially anterior position in the presternal area is the pilose, biramous tritosternum. The area at the point of origin of the tritosternum is free of reticulation, giving the effect of a small plate. The anterior half of the sternal plate seems to be more strongly chitinised, the posterior limit of this hyperchitinisation being at the level of the second pair of sternal pores. The first pair of pores lies just posterior to the first pair of setae, which are situated on the anterior border and somewhat in from the lateral margins. The median sternal length varies from 154 μ to 177 μ. The sternal width, taken at the level of the second sternal seta, varies from 215 μ to 265 μ. The ratio SL/SW is from .60-.84. Sternal setae measurements are : st.1. = 90-95 μ ; st. 2. = 140-145 μ ; st. 3. = 150-155 μ. The matasternal setae are somewhat longer being 170-180 μ.

A considerable amount of variation can be seen in the genital shield both in shape and setation (fig. 4). Width measurements were not taken as, owing to the lack of symmetrical setation, no constant level of measurement could be established. However, one can see the considerable length variation. GL (taken from the medial posterior tip of the sternal plate to the posterior tip of the genital shield) varies from 353 μ to 443 μ, the difference being 90 μ. The main variability is that

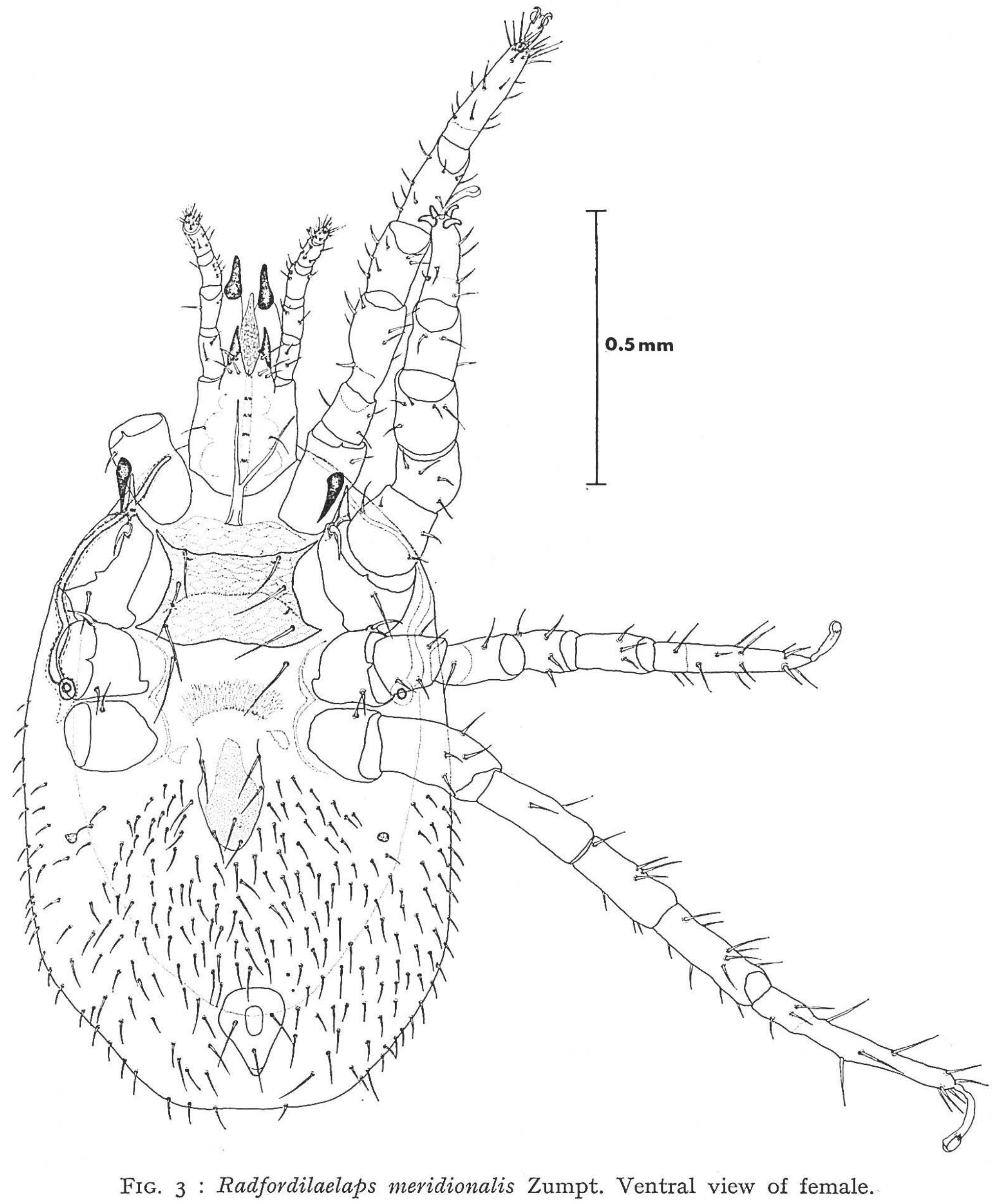

FIG. 3 : *Radfordilaelaps meridionalis* Zumpt. Ventral view of female.

of the genital plate (i.e. excluding the genital flap) since GFL, the length of the genital plate taken from the posterior border of the genital flap, measures from 119 μ to 197 μ and the difference being 78 μ. Thus the genital flap varies only 12 μ in comparison to the 78 μ variability of the genital plate. It would seem that the great variability of the genital plate comes from the degree of chitinisation of the posterior area of the genital plate (fig. 4). The number of setae on the genital plate varies from eight (rarely nine) to five. In all cases there are two pairs of setae, situated in the anterior two-thirds of the genital plate, so that hypertrichy may occur on the posterior tip. In fig. 4 the genital plates have been drawn in an arbitrarysequence, tending from a holotrichous condition with a clearly defined border (fig. 4 a) and bearing nine setae through a series of plates with a weakly chitinised posterior and bearing nine to seven setae (fig. 4, B, G), to a holotrichous or hypotrichous condition of five setae and clearly defined border (fig. 4h). From the above mentioned figures it can be seen that the authors consider the delineations of a genital plate as the area free of cuticular striation. In cases of weak chitinisation of the posterior tip, the limits of the plate are ill-defined, and seem to be a result of an encroachment of the cuticular area or a reduction of chitinisation. From figs. 4 b-g, one could say that the true genital plate bears 5 setae (fig. 4 f bears four) and there is a hyaline 'flap' or 'ring' bearing two to four unpaired setae. However, two of the depicted plates (figs. 4 a and h) have no such flap and bear nine and five setae respectively on a homogenously chitinised shield with distinct limits. Two possible alternatives to explain this phenomenon present themselves, the one being of mechanical instigation, and the other developmental. The specimens with the weakly defined posterior borders may have been overcleared in lactophenol, during the mounting process, or alternatively, they represent a tendency in reduction of the genital plate. However, even if one accepts the former as a solution, one cannot deny that the posterior border must have been more weakly chitinised at the outset, since it is only this area that suffers this cuticular encroachment. Thus, the distinction is purely a temporal one. In the one case, it would be an already manifest reduction of the genital shield in the posterior region, while in the other the *tendency* is present, in the form of a weakly chitinised posterior region. This trend in the reduction of chitinised areas is a characteristic of parasitic adaptation. The probable position of *Radfordilaelaps meridionalis* along this free-living to obligatory parasitism gradient will be discussed later in the paper.

The anal plate is pear-shaped to spade-shaped, being longer than broad. AL is from 152 μ to 183 μ, a fluctuation of 31 μ. AW is from 121 μ to 137 μ, a difference of 16 μ. The greater deviation in the length could be perhaps explained by the fact that the anal plate tends to curve over and often the overall length cannot be seen in the same plane of focus, resulting in a false range of lenghts in the lower limits. AL/AW is from 1.23 to 1.51. There is a concentrically reticulate pattern about the anal aperture, and marginally, a faint granulation can be seen. The anal aperture is its length, or slightly less, from the anterior margin of the plate. The paranal setae are from 70 μ to 85 μ in length, and situated level with the anal

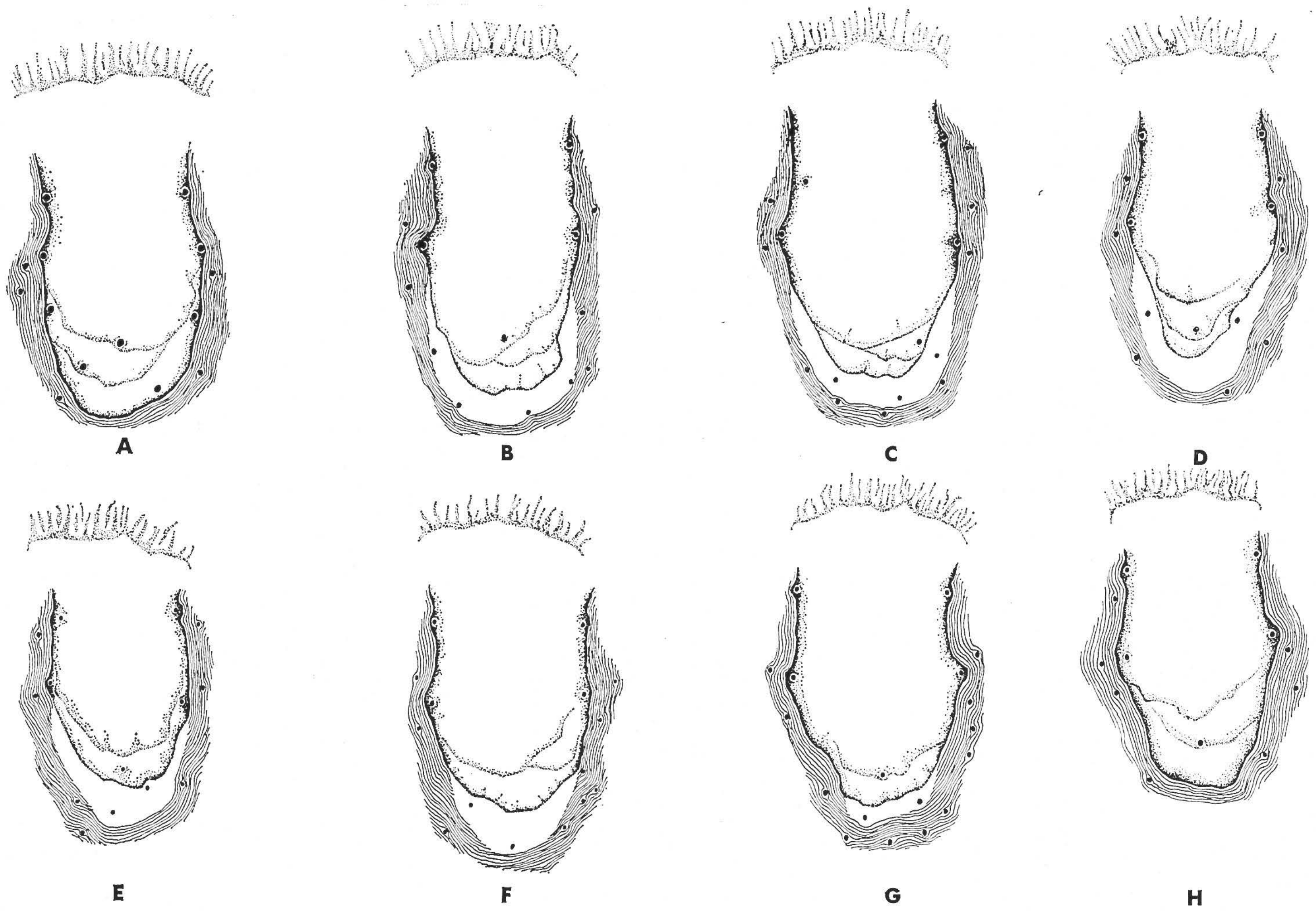

FIG. 4 (A-H) : *Radfordilaelaps meridionalis* Zumpt.
Genital plates of eight females showing intraspecific variation in shape and setation.

midline or in the anterior half of the anal aperture. The postanal seta varies from 80 μ to 95 μ in length and situated medially behind the anus. There are large numbers of aciculae born terminally on the anal plate.

The integument of the idiosoma exhibits a hypertrichous condition, being more setulate on the mid-venter. Laterally, behind coxae IV, lie the metapodal plates, being small and of varied shape. On the margin of the idiosoma the setae tend to be barbed while centrally they are simple. In length the integumental setae are slightly smaller or equal to the paranal setae. The peritreme reaches the anterior border of coxa I.

The chaetotaxy of the legs is as follows :

Leg No.	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	6	13	13	13	Numerous (38 approx.)
II	2	5	11	11	10	16
III	2	5	6	9	8	16
IV	1	5	6	11	10	16
Pedipalp	–	2	5	6	7–9	16 (approx.)

The proximal seta on coxa I takes the form of a large inwardly curving spine. The circumsegmental fringe of filaments on the anterior border of the leg segments has been reduced to one medioventral hypertrophied spine, found on coxae I to IV. In addition, coxa II bears a large spine-like process on its anterior dorsolateral border. The ventral anteriolateral setae of coxae II and III are thickened, curving to the posterior, the former seta being more thickened and curved than the latter. Tarsus II bears four stout blunt spines terminally. The apotele of the pedipalp is two-tined. The first limb bears a clawed ambulacrum, while the remaining three have no claws, the ambulacrum consisting of a pulvillus only. This is unusual, as the first limb of Mesostigmata is sensory in function, bearing a reduced claw or the claw being lost, with the remainder strengthened for walking.

Male (figs. 5 & 6).

Deutosternum bears six rows of two to three denticles, which are larger than those of the female. The male chelicerae (fig. 5) are modified and similar to those of the *Laelaps-Androlaelaps* group, and consist of one fixed (*f.d.*) and one movable digit (*m.d.*). The fixed digit is a slender, strongly curved, terminally pointed structure, devoid of denticulation, and bearing a slender *pilus dentilus* (*p.dent.*) on its external face. The *pilus dentilus* is two to three times the length of the dorsal seta. The dorsal seta (*d.s.*) is located posterior to or level with the point of origin of the fixed digit. The base to tip length of the fixed digit is in the region of 80 μ. The movable digit is greatly modified and carries a grooved spermadactyl (*spdyl.*) ventrally. The length of the fixed digit varies from a half to two-thirds the length of the spermadactyl, being very difficult to discern. The lyriform fissure (*d.l.fiss.*) is just anterior to the dorsal seta, being dorsal and not extending ventrally as in the female. The lateral fissure (*lat. fiss.*) is similarly placed to that of the female being posterior to the movable digit. The arthrodial process (*arth. pr.*) is a coronet fringed with subequal filaments. These are somewhat coarser than those of the female.

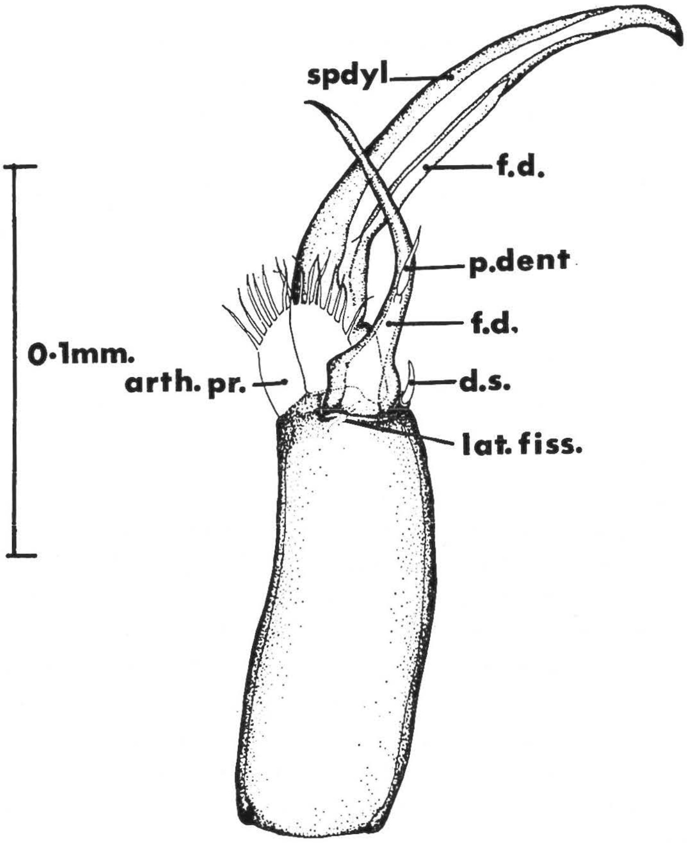

FIG. 5 : *Radfordilaelaps meridionalis* Zumpt. Male chela.

The ratio of the capitular and hypostomal setae is as found in the female. Likewise, the hypostomal process, which is pilose, having an inner serrated border with two lateral brushes of club-shaped filaments, is as in the female.

The dorsal shield is similar in shape to that of the female and having a pair of prominent shoulders at the anterior tip. The following are measurements of the dorsal plates of four males (in μ units).

Although insufficient material was examined, the below measurements may act as a guide. As in the female, the dorsal shield of the male bears laterally running reticulations. It would seem that it is more heavily chitinised in comparison with the female, as no 'rosettes' could be seen. There is no reduction of setae on the dorsal shield from anterior to posterior, instead a strongly hypertrichous condition exists throughout.

Measurement	1	2	3	4	Variation	Difference
DL	*898*	855	*800*	864	800–898	98
DW	522	478	*521*	*530*	521–530	9
DL/DW	1.72	*1.79*	*1.54*	1.63	1.54–1.79	

Medially, below the gnathosoma, is the pilose, bifurcate tritosternum. The presternal area is reticulate. Covering most of the idiosoma medioventrally is the holoventral plate (fig. 6). It is made up of a fusion of the sternal, metasternal, endopodal, genital, ventral and anal plates. The fusion of the endopodal plates to the holoventral plate is incomplete and the exact point of union is difficult to establish, but seems to be at the level of the middle of the third coxa. The shield is reticulate with an underlying pattern of granulation throughout. Medially, on the anterior border, is the genital aperture, closed by a single valve. The first pair of holoventral setae is placed similarly to that of the female. Holoventral seta two is one and a third to one and a half times as long as the first holoventral seta. Holoventral seta three is slightly longer than holoventral seta two and slightly shorter than the largest pair of holoventral setae, namely holoventral seta four or the metasternal seta (120 μ-130 μ). Two pairs of pores are situated, as in the female, behind the first and second pairs of holoventral setae respectively. Excluding the above first four pairs of holoventral setae, the remainder of the setae are unpaired and roughly subequal, varying from 35 μ to 50 μ in length. These setae number close on one hundred (70-90) and start between the third and fourth pairs of holoventral setae, extending to the border of the anal area.

The paranal setae are inserted on either side of the anal aperture, at about one-sixth the anal length from anterior border of the anus. The postanal seta is medioterminal to the anus and roughly subequal to the paranal setae, being 50 μ in length. The terminal tip of the anal area bears a large number of aciculae. In general, the holoventral plate exhibits similar hypertrichy to that of the dorsal shield.

The metapodal plates are somewhat larger than those of the female and are irregularly oblong. The idiosomal setae exhibit a hypertrichous condition, and are more dense around the lateral aspects of the holoventral shield. The setae are simple, except for a few scattered barbed setae on the posteriolateral periphery. The peritremes, as in the female, reach level with the anterior of coxa I.

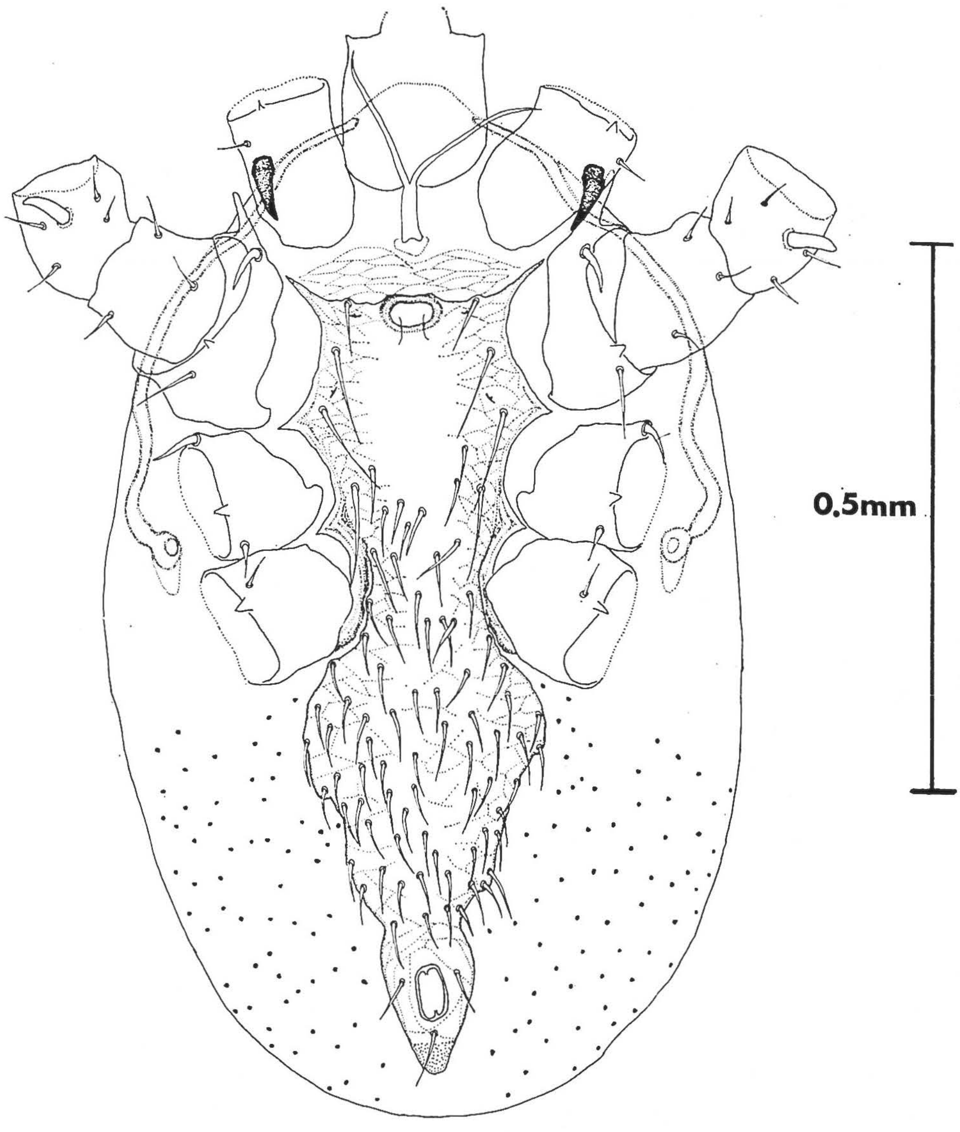

FIG. 6 : *Radfordilaelaps meridionalis* Zumpt. Ventral view of male.

The leg setation of the male is listed below.

Leg No.	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	6	13	13	13	38 approx.
II	3	5	11	11	9–10	16
III	2	5	6	9	8	16
IV	1	5	6	10	11	16
Pedipalp	–	2	5	6	7	18 approx.

The proximal seta of coxa I is thickened into a prominent spine which is characteristic for the genus, and found in all stages examined (i.e. all except the larva). The circumsegmental filaments on the anterior border of the limb segments have been reduced, as in the female. A single hypertrophied spine-like process remains on all the coxae medioventrally, with coxa II bearing a large, anteriolateral spine-like process ventrally, as in the female. The anteriolateral setae of coxae II and III are thickened and curving posteriorly, the former being more curved and thicker than the latter. This, again, is a feature common to all stages studied. Femur II bears a stout spine ventrally, reminiscent of the *Androlaelaps* group. Four stout, blunt setae are located on the terminal tip of tarsus II and an additional stout, blunt, bipartite seta is placed midventrally. An apotele is present on the terminal portion of the pedipalp. The ambulacra are as those found in the female with only the first ambulacrum being clawed.

Protonymph (fig. 7).

In the protonymph, the deutosternum exhibits a certain amount of deviation from that seen in the female and male of this species. Generally speaking, the deutosternum bears six rows of two to four teeth per row. However, in the six specimens examined, the terminal or anterior row consisted of two prominent teeth in four cases, but in the other two specimens, the teeth had divided into one group of two and another of three small teeth. Also, in one specimen, there was a row of five teeth found lower down on the deutosternum. The chelicerae are chelate, with the fixed digit bearing a *pilus dentilus* on its external surface. They are similar to those of the female but somewhat smaller, being 45 µ to 50 µ in length, and bearing a coronet arthrodial process with subequal filaments.

The ratio of the capitular and hypostomal setae is as found in the female, and the hypostomal process is also the same.

The dorsal chitinisation consists of an anterior podonotal shield, a posterior pygidial shield and with two to three pairs of mesonotal scutellae situated between

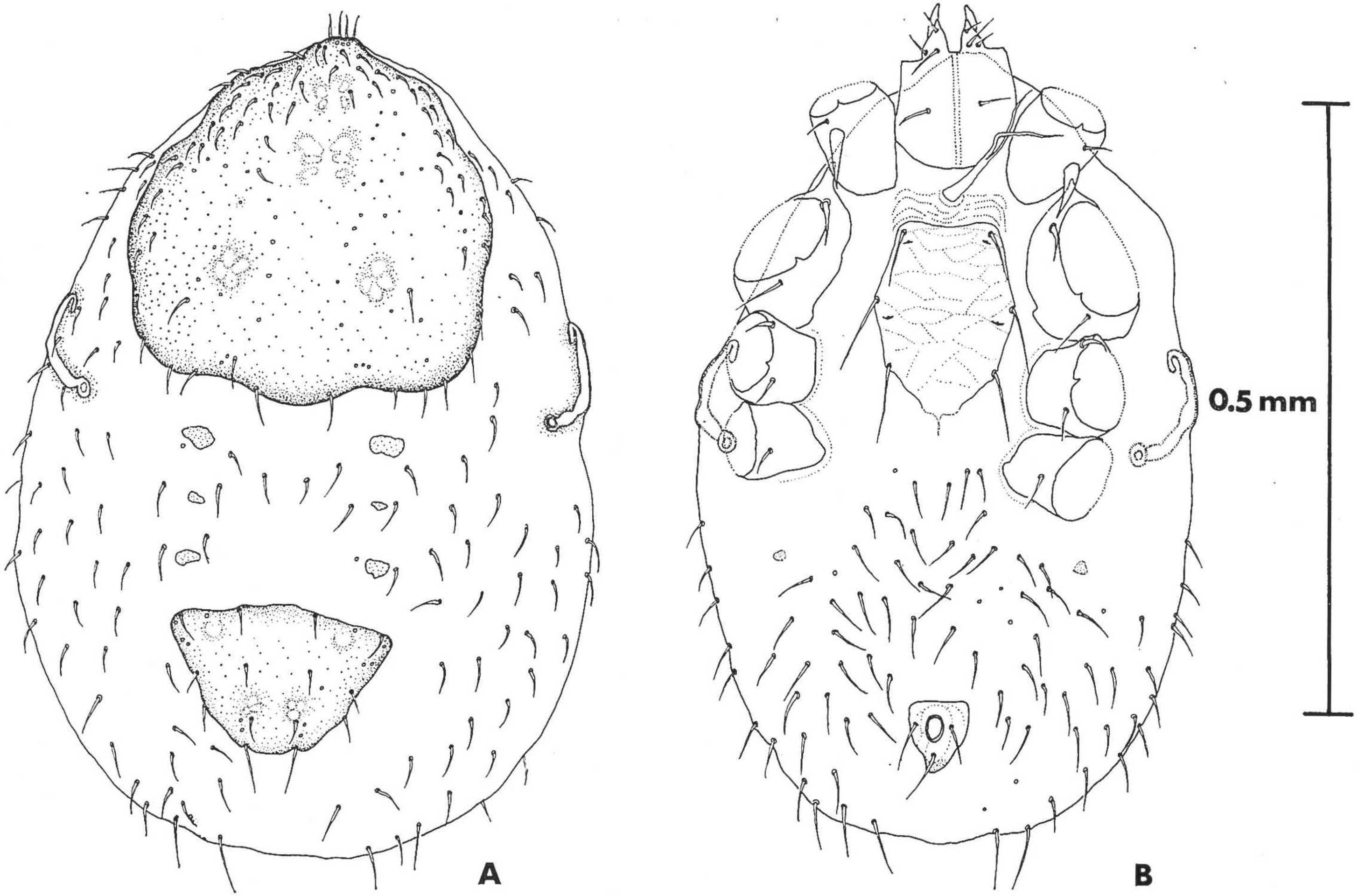

FIG. 7 (A-B) : *Radfordilaelaps meridionalis* Zumpt.
A. — Dorsal view of protonymph. B. — Ventral view of protonymph.

the two (fig. 7 A). The podonotal shield exhibits the hypertrichous condition of the female, and rosette areas can be seen. A faint lateral reticulation can be seen. The granulation is lacking or indistinct. Usually three pairs of irregularly-shaped mesonotal scutellae can be seen. The pygidial shield tends towards holotrichy or perhaps hypotrichy, the number of setae being constant. This can only be seen because the setulation is paired and scanty in comparison with the podonotal shield. The two terminal setae of the pygidial shield are barbed, while the remainder, as those of the idiosoma, are simple. Rosettes occur on the pygidial shield too.

The tritosternum is bifid and pilcse. The presternal area is reticulate and poorly demarcated from the sternal plate, which is pentagonal in shape (fig. 7 B). It is broadest at the second pair of sternal setae, and has a faint lateral reticulation. The sternal setae are situated on the lateral margins of the plate, with the first pair being shorter than the remaining two roughly subequal setae (st. 1. : st. 2. : st. 3. is 65 μ : 80 μ : 90 μ). Two pairs of sternal pores are situated behind sternal setae one and two respectively.

The idiosoma displays a hypertrichous condition, with the setae being grouped medially and laterally. The peritreme is short, situated between coxae II and IV, recurving anteriorly. A faint pair of metapodal plates can be seen.

The anal plate is a half-elipse, with a slight constriction posterior to the postanal seta. The anterior border is straight. The paranal setae are somewhat shorter than the postanal seta (55 μ and 60 μ respectively) and situated lateral to the anus and in the anterior third of its length. Immediately posterior to the postanal seta are numerous aciculae reaching to the posterior tip of the anal plate.

The leg setation is listed below.

Leg No.	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	4	10	8	8	30 approx.
II	3	4	8	6	7	15
III	2	4	5	6	7	15
IV	1	4	4	6	7	15
Pedipalp	–	1	4	4–5	7	14

Proximal seta of coxa I is thickened into a stout spine; circumsegmental filaments are reduced into a single hypertrophied spine found medioventrally on the anterior border of coxae I-IV, with coxa II bearing a large anterior lateral process dorsally. Anteriorlateral setae of coxae II and III are thickened and curved posteriad. Tarsus II bears four stout blunt spines terminally. A two-tined apotele is present

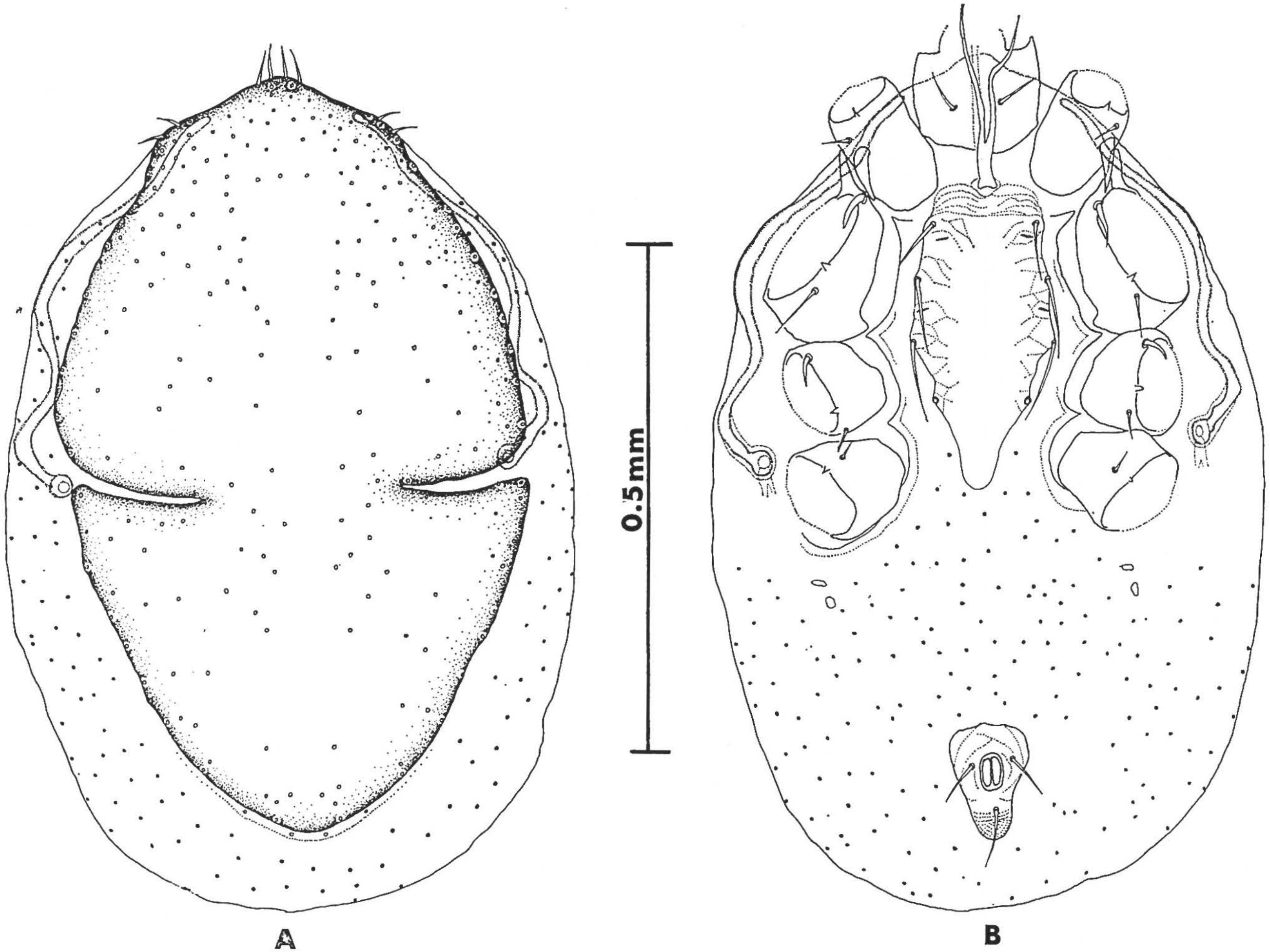

FIG. 8 (A-B) : *Radfordilaelaps meridionalis* Zumpt.
A. — Dorsal view of deutonymph. B. — Ventral view of deutonymph.

terminally on the pedipalp. Ambulacrum I is clawed, the remainder only with pulvilli.

Deutonymph (fig. 8).

In the deutonymph, a reduction of deutosternal teeth seems to have taken place. In four specimens, six rows of two teeth per row were seen, except for the first or anterior row, in which the two teeth have subdivided to give four to five small teeth. The chelae are slightly larger than those of the protonymph but of the same basic female type, being 55 to 60 μ long.

Again, the ratio of the capitular pair of setae to hypostomal pairs one, two and three, is the same as in the female.

The prodonotal, mesonotal and pygidial elements of the dorsum have united in the deutonymph to form an almost entire dorsal shield. Lateral incisions of incomplete union can be seen at the level of the stigmata (fig. 8 A). Rosettes can be seen in the same areas that correspond to the adult female. A lateral reticulate pattern covers the shield, with an underlying granulation in the rosette areas. A hyaline margin can be seen in the posterior of the shield but it loses clarity anteriorly. The terminal pair of setae on the dorsal shield proper are barbed, the remainder being simple. Anteriorly, shoulders are present. The setation resembles that of the female, tending from hypertrichy anteriorly to holotrichy posteriorly. DL varies from 702 μ to 797 μ ; DW is from 398 μ to 538 μ ; DL/DW is from 1.68 to 1.86.

The tritosternum is biramous and pilose, set medioanterially in the presternal area. This area is reticulate and indistinctly separated from the likewise reticulate sternal area (fig. 8 B). The sternal setae are set in the lateral margins of the plate and number four pairs. The lengths of st. 1: st. 2: st. 3: are roughly 65 μ: 90 μ: 100 μ respectively. The fourth pair, the metasternal setae were lost in all the specimens examined and so no measurements were taken, but in all probability would be of the order of 100 μ plus. Fusion of the endopodal plates to the sternal shield has not taken place, but the shield has elongated to reach the level of the fourth coxa. SL varies from 286 μ to 362 μ ; SW is from 153 μ to 187 μ.

The anal plate is large and more irregular than that of the protonymph, AL being from 95 μ to 102 μ, AW from 75 μ to 95 μ, while AL/AW varies from 1.22 to 1.54. The plate is reticulate with uneven chitinisation on the margins. The paranal setae are inserted level with the anterior third of the anal length, being 55 μ long, while the postanal seta is slightly longer, being some 60 μ in length. Aciculae cover the area posterior to the postanal seta.

The remainder of the venter exhibits a hypertrichous condition. The peritremes have attained their full length, reaching the anterior border of coxa I.

The leg setation is as follows :

Leg No.	Coxa	Trochanter	Femur	Genu	Tibia	Tarsus
I	2	6	13	13	13	38 approx.
II	2	5	11	11	10	16
III	2	5	6	9	8	16
IV	1	5	6	11	10	16
Pedipalps	–	2	5	6	7	18 approx.

The remainder of the leg detail is identical to that of the protonymph, or for that matter, the female.

TABLE 2. — Idiosomal shield measurements of ten deutonymphs of *Radfordilaelaps meridionalis* Zumpt (in μ units).

Shield Measurement	1	2	3	4	5	6	7	8	9	10	Variation
DL	754	870	739	*797*	754	885	739	842	727	*702*	702-797
DW	442	501	440	478	442	*578*	413	487	*398*	412	398-538
DL/DW	1.71	1.74	*1.68*	1.67	1.71	*1.86*	1.79	1.73	1.82	1.70	1.68-1.86
SL	299	*362*	304	312	304	340	*286*	*362*	304	312	286-362
SW	170	163	177	*153*	164	*187*	170	174	*153*	*153*	153-187
AL	116	116	*95*	—	109	*122*	105	*122*	102	—	95-122
AW	*75*	78	78	—	85	*95*	85	91	78	—	75-95
AL/AW	*1.54*	1.49	*1.22*	—	1.28	1.29	1.24	1.33	1.31	—	1.22-1.54

Discussion.

In trying to place *Radfordilaelaps meridionalis* Zumpt into categories such as free-living mite and obligatory or facultative parasite or, for that matter, establishing taxonomical affiliations, one is faced with the problem of basing assumptions on morphological similarity and comparative deductions from other related groups of mites. ZUMPT and PATTERSON (1951) pointed out, with respect to feeding habit status, that " All transitions between these two ecological groups are found at present, and it is sometimes extremely difficult, if not impossible, to separate, without ecological studies, the real parasites from non-parasitic and symphoristic forms ".

Inductively, however, one can arrive at certain conclusions, which are, of course, subject to correction, following a bionomical study of this species. *Radfordilaelaps meridionalis* Zumpt is a dermanyssid mite (Dermanyssidae Kolenati, 1859 has priority over Laelaptidae Berlese, 1892, as pointed out by Evans and Till, 1966) and has morphological affiliations to both the Haemogamasinae and Laelapinae sub-familial units. The gradient from a free-living mode of life to an obligate parasitism involves an intermediate non-specialised (polyphagous) feeding phase which includes facultative nest-inhabiting parasites. In our opinion, *Radfordilaelaps* belongs to this last mentioned category, showing a mixture of free-living and parasitic characters. The Laelapinae are closer to obligate parasitism than are the Haemogamasinae, and although both have representatives amongst the facultative parasites, the Haemogamasinae are fewer and somewhat doubtful, probably only reaching the polyphagous nest inhabitant phase. The enlarged dorsal seta on the chelicerae of *Radfordilaelaps* is a free-living character, as is the coronet-like arthrodial process (*Androlaelaps-Laelaps* complex tends to a reduction of the process). The Haemogamasinae also exhibit a marked hypertrichy of the genital plate, a feature of *Radfordilaelaps*. However, there are several morphological features of this species which approximate the condition found in the Laelapinae, with special reference to the *Laelaps-Androlaelaps* complex. In the male of *Radfordilaelaps* the reduction of the fixed digit, and proliferation of the spermadactyl follows the pattern of the Laelapinae. The spine on femur II of the male *Radfordilaelaps* is also reminiscent of genus *Androlaelaps*. Six rows of deutosternal teeth is also a feature of the Laelapinae, while the lower number of teeth per row of *Radfordilaelaps* (2-8 is the normal variation) approximates the condition found in obligatory parasites. Hypertrophy of the medial process of the circumsegmental filaments and the anterior dorsolateral spine on coxa II is also a move towards the obligate mode of life, as is the reduction of the genital plate. The last mentioned is a debatable point. One might say that it is not a reduction but a proliferation (i.e. going from fig. 4 h to a instead of a to h). However, if one accepts that *Radfordilaelaps* is a facultative parasite, or at least, a polyphagous nest inhabitant, then regressive evolution is highly unlikely, and reduction of the genital plate is apparently the case.

To conclude, it would seem that the free-living progenitors of the parasitic forms are of *Hypoaspis* stock (Evans & Till, 1966 ; Zumpt & Patterson, 1951), with the intermediate polyphagous forms found amongst the Haemogamasinae and more primitive Laelapinae. It would seem that *Radfordilaelaps* is an intermediate form between these two sub-families, having somewhat closer affiliation with the Laelapinae than the Haemogamasinae.

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REFERENCES

EVANS (G. O.) and TILL (W. M.), 1965. — Studies on the British Dermanyssidae (Acari : Mesostigmata). Part I : external morphology. Bull. Brit. Mus. (Nat. Hist.), **13** (8) : 247-294.

EVANS (G. O.) and TILL (W. M.), 1966. — Studies on the British Dermanyssidae (Acari : Mesostigmata). Part II : classification. Bull. Brit. Mus. (Nat. Hist.), **14** (5) : 107-370.

ZUMPT (F.), 1950. — A new blood-sucking mite from the South African Springhare. J. ent. Soc. S. Afr., **13** : 83-86.

ZUMPT (F.) and PATTERSON (P. M.), 1951. — Further notes on laelaptid mites parasitic on Vertebrates. A preliminary study to the Ethiopian fauna. J. ent. Soc. S. Afr., **14** : 63-93.