BIOLOGY AND SYSTEMATICS OF SOME SOUTHERN AFRICAN MYRMELEONTOID INSECTS (ORDER NEUROPTERA)

BY

M.W. MANSELL

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Department of Zoology and Entomology,
Rhodes University,
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CONTENTS

1. INTRODUCTION

This is a study of the biology and systematics of the Myrmeleontidae and Nemopteridae, two of five families comprising the superfamily Myrmeleontoidea in the order Neuroptera. Originally the Myrmeleontidae were chosen for study because they have many southern African representatives about which little was known. Also, the taxonomy of the southern African Myrmeleontidae was unsatisfactory: systematic studies had previously been based only on adult morphology, descriptions of genera and species were superficial and in many cases published in parochial journals. Some pit-building myrmeleontid larvae were known but none had ever been reared or correlated with identified adult specimens. The initial objective of this research therefore, was to discover and correlate the larval stages of the Myrmeleontidae with known adult specimens, and as a prerequisite, to produce a catalogue of described taxa in the Myrmeleontidae from southern Africa (Appendix 2).

Research on the myrmeleontids has now been in progress for about eight years and during this time numerous collecting trips have been arranged, collections of adult and larval specimens compiled, and literature has been surveyed. Visits have been made to all the southern African museums, and during 1974, a six-month-long study tour was undertaken to museums in Britain and Europe to study collections of adult Myrmeleontidae.

Eventually the study of myrmeleontids became attenuated in favour of a more detailed investigation of the Nemopteridae, a family which comprises two distinct subfamilies, Nemopterinae and

Crocinae. This redirection of research interests came with a realization that it would require many more years to complete a study of the Myrmeleontidae. However, the information which has been compiled on the myrmeleontids and the experience gained, provides a background and perspective for the more detailed account of the Nemopteridae (especially Crocinae) which is a central theme of this dissertation.

Interest in the Nemopteridae was initially stimulated by the monographic revision of Tjeder (1967) in which he stated that nothing was known about the immature stages of Nemopteridae from southern Africa. During 1973 a search for nemopterid larvae was started and the larvae of <u>Derhynchia</u> <u>vansoni</u> Tjeder were discovered, correlated and described (Mansell, 1973). These larvae were the first belonging to the subfamily Nemopterinae to be described from Africa. In 1974 larvae of the other nemopterid subfamily, the Crocinae, were found, also for the first time, in a small cave in the Namib desert of South West Africa (Mansell, 1976). These were the only crocin larvae known from the southern hemisphere at the time, and their discovery has led to a detailed study of the subfamily in southern Africa. The Crocinae in the subregion now comprise ten known species and the biological and systematic information gained is presented here.

The account starts (chapter 2) with a general consideration of the classification, distribution and phylogeny of the Myrmeleontoidea, emphasizing the position of the Myrmeleontidae, Nemopterinae and particularly the Crocinae. Chapter 3 deals only with the Myrmeleontidae and Nemopteridae, the first section providing a summary of previous work on these two families from southern Africa. This is follwed by a description of the procedures adopted in the study, and a general account of the biology of the Myrmeleontidae Nemopterinae and Crocinae. In chapter 4 a systematic revision of the subfamily Crocinae in southern Africa is presented and summarized in a set of illustrated keys. All this information is then discussed in a wider context in chapter 5.

2. THE SUPERFAMILY MYRMELEONTOIDEA

The superfamily Myrmeleontoidea is one of five superfamilies comprising the order Neuroptera (Riek, 1970). The Neuroptera are considered a separate order from the Megaloptera and Raphidioptera, and constitute what was formerly known as the suborder Planipennia (Riek, 1970; Kristensen, 1975).

2.1 Families and characteristics of the Myrmeleontoidea

The Families. The superfamily Myrmeleontoidea contains the families Myrmeleontidae, Nemopteridae, Ascalaphidae, Stilbopterygidae and Nymphidae. This classification is recognised by recent authors, including Richards & Davies (1977), Hölzel (1975), Riek (1970) and Stange (1967). The present arrangement of the families was suggested by Withycombe (1925), when he divided the Neuroptera into five superfamilies. In the Myrmeleontoidea, he included four of the five families mentioned above, and included the fifth, the Stilbopterygidae, within the Ascalaphidae. The classification proposed by Withycombe was also followed by Berland and Grassé (1951).

Tillyard (1926) assigned the Nemopteridae to a separate superfamily, the Nemopteroidea, and recognised five families, Myrmeleontidae, Ascalaphidae, Stilbopterygidae, Nymphidae and Myiodactylidae, within the Myrmeleontoidea. Tillyard's classification was also used by Brues, Melander & Carpenter (1954). Although the Nemopteridae are unique in the extreme specialization of the hindwings, they possess many characters such as the venation of the forewings and the morphology of the larvae, which warrant their inclusion in the Myrmeleontoidea, so Tillyard's (1926) classification has not been adopted by recent authors or by me.

Characteristics. The Myrmeleontoidea are characterized by larvae which have broad bodies bearing setae modified as dolichasters, and curved mandibles, which together with the maxillae form the specialized suctorial mouthparts (Imms, 1964). The larvae of all families, except the Nemopteridae, have mandibular teeth. The metathoracic legs of Myrmeleontidae, the prothoracic legs of some Nemopteridae (Mansell, 1973) and all the legs of the Ascalaphidae have the tibiae and the tarsi fused and tarsal empodia are lacking in all families. Larvae are all terrestrial or arboreal, and pupation takes place in a silken cocoon which is constructed from silk produced by modified malpighian tubules (Withycombe, 1925).

In the adults, the wings all conform to a similar basic pattern, being reticulated with a narrow costal area (except some Nymphidae) and only one radial sector. The sub-costa and radius are fused distally and only in the Nymphidae do cross-veins occur between them (Richards & Davies, 1977). The median and cubital veins in the forewings are forked and, with the exception of the Nymphidae which show a generalized pattern, the forks usually coalesce with other veins which obscure their true appearance. The anal veins are also much reduced (Tillyard, 1926).

The two families under detailed consideration here, the Myrmeleontidae and the Nemopteridae, are easily distinguished from one another and from the other families in the Myrmeleontoidea. Adult Myrmeleontidae (fig. 1) have two pairs of similar elongated wings with a long hypostigmatic cell below the pterostigma. The antennae are short and clavate or apically thickened. Larvae are

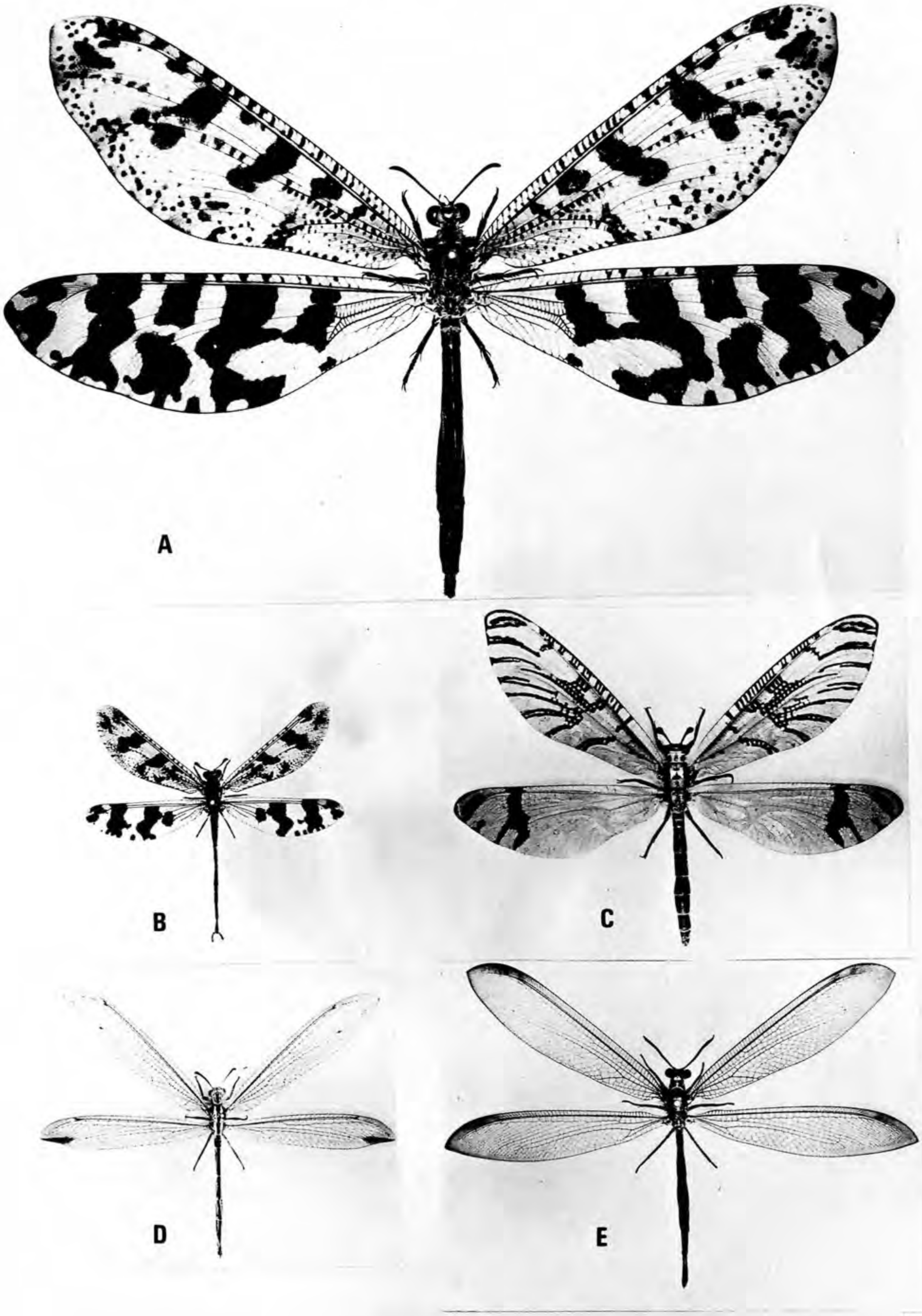


Fig. 1. A – E. Examples of Myrmeleontidae,
A. *Palpares inclemens* (Walker); B. *Palpares* sp.;
C. *Tomatares citrinus* Hagen; D. *Furgella damarinus* (Peringuey); E. *Myrmeleon quinquemaculatus* Hagen.
All natural size.

stout bodied with mandibles bearing from one (Stange, 1970) to six "teeth" on the inner surfaces. The tibiae and tarsi of the metathoracic legs are always fused. The occipital region of the head is not markedly bilobed as in the Ascalaphidae.

The family Myrmeleontidae has been divided into several subfamilies and tribes, but no accord seems to exist between authors regarding the infra-classification of the family. Banks (1899) distinguished two subfamilies, Myrmeleontinae and Dendroleontinae in the Myrmeleontidae of North America. Esben-Petersen (1918) arranged the family into two divisions, Archaemyrmeleonida and Neomyrmeleonida, with the former comprising, what Esben-Petersen considered, the more archaic Myrmeleontidae, namely the genus <u>Palpares</u> Rambur. I do not share this view for reasons which will be outlined below. The Neomyrmeleonida included the subfamilies Myrmeleontinae and Dendroleontinae (Esben-Petersen, 1918), which were subdivided into four and six tribes respectively. Navas (1912b, 1912d, 1926d) added a further six tribes but did not establish additional subfamilies. However, Navas' work was unreliable and his interpretations are to be regarded with circumspection. Markl (1954) classified the myrmeleontid genera into twenty three tribes. He managed to accommodate most of the world genera in these tribes but made no attempt to arrange the tribes into subfamilies. Hölzel (1972) maintains that Markl's tribes are unsatisfactory as they exhibit varying degrees of relationship to one another and these relationships are not indicated in his arrangement. He states further (Hölzel, 1972), that the establishment of subfamilies to include closely related genera is essential in indicating the degree of relationship between genus-groups. Tjeder (pers. comm.) has also expressed doubts regarding the reality of Markl's tribes. Stange (1967, 1970) recognised four subfamilies, Myrmeleontinae, Acanthaclisinae, Dendroleontinae and Palparinae and at least eight tribes. Riek (1970) divided the Australian Myrmeleontidae into four subfamilies, Myrmeleontinae, Acanthaclisinae, Dendroleontinae and Macronemurinae and did not mention the Palparinae as they do not occur in Australia. Hölzel (1972) recognised only three subfamilies, Palparinae, Echthromyrmicinae and Myrmeleontinae, including the Acanthaclisinae and Dendroleontinae in the Myrmeleontinae as tribes.

It is evident that the subdivision of the Myrmeleontidae is still unresolved. The existing tribes are subjectively defined, being based almost exclusively on wing venation. This is probably insufficient to provide information for the interpretation of relationships. Until comprehensive data pertaining to characters such as larval morphology and biology and genital structures has been obtained, no meaningful or objective contribution can be made by endeavouring to arrange the southern African taxa into tribes.

The delimitation of subfamilies is also problematical. The division of subfamilies proposed by Hölzel (1972) is unrealistically simple and his subfamily Myrmeleontinae contains too many diverse genera to serve any purpose other than that of a repository. For example, the genera Tricholeon and Cymothales (Dendroleontinae) differ from Hagenomyia and Myrmeleon (Myrmeleontinae) in so many features, including wing venation, form of legs and antennae, larval morphology and biology, that they cannot be grouped together. If subfamilies are to be established, they should be applicable world-wide and should reflect relationships within and between groups, preferably based on phylogeny where evidence is substantive.

At present the delimitation of subfamilies proposed by Riek (1970) and Stange (1970) is the most realistic and if applied, many of the southern African genera could be accommodated as follows; *Palpares*, *Lachlathetes*, *Crambomorphus*, *Golafrus*, *Palparidius*, *Pamexis*, *Tomatares* in the Palparinae, *Centroclisis*, *Syngenes* in the Acanthaclisinae, *Myrmeleon*, *Hagenomyia*, *Cueta*, *Nesoleon* in the Myrmeleontinae, *Cymothales*, *Tricholeon*, *Bankisus* in the Dendroleontinae and *Macronemurus* in the Macronemurinae. Several genera cannot be included, but more comprehensive knowledge of the family, on a world-wide basis, is required before the validity and extent of the subfamilies and the affinities of the other genera can be fully understood.

The adult Nemopteridae are characterised by modification of the hindwings into long ribbon- or thread like structures (fig. 2), a specialization unique among the Insecta. The mouthparts are elongated to form a rostrum (except in *Derhynchia vansoni* Tjeder) and the antennae are delicate and setaceous. In the larvae the mandibles are devoid of "teeth" (except for *Croce filipennis* Westwood, from India; Imms, 1911), and some species in the subfamily Crocinae have markedly elongated prothoraxes.

The family Nemopteridae is divided into two easily recognisable subfamilies, Nemopterinae and Crocinae. Adult Nemopterinae have ribbon-like hindwings which are often dilated apically and twisted,

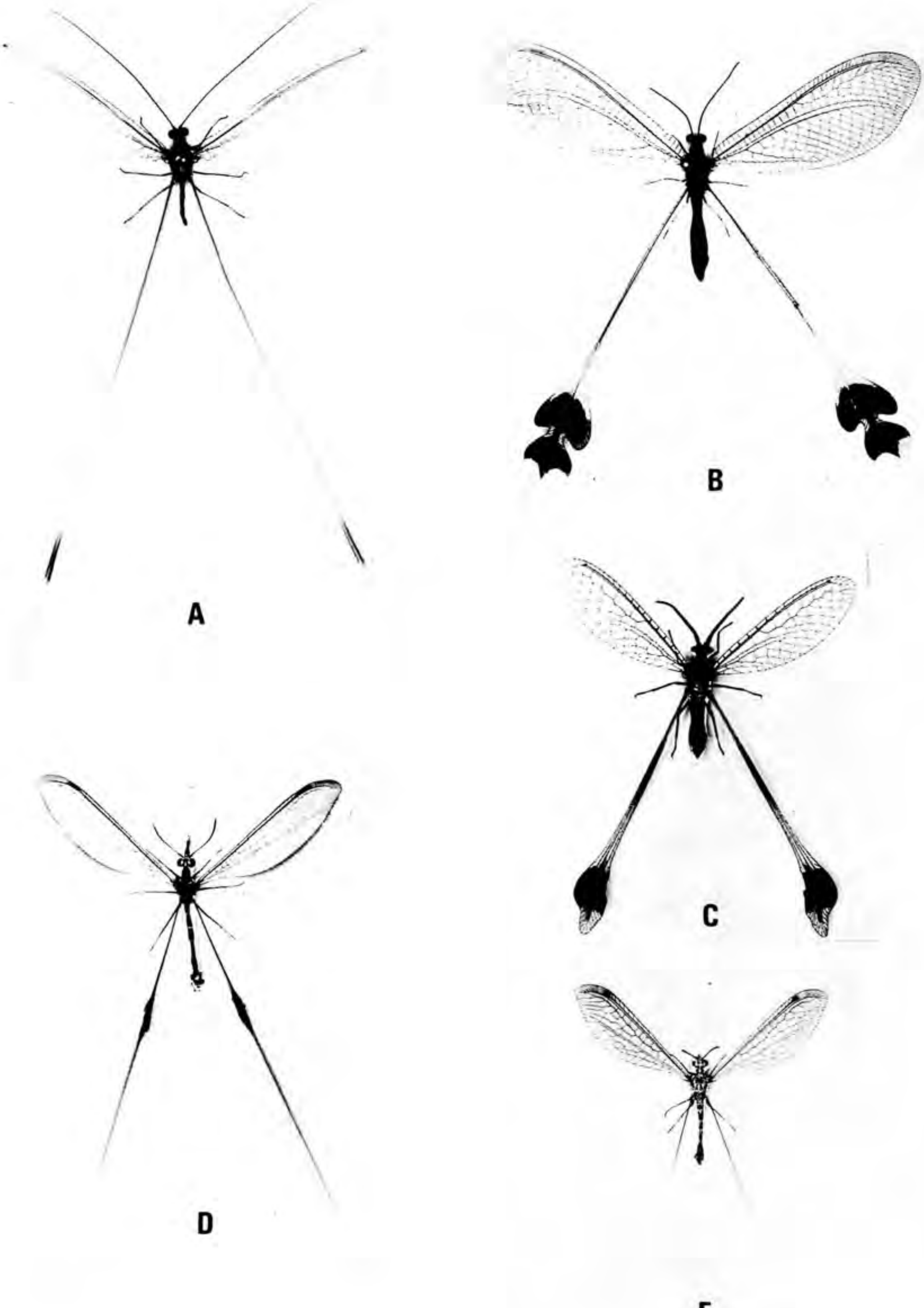


Fig. 2. A - E. Examples of Nemopteridae,
A. *Nemia angulata* (Westwood) (natural size);
B. *Sicyoptera cuspidata* Tjeder (1½ x nat. size);
C. *Palmipenna pilicornis* Tjeder (2 x nat. size), (subfamily Nemopterinae); D. *Laurhervasia rhodesiae* Tjeder (2 x nat. size); E. *Concroce walkeri* Tjeder (2 x nat. size), (subfamily Crocinae).

whilst the Crocinae are smaller and more delicate than the Nemopterinae and have thin thread-like hindwings (fig. 2). Larval Nemopterinae have short prothoraxes like those of the Myrmeleontidae but the mandibles are devoid of teeth. By contrast, the larvae of most species in the Crocinae have an extremely elongated prothorax and long legs.

The subfamily Crocinae has been subdivided into two tribes by Orfila (1955). The tribe Pastranaiini has distinct anal venation in the forewing, where Cu2 is not fused with 1A, and comprises the genera Pastranaia Orfila from South America and Josandreva Navas from Spain, Chad and Socrota. The second tribe, Crocini has reduced anal venation where Cu2 and 1A are fused, and it comprises the remaining genera, including all those known from southern Africa. The merit in subdividing the Crocinae into tribes is questionable, especially as the division is based on only one venational characteristic. It is necessary to obtain more data on biology and larval and adult morphology before recognising or rejecting this subdivision. It is not used in the present study.

2.2 Geographical distribution of the Myrmeleontoidea

World distribution. Representatives of the Myrmeleontoidea are widely distributed, occurring throughout the tropical, sub-tropical and temperate regions of the world (Markl, 1954), but not in the British Isles (Killington, 1936).

The Myrmeleontidae, which is the largest family, has the widest distribution, occurring on all the continents and larger islands. The family is also present on many of the smaller islands such as Hawaii (Zimmerman, 1957), Galapagos (Stange, 1969), Europa (Fraser, 1951) and Mauritius. Some species extend as far north as British Columbia and Ontario in North America and Finland in Europe (Wheeler, 1930) and as far south as New Zealand (Tillyard, 1926).

The distribution of the Nemopteridae, as illustrated by Tjeder (1967), is more limited than that of the Myrmeleontidae. Nemopteridae inhabit the arid regions of the world according to Tjeder (1967), show four recent centres of distribution; one ranging from Spain and Morocco in the west to northern India in the East, an Ethiopian one from French Guinea in the west to central and eastern Africa and from there southwards to the Cape, an Australian one and a South American one. Both subfamilies are represented in each of these distribution centres. Although Nemopteridae are absent from North America, two fossil records from the Oligocene shales of Colorado and Montana (Carpenter, 1960), indicate that the family once occurred in that area.

The Ascalaphidae have a similar distribution to the Myrmeleontidae (Killington, 1936), but are absent from some islands such as New Zealand, Tasmania (Tillyard, 1926) and Hawaii (Zimmerman, 1957).

The family Nymphidae has the most limited distribution of all, being confined to Australia, Tasmania, New Guinea and Lord Howe Island (Riek, 1970), whilst the Stilbopterygidae only occur in Australia and South America.

Distribution in southern Africa. Southern Africa has a rich fauna of Myrmeleontidae, Nemopteridae and Ascalaphidae. The

Ascalaphidae are presently the subject of a monograph by B. Tjeder (pers. comm.) and will not be considered here. A feature of the myrmeleontid and nemopterid faunas is the high percentage of endemics, particularly in the western and southern areas of the subregion. Tjeder (1974) estimated that 72% of the Myrmeleontidae and 94% of the Nemopteridae occurring in southern Africa were endemic to the region. The faunas of Angola and Zambia are poorly known but this should not affect the estimated percentage of endemism as most of the endemic taxa occur in areas which do not border on these two countries.

The number of taxa in the Myrmeleontidae occurring in southern Africa is not accurately known as the family has not been monographed. Tjeder (1974) estimated that there were 127 species in 39 genera, judging from a literature survey. I estimate that there are probably about 120 species in 30 genera (Appendix 2). Many species, and especially genera, erected by Navas are synonyms requiring relegation. Species lost through synonomy will be compensated for by newly described taxa, but this will not affect the number of genera. Most species in my study collection, which is comprehensive, can be accommodated in existing genera. The number of genera presently listed in the catalogue is 36 but this number will certainly be reduced when more is known about the taxa they contain.

The Myrmeleontidae show two distributional trends in southern Africa (fig. 3). There is a westerly fauna which is arid-adapted and contains many endemic taxa, and an easterly fauna, influenced by species extending into south east Africa from their

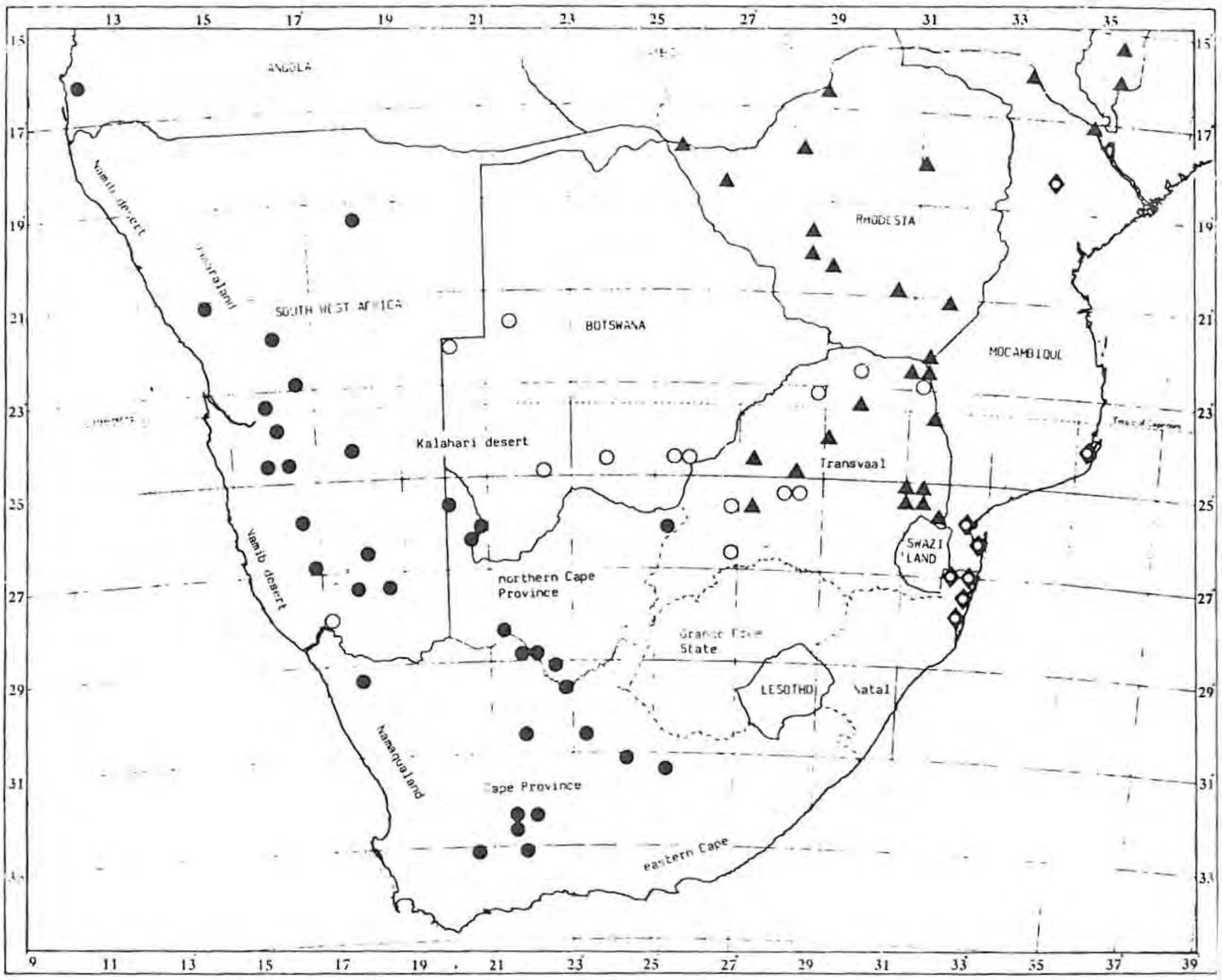


Fig. 3. The recorded distribution of <u>Palpares immensus</u> McL. (closed circles), <u>Palpares inclemens</u> (Walker) (diamonds), <u>Lachlathetes moestus</u> (Hagen) (closed triangles) and <u>Palparidius concinnus</u> Péringuey (open cirlces), illustrating the distributional trends of the family Myrmeleontidae in southern Africa. International boundaries are marked as solid lines, provincial boundaries are shown as dotted lines. Some smaller areas referred to in the text are also indicated.

main centres of distribution in east and central Africa. A few species are cosmopolitan, occurring throughout the subregion.

The westerly myrmeleontid fauna is characterized by many endemic species, especially in the Palparinae, and includes Crambomorphus sinuatum (Olivier), Golafrus oneili (Péringuey), Palpares karooanus Péringuey, P. annulatus Stitz, P. bifasciatum (Olivier), P. flavofasciatus MacLachlan, P. pulchellus Esben-Petersen, P. elegantulus Péringuey, P. gratiosus Navas, Palparidius capicola Péringuey as well as three undescribed species from the Namib desert in South West Africa. There are also several non-palparine species characteristic of the western fauna including Nannoleon michaelseni Esben-Petersen, Obus elizabethae (Banks), Myrmeleon doralice Banks, Furgella damarinus (Péringuey) and Nesoleon boschimanus (Péringuey). Many of these species are restricted in their distribution, but Palpares immensus MacLachlan, which is also a characteristic western form, extends from Hanover in the Cape Province, through South West Africa to Angola (fig. 3).

A few species which occur in the west have also extended their ranges eastwards into the northern Transvaal and Mocambique, via the low-lying arid Limpopo depression. Three examples are Palparidius conncinus Péringuey, Palpares kalahariensis Stitz and F. damarinus.

Taxa comprising the eastern fauna include Palpares inclemens (Walker), P. lentus Navas, P. festivus Gerstaecker, P. cataractae Péringuey, P. sparsus MacLachlan, and Lachlathetes moestus (Hagen) in the Palparinae. Non-palparine taxa include Banyutus lethalis (Walker), Bankisus oculatus Navas, Maula stigmata Navas, Creoleon *diana* (Kolbe) and *Cymothales mirabilis* Gerstaecker. *P. inclemens* occurs in coastal forests and extends from St. Lucia in the south to Dar-es-Salaam, Zanzibar (Kolbe, 1898a) and Kilamandjaro in the north (fig. 3). *L. moestus* occurs from Swaziland northwards into central and east Africa (fig. 3) and *M. stigmata* extends from Zaire (Navas, 1912i) down the east coast as far south as Port Alfred in the eastern Cape Province (33.36S 26.54E). Other species occurring in central and east Africa which extend into the eastern Transvaal (Kruger National Park) include *P. cataractae*, *P. sparsus*, *C. diana* and *B. lethalis*.

Two species, *Myrmeleon obscurus* Rambur and *M. alcestris* Banks, occur throughout the subregion. *M. obscurus* is the most widespread species, occurring throughout most of Africa (except north Africa) as well as Malagasy (Fraser, 1951) and Mauritius. Two other species, *Myrmeleon quinquemaculatus* Hagen and *Hagenomyia tristis* (Walker) have a similar distribution, but are absent from Mauritius and the arid regions of southern Africa.

In the Nemopteridae, Tjeder (1967) described 55 species in 12 genera from southern Africa, constituting 45% of the known world fauna. Mansell (1977) added a further genus and species, and an additional genus and three species are listed in this study, bringing the total to 59 species in 14 genera.

The recorded distribution of the Nemopteridae was detailed by Tjeder (1967), who also outlined their ecological requirements. The family occurs predominantly in the arid western areas of the subregion and is not known from Natal, Zululand, Swaziland or Lesotho. Six species have been recorded from Rhodesia while only four, *Nemeura glauningi* (Kolbe), *Nemopistha contumax* Tjeder (Nemopterinae), *Laurhervasia rhodesiae* Tjeder and *Laurhervasia transvaalensis* spec. nov. (Crocinae), occur in the Transvaal. Of these, the first two are the only species known from Mocambique (Tjeder, 1967), whilst the two crocin species have only been found north of the Soutpansberg mountains in the northern Transvaal (22.48 S latitude). These taxa mainly belong to a northern faunal element which extend southwards into the Transvaal. Tjeder (1967) states that *Nemeura* and *Nemopistha* have a wider distribution in central and east Africa, whilst *L. rhodesiae* has now been recorded from Malawi in central Africa as well.

Four species of Nemopteridae extend into the eastern Cape, *Semirhynchia dunbrodiana* (Pér.) to Port Elizabeth (Tjeder, 1967), *Nemeura gracilis* (Hagen) to the Baviaanskloof mountains (24.25 E), *Laurhervasia setacea* (Klug) to Colesburg (30.43S 25.05E) and *Concroce walkeri* Tjed. to Graaff Reinet (32.15S 24.32E), (figs. 4 and 5).

Distribution records for the subfamily Nemopterinae have not been significantly extended beyond those published by Tjeder (1967), (fig. 4). On the other hand, distributional data for the subfamily Crocinae has been considerably expanded (fig. 5). Figure 5 represents the recorded occurrence of Crocinae in southern Africa and reveals two main centres of distribution. The first distribution centre for the Crocinae is in the south western Cape Province. Four species, *L. setacea*, *Concroce capensis* Tjed., *Tjederia namaquensis* Mansell and *Concroce parva* spec. nov., occupy an area extending from the Cedarberg mountains in the north west

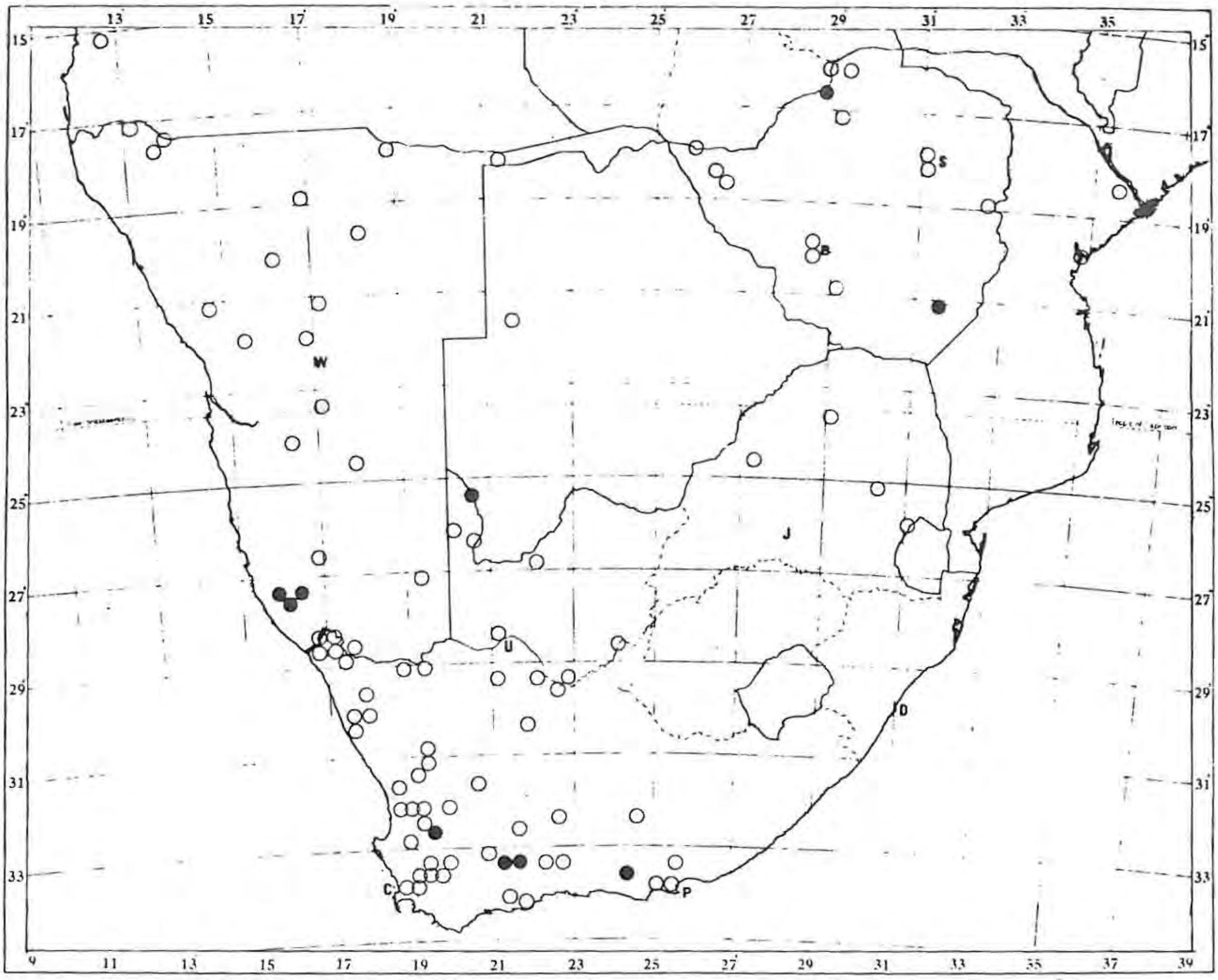


Fig. 4. The recorded distribution of the subfamily Nemopterinae in southern Africa. Open circles represent records published by Tjeder (1967), closed circles are new records. B = Bulawayo; C = Cape Town; D = Durban; J = Johannesburg; P = Port Elizabeth; S = Salisbury; U = Upington; W = Windhoek.

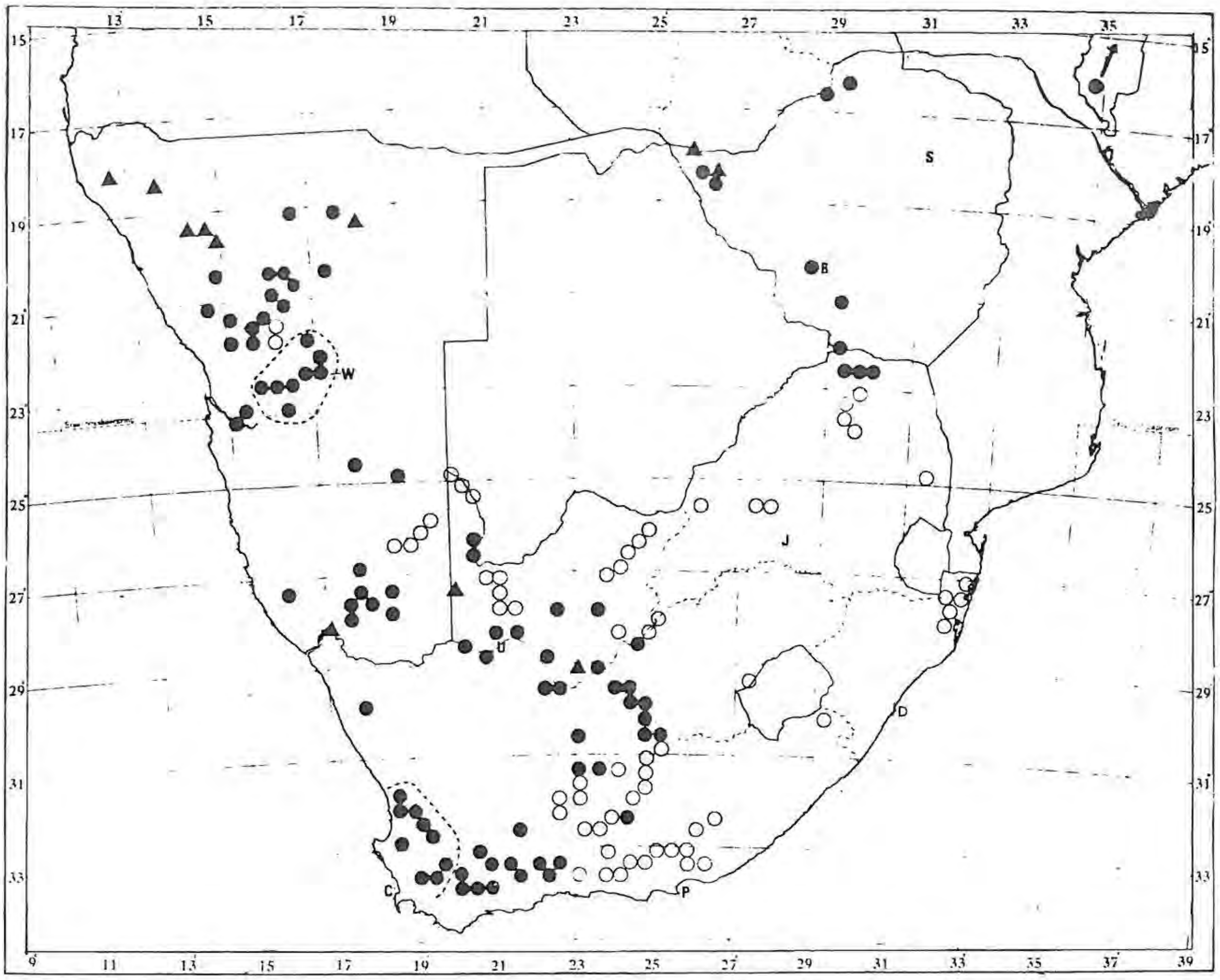


Fig. 5. The recorded distribution of the subfamily Crocinae (all species) in southern Africa. Closed circles represent occurrence of Crocinae recorded during the study. Open circles are negative records, where localities were unsuccessfully searched. Closed triangles are localities recorded by Tjeder (1967) which were not revisited. The areas demarcated by bold dotted lines are the two main centres of crocin distribution; four species occur sympatrically in each of these areas and only Laurhervasia setacea (Klug) is common to both. B = Bulawayo; C = Cape Town; D = Durban; J = Johannesburg; P = Port Elizabeth; S = Salisbury; U = Upington; W = Windhoek.

(32°S 18°E) to the Hex River Valley in the east (33.30S 19.40E). The first three species are sympatric in the Cedarberg mountains and at Piketberg (32.55S 18.45E), whilst *L. setacea* and *C. parva* occur sympatrically in the Hex River Valley. The second distributional centre encompasses mountains in the vicinity of Windhoek (22.34S 17.06E), the Khomas Hochland and the Pro-Namib desert in South West Africa. Four species, *Tjederia brevicornis* spec. nov., *L. setacea*, *Laurhervasia namibica* spec. nov. and *Thysanocroce damarae* (MacLachlan), occur together in this area, although the latter three also extend their ranges north- and southwards. Representatives of the Crocinae occur throughout South West Africa, wherever there are suitable larval habitats.

The distribution of most crocin species is restricted to specific areas, but *L. setacea* is widespread, occurring from Damaraland in northern South West Africa, southwards to Worcester (33.39S 19.26E) in the Cape Province then eastwards to Meiringspoort (33.23S 22.33E) and along the Orange river to Colesburg. *Laurhervasia rhodesiae* also has an extensive range, occurring from the northern Transvaal, through Rhodesia and recorded as far north as Monkey Bay in Malawi (14.04S 35.05E).

2.3 Phylogeny of the Myrmeleontoidea

The order Neuroptera comprises five superfamilies, including the Myrmeleontoidea, and its lineage has been traced back in the fossil record to the lower Permian of Kansas (about 260 million years). The oldest known neuropteran fossil, *Permoberotha villosa* (family Permoberothidae), was described from these strata by Tillyard (Killington, 1936). Jeannel (1949), basing his conclusions on the work of Martynov, indicated that the Megaloptera, Raphidioptera and Planipennia (Neuroptera) were already differentiated in the Carboniferous (over 270 million years ago). The antiquity of the Neuroptera has been established, but the early origins of this order are not clear. Martynova (1961) suggested that the Neuroptera evolved from a branch of the Blattoidea, but this was doubted by Riek (1970) on the grounds of morphology. Handlirsch (cited by Tillyard, 1918b) maintained that the Neuropteroidea (Megaloptera, Raphidioptera, Neuroptera) were descended from the Palaeodictyoptera which were widespread in the upper Carboniferous (Riek, 1970). Jeannel (1949) suggested that the Coleoptera, Strepsiptera, Neuroptera, Megaloptera, Raphidioptera and Hymenoptera were derived from a common ancestral stock, dating back to the Carboniferous, and several authors have supported this conclusion (Richards & Davies, 1977), although evidence is not substantive. From their origin in the Carboniferous or lower Permian, the Neuroptera continued to evolve, and according to Riek (1970), their radiation was almost complete by the middle of the Mesozoic era (Jurassic). As indicated by fossil remains from this period, the order was well represented by the families Prohemerobiidae, Nymphitidae, Kalligrammatidae and Mesochrysopidae (Killington, 1936).

Several authors have considered phylogeny in the superfamily Myrmeleontoidea during their studies on the evolution of the Neuroptera. Handlirsch (1908) was the earliest of these workers, basing his conclusions on palaeontological evidence. He maintained that the Myrmeleontidae, Ascalaphidae and Nymphidae were derived from the now extinct Nymphitidae, whilst the Nemopteridae evolved from Jurassic Kalligrammatidae. Handlirsch thought that the Nymphitidae, Kalligrammatidae and Mesochrysopidae had branched off very early from the main neuropterous stem. The Kalligrammatidae are unlikely ancestors for the Nemopteridae as they were very different morphologically from the modern Nemopteridae. The Kalligrammatidae resembled the present Psychopsidae, and as stated by Jeannel (1960), were probably allied to them.

Tillyard (1916, 1926) suggested that the Myrmeleontoidea arose in the Jurassic (about 180 million years ago) from the same stem as the Osmylidae. He postulated that the Nymphidae arose as a small terrestrial side-branch of the Osmylidae and in turn gave rise to the Myrmeleontidae and Ascalaphidae. He was uncertain as to the origins of the Nemopteridae and assigned them to a separate superfamily, Nemopteroidea, but thought that they were probably allied to the Nymphidae.

Withycombe (1925) studied the immature stages of the Neuroptera, basing phylogenetic considerations on this approach, as an alternative to theories derived from palaeontological evidence and wing venation. He agrees that the Myrmeleontoidea originated from an osmyloid stock through the family Nymphidae. The Nymphidae do resemble the Osmylidae, and the genus Myiodactylus, now included in the Nymphidae (Riek, 1970), was once assigned to a separate family, Myiodactylidae, by Comstock (1918) who considered it a link between the Nymphidae and Osmylidae. Withycombe (1925) accepted the suggestion by Tillyard (1915, 1916b) that the Myrmeleontidae and Ascalaphidae were derived from nymphid ancestors, and that the Nemopteridae also probably originated from this source. Withycombe (1925) intimated that the Nemopteridae diverged from the nymphid line before the Myrmeleontidae and Ascalaphidae, but are so specialized that they should be included with the other families in the Myrmeleontoidea, and not placed in a superfamily of their own. As stated earlier, the Nemopteridae share many characters in common with the other myrmeleontoid families, which indicate a close relationship with them.

The phylogeny of the Neuroptera proposed by Withycombe (1925) provides a basis for considering in more detail, the relationships of the myrmeleontoid families, and in particular the Myrmeleontidae and Nemopteridae. In his phylogenetic diagram, Withycombe (1925) depicted the Nemopteridae branching from the nymphid line before the Myrmeleontidae and Ascalaphidae. This was supported by Hölzel (1975) who stated that the Nemopteridae could be regarded as the sister-group of the other Myrmeleontoidea. Withycombe (1925) suggested further that the Ascalaphidae arose from the Myrmeleontidae, or myrmeleontoid-stock, through some protoascalaphine form. The Stilbopterygidae, as suggested by Hölzel (1975), may provide this link. Stilbopterygidae were usually placed in the Ascalaphidae as a subfamily (Berland & Grassé, 1951; Riek, 1970), but they have also been classified as Myrmeleontidae (Kimmins, 1970). The Stilbopterygidae are now regarded as a separate family (Riek, 1970, 1976; Richards & Davies, 1977) which is closely related to the Myrmeleontidae and probably represents the sister group of this family. These two families comprise the sister group of the Ascalaphidae (Riek, 1976). In support of this, I have found that the larva of *Tricholeon nigripes* Kimmins (Myrmeleontidae), from South Africa, shows strong morphological resemblances to the larva of *Aeropteryx linearis* (Navas) (Stilbopterygidae), illustrated by McFarland (1968). The shape of the mandibles is similar, being rounded in cross section and both larvae have well developed lateral setose processes on the thorax.

The phylogenetic tree that I would propose for the Myrmeleontoidea is similar to that implied by Hölzel (1975) and Riek (1976), and can be diagrammatically represented as follows:

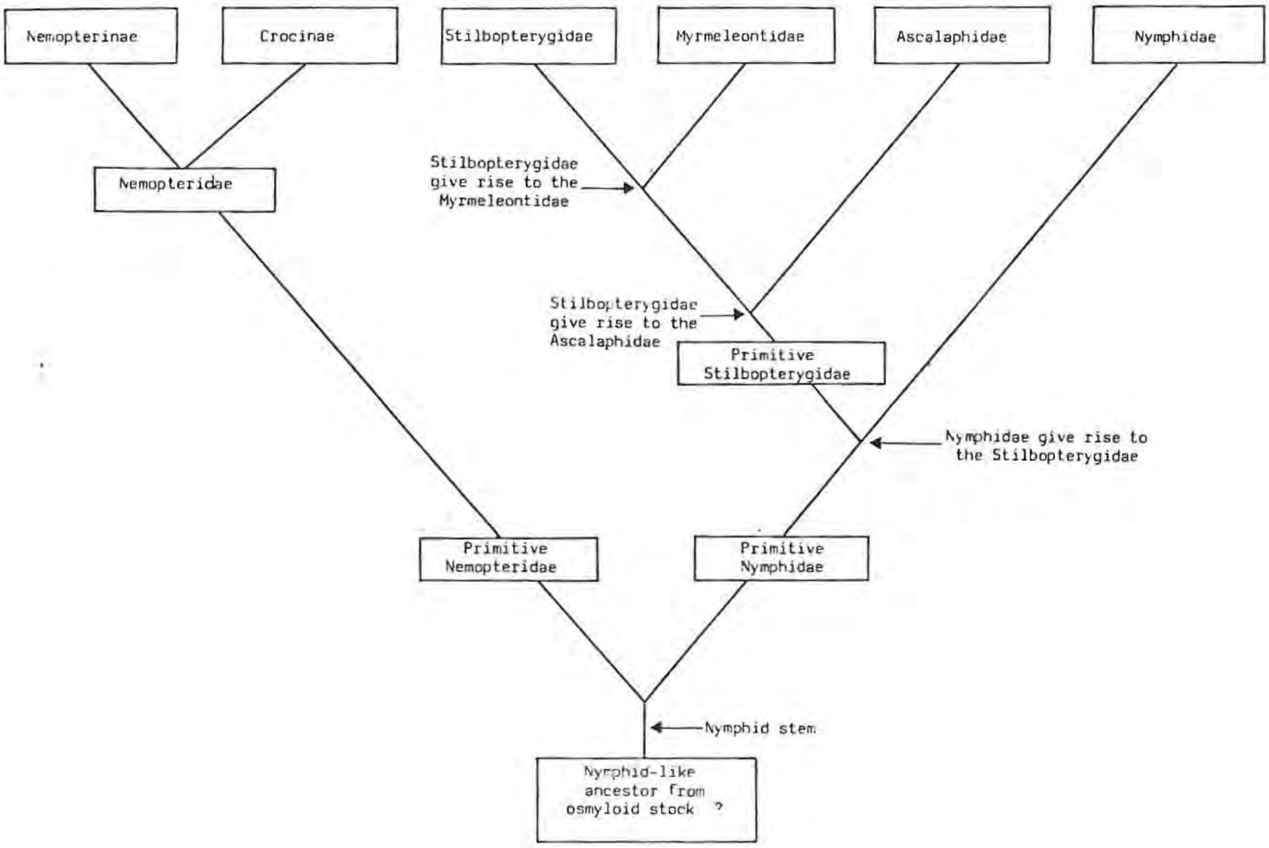


Fig. 6. Diagrammatic representation of the phylogeny of myrmeleontoid families as suggested in this study.

As indicated in the diagram, the Nemopteridae separated first from the main nymphid stem and later divided into the subfamilies Nemopterinae and Crocinae, which have a sister group relationship to one another (Hölzel, 1975). The Stilbopterygidae branched off next and gave rise to the Ascalaphidae which retain certain stilbopterygid characters such as short antennae in the pupa (Withycombe, 1925) and the development of lateral thoracic protuberances (setose processes) which bear dolichasters. The Myrmeleontidae then originated from the Stilbopterygidae with suppression of the lateral processes, enabling them to exploit the exposed sand habitat. The present Nymphidae are the surviving remnants of the lineage which engendered the other families and are now a relic group with a very limited distribution (Hölzel, 1975). The Stilbopterygidae are also considered to be a relic family by Hölzel (1975), although their distribution is wider than that of the Nymphidae.

Relationships within the Myrmeleontidae and the Nemopteridae. The Myrmeleontidae were divided into two groups the Archaeomyrmeleonida and the Neomyrmeleonida, by Esben-Petersen (1918), on the basis of wing venation. In the Archaeomyrmeleonida, which comprises the subfamily Palparinae, the posterior cubital vein (Cu2 or CuP) does not fuse with the first anal vein (1A) but is distinct to the wing margin. This condition is considered to be plesiomorphic as it resembles the condition prevailing in the Nymphidae (Esben-Petersen, 1918), and the Archaeomyrmeleonida are considered to constitute the most archaic myrmeleontids. The remaining Myrmeleontidae are placed in the Neomyrmeleonida and are characterized by the fusion of veins Cu2 and 1A and reduced development of the anal venation. Esben-Petersen (1918) divided the Neomyrmeleonida into the subfamilies Myrmeleontinae and Dendroleontinae and stated that the latter was the older of the two. The Dendroleontinae are considered more primitive as they have the radial sector (Rs) arising close to the base of the hindwing with only one or two crossveins between the median (M) and radius (R) before Rs. This is considered to be a plesiomorphic character as it resembles the situation found in the Nymphidae (Tillyard, 1915, 1916a). The Myrmeleontinae have two or more crossveins between R and M before Rs in the hindwings and Rs originates further away from the wing base. The displacement of Rs away from the wing base is considered to be apomorphic (Tillyard, 1915).

Contrary to the belief that the Palparinae represent the most primitive Myrmeleontidae (Esben-Petersen, 1918; Hölzel, 1972), I hold that this subfamily contains some of the most recently evolved forms. This conclusion is based on present distribution patterns and larval morphology and is expanded in the discussion. I share the opinion that the Dendroleontinae are archaic and show the closest affinities to the Stilbopterygidae and Ascalaphidae of all Myrmeleontidae. The Stilbopterygidae probably gave rise to forms allied to the Dendroleontinae and these led to the Acanthaclisinae, Macronemurinae and the highly specialized, albeit ancient, Myrmeleontinae and later to the Palparinae.

Withycombe (1925) pointed out that the excessive emphasis had been placed on wing venation in determining relationships within the Myrmeleontidae, and this situation still prevails.

Larval morphology and biology have never been used to elucidate relationships and I believe that it is here that many important phylogenetic characters are to be found. This point will also be elaborated in the discussion.

The Nemopteridae are unlikely to have evolved from the Myrmeleontidae as may be suggested on the grounds of larval resemblance. The Nemopteridae show similarities to the Nymphidae in the wing venation and the antennae of both families are filiform. The fact that some Nemopterinae have a sand dwelling larva must be considered a convergent development with the myrmeleontids and not as having been derived from them. The mode of burrowing is different in the two families, the Myrmeleontidae burrowing backwards into the sand whilst the known nemopterin larvae burrow forwards into sand (Mansell, 1973). Also, Myrmeleontidae live just below the surface of the sand whilst the nemopterins are found a few centimetres below the surface.

Withycombe (1925) maintained that the Crocinae were more specialized than the Nemopterinae because the larvae of the latter subfamily are generalized and archaic. Tjeder (1967) is of the opposite opinion, basing his argument on wing venation, structure of the genitalia and the form of the prothoracic segments in larval Crocinae. Tjeder (1967) maintained that as these segments were sclerotized, the structure was reminiscent of the primitive Megaloptera. Hölzel (1975) argues that the Crocinae are the more specialized subfamily and presents evidence to support this. It is also my view that the Crocinae are the more highly evolved subfamily and this view is elaborated later.

Thus far I have discussed the Myrmeleontoidea as a group, stressing the position of the Myrmeleontidae and Nemopteridae within the superfamily. Initially the southern African Myrmeleontidae were chosen for study as they constitute the dominant myrmeleontid family in the region. This broad study provided the background and led to a more detailed investigation of the family Nemopteridae, particularly the subfamily Crocinae. Little is known of the family Ascalaphidae in southern Africa although it is presently the subject of a taxonomic review by Tjeder, and the Stilbopterygidae and Nymphidae do not occur in Africa. The rest of this account deals only with the Myrmeleontidae and Nemopteridae, with special emphasis on the subfamily Crocinae.

3. THE SOUTHERN AFRICAN MYRMELEONTIDAE AND NEMOPTERIDAE

3.1 Previous work on southern African Myrmeleontidae and Nemopteridae.

The Myrmeleontidae of southern Africa have never been monographically treated. Publications dealing with the family are scattered through the literature spanning the period from 1758 to the present and all, except three of these accounts, (Youthed & Moran, 1969a, b, c), are of a taxonomic nature.

Apart from the studies of Péringuey (1910, 1911) and Youthed & Moran (1969a, b, c), all research on African Myrmeleontidae has been conducted by taxonomists outside Africa.

The first account of a southern African myrmeleontid appeared in 1758 when Linnaeus described Hemerobius speciosum (Palpares speciosus) from the Cape. In 1767 Linnaeus erected the genus Myrmeleon, an extant name, but now considerably restricted compared to its original sense. Thunberg (1784), Olivier (1809, 1811) and Burmeister (1839) followed Linnaeus, and between them added eight species to the known fauna. In 1842 Rambur described three new species from southern Africa and established the name Palpares for the distinctive and numerically dominant African genus. Walker (1853, 1860) described eleven species from the subregion but took the retrogressive step of ignoring all established genera, except Myrmeleon, in his work. The German entomologist and bibliographer, Herman Hagen, correlated information on Myrmeleontidae in two publications (1860, 1866), the latter work being of fundamental importance to any study of the Neuroptera. In three other papers (Hagen, 1853, 1862, 1887), he described and discussed several southern African taxa including the genera Tomatares and Pamexis. Gerstaecker (1863, 1885, 1888, 1894) worked extensively on east and southern African Myrmeleontidae and many of his taxa are still recognised. The British neuropterist, Robert MacLachlan revised Walker's catalogue in 1867, adding one genus and seven species in the process, and in 1873 MacLachlan examined and elaborated upon some of the taxa proposed by Rambur in 1842. Although Kolbe (1898a) only described species from east Africa, many of those mentioned by him also occur further south. Van der Weele (1903, 1908) did not describe any new species from the subregion, but provided additional information on the taxa established by Olivier and Gerstaecker.

The only resident taxonomist to publish descriptions of the local Myrmeleontidae was Péringuey. In two papers (1910, 1911) he erected the genus Palparidius and described twenty three new species, thirteen of which are still considered valid.

In six publications, Nathan Banks (1909, 1911, 1913a, 1913b, 1938a, 1941) contributed two new genera and ten species to the documented fauna, besides providing keys and explanatory notes on many others. In one paper (Banks, 1913b), he endeavoured to elucidate and summarize all taxonomic data on the genus Palpares. This genus was also the subject of a paper by Stitz (1912) who described twelve new species and varieties, including four from southern Africa. Only two of these species are still recognised. A significant contribution to myrmeleontid taxonomy was made by Esben-Petersen, who included southern African species in eight of his publications (Esben-Petersen, 1912, 1916, 1920a, 1922, 1925, 1928a, 1928b, 1931). He described four genera and eight species but essentially he tried to synthesize and interpret the information that was available. Unfortunately his death in 1942 left much data unpublished.

Longinos Navas, in numerous publications between 1902 and 1940, was mainly responsible for the prevailing disorder in myrmeleontid systematics. His taxonomic procedures were inconsistent and impetuous, resulting in the publication of hundreds of names, a large proportion (over 50%) of which are synonomys. Amongst the profusion of names created by Navas, there are, however, some of which are valid, necessitating a careful evaluation of his work. The confusion caused by Navas is unlikely to be completely resolved as some of his type specimens are no longer extant and many descriptions too cursory to be of value. Southern African species are described or mentioned in over twenty six of Navas's publications.

In 1943 Kimmins compared the genera *Nesoleon* Banks and *Cueta* Navas, both of which occur locally, and in 1948 he established the genus *Exaetoleon* and described two species from the Cape Province. The most recent contribution to the systematics of southern African Myrmeleontidae was made by Markl (1953, 1954). In 1953 he described a new genus and species, and in 1954 published his comprehensive study on the classification of the family. In the latter work Markl attempted to arrange the world genera into twenty three tribes and although this arrangement is controversial (Hölzel, 1972), it concentrates all the known genera into one publication, thereby providing a valuable reference work. Mansell (1974) gave a summary of the Myrmeleontidae as part of a larger survey on the status of Hexapod taxonomy in southern Africa.

The southern African Nemopteridae were monographed by Tjeder (1967). In the monograph he reviewed all work prior to 1967 concerning Nemopteridae from the subregion. In addition, he presented a general account on the morphology and biology of the Nemopteridae, five genera and thirty six species were added to the documented fauna and an extensive bibliography was provided.

Subsequent to Tjeder's monograph four papers relating to southern African Nemopteridae have been published. In 1973 Mansell described the larva of Derhynchia vansoni Tjeder. Hölzel (1975) published a monographic revision of the subfamily Crocinae, including the southern African species, but did not extend the information beyond that provided by Tjeder (1967). In 1976 Mansell gave an account of the larva of Laurhervasia setacea (Klug), and in 1977 described a new genus and species, Tjederia namaquensis, from the south western Cape Province.

3.2 Materials and methods.

This study on the biology and systematics of Myrmeleontidae and Nemopteridae was based on:

(i) the collection, curation and examination of imagos

(ii) the collection and rearing of larvae and their correlation with the adults and

(iii) an extensive literature survey for the compilation of a genus and species catalogue of myrmeleontid taxa.

The study concerns primarily the fauna of the area south of the Zambezi and the Cunene Rivers, these boundaries being arbitrarily chosen to limit the scope of the investigation.

Collections were made throughout this region, including Rhodesia, Mocambique, Botswana, with extensive collecting in northern Natal, the Kruger National Park (eastern Transvaal), the Kalahari Gemsbok Park (north western Cape Province), the eastern and south western Cape Province and South West Africa.

(i) Collection and examination of imagos. A research collection comprising 1800 set, pinned and labelled Myrmeleontidae and 900 Nemopteridae (720 Crocinae, 180 Nemopterinae) was compiled during the course of this study, together with an alcohol collection of about 1500 Myrmeleontidae. Other collections of southern African Myrmeleontidae, including those overseas, are small and lack sufficient representative taxa for a comprehensive study, but were also examined.

Adults of both the Myrmeleontidae and Nemopteridae were obtained by light trapping, by rearing larvae through to adulthood, and some were collected by other persons. The light trap consisted of a light suspended near a vertical white sheet or wall. The light source was provided by a 160W mercury vapour bulb, powered by a portable Honda generator, or a Coleman pressure lamp. Specimens that settled on the sheet or wall were selected and killed in potassium cyanide vapour and then pinned, or stored dry between sheets of tissue paper. Initially specimens were preserved in alcohol but this is unsatisfactory if the material is required for a dried collection. Adult Neuroptera preserved in alcohol discolour, lose their pubescence and are difficult to pin, thereby impairing their quality and rendering them unsuitable as museum specimens. Material stored in this manner is suitable though for dissection and gross morphological study. As adult Neuroptera occur seasonally, collecting was carried out in summer, between October and March.

In the laboratory, adults were measured and morphological features studied. Measurements were carried out using an eyepiece graticule in a WILD M5 stereomicroscope and the following parameters were recorded; length of forewing, length of hindwing, length of antenna, length of rostrum (from the tip of the labrum to the base of the antennae, for Nemopteridae only), length of body (from the anterior margin of the pronotum). Drawings were made with the aid of a camera lucida attached to the microscope. Preparations of the genitalia were obtained by maceration in a warm 10% solution of potassium hydroxide, transferring them to 70% ethyl alcohol and then staining in chlorazol black E. The preparations were placed in a drop of glycerine on a slide, examined and drawn, then stored in a small polythene "Beem" capsule containing glycerine and mounted on the specimen pin.

Specimens were identified from descriptions in the literature (where possible) and by comparison with museum specimens, including the types in most cases. All relevant material at the Institutions listed below was photographed, and data on the labels and comments on salient morphological features were recorded by dictation into a casette tape recorder. The accumulated photographic record comprises 940 negatives representing about 360 species, mainly African but including some from other regions of the world as well. The number of specimens photographed at each of the institutions is indicated in brackets in the list below.

Albany Museum, Grahamstown, South Africa.
South African Museum, Cape Town, South Africa. (36)
Transvaal Museum, Pretoria, South Africa.
National Collection, P.P.R.I., Pretoria, South Africa.
State Museum, Windhoek, South West Africa.
National Museum, Bulawayo, Rhodesia.
British Museum (Nat. Hist.) London, England. (97)
Linnaean Society, London, England. (2)
Royal Scottish Museum, Edinburgh, Scotland.
Institute Royal des Sciences Naturelles, Brussels, Belgium. (9)
Musee Royal de l'Afrique Centrale, Tervuren, Belgium. (60)
Naturhistoriska Riksmuseet, Stockholm Sweden. (4)
Zoological Institute, Lund University, Lund, Sweden.
Museum Nationale d'Histoire Naturelles, Paris, France. (119)
Zoological Museum, Copenhagen University, Copenhagen, Denmark. (20)
Museo de Zoologia, Barcelona, Spain. (14)

(ii) Collection and examination of immature stages.

Prior to this study there were no collections of larval Myrmeleontoidea available. During the course of this investigation all the larvae collected were observed, measured and most were reared to adulthood in the laboratory. A total of 1700 nemopterid, and approximately 1000 myrmeleontid larvae were examined.

Larval Myrmeleontidae and Nemopteridae were collected by sieving and by searching in small caves and under rock overhangs. Myrmeleontid larvae which do not construct pits were located by sieving when the use of traps proved unsuccessful. Specimens were transferred to the laboratory, each in a separate vial to prevent cannibalism. Larvae were maintained in plastic dishes or small jars containing sand, under normal ambient conditions in the laboratory. The larvae were fed once a week on worker caste individuals of Trinervitermes trinervoides Sjöstedt (Isoptera). The above procedures apply to the larvae of both the Myrmeleontidae and the Nemopteridae.

Live larvae were anaesthetized in carbon dioxide and measured as soon as they were immobile. Recovery from this treatment was always rapid and complete. The following larval parameters were recorded for each individual; head width, head length, mandible length, prothoracic length (Crocinae only), body width and total body length (fig. 7).

When the larvae pupated, emergence cages were placed over their containers. Newly emerged adults were transferred to gauze cages (60 x 35 x 35 cm) during observation. Captive Myrmeleontidae did not mate or oviposit, but mating and oviposition was frequently observed in the Crocinae, and their eggs were collected and studied. Morphological details of larvae and eggs were examined and photographed using a JEOL JSM U3 scanning electron microscope. Specimens were cleaned by immersion in 70% ethyl alcohol in a vial which was placed in an ultrasonicating bath for approximately thirty seconds. They were then air dried and examined immediately in the microscope. As reported by Cross & Mansell (1978) (Appendix I), no special preparative techniques were required except for the application of an electron conducting aerosol to some specimens.

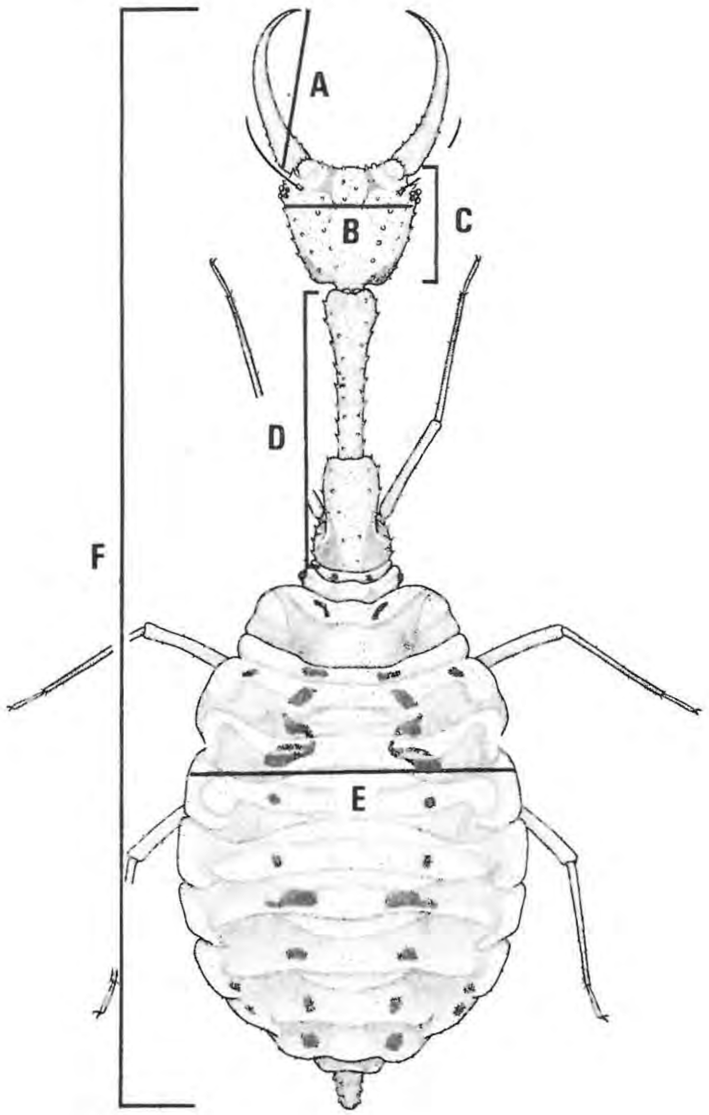


Fig. 7. The parameters measured for each larval specimen;
A = mandible length, B = head width, C = head length,
D = prothoracic length, E = body width, F = body length.

(iii) Compilation of genus and species catalogues. A literature survey was carried out to compile a genus and species catalogue. The resulting card index provided a reference system to the southern African taxa and is being expanded to incorporate the world fauna. A genus and species catalogue for the southern African Myrmeleontidae is presented in Appendix 2. This catalogue is an expansion of that in the British Museum and includes synonomies, type locality data, location of type specimens and indicates which of the type specimens have been examined and photographed during the course of this study. In addition, a bibliography of the literature pertaining to the Crocinae is contained in the body of the thesis. It is superfluous to present a catalogue for the Nemopteridae as this was adequately covered by Tjeder (1967), and only one publication on the subfamily has appeared since then (Mansell, 1973).

3.3 Biology of the southern African Myrmeleontidae.

The larvae of some species of Myrmeleontidae construct pits and because of this the family has attracted the attention of scientists and naturalists from the earliest times (Wheeler, 1930; Debach, 1964). There are many accounts in the literature dealing with larval biology but the majority of these relate only to the meagre European fauna. Wheeler (1930) has reviewed the early literature and only a few publications concerning myrmeleontid larvae have appeared since then. These include works by Haub (1942), Steffan (1964, 1968, 1971), Youthed and Moran (1969a, b, c) Bong-Heang (1970), Stange (1970), Freiheden (1973), Tuculescu et al (1975) and McClure (1976).

The Myrmeleontidae have a dichotomy of habit, in that the larvae of some species construct pits whilst the majority are free living and do not construct pits. In southern Africa, pit-building species are confined to three small but highly successful genera, Myrmeleon L., Hagenomyia Banks and Cueta Navas. In Myrmeleon and Hagenomyia pits are always constructed in sheltered areas, but M. obscurus and M. doralice Banks are sometimes found in exposed situations. Myrmeleon pallescens (Navas) constructs its pits in caves or in areas under rock overhangs. M. quinquemaculatus, the largest pit-building species, is always found in situations where maximum protection is ensured, under rock overhangs, under logs or often sheltered by buildings. The large pits of this species are conspicuous, so the sheltered habitat may limit predation by birds as well as affording cover from the weather. In M. lanceolatus Ramb., M. alcestris Banks, M. stigmalis Navas and H. tristis, the pits are sheltered by vegetation or rock overhangs.

The Cueta species always construct pits in the open, often in hard rocky ground where there is no protection from the weather or predators. These larvae have modified setae on abdominal sternite 8 fused into two strut-like structures to facilitate burrowing in hard ground. Youthed (1973) has demonstrated that Cueta larvae are more tolerant of high temperatures than the larvae of three other species that she studied, namely Syngenes longicornis (Rambur), M. obscurus and M. medialis Banks.

The mechanism, and factors affecting pit construction in M. obscurus have been described by Youthed & Moran (1969a), and more recently by Tuculescu et al (1975) for the American Myrmeleon *immaculatus* de Geer. Youthed & Moran (1969b, c) also established that *M. obscurus* larvae possess endogenous activity rhythms which controlled pit construction. They demonstrated that a peak period of pit building occurred at dusk each day and that the size of the pits was always greatest at the time of full moon.

The construction of pits is a specialized, albeit ancient feeding adaptation that probably evolved during the late Jurassic or Cretaceous period, before the disintegration of Gondwanaland. This adaptation has several advantages; (i) prey is directed to within reach of the larval mandibles, facilitating its capture; (ii) the pit functions as a selective device, limiting the size of the prey; prey which is too large will escape from the pit, whereas smaller prey will be trapped and rapidly subdued without injury to the predator; (iii) Youthed (1973) has suggested that the pit enables the larva to remain near the sand surface even when temperatures are high. For example, when the surface temperature of the sand was 47,3°C, the temperature of the shaded side of the pit was 40°C and the upper lethal temperature limit of *M. obscurus* is 47,6°C. The larva is able to use this temperature differential to remain near the surface, even during the hot part of the day, thereby prolonging the potential period of prey capture.

There are, however, several disadvantages to the pit-building habit; (i) conspicuous pits increase susceptibility to predation; (ii) there is a physical limit to the size of a pit which can be constructed in sand without it collapsing, and this restricts the size of the myrmeleontid larvae which can exploit the adaptation. The largest of the pit-building species, *M. quinquemaculatus*, is about half the size of the larva of most *Palpares* species which do not construct pits. Most of the pit-building ant-lions are small; (iii) energy must be expended on pit construction, but this must be weighed against the increased chance of prey capture; (iv) coupled with pit-building is a decreasing capacity for forward locomotion and restricted agility. All *Myrmeleon* species and *H. tristis* are only capable of moving backwards. *Cueta* species still retain the ability to move forwards, but are slow and ineffectual when compared to the non-pit-building species. The specialized pit-building habit thus prevents the ant-lion from pursuing its prey on the surface, thereby limiting its versatility as a predator.

The disadvantages of a pit-building mode of existence are outweighed by the advantages and the pit-building genus *Myrmeleon* is highly successful, being both cosmopolitan and the most abundant genus in the Myrmeleontidae.

During the course of this study twelve species of pit-building Myrmeleontidae have been collected in the larval stage and correlated with the adults. Prior to this research the identity of all larval Myrmeleontidae in southern Africa was unknown. The pit-building species whose larvae have been correlated with the adults are; *M. quinquemaculatus*, *M. obscurus*, *M. alcestris*, *M. lanceolatus*, *M. stigmalis*, *M. doralice*, *M. pallescens*, *H. tristis*, *Cueta infima* Navas and *Cueta mysteriosa* (Gerst.) as well as two unidentified species of *Myrmeleon*. This represents the majority of the pit-building species in southern Africa. It is evident that, contrary to general belief, the pit-building habit is confined to relatively few Myrmeleontidae but has led to an impressive radiation in those species which have evolved the habit. I believe that the pit-building adaptation has probably evolved only once in the Myrmeleontidae because the habit is restricted to a few genera which are morphologically similar in all stages. However, this conclusion is tentative and would repay further study.

The larvae of over one hundred species in twenty four genera, occurring in southern Africa are free living and do not construct pits. Uncertainty exists regarding the larval habits in the genera *Nesoleon* Banks, *Exaetoleon* Kimmins and *Capophanes* Banks, but I believe them to be free living. During the course of this investigation the larvae of seventeen species of non-pit-building ant-lions, representing ten genera, have been collected and twelve species correlated with the adults. Larvae which have been correlated and identified are *Palparidius capicola*, *Palpares inclemens*, *P. speciosus*, *F. damarinus*, *Neuroleon* sp., *B. lethalis*, *Formicaleon* spp., *Centroclisis dasymalla* (Gerst.), *Syngenes longicornis* (Rambur), *Formicaleon pondoensis* Kimmins and *T. nigripes*.

Larvae of what are probably *P. immensus*, *G. oneili*, *C. sinuatum*, *P. annulatus* and the correlated larvae of *P. capicola* and *F. damarinus*, occur in the sand dunes of the Kalahari desert. Two unidentified *Palpares* larvae and a *Neuroleon* have been found in Namib desert, living in sand at the base of grass tussocks. *Palpares inclemens*, *B. lethalis* and *Formicaleon* sp. have been collected from sand on the verge of coastal dune forest at Lake Sibaya in northern Natal. *Centroclisis dasymalla*, *S. longicornis* and *F. pondoensis* occur in sand along the east coast of South Africa. The larva of *P. speciosus* was found on the surface of the ground after rain. *Tricholeon nigripes* and a *Formicaleon* have larvae which inhabit sand and detritus in small caves and under rock overhangs.

Unlike the pit-builders, larvae which do not build pits are extremely difficult to rear in the laboratory and this makes correlations difficult to obtain.

Prey capture and feeding behaviour has been studied in *Syngenes longicornis*, a local non-pit-building species, and is similar to that described in *Brachynemurus minisculus* Banks and *B. singularis* Currie, from North America by Stange (1970). Prey is detected through substrate borne vibrations and three behavioural patterns associated with prey capture were observed in *S. longicornis*; the larva either remains stationary beneath the surface until the prey approaches sufficiently close whereupon it is captured by the larva flicking its head out of the sand, securing the prey with the mandibles prior to dragging it under. This manouvre is facilitated by the extensible prothoracic region of the larva. Secondly, the larva may burrow backwards through the sand to the source of the vibrations caused by potential prey, which is then captured as described above. Lastly, upon detection of vibrations, the larva emerges from the sand and runs forward in the direction of the prey. The larva then secures the prey on the surface of the sand or burrows into the sand and captures it in the normal manner. The third method of prey capture was infrequently employed as it exposes the larva to cannibalism whilst on the surface. Also, the soft abdominal and thoracic regions of the predator are vulnerable to retaliatory attacks by the prey. Once the cuticle has been punctured, the larva is unable to burrow and subsequently dies. Apart from the above observations, hunting on the surface was not observed in any other species. Experiments using pitfall traps in the Kalahari desert failed to produce any evidence of surface activity by myrmeleontids at night.

Time required for completion of the larval stage varies from two years in M. obscurus, under optimal conditions, to four years in some Palpares species. Palpares larvae collected during their third instar have been maintained in the laboratory for up to two years without further development.

Pupation takes place in a spherical silken cocoon in the sand, the silk being produced by modified malpighian tubules (Withycombe, 1925). In the field, cocoons were always encountered 6 - 10 cm below the sand surface near vegetation which provides shade, ensuring protection for the developing pupa. Eclosion from the cocoon and the pupal moult in all observed cases was similar to that described for Myrmeleon celebensis MacLachlan, by Bong-Heang (1970).

There are no published accounts of mating behaviour in the Myrmeleontidae. An undescribed species of Palpares, occurring in the Namib desert, was observed to couple in flight during the day, but although this was observed several times, close proximity could not be gained to permit detailed observations. Oviposition has not been observed in the southern African species but Stange (1970) has described apparent oviposition behaviour by Brachynemurus peregrinus Hagen in California.

During the present studies fertilized eggs were only obtained by severing the abdomen of a gravid female *M. lanceolatus*, as Myrmeleontidae will not oviposit of their own accord in the laboratory. Development of the embryo occupied about twenty one days, at which time the segmentation of the body, the legs and the setae were visible through the chorion. Upon hatching, the chorion is split near the micropylar end by pressure from the dorsal surface of the larva, which is orientated with this surface ventrally. The split occurs in the ventral surface of the egg which is in contact with the substrate. After the chorion has been ruptured, the larva remains on its dorsal surface, partly within the eggshell, for about fifteen minutes. Once the legs have hardened, the larva flips over with a sudden movement, freeing itself completely from the eggshell and burrows immediately. The first pits were constructed approximately twelve hours after the larvae hatched. Upon hatching, the mandibles are pale and soft and play no part in rupturing the chorion. As has been stated by Withycombe (1925) who described hatching in *Glenoleon heteropteryx* Gerst., apparently no egg breaker is used in rupturing the chorion.

Birds and lizards prey upon larval Myrmeleontidae and a gecko, *Pachydactylus* sp., has been observed feeding on adult myrmeleontids around a light. An analysis of stomach contents of hornbills (*Tockus* sp.) from the Kruger National Park, and a species of lizard from Rhodesia, yielded larval myrmeleontid remains. In the case of the hornbills, the larvae belonged to the pit-building genus *Cueta*, and the lizards ate *Cueta* and a non-pit-building *Formicaleon*.

Palpares inclemens, from Lake Sibaya, is parasitized by

Hybothorax palparicida Bouček (Hymenoptera, Chalcididae) (Bouček, 1974). Myrmeleon lanceolatus from Grahamstown is parasitized by Hybothorax sp. and M. obscurus from the Island, Mauritius, by another species of Hybothorax. A parasite belonging to the genus Lasiochalcida (Chalcididae) has been reared from M. alcestris collected at Mkuze in northern Natal. An unidientified bombyliid (Diptera, Bombyliidae) has been found to parasitize M. obscurus in Rhodesia. These are all parasites of the larval stage and reach maturity in the cocoon of the host, killing the host larva prior to its pupation, but parasitoids are only rarely encountered in southern African Myrmeleontidae.

There are no data on host location or oviposition behaviour for southern African myrmeleontid parasites. Steffan (1958, 1959, 1961a, 1961b, 1966) has given accounts of behaviour in Lasiochalcida pubescens (Klug), L. agilis (Klug), L. guineensis Steffan and Hybothorax graffi Ratz. as well as a resumé of their hosts, all from France.

Some species of adult Myrmeleontidae are carnivorous whilst others are pollen feeders. Palpares speciosus fed on adult Lepidoptera whilst in captivity and an examination of the gut contents of L. moestus yielded unidentifiable insect remains. Furgella damarinus has been observed eating smaller myrmeleontids at lights. Stange (1970) reports the presence of insect remains and also pollen grains in the stomachs of North American Brachynemurini and suggests that the adults of some species are associated with flowers.

3.4 Biology of the Nemopteridae

Subfamily Nemopterinae.

There is little information on the biology of the Nemopterinae. Tjeder (1967) reviewed what was known regarding the immature stages and this comprised brief accounts of Nemoptera bipennis (Illiger) from Europe and Chasmoptera hutti (Westwood) from Australia. I described the third instar larva of Derhynchia vansoni Tjeder (Mansell, 1973), and the following account is largely drawn from this publication, which is bound into the thesis overleaf. The larvae of D. vansoni occur in the Kalahari desert and live in loose sand 15 - 25 cm beneath the surface and are morphologically well adapted to a subterranean mode of existence. The antennae are reduced to two segments and are held close to the head, and eyes are absent. The larvae are hirsute and the long setae prevent sand particles from impinging upon the body surface, ensuring that a layer of air surrounds the larva. Unlike myrmeleontid larvae which burrow backwards, these larvae enter the sand head first. The head and prothoracic legs are used to tunnel into the sand until the prothorax is covered, the ventral surface of the 8th abdominal segment is brought into contact with the sand by a contraction of the body. When the body is expanded the 8th abdominal segment functions as a pivot, exerting a thrusting force which propels the larva deeper into the sand. When placed upon sand the larvae will burrow immediately: on a hard substrate the larvae move forwards but unlike myrmeleontids, appear to be incapable of moving backwards. The 8th abdominal segment plays a major role in locomotion by propelling the larva forwards, the movement being similar to that described for burrowing.

Although feeding was not observed, it is probable that this takes place entirely beneath the surface. The main factor which supports this statement is the inability of the larvae to move backwards. In the Myrmeleontidae, prey is captured on the surface and is rapidly dragged under by the larva moving backwards into the sand. During this process the prey is held secure by the tips of the mandibles and the mandibular teeth and the body is usually out of reach of the prey. Because of the mode of burrowing in _D. vansoni_ however, the prey, if captured on the surface would have to be pushed rather than dragged under the sand. This would impede burrowing and also the larva would be susceptible to retaliatory attacks by the prey, as the abdomen is exposed above the surface during most of the burrowing process. Burrowing in _D. vansoni_ is also very slow and therefore does not facilitate rapid subdual of prey as is the case with myrmeleontid larvae.

Pupation takes place in a silken, spherical, sand covered cocoon which is usually located at the base of a grass tuft, 5 - 10 cm beneath the surface. Several vacated cocoons were located in such situations, and the cocoons measured about 7,5 mm in diameter.

Derhynchia vansoni was the first larval representative of the subfamily Nemopterinae to be found in southern Africa (Mansell, 1973) and subsequent to this the larvae of two additional species have been found. The larva of an unidentified species from the Namib desert occurs in loose sand, like _D. vansoni_. In the south western Cape, one larva of _Semirhynchia_ sp. was found living in plant detritus in a small cave. This latter larva did not feed and pupated shortly after collection. Of the five known larval species of Nemopterinae in the world, three are free living in sand (D. vansoni, C. hutti and an unidentified species), one (Semirhynchia) was found amongst plant detritus in a small cave whilst the habitat of the fifth, N. bipennis is unknown. There are no data on feeding behaviour or food preferences for immature Nemopterinae.

The information on adult biology has also been reviewed by Tjeder (1967). There are no records of mating or oviposition, and food apparently consists exclusively of pollen. Adults of Palmipenna pilicornis Tjeder have been collected during the daytime in the Namib desert, whilst feeding upon flowers of plants in the family Compositae. According to Tjeder (pers. comm.), the adults of P. palmulata Tjeder, exhibit an interesting behaviour pattern, possibly as an evasive action against predators. On being disturbed, the insects fly up and then close the wings and spiral to the ground like a falling leaf.

Parasites are unknown but observations have been made of robber-flies (Diptera, Asilidae) preying upon adult specimens of Nemopterella.

Subfamily Crocinae.

Southern African Crocinae can be divided into two groups on the basis of habitat preference (fig. 8) and morphological features. The first group, represented by six species in the genera Laurhervasia and Tjederia, have larvae which inhabit small caves and areas under rock overhangs, where they live in fine dry sand or dust. Larvae of this first group are characterized by the extreme elongation of the prothorax. The second group, comprising four species

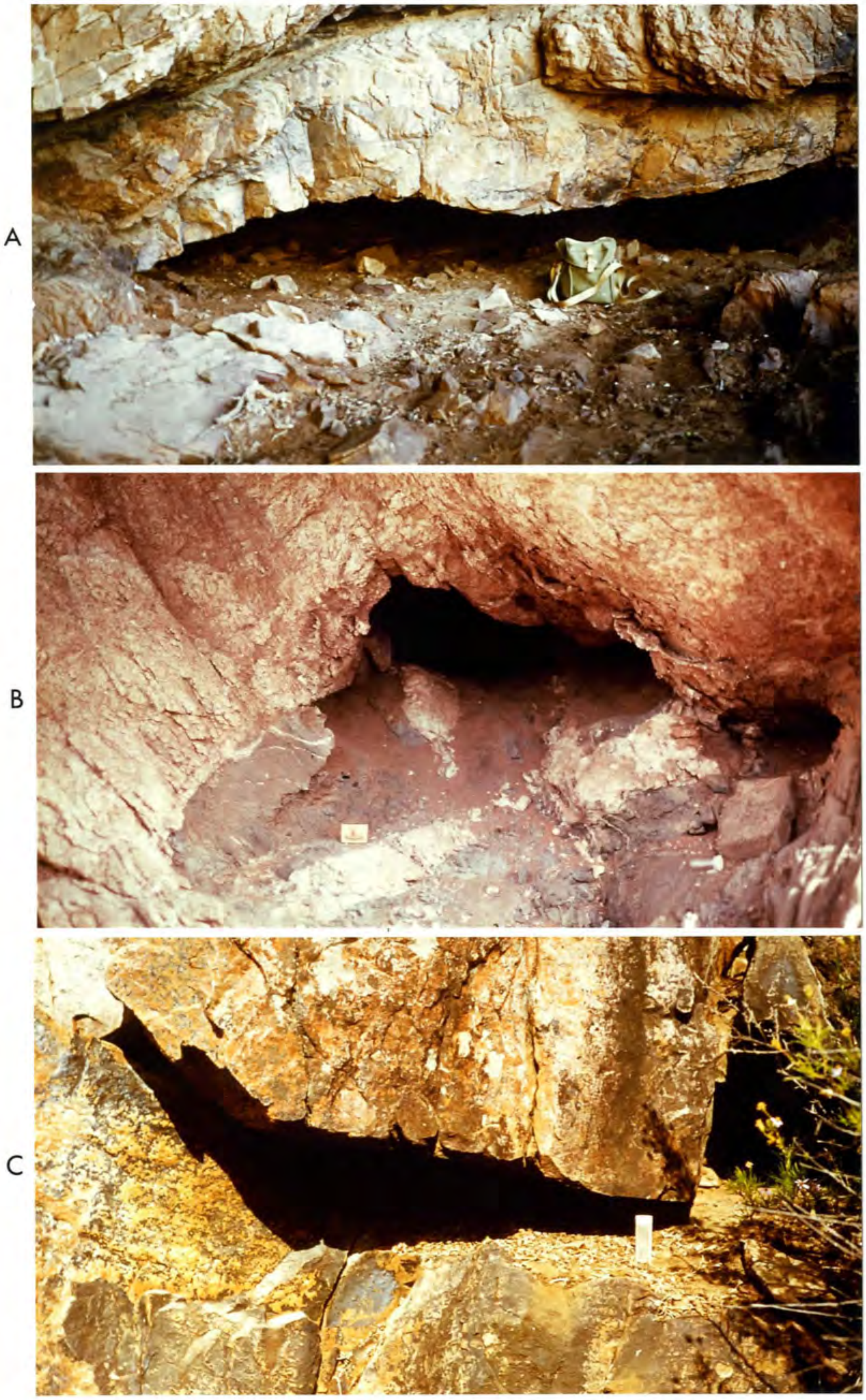


Fig. 8. A - C. Examples of habitats occupied by larval Crocinae. A. Cave habitat of *Tjederia namaquensis* Mansell and *Laurhervasia setacea* (Klug), the bag in the foreground is 24 cm high. B. Habitat of *Laurhervasia namibica* spec. nov., the matchbox is 3,5 cm high. C. Crevice habitat of *Concroce capensis* Tjeder (note plant detritus in the foreground), the vial is 5,5 cm high.

belonging to the genera Concroce and Thysanocroce, are not true cave dwellers but live in plant detritus in rock crevices and under rock overhangs. They are often found in association with the nests of rodents. Features of these larvae are that they are all cryptic and have short prothoraxes.

The following account of the biology of these insects is largely derived from Mansell (1976, 1977) and both papers are bound into the thesis in chapter 4. Larvae belonging to the first group were all found in small, low (ca. 1 m high) caves or under rock overhangs, a feature of the habitats being that they provide complete protection from rain, direct sunlight and wind (fig. 8A,B). The larvae live among accumulated sand, dust and debris on the floors of the caves. The caves were usually inhabited by bats, porcupines and small carnivores and the debris which they provide, harbours and attracts insects and other small invertebrates. It has been established that a characteristic fauna is associated with caves and areas suitable for crocin habitation. This fauna comprises Dermestidae (Coleoptera), Collembola, Thysanura, Psocoptera, Hemiptera (an unidentified reduviid) and a spider, Sicarius testaceus Purcell, as well as various other small arthropods. The first four categories probably constitute the principle prey of the Crocinae, whilst the spider is a predator and has been seen killing Crocinae. In the caves, the food chain commences with an input of energy in the form of animal detritus (faeces and pellets) and plant debris. The scavengers, such as Dermestidae, utilize this food source and in turn become the food of the predators. It has also been found that caves inhabited by the hyrax Procavia capensis (Pallas), are unsuitable for Crocinae, probably for two reasons. Firstly, disturbance of the habitat by the hyraxes and secondly, hyrax dung is not easily denatured and tends to accumulate, eliminating sandy areas.

Larvae in the second group (Concroce and Thysanocroce) live in plant detritus in rock crevices and under rock overhangs (fig. 8C). These habitats do not offer as much protection from the weather as do those inhabited by Laurhervasia and Tjederia. Larval Concroce and Thysanocroce do not live in dust but conceal themselves amongst plant detritus; they have much the same diet as the first group.

All the known crocin larvae are able to move backwards and forwards and are capable of climbing vertical cave walls, often using this ability to retreat when disturbed. Laurhervasia and Tjederia have long legs, are extremely agile and capable of rapid locomotion. Normally however, they lie concealed among the dust and debris in the cave with the abdomen buried in the substrate, leaving the head and thorax exposed. The whole insect is covered with a layer of fine dust, which enhances concealment, making the larvae very difficult to detect as long as they remain motionless. They only seem to move when disturbed or in pursuit of prey. In the laboratory, they remain motionless for long periods of time, sometimes up to a week or more, similar to other species described by Tjeder (1967). The larvae of Concroce and Thysanocroce have short legs, are slow moving and are cryptic, concealing themselves amongst detritus.

Unlike myrmeleontid larvae which rely on a fast strike and rapid subdual of their prey, the larvae of Crocinae approach immobile or slow-moving prey cautiously and then slowly insert the mandibles, as has also been described in Klugina aristata (Klug) by Hafez & El Moursy (1964), from Egypt. Sudden movement of the prey will usually elicit rapid retreat by the crocin larva. In the laboratory, they have been fed on Isoptera (Trinervitermes trinervoides (Sjöst.)), Psocoptera, Diptera (Drosophila), larvae of Dermestidae, Formicidae and small Homoptera such as Aphididae. They will feed upon prey much larger than themselves, provided it has been immobilized, and this tends to indicate that they do not rely entirely upon their own ability to subdue and kill prey, but also scavenge. Crocin larvae can, however, detect moving prey and will sometimes leave their places of concealment to pursue it. These larvae do not "overfeed" if presented with excess food, as is often the case in Myrmeleontidae, and this supports the supposition that the Crocinae are scavengers. The duration of the three larval instars is from two to three years depending upon availability of food.

Pupation takes place in a silken, spherical cocoon which is impregnated with sand grains on the exterior surface. During cocoon spinning, the long prothoracic region of the larva is gradually resorbed, thereby facilitating its accommodation within the cocoon. The long hindwings are coiled and folded across the body of the pupa as described by Pierre (1952) for Pterocroce troglophilus Pierre, from Algeria. In the field, cocoons were found on or just below the surface of the substrate or occasionally attached to the walls of the caves. At eclosion the cocoon is breached by the pupa biting a hole through the silk and forcing the head and thorax through the opening. Once the head and thorax of the exarate pupa protrude from the cocoon, the pupa moults into the adult leaving the pupal exuvium wedged in the eclosion aperture. Hafez & El Moursy (1964) state that the adult "bores by its beak into the cocoon thus forming a hole through which it comes out", but this is not the case in the southern African species. Once the adult is free of the pupal exuvium, the meconium is voided and the teneral adult seeks a vertical surface to cling to whilst the wings expand and harden.

Hafez & El Moursy (1964) described the mating behaviour of Klugina aristata (Klug), and during the present study mating has been observed in five species belonging to three genera. The behaviour pattern was the same for all five species and differs from that described by Hafez & El Moursy. The mating sequence is illustrated in fig. 9. The insects fly with an up and down, backwards and forwards, circular motion with the body held vertically and the hindwings hanging downwards, sweeping back and forth, acting as tactile sensors. The characteristic flight pattern enables the insects to fly for extended periods in confined spaces. Mate location appears to be mechanical, for when two individuals come into proximity during flight, the flight pattern becomes more rapid and restricted to a smaller area. This behaviour is also elicited when two individuals of the same sex gain close proximity to one another. Hafez & El Moursy (1964) suggest that the females may be attracted to the males by pheromones produced in modified hypodermal glands on the sixth abdominal tergite (pleuritocavae of Tjeder, 1967), or from the bullae on the wings of the males. This may be the case

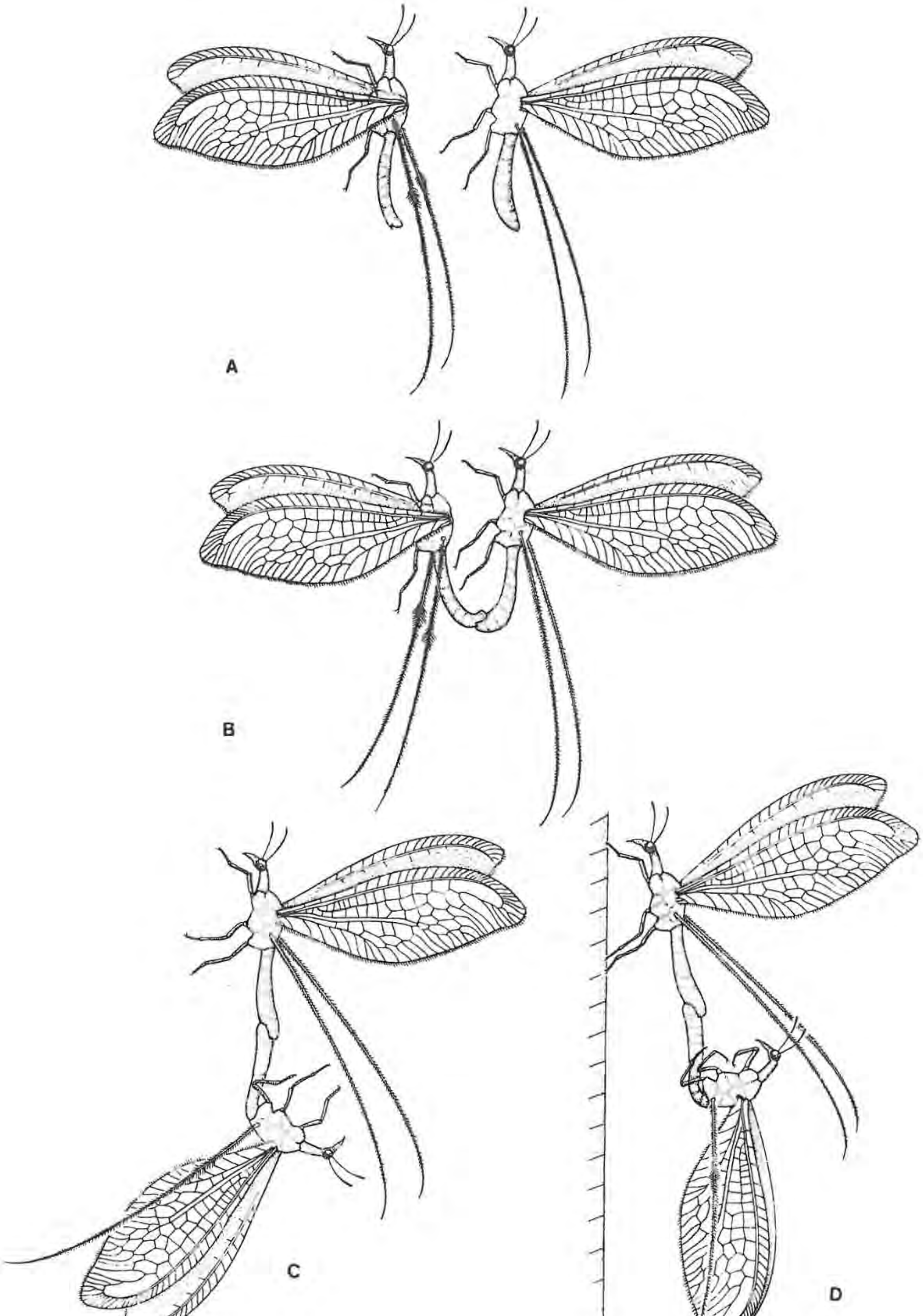


Fig. 9. A – D. Mating behaviour in the subfamily Crocinae. A. The ♂ and ♀ fly with bodies held vertically parallel to one another. B. Coupling takes place during flight. C. The ♂ drops downwards. D. ♀ settles on a vertical surface with the ♂ suspended below her. In diagrams A & B the ♂ is on the left, in C & D it is below the ♀.

in some species, but pleuritocavae are not found in any of the southern African species, and in some cases, *Tjederia* and *Concroce*, bullae are also absent. Prior to coupling, the male becomes orientated in front of the female and they fly briefly with the bodies held vertically parallel, close to one another. The male then bends the extremity of the abdomen backwards and upwards to engage the genitalia of the female. Once coupling has been achieved, the male drops downwards and remains suspended upside down from the terminalia of the female, and she continues to fly. After flying for up to three minutes, the female settles on a vertical surface with the male hanging below her. The thorax of the male is held at right angles to the abdomen, with the wings orientated downwards thereby preventing damage by contact with the substrate. In *Concroce*, the body of the male is held in a U-shaped curl as opposed to a right angle, this being the only observed difference between species in mating. The insects remain coupled for up to thirty five minutes. According to Hafez & El Moursy (1964), the male of *K. aristata* hovers around and comes to rest over the back of the female. This pre-coupling orientation was not observed in any of the southern African species and Hafez & El Moursy do not state whether the male is suspended below the female during flight prior to settling.

During oviposition, females did not alight on the substrate, but dropped the eggs haphazardly, sometimes from heights exceeding 30 cm, whilst resting on the vertical wall of the cage. Despite being dropped onto a hard wooden benchtop in the laboratory, the eggs were not damaged and the delicate aeropyles on the chorion remained intact. Under natural conditions the substrate is more yielding and upon impact, the eggs would probably become covered with a layer of concealing dust. The number of eggs laid by each female varied considerably with the highest number of 63 recorded for T. brevicornis. Upon emergence from the cocoon, the females are already gravid and oviposition commences about 12 hours after the females have been fertilized.

Newly laid eggs are translucent white in colour and in mature, fertile eggs two black dots (the larval eyes) are visible through the chorion at the cephalic end with the larval segments also discernible within the egg. Prior to hatching the larva is orientated in the egg with the head folded ventrally under the body. On hatching the chorion is ruptured at the cephalic end by the larva pushing against it with the thorax. The larva then straightens itself with the head and thorax remaining in their original position whilst the abdomen extrudes through the ruptured chorion. The head and thorax remain temporarily within the eggshell. This manouvre results in the larva coming to rest upon its dorsal surface enabling the soft legs to expand and harden before having to support the larva. Hatching procedure was the same for all the species observed.

The adult stage of the life cycle is short, lasting between one and three weeks, in contrast to several years for the larval stage. Adults are only encountered in summer between October and March, whilst larvae in all three instars are to be found throughout the year. The adults are attracted to light but they are not exclusively nocturnal as they have frequently been observed flying in caves during the day.

Feeding behaviour has not been recorded but the gut contents of field-collected specimens yielded only pollen, as has also been mentioned by Tjeder (1967). Only one incidence of parasitism has been recorded where a larva of _T. brevicornis_ was parasitized by an unidentified bombyliid (Diptera, Bombyliidae).

Having dealt with what is known of the biology of the Nemopteridae, it is now appropriate to discuss details of the systematics of the subfamily Crocinae.

4. SYSTEMATIC REVISION OF THE SUBFAMILY CROCINAE IN SOUTHERN AFRICA.

In his monograph on the southern African Crocinae, Tjeder (1967) described six species in two genera on the basis of adult morphology. At the time of Tjeder's monograph (1967), immature stages of the Crocinae were unknown from the southern hemisphere. The larvae of all species known from southern Africa have now been discovered and are described and the eggs are also known in seven of the species.

The present revision catalogues and describes ten species in four genera, four species being described for the first time. An additional genus species *T. namaquensis* was described earlier (Mansell, 1977). One species, *Concroce hessei* Tjed., is relegated to synonomy and the genus *Thysanocroce* Withycombe, formerly synonomised with *Laurhervasia* is reinstated as a valid genus. The present revision is based on larval morphology, biology and distribution in addition to adult characteristics. Figure 10 illustrates some morphological features of the larvae mentioned in the text. The ten species dealt with are;

Laurhervasia setacea (Klug)
Laurhervasia rhodesiae Tjeder
Laurhervasia transvaalensis spec. nov.
Laurhervasia namibica spec. nov.
Thysanocroce damarae (MacLachlan)
Concroce capensis Tjeder
Concroce walkeri Tjeder
Concroce parva spec. nov.
Tjederia namaquensis Mansell
Tjederia brevicornis spec. nov.

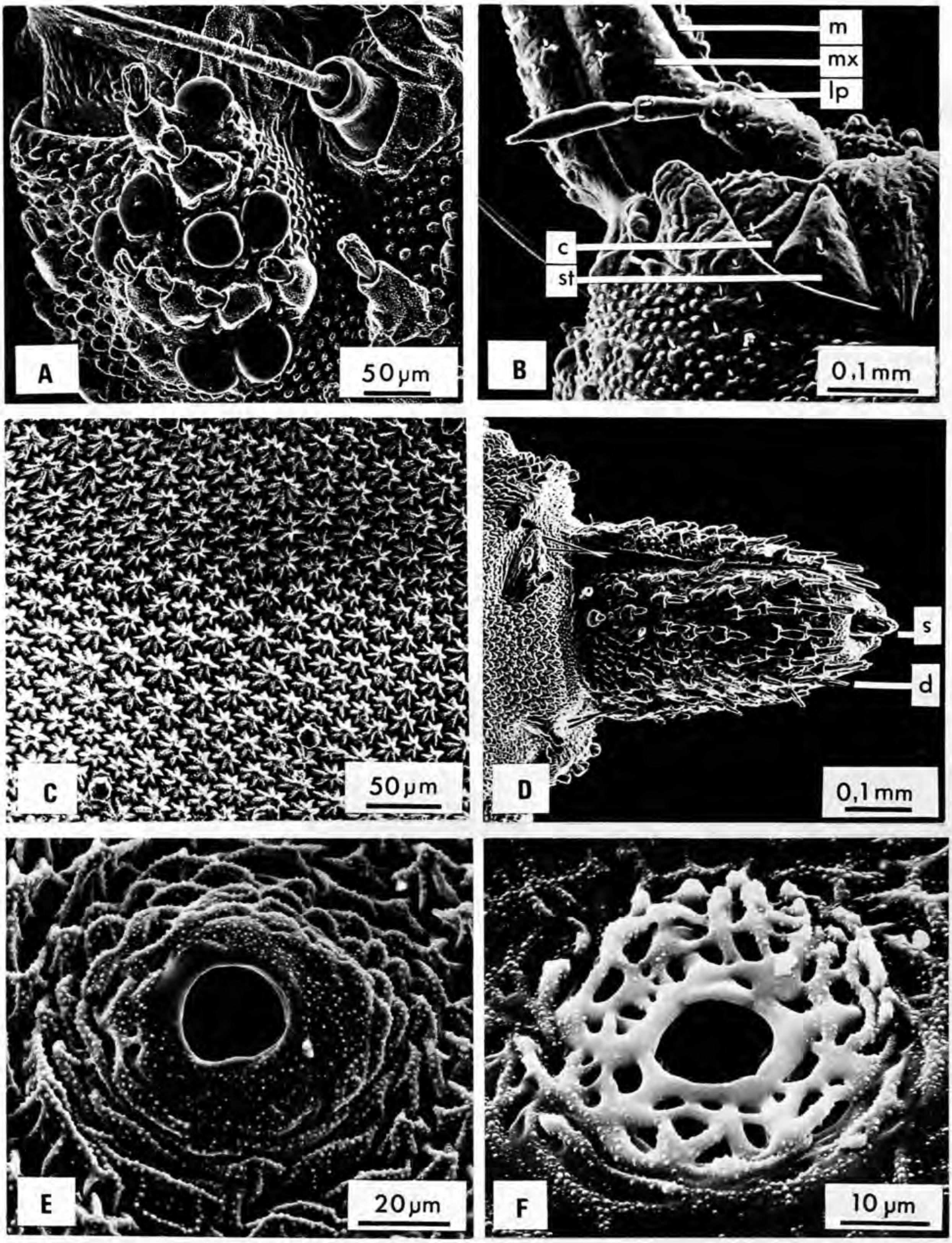


Fig. 10 A – F. Morphological features of larval Crocinae. A. Lateral surface of head showing eye and base of antenna. B. Ventral surface of head. C. Cuticle of abdomen showing stellate conformation. D. Ventral surface of segment 8, showing spinneret and dolichasters. E. Spiracular opening, *Concroce walkeri* Tjed. F = Spiracular opening, *Laurhervasia setacea* (Klug). c = cardo, d = dolichaster, lp = labial palp, m = mandible, mx = maxilla, s = spinneret, st = stipes.

4.1 genus LAURHERVASIA Navas, 1914.

Synopsis:

Laurhervasia Navas, 1914a:647. Type species: Croce lawi Navas,
1913b:87. (=Nemoptera setacea Klug,
1836:95) by original designation.

Thysanocroce Withycombe, Tjeder, 1967:325. Incorrect synonomy.

Laurhervasia Navas; Tjeder, 1967:325.

Laurhervasia Navas; Hölzel, 1975:88.

Laurhervasia Navas; Mansell, 1977:210, 202.

The adult characteristics of the genus Laurhervasia have been described by Tjeder (1967) and include; a long narrow rostrum; antennae about one third the length of the forewing; 3 crossveins usually present between R and M before Rs.; males with bullae in the hindwings (although bullae are sometimes absent from the wings of L. namibica); pleuritocavae absent; abdominal tergite 9 in the male not divided dorsally; ectoprocts with large callus cerci; sternite 9 flat and short; parameres with large apical regions which are enclosed in a membrane; proximal projections present on the parameres; gonosetae present but spinellae absent; tergite 9 in the female divided into two; lateral plates of sternite 8 fused with the gonapophyses laterales.

The larvae are characterized by elongated porthoraxes (longer than twice the head length) and a cave dwelling habit. The eggs are known in two species and are oval in shape with globular aeropyles on the chorion.

The four species in this genus are L. setacea, L. rhodesiae, L. transvaalensis and L. namibica and are dealt with in this order.

Laurhervasia setacea (Klug, 1836).

Synopsis:

Nemoptera setacea Klug, 1836:95.

Nematoptera setacea (Klug), Burmeister, 1839:986.

Nematoptera setacea (Klug); Westwood, 1841:13.

Nematoptera setacea (Klug); Westwood, 1842:379.

Nemoptera setacea (Klug); Walker, 1853:474. Incorrect identification.

Nemoptera setacea (Klug) (nec Walker); Hagen, 1866:453.

Croce setacea (Klug), MacLachlan, 1885:379.

Croce setacea (Klug); Kirby, 1900:464.

Croce setacea (Klug); Navas, 1910:400.

Croce lightfooti Péringuey, 1910:453. Synonomised by Tjeder, 1967:329.

Croce setacea (Klug); Navas, 1912j:18.

Croce Lawi [sic!] Navas, 1913b:87. Synonomised by Tjeder, 1967:329.

Croce Lawi [sic!] Navas; Navas, 1914a:647.

Croce lawi Navas; Withycombe, 1923:271.

Thysanocroce ? setacea (Klug), Withycombe, 1923:285.

Laurhervasia setacea (Klug), Tjeder, 1967:329.

Nemoptera testacea [sic!] Klug; Tjeder, 1967:329.

Laurhervasia setacea (Klug); Hölzel, 1975:88.

Laurhervasia setacea (Klug); Mansell, 1976:153.

Laurhervasia setacea (Klug); Mansell, 1977:202.

Description of adult and larva.

The adult of L. setacea was redescribed by Tjeder (1967:329) and the larva was described by Mansell (1976:153). The formal description of the larva is bound into the thesis overleaf.

Subsequent to these publications additional data have been collected which suggests that this species is widespread and polytypic. Some of the populations differ from one another in the sizes of their constituent individuals, but there is considerable overlap in these measurements. Tables 1 and 2 provide a summary of comparative morphometric data for several of these populations, to illustrate the variability.

Laurhervasia setacea can be divided into two population groups on the basis of larval morphology and to a lesser extent on adult characteristics, although the majority of adults from the different populations are morphologically indistinguishable from one another. The two groups are (i) the populations from the Cape Province and southern South West Africa (group A) and (ii) those occurring in central- and northern South West Africa (group B), (fig. 13). The principal differences between the two groups are found in the larvae, but there is overlap in the sizes of the four parameters measured (table 2). In group A, the head is wider than long, not markedly tapered and usually bears a distinct triangular marking on the dorsal surface. In group B the head is usually as long as it is wide, tapering posteriorly and uniformly dark, although some individuals do possess a discernible triangular mark on the dorsal surface. The prothoraxes of individuals in group A are usually shorter than those from group B and fig. 11 illustrates this, and the other features which differ between the two groups. The populations comprising the two groups are all considered to be members of the same variable species as no constant, unambiguous characters can be found to separate them and a statistical comparison did not

Table 1. Mean measurements for L. setacea adults from ten populations. The ranges are given below the means. All measurements in mm. N = numbers in sample.

Group	N	Forewing length	Hindwing length	Body length	Antennal length	Rostrum length ♂	Rostrum length ♀	Radial crossveins
Kuruman Dist. (A)	8	13,5 12,5-14,5	38,4 35,0-41,0	8,0 7,2-8,8	3,6 3,2-4,2	1,20 1,04-1,28	1,34 1,24-1,44	7, 8 or
Oudtshoorn (A)	24	14,2 12,0-15,0	36,6 35,0-43,0	8,1 7,0-9,3	3,6 3,3-4,3	1,33 1,24-1,44	1,46 1,24-1,56	8 or 9
S.W.A. Aurusberge (A)	11	14,4 13,5-16,0	41,3 38,0-46,0	8,9 8,0-10,0	4,0 3,4-4,4	1,39 1,24-1,60	1,47 1,40-1,52	8 or 9
Iwee Rivieren (A)	10	13,5 12,5-14,0	41,4 33,0-45,0	8,3 6,8-8,8	4,0 3,6-4,4	1,34 1,24-1,40	1,41 1,36-1,48	9 or 8
Piketberg (A)	12	12,5 11,5-14,0	35,7 31,0-41,0	7,2 6,4-8,4	3,8 3,5-4,0	1,27 1,20-1,40	1,43 1,28-1,48	7 or 8
S.W.A. Mariental (A)	6	14,8 14,0-15,0	44,5 39,0-48,0	9,0 8,8-9,6	4,3 4,0-4,6	1,42 1,40-1,48	1,58 1,48-1,68	9
S.W.A. Ai Ais (A)	17	14,5 13,0-16,0	44,1 39,0-51,0	8,8 8,4-10,7	4,2 3,6-4,6	1,48 1,36-1,68	1,53 1,44-1,68	8 or 9
S.W.A. Windhoek (B)	8	14,6 14,0-15,0	42,3 37,0-45,0	9,8 9,0-10,0	3,9 3,3-4,5	1,33 1,24-1,40	1,52 1,48-1,56	9 or 8
S.W.A. Paresis Mts. (B)	25	14,0 13,0-16,0	40,3 35,0-47,0	9,2 8,0-10,0	3,7 3,4-4,4	1,33 1,20-1,44	1,40 1,32-1,48	8
S.W.A. Okahandja (B)	18	15,1 14,0-16,0	43.8 39,0-49,0	10,1 9,0-11,0	4,0 3,3-4,5	1,35 1,24-1,40	1,46 1,36-1,52	8

Table 2. Comparison of measurements (mm) for third instar larvae of L. setacea from eleven localities. The ranges are given below the means. N = numbers in sample.

	N	Head width	Head length	Mandible length	Prothoracic length
Kuruman District "Wonderwerk Cave" (A)	26	0,98 0,92-1,04	0,92 0,84-1,00	1,31 1,24-1,40	2,46 2,16-2,80
"Glittering Grotto" Oudtshoorn (A)	34	0,99 0,92-1,09	0,95 0,88-1,04	1,36 1,28-1,44	2,49 2,32-2,72
Holgate Siding Oudtshoorn District (A)	30	0,97 0,92-1,00	0,93 0,88-1,00	1,26 1,16-1,36	2,52 2,24-2,64
Montagu (A)	39	0,97 0,88-1,04	0,93 0,88-1,00	1,28 1,16-1,40	2,51 2,28-2,76
Piketberg (A)	17	0,94 0,88-1.00	0,89 0,84-0,96	1,22 1,16-1,32	2,35 2,20-2,52
S.W.A. Mariental (A)	29	0.98 0,88-1,08	0,94 0,88-1,00	1,27 1,20-1,40	2,48 2,28-2,64
S.W.A. Ai Ais (A)	18	0,98 0,92-1,00	0,93 0,88-0,96	1,29 1,16-1,36	2,51 2,36-2,64
S.W.A. Windhoek (B)	20	0,94 0,88-0,96	0,94 0,88-1,00	1,35 1,28-1,44	2,76 2,60-2,92
S.W.A. Usakos (B)	16	0,88 0,84-0,92	0,88 0.84-0,92	1,27 1,20-1,36	2,57 2,40-2,80
S.W.A. Paresis Mts. Otjiwarongo Dist. (B)	40	0,93 0,88-0,96	0,92 0,88-0.96	1,35 1,28-1,40	2,75 2,56-2,96
S.W.A. Okahandja (B)	28	0,93 0,88-0,96	0,92 0,84-0,96	1.31 1,20-1,44	2,64 2,48-2,64

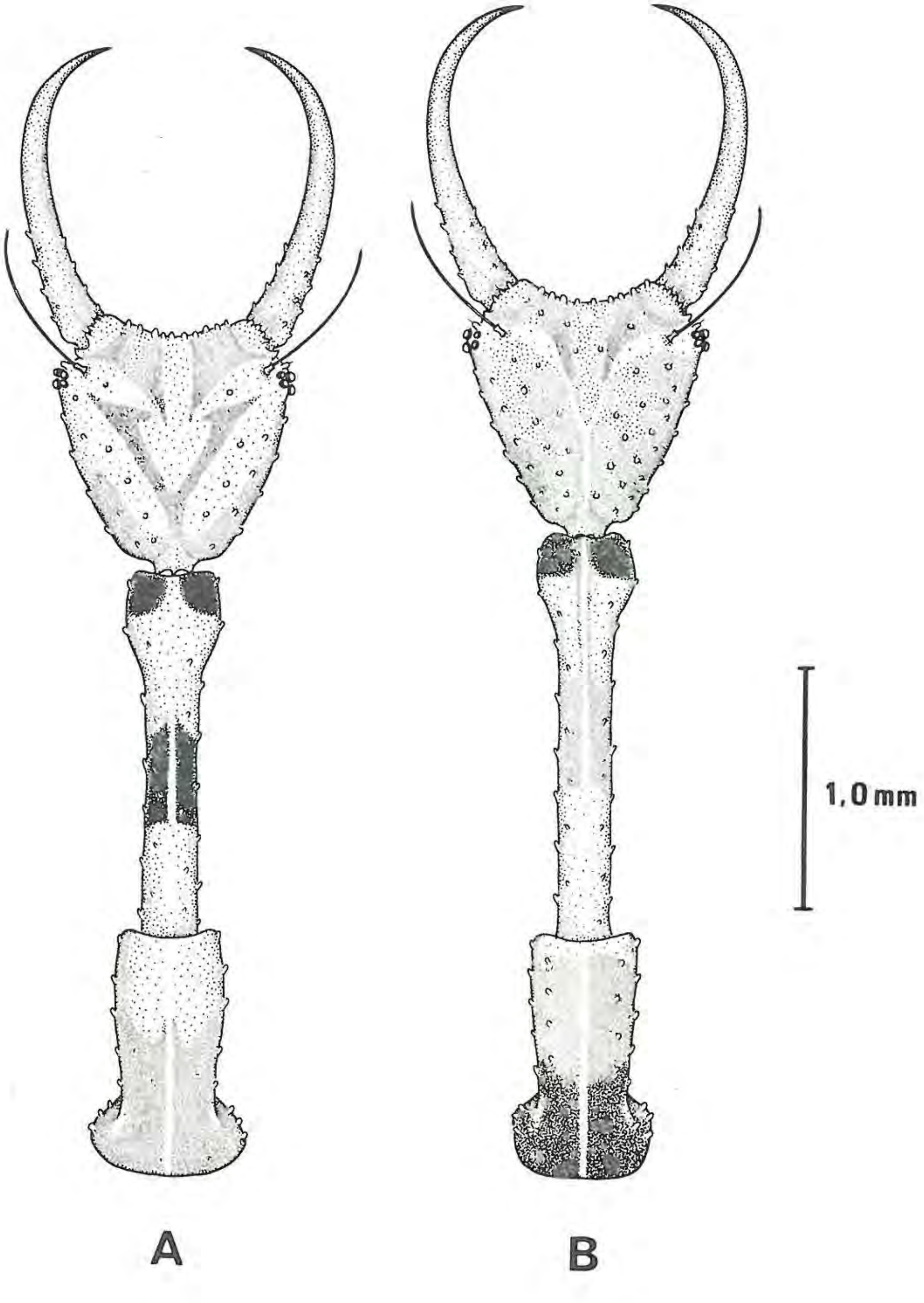


Fig. 11. A & B. Comparison of Laurhervasia setacea (Klug) larvae from the two population groups. A. Southern South West Africa and Cape Province (typical form). B. Central and northern South West Africa.

reveal any distinctive morphometric trends. Their distributions also overlap providing the potential for gene flow between the different populations.

Material examined. Adults, 212 specimens.

SOUTH AFRICA, CAPE PROVINCE. 20 km S. Twee Rivieren (26.39S 20.37E), 7♂♂ 3♀♀, 23.xii.1974; Kromrivier Farm, Cedarberg (32.32S 19.18E), 2♂♂ 6♀♀, 5.i.1975; Stadsaal Caves Cedarberg (32.31S 1919.E), 1♂ , 6.i.1975; Seven Weeks Poort (33.25S 21.24E), 1♂ 3♀♀, 9.i.1975; 10 km N. Prieska (29.40S 22.30E), 4♂♂ 1♀, 17.vii.1975; De Hoek Farm Oudtshoorn Dist. (33.23S 22.11E), 11♂♂ 13♀♀, 31.viii.1975, A.J. Urban & S.B. Malcolm; Augrabies (28.35S 20.21E), 2♂♂, 22.vii.1976; Springbok (29.43S 17.55E), 4♂♂ 2♀♀, 4.ix.1976; Goudini Spa, Worcester (33.40S 19.16E), 1♂, 3.ii.1977; Rooinek Pass, Laingsburg Dist. (33.19S 20.56E), 1♂, 5.ii.1977; Wonderwerk Cave, Kuruman Dist. (27.52S 23.34E), 6♂♂ 2♀♀, 4.v.1977; 18 km N.W. Upington (28.24S 21.07E), 2♂♂ 2♀♀, 6.v.1977; Volop (28.54S 22.27E), 1♂ 1♀, 10.v.1977; 14 km W. Douglas (29.03S 23.37E), 1♀, 10.v.1977; Piketberg (32.55S 18.45E), 6♂♂ 6♀♀, 27.vii.1977; Montagu (33.48S 20.06E), 1♂ 1♀, 28,vii.1977; Huis Rivier Pass (33.28S 21.31E), 1♂, 29.vii.1977; Rooikoppe, Oudtshoorn Dist. (33.33S 22.26E), 1♂ 1♀, 29.vii.1977; Meiringspoort (33.23S 22.33E), 1♂ 1♀, 29.vii.1977; Wildehondpas, Montagu Dist. (33.56S 20.28E), 2♂♂ 2♀♀, 24.xi.1977, V.C. Moran & R.L. Kluge; Holgate Siding, Oudtshoorn Dist. (33.48S 22.22E), 1♂ 1♀, 25.xi.1977, V.C. Moran & S. Neser; Matjiesfontein (33.14S 20.35E), 1♂ 1♀, 10.i.1978 (adults collected); Algeria Forestry Station, Cedarberg (32.22S 19.03E), 1♀, 8.i.1978 (adult collected);

SOUTH WEST AFRICA. Aurusberg (27.27S 16.05E), 5♂♂ 6♀♀, 23.x.1974; Ai Ais (27.56S 17.31E), 8♂♂ 9♀♀, 1.i.1975; Fish River Canyon (27.52S 17.45E), 1♀, 15.vii.1975; Hardap Dam, Mariental (24.28S 17.48E), 4♂♂ 2♀♀, 21.vii.1976; Kanus Siding, Karasburg Dist. (27.53S 18.38E), 2♂♂ 2♀♀, 7.v.1977; Noachabeb Farm, Karas Mountains (27.23S 18.31E), 2♂♂, 7.v.1977; Holoog Siding (27.24S 17.58E), 2♀♀, 9.v.1977; Windhoek (22.34S 17.07E), 6♂♂ 2♀♀, 19.viii.1977, M.W. Mansell & V.C. Moran; 10 km N. Windhoek (22.31S 17.06E), 2♀♀, 19.viii.1977, M.W. Mansell & V.C. Moran; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 1♀, 20.viii.1978; Usakos (21.59S 15.38E), 2♂♂4♀♀, 21.viii.1977, M.W. Mansell & V.C. Moran; Omigonde Farm, Kalkveld Dist. (21.07S 16.21E), 1♂ 2♀♀, 22.viii.1977, M.W. Mansell & V.C. Moran; Paresis Mountains, Otjiwarongo Dist. (20.22S 16.20E), 13♂♂ 12♀♀, 23.viii.1977, M.W. Mansell & V.C. Moran; Okahandja (21.59S 16.55E), 10♂♂ 8♀♀, 24.viii.1977, M.W. Mansell & V.C. Moran.

Larval collection dates given above in chronological order. All collected by M.W. Mansell, except where otherwise indicated. Specimens were reared from larvae from all except two localities which are indicated.

Material examined. *Larvae*, 708 specimens.

SOUTH AFRICA, CAPE PROVINCE. Five localities listed by Mansell (1976:156), 76 larvae; Stadsaal Caves Cedarberg (32.31S 19.19E), 1 larva, 6.i.1975; Augrabies (28.35S 20.21E), 2 larvae, 22.vii.1976; Springbok (29.43S 17.55E), 12 larvae, 4.ix.1976; Goudini Spa, Worcester Dist. (33.40S 19.16E), 2 larvae, 3.ii.1976; Rooinek Pass, Laingsburg Dist. (33.19S 20.56E), 3 larvae, 5.ii.1977; Wonderwerk Cave, Kuruman Dist. (27.52S 23.34E), 31 larvae, 4.v.1977; Olifantshoek (27.56S 22.44E), 5 larvae, 5.v.1977; 18 km N.W. Upington (28.24S 21.07E), 10 larvae, 6.v.1977; Leerkrans, 15 km E. Upington (28.25S 21.30E), 1 larva, 10.v.1977; Volop (28.54S 22.27E), 22 larvae, 10.v.1977; 14 km W. Douglas (29.03S 23.37E), 6 larvae, 10.v.1977; De Doorns (33.29S 19.40E), 3 larvae, 26.vii,1977; Piketberg (32.55S 18.45E), 19 larvae, 27.vii.1977; 10 km W. Montagu (33.47S 20.07E), 11 larvae, 28.vii.1977; Huis Rivier Pass (33.28S 21.31E), 3 larvae, 29.vii.1977; Rooikoppe, Oudtshoorn Dist. (33.33S 22.26E), 9 larvae, 29.vii.1977; Meiringspoort (33.23S 22.33E), 10 larvae, 29.vii.1977; Kogmanskloof, Montagu (33.48S 20.28E), 29 larvae, 24.xi.1977, V.C. Moran & R.L. Kluge; Wildehondpas, 34 km S.E. Montagu (33.56S 20.28E), 23 larvae, 24.xi.1977, V.C. Moran & S. Neser; Poshoogte, 50 km S.W. Ladismith (33.47S 20.55E), 15 larvae, 24.ix.1977, V.C. Moran & R.L. Kluge; Opsoek, Huis Rivier Pass (33.28S 21.31E), 7 larvae, 24.xi.1977, V.C. Moran & R.L. Kluge; Holgate Siding, Oudtshoorn Dist. (33.48S 22.22E), 39 larvae, 25.xi.1977, V.C. Moran & S. Neser; Neuspoort, Kakamas Dist. (28.43S 20.42E), 5 larvae, 27.xii.1977; Heerenlogements Cave (31.58S 18.33E), 2 larvae, 7.i.1978; Algeria Forestry Station Cedarberg (32.22S 19.03E), 2 larvae, 8.i.1978; Victoria West (31.24S 23.07E), 15 larvae, 14.iv.1978, M.W. Mansell & V.C. Moran; Excelsior Farm, 40 km W. Richmond (31.23S 23.40E), 8 larvae, 14.iv.1978, M.W. Mansell & V.C. Moran; 39 km W. Britstown (30.39S 23.11E), 10 larvae, 14.iv.1978, V.C. Moran; Hopetown (29.38S 24.05E), 4 larvae, 15.iv.1978, M.W. Mansell & V.C. Moran; Tafelkop Farm, Petrusville Dist. (30.15S 24.47E), 1 larva, 15.iv.1978, V.C. Moran; Derdepoort, Colesburg Dist. (30.26S 24.59E), 2 larvae, 15.iv.1978, M.W. Mansell & V.C. Moran; Eerstepoort, Colesburg Dist. (30.34S 24.59E), 2 larvae, 15.iv.1978, M.W. Mansell & V.C. Moran; Colesburg (30.43S 25.05E), 1 larva, 15.iv.1978; Barkly West (28.32S 24.32E), 8 larvae, 10.viii.1978.

ORANGE FREE STATE. 5 km N. Orania (29.48S 24.27E), 7 larvae, 15.iv.1978, M.W. Mansell & V.C. Moran; Havenga Bridge (29.54S 24.38E), 2 larvae, 15.iv.1978, M.W. Mansell & V.C. Moran.

SOUTH WEST AFRICA. Three localities listed by Mansell (1976:156), 41 larvae; 20 km N. Gochas (24.46S 18.42E), 4 larvae, 2.vii.1976; Hardap Dam, Mariental (24.28S 17.48E), 37 larvae, 20.vii.1976; Tsisab Ravine, Brandberg (21.08S 14.30E), 7 larvae, 10.vii.1976; Neineis, Omaruru River (21.26S 15.04E), 3 larvae, 10.vii. 1976; 20 km W. Khorixas (20.21S 14.48E), 8 larvae, 11.vii.1976; Kanus Siding, Karasburg Dist. (27.53S 18.38E), 7 larvae, 7.v.1977; Noachabeb Farm, Karas Mountains (27.23S 18.31E), 10 larvae, 7.v.1977; Seeheim (26.52S 17.48E), 2 larvae, 9.v.1977; Holoog Siding (27.24S 17.58E), 14 larvae, 9.v.1977; Klein Karas (27.34S 18.05E), 1 larva, 9.v.1977; Windhoek (22.34S 17.07E), 20 larvae, 20.vii.1976 & 19.viii.1977, M.W. Mansell & V.C. Moran; 10 km N. Windhoek (22.31S 17.06E), 4 larvae, 19.viii.1977, M.W. Mansell & V.C. Moran; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 1 larva, 20.viii.1977; Kahn River, Usakos (21.52S 15.36E), 4 larvae, 21.viii.1977; Usakos (21.59S 15.38E), 30 larvae, 21.viii.1977, M.W. Mansell & V.C. Moran; Kakombo Farm, 4 km N.E. Omaruru (21.22S 15.58E), 6 larvae, 22.viii.1977, M.W. Mansell & V.C. Moran; Omigonde Farm, Kalkveld Dist. (21.07S 16.21E), 3 larvae, 22.viii.1977, M.W. Mansell & V.C. Moran; Paresis Mountains, Otjiwarongo Dist. (20.22S 16.20E), 61 larvae, 23.viii.1977, M.W. Mansell & V.C. Moran; Okahandja (21.59S 16.55E), 38 larvae, 24.viii.1977, M.W. Mansell & V.C. Moran. Larval collections dates presented in chronological order, all collected by M.W. Mansell, except where otherwise indicated.

Description of egg (fig. 12). Oval in shape, 0,73 mm in length. Surface of chorion covered with regularly distributed, globular aeropyles. A plastron-like structure is situated over the micropyle at the cephalic end of the egg.

Distribution (fig. 13). Laurhervasia setacea occurs from Otjiwarongo in northern South West Africa as far south as Worcester and Montagu in the Cape. It occurs throughout the north western Cape and extends into the eastern Cape along the Orange River as far as Colesburg. In the south the species extends to the eastern extremity of the Swartberg Mountain range near Oudtshoorn.

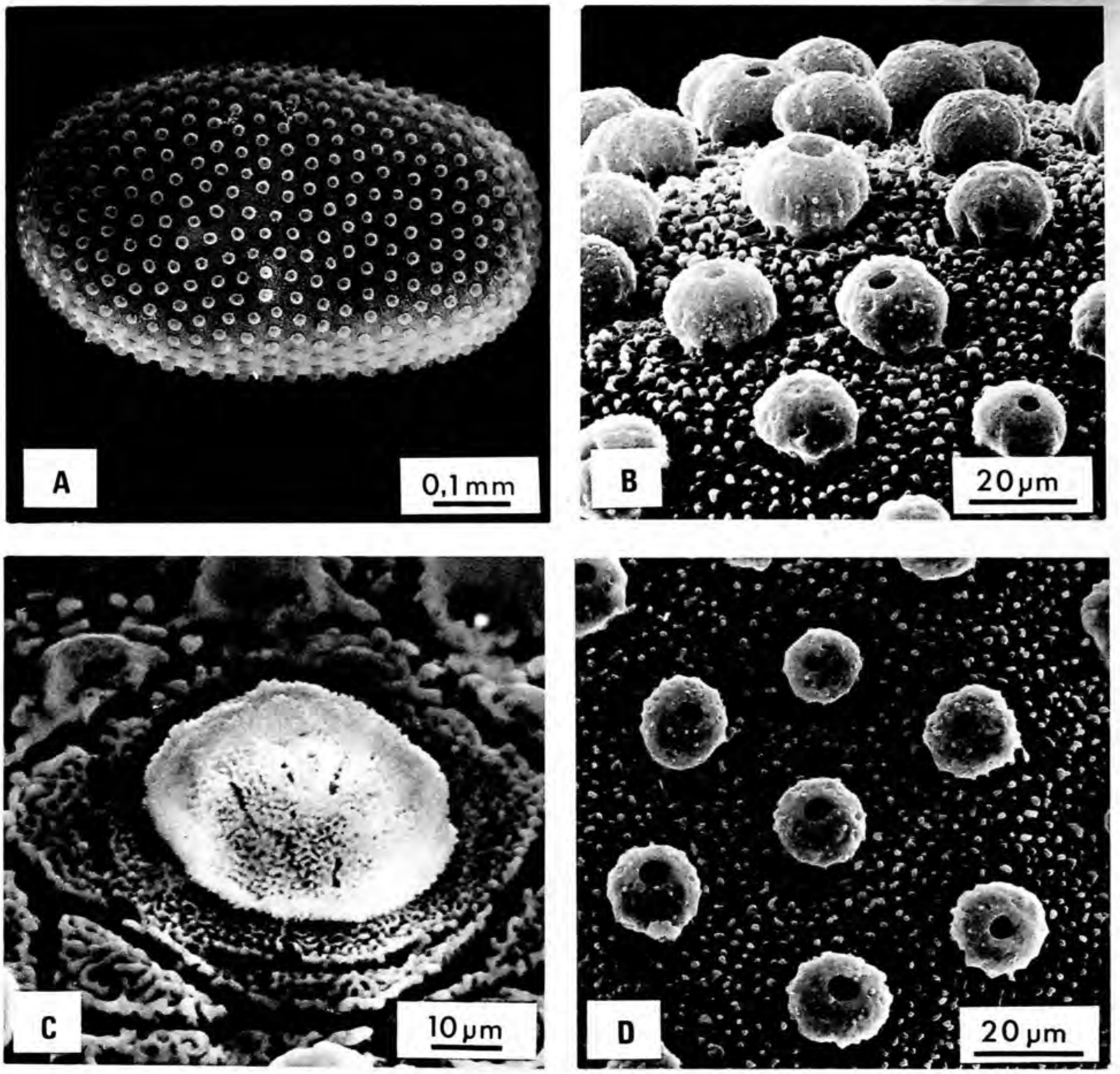


Fig. 12 A - D. Egg of *Laurhervasia setacea* (Klug). A. Whole egg, lateral view. B. Aeropyles on chorion. C. Plastron-like structure covering the micropyle. D. Dorsal view of aeropyles.

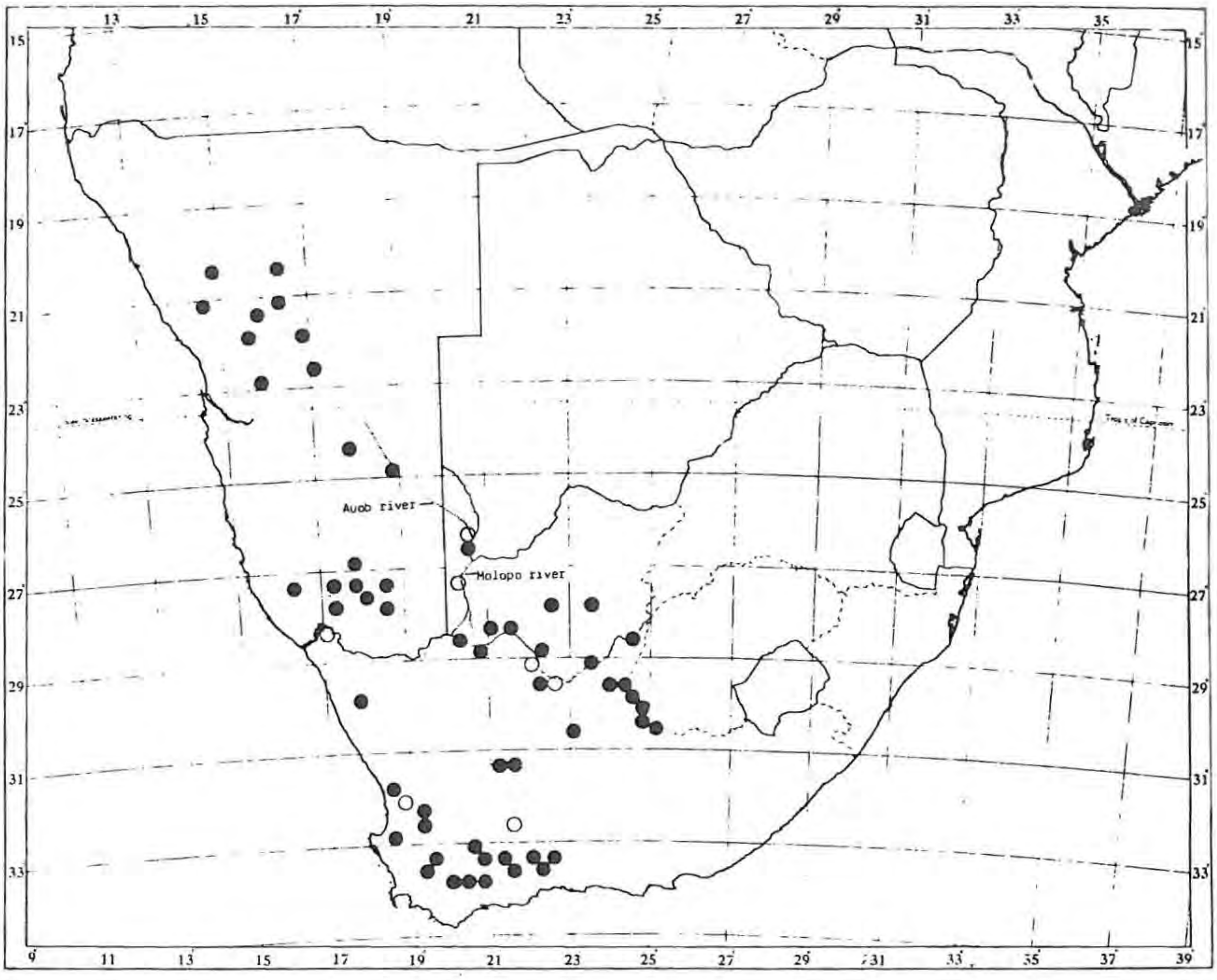


Fig. 13. The recorded distribution of Laurhervasia setacea (Klug) in southern Africa. Open circles represent localities published by Tjeder (1967), closed circles are localities recorded during this study. The dotted lines indicate the courses of the Auob and Molopo rivers.

Laurhervasia rhodesiae Tjeder, 1967.

Synopsis:

Laurhervasia rhodesiae Tjeder, 1967:336.

Laurhervasia rhodesiae Tjeder; Hölzel, 1975:91.

Laurhervasia rhodesiae Tjeder; Mansell, 1977:202.

Description of adult.

As described by Tjeder (1967:336), with the following additional measurements and locality records; size (mean measurements in mm from 78 specimens, the size ranges are given in brackets). Length of body 7,8 (6,0-9,6); length of forewing 13,4 (10,0-16,0); length of hindwing 38,5 (28,0-46,0); length of antenna 3,8 (3,2-4,8); length of rostrum male 1,38 (1,20-1,44); length of rostrum female 1,49 (1,28-1,68).

Material examined. Adults, 78 specimens.

RHODESIA. Kariba (16.33S 28.53E), 7♂♂ 4♀♀, 25.xii.1975; 10 km W. Makuti (16.15S 29.13E), 2♂♂ 4♀♀, 29.xii.1975; Matopos (20.26S 28.32E), 6♂♂ 6♀♀, 30.xii.1975; Lukozi Mission (18.22S 26.38E), 14♂♂ 11♀♀, 9.i.1976; Sinamatella Camp, Wankie (18.36S 26.19E), 4♂♂ 3♀♀, 10.i.1976; Khami Ruins, Bulawayo (20.20S 28.30E), 4♂♂ 8♀♀, 14.i.1976; West Nicholson (21.06S 29.25E), 1♂ 1♀, 15.i.1976; MALAWI. Nkudzi Bay (14.24S 35.12E), 1♂ 1♀, 23.v.1976, B.H. Gunn; TRANSVAAL. Waterpoort (22.53S 29.37E), 1♀, 4.viii.1978. All reared from larvae collected by M.W. Mansell, except where otherwise indicated. Larval collection dates given above in chronological order of collection.

Description of larva (fig. 14).

Characterized by a relatively short prothorax (about two and a half times the head length), a dark head with three light patches. Several rows of macules on the meso and metathorax and abdomen impart a mottled appearance to the larva.

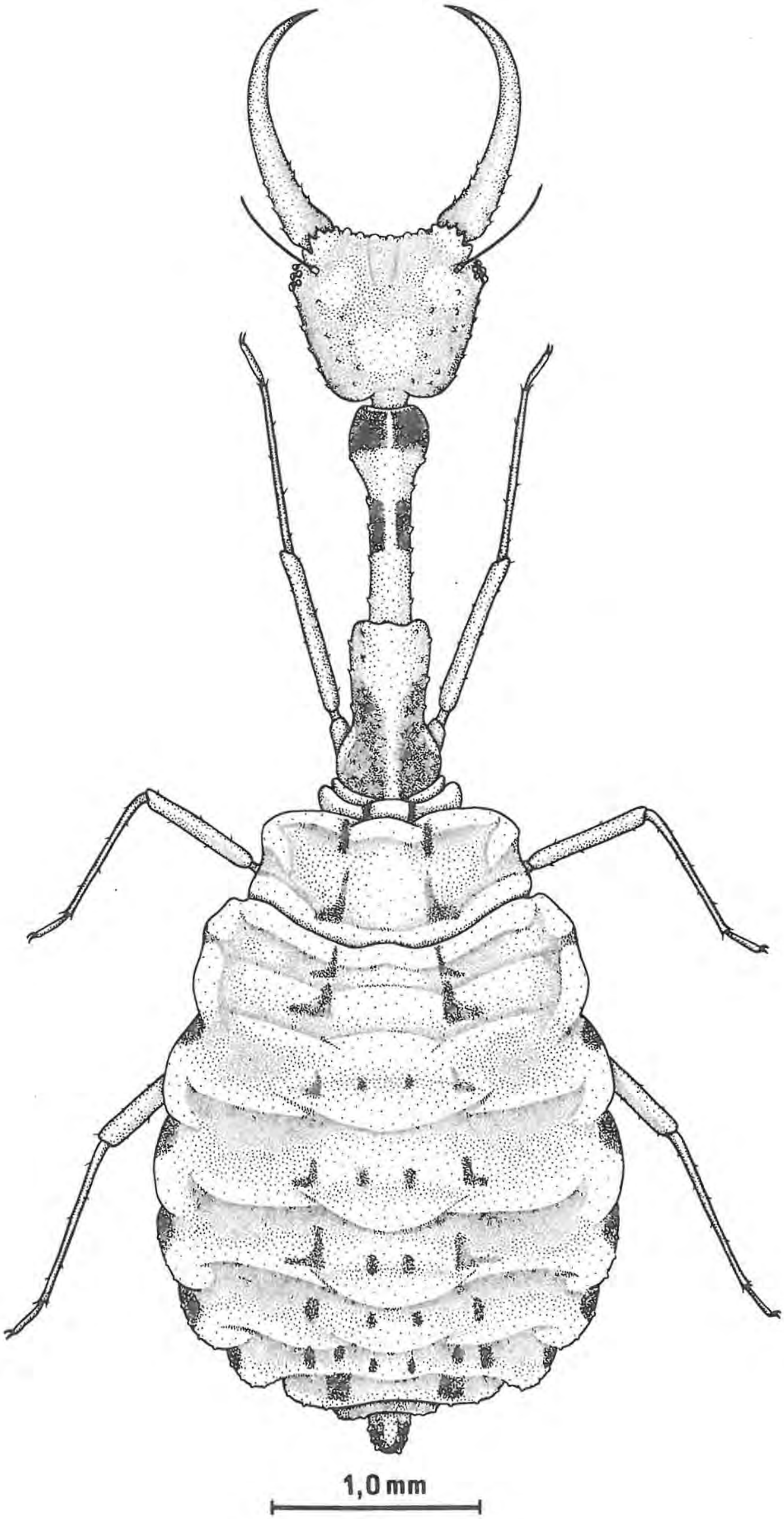


Fig. 14. The larva of Laurhervasia rhodesiae Tjeder.

Table 3. Mean measurements (mm) for L. rhodesiae larvae. The range is given below the means.

Instar	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	1	13	90
Head width	0,36	0,54 0,52-0,60	0,86 0,80-0,92
Head length	0,32	0,49 0,44-0,52	0,78 0,72-0,84
Mandible length	0,44	0,66 0,60-0,72	1,11 1,04-1,24
Prothoracic length	0,56	0,99 0,88-1,08	1,87 1,72-2,12
Body width*	0,76	1,38 0,84-1,64	2,39 1,32-3,00
Body length*	3,32	4,17 3,28-4,88	7,10 5,20-8,72

* - Variable, depending upon state of maturity and feeding.

Head wider than long, tapering slightly in posterior region, with occipital margin truncated and slightly concave. Dorsal surface of head with dolichaster-bearing papillae interspersed with smaller papillae, usually dark in colour with three light patches; ventral surface pale yellow. Eyes consisting of seven facets, one ventral and six dorso-lateral (fig. 10A). Antennae comprising a short cylindrical basal segment (fig. 10A), light brown in colour and supporting a delicate eight-segmented flagellum. Proximal and distal segments long with intermediate six segments short, distal segment bearing three apical bristles. Mandibles yellowish brown, devoid of teeth, curved near the apices and bearing dolicahsters along the basal third. Maxillae each reduced to a single blade fitting into the ventral surfaces of the mandibles to form the typical suctorial tubes. Maxillary palps absent but cardo and stipes discernible. Labium consisting of a single median plate bearing three-segmented labial palps on each side; basal segment of palp large and flattened, bearing dolichasters, middle segment short cylindrical, terminal segment long and fusiform bearing an oval pit sense organ on the dorsal surface (fig. 10B).

Prothorax comprising three regions, anterior region elongated, cylindrical dilating apically with distal portion of dilation brown and a pale brown band present in the middle of this region. Mid-region shorter, wider, divided into tergite and sternite and bearing the prothoracic legs. Two lateral brown markings overlie the coxal bases and extend anteriorly on the mid-region. Posterior region short, broad, unsclerotized incorporated with the rest of the body and bearing the prothoracic spiracles laterally. Cuticle of stellate conformation (fig. 10C). Mesothorax almost rectangular with two diffuse dark markings separated by the dorsal midline. Metathorax similar but wider and bearing the metathoracic spiracles. Legs uniformly yellowish brown with light brown annulations at proximal ends of tibiae, and rows of sparsely arranged setae. Tarsi one-segmented terminating in paired claws.

Abdomen ten segmented, segments 1 to 6 similar to each other, segment 2 is the widest portion of the body. Two rows of dark markings occur on either side of dorsal midline with markings on segments 3 and 6 prominent. Numerous smaller diffuse markings also present on abdominal tergites. Segment 7 small rectangular, segment 8 conical bearing dolichasters, segments 9 and 10 telescoped into segment 8, together forming the spinneret (fig. 10D). Segments 1 to 7 bearing minute lateral spiracles. Ventral surface of thorax and abdomen pale.

Material examined. Larvae, 104 specimens.

RHODESIA. Kariba (16.33S 28.53E), 14 larvae, 25.xii.1975; 10 km W. Makuti (16.15S 29.13E), 7 larvae, 29.xii.1975; Matopos (20.26S 28.32E), 18 larvae, 30.xii.1975; Lukozi Mission (18.22S 26.38E), 33 larvae, 9.i.1976; Sinamatella Camp, Wankie (18.36S 26.19E), 4 larvae, 10.i.1976; Khami Ruins, Bulawayo (20.20S 28.30E), 1 larva, 14.i.1976; MALAWI. Nkudzi Bay (14.24S 35.12E), 2 larvae, 23.v.1976, B.H. Gunn; Monkey Bay (14.04S 35.05E), 20 larvae, 10.i.1978, B.H. Gunn; BOTSWANA. Shashi/Limpopo River junction (22.12S 29.15E), 1 larva, A.T. Forbes; SOUTH AFRICA, TRANSVAAL. Waterpoort (22.53S 29.37E), 4 larvae, 4.viii.1978. All collected by M.W. Mansell, except where otherwise indicated. Collection dates given in chronological order.

Egg.

Unknown.

Distribution (fig. 15).

Laurhervasia rhodesiae occurs from the northern Transvaal and eastern Botswana through Rhodesia to as far north as Monkey Bay in Malawi. There are no records north of Monkey Bay on Lake Malawi, but it is possible that this species extends further along the Rift Valley.

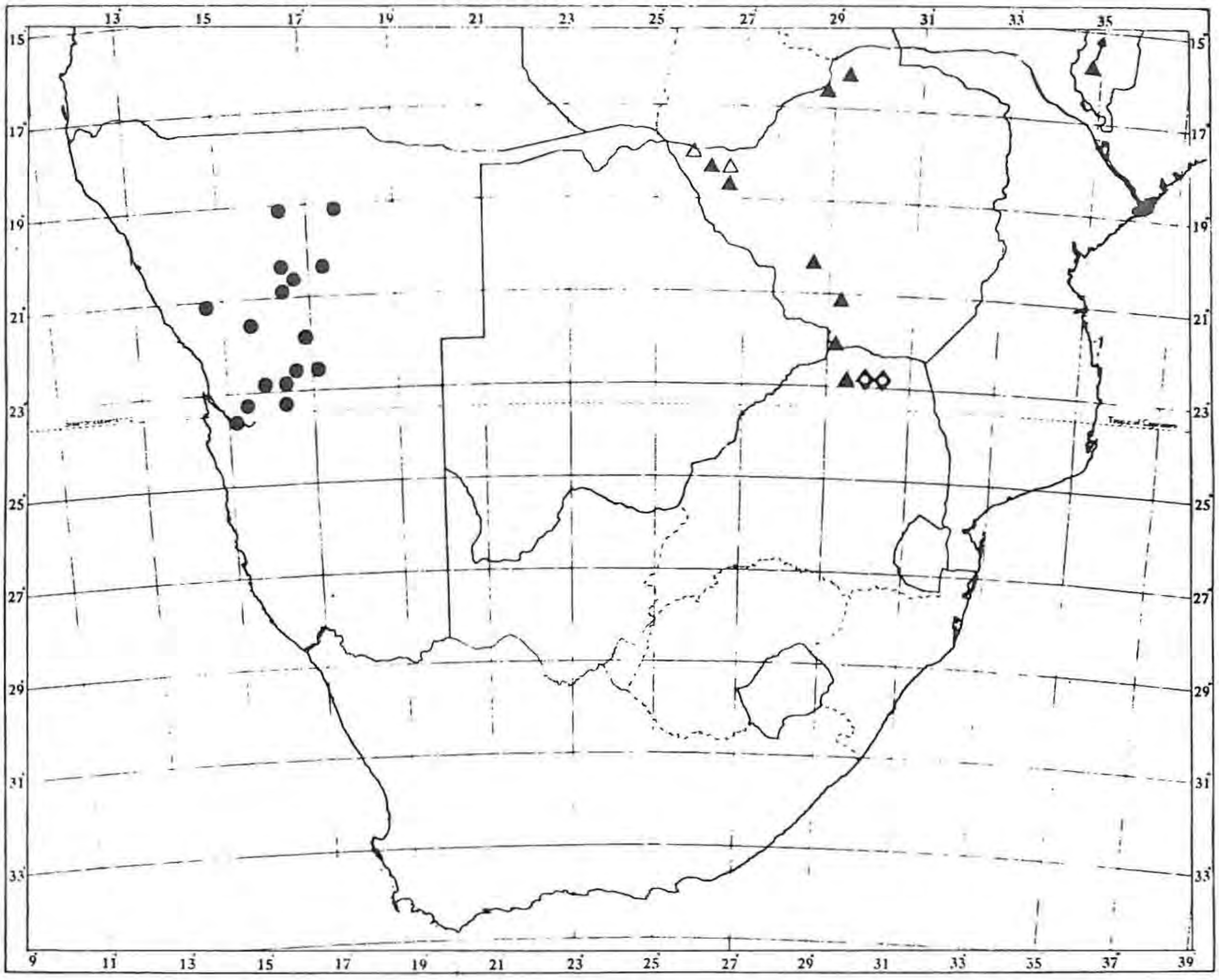


Fig. 15 The recorded distribution of Laurhervasia namibica spec. nov. (closed circles), Laurhervasia transvaalensis spec. nov. (diamonds) and Laurhervasia rhodesiae Tjeder (open and closed triangles). Open triangles represent localities published by Tjeder (1967) which were not revisited, closed circles are localities recorded during this study.

Laurhervasia transvaalensis spec. nov. figs. 15, 16 and 17.

Description of adult (fig. 16A-H).

Similar to L. setacea but distinguished by the longer rostrum and antennae.

Size (mean measurements in mm for 18 specimens, the size ranges are given in brackets). Length of body 8,7 (8,2-10,0); length of forewing 15,0 (14,3-15,5); length of hindwing 42,4 (39,0-45,0); length of antenna 4,8 (4,4-5,6); length of rostrum male 1,56 (1,52-1,68); length of rostrum female 1,72 (1,68-1,80). Holotype male, 10,0; 15,0; 44,0; 5,6; 1,68. Allotype female 8,2; 15,0; 44,0; 5,0; 1,68 respectively.

Head (fig. 16A) yellowish in colour with two brown spots above antennal bases and two larger markings in the occipital region. Mouthparts pale yellow. Clypeus pale proximally below antennae, uniformly brown distally, genae and labrum uniformly brown. Antennae long, uniformly pale yellowish brown with scape and pedicel yellow. Antennal setae short and brown in colour.

Thorax uniformly brown dorsally, pale ventrally. Prothorax with long brown setae along margins and shorter setae on dorsum and pterothorax with sparsely arranged short dark setae on dorsum. Legs pale yellowish brown with darker annulations at proximal ends of tibiae. Tarsi five-segmented with proximal tarsomere longer than combined length of the other four. Paired claws pale brown, legs densely clothed with short brown setae. Forewings (fig. 16B) with distinct pterostigma formed by incrassate costal veins, brown proximally, pale distally. Wing veins yellowish brown, bearing erect brown setae. Three crossveins present between R and M before

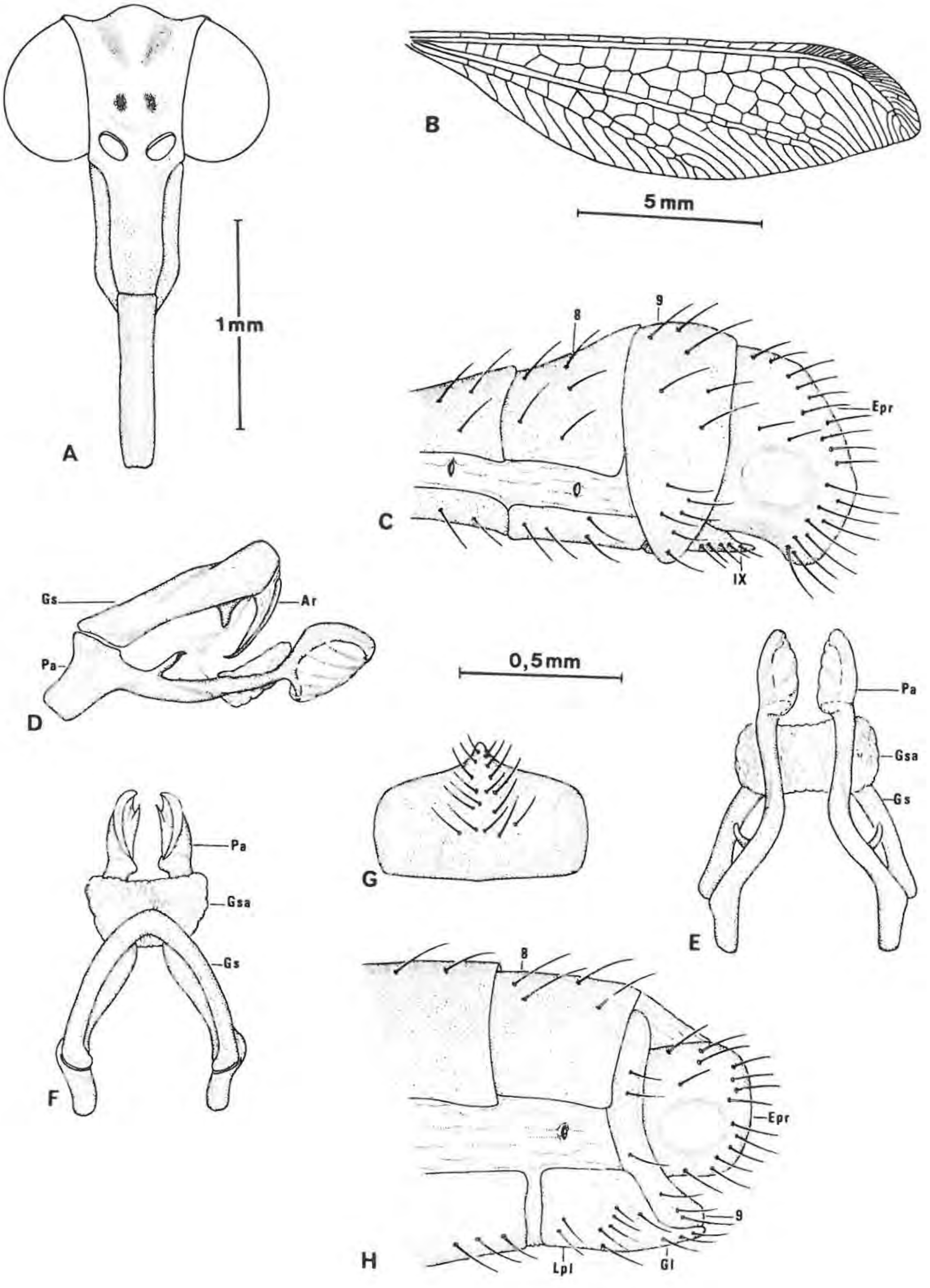


Fig. 16 A - H. Laurhervasia transvaalensis spec. nov.
A. Head, frontal view. B. Wing. C. Apex of abdomen ♂. D. Gonarcus and parameres, lateral view. E. Gonarcus and parameres, ventral view. F. Gonarcus and parameres, dorsal view. G. Sternite 9. H. Apex of abdomen ♀. Ar - arcessus; Epr - ectoproct; Gl - gonapophyses laterales; Gs - gonarcus; Gsa - gonosaccus; Lpl - lateral plate of sternite 8; Pa - paramere; IX - sternite 9; 8,9 - tergites.

Rs and 9 or 10 (occasionally 8 or 11) radial crossveins between R and Rs before the hypostigmatic cell. Vein 1A fused with Cu2 for almost its entire length. Hindwings narrow, uniformly yellowish brown except for pale extremities and densely clothed in short, pale setae. Hindwings of males with large conspicuous bullae.

Abdomen light brown with darker marks across the posterior halves of each tergite, imparting a banded effect, sternites pale. Setae sparsely arranged but becoming more dense and longer towards the abdominal apex. Pleuritocavae absent. Male (figs. 16C-G) with tergite 9 undivided, narrowing to fairly acute apices overlapping sternite 9 which has a short projecting tip. Ectoprocts shaped as in fig. 16C, with the posterior ventral margin projecting slightly and prominent callus cerci. Gonarcus stout, arch-shaped with arcessus flanked by acute entoprocesses. Parameres (figs. 16D-F) stout and curved, between 1-1,06 mm in length. Proximal region flattened and broad, orientated at about a 45^{0} angle to the length of the paramere. Proximal projections well developed. Distal lobe of paramere large, about 0,3 mm in length with two chitinous projections shaped like a hand and thumb in profile, ensheathed in a membrane. Flange-like projections present, closely adpressed to the inner surfaces of the distal lobes. Gonosaccus with spinellae but lacking gonosetae. Female (fig. 16H) with tergite 9 divided dorsally, the two halves curving downwards, becoming closely adpressed to the dorsal margins of the gonopophyses laterales. Lateral plates of sternite 8 fused to the gonopophyses laterales which are joined ventrally by a convoluted, expandable membrane. Ectoprocts almost quadrate with well developed callus cerci.

Material examined. *Adults,* 18 specimens.

SOUTH AFRICA, TRANSVAAL. Castle Koppies, 15 km N. Wyliespoort (22.48S 29.56E), 9♂♂ 9♀♀, 15.i.1976, M.W. Mansell.

Description of larva (fig. 17).

Characterized by dark brown head with three light patches on dorsal surface and longer prothorax than that of *L. rhodesiae*.

Table 4. Mean measurements (mm) for *L. transvaalensis* larvae, the size ranges are given below the means.

Instar	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	2	9	43
Head width	0,36 0,36	0,55 0,52-0,60	0,93 0,88-1,00
Head length	0,34 0,32-0,36	0,52 0,48-0,56	0,88 0,84-0,96
Mandible length	0,48 0,48	0,71 0,68-0,76	1,26 1,20-1,36
Prothoracic length	0,62 0,60-0,64	1,19 1,16-1,28	2,36 2,16-2,64
Body width*	0,70 0,60-0,80	1,33 0,96-1,48	2,51 1,56-3,12
Body length*	2,52 2,44-2,60	4,53 4,08-5,00	7,86 6,16-9,72

* Variable, depending upon feeding and state of maturity.

Head almost quadrate in shape, longer than wide tapering gradually towards the occipital region. Surface of head covered with dolichaster-bearing papillae, interspersed with smaller papillae. Third instar larvae with dorsal surface of head dark, overlain by

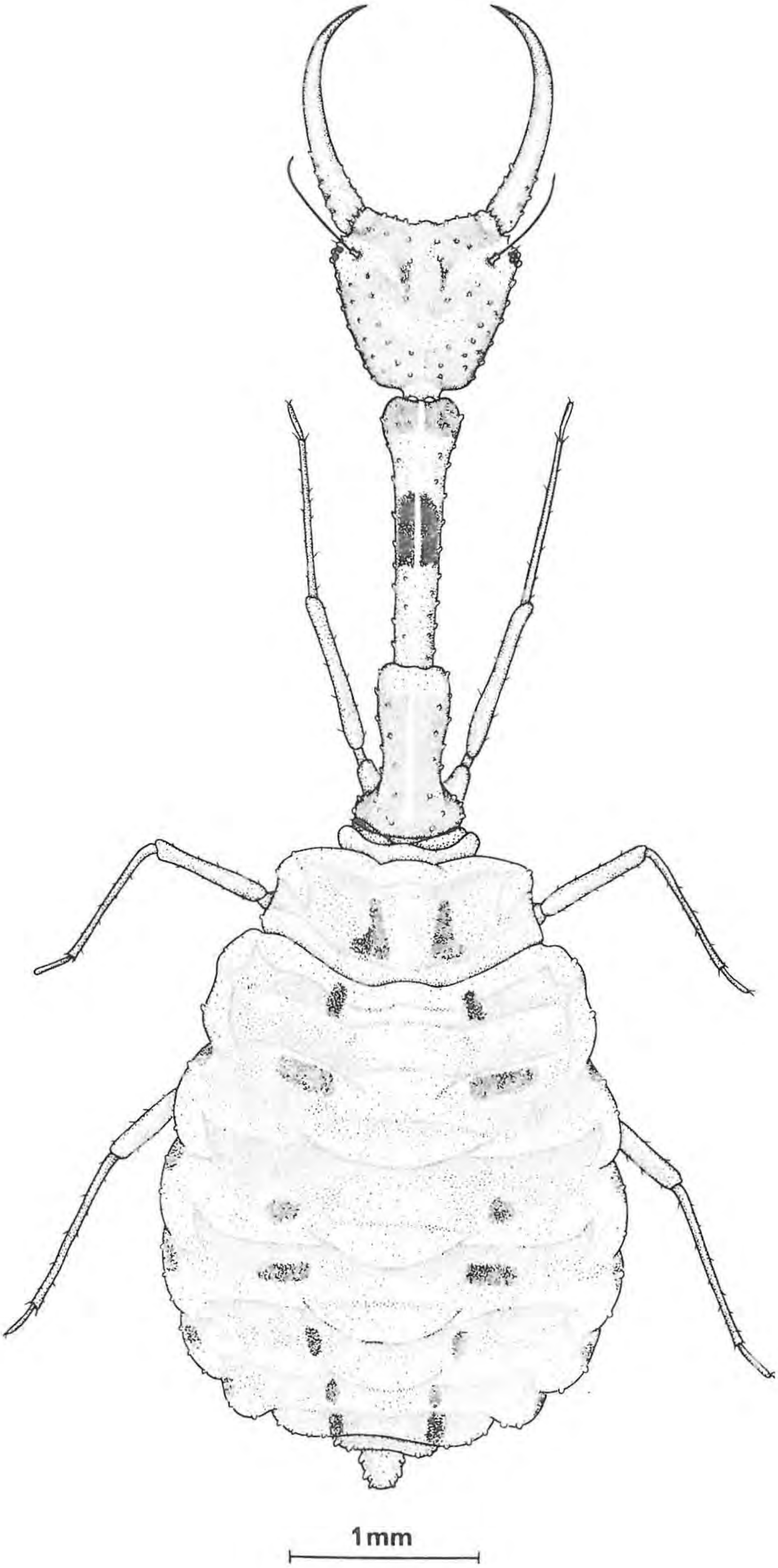


Fig. 17. The larva of Laurhervasia transvaalensis spec. nov.

three light patches, one on either side of the midline between the tentorial pits and the eyes and one elongated patch posterior to these, straddling the midline. Heads of first and second instar larvae brown with two light patches discernible and a Y-shaped epicranial suture on the dorsal surface. Eyes each comprising seven facets, one ventral, and six dorso-laterally situated (fig.10A). Antennae each consisting of a stout brown pedicel supporting a delicate eight-or nine-segmented flagellum. Proximal and distal segments of flagellum long, intermediate segments short with terminal segment bearing three minute apical bristles. Mandibles longer than head, uniformly light brown, devoid of teeth, curved near the apices with small dolichaster-bearing papillae along the basal third. Maxillae each reduced to a single blade, fitting into the ventral surfaces of the mandibles to form the typical suctorial tubes. Cardo and stipes discernible but maxillary palps absent. Labium reduced to a single median plate bearing three-segmented labial palps on either side; basal segment large and flattened, mid-segment short, dilating apically, terminal segment elongated tapering to an acute tip and bearing an oval pit sense organ on the dorsal surface (fig. 10B).

Prothorax elongated, comprising three regions. Apical region elongated, narrow dilating apically with a brown band, divided by the pale midline, across the dorsal surface of the dilated area. A wide brown band divided by the pale midline occurs in the middle of this region. Mid-region of prothorax shorter, wider, divided into tergite and sternite and bearing the prothoracic legs. This region is dark brown dorsally except for a pale area near the anterior margin. The anterior and mid-regions of the prothorax sclerotized with sparsely arranged dolichaster-bearing papillae. Posterior region of prothorax short unsclerotized incorporated with the rest of the body and bearing two spiracles laterally. Two brown markings are present on either side of the dorsal midline. Cuticle of stellate conformation (fig. 10C). Mesothorax rectangular in shape, brown in colour with two fuscous marks on either side of a pale, broad median patch. Metathorax similar to mesothorax but wider with two prominent fuscous patches on the posterior margin of the metatergites. A pair of dorsally situated spiracles occur on this segment. Ventral surface of thorax and abdomen uniformly pale brown. Legs long, slender, pale yellowish brown with a faint brown annulation at the proximal ends of the tibiae. Distal regions of tibiae also slightly darker. Rows of dolichaster-bearing papillae occur on the legs with sensory setae at the articulations. Tarsi one-segmented, terminating in paired claws.

Abdomen comprising ten segments. Segments 1 to 7 all similar, each bearing a pair of lateral spiracles and two fuscous marks widely separated by the dorsal midline, those on segment 3 being prominent. Abdomen rounded in the posterior region with segment 6 short and broad. Segment 8 conical, bearing fusiform dolichasters which are well developed on the ventral surface. Segments 9 and 10 telescoped into segment 8, together forming the spinneret (fig. 10D).

Material examined. Larvae, 54 specimens.

SOUTH AFRICA, TRANSVAAL. Castle Koppies, 15 km N. Wyliespoort (22.48S 29.56E), 48 larvae, 15.i.1976 & 4.viii.1978; Njeljedam (22.46S 30.00E), 6 larvae, 4.viii.1978, M.W. Mansell.

Egg.

Unknown.

Distribution (fig. 15).

Laurhervasia transvaalensis has only been recorded from two localities to the north of the Soutpansberg in the northern Transvaal.

Remarks.

Laurhervasia transvaalensis shows morphological resemblance to both L. rhodesiae and L. setacea. It resembles L. rhodesiae in the possession of long antennae, the large bullae in the hindwings of the males, and by the pattern on the heads of the larvae which are similar in the two species. Also, it is sympatric with L. rhodesiae in the southern extension of the range of the latter species. The adults of L. transvaalensis may be distinguished from L. rhodesiae by their paler colour (L. rhodesiae is a darkly coloured species), by the markings on the head and by the male genitalia (gonarcus and parameres) which are very stoutly developed in L. rhodesiae, but relatively slender in L. transvaalensis. In the larvae, L. rhodesiae is smaller in respect of head width, head length, mandible length and prothoracic length. The prothoraxes of L. transvaalensis larvae are longer than those of L. rhodesiae and no overlap has been recorded between the two taxa.

The adults of L. transvaalensis are very similar to L. setacea in general appearance and the male genitalia in the two species are difficult to distinguish from one another. The main morphological criteria by which the two species may be distinguished, are the antennae and rostrum which are much longer in L. transvaalensis than in *L. setacea*. The larvae of the two species are distinguishable from one another, in most cases, on the basis of size, those of *L. setacea* being larger although there is some overlap. The markings on the head of larval *L. transvaalensis* (fig. 17) appear to be consistent and a good character for distinguishing the species from *L. setacea*.

The most important factor in their separation however, is that as far as is known, populations of the two taxa are allopatric and widely separated.

Laurhervasia namibica spec. nov. figs. 15, 18, 19, 20.

Description of adult (fig. 18A-I).

Small with broad wings, dried specimens pale in colour, living specimens with light brown tergites and pale sternites. Sexes alike, males usually with narrower forewings than females and the males of some populations with small bullae in hindwings. Size (mean measurements in mm from 56 specimens - range in brackets): length of body 7,2 (6,0-8,1); length of forewing 12,1 (10,6-13,1); length of hindwing 35,6 (30,0-38,0); antennae 3,8 (3,3-4,6); rostrum 1,2 (1,1-1,5). Holotype male 7,3; 12,5; 37,0; 3,5; 1,2. Allotype female, 6,6; 12,2; 37,0; 4,5; 1,3, respectively.

Head (fig. 18A) creamy-white in colour with two diffuse markings usually present on vertex but not extending onto raised portion of the frons. Mouthparts pale yellow, genae dark brown, labrum and distal portion of clypeus brown, proximal half of clypeus pale. Antennae long, (greater than one third, but less than half the forewing length) scape and pedicel pale, flagellum uniformly pale yellowish brown covered in short brown setae.

Prothorax pale brown with mid dorsal portion paler and short black setae along the margins. Meso- and metathorax brown dorsally with pale midline and sparse black setae on the tergites. Pleurites and sternites uniformly pale. Legs pale yellow, clothed in short black setae tarsi five-segmented, paired tarsal claws brown. Forewing (fig. 18B) usually broad with yellow venation and pale pterostigma. Three crossveins usually present between R and M before the origin of Rs and seven (rarely 6-9) radial crossveins between

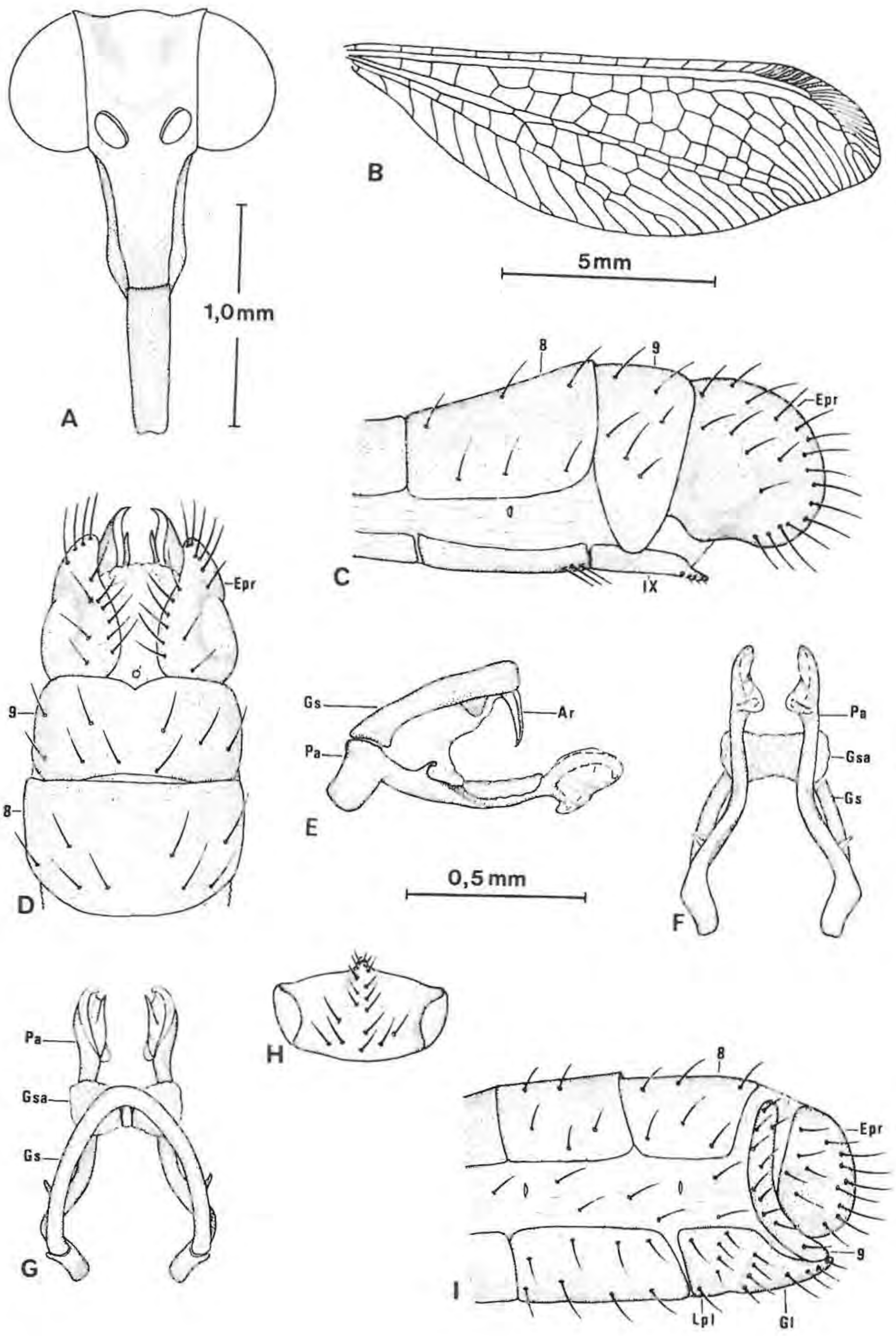


Fig. 18. A - I. *Laurhervasia namibica* spec. nov.
A. Head, frontal view. B. Wing. C. Apex of abdomen ♂, lateral view. D. Apex of abdomen ♂, dorsal view. E. Gonarcus and parameres, lateral view. F. Gonarcus and parameres, ventral view. G. Gonarcus and parameres dorsal view. H. Sternite 9. I. Apex of abdomen ♀.
Ar - arcessus; Epr - ectoproct; Gl - gonapophyses laterales; Gs - gonarcus; Gsa - gonosaccus; Lpl - lateral plate of sternite 8; Pa - paramere; IX - sternite 9; 8,9 - tergites.

R and Rs before hypostigmatic cell. Vein 1A fused with Cu2 for almost its entire length. Delicate brown setae occur along the wing veins and the posterior margin has a dense fringe of setae. Hindwings pale brown, becoming white towards the apices and densely clothed in pale setae. Small bullae (less than 1 mm in length) are present in the hindwings of males from most populations, but absent in some populations.

Abdomen. Tergites light brown with pale posterior margins, sternites uniformly pale. Pleuritocavae absent. Male (figs. 18C-H). Ectoprocts oval in shape with long black setae at the posterior margin. Tergite 9 undivided, tapering to fairly acute apices overlapping sternite 9 which has a short projecting tip (fig. 18H). Gonarcus characteristically V-shaped with slender arcessus and flange-like entoprocesses. Parameres (figs. 18E-G) slender, between 0,76-1,10 mm in length, with the proximal regions orientated at almost right angles to the length of the parameres. Proximal projections are present and well developed. Distal regions of parameres shaped like a hand and thumb in profile ensheathed in a membrane with closely adpressed flanges on the internal surfaces. Gonosaccus lacking gonosetae but with weakly developed spinellae. Female (fig. 18I). Ectoprocts almost oval in shape with indistinct callus cerci. Tergite 9 divided dorsally, narrow and curving downwards becoming closely adpressed to the dorsal margins of the gonapophyses laterales. Lateral plates of sternite 8 fused with the gonapophyses laterales, the line of fusion being demarcated by a hairless zone.

Material examined. Adults, 56 specimens.

SOUTH WEST AFRICA. Kuiseb River near Gobabeb (23.34S 15.02E), ♂ holotype, 5♂♂ 9♀♀ paratypes, 5.vii.1975; Mirabib Inselberg, Namib Desert Park (23.28S 15.18E), ♀ allotype, 4♂♂ 4♀♀ paratypes, 8.vii.1975; Gamsberg Pass (23.16S 16.15E), 2♂♂ 2♀♀ paratypes, 3.vii.1975; Lake Otjikoto (19.12S 17.37E), 1♂ 4♀♀, 19.vii.1976; Halali Camp, Etosha (19.02S 16.29E), 1♀, 19.vii.1976; Komunab Farm, Karabib Dist. (22.45S 15.48E), 1♂ 2♀♀ paratypes, 20.viii.1977, M.W. Mansell & V.C. Moran; Ameib Farm, Usakos Dist. (21.48S 15.36E) 3♂♂ 5♀♀ paratypes, 21.viii.1977, M.W. Mansell & V.C. Moran; Otjihaenamaparero Farm, Kalkveld Dist. (20.54S 16.14E), 3♀♀ paratypes, 22.viii.1977, M.W. Mansell & V.C. Moran; Paresis Mountains, Otjiwarongo Dist. (20.22S 16.18E), 1♂ 4♀♀, 23.viii.1977, M.W. Mansell & V.C. Moran; Otjosongombe Farm, Waterberg (20.29S 17.20E), 2♀♀ paratypes, 24.viii.1977, M.W. Mansell & V.C. Moran; Okahandja (21.59S 16.55E), 1♀ paratype, 24.viii.1977, M.W. Mansell & V.C. Moran. All reared from larvae collected by M.W. Mansell except where otherwise indicated; larval collection dates given above.

Description of larva (fig. 19).

Characterized by pale quadrate head, shortish prothorax which lacks a conspicuous median band, and four prominent dark marks on the abdominal tergites.

Table 5. Mean measurements (mm) for *L. namibica* larvae. The size ranges are given below the means.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	1	19	88
Head width	0,32	0,51 0,48-0,56	0,84 0,80-0,92
Head length	0,32	0,47 0,44-0,48	0,77 0,68-0,84
Mandible length	0,44	0,65 0,60-0,68	1,05 0,92-1,12
Prothoracic length	0,52	0,99 0,92-1,08	1,90 1,68-2,20
Body width*	0,64	1,33 0,76-1,52	1,99 1,20-2,84
Body length*	2,12	4,07 2,28-4,48	6,16 5,04-8,16

* Variable, depending upon feeding and maturity within the instar.

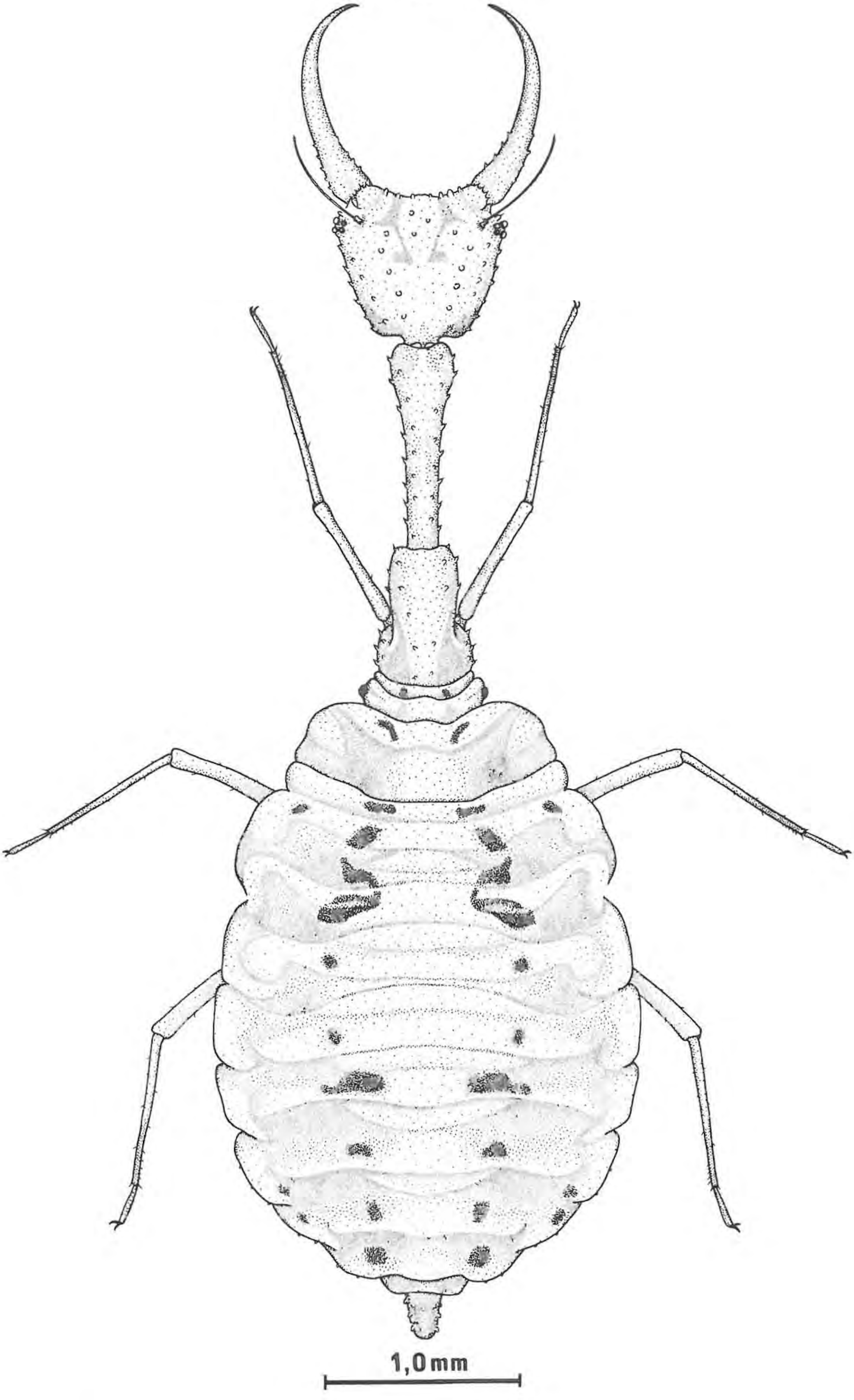


Fig. 19. The larva of Laurhervasia namibica spec. nov.

Head quadrate in shape, wider than long, not tapered towards occipital region. Surface covered with papillae, bearing dolichasters, interspersed with smaller papillae. Well defined tentorial pits, surrounded by diffuse brown markings, present on the dorsal surface. Lateral and occipital regions of head lightly marked with brown. Eyes each comprising seven facets, six dorso-lateral and one ventral (fig. 10A). Antennae consisting of a stout pedicel bearing a delicate segmented flagellum with the proximal and distal segments long, intermediate segments short, varying in number from 5 to 6. Terminal segment with 2 or 3 delicate apical bristles. Mandibles longer than head, devoid of teeth but bearing dolichasters along the basal third. Maxillae reduced to a single blade recessed into the ventral surfaces of the mandibles thereby forming the typical suctorial tubes. Maxillary palps absent, cardo and stipes discernible. Labium reduced to a single median plate, bearing three-segmented labial palps on either side (fig. 10B). Basal segment of palp large, mid-segment short, terminal segment long fusiform and tapering to acute tip with an oval-shaped pit-sense organ on the dorsal surface.

Prothorax elongated, consisting of three segments. Anterior region elongated, cylindrical and dilating apically with the dilation lightly marked with brown, median band light in colour with remainder of segment pale buff. Mid-region of prothorax shorter, wider divided into tergite and sternite and bearing the prothoracic legs. Lateral brown markings overlie the bases of the coxae. Posterior region short, unsclerotized, incorporated with the rest of the body and bearing the prothoracic spiracles. Dolichasters and sensory hairs present on this region which has cuticle of stellate conformation (fig. 10C), with two brown markings on either side of the midline. Mesothorax rectangular in shape with two brown marks anteriorly. Metathorax similar but wider with prominent brown markings on either side of the dorsal midline and smaller diffuse markings sometimes present laterally. Metathoracic spiracles situated dorsally, but difficult to discern. Legs long and slender, uniformly pale yellow with faint brown markings on the proximal ends of the tibiae. Tarsi one-segmented, bearing light brown paired claws. Rows of dolichasters present on legs and tibiae with short spurs distally.

Abdomen ten-segmented. Segments 1 to 6 similar to each other but becoming progressively smaller, each bearing a pair of minute lateral spiracles. Segment 3 with two prominent brown markings on either side of dorsal midline, remaining segment with smaller markings and diffuse lateral markings sometimes present. Segment 7 short and broad, segment 8 cone-shaped, bearing dolichasters and setae and brown in colour. Segments 9 and 10 very small telescoped into segment 8, together forming the spinneret (fig. 10D).

Material examined. Larvae, 108 specimens.

SOUTH WEST AFRICA. Khomas Hochland, Gamsberg Pass (23.16S 16.15E), 3 larvae, 3.vii.1975; Kuiseb River near Gobabeb (23.34S 15.02E), 14 larvae, 5.vii.1975; Mirabib Inselberg, Namib Desert Park (23.28S 15.18E), 7 larvae, 8.vii.1975; Halali (19.02S 16.29E), 3 larvae, 17.vii.1976; Lake Otjikoto (19.13S 17.34E), 3 larvae, 19.vii.1976, all M.W. Mansell. Windhoek (22.34S 17.07E), 5 larvae, 19.viii.1977; Khomas Hochland, 46 km W. Windhoek (22.40S 16.34E), 1 larva, 20.viii.1977; Khomas Hochland, von Francois Fort (22.48S 16.26E), 1 larva; Komaunab Farm, Karibib Dist. (22.45S 15.48E), 10 larvae, 20.viii.1977; Ameib Farm, Erongo Mountains (21.48S 15.36E), 14 larvae, 21.viii.1977; Otjihaenamaparero Farm, Kalkveld Dist. (20.54S 16.14E), 9 larvae, 22.viii.1977; Paresis Mountains, Otjiwarongo Dist. (20.22S 16.18E), 17 larvae, 23.viii.1977; 10 km S. Otjiwarongo (20.30S 16.38E), 1 larva, 24.viii.1977; Otjosongombe Farm, Waterberg (20.29S 17.20E), 14 larvae, 24.viii.1977;

Okahandja (21.59S 16.55E), 5 larvae, 24.viii.1977, all collected by M.W. Mansell & V.C. Moran. Tsisab Ravine, Brandberg (21.08S 14.30E), 1 larva, 29.vi.1978, D. Gautier.

Description of egg (fig. 20).

Oval in shape, about 0,68 mm in length, with globular aeropyles on the chorion and a complex plastron-like structure over the micropyle at the cephalic end. It resembles the egg of L. setacea (fig. 12) but is smaller and appears to have more aeropyles per surface area of chorion.

Distribution (fig. 15).

This species is apparently confined to South West Africa: it extends from the Namib desert in the west across the Pro-Namib, eastwards into the central highlands near Windhoek. It has been recorded from Gobabeb in the south to as far north as Halali and Lake Otjikoto. The species is encountered in low numbers throughout its range and is uncommon.

Remarks.

The adults of L. namibica resemble L. setacea but may be distinguished by the smaller size and paler colour. The antennae are longer, relative to wing length than those of L. setacea and the wings are usually shorter and broader than in L. setacea. The male ectoprocts of the two species differ in shape, being oval in L. namibica whereas in L. setacea the posterior ventral margin projects downwards. The male genitalia in the two species are similar but with slight differences: the entoprocesses on the gonarcus are flange-like in L. namibica but acute in L. setacea and the parameres are more slender, projecting further beyond the gonarcus in L. namibica than in L. setacea. The lengths of

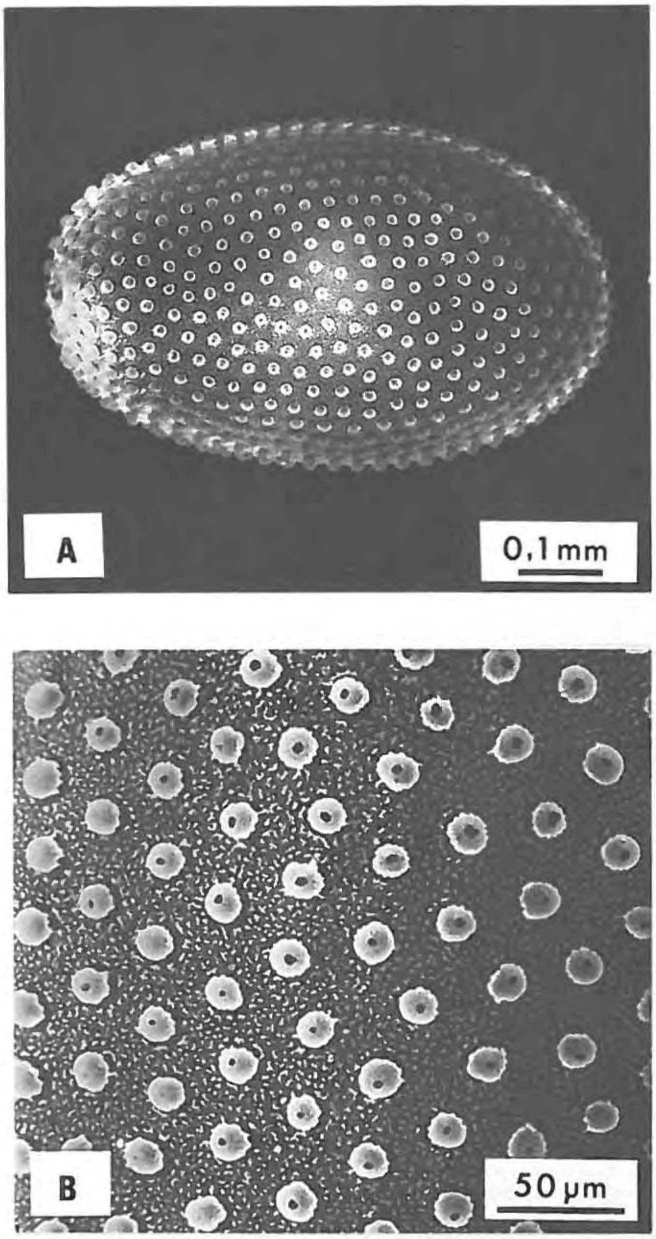


Fig.20 A – B. Egg of Laurhervasia namibica spec. nov.
A. Whole egg, lateral view. B. Aeropyles on chorion.

the parameres in the two species are similar. The bullae in the hindwings of the male of *L. namibica* (where present) are minute, less than 0,88 mm in length, whereas in *L. setacea* they are longer, exceeding 1 mm, and more conspicuous. When two populations of *L. namibica* (aresis Mountains and Lake Otjikoto) were discovered, in which the males lacked bullae they were originally thought to be a separate species. However, these populations are identical in every other respect to all the other populations of *L. namibica*, so it was impossible to describe a new species on the basis of this solitary character, especially when the bullae in the normal males are so small. The populations of *L. namibica* in which the males lack bullae are considered an integral part of the species, but specimens will not be included in the type series.

Adult *L. namibica* may be distinguished from *T. damarae*, with which it is sympatric, by the lack of parallel stripes on the vertex and the lack of proximal projections on the male parameres of *T. damarae*. Entoprocesses are present on the gonarcus in *L. namibica* but are absent in *T. damarae*. *Laurhervasia namibica* cannot be confused with *L. rhodesiae* or *L. transvaalensis* as their populations are allopatric.

The larvae of *L. namibica* characterize the species, being pale buff in colour with a shortish prothorax and quadrate head. The dimensions of the head, mandibles and prothorax are less than those of *L. setacea* which is also much darker in colour. The larvae of *T. damarae* are similar to *L. namibica* in general coloration, but they have extremely short prothoraxes (fig. 21).

4.2 genus THYSANOCROCE Withycombe, 1923.

Synopsis:

Thysancroce Withycombe, 1923:271. Type species = Croce damarae MacLachlan, 1898:170. By original designation.

Thysanocroce Withycombe; Pierre, 1952:21.

Thysanocroce Withycombe; Tjeder, 1967:325, 326. Referred to Laurhervasia Navas. Incorrect synonomy.

Thysanocroce Withycombe; Hölzel, 1975:88.

The genus Thysanocroce was established by Withycombe (1923) who stated that it could be distinguished from existing genera by the lack of bullae in the forewings, but by their presence in the hindwings. In addition, adults of the genus are characterized by the possession of a long rostrum and features of the male genitalia: the parameres lack proximal projections and there are no entoprocesses on the gonarcus. The larvae, which provide the main characteristics of the reinstated genus, have short prothoraxes and legs, and are not true cave dwellers, but live in detritus.

There is only one species in the genus, Thysanocroce damarae (MacLachlan).

Thysanocroce damarae (MacLachlan, 1898). (figs. 21 & 22).

Synopsis:

Croce damarae MacLachlan, 1898:170.

Croce damarae MacLachlan; Kirby, 1900:464.

Croce damarae MacLachlan; Navas, 1910:398.

Nina damarae (MacLachlan), Navas, 1912j:18,19.

Thysanocroce damarae (MacLachlan), Withycombe, 1923:271, 284.

Croce lightfooti Péringuey, 1910:453. Synonomised by Withycombe, 1923:285. Incorrect synonomy according to Tjeder, 1967:333 .

Laurhervasia kriegi Navas, 1936c:161. Synonomised by Tjeder, 1967:333.

Laurhervasia damarae (MacLachlan), Tjeder, 1967:333.

Laurhervasia damarae (MacLachlan); Hölzel, 1975:90.

Laurhervasia damarae (MacLachlan); Mansell, 1977:202.

Thysanocroce damarae (MacLachlan); [Genus Thysanocroce reinstated].

Description of adult.

As described by Tjeder (1967:333) under Laurhervasia damarae, with the following additional measurements and locality records; length of antenna 3,9 mm (range 3,6-4,2); length of rostrum 1,5 mm (range 1,2-1,7).

Material examined. Adults, 9 specimens.

SOUTH WEST AFRICA. 10 km N. Windhoek (22.31S 17.06E), 1♀, 19.viii.1977; Bergkrans Farm, 100 km W. Windhoek (22.50S 16.12E), 1♀, 20.viii.1977; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 1♀, 20.viii.1977. All reared from larvae collected by M.W. Mansell & V.C. Moran. Larval collection dates given. Komuanab Farm, Karibib Dist. (22.45S 15.48E), 1♂, 14.iii.1972, H.D. Brown; Bethanis Farm, 80 km W. Khorixas (20.22S 14.20E), 1♂ 4♀♀, 13.v.1978, V.B. Whitehead.

Description of larva (fig. 21).

Characterized by pale creamy-white body with three dorsal longitudinal rows of brown markings extending from the mesothorax posteriorly, and the uniformly pale brown head and short prothorax. Only three larval specimens were available.

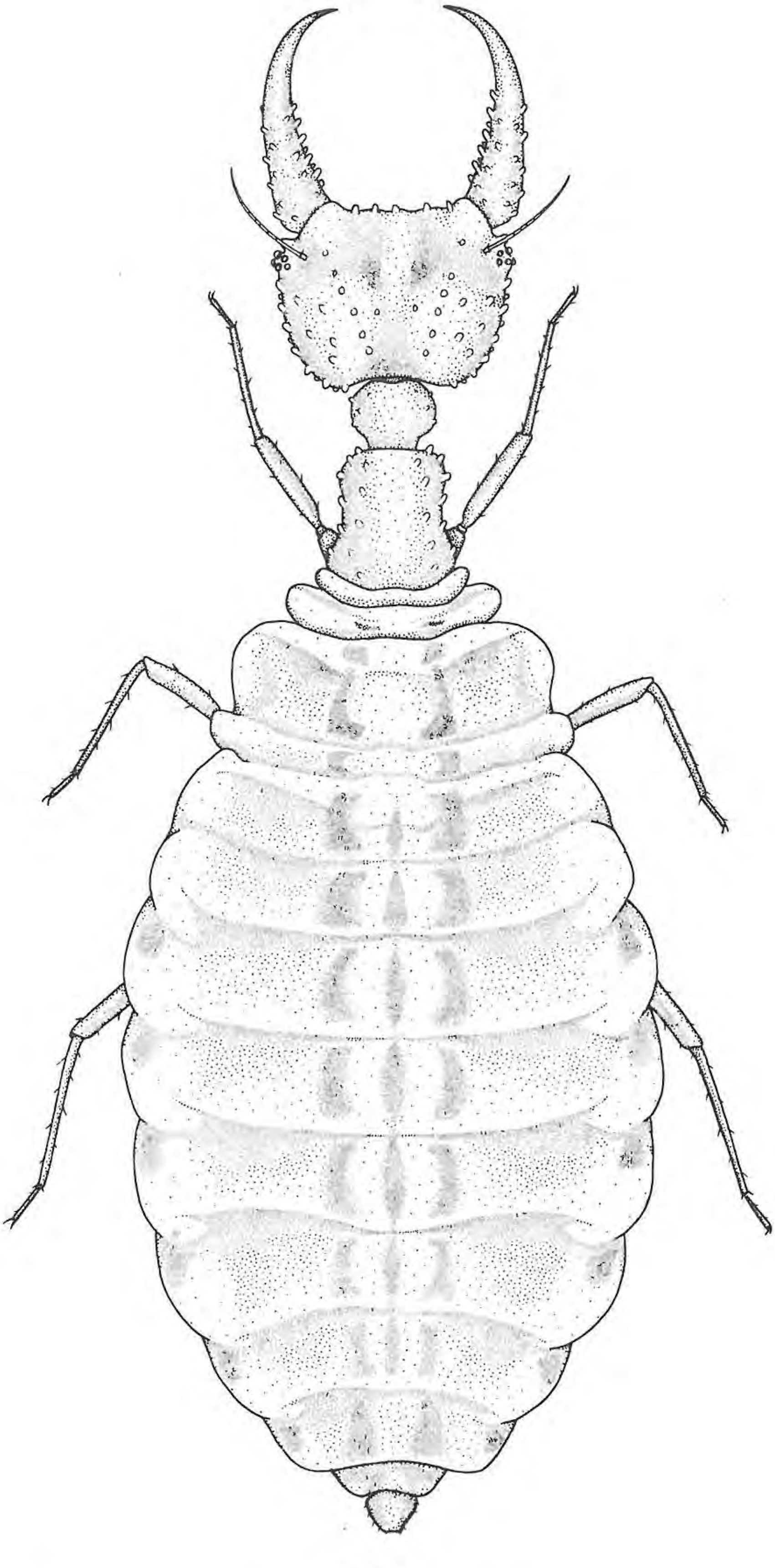


Fig. 21. The larva of Thysanocroce damarae (MacLachlan).

Table 6. Mean measurements (mm) for 3 Thysanocroce damarae (3rd instar) larvae. The ranges are given below the means.

	Head width	Head length	Mandible length	Prothoracic length	Body width	Body length
Mean	0,91	0,71	0,91	0,84	2,13	5,76
Range	0,88-0,92	0,68-0,72	0,88-0,92	0,84	1,84-2,44	4,80-6,24

Head rectangular in shape, wider than long, uniformly pale brown in colour with two small dark markings anterior to the tentorial pits. Surface of head covered with prominent dolichaster-bearing papillae, sparse on the ventral surface. Eyes each consisting of seven facets, six dorso-lateral and one ventral (fig. 10A). Dolichaster-bearing papillae present between the facets with the most anterior occular papilla very prominent. Antennae comprising a stout basal segment supporting a delicate seven-segmented flagellum. The proximal and distal segments of flagellum long and intermediate five segments short. Mandibles light brown in colour, longer than head, curved near apices, devoid of teeth but with well developed dolichaster-bearing papillae along the basal two thirds, particularly on inner surfaces. Maxillae reduced to single blades fitting into the ventral surfaces of the mandibles to form suctorial tubes. Maxillary palps absent but cardo and stipes discernible. Labium reduced to a single median plate bearing three-segmented labial palps on each side; basal segment large, middle segment short and cylindrical, terminal segment long, tapering to an acute tip (fig. 10B) and bearing an oval pit sense-organ on the dorsal surface.

Prothorax short, comprising three distinct regions; anterior region truncated, almost round in shape, pale brown distally, creamy white proximally with sparsely arranged dolichaster-bearing papillae. Sensory setae visible along anterior margin at articulation with head. Mid-region of prothorax longer and wider, divided into tergite and sternite, bearing the prothoracic legs. Tergite pale yellowish brown in colour, covered with prominent dolichaster-bearing papillae, sternite pale, devoid of papillae. Posterior region short, unsclerotized divided by a transverse fold and incorporated with the rest of the body. Cuticle of posterior region of stellate conformation (fig. 10C) with a row of truncated star-shaped dolichasters and two faint brown marks posterior to the transverse fold. Two lateral spiracles present on this region. Mesothorax rectangular in shape, creamy-white in colour with two large brown markings on either side of the dorsal midline. Cuticle of stellate conformation bearing sparsely arranged star-shaped dolichasters. Metathorax similar to mesothorax but wider with three dark markings, one median and one on either side of the dorsal midline and extending posteriorly down the abdomen. Two lateral spiracles and star-shaped dolichasters present on the meta-tergites. Legs short, stout, yellowish brown in colour. Longitudinal rows of dolichaster-bearing papillae present on femurs with setae on tibiae and tarsi. Tarsi one-segmented, terminating in paired claws.

Abdomen ten segmented, segments 1 to 7 similar to each other but becoming progressively smaller. Creamy white in colour with three dark markings, one median and one on either side of the dorsal midline imparting appearance of three dorsal longitudinal stripes extending the length of body. Dark markings also present laterally. Seven pairs of easily discernible spiracles situated laterally (not visible from dorsal surface) on segments 1 to 7. Segment 7 short and broad, segment 8 cone shaped with dolichaster-bearing papillae and segments 9 and 10 telescoped into segment 8 together forming the spinneret. Dorsal surface of abdomen with sparsely arranged star-shaped dolichasters. Lateral surfaces with dark longitudinal line traversing entire length of abdomen below the spiracles. Ventral surface pale with pale dolichasters.

Material examined. Larvae, 3 specimens.

SOUTH WEST AFRICA. 10 km N. Windhoek (22.32S 17.06E), 1 larva, 19.viii.1977; Bergkrans Farm, 100 km W. Windhoek (22.50S 16.12E), 1 larva, 20.viii.1977; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 1 larva, 20.viii.1977; all collected by M.W. Mansell & V.C. Moran.

Egg.

Unknown.

Distribution (fig. 22).

Thysanocroce damarae has been recorded only from the central and northern regions of South West Africa and is apparently endemic to the territory.

Remarks.

Withycombe (1923) erected the genus Thysanocroce to accommodate Croce damarae MacLachlan. In doing so, he distinguished Thysanocroce from Laurhervasia Navas, stating that the latter genus differed from other genera by having the radial area (between R and Rs) completely filled with crossveins. The

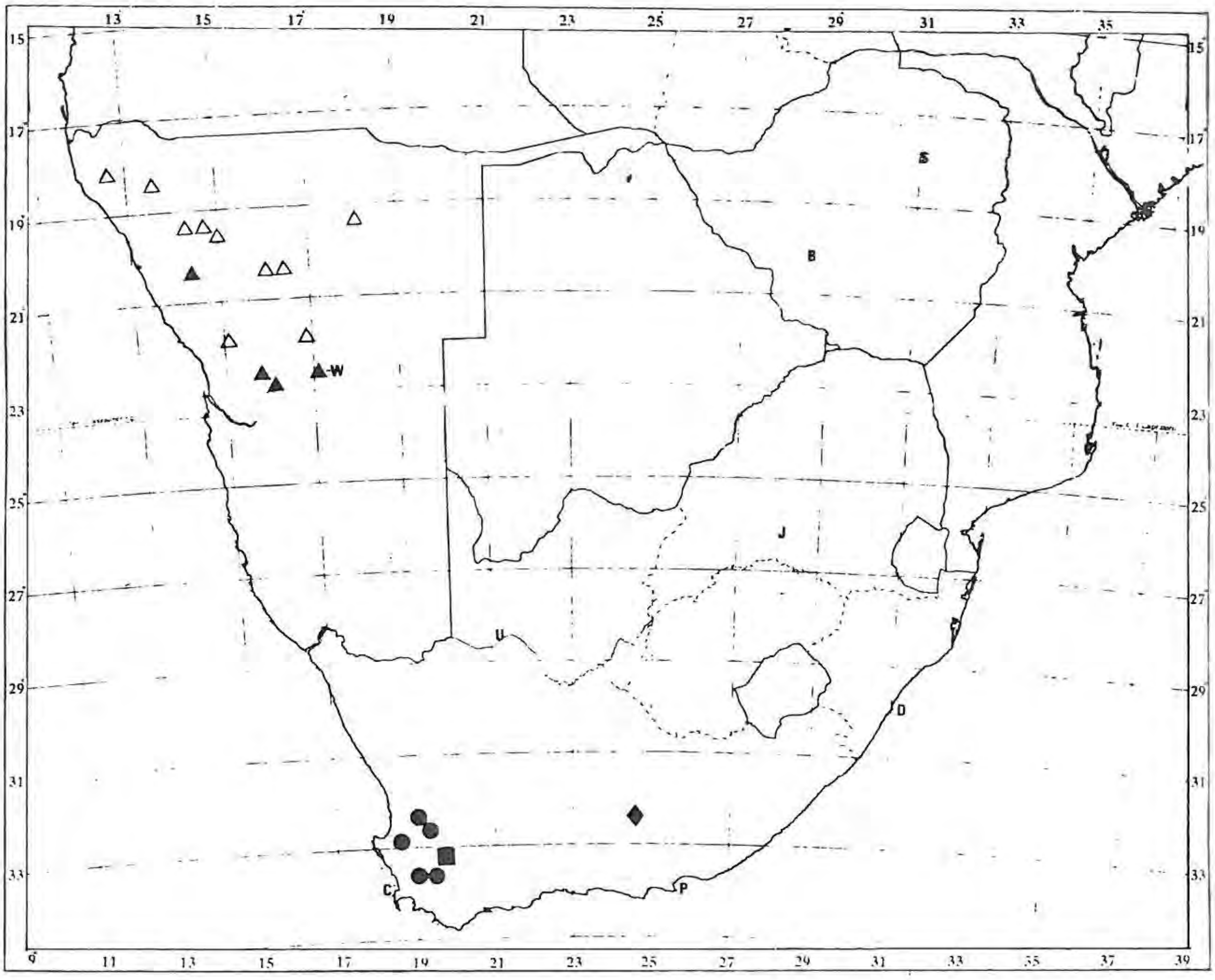


Fig. 22 The recorded distribution of Thysanocroce damarae (McL) (triangles), open triangles represent localities published by Tjeder (1967), closed triangles are localities recorded during this study, Concroce capensis Tjeder (closed circles), Concroce parva spec. nov. (closed square) and Concroce walkeri Tjèder (closed diamond). B = Bulawayo; C = Cape Town; D = Durban; J = Johannesburg; P = Port Elizabeth; S = Salisbury; U = Upington; W = Windhoek.

statement that the radial area was completely filled with crossveins originated from Navas (1914a) in his original description of *Laurhervasia*, and is incorrect. This character, erroneously described by Navas, misled Withycombe (1923) into establishing the genus *Thysanocroce*, in which part of the radial area is free of crossveins, to distinguish it from *Laurhervasia*. Tjeder (1967) pointed out the mistake made by Navas and stated that the type species of the two genera, *Nemoptera setacea* Klug (*Croce lawi* Navas) for *Laurhervasia*, and *Croce damarae* for *Thysanocroce*, were closely allied and undoubtedly congeneric. He therefore synonomised *Thysanocroce* with *Laurhervasia*, a justifiable action as the adults of *L. setacea* and *T. damarae* are morphologically very similar. However, the discovery of the larva of *T. damarae* has led to the conclusion that this species cannot be accommodated in the genus *Laurhervasia*. The larvae of *T. damarae* have short prothoraxes and legs, and live in plant detritus under rock overhangs. By contrast, larvae of the genus *Laurhervasia* all have long prothoraxes and legs, and are cave dwellers, living in sand and dust. The two larval forms are therefore quite unrelated morphologically and biologically. The male genitalia of adult *T. damarae* also differ from those of *Laurhervasia* species in that there are no entoprocesses on the gonarcus or proximal projections on the parameres in *T. damarae*.

The larvae of *T. damarae* do resemble those of *Concroce* in their morphology and biology, but the adults are so distinct from one another, that they cannot be placed in the same genus. An additional genus was therefore required to accommodate *Laurhervasia damarae*, and rather than establish a new genus, it was decided to reinstate <u>Thysanocroce</u> Withycombe in terms of article 17(1) of the International Code of Zoological Nomenclature.

4.3 Genus CONCROCE Tjeder, 1967.

Synopsis:

Concroce Tjeder, 1967:338. Type species = Concroce hessei Tjeder,
by original designation.

Concroce Tjeder; Hölzel, 1975:91.

Concroce Tjeder; Mansell, 1977:202.

The adult characteristics of the genus Concroce were described by Tjeder (1967:338) and include; hindwings of males without bullae; tergite 9 of male split dorsally into two halves; gonarcus lacking entoprocesses; gonosetae absent; female with lateral plates of sternite 8 not fused with gonapophyses laterales; all species with a longitudinal black or brown stripe along the sides of the thorax. In addition, the males lack proximal projections on the parameres; the wings are short and broad with 2 crossveins between R and M before Rs; 5 to 7 radial crossveins are usually present between R and Rs before the clear area.

The larvae are characterized by short prothoraxes (less than twice the head length), short legs and almost quadrate heads. They are not true cave dwellers but live in plant detritus under rock overhangs. The eggs are known in all three species and are characterized by the mushroom-shaped aeropyles.

The three species in this genus are C. capensis, C. walkeri and C. parva and are dealt with in that order.

Concroce capensis Tjeder, 1967. figs. 22, 23, 24, 25.

Synopsis:

Concroce capensis Tjeder, 1967:341. "Du Toit's Kloof in the S.W.

Cape Province".

Type – National Museum, Bulawayo,

Rhodesia. EXAMINED.

Concroce hessei Tjeder, 1967:339. "Piquetberg".

Type – South African Museum,

Cape Town. EXAMINED.

syn. nov.

Concroce capensis Tjeder; Hölzel, 1975:91, 92.

Concroce hessei Tjeder; Hölzel, 1975:91, 92.

Concroce capensis Tjeder; Mansell, 1977:202.

Description of adult (fig. 23A-G).

As described by Tjeder (1967:339, 341) under C. hessei and C. capensis with following information; size (mean measurements in mm from 35 specimens, the size ranges are given in brackets). Length of body 6,6 (5,8-7,4); length of forewing 11,0 (10,5-12,0); length of hindwing 31,0 (26,0-35,0); antenna 3,1 (3,0-3,6); rostrum 1,1 (1,00-1,28).

Wings with two crossveins between R and M before Rs (occasionally 1 or 3) and 6 or 7 radial crossveins between R and Rs before the clear area. In wings examined, the first branch of the radial sector arises between the first and second radial crossveins in 32% of wings, between the second and third in 60% of wings, between the third and fourth in 6% of wings and before the first crossvein in 2% of the wings.

Coloration of the head and thorax as described by Tjeder (1967:339, 341) but variable, especially on the thorax. However, the four markings on the head (Tjeder, 1967 fig. 2014) and the

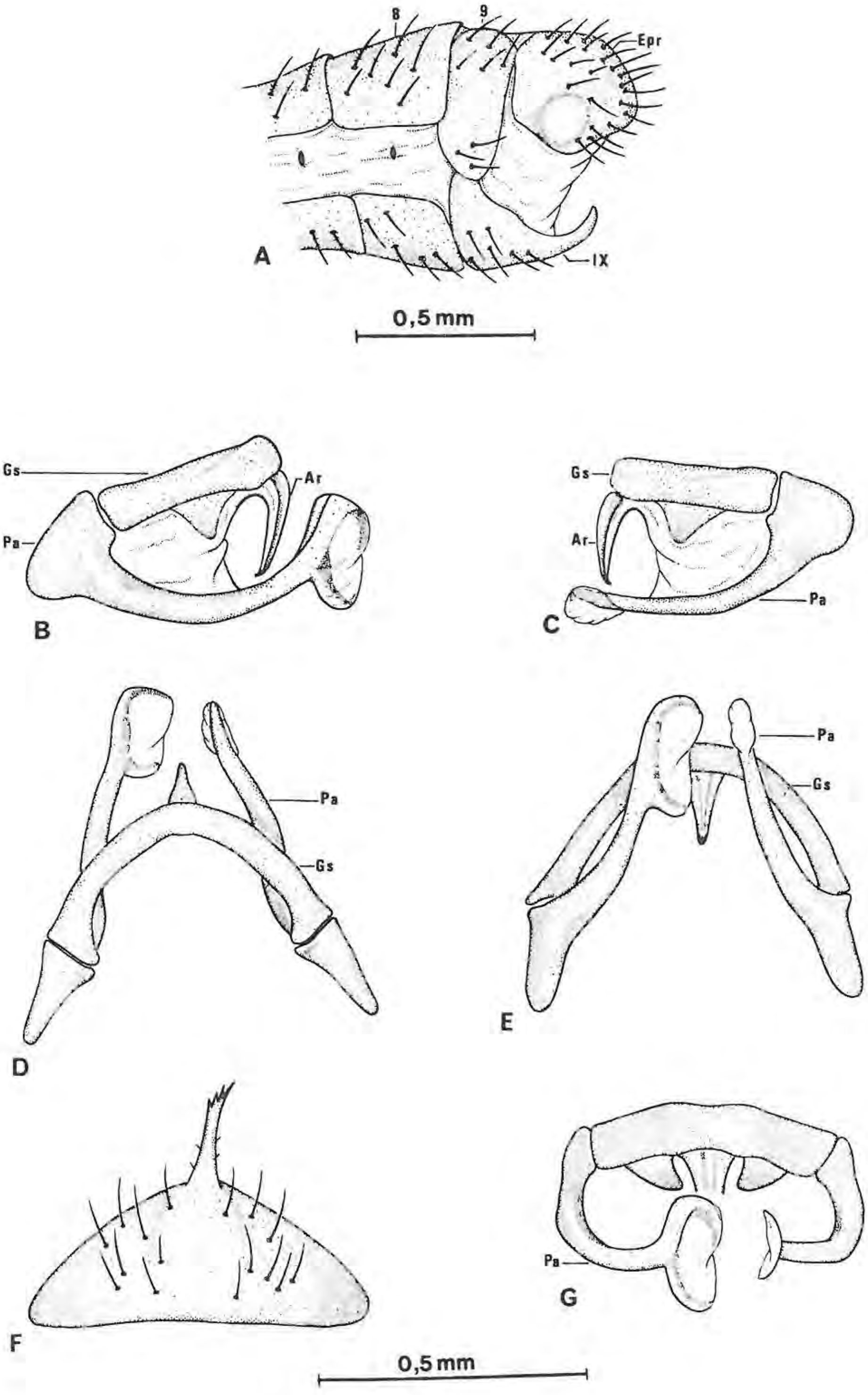


Fig. 23 A - G. Concroce capensis Tjeder.
A. Apex of abdomen ♂. B. Gonarcus and left paramere. C. Gonarcus and right paramere. D. Gonarcus and parameres, dorsal view. E. Gonarcus and parameres, ventral view. F. Sternite 9. G. Gonarcus and parameres, anterior view.
Ar - arcessus; Epr - ectoproct; Gl - gonapophyses laterales; Gs - gonarcus; Lpl - lateral plate of sternite 8; Pa - paramere; IX - sternite 9; 8,9 - tergites.

broad lateral thoracic stripe were present in all examined specimens.

Abdomen of female as described by Tjeder (1967, fig. 2016) under <u>C. hessei</u>. In abdomen of male (fig. 23A-G) sternite 9 short but with long posterior projection, curving upwards and slightly towards the right, terminating in four slender subequal finger-like projections. Gonarcus slender with acute arcessus and two large triangular flanges in the positions of entoprocesses. Parameres slender with distal portions asymmetrical, the left being larger than the right. Left lobe with two chitinous extensions forming a semicircle, supporting a membranous sac. Right lobe terminating in a weak hook, supporting a small membranous sac. Apical portions of parameres closely adpressed to one another but not fused. Proximal projections on parameres lacking. Male genitalia very small with parameres between 0,58 and 0,72 mm in length.

<u>Material examined</u>. <u>Adults</u>, 35 specimens.

SOUTH AFRICA. Kromrivier Farm, Cedarberg (32.32S 19.18E), 1♂ 2♀♀, 5.i.1975; Goudini Spa, Worcester (33.40S 19.16E), 4♂♂ 6♀♀, 3.ii.1977; Piketberg (32.55S 18.45E), 6♂♂ 10♀♀, 27.vii.1977, all reared from larvae. Algeria Forestry Station, Cedarberg (32.22S 19.03E), 2♂♂ 2♀♀, 8.i.1978; Bains Kloof (33.33S 19.09E), 2♂♂, 9.i.1978, collected at light. All collected by M.W. Mansell.

<u>Description of larva (fig. 24)</u>.

Characterized by short prothorax, quadrate head, dark mottled appearance and short stout legs.

Table 7. Mean measurements (mm) for C. capensis larvae, the size ranges are given below the means.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	2	6	43
Head width	0,36 0,36	0,55 0,52-0,60	0,86 0,80-0,92
Head length	0,32 0,32	0,44 0.44	0,67 0,60-0,72
Mandible length	0,44 0,44	0,63 0,60-0,68	1,00 0,92-1,08
Prothoracic length	0,36 0,36	0,59 0,56-0,68	0,97 0,88-1.08
Body width*	0,46 0,32-0,60	1,13 0,88-1,40	1,92 1,28-2,80
Body length*	2,30 2,24-2,36	3,44 2,88-4,24	5,53 4,56-6,96

* Variable, depending upon feeding and state of maturity within instar.

Head quadrate in shape, wider than long, squarish in occipital region. Surface covered by prominent dolichaster-bearing papillae, interspersed with smaller papillae, imparting a granulated appearance to the surface. Third instar larvae with dark brown head displaying three light patches, one on dorsal midline and one on either side of the tentorial pits. Second instar larvae with uniformly pale brown head and first instar with pale yellowish-brown head. Y-shaped epicranial sutures present on heads of second and first instar larvae. Eyes each comprised of seven facets, one anterior, four posterior to this followed by a further row of two facets. Prominent dolicahster-bearing papillae are present between the facets (fig. 10A). Antennae consisting of a stout, dark brown pedicel supporting a delicate nine-segmented flagellum. Proximal and distal flagellar segments long, intermediate seven segments short, with apical segment supporting several delicate bristles.

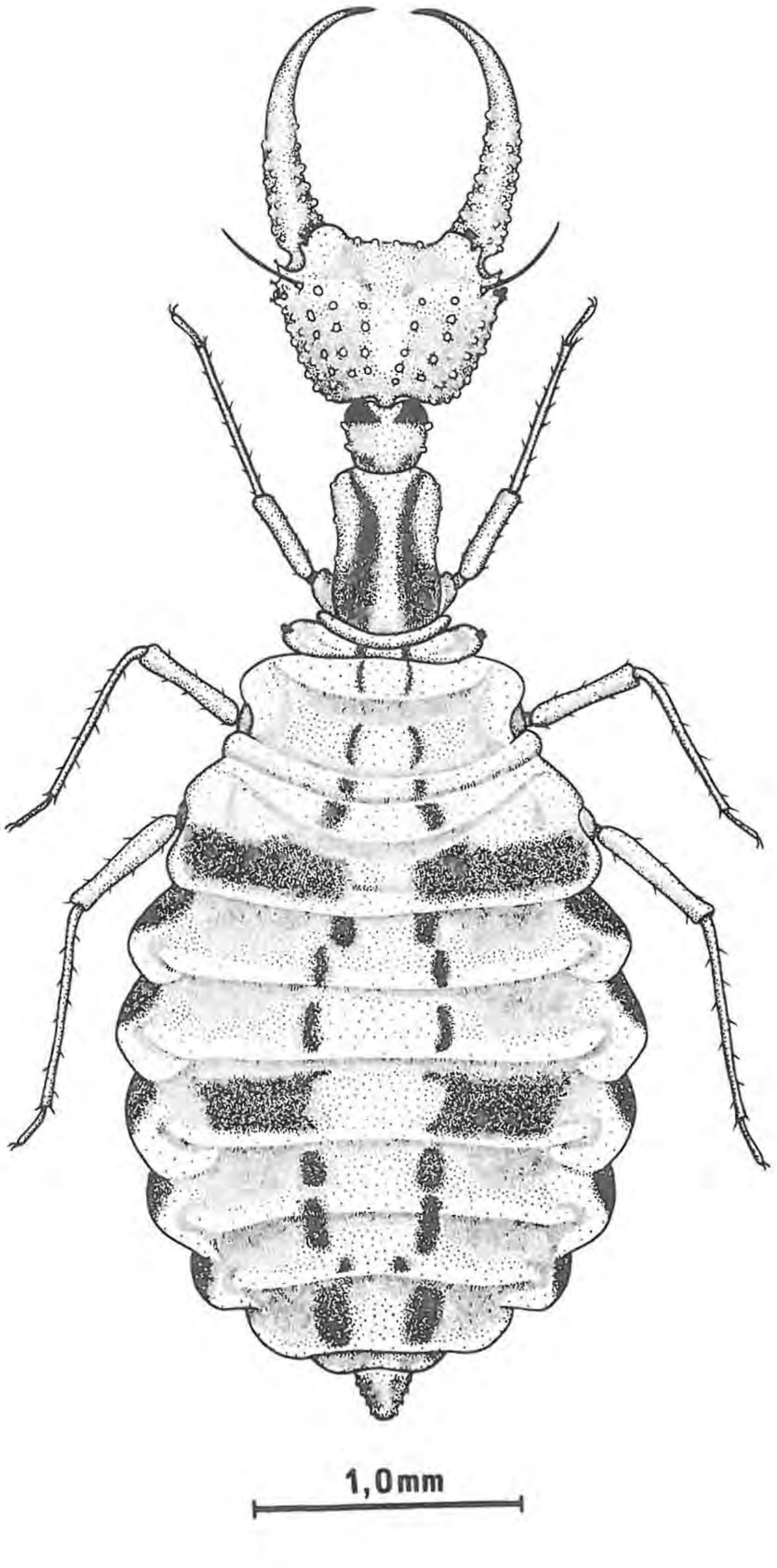


Fig. 24. The larva of Concroce capensis Tjeder.

Mandibles longer than head, uniformly brown, curved near the apices, devoid of teeth but with rows of dolichaster-bearing papillae along the basal two thirds. Maxillae each reduced to a single blade fitting into the ventral surfaces of the mandibles to form the typical suctorial tubes. Cardo and stipes distinguishable but maxillary palps absent. Labium reduced to a single median plate bearing three-segmented labial palps on either side. Basal segment of labial palp large, middle segment short and cylindrical, terminal segment fusiform, tapering to an acute tip (fig. 10B). An oval pit-sense organ present on the dorsal surface and six microscopic finger-like setae occur at the apex of the terminal segment.

Prothorax short, comprising three regions. Anterior region very short, almost oval in shape, bearing sensory setae at the articulation with the head; diffusely brown in colour with two prominent fuscous markings anteriorly on either side of the pale midline. Middle region of prothorax longer and wider, bearing the prothoracic legs and divided into tergite and sternite. Two large dark brown markings cover most of this region on either side of the pale dorsal midline. Coloration similar in second- but pale in first instar larvae. Anterior and middle regions of prothorax sclerotized. Posterior region of prothorax short, unsclerotized, with cuticle of stellate conformation (fig. 10C) and incorporated into the rest of the body. This region usually has two pairs of fuscous markings on either side of the dorsal midline and the prothoracic spiracles are situated on this region. Rows of dolichaster-bearing papillae present on all three regions of prothorax.

Mesothorax rectangular in shape, anterior region rusty-brown, posterior region pale buff, overlain by several fuscous markings and spots on either side of the midline. Metathorax similar but wider with two large fuscous markings covering most of the posterior region on either side of the midline. Two narrow fuscous markings extend, and converge anteriorly onto the mesothorax. These markings also discernible in first and second instar larvae. Spiracles are situated dorsally on either side of the metathorax. Legs short, light brown in colour, paler at the articulations with dark markings on the coxae: rows of dolichaster-bearing setae present on the legs and sensory setae at articulations, tarsi one-segmented, terminating in paired claws. Ventral surface of thorax pale, overlain with irregular dark markings. Cuticle of stellate conformation (fig. 10C).

Abdomen ten-segmented, segments 1 to 7 all similar but becoming progressively smaller and bearing spiracles laterally. Segment 3 with prominent fuscous markings on either side of the dorsal midline, similar to the markings on the metathorax. The other segments with smaller irregularly shaped brown and fuscous markings on either side of the midline and dark markings on the lateral surfaces of the segments. Spiracular openings lacking sieve-plate-like coverings (fig. 10F) or spiracular closing mechanism, but with setae in the trachea just below the openings (fig. 10E). Segment 8 conical, bearing sensory setae at the articulation with segment 7 and well developed dolichasters. Segments 9 and 10 very small, telescoped into segment 8 and together forming the spinneret.

Material examined. Larvae, 51 specimens.

SOUTH AFRICA. Kromrivier Farm, Cedarberg (32.32S 19.18E), 7 larvae, 5.i.1975; Goudini Spa, Worcester (33.40S 19.16E), 11 larvae, 3.ii.1977; Piketberg (32.55S 18.45E), 33 larvae, 27.vii.1977. All collected by M.W. Mansell.

Description of egg (fig. 25A-D).

Oval in shape, about 0,67 mm in length. Surface of chorion covered with regularly arranged mushroom-shaped aeropyles. A complex plastron-like structure is situated over the micropyle at the cephalic end of the egg.

Distribution (fig. 22).

Concroce capensis is confined to the mountainous areas of the south western Cape Province and is endemic to the region.

Remarks.

Tjeder (1967) established the genus Concroce for three new species, C. hessei, C. capensis and C. walkeri, which he described. The type locality of C. hessei is Piketberg, that of C. capensis is Du Toit's Kloof whilst C. walkeri was described from "South Africa", each of these species being described from a single specimen. The type species of the genus, C. hessei, was described from a female specimen and Tjeder (1967) stated in the description that it was possibly the female of C. capensis or C. walkeri. He described the three as separate species rather than make an incorrect association of the female with either of the males.

Collections have now been made at the two type localities (Piketberg and Du Toit's Kloof), where male, female and larval

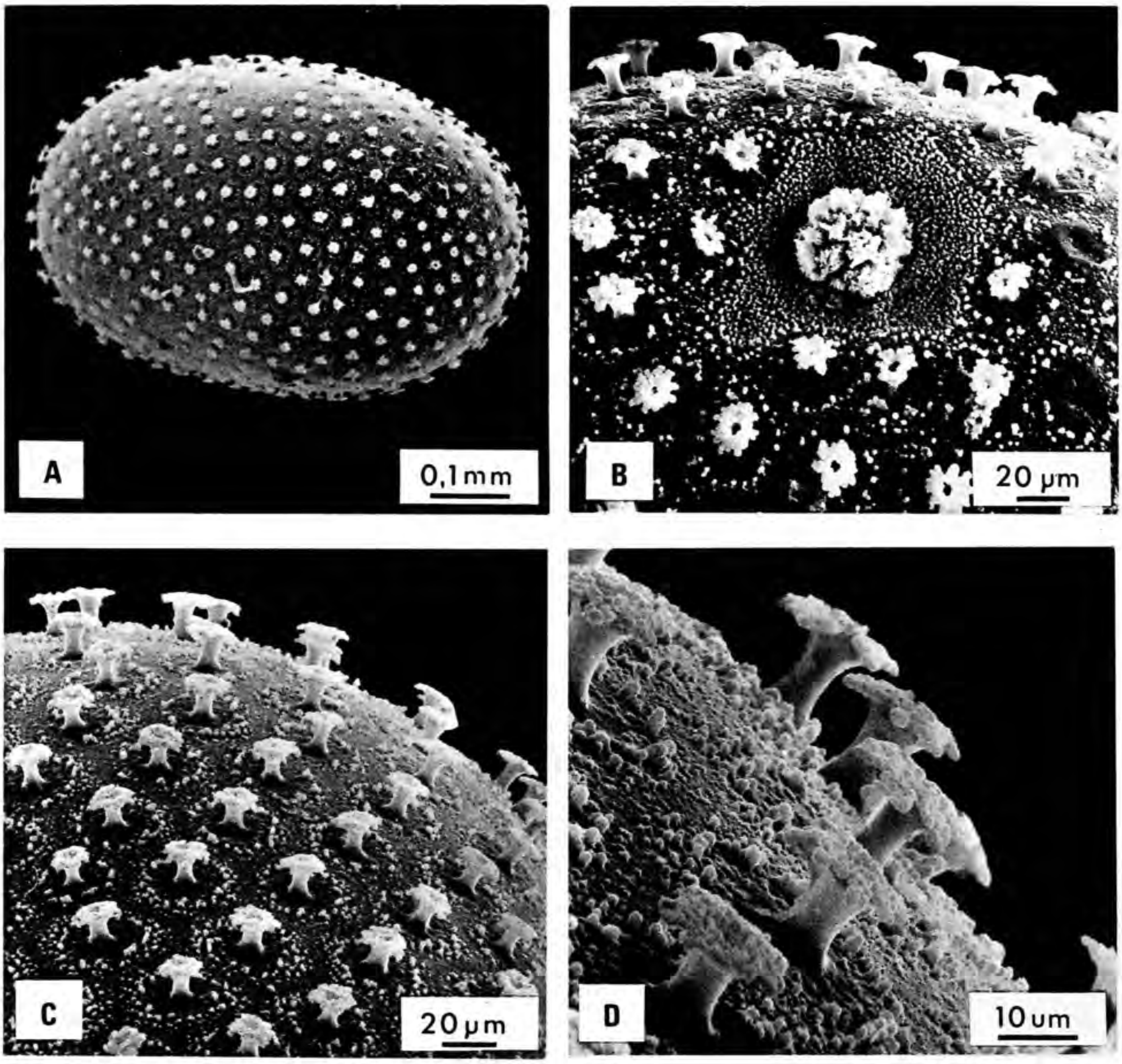


Fig. 25 A - D. Egg of <u>Concroce</u> <u>capensis</u> Tjed. A. Whole egg, lateral view. B. Plastron-like structure covering the micropyle. C. Aeropyles on chorion. D. Detailed structure of aeropyles.

specimens were obtained and compared. The type specimens of *C. hessei* and *C. capensis* have also been compared with the specimens from the above localities. In addition, *C. walkeri* has also been discovered at Graaff Reinet and compared with the other two species. From these investigations, it has been concluded that *C. hessei* and *C. capensis* are conspecific, confirming the reservations expressed by Tjeder (1967). Consequently *C. hessei* is relegated to synonomy with *C. capensis*.

Concroce hessei was described before *C. capensis* in the same publication (Tjeder, 1967), but in terms of article 24(a) of the International Code of Zoological Nomenclature, page precedence does not infer priority, as this is determined by the action of the first reviser. There is no indication as to whether priority should be given to the name of the type species of the genus, as is the case of *C. hessei*; consequently I assume that such a name has the same status as any other (synonyms) described at the same time. *Concroce capensis* has been designated as the senior synonym because the type is a male and this will facilitate more accurate identification of the taxon. Also, as the species is confined to the south western Cape Province, the name "capensis" is more appropriate.

Concroce walkeri Tjeder, 1967. figs. 22, 26, 27, 28.

Synopsis:

Nemoptera setacea Klug, Walker 1853:474. Incorrect identification.

Concroce walkeri Tjeder, 1967:343. "South Africa". Type-British Museum (Nat. Hist.), London. Not examined.

Concroce walkeri Tjeder; Hölzel, 1975:93.

Concroce walkeri Tjeder; Mansell, 1977:202.

ADULTS. (figs. 26A-H). Sexes alike, characterized by very short rostrum. Size (mean measurements in mm from 9 specimens - range in brackets): length of body 7,1 (6,8-7,4); forewing 11,0 (10,5-11,5); hindwing 29,3 (24,0-33,0); antenna 2,2 (2,0-2,4); rostrum 0,64 (0,60-0,72).

Head (fig. 26H). Yellow, with two distinct marks above the antennal bases and diffuse brown markings on the vertex. Rostrum shorter than inter-orbital space measured across frons. Mouthparts black with palps pale at articulations and apices; clypeus yellow, genae and labrum black. Antennae short, black with pale annulations on proximal half of each flagellomere but apices of antennae uniformly black and slightly thickened. Scape uniformly pale yellow, pedicel yellow with brown annulation distally.

Prothorax yellow, two brown spots and short black setae present along anterior margin with two brown markings extending posteriorly on either side of midline. Lateral margins pale,

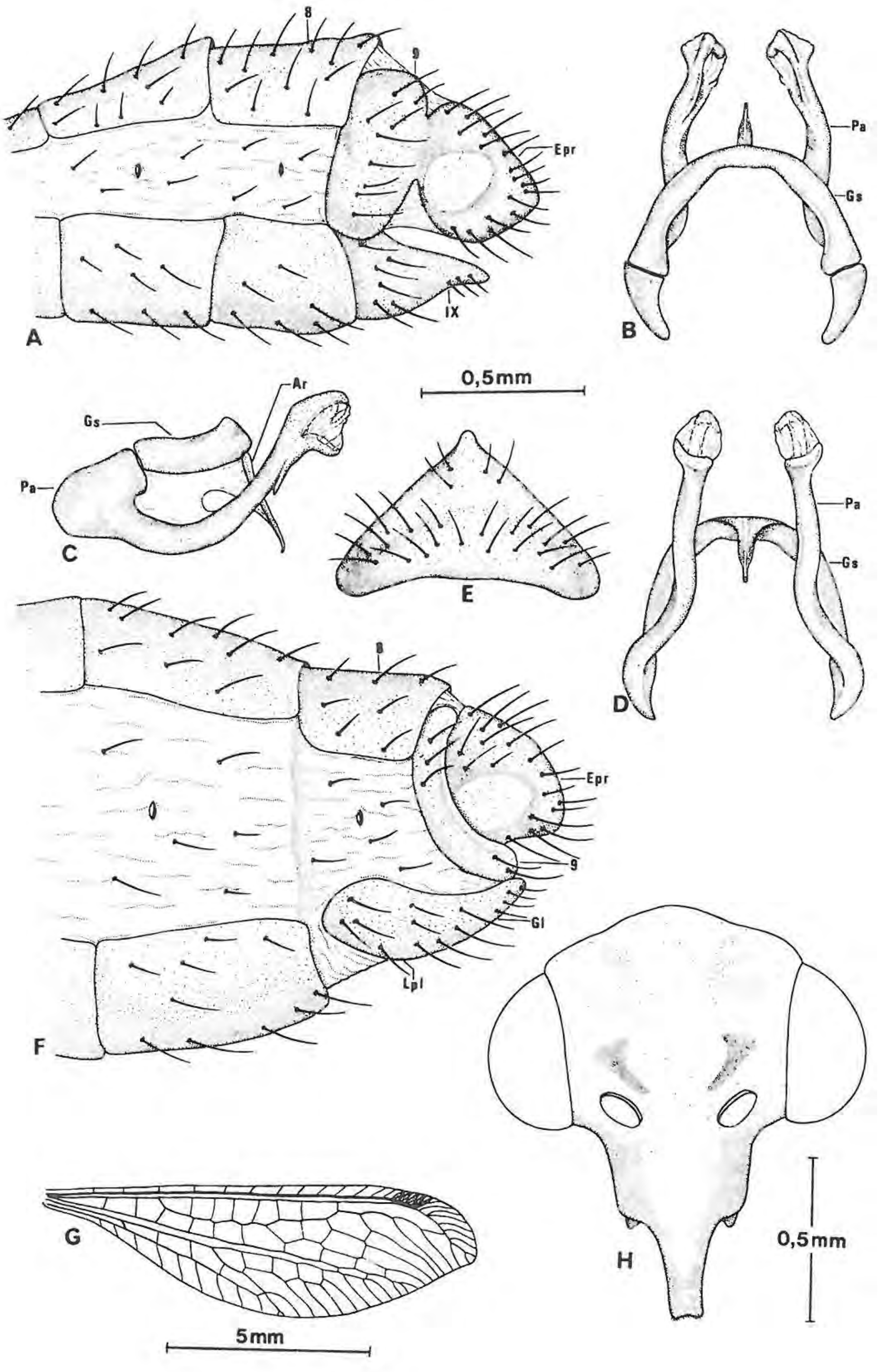


Fig. 26 A - H. <u>Concroce</u> <u>walkeri</u> Tjeder.
A. Apex of abdomen ♂. B. Gonarcus and parameres, dorsal view. C. Gonarcus and parameres, lateral view. D. Gonarcus and parameres, ventral view. E. Sternite 9. F. Apex of abdomen ♀. G. Wing. H. Head, frontal view. Ar - arcessus; Epr - ectoproct; Gl - gonapophyses laterales; Gs - gonarcus; Lpl - lateral plate of sternite 8; Pa - paramere; IX - sternite 9; 8,9 - tergites.

sternites black with the marking extending posteriorly as a broad stripe across the meso- and metapleurites above the coxae. Meso- and metathorax yellow with diffuse brown markings overlying the wing bases. Pleurites pale below the wing bases above the characteristic black stripe. Pleurites pale. Legs pale yellow with black annulations proximally on tibiae. Tarsi five-segmented with proximal tarsomere longer than the combined length of the other four. Paired tarsal claws pale brown, legs densely covered with short black setae. Forewings (fig. 26G) with distinct pterostigma, brown proximally, yellow distally, formed by incrassate costal veins. Two crossveins usually present between R and M before Rs and 6 or 7 radial crossveins between R and Rs. Vein 1A fused with Cu2 for almost its entire length. Hindwings narrow, without dilations, pale yellowish-brown proximally becoming progressively whiter towards the extremities and densely clothed with pale, delicate setae. Bullae absent from wings of males.

Abdomen pale yellow, brown along the pleurites and diffuse brown markings, not conforming to any constant pattern, on the tergites. Sternites pale along the ventral midline. Sparsely arranged short black setae are present on the abdomen. Male (figs. 26A-E) with tergite 9 divided dorsally, each half fused with the respective ectoproct. Ventral margins of tergite 9 rounded, barely overlapping sternite 9 which is triangular with a short apex. Gonarcus arch-shaped, stout with long slender arcessus. Entoprocesses lacking but a pale laminar extension, illustrated by Tjeder (1967, fig. 2021B) difficult to discern. Parameres about 0,94 mm in length, strongly curved with symmetrical distal lobes.

Each lobe consisting of an apical portion curving forwards and then downwards with a thumb-like projection posterior to this, supporting a membrane. A spine-like projection extends backwards along the ventral surface of each paramere. Proximal region of parameres lacking projections. The flattened area large, orientated in line with the gonarcus. Gonosetae, spinellae and pleuritocavae absent. Female (fig. 26F) with tergite 9 divided dorsally, the two halves curving downwards and posteriorly, becoming closely adpressed to the dorsal margin of the gonapophyses laterales. The lateral plates of sternite 8 fused with the gonapophyses laterales which are joined to one another by a convoluted expandible membrane. Genital opening situated between the apices of the gonapophyses laterales. Ectoproct with posterior margin rounded, bearing long black setae. Callus cerci in both males and females prominent, glossy white devoid of setae.

<u>Material examined</u>. <u>Adults</u>, 9 specimens.

SOUTH AFRICA. Graaff Reinet (32.15S 24.32E), 3♂♂ 6♀♀, 16.iv.1978, M.W. Mansell & V.C. Moran. All reared from larvae, larval collection date given.

<u>Description of larva (fig. 27)</u>.

Characterized by short prothorax, quadrate head and general light brown body colour.

Head quadrate in shape, wider than long, squarish in the occipital region. Surface covered with raised dolichaster-bearing papillae, both dorsally and ventrally. Anterior tentorial pits present dorsally. Heads of second and third instar brown with darker markings on the anterior portions and two lighter markings converging posteriorly from the tentorial pits to the occipital

Table 8. Mean measurements (mm) for C. walkeri larvae, the size ranges are given below the means.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	2	13	22
Head width	0,36 0,36	0,59 0,56-0,64	1,02 0,92-1,08
Head length	0,32 0,32	0,50 0,48-0,52	0,81 0,72-0,88
Mandible length	0,50 0,48-0,52	0,69 0,68-0,76	1,16 1,04-1,24
Prothoracic length	0,38 0,36-0,40	0,71 0,68-0,76	1,22 1,12-1,32
Body width*	0,72 0,68-0,76	1,09 0,80-1,56	2,36 1,60-3,08
Body length*	2,34 2,20-2,48	3,61 2,88-4,44	6,61 5,36-7,84

* Variable, depending upon feeding and state of maturity within instar.

region. First instar larvae with faint brown marking anteriorly on a pale yellow head. First and second instar larvae with well defined Y-shaped epicranial sutures. Eyes each comprising seven facets, with dolichaster-bearing papillae interspersed between facets (fig. 10A). Antennae comprising a stout brown pedicel supporting a delicate nine-segmented, pale yellow flagellum. Proximal and distal segments of flagellum long, intermediate seven segments short with distal segment bearing three delicate apical bristles. Mandibles longer than head, uniformly pale brown, devoid of teeth, curved near the apices and with dolichasters along the basal half. Maxillae each reduced to a single blade, fitting

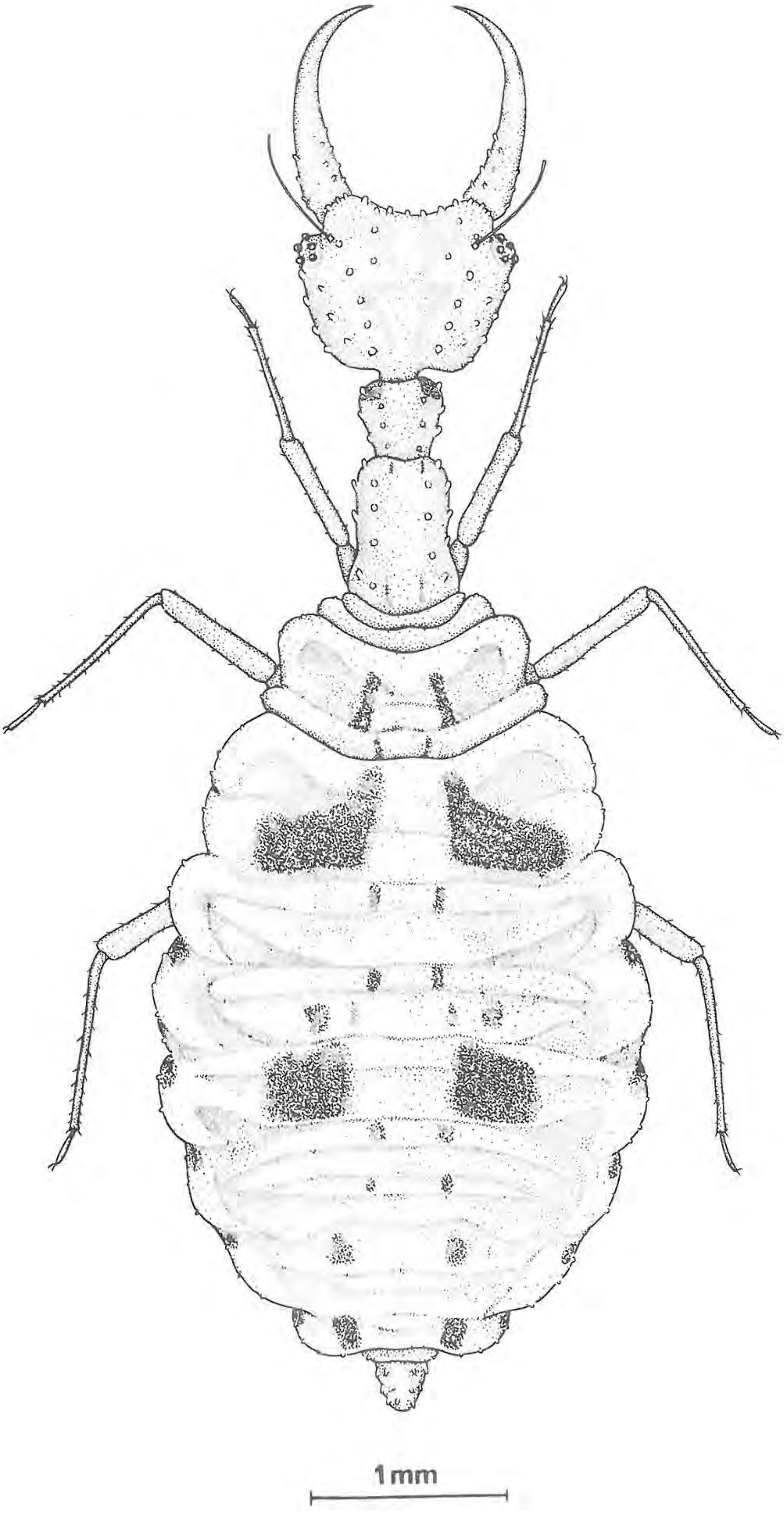


Fig. 27. The larva of Concroce walkeri Tjeder.

into the ventral surfaces of the mandibles to form the typical suctorial tubes. Cardo and stipes distinguishable but maxillary palps absent. Labium reduced to a single median plate bearing three-segmented palps on either side; basal segment large and cylindrical, intermediate segment narrower, dilating apically (fig. 10B), terminal segment fusiform with oval pit-sense organ on the dorsal surface.

Prothorax short, comprising three regions. Anterior region short, sclerotized, dilating anteriorly, bearing sensory setae at articulation with head and sparsely arranged dolichasters. This region pale yellowish brown in colour with two fuscous markings on the dilated area. Mid-region of prothorax longer, wider, divided into tergite and sternite and bearing the prothoracic legs. Sclerotized with rows of dolichasters on this region, which is light brown in colour with two fuscous dots anteriorly and two dark markings above the coxae. Posterior region short, broad unsclerotized with conspicuous transverse fold and incorporated into rest of the body. Indistinct prothoracic spiracles present laterally and cuticle of stellate conformation (fig. 10C) brown in colour with two pairs of darker markings on either side of the dorsal midline. Prothoracic markings similar in second, but paler in first instar larvae. Mesothorax rectangular in shape, with transverse fold. Pale brown in colour with two dark markings on either side of the dorsal midline and dark markings on the lateral surfaces. Metathorax similar but wider, also with transverse fold. A broad medially-interrupted dark brown band overlies the posterior region of this segment, behind the prominent metathoracic spiracles. Legs pale brown with dark markings on the coxae and paler markings at the proximal ends of the tibiae. Longitudinal rows of dolichasters present on the legs with sensory setae at the articulations. Tarsi one-segmented, terminating in paired claws.

Abdomen ten-segmented, light brown in colour with a pair of prominent brown markings on either side of the dorsal midline on segments 3 and 6. Smaller brown markings and two large marks laterally occur on the other segments. Segments 1 to 6 all similar, becoming progressively smaller, each bearing a pair of lateral spiracles. Segment 7 with a pair of sensory plates bearing dolichasters and setae at the ventral articulation with segment 8 (fig. 10D). Segment 8 conical, bearing prominent dolichasters. Segments 9 and 10 telescoped into segment 8, together forming the spinneret. These two segments bear sparse microscopic setae. Cuticle of abdomen of stellate conformation with sparsely arranged fusiform dolichasters. All spiracular openings lack the complex sieve-like coverings but setae occur in the trachea (fig. 10E).

Material examined. Larvae, 37 specimens.

SOUTH AFRICA. Graaff Reinet (32.15S 24.32E), 37 larvae, 16.iv.1978, M.W. Mansell & V.C. Moran.

Description of egg (fig. 28A-F).

Oval in shape, 0,77 mm in length. Surface of chorion covered with mushroom-shaped aeropyles, the base of each aeropyle being stout and surrounded by a ring of wax globules. A complex plastron-like structure is situated over the micropyle at the cephalic end of the egg.

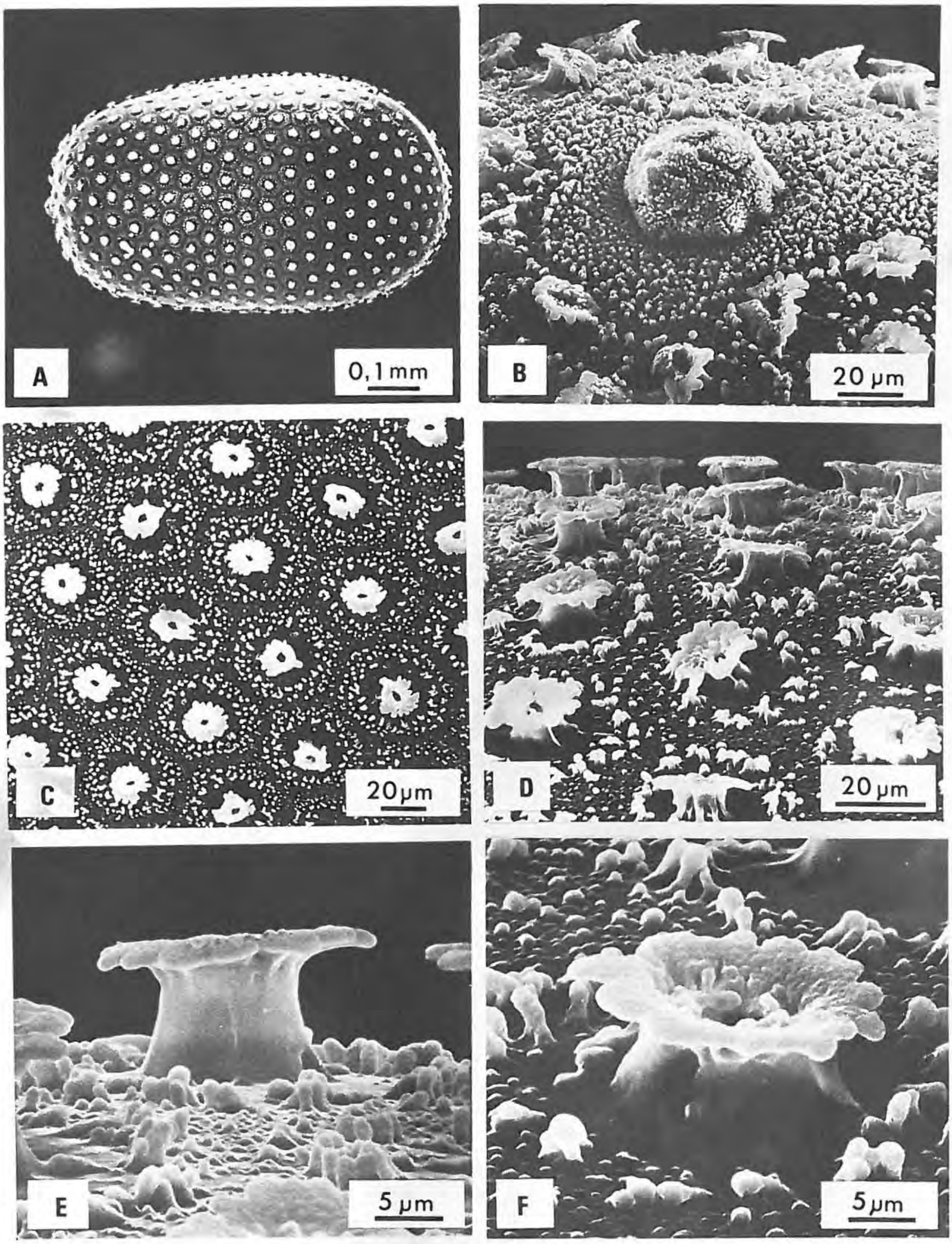


Fig.28 A - F. Egg of <u>Concroce walkeri</u> Tjed. A. Whole egg, lateral view. B. Plastron-like structure covering the micropyle. C. Aeropyles on chorion. D, E, F, Detailed structure of aeropyles.

Distribution (fig. 22).

Concroce walkeri has only been recorded from one locality in the mountains surrounding Graaff Reinet in the eastern Cape.

Remarks.

Concroce walkeri was described by Tjeder (1967) from a single specimen in the British Museum (Nat. Hist.), which was recorded by Walker (1853) as Nemoptera setacea Klug, from "South Africa". The specimen is now in poor condition (Tjeder, 1967) and all that was available to Tjeder was a microscope-slide preparation of the genitalia. This species was collected as larvae in Graaff Reinet, and a series of adults have been reared from the larvae. Male genitalia obtained from these specimens compare very well with the excellent description given by Tjeder (1967:342), leaving no doubt that these specimens are C. walkeri. A complete redescription of the adult has therefore been given, on the basis of new material now available.

Adult C. walkeri differ from C. capensis in having short antennae and rostrums. Also, the parameres of the males in C. walkeri are symmetrical as opposed to the asymmetrical condition of the parameres in C. capensis. The female of C. walkeri has the lateral plates of sternite 8 fused with the gonapophyses laterales whereas in C. capensis they are separate.

Concroce walkeri resembles C. parva (described below) in general appearance but may be distinguished from C. parva by being larger, by the very short rostrum and the symmetrical parameres of the male. The parameres in C. parva are asymmetrical.

The larva of *C. walkeri* is larger than those of *C. capensis* and *C. parva*, and brown in colour as opposed to the black markings on the larvae of the first two species. The egg also differs in that the mushroom-shaped aeropyles are shorter and stouter in *C. walkeri* than they are in *C. capensis* and *C. parva*.

Concroce parva spec. nov. figs. 22, 24, 25, 29.

Description of adult (fig. 29A-J).

Similar to C. walkeri but smaller. Characterized by yellow colour, short rostrum (but longer than the interorbital distance across the vertex), short antennae and broad wings. Sexes alike.

Size (mean measurements in mm for 22 specimens, the size ranges are given in brackets). Length of body 6,0 (5,4-6,8); length of forewing 9,6 (8,5-10,5); length of hindwing 26,0 (23,0-29,0); antenna 2,0 (1,8-2,2); rostrum 0,75 (0,72-0,84). Holotype ♂, 6,4; 9,5; 29,0; 2,1; 0,76, Allotype ♀, 6,5; 10,0; 27,0; 2,0; 0,76 respectively.

Head (fig. 29J) uniformly yellow with two pairs of fuscous markings: one well defined pair immediately above the antennal bases and a paler pair on the vertex. Mouthparts yellowish-brown, clypeus short and broad, yellow in colour, genae and labrum black. Rostrum very short, less than twice the length of the interorbital space. Antennae short, scape and pedicel yellow, flagellum yellowish-brown with broad brown annulations on each segment. Apex of antenna uniformly brown.

Thorax yellow. Prothorax with two diffuse brown markings diverging posteriorly on either side of the midline. Stiff black setae are also present on the prothorax, especially along the anterior margin. Meso- and metathorax with faint brown mark overlying the wing bases. A broad brown stripe extends along from the prothorax across the meso- and metathorax below the wings and along the abdominal pleurites. Legs yellowish-brown, densely covered with

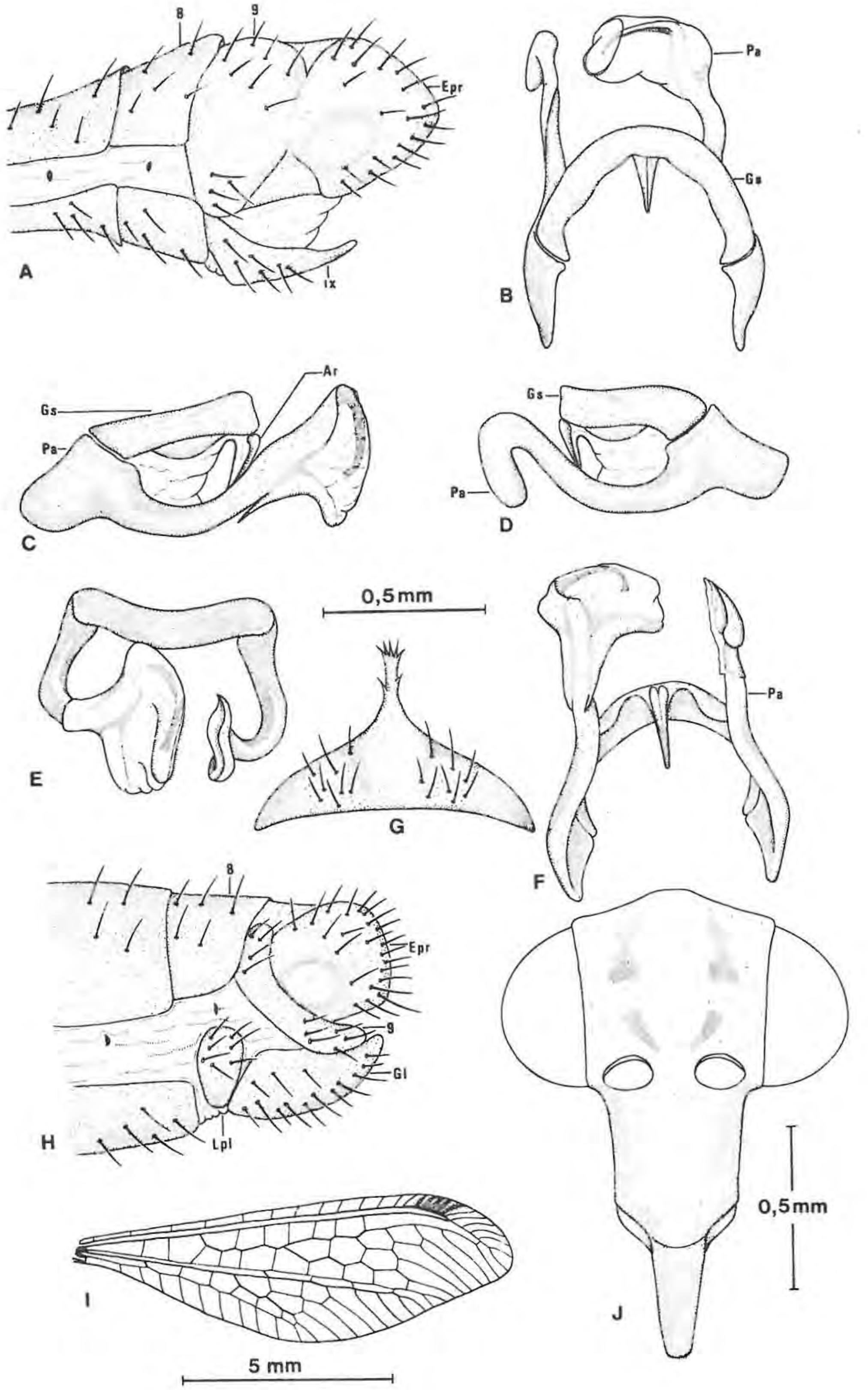


Fig. 29 A – J. Concroce parva spec. nov.
A. Apex of abdomen . B. Gonarcus and parameres, dorsal view. C. Gonarcus and left paramere, lateral view. D. Gonarcus and right paramere, lateral view. E. Distal lobes of parameres, anterior view. F. Gonarcus and parameres, ventral view. G. Sternite 9. H. Apex of abdomen . I. Wing. J. Head, frontal view.
Ar – arcessus; Epr – ectoproct; Gl – gonapophyses laterales; Gs – gonarcus; Lpl – lateral plate of sternite 8; Pa – paramere; IX – sternite 9; 8,9 – tergites.

short black setae. Tarsi five-segmented, with proximal tarsomere longer than combined length of distal four. Paired tarsal claws pale brown in colour. Wings with distinct yellow pterostigma formed by incrassate costal crossveins. Venation dark brown in colour with black setae. Two crossveins present between R and M before Rs and 5 or 6 (rarely 4 to 7) radial crossveins between R and Rs. Ten to fourteen costal crossveins present in the costal space. Vein 1A fused with Cu2 for almost its entire length. Hindwings relatively short, slender, brown proximally and pale along most of distal portion. Bullae absent from wings of the male.

Abdomen yellow in colour with diffuse brown markings on tergites and a distinct black line along the pleurites, extending onto the sternites. Pleuritocavae absent. Male (figs. 29A-G) with tergite 9 divided in the dorsal midline, the two halves fused with the respective ectoprocts. Sternite 9 with elongated tip terminating in five tiny finger-like projections (fig. 29G). Gonarcus stout with well developed arcessus and two flange like extensions. Parameres very stout, curved with distal lobes asymmetrical, the left lobe distinctly larger than the right. Left paramere about 1,08 mm long with distal lobe consisting of two chitinous extensions supporting a large membranous sac. One chitinous extension thumb-like, projecting ventrally, the other longer, projecting upwards and then curving down and inwards. A semi circular arrangement of small setae occurs on the inner surface of the membranous sac opposite the distal lobe of the right paramere. Right paramere (fig. 29D) broad with crook shaped distal lobe supporting a smaller membranous sac. The distal lobes of the parameres fit closely together, but are not fused. Proximal projections on parameres absent and gonosaccus lacking spinellae and gonosetae. Female (fig. 29H) with tergite 9 divided dorsally, curving downwards and posteriorly, closely adpressed to the anterior margin of the ectoprocts and dorsal margins of the gonapophyses laterales. Genital opening at the posterior apex of the gonapophyses laterales which can be widely separated from one another, being joined by a convoluted membrane. Lateral plates of sternite 8 bearing setae and not fused with gonapophyses laterales. Ectoprocts almost quadrate in shape, with distinct callus cerci.

Material examined. Adults, 22 specimens.

SOUTH AFRICA. Hex River Valley, near De Doorns (33.29S 19.40E), ♂ holotype, ♀ allotype, 7♂ 13♀ paratypes, 9.i.1975 & 26.vii.1977, all reared from larvae collected by M.W. Mansell.

Description of larva (fig. 24).

The larva of C. parva is almost identical to that of C. capensis described above but may be distinguished by two features; (a) the larvae of C. parva are slightly larger than those of C. capensis (tables 7 and 8) and (b) in C. capensis the prothorax is shorter than the mandibles whereas in C. parva the prothorax is the same length or slightly longer than the mandibles. Apart from these two features the larvae are indistinguishable, so one drawing (fig. 24) serves to illustrate both species.

Material examined, Larvae, 59 specimens.

SOUTH AFRICA. Hex River Valley, near De Doorns (33.29S 19.40E), 43 larvae, 9.i.1975 & 26.vii.1977, all collected by M.W. Mansell. In addition, 16 specimens were reared from eggs laid by females in the laboratory.

Table 8. Mean measurements (mm) for C. parva spec. nov. larvae. The measurement ranges are given below the means.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	12	18	29
Head width	0,36 0,36	0,55 0,52-0,60	0,92 0,88-1,00
Head length	0,32 0,32	0,47 0,44-0,52	0,72 0,68-0,80
Mandible length	0,46 0,36-0,40	0,68 0,64-0,72	1,09 1,04-1,20
Prothoracic length	0,38 0,36-0,40	0,67 0,64-0,72	1,14 1,04-1,20
Body width*	0,76 0,64-0,80	1,03 0,88-1,40	2,04 1,44-2,40
Body length*	2,43 2,12-2,76	3,52 3,16-4,20	6,25 5,12-6,80

* Variable, depending upon feeding and state of maturity in instar.

Description of egg (fig. 25A-D).

The eggs are morphologically identical to those of C. capensis described above, being characterized by the mushroom-shaped aeropyles on the chorion.

Distribution (fig. 22).

Concroce parva has only been recorded from one locality in the south western Cape Province, and is endemic to the area.

Remarks.

The adults of C. parva are the smallest of all the known southern African Crocinae. They resemble C. walkeri in body coloration, wing venation and the short rostrum and antennae. The two species differ in that *C. parva* is smaller and has a longer rostrum than *C. walkeri.* In *C. parva* the parameres of the male are asymmetrical as opposed to the symmetrical parameres of *C. walkeri*. The shapes of sternite 9 also differ between the two species, in *C. parva* it has a long projecting tip terminating in five delicate finger-like projections, but in *C. walkeri* the tip only projects slightly and is rounded in shape.

The larva of *C. parva* is much smaller than that of *C. walkeri* and has black markings on the body as opposed to the brown body coloration of *C. walkeri*.

The adults of *C. parva* are distinguishable from *C. capensis* in that *C. parva* is smaller, has a shorter rostrum and antennae and a yellow body, whereas *C. capensis* is darkly coloured. Although the parameres of both species are asymmetrical, the male genitalia are clearly different morphologically.

The larvae and eggs of *C. parva* are almost identical, the larvae being distinguishable by the features outlined above whereas the eggs are apparently indistinguishable. The two species are however, quite distinct from one another on the basis of adult morphology.

The species of *Concroce* constitute a distinctive and circumscribed taxon which is apparently endemic to the mountainous areas of the Cape Province.

4.4 Genus TJEDERIA Mansell, 1977.

Synopsis:

Tjederia Mansell, 1977:195. Type species - Tjederia namaquensis Mansell, 1977:197, by original designation and monotypy.

The distinguishing features of the genus were described by Mansell (1977:195) and this description is bound into the thesis overleaf. There are two species in the genus, namely T. namaquensis Mansell and T. brevicornis spec. nov. and they are dealt with in this order.

Tjederia namaquensis Mansell, 1977.

Synopsis:

Tjederia namaquensis Mansell, 1977:197. "Stadsaal Caves, Cedarberg (32.31S 19.19E)" Type - National Collection of Insects, Plant Protection Research Institute, Pretoria.

Description of adult, larva and egg.

These were described by Mansell (1977:197) and the formal description is bound into the thesis overleaf. The following additional distributional data has been recorded subsequently.

Additional material examined. Larvae, 36 specimens.

SOUTH AFRICA. Versveld Pass, Piketberg (32.52S 18.45E), 12 larvae, 26.vii.1977; Piketberg (32.54S 18.45E), 15 larvae, 27.vii.1977; Heerenlogements Cave, Vanryhnsdorp Dist. (31.58S 18.33E), 7 larvae, 7.i.1978; Algeria Forestry Station, Cedarberg (32.33S 19.03E), 2 larvae, 8.i.1978. All collected by M.W. Mansell.

Distribution (fig. 30).

This species appears to be confined to the south western Cape Province , Namaqualand and southern South West Africa.

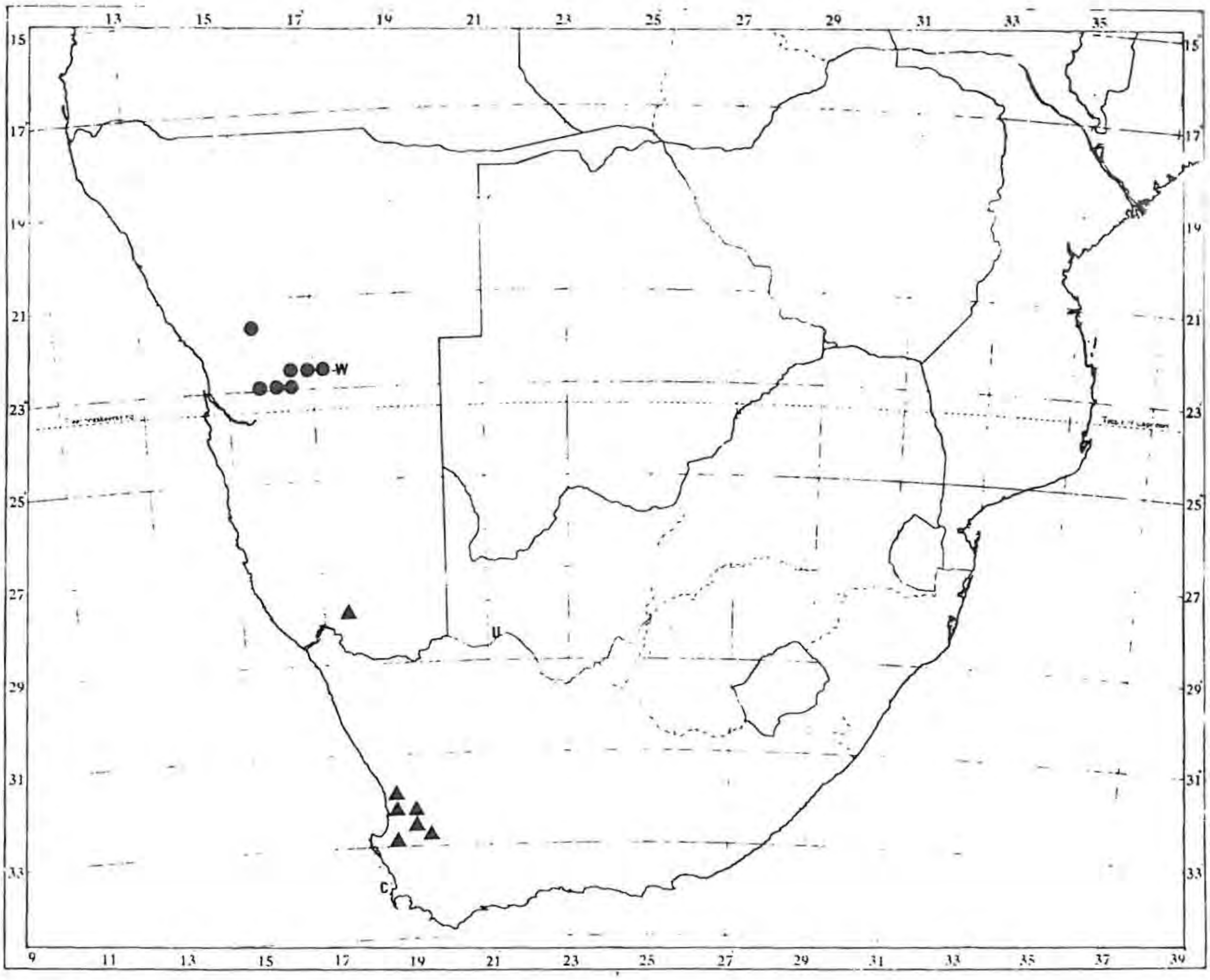


Fig. 30. The recorded distribution of Tjederia brevicornis spec. nov. (closed circles) and Tjederia namaquensis Mansell (closed triangles). C = Cape Town; U = Upington; W = Windhoek.

Tjederia brevicornis spec. nov. figs. 30, 31, 32.

Description of adult (fig. 31A-H).

Characterized by short slightly clavate antennae and narrow irridescent, slightly opaque wings with pale yellow venation. Sexes similar but females with broader forewings, and usually slightly longer rostrum and antennae than males. Size (mean measurements in mm from 98 specimens, - size ranges are given in brackets. Male and female measurements given separately for the parameters in which they differ). Length of body 6,9 (5,6-8,4); length of forewing 12,7 (11,0-14,5); length of hindwing 34,5 (28,0-40,0); antennae male 2,4 (2,0-2,8); antennae female 2,8 (2,6-3,0); rostrum male 1,02 (0,90-1,12); rostrum female 1,14 (0,96-1,30). Holotype ♂, 7,2; 12,5; 34,0; 2,4; 1,10. Allotype ♀, 7,3; 13,0; 35,0; 2,6; 1,10, respectively.

Head creamy white in colour with two dark macules above the antennal bases and extending posteriorly over the vertex. These markings occasionally pale and diffuse. Mouthparts pale yellow with clypeus pale proximally, brown distally, labrum brown, genae dark brown. Antennae with flagellum uniformly pale brown, thickening gradually towards the apex. Scape pale, pedicel pale with brown annulation distally. Flagellum densely clothed in short brown setae.

Thorax uniformly pale brown, paler ventrally. Prothorax pale brown dorsally with a dark brown marking along each lateral margin and bearing long black setae along anterior and posterior margins with shorter setae on dorsum. Mesothorax with sparsely arranged short black setae on dorsum and a thin black

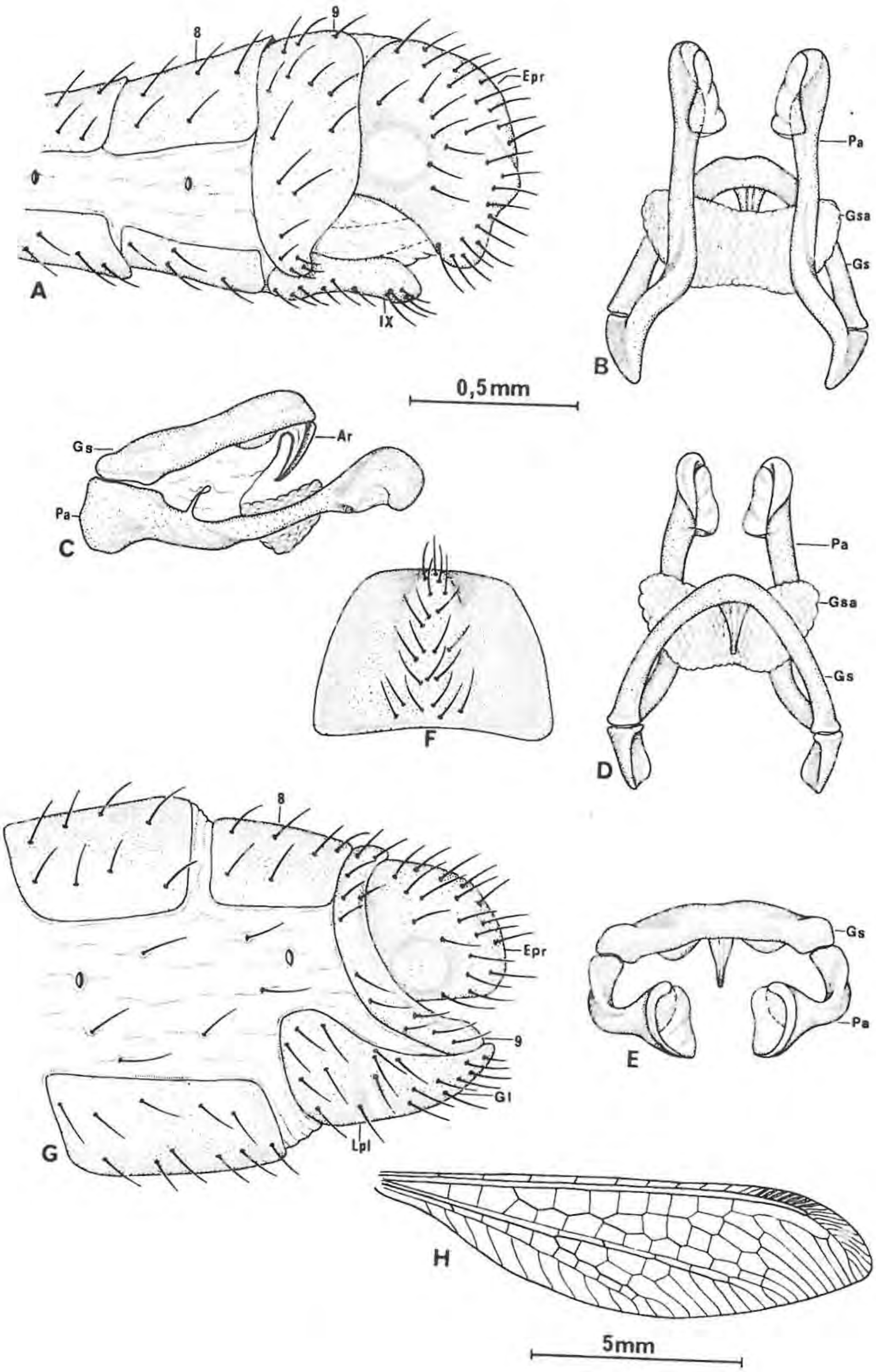


Fig. 31. A – H. *Tjederia brevicornis* spec. nov.
A. Apex of abdomen ♂. B. Gonarcus and parameres, ventral view. C. Gonarcus and parameres, lateral view. D. Gonarcus and parameres, dorsal view. E. Gonarcus and parameres, anterior view. F. Sternite 9. G. Apex of abdomen ♀. H. Wing. Ar - arcessus; Epr - ectoproct; Gl - gonapophyses laterales; Gs - gonarcus; Gsa - gonosaccus; Lpl - lateral plate of sternite 8; Pa - paramere; IX - sternite 9; 8,9 - tergites.

line overlying the wing bases. Metathorax overlain with irregular fuscous markings and bearing a row of setae across the metascutellum. Legs uniformly pale yellow with brownish annulations on proximal ends of tibiae and densely clothed with short black setae. Tarsi five-segmented with proximal tarsomere longer than the combined length of the other four. Paired claws pale brown. Forewings (fig. 31H) narrow in the males, broader in the females with pale yellow venation and brown setae. Radial vein conspicuously darker than other veins. Wing membrane markedly irridescent with slight opaque yellowish tinge, imparting the appearance of a teneral wing. Two crossveins present between R and M before Rs and 6 or 7 (occasionally 5, 8 or 9) radial crossveins between R and Rs before hypostigmatic cell. The first branch of Rs arises between radial veins two and three in 55% of wings, between radial veins three and four in 29% of wings, between one and two in 15% of wings and beyond four in 1% of the wings examined. Ten, eleven or twelve costal veins usually present before the pterostigma which is pale. Apical area of wings filled with crossveins. Vein Cu2 fused with 1A for almost its entire length and posterior margin of forewing bearing a fringe of pale grey setae. Hindwings narrow, white in colour but pale yellowish brown proximally and densely covered with short white setae. Bullae absent from the wings of males.

Abdomen uniformly pale brown with diffuse dark markings on the tergites. Pleuritocavae absent. Male (figs. 31A-F) with tergite 9 undivided dorsally, narrowing to acute apices overlapping sternite 9 which is almost rectangular in shape with no posterior projection. Ectoprocts shaped as shown in fig. 31A with posterior ventral margin projecting downwards. Callus cerci present and long black setae occur along posterior margins of ectoprocts. Gonarcus arch-shaped with short arcessus and delicate flange-like entoprocesses. Parameres slender, slightly curved and between 1,02-1,12 mm long. The distal lobes are symmetrical lacking prominent ventrally directed projection, but with distal ends of parameres curving downwards and inwards, each supporting a membranous sac. Proximal region of paramere with long slender projection and the flattened quadrate region orientated at right angles to the length of the paramere. Gonosetae absent, spinellae present. Female (fig. 31G) with tergite 9 divided dorsally, each half narrow, curving downwards and posteriorly becoming closely adpressed to the dorsal margins of the gonapophyses laterales. Lateral plates of sternite 8 fused with gonapophyses laterales, the line of fusion demarcated by a hairless zone. Genital opening situated at the posterior apices of the gonapophyses laterales which are joined ventrally by a convoluted expandible membrane. Ectoprocts oval in shape with ventral margins flattened. Callus cerci well developed and lacking setae. Anal opening situated dorsally between ectoprocts.

Material examined. Adults, 98 specimens.

SOUTH WEST AFRICA. Windhoek, "Bowker Cave" (22.34S 17.07E), ♂ holotype, ♀ allotype, 26♂ 10♀ paratypes, 20.vii.1976 & 19.viii.1977; Klein Windhoek (22.34S 17.09E), 4♂ 6♀ paratypes, 19.viii.1977; Mavis Siding (22.33S 17.10E), 8♂ 5♀ paratypes, 25.viii.1977; 10 km N. Windhoek (22.31S 17.06E), 1♀ paratype, 19.viii.1977; 34 km W. Windhoek (22.36S 16.43E), 4♂ 2♀ paratypes, 20.viii.1977; Dirleen Farm, 46 km W. Windhoek (22.40S 16.34E), 6♂ 4♀ paratypes, 20.viii.1977; Von Francois' Fort (22.48S 16.26E), 2♂ paratypes, 20.viii.1977; Bergkrans Farm, 100 km W. Windhoek (22.50S 16.12E), 3♂ 3♀ paratypes, 20.viii.1977; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 5♂ 3♀ paratypes, 20.viii.1977; Ameib Farm, Usakos Dist. (21.48S 15.36E), 3♂ 1♀ paratypes, 21.viii.1977. All reared from larvae collected by M.W. Mansell & V.C. Moran. Larval collection dates given.

Description of larva (fig. 32).

Characterized by two colour forms; in the highlands near Windhoek and the Khomas Hochland the larvae are dark and heavily mottled, whilst in the Pro-Namib Desert, the larvae, whilst retaining the general colour pattern are very much paler.

Table 9. Mean measurements (mm) for I. brevicornis larvae. The size ranges are given below the means.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	19	68	219
Head width	0,32 0,32	0,53 0,48-0,56	0,88 0,76-0,96
Head length	0,31 0,28-0,32	0,49 0,44-0,52	0,81 0,68-0,88
Mandible length	0,41 0,36-0,44	0,66 0,60-0,72	1,12 0,96-1,28
Prothoracic length	0,50 0,48-0,56	1,07 0,96-1,20	2,20 1,72-2,44
Body width*	0,81 0,72-0,96	1,49 0,80-1,80	2,55 1,48-3,68
Body length*	2,44 2,08-2,84	4,46 3,20-5,00	7,20 5,68-8,96

* Variable, depending on feeding and state of maturity within the instar.

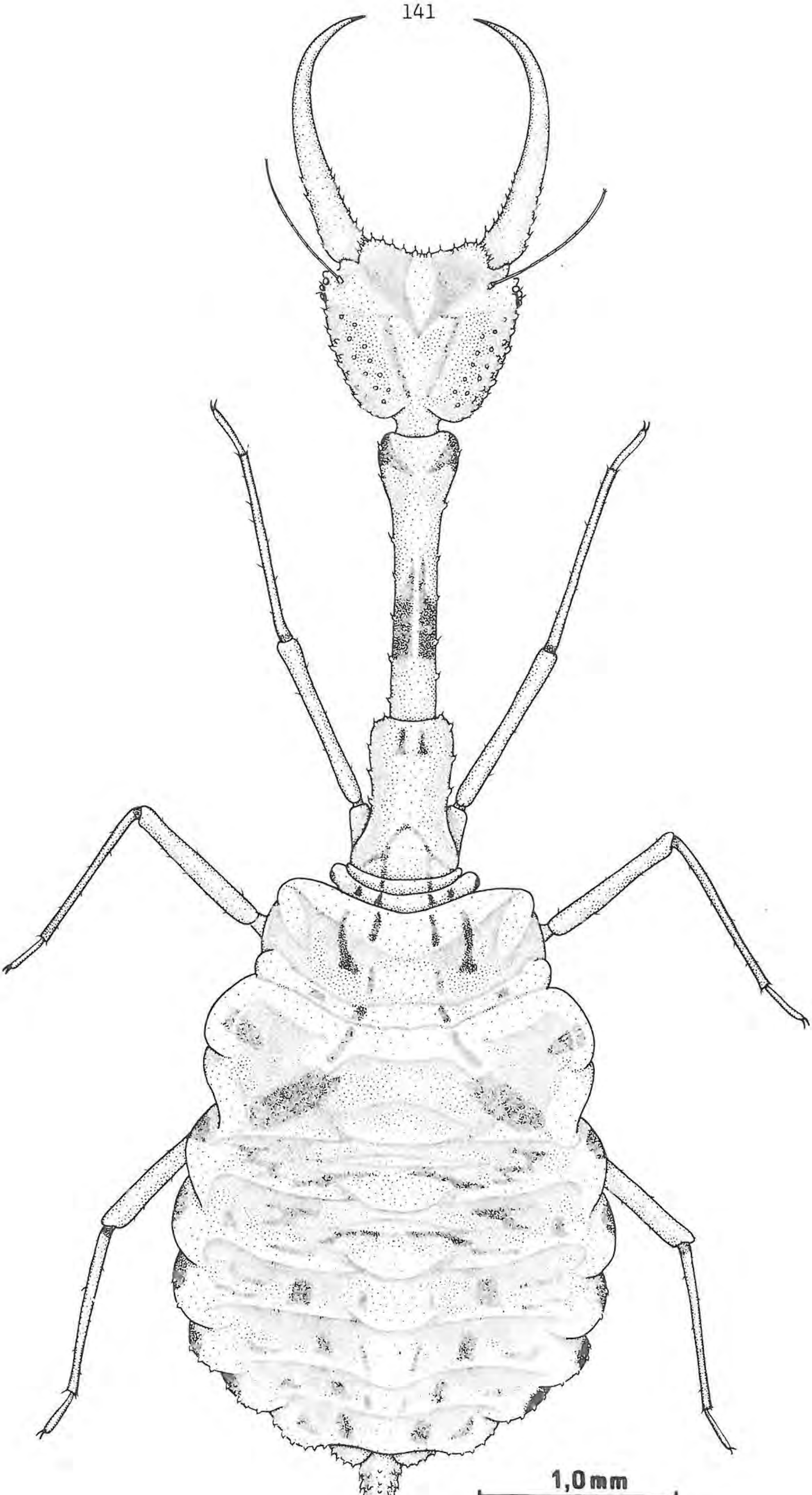


Fig. 32. The larva of Tjederia brevicornis spec. nov.

Head triangular in shape, wider than long, tapering towards the occipital region. Surface has raised dolichaster-bearing papillae interspersed with smaller papillae and tentorial pits present dorsally. Third instar larvae with anterior region of head covered by a triangular black mark with a light patch in its centre. Posterior to this characteristic mark, an open triangular marking is also usually present. Remainder of head dark in the highland forms and pale in the Pro-Namib larvae, with two light patches adjacent to each tentorial pit. A third pale mark on the centre of the head also discernible in the Pro-Namib forms. These markings are also present in first and second instar larvae, but pale in the first instar, with Y-shaped epicranial sutures also visible in these two instars. Eyes each comprised of seven facets, six dorsally and one ventrally situated (fig. 10A). Antennae each consisting of a stout black pedicel supporting a delicate eight-segmented flagellum. Proximal and distal flagellomeres long, intermediate six short, with distal segment bearing delicate apical bristles. Mandibles longer than head, uniformly yellowish-brown, devoid of teeth, curved near the apices with dolichasters along the basal third. Maxillae each reduced to a single blade fitting into the ventral surfaces of the mandibles to form the typical suctorial tubes. Cardo and stipes distinguishable but maxillary palps absent. Labium reduced to a single median plate bearing three-segmented labial palps on either side; basal segment broad and flattened with dolichasters along its anterior margin, middle segment short, dilating apically, terminal segment fusiform, tapering to an acute tip (fig. 10B) and bearing an oval pit-sense organ on its dorsal surface.

Prothorax elongated, approximately three times the length of the head and comprising three regions. Anterior region elongated, dilating apically and bearing sensory setae at the articulation with the head. Two brown markings occur on the dilated area and a wide brown band separated by a pale narrow midline lies in the middle of this region. Mid-region of prothorax shorter, wider divided into tergite and sternite and bearing the prothoracic legs. Dark markings cover most of this region with a pair of spots on the anterior margin usually prominent. The anterior and mid-regions sclerotized, bearing sparsely arranged dolichasters. These portions of the prothorax uniformly brown in first- and diffusely brown in second instar larvae but with well defined pale narrow midline. Posterior region short, unsclerotized incorporated with the rest of the body and bearing the prothoracic spiracles laterally. The cuticle of this region stellate in conformation (fig. 10C) with two pairs of brown markings on either side of the dorsal midline. Mesothorax rectangular in shape, pale buff in colour, heavily overlain with brown maculations in the highland forms but pale in the larvae from the Pro-Namib. Mesothorax similar but wider with distinct transverse fold dividing it into two apparent regions. A prominent brown marking, interrupted in the midline covers most of the posterior region of this segment. Metathoracic spiracles are situated dorsally on this segment but are difficult to discern. Legs uniformly brownish-yellow, long and slender with faint brown annulations on either side of the femero-tibial joint. Rows of sparsely arranged setae occur on the legs with sensory setae at the articulations. Tarsi one-segmented, terminating in paired claws.

Abdomen ten-segmented. Segments 1 - 7 all similar but becoming progressively smaller with each bearing a pair of lateral spiracles. Segment 8 conical, bearing setae ventrally and densely arranged dolichasters. Segments 9 and 10 telescoped into segment 8, together forming the spinneret (fig. 10D). Abdomen heavily overlain with brown markings, imparting a maculated appearance to the larvae. Two large brown markings occur on either side of the dorsal midline on the abdominal segments 3 and 6. Segment 8 pale. Ventral surface of abdomen also with dark maculations. The Pro-Namib larvae pale with only the larger markings prominent.

Material examined. Larvae, 306 specimens.

SOUTH WEST AFRICA. Windhoek, "Bowker Cave" (22.34S 17.07E), 56 larvae, 19,viii.1977; Klein Windhoek (22.34S 17.09E), 29 larvae, 19.viii.1977; Mavis Siding (22.33S 17.10E), 48 larvae, 25.viii.1977; 10 km N. Windhoek (22.31S 17.06E), 3 larvae, 19.viii.1977; 34 km W. Windhoek (22.36S 16.43E), 25 larvae, 20.viii.1977; Dirleen Farm, 46 km W. Windhoek (22.40S 16.34E), 24 larvae, 20.viii.1977; Von Francois' Fort (22.48S 16.26E), 20.viii.1977; Bergkrans Farm, 100 km W. Windhoek (22.50S 16.12E), 18 larvae, 20.viii.1977; Komuanab Farm, Karibib Dist. (22.45S 15.48E), 38 larvae, 20.viii.1977; Ameib Farm, Usakos Dist. (21.48S 15.36E), 36 larvae. All collected by M.W. Mansell & V.C. Moran. In addition, 18 larvae were reared from eggs laid by females in the laboratory.

Description of egg (fig. 33A-D).

Oval in shape, 0,62-0,68 mm in length. Surface of chorion covered with bower-shaped aeropyles, each of which is surrounded by a hexagonal pallisade of waxy globules regularly arranged over the surface of the egg. Withycombe (1925) suggested that patterns of this nature are generally due to the impressions of the ovarian follicle cells prior to oviposition. A complex plastron-like structure is situated over the micropyle at the cephalic end.

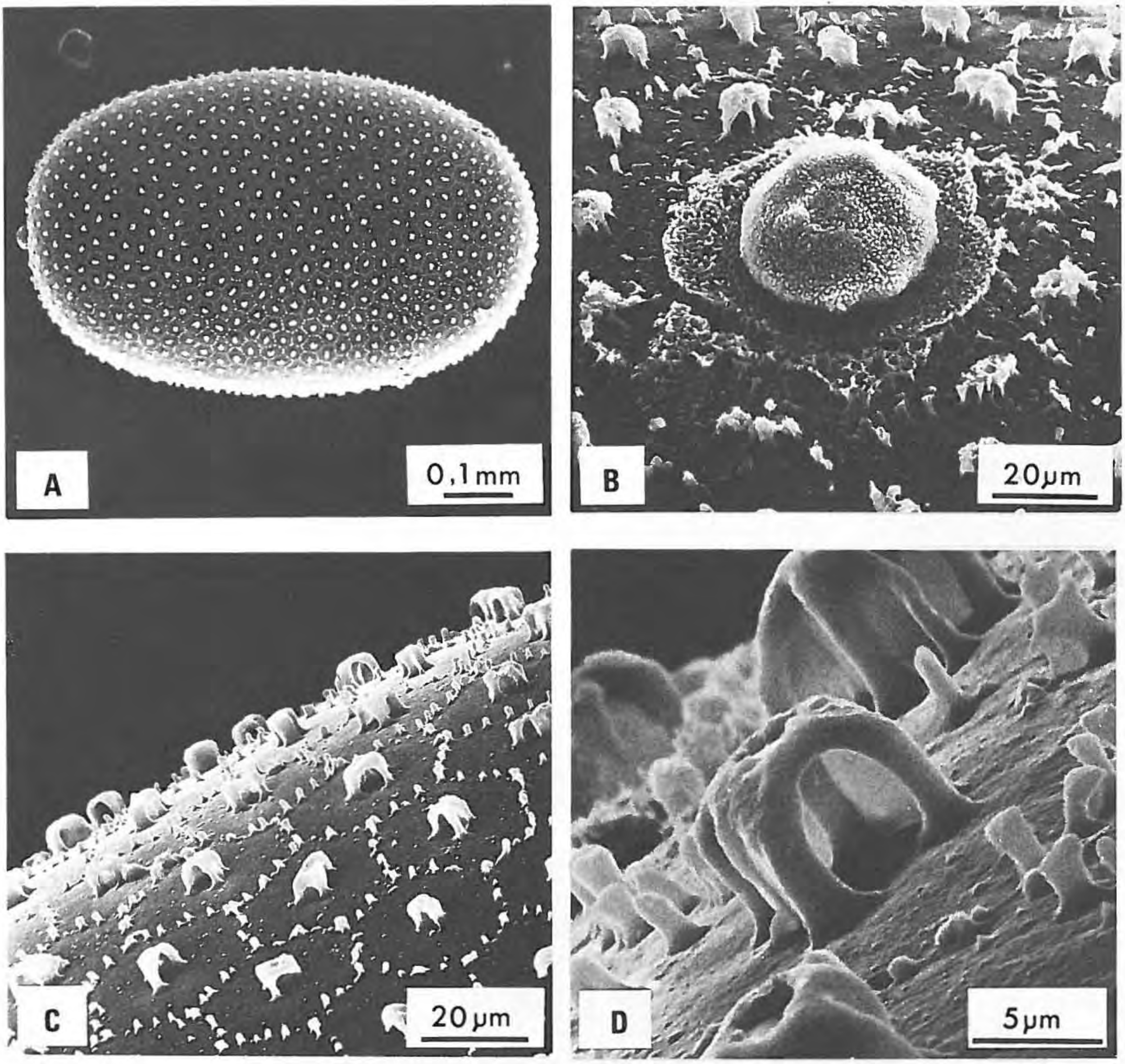


Fig.33 A - D. Egg of Tjederia brevicornis spec. nov. A. Whole egg, lateral view. B. Plastron-like structure covering the micropyle. C. Aeropyles on chorion. D. Detailed structure of aeropyles.

Distribution (fig. 30).

Tjederia brevicornis appears to be confined to a small area of South West Africa. It is abundant in the central highlands around Windhoek and the Khomas Hochland which is the escarpment area between the highlands and the Namib desert. The species has been recorded as far north as the Erongo mountains and occurs in the arid transitional area between the Khomas Hochland and the Namib desert. This transitional area is known as the Pro-Namib.

Remarks.

Tjederia brevicornis adults are characterized by antennae which are shorter than those of other southern African species, with the exception of *C. walkeri* and *C. parva*, and the species is named accordingly. It has been assigned to the genus *Tjederia* Mansell, as the adults resemble those of *T. namaquensis* more closely than the species in *Laurhervasia*, *Thysanocroce* or *Concroce*. *Tjederia brevicornis* is not sufficiently distinct from *T. namaquensis* to justify the establishment of a separate monotypic genus. The males of both *T. brevicornis* and *T. namaquensis* have tergite 9 entire, the distal lobes of the parameres are similar in shape and the parameres have long proximal projections. The structure of the distal paramere lobes in these two species are less complex than the condition prevailing in species of *Laurhervasia*, *Thysanocroce* and *Concroce*. I feel that the morphology of the paramere distal lobes provide significant taxonomic data because of their obviously important role in the mating procedure. They could provide the major mechanical barrier preventing hybridization between species. The wings of the males in both species of *Tjederia* are narrow, with only 2 crossveins before Rs, and the hindwings lack bullae. In *Laurhervasia* and *Thysanocroce*, which could be confused with *Tjederia*, there are three crossveins before Rs and bullae are usually present in the hindwings of males. *Concroce* is distinct and cannot be confused with *Tjederia*.

The principal differences between the two species of *Tjederia* occur in the immature stages. In *T. namaquensis* the prothorax is very long (more than 3½ times the head length) whereas in *T. brevicornis* it is approximately 3 times the head length. The shapes of the heads also differ, being longer than wide and strongly tapered in *T. namaquensis* and wider than long in *T. brevicornis*. However, such variations also prevail between species of *Laurhervasia* which is a circumscribed genus. The eggs of *T. namaquensis* and *T. brevicornis* are very different in that the aeropyles on the eggs of the latter (fig. 33D) are more elaborate than those of *T. namaquensis* (see Mansell, 1977, fig. 11. Copy bound into thesis). It has been decided that the larvae are not sufficiently distinct, and that there is insufficient information on the taxonomic importance of the egg to support the assignment of the two *Tjederia* species to separate genera. The larvae of *T. brevicornis* exist in two colour forms, a situation reminiscent of that recorded for *Pterocroce storeyi* from Egypt, by Withycombe (1923). The larvae occurring in the central highlands near Windhoek and the Khomas Hochland are dark in colour and heavily mottled whilst those from the Pro-Namib are buff in colour with a distinct black band across the metatergites. The highland forms inhabit caves with dark substrates whereas the Pro-Namib larvae occur in caves where the substrate is composed of pale granitic sand. The adults of the Pro-Namib forms are also paler in colour than their highland counterparts. Initially these two forms were regarded by me as possibly different species, but morphological and morphometric data tended to contradict this. They were shown to be the same species through breeding experiments in which adults from the two forms mated with each other and produced viable eggs.

In *T. brevicornis* it has been established that the sex of the individual can be predicted in the larval stage on the basis of size. Although there is some size overlap, statistical comparisons have revealed that the larvae of females are significantly larger, for four parameters measured, than their male counterparts. Larval measurements of 46 reared males and 38 females were compared statistically and the results are given in table 10.

In the Crocinae, female larvae are generally larger than the males and this is particularly evident in *T. brevicornis*, the availability of a large number of specimens of *T. brevicornis* has provided sufficient data to demonstrate this statistically.

Table 10. Comparison of measurements (mm) for third instar *T. brevicornis* larvae from which male and female adults were reared.

Parameter	Sex	N	Mean	Range	SD	"t"	°of F	P
Head width	♂♂ ♀♀	46 38	0,86 0,92	0,80-0,92 0,88-0,96	0,028 0,028	9,699	82	<0,001
Head length	♂♂ ♀♀	46 38	0,78 0,83	0,68-0,84 0,80-0,88	0,032 0,029	7,956	82	<0,001
Mandible length	♂♂ ♀♀	46 38	1,09 1,16	1,00-1,16 1,12-1,28	0,036 0,041	8,321	82	<0,001
Prothoracic length	♂♂ ♀♀	46 38	2,11 2,26	1,92-2,28 2,00-2,44	0,082 0,090	7,809	82	<0,001

4.5 Illustrated dichotomous key to the southern African Crocinae.

The key is arranged into six sections

(A) Key to the genera - adults (pg. 151).
(B) " " " " - larvae (pg. 152).
(C) " " " genus *Laurhervasia*, adults (pg. 154).
larvae (pg. 155).
(D) " " " " *Thysanocroce*, adult and larva (pg. 155).
(E) " " " " *Concroce*, adults (pg. 156), larvae (pg. 157)
(F) " " " " *Tjederia*, adults and larvae (pg. 158)

The illustrations are not all reduced to comparable scales, so should not be taken as an indication of relative sizes.

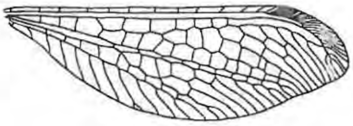
(A) KEY TO THE GENERA - ADULTS

Thorax with longitudinal black stripe below wings

CONCROCE Tjeder (pg. 156)

Thorax without longitudinal black stripe below wings

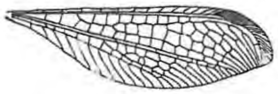
Three crossveins usually present between R and M before Rs



Parameres with ventral projections in distal lobes

Bullae usually present in hindwings of males

Two crossveins usually present between R and M before Rs

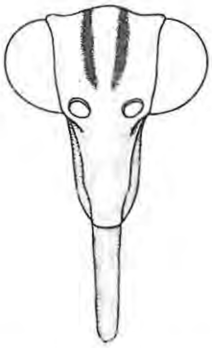


Parameres lacking ventral projections in distal lobes

Bullae absent

TJEDERIA Mansell (pg. 158)

Head with two distinct parallel stripes on vertex

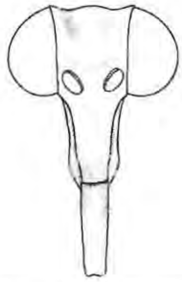


Parameres lacking proximal projections
Gonarcus without entoprocesses

Males with bullae in hindwings
Only recorded from South West Africa

THYSANOCRUCE Withycombe (pg. 155)

Head usually with diffuse markings or macules on vertex



Parameres with proximal projections
Gonarcus with entoprocesses

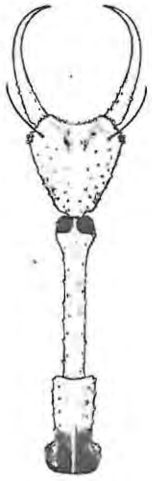
Males with bullae in hindwings

LAURHERVASIA Navas (pg. 154).

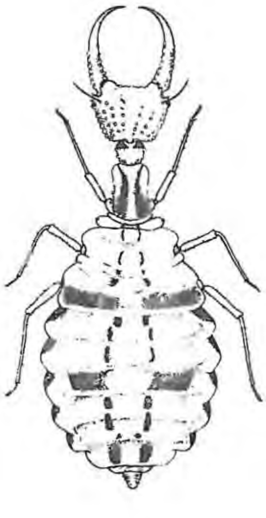
(B) KEY TO GENERA - LARVAE

Prothorax short, less than twice the head length

Prothorax longer than twice the head length

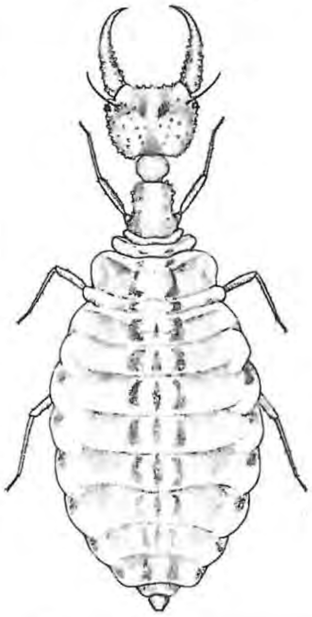


Larva heavily marked with black or brown



CONCROCE Tjeder (pg. 157)

Larva pale in colour



THYSANOCROCE Withycombe (pg. 155)

Prothorax shorter than three times the head length

continued overleaf

Prothorax very long, greater than three times the head length

TJEDERIA Mansell (pg. 158)

continued from previous page

Head darkly marked in clypeal region, enclosing pale oval patch. Larvae darkly coloured or pale with stripe across metatergites. Only recorded from South West Africa

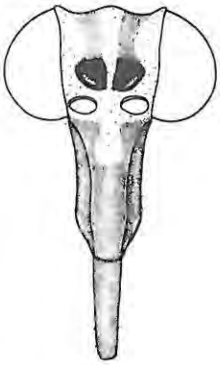
TJEDERIA Mansell (pg. 158)

Head usually with distinct triangular marking on dorsal surface. Pale oval patch on clypeal region not enclosed by dark markings.
  Head strongly tapered in some South West African populations

LAURHERVASIA Navas (pg. 155)

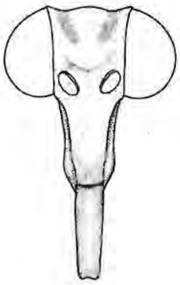
(C) KEY TO THE GENUS LAURHERVASIA (ADULTS)

Body dark brown in colour, vertex of head with a pair of stripes and shiny macules above antennal bases. Bullae prominent, more than 2 mm in length



Laurhervasia rhodesiae Tjeder

Body light brown in colour, markings on head variable, but shiny brown macules not present



Large species, forewing length about 14 mm, hindwing about 40 mm. Bullae large, longer than 1 mm

Small species, forewing length about 12 mm, hindwing 35 mm. Bullae in males small, less than 1 mm in length, or absent. This species is confined to South West Africa

Laurhervasia namibica spec. nov.

Antennae long, about one third the length of the forewing. Rostrum longer than 1,5 mm. Only recorded from the northern Transvaal

Laurhervasia transvaalensis spec. nov.

Antennae about a quarter the length of the forewing. Rostrum usually less than 1,5 mm. Recorded from the Cape Province and South West Africa

Laurhervasia setacea (Klug)

(C) KEY TO THE GENUS LAURHERVASIA (LARVAE)

Prothorax longer than two and a half times the head length, but less than three times

Prothorax two and a half times the head length or less

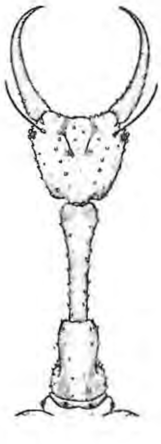
Head brown with three light patches, one across the dorsal midline and two adjacent to tentorial pits. Only known from northern Transvaal

Laurhervasia transvaalensis spec. nov.

Head darkly marked with brown, a distinct triangular marking usually present on dorsal surface

Laurhervasia setacea (Klug)

Head quadrate, pale in colour, body coloration pale. Only known from South West Africa



Laurhervasia namibica spec. nov.

Head quadrate, brown in colour, with three pale areas on dorsum. Body brown and mottled. Known from northern Transvaal, Rhodesia and Malawi

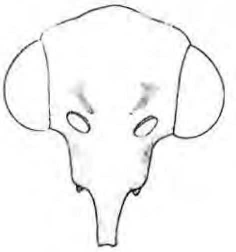
Laurhervasia rhodesiae Tjeder

(D) GENUS THYSANOCROCE

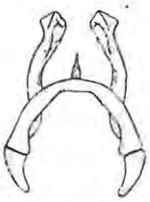
There is only one species in this genus, *Thysanocroce damarae* (MacLachlan). The characteristics are given in the key to genera on pages 151 and 152.

(E) KEY TO GENUS CONCROCE (ADULTS)

Rostrum short, less than interorbital distance across vertex

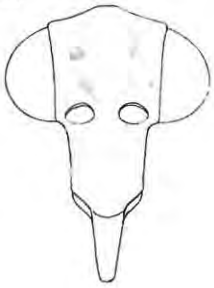


Parameres of male genitalia symmetrical



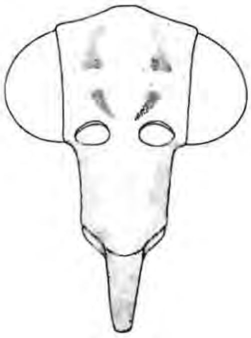
Concroce walkeri Tjeder

Rostrum longer than interorbital distance across vertex



Parameres of male genitalia asymmetrical

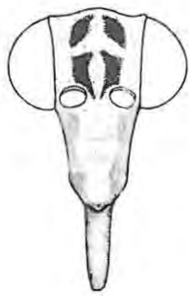
Rostrum less than one and a half times the interorbital distance



Body yellow in colour, antennae shorter than prothoracic leg.

Concroce parva spec. nov.

Rostrum longer than one and a half times the interorbital distance

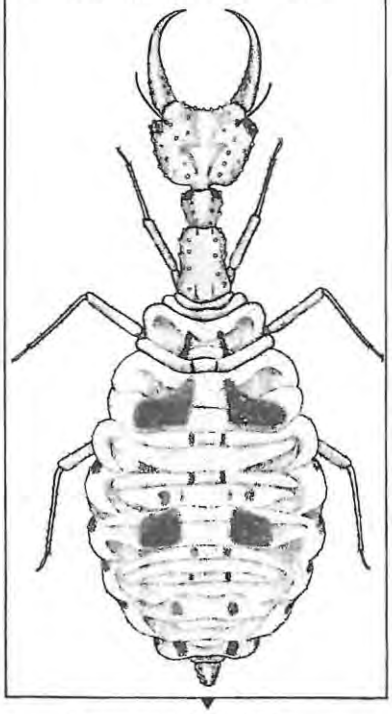


Body dark in colour, antennae longer than prothoracic leg.

Concroce capensis Tjeder

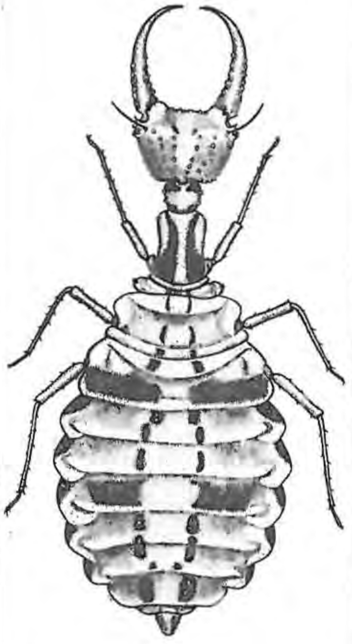
(E) KEY TO THE GENUS CONCROCE (LARVAE)

Body with brown markings



Concroce walkeri Tjeder

Body with black markings



Mandibles longer than prothorax

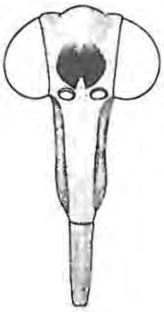
Concroce parva spec. nov.

Mandibles shorter than prothorax

Concroce capensis Tjeder

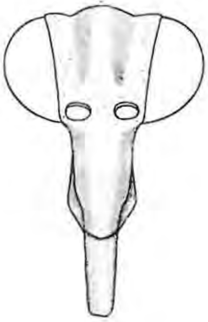
(F) KEY TO THE GENUS TJEDERIA (ADULTS)

Rostrum longer than twice the interorbital distance. A single black macule is situated above the antennal bases. Antennae longer than the prothoracic legs



Tjederia namaquensis Mansell

Rostrum length less than twice the interorbital distance. Antennae short, less than the length of the prothoracic legs



Tjederia brevicornis spec. nov.

(F) KEY TO THE GENUS TJEDERIA (LARVAE)

Prothorax longer than three and a half times the head length. Head strongly tapered

Tjederia namaquensis Mansell

Prothoracic length less than three and a half times the head length. Head not strongly tapered. Only known from central South West Africa

Tjederia brevicornis spec. nov.

5. DISCUSSION.

5.1 Systematics.

Systematic theories. In a study of this nature there are two factors which should be clearly comprehended from the outset. The first is exactly what is understood by the term species and secondly, the systematic philosophy one should adopt to interpret the relationships of the taxa under review.

Many species definitions have been proposed and discussed (see Mayr, 1969) but only two, the morphological species concept and the biological species concept are important. Despite advances in systematic theory and techniques, descriptions of the majority of insect taxa are based on morphological criteria alone. This is inevitable as preserved specimens are often all that is available to taxonomists. There is merit in distinguishing taxa on morphological features as the genotypic composition of a species is reflected in the phenotype (Mayr, 1969) which can provide much information on the taxon. The morphological species concept has, and will continue to play an important part in systematics but should not be considered as the final stage of any systematic study, a point which will be elaborated below.

The biological species concept as defined by Mayr (1969) and defended by White (1978) is the most widely recognised idea of what constitutes a species and the one to which I subscribe. Mayr (1969) defines species as "groups of interbreeding populations that are reproductively isolated from other such groups". According to Mayr (1969) a species is a gene pool which is protected from harmful gene flow from other species by devices termed isolating mechanisms.

In the present study, the species has been regarded as a living unit composed of many individuals from different local populations. These populations have been sampled and investigated to obtain biological and morphological features from all stages of the life cycle, and these data have been used to define the characteristics of the total population or species. Taxa based on morphological criteria only are considered provisional, and the contribution of the morphological species concept has been to enable taxonomists to describe species from a few specimens. In so doing they reveal the existence of an undescribed gene pool, exposing it for detailed study.

In recent years, systematics has stimulated the development of several philosophies which attempt to formulate a stable system of biological classification. These philosophies endeavour to overcome subjective classificatory methods employed by practising taxonomists and to introduce objectivity into systematics (Sokal & Sneath, 1963). Three major schools of systematic theory have developed and are currently recognised, they are; (i) the cladistic or phylogenetic approach as developed by Hennig (1966), (ii) the phenetic approach involving numerical techniques (e.g. Sokal & Sneath, 1963) and (iii) the evolutionary approach supported by Mayr (1969).

According to the philosophy of cladistic systematists, relationships among organisms are based upon joint possession of derived (advanced) features which are termed apomorphic. Species which share apomorphic features are related, and the greater the number of shared apomorphic characters (synapomorphies), the closer the relationship of the organisms, and from this, hierarchies and classifications can be established (Bock, 1973). Two species derived from the same ancestral form are termed "sister-species" and they are more closely related to one another than to any others as they share a line descent which is common only to them (Brundin, 1966). The relationships between organisms is therefore determined by phylogenetic branching and can be regarded as genealogical (Bock, 1973). This approach considers shared plesiomorph (primitive) characters, or synplesiomorphies, as insignificant in determining relationships (Brundin, 1966), and hence general similarity between organisms is unimportant.

By contrast, the phenetic approach determines relationships on the degree of overall similarity. Greater similarity between organisms indicates closer relationship and a smaller amount of evolutionary change from the common ancestor (Bock, 1973). Numerical techniques necessitating the use of computers, are used to determine the degree of similarity between these organisms.

The evolutionary approach embodies elements from both the cladistic and phenetic philosophies and has been termed the "eclectic approach" by Bock (1973). Evolutionary systematics attempts to elucidate the sequence of events in the evolution of each species as determined by common possession of derived features which indicate the origin and branching sequences in each lineage. It also evaluates genetical similarity between organisms based on their degree of morphological similarity. Greater similarity between organisms implies a smaller amount of evolutionary modification from the common ancestor, and the possession of a greater amount of shared genetical material (Bock, 1973).

These philosophies have had a profoundly beneficial effect upon systematic thought and practice in that systematists have been obliged to examine and critically evaluate their taxonomic practices. On the other hand, proponents of the various schools of thought have tended to expound their theories to the exclusion of all others, resulting in ignorance of useful attributes embodied in other approaches. There is a realization among systematists however, that the philosophical approaches can complement one another and that they are not necessarily irreconcilable. Key (1974) has summarized the situation with the statement "The conclusion is now inescapable that there is no 'best' classification, much less a 'correct' classification. We have to be content to achieve a 'good' classification, and this must incorporate criteria of convenience as well as phenetic distance".

In this study, the three taxonomic philosophies have been evaluated to decide upon the best theory for a study of myrmeleontoid systematics, and an approach based on the school of evolutionary systematics was adopted. This system enables one to utilize ideas from both the cladistic and phenetic schools whilst not being limited by the rigorous principles imposed by the latter two theories.

The phylogenetic or cladistic approach is an ideal theory but is difficult to apply in practice and with confidence. In most groups, certainly the Myrmeleontoidea, the evaluation of characters as apomorphic or plesiomorphic is still speculative, especially where the group has not been exhaustively studied or where there is a poor fossil record. Once an interpretation is open to speculation, it becomes subjective and, in this regard, the cladistic approach becomes as unreliable as the conventional methods it attempts to supercede.

The phenetic philosophy requires, that as many characters as possible, all with equal status be used in determining the relationships between organisms, based on overall similarity. An inherent weakness in this philosophy is that it implies that characters must not be selected on the basis of a prioriweighting, and yet it does exactly that. It is impossible to record all the characters of an organism so the obvious features are automatically "selected" in preference to obscure ones. As Key (1974) has indicated, different classifications may result when different sets of characters are used, e.g. adult or larval. Also, the observable features are usually morphological and, as Mayr (1969) has pointed out, phenetic classificaton exaggerates small phenotypic differences in the same interbreeding population whilst it cannot deal with the existence of sibling species which are morphologically similar but reproductively isolated. Notwithstanding these criticisms, the phenetic approach could be used to indicate relationships, provided data were obtained from as many facets of the organisms' life cycle as possible. In the case of large groups of organisms, numerical methods could indicate generic trends, but these indications should not be regarded as final but should be compared with evolutionary data as well. A numerical analysis of the southern African Crocinae was not attempted as they are a small group and characters could be compared directly.

Taxonomic difficulties. Difficulties encountered in resolving the taxonomy of the family Myrmeleontidae are due mainly to inadequate descriptions of genera and species. Most descriptions are superficial with excessive emphasis on wing venation and colour patterning, which is often variable. There is not one description of a southern African taxon which provides information on the internal genitalia of the male. These deficiencies have resulted in the creation of numerous synonyms, particularly through the careless work of Longinos Navas. Because most descriptions are inadequate, type specimens have to be examined and difficulties are encountered in this regard as well. Most type material pertaining to southern African species is held in overseas institutions, and trustees of these institutions are justifiably reluctant to risk this material being damaged by postage. Some type specimens relevant to this work are held in museums in East Germany and for political reasons access cannot be gained to study these specimens. Also, many types have been destroyed or lost, such as those destroyed by fire in Hamburg during the second world war.

The main difficulty therefore lies in correct identificaton of species and this is aggravated by descriptions that are scattered in numerous, often obscure publications. As yet, no monograph had consolidated this information and the catalogue in appendix 2 is the first attempt to summarize the literature relevant to the southern African Myrmeleontidae. Larval characteristics have previously never been used in myrmeleontid systematics, and a practical difficulty encountered in this regard is that the larvae of most non-pit-building species are difficult to rear in captivity.

In the Nemopteridae, the taxonomic difficulties encountered are different from those presented by the Myrmeleontidae. The comprehensive monographic revision of the Nemopteridae (Tjeder, 1967) has eliminated the preliminary problems, still prevailing in the Myrmeleontidae, and provides a basis for a more detailed study of the group.

In the Crocinae, the significance of some morphological characters has proved problematical, in particular the bullae and the genitalia of the males. The presence or absence of bullae in wings of the males has been used to characterize genera (Tjeder, 1967; Hölzel, 1975) but during this study the taxonomic and evolutionary importance of bullae has been questioned. Males in the genus Laurhervasia possess bullae in the hindwings but in L. namibica they are very small and in specimens from two localities they are lacking. Apart from this feature, specimens from these two localities are identical to all other conspecific individuals. It would be difficult to assign the abberant specimens from the two localities to a different species on this single character. In this case the presence or absence of bullae has been interpreted as a feature of little taxonomic significance. It is also impossible to use bullae as indicators of evolutionary lineages in the southern African Crocinae as they cannot be considered apomorphic or plesiomorphic. Adult Concroce lack bullae and the larvae have short prothoraxes, a larval condition considered to be plesiomorphic by Hölzel (1975) and with which I agree. Adults of Tjederia also lack bullae but the larvae have elongated prothoraxes, a condition which is apomorphic. By contrast, the adults of T. damarae have bullae but the larvae have short prothoraxes. The possession of a short or long prothorax is certainly more important phylogenetically and taxonomically, so although the presence or absence of bullae is a convenient character to use, their diagnostic value should not be overestimated.

Male genitalia are important in distinguishing genera and, in most cases, species of Crocinae. The male genitalia in species of Laurhervasia all conform to a similar pattern and species distinction is difficult.

The three species of Concroce are readily distinguishable on the basis of male genitalia but are difficult to interpret phylogenetically. Males of C. capensis and C. parva have asymmetrical parameres and identical larvae and eggs, which infers a close relationship, whereas C. walkeri has symmetrical parameres and the larvae and eggs differ from the first two species. Concroce parva adults and those of C. walkeri are very similar in body coloration, antennal length, wing structure, rostrum length and general appearance, and quite distinct from C. capensis, so it is difficult to interpret their true relationship.

From this it can be seen that the Crocinae have many, apparently diagnostic, characters that are contradictory to one another, making it difficult to interpret evolutionary trends for taxonomic purposes.

The importance of immature stages in systematics. In this study, detailed attention has been give to the immature stages, in addition to the adults, as essential systematic data can be provided by the early stages of the life cycle.

In the Myrmeleontoidea the larva is the dominant phase of the life cycle as regards longevity, and as they are exposed to environmental conditions for far longer than the adults, the major influence of selection pressure could be expected in this stage. The larvae will adapt and the adaptations become manifested in their morphological, behavioural, physiological and biological characteristics through modification of the genotype. The adults usually occupy different habitats to the larvae and may be subjected to a different set of selection pressures causing them to evolve along different lines from the larvae (Withycombe, 1925; van Emden, 1957). It is these differences however, which complement each other in characterizing a particular taxon. Any adaptations evolved by the larvae must be transferred through the adult genotype as there is no gene flow between larvae. Conversely, any adaptations evolved in the adult must be perpetuated through the larva.

To understand a species in its entirety therefore, it is necessary to consider all stages of the life cycle. By concentrating only upon the adult stage, as has been the approach of most taxonomists many diagnostic characters may, and have been ignored, as is the case in the southern African Myrmeleontoidea, where the immature stages have hitherto been totally neglected. This is not entirely the fault of the earlier taxonomists, as adult specimens were usually all that was available to them and many excellent studies were produced on this basis (e.g. Tjeder, 1967). Despite this, the emphasis on the adult stage has yielded only a portion of the potential data. It is the task of the modern systematist to obtain this missing information on immature stages and to improve upon the classifications that are available.

Prior to this study little was known about larval Myrmeleontidae and nothing at all concerning larval Nemopteridae from southern Africa, and data on immature stages had never been utilized to elucidate their systematics. The study has now provided information on the immature stages of both families and these data have contributed towards a better understanding of their systematics as the following examples may illustrate.

In the Myrmeleontidae, known larvae provided morphological and biological criteria for distinguishing genera. The family can be divided into two groups on the basis of larval biology; those which construct pits and those which do not. There are three genera of pit-building myrmeleontids known from southern Africa, *Myrmeleon*, *Hagenomyia* and *Cueta*, all three genera described only as adults. A study of their larvae revealed that *Myrmeleon* and *Hagenomyia* are very similar in morphology, and the location and physical properties of their pits, and are probably congeneric. *Cueta*, by contrast, is quite distinct, constituting a very circumscribed group, despite the adults being morphologically similar to *Myrmeleon*.

In the non-pit-building species, larvae in the subfamily Palparinae provided morphological data which could be used to define genera. Several attempts which have been made to subdivide the genus *Palpares* on features of wing venation or even the shape of the wings, and genera which have been established from *Palpares* include *Golafrus* Navas, *Lachlathetes* Navas, *Crambomorphus* MacL., *Nosa* Navas and *Palparellus* Navas. The genus *Palpares* does require subdivision and the known larvae of the southern African Palparinae could provide morphological evidence to support such a division. In all, nine species of larval Palparinae have been collected, and although six have not been positively correlated with the adults, they can be divided into five categories. These categories are based on the number of mandibular teeth, the shape of the head and body coloration. In the first category, larvae have 3 teeth, the distal tooth being the shortest, a quadrate head and a dark body. This group includes *Palpares speciosus*, and what is probably *P. annulatus,* and their larvae are morphologically similar to the illustration of *P. libelluloides* L. from Europe (Redtenbacher, 1884). The second group comprises one larva with 3 teeth of which the distal tooth is longest, a quadrate head and a dark mottled body and is probably the larvae of *Crambomorphus sinuatum*. In category three, the larvae have 4 teeth, an elongated head and a reddish or greenish mottled body, and comprises *P. inclemens*, and what is probably *P. immensus*. The fourth category includes the larva of *Palparidius capicola* which has 5 mandibular teeth, an elongated head and white body with longitudinal markings, and two unidentified palparine larvae from the Namib desert also belong in this category. The last category is represented by a large white larva with black markings on the body, an elongated head and 6 mandibular teeth and is probably the larva of *Golafrus oneili*.

These preliminary observations require support from further collecting but it is evident from this that there are definite morphological trends in the larvae which indicate evolutionary divergence. These trends could provide evidence to support generic differentiation in the systematics of the group.

In the Nemopteridae there is not yet much information on the immature stages of the subfamily Nemopterinae but in the Crocinae all descriptions and delimitation of genera and species in this study have been based on larval as well as adult characters. Larvae of all the known crocin species from southern Africa have been described and have provided data for the characterization of taxa as the following examples will illustrate. Tjeder (1967) recognised two genera, *Laurhervasia* and *Concroce* on the basis of adult morphology, and the subsequent discovery of their larvae has supported this. Larvae in the genus *Laurhervasia* all have elongated prothoraxes and are cave dwellers, whereas larval *Concroce* have short prothoraxes and live in detritus under rock overhangs. By contrast, the discovery of the larvae of *Thysanocroce damarae* has necessitated its removal from the genus *Laurhervasia* to *Thysanocroce*, a genus which has been reinstated to accommodate *L. damarae*. Although the adults of *T. damarae* are similar to those of *Laurhervasia,* the larvae are so distinct morphologically and biologically that its classificaton in the genus *Laurhervasia* is precluded. The existence of an undescribed genus (subsequently *Tjederia* Mansell) was first detected through characteristics of the larvae and confirmed when the adults were reared. The larvae of *Tjederia* provide an example of possible incipient speciation in the two colour forms of *T. brevicornis* which exist in South West Africa.

The use of larval features is also important in the tracing of phylogenetic lineages in the Myrmeleontidae and Nemopteridae.

5.2 Phylogenetic considerations.

The majority of pit-building species of Myrmeleontidae belong to the genus Myrmeleon, which is highly successful and cosmopolitan. Despite their obvious specialization they are, in my opinion, an ancient group as the pit-building adaptation must have evolved sometime before, or during the Cretaceous period. It seems that the pit-building taxa specialized and radiated very early becoming an extremely successful group which still persists. Although the pit-building habit enabled some Myrmeleontidae to specialize and proliferate very early in the history of the family, it has also placed limitations upon these forms. Coupled with pit-building is the reduction in capacity for forward locomotion, restricting mobility. Also, their size is limited as a large pit is conspicuous rendering the occupant vulnerable to predation. The free living forms which are not bound to a pit-building existence, however, have been able to radiate and diversify and they are now numerically superior to the pit-building taxa.

The non-pit-building myrmeleontid fauna of the three southern continents differs at the genus and species levels and it is evident from this that the radiation of the non-pit-building taxa must have continued independently after the disintegration of Gondwanaland, for reasons which are discussed below. In this regard, the numerically dominant African group, the subfamily Palparinae, probably only evolved after the Cretaceous, when Africa, Australia and South America were separated from each other. The Palparinae have apparently evolved on the African continent and have spread into southern Europe and across into India. The genus Palpares also occurs on Malagasy but the species are different from those of Africa, suggesting that they have evolved subsequent to the separation of Malagasy from Africa, probably in the late Cretaceous to early Tertiary (about 65 million years ago).

The subfamily Palparinae is not represented in South America (Stange, 1970) or Australia (Riek, 1970). It is my contention that the Palparinae are a recent group of Myrmeleontidae and not the most ancient as is generally believed (e.g. Esben-Petersen, 1918; Hölzel, 1972). If the Palparinae were ancient, the subfamily or closely related genera could be expected to occur in Australia or South America, but they do not. In the larvae, the development of mandibular teeth provides additional support for the Palparinae being considered a recent group. In southern African species the tooth number varies between three and six and the development of large numbers of mandibular teeth could be considered apomorphic as the Nymphidae only have one tooth whilst most of the other Myrmeleontidae, Ascalaphidae and Stilbopterygidae have three. The conclusion of earlier authors that the Palparinae are an archaic group is based on one venational character (vein 1A does not fuse with Cu2 in the forewings) and must surely be outweighed by these other considerations.

Members of the subfamily Dendroleontinae occur throughout the world, being well represented in South and North America (Stange, 1967, 1970), Australia (Riek, 1970) and also occurring in southern Africa. They probably constitute the most archaic Myrmeleontidae as was already indicated by Tillyard (1915, 1916a). The known larvae of the Dendroleontinae resemble those of the

Stilbopterygidae and Ascalaphidae in their morphology. The larva of *Tricholeon nigripes* from South Africa and the European *Dendroleon pantherinus* have lateral setose processes on the thorax, and the mandibles are similarly shaped to those of the Stilbopterygidae (see Riek, 1976) and Ascalaphidae. The larvae of *D. pantherinus* and *Glenurus gratus* (Say) (from North America) live in holes in trees (Redtenbacher, 1884; Stange, 1970) which can be equated with the arboreal habit of larval Ascalaphidae. Larvae of *T. nigripes*, and several species in the Dendroleontinae from North America (Stange, 1970), live in caves which is a departure from the normal myrmeleontid mode of existence. I believe that the Dendroleontinae are among the most primitive of the Myrmeleontidae and the most closely related to the Stilbopterygidae, from which the Myrmeleontidae were derived.

For the reasons outlined above, I maintain that the arrangement of the Myrmeleontidae into Archaeomyrmeleonida and Neomyrmeleonida by Esben-Petersen (1918) is invalid. The Palparinae which constitute the Archaeomyrmeleonida are not as archaic as supposed by Esben-Petersen whilst the Neomyrmeleonida contain some of the most primitive forms such as the Dendroleontinae.

In the Nemopteridae the subfamily Nemopterinae can be considered more archaic than the Crocinae. The wing venation is more generalized than that of the Crocinae as it resembles the condition prevailing in the Nymphidae (Hölzel, 1975). Also, the larvae of *D. vansoni*, *C. hutti* (from Australia), *Semirhynchia* sp. and another uncorrelated species in the Nemopterinae are all myrmeleontid-like in appearance. Their habitats are also similar to those of the

Myrmeleontidae, the larvae of *Semirhynchia* living in small caves, whilst all the others are sand dwellers.

The Crocinae probably evolved from the Nemopterinae through a cave and detritus-dwelling form such as *Semirhynchia*, the exploitation of the cave habitat leading to a reduction in size and the extreme specialization of the hindwings. These modifications have equipped the insects for flight in confined spaces enabling them to take advantage of the equable habitats provided by small caves and hollows. The hindwings have become modified to function as tactile "sensors"; when crocins fly the body is held vertically and the wings sweep backwards and forwards in an arc. If the wings touch anything during this flight pattern, appropriate evasive action is taken.

The Crocinae whose larvae have short prothoraxes and are detritus dwellers (*Thysanocroce*, *Concroce*), provide the link between the Nemopterinae and the majority of crocin species, in which the larvae have elongated prothoraxes and are cave dwellers. This is supported by the fact that the larva of *T. damarae*, although smaller, is very similar morphologically to *Semirhynchia* sp. (Nemopterinae). The species in the genus *Concroce* are mainly montane in habit (Tjeder, 1967) whilst those of *Laurhervasia* and *Tjederia* often occur in hot arid areas. It is possible that the species now inhabiting the arid regions evolved from the montane forms and have subsequently been able to colonize the arid areas through physiological and morphological adaptations. For example they are able to live in fine dust in well protected caves and this has been facilitated by the development of sieve plate coverings to the spiracular openings (fig. 10F). These structures prevent dust particles from entering the trachea and may also reduce water loss. The species which live in detritus do not have these elaborate coverings to the spiracular openings (fig. 10E). A second morphological adaptation enabling Crocinae to inhabit caves may have been the development of an elongated prothorax. Although a proteolytic enzyme is injected through the mandibles and maxillae of crocin larvae, the prey is not immediately killed, but struggles before succumbing. During this brief period the soft abdominal cuticle of the crocin larva is exposed to injury by the mandibles of the prey, leading to rapid death of the crocin through desiccation. This was observed several times in the laboratory where larvae were injured by prey which was too large. In larval Myrmeleontidae, prey is grabbed on the surface and dragged under immediately, facilitating its rapid subdual. The abdomen of the myrmeleontid remains buried during prey capture and the backward movement of the larva through the sand also has the effect of forcing the prey away from the vulnerable abdomen of the predator.

Crocinae with short prothoraxes live buried amongst plant detritus and this affords protection to the body of the larva. By contrast, the cave-dwelling Crocinae live exposed upon the surface, as many of the caves that they inhabit have only a thin layer of dust overlying a rocky substrate. Consequently these Crocinae are the only species in the Myrmeleontidae and Nemopteridae whose body is completely exposed during prey capture. It is probable that an elongated prothorax has been selected for, to keep the larval mandibles, and hence the prey, away from the body of the predator thereby protecting it from the struggling prey. This has enabled Crocinae to live exposed on the surface, allowing them to exploit the favourable environment provided by small caves. There are doubtless other reasons for the specialized elongation of the prothorax, as selection pressures to produce this bizarre adaptation must have been severe.

As regards the southern African Crocinae therefore, it may be concluded that the genera Thysanocroce and Concroce with short prothoraxes are more closely related to the Nemopterinae, from which they were derived, whilst Laurhervasia and Tjederia with their elongated prothoraxes are more specialized.

5.3 Zoogeography.

World distribution.

A study of any group of organisms which includes a consideration of their phylogeny and zoogeography must take into account former distribution patterns and factors which have modified them. The similarities in the myrmeleontoid faunas of the southern continents, Africa, South America and Australia are only explicable in terms of the existence of former intercontinental connections.

In the Myrmeleontidae, the genus Myrmeleon is cosmopolitan, occurring throughout the world and is characterized by the pit-building habit of the larvae which possess similar morphological attributes and behavioural features, even between species from different continents. It is unlikely that the similar characteristics of all Myrmeleon species, in particular the specialized pit-building adaptation, could have evolved independently on widely separated land-masses. The subfamily Acanthaclisinae is represented throughout the world by a number of genera which are similar to one another, for example, Acanthaclisis occurs in Europe, Asia and Australia, Vella Navas in North and South America, and Centroclisis Navas in Africa and Malagasy. The subfamily Macronemurinae is represented in Australia by about 40 species in 14 genera (Riek, 1970) and in South Africa by about 6 species in the genus Macronemurus Costa. Representatives of the Dendroleontinae are widespread with 8 genera occurring in Australia (Riek, 1970), at least 3 (Cymothales Gerst., Tricholeon Esb.-Pet., Bankisus Navas) in southern Africa and several genera (e.g. Elachyoleon Esb.-Pet., Glenurus Hagen etc.) in North and South America (Stange, 1970). These few examples serve to indicate that although the myrmeleontid faunas of the different areas may differ at the genus and species level, their general composition is similar. Differences recorded at the levels of these two categories (genus and species) have probably evolved on each continent subsequent to its isolation from the ancient land-mass, Gondwanaland.

Both subfamilies of the Nemopteridae occur on the three southern continents and this distribution suggests a Gondwanaland origin for them as well. The Nemopteridae are highly specialized, particularly as regards the development of the hindwings and specimens from different continents are morphologically and biologically very similar. This is especially pertinent to the subfamily Crocinae about which there is more information than the Nemopterinae. Adult Crocinae are delicate and ephemeral with low vagility, attributes which reduce potential for long range dispersal. The larvae are characterized by unique morphological features, such as elongated prothoraxes in some species, and very specialized habitat requirements in all. The larvae are now known from three of the four distribution centres mentioned in chapter 2; North Africa, the Middle East and India (Imms, 1911; Eltringham, 1923; Withycombe, 1923; Pierre, 1952; Hafez & El Moursy, 1964), from southern Africa (Mansell, 1976, 1977) and recently, during 1978, Moran and Zimmermann have collected larvae in Argentina, Bolivia and Peru, which are now in my collection.

Immature stages of the Crocinae are, as yet, unknown from Australia, the fourth distribution centre. Known larvae from all areas are similar to each other in morphology and biology in that most species have elongated prothoraxes and a cave dwelling habit. Other species have shorter prothoraxes, such as those in the genera Croce MacLachlan from India, Klugina Navas from Egypt, Concroce and Thysanocroce from southern Africa, and an undescribed species discovered by Moran and Zimmermann in Argentina.

It is unlikely that these insects could have dispersed recently to their present positions across the expanse of oceans from one distributional centre. The explanation for the present recorded distribution, along with the other Myrmeleontoidea, is that these insects originated on the former southern land mass, Gondwanaland and that the disintegration of the super-continent led to a fragmentation of the families into their present distribution patterns.

Evidence for the existence of former super-continents and

and their subsequent breakup is provided by the science of plate tectonics, or continental drift as the theory was formerly known. The idea of continental drift was first proposed by Alfred Wegener in 1912 (Hallam, 1975) and has gained acceptance as the study of plate tectonics which has become an integral part of biogeographic, phylogenetic and systematic studies (Mackerras, 1974).

The southern continents, Africa, South America, Australia, India and Antarctica were united into a single continent, Gondwanaland, in the Mesozoic era. After Gondwanaland separated from the northern continent, Laurasia, about 180 million years ago (Cracraft, 1973), the southern land-mass also began to break up. This process is now generally thought to have taken place between the upper Jurassic (about 150 million years ago) and the upper Cretaceous (about 70 million years ago) (Brundin, 1966; Cracraft, 1973). Antarctica, including Australia, probably broke away first in the late Jurassic to the early Cretaceous, with India separating in the mid-Cretaceous (Cracraft, 1973). South America is thought to have separated from Africa commencing in the south in the early Cretaceous (about 130 million years ago) and split progressively northwards with the final separation occurring in the late Cretaceous (80 million years ago) (Mackerras, 1974). According to Cracraft (1973), continuous land connections persisted between Africa and South America, and between South America and Antarctica until the late Cretaceous. In the early Tertiary (about 70 million years ago) Antarctica became separated from South America, and according to Brundin (1966), Australia and Tasmania had separated from Antarctica prior to this (sometime during the Cretaceous). From this evidence it would seem that Australia was a separate land mass long before the end of the Cretaceous and Dietz & Holden (1970) maintain that Australia was separated from Africa by the end of the Jurassic (about 130 million years ago).

As South America and Africa were isolated from each other by the Tertiary (about 70 million years ago), it may be assumed that the myrmeleontoid faunas of the three southern continents have been evolving independently since at least that time. The faunas of Australia and Africa may have been isolated from each other since the late Jurassic (about 130 million years ago) which means that most myrmeleontoid subfamilies (except the Palparinae) were already differentiated by that time. It may be argued that a faunal interchange could have taken place between the two continents (Africa and Australia) via the South America and Antarctica connection, but there are two reasons for doubting this; firstly agreement on the nature or actual existence of such a connection is tenuous and secondly, according to Brundin (1966), the connection corresponded to southern Chile, the Scotia arc and west Antarctica forming the southern margin of Gondwanaland, and was situated in a moist temperate climate. Judging by present requirements, such a climate would not be conducive to the dispersal of myrmeleontoid insects, particularly the Myrmeleontidae and Nemopteridae, which are essentially arid adapted.

Before the idea of plate tectonics was established, Tillyard (1926) postulated that western Australia had connections with lands linking Australia with Madagascar (Malagasy) and possibly South

Africa from the mid-Jurassic to the upper Cretaceous. He maintained (Tillyard, 1926) that some insects with African and Madagascan affinities, notably the Nemopteridae (subfamily Crocinae and other Neuroptera reached western Australia at that time, accounting for the rich fauna of the area.

Having briefly considered the distribution of the Myrmeleontidae and the Nemopteridae on a world basis, some attention should now be given to their distributions in southern Africa.

Local distribution patterns.

In chapter 2 it was stated that the southern African Myrmeleontidae show two distributional trends; there is a distinct westerly fauna and a characteristic eastern faunal element (fig. 3). The western fauna, containing many endemic taxa, has apparently evolved in the arid regions of the sub-continent and their eastward extension has been limited by higher rainfall patterns in the east. In areas where low rainfall belts extend eastwards, such as along the low lying arid Limpopo river depression, some elements of the western fauna have been able to disperse into the eastern parts of the subregion. The presence of an eastern tropical corridor has been mentioned by several authors and its effect upon the distribution of the insects they studied (e.g. Balinsky, 1962, Endrödy-Younga, 1978). According to Endrödy-Younga (1978) the tropical coastal forest belt continues along the east coast of Africa introducing alien elements into the South African sub-region, and Poynton & Broadley (1978) state that there is a complete transition from an east African fauna and flora to a southern non-tropical fauna along the coastal zone from Zululand to the eastern

Cape. The composition of the southern African myrmeleontid fauna is also influenced by this eastern tropical corridor, along which species from central and east Africa are able to extend their ranges into southern Africa. The easterly fauna contains few, if any, endemic species when compared to the western fauna as it is largely influenced by elements from further north.

The Nemopteridae of southern Africa are concentrated in the western areas and are essentially arid adapted. There is also a concentration of endemic taxa in the western and south western Cape Province (Tjeder, 1967). In the subfamily Nemopterinae, about 50% of the documented southern African fauna inhabits the south west Cape and Namaqualand (fig. 4), areas which are renowned for their unique flora. The diet of adult Nemopteridae seems to consist exclusively of pollen (Tjeder, 1967) and many of the specimens recorded by Tjeder (1967) were collected in September and October which is early in summer, before most adult Myrmeleontoidea appear. This does, however, coincide with the appearance of the spring flowers in the south west Cape and it could be speculated that the flora has enhanced the radiation of the family in this area, accounting for its richness.

The subfamily Crocinae is predominantly an arid adapted fauna occurring in the western parts of the subregion. There are two main distribution centres, one in the south western Cape Province and the other in the highlands of South West Africa (fig. 5). Representatives of the subfamily also occur in areas outside the two centres but most species are limited in their distribution to one of them. Laurhervasia setacea however, is more widespread, extending from the eastern and south western Cape Province into central South West Africa (fig. 13). Crocinae have not been recorded from the eastern regions of southern Africa (with the exception of the Orange river dispersal path) beyond about 24° East. In the south, Crocinae, represented by *L. setacea* (fig. 5) extend along the Swartberg mountain range as far east as Meiringspoort (33.23S 22.33E), but do not extend further east into the adjacent Baviaanskloof and Coega mountain ranges. To the north of this, *L. setacea* has been recorded from Victoria West (31.24S 30.07E) and near Britstown (30.39S 23.11E) but have not been found further east at localities such as Middleburg (31.29S 25.00E), Richmond (29.53S 30.17E) or Hanover (31.05S 24.27E) despite the presence of ideal larval habitats. By contrast, *L. setacea* occurs all along the Orange river as far east as Colesburg (30.43S 25.05E). This suggests that *L. setacea* is expanding its range and is able to migrate along mountain ranges. However, small barriers such as the valley separating the Swartberg and Baviaanskloof mountain ranges have thus far proved insurmountable. As the range extends further east, the climate becomes less arid and more unsuitable for crocin colonization. However, it appears that wherever there is a continuous series of appropriate habitats such as those provided by river valleys and unbroken mountain ranges, *L. setacea* can extend its range eastwards.

In this regard the Orange river with its associated rocky habitats has been used by *L. setacea* as an eastward migration path. From this dispersal route *L. setacea* has been able to extend up some of the tributaries such as the Molopo and Auob rivers which traverse the Kalahari desert. The calcrete banks of these rivers (fig. 13) provide a series of habitats in an area otherwise unsuited to crocin colonization.

Laurhervasia setacea has also extended up the Vaal river, the major tributary of the Orange, to as far north as Barkly West (28.32S 24.32E). It may be argued that this represents a relic distribution pattern, but it is significant that, in the east of the subregion, Crocinae are absent from ideal habitats that are not situated close to the Orange river. If the former range had decreased, isolated populations could be expected in suitable areas but this does not appear to be the case.

In the northern regions of South Africa, L. rhodesiae and L. transvaalensis have only been recorded to the north of the Soutpansberg mountains (ca. 23° South) in the low lying arid Limpopo river depression (fig. 5). Laurhervasia rhodesiae belongs to a northern faunal element extending its range northwards through Rhodesia into the Rift valley of central Africa. Laurhervasia transvaalensis has only been recorded from two adjacent localities in the northern Transvaal, and may have been derived from L. rhodesiae at the southern limit of its range.

The remaining crocin species also tend to be limited in their distribution and some, particularly the genus Concroce, could be regarded as relic faunas. Present records indicate that they are limited to small areas, possibly rainshadows, in the mountains of the Cape Province (fig. 22). These may be the remnants of a formerly widespread group but more collecting and comparison with species from other regions of the world is required before their antiquity can be established. By contrast, other species with limited distributions, such as T. brevicornis could not be regarded as the relic faunas as they are probably still in the process of evolving and extending their ranges. Evidence for this is the existence of two distinctive colour morphs, which interbreed when geographical barriers are removed.

Figure 5 shows areas which have been explored for Crocinae and indicates positive or negative records and those regions which still remain to be investigated. Attempts have not yet been made to collect Crocinae in Botswana as almost the whole country consists of Kalahari sands with very few hills or rock outcrops, rendering the area unsuitable for crocin habitation. The area to the south west of Upington (fig. 5) is arid, and Crocinae undoubtedly occur there, but the topography of the region is very flat and habitats scarce. Large areas of Natal and Lesotho still require investigation, but it is very unlikely that Crocinae occur there: the eastern regions of southern Africa are situated in a high rainfall area which is unsuitable to Crocinae. Also, despite extensive collecting by many entomologists in Natal, Crocinae have never been recorded from the area.

There is much potential for further research on southern African Myrmeleontidae and Nemopteridae. Several areas still require investigation to extend information on distribution patterns. Collecting must also be carried out in other regions of the world to provide comparative data for evolutionary and zoogeographical studies. The larvae of many southern African species are still unknown, and the adults require further examination to improve the knowledge on these two families.

6. SUMMARY.

1. The biology of southern African Myrmeleontidae and Nemopteridae (Neuroptera, Myrmeleontoidea) was studied with special emphasis on the nemopterid subfamily Crocinae.

2. The superfamily Myrmeleontoidea is considered to be a monophyletic group derived from ancestors similar to the family Nymphidae. The Myrmeleontidae and Nemopteridae are the most highly evolved families, and the Nemopteridae have a sister-group relationship with the other four myrmeleontoid families. Within the Nemopteridae, the Crocinae are considered more advanced than the subfamily Nemopterinae.

3. An account of previous work on the two families is presented: literature relating to the Myrmeleontidae is catalogued in appendix 2 and publications dealing with the Nemopteridae are surveyed in the text.

4. Biological and morphological information derived from the immature stages as well as the adults was used in the systematic study of the two families.

5. The geographical distribution and phylogeny of the Myrmeleontoidea is discussed with particular reference to the Myrmeleontidae and Nemopteridae.

6. The Myrmeleontidae have a world wide distribution whilst the Nemopteridae are more restricted, being limited to the arid and semi-arid regions of the world. It is concluded that the two families originated on Gondwanaland, and their present distribution is explained on the basis of evidence provided by plate tectonics.

7. In southern Africa, the Myrmeleontidae show two distributional trends: there is a distinct western fauna including many endemics and an eastern fauna which comprises taxa with a wide distribution in central and east Africa, extending their ranges into the eastern parts of the subregion. The Nemopteridae occur predominantly on the western side of the subcontinent and over 90% of the species are endemic to southern Africa.

8. A systematic revision of the southern African Crocinae is presented and summarized in a set of illustrated keys to the adults and larvae.

9. There are now ten known crocin species in four genera from the subregion, four species being described for the first time in this thesis. The larvae of all ten species and the eggs of seven, have been correlated with the adults and are described.

10. Two crocin genera, Concroce and Thysanocroce, have larvae with short prothoraxes, whilst those in Laurhervasia and Tjederia are elongated. Larvae of the first two genera live in plant

detritus under rocks and in crevices whereas larvae of the latter two genera inhabit small dusty caves.

11. These findings on the Myrmeleontidae and Nemopteridae are discussed in the context of general systematic theory, phylogeny and zoogeography.

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8. APPENDIX 1.

SEM morphological investigation of insect larvae and eggs using abbreviated preparative techniques

by

R.H.M. Cross & M.W. Mansell

Elektronmikroskopievereniging van Suidelike Afrika PRETORIA (1978)

SEM MORPHOLOGICAL INVESTIGATION OF INSECT LARVAE AND EGGS USING ABBREVIATED PREPARATIVE TECHNIQUES

R.H.M. Cross+ & M.W. Mansell++

\+ Electron Microscopy Unit, Rhodes University, Grahamstown
++ Plant Protection Research Institute, c/o Department of Zoology and Entomology, Rhodes University, Grahamstown

Much emphasis is placed upon the importance of using the 'correct' preparative procedures for SEM examination of biological specimens. Whilst the importance of achieving accurate results without the introduction of artefacts is paramount, it is not always necessary to use expensive and time-consuming techniques in order to realise this objective, provided that sufficient control methods are applied to ensure the validity of the results.

Insect larvae in general, and particularly those of the Crocinae (Neuroptera, Nemopteridae) (the subject of this investigation), have a hard and resilient cuticle especially in the regions of the head, thorax and terminal segments of the abdomen. These areas are able to withstand the vacuum environment within the SEM after minimal pretreatment showing little distortion or other artefacts. The abdomen does become swollen but this tends to offset to a certain extent the shrinkage caused by air-drying from 80% alcohol. More specific morphological features (Figs. 2 & 4) such as palps, antennae, etc, appear to suffer no discernible distortion. The eggs of the Crocinae (Figs. 1 & 3) have a resilient chorion and most specimens are also able to withstand the SEM environment without pretreatment.

Larvae of several species of Crocinae were killed in HCN vapour and transferred to 80% alcohol for a minimum of 2 hours during which they were subjected to a brief period (about 30 sec.) of ultrasonic cleaning. They were allowed to dry in air on filter paper, were fixed to specimen stubs and transferred to the SEM. In some cases improved results were obtained if the larvae were lightly sprayed with a conducting film aerosol just prior to SEM observation. SEM examination was carried out at low accelerating voltages (6 - 8 kV) with beam currents in the region of 5×10^{-12} amp. As this was purely a taxonomic investigation high magnifications were seldom necessary but it was possible to obtain acceptable micrographs at screen magnifications of up to 5000x. Higher magnifications would no doubt have been possible but were not required. Eggs were subjected to the same preparation as the larvae with the exception of the HCN vapour treatment which was not necessary.

Apart from the obvious advantages of low cost and speed, a further advantage of the use of this abbreviated technique is that specimens can be returned to an apparently unchanged 'wet' state when replaced in 80% alcohol after SEM observation, thus permitting subsequent dissection and light microscopy if required.

1977b

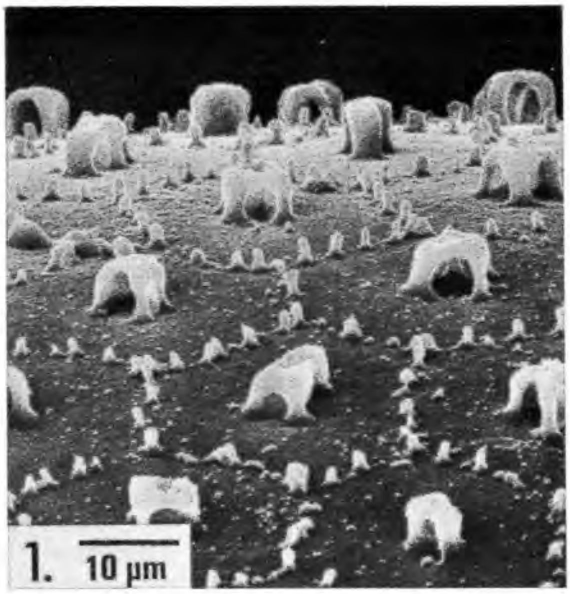

Fig. 1. Chorion of egg of *Tjederia* sp.

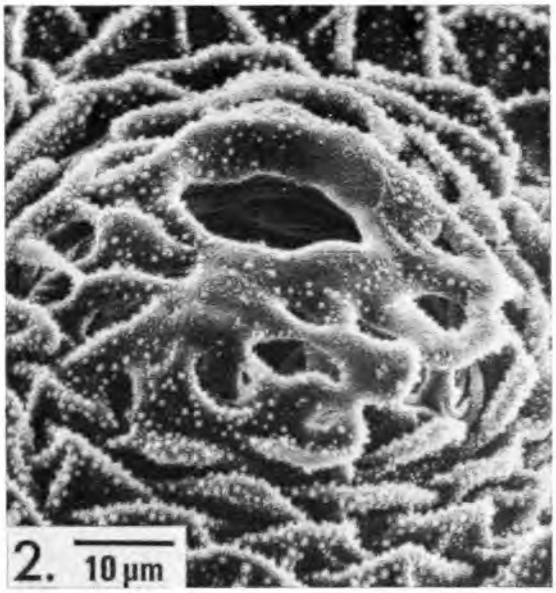

Fig. 2. Abdominal spiracle of *Concroce* sp.

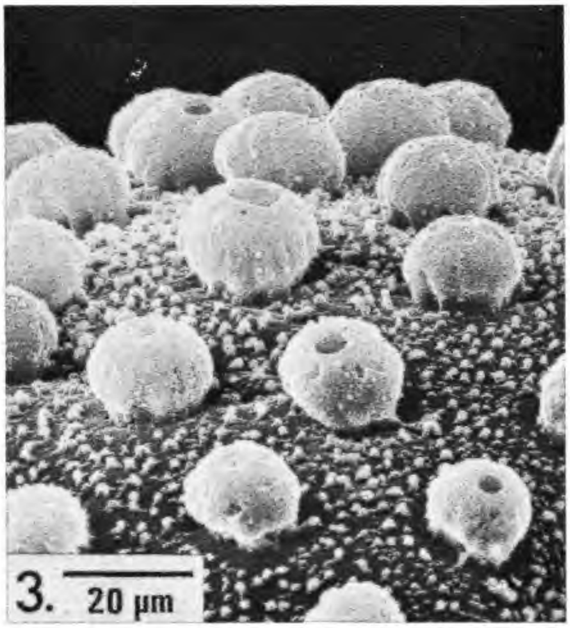

Fig. 3. Chorion of egg of *Laurhervasia setacea* (Klug)

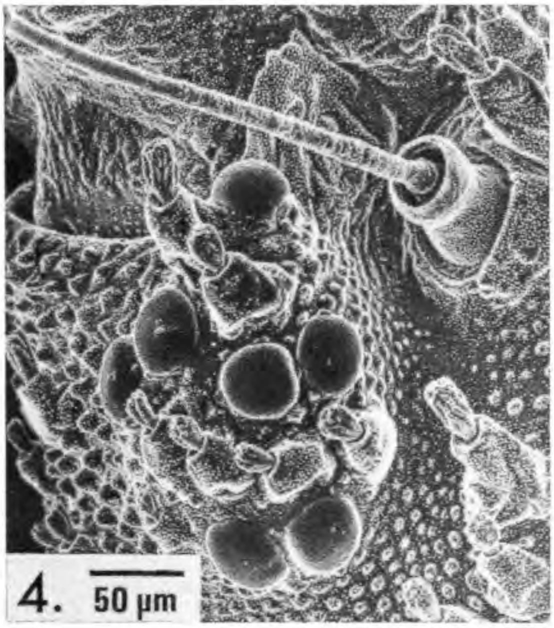

Fig. 4. Eye (stemmata) and antennal base of *Concroce* sp.

9. APPENDIX 2.

CATALOGUE OF THE SOUTHERN AFRICAN MYRMELEONTIDAE.

A synopsis is presented in the form of an annotated catalogue to integrate published information on southern African Myrmeleontidae. In the catalogue, each genus and species described from southern Africa is listed in alphabetical order. All references to a particular taxon are listed under the name of the taxon in order of date of publication. Genera and species not originally described from southern Africa, but subsequently recorded from the subregion, are also included in the catalogue.

The originally published names of the taxa are cited in alphabetical sequence, and names which have been changed or synonomised are referred to the name currently recognised, or to the senior synonym. Where a name has been synonomised, and the synonomy is considered valid, the original data pertaining to that name and the reference to the synonomiser, are presented under the heading of the senior synonym. Names of taxa not originally described from southern Africa, but subsequently synonomised with the name of a southern African taxon, are included in the list of synonomies, but are not listed in the alphabetical sequence of names.

The type localities of the species are quoted in their original form and elaborated where necessary, the explanatory notes (localities) being placed in brackets. The present location of each type specimen is indicated by the initials of the holding institution as listed below. This is followed by an indication of whether I have seen and photographed the type (written as EXAMINED). An asterisk indicates those species represented in my collection.

AMNH - American Museum of Natural History, New York, U.S.A.

BMNH - British Museum (Natural History), London, England.

CUM - Cambridge University Museum, Cambridge, England.

DEIE - Deutsches Entomologisches Institut, Eberswalde, East Germany.

HM - Hamburg Museum, West Germany.

IRSN - Institute Royal des Sciences Naturelles, Brussels, Belgium.

LSL - Linnaean Society, London, England.

MB - Institut für spezielle Zoologie und zoologische Museum, Berlin, East Germany.

MG - Musee d'Histoire Naturelle Ville de Genéve, Geneva, Switzerland.

MP - Museum National d'Histoire Naturelles, Paris, France.

MRAC - Musee Royal de l'Afrique Centrale, Tervuren, Belgium.

MZB - Museo de Zoologia, Barcelona, Spain.

NCOLL - Navas Collection, Colegio del Salvador, Zaragosa, Spain.

MNV - Naturhistorisches Museum, Vienna, Austria.

SAM - South African Museum, Cape Town, South Africa.

SM - Zoologische Sammlung des Bayerischen Staates, Munich, West Germany.

UMO - Hope Dept. of Entomology, University Museum, Oxford, England.

USNM - United States National Museum, Washington D.C., U.S.A.

ZIMG - Zoologisches Institut, der Universität, Greifswald, East GErmany.

ZIH - Zoologisches Institut, der Universität, Halle, East Germany.

ZMCU - Zoological Museum, Copenhagen University, Copenhagen, Denmark.

Genus ACANTHACLISIS Rambur, 1842. [Does not occur in southern Africa]

Acanthaclisis brachygaster Rambur = Centroclisis brachygaster (Rambur)

Acanthaclisis dasymalla Gerstaecker = Centroclisis dasymalla (Gerstaecker)

Acanthaclisis distincta Rambur = Centroclisis distincta (Rambur)

Acanthaclisis felina Gerstaecker = Centroclisis felina (Gerstaecker)

Acanthaclisis lineatipennis Péringuey = Centroclisis distincta (Rambur)

Acanthaclisis longicornis Rambur = Syngenes longicornis (Rambur)

Acanthaclisis mashunensis Péringuey = Centroclisis distincta (Rambur)

Genus AFROLEON Navas = MYRMELEON Linnaeus

Afroleon basutus Navas = Myrmeleon lanceolatus Rambur

Genus AVIA Navas = CENTROCLISIS Navas

Genus BANKISUS Navas, 1912.

Bankisus Navas, 1912c:45. Type species by original designation and monotypy = Bankisus oculatus Navas, 1912c:46.

Navasius Esben-Petersen, 1936:202. Type species by original designation = Navasius elegantulus Esben-Petersen, 1936:202.
Synonomised by Markl, 1954:221.

Bankisus Navas; Banks, 1938a:126.

Bankisus Navas; Markl, 1954:221.

*Bankisus oculatus Navas, 1912.

Bankisus oculatus Navas, 1912c:46. "Afrique, Mashonaland". (Rhodesia). Type-BMNH. EXAMINED.

Bankisus sculatus [sic!] Navas; Navas, 1912c:46.

Bankisus oculatus Nav.; Navas, 1912e:96.

Bankisus oculatus Navas; Banks, 1913a:154.

Gymnocnemia kristenseni Esben-Petersen, 1915a:179. "Abessinia". (Ethiopia). Type-ZMCU. EXAMINED. syn. nov.

Navasius kristenseni (Esb.-Pet.), Esben-Petersen, 1936:206.

Genus BANYUTUS Navas, 1912.

Banyutus Navas, 1912b:66.	Type species by original designation = Myrmeleon lethalis Walker, 1853:374.
Banyutus Navas; Navas, 1912d:234.	
Banyuto [sic!] Nav.; Navas, 1925c:130.	
Folla Navas, 1925c:130.	Type species by original designation and monotypy = Folla elisabethana Navas, 1925c:131. Synonomised by Markl, 1954:237.
Banyutus Navas; Navas, 1932a:274.	
Dallus Navas, 1932a:274.	Type species by original designation = Dallus Quarrei [sic!] Navas, 1932a:275. Synonomised by Markl, 1954:237.
Banyutus Navas; Markl, 1954:237.	

*Banyutus horridus Navas, 1912.

Banyutus horridus Navas, 1912e:92. "Mozambique, Valle de Pungoué". Type-MP. EXAMINED.

Banyutus horridus Nav.; Navas, 1932a:274.

*Banyutus lethalis (Walker, 1853).

Myrmeleon lethalis Walker, 1853:374. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED.

Myrmeleon leucospilos Hagen, 1853:482. Reference not seen. Type-Not located. Synonomised by Hagen, 1860:366.

M. [yrmeleon] lethalis Walker; Hagen, 1860:366.
Formicaleo leucospilos (Hagen), Hagen, 1866:404, 442.
Myrmeleon lethalis Walker; Hagen, 1866:412.
Myrmeleon lethalis Walker; MacLachlan, 1867:279.
Formicaleo leucospilos (Hagen); MacLachlan, 1867:279.
Formicaleo leucospilos (Hagen); Hagen, 1873:385.
Myrmeleon lethalis Walker; MacLachlan, 1873a:138.
Myrmeleon leucospilos Hagen; MacLachlan, 1873a:138.
Formicaleo leucospilos (Hag.); Kolbe, 1898a:20.
Formicaleo lethalis (Walker), v.d.Weele, 1907:271.
Formicaleo lethalis (Walker); v.d.Weele, 1909a:63.
Formicaleo lethalis (Walker); v.d.Weele, 1910:15.
Formicaleon lethalis (Walker), Banks, 1911:20.
Formicaleo lethalis (Walk.); Navas, 1911b:243.
Myrmeleon lethalis Walker; Navas, 1912b:67.
Banyutus lethalis (Walker), Navas, 1912b:68.
Banyutus lethalis (Walk.); Navas, 1912i:98.
Banyutus lethali [sic!] (Walk.); Navas, 1914d:94.
Formicaleon lethalis (Walker); Banks, 1920:27.
Banyutus lethalis (Walker); Banks, 1920:28.
Banyutus lethalis (Walk.); Navas, 1925c:130.
Banyutus lethalis (Walk.); Navas, 1926b:86.
Banyutus lethalis (Walk.); Navas, 1929a:98.
Banyutus lethalis (Walk.); Navas, 1931a:102.
Banyutus leucospilos (Hag.), Navas, 1932a:274.
Banyutus leucospilos (Hag.); Navas, 1933b:311.
Banyutus lethali [sic!] (Walk.); Navas, 1936a:338.

Genus BORDUS Navas, 1936

Bordus Navas, 1936c:165. Type species by original designation and monotypy = Bordus temeratus Navas, 1936c:166.

Bordus Navas; Markl, 1954:248.

Bordus temeratus Navas, 1936.

Bordus temeratus Navas, 1936c:166. "S.W. Afrika, Farm Okaundua, Okahandja". Type-HM. Destroyed.

Genus *BRACHYPLECTRON* Esben-Petersen, 1925.

Brachyplectron Esben-Petersen, 1925:336. Type species by original designation and monotypy = *Brachyplectron capense* Esben-Petersen, 1925:336.

Brachyplectron Esben-Petersen; Markl, 1954:243, 260.

**Brachyplectron capense* Esben-Petersen, 1925.

Brachyplectron capense Esben-Petersen, 1925:336. "Stellenbosch". (Cape Province). Type-BMNH. EXAMINED.

Genus *CAMPESTRETUS* Navas, 1933.

Campestretus Navas, 1933a:103. Type species by original designation = *Neuroleon extraneus* Navas, 1912b:71.

Campestretus Navas; Markl, 1954:238.

Campestretus lepidus (Kolbe, 1898).

Macronemurus lepidus Kolbe, 1898a:23. "Ost-Afrika ? Usambara". (Tanzania). Type-MB. Not examined.

Formicaleon lepidus (Kolbe), Banks, 1911:16, 20.

Neuroleon ? extraneus Navas, 1912b:71. "Africa, meridional Mashonaland". (Rhodesia). Type-BMNH. EXAMINED. Synonomised by Banks 1913a:153.

Formicaleo (Macronemurus) lepidus (Kolbe), Esben-Petersen, 1920a:191.

Campestretus extraneus (Navas), Navas, 1933a:104.

Campestretus extraneus (Nav.); Navas, 1933b:311.

Genus *CAPOPHANES* Banks, 1938.

Capophanes Banks, 1938a:125 Type species by original designation and monotypy = *Capophanes conspersa* Banks, 1938a:126.

Capophanes Banks; Markl, 1954:243, 260.

Capophanes conspersa Banks, 1938.

Capophanes conspersa Banks, 1938a:126. "Mt Brukkaros, S.W. Africa". (Keetmanshoop Dist.). Type-USNM. Not examined.

Genus CENTROCLISIS Navas, 1909.

Centroclisis Navas, 1909:71. Reference not seen.

Centroclisis Navas; Banks, 1911:2, 5.

Neboda Navas, 1911c:114. Reference not seen.
Synonomised by Markl, 1954:231.

Centroclisis Navas; Navas, 1912b:52.

Sogra Navas, 1912b:43. Type-species by original designation = Acanthaclisis distincta Rambur, 1842:380.
Synonomised by Esben-Petersen, 1916:13.

Jaya Navas, 1912f:163. Type species by original designation and monotypy = Jaya Rogeri [sic!] Navas, 1912f:164.
syn. nov.

Sogra Navas; Navas, 1912f:163.

Avia Navas, 1912k:75. Reference not seen.
syn. nov.

Centroclisis Navas; Banks, 1913a:149.

Neoclisis Navas, 1914f:205. Reference not seen.
Synonomised by Markl, 1954:231.

Centroclisis Navas; Esben-Petersen, 1916:13.

Centroclisis Navas; Banks, 1920:22.

Sograssa Navas, 1925d:71. Reference not seen.
Synonomised by Esben-Petersen, 1928b:77.

Centroclisis Navas; Esben-Petersen, 1928b:77.

Stenoclisis Navas, 1932b:62. Reference not seen.
Synonomised by Markl, 1954:231.

Centroclisis Navas; Markl, 1954:231.

Centroclisis Navas; Hölzel, 1972:13.

*Centroclisis brachygaster (Rambur, 1842)

Acanthaclisis brachygaster Rambur, 1842:381.
No locality cited.
Type-MP. EXAMINED.

Myrmeleon brachygaster (Rambur), Walker, 1853:318.

A. [canthaclisis] brachygaster Ramb.; Hagen, 1860:262.

Acanthaclisis brachygaster Rbr,; Hagen, 1866:378, 436.

Acanthaclisis brachygaster Rambur; MacLachlan, 1873a:132.

Acanthaclisis rufescens Gerstaecker, 1885:10.
"Mungo (Camaroons)".
Type-ZIMG ?. Not examined.
Synonomised by Banks, 1913a:149.

Sogra brachygaster (Ramb.), Navas, 1911a:241.

Sogra brachygaster (Ramb.); Navas, 1912f:149.

Sogra vitanda [♀] Navas, 1912f:154. "Africa, Damara, Steynsburg. Col. del. Cabo". (South West Africa, Cape Province). Type- ♀ NMV. Not examined. Synonomised by Esben-Petersen, 1920a:195.

Sogra brachygaster (Ramb.); Navas, 1912g:26.

Sogra mordax Navas, 1912f:151. "Pangani (Africa Or.)". (Tanzania). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1920a:194.

Sogra iracunda Navas, 1912f:159. "Africa oriental, Pangani, Kisongera". (Tanzania). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1920a:194.

Sogra brachygaster (Rbr.); Banks, 1913a:149.

Sogra bachygaster [sic!] (Ramb.); Navas, 1914c:372.

Sogra brachygaster (Ramb.); Navas, 1915b:176.

Centroclisis brachygaster (Rambur), Banks, 1920:26.

Centroclisis brachygaster (Rbr.); Esben-Petersen, 1920a:194, 195.

Centroclisis brachygaster (Rambur) forma mordax Esben-Petersen, Esben-Petersen, 1920a:194.

Sogra brachygaster (Ramb.); Navas, 1925c:129.

Sogra brachygaster (Ramb.); Navas, 1926a:79.

Sogra brachygaster (Ramb.); Navas, 1927a:8, 9.

Sogra brachygaster (Ramb.); Navas, 1932a:271.

Sogra brachygaster (Ramb.) var. sordida Nav., Navas, 1932a:271.

Sogra brachygaster (Ramb.) var. nebulosa Navas, Navas, 1932a:272.

Sogra brachygaster (Ramb.) var. sordida Nav.; Navas, 1933a:101.

Sogra brachyaster [sic!] (Ramb.); Navas, 1936a:335.

*<u>Centroclisis</u> <u>dasymalla</u> (Gerstaecker, 1863).

Acanthaclisis dasymalla Gerstaecker, 1863:174. "Caffraria". (Cape Province, South Africa). Type-ZIMG. Not examined.

Acanthaclisis dasymalla Gerstaecker; Hagen, 1866:378.

Acanthaclisis dasymalla Gerst.; Gerstaecker, 1894:118.

Acanthaclisis dasymalla Gerstaecker; Kolbe, 1898a:15.

Acanthaclisis dasymalla G.; v.d.Weele, 1908:60.

A [canthaclisis] dasymalla Gerst.; Péringuey, 1910:443.

Acanthaclisis dasymalla Gerst.; Banks, 1911:15.

Sogra dasymalla (Gerst.), Navas, 1911a:241.

Sogra dasymella [sic!] (Gerst.); Navas, 1912g:26.

Jaya Rogeri [sic!] Navas, 1912f:164. "Abisinia, Dire
Bana". (Ethiopia).
Type-MP. EXAMINED.
Synonomised by Esben-Petersen,
1928b:76.

Acanthaclisis dasymalla Gerst.; Esben-Petersen, 1916:12.

Jaya dasymalla (Gerst.), Esben-Petersen, 1928b:76.

Centroclisis dasymalla (Gerstaecker), comb. nov.

*Centroclisis distincta (Rambur, 1842).

Acanthaclisis distincta Rambur, 1842:380. "Senegal"
Type-MP. EXAMINED.

Myrmeleon distinctus (Ramb.), Walker, 1853:316.

Myrmeleon edax Walker, 1853:317. No locality cited.
Type-BMNH. EXAMINED.
Synonomised by Gerstaecker,
1885:10.

Myrmeleon molestus Walker, 1853:322. No locality cited.
Type-BMNH. EXAMINED.
Synonomised by v.d. Weele, 1907:264.

Acanthaclisis gabonicus Fairm., 1858:261.
Reference not seen.
Type not located.
Synonomised by v.d. Weele, 1907:264.

A [canthaclisis] distincta Ramb.; Hagen, 1860:363.

Acanthaclisis distincta Rbr.; Hagen, 1866:378.

Acanthaclisis distincta Rambur; MacLachlan, 1873a:132.

Acanth [aclisis] distincta Ramb.; Gerstaecker, 1885:10.

Acanthaclisis distincta Rbr.; Hagen, 1887:156.

Acanthaclisis felina Gerstaecker, v.d.Weele, 1907:264.
Incorrect synonomy.

Acanthaclisis distincta Rambur; Kolbe, 1898a:15.

Acanthaclisis lineata Kirby, 1903:404.
Reference not seen.
Synonomised by v.d.Weele, 1907:264.

Acanthaclisis distincta Rambur; v.d.Weele, 1907:264.

Acanthaclisis distincta Rbr.; v.d.Weele, 1908:60.

Acanthaclisis distincta Rambur; v.d.Weele, 1909a:62.

Acanthaclisis mashunensis Péringuey, 1910:442. "Southern Rhodesia (Salisbury)". Type-SAM. EXAMINED. *syn. nov.*

Acanthaclisis lineatipennis Péringuey, 1910:443. Locality not cited. Type-SAM. EXAMINED. Synonomised by Esben-Petersen, 1916:14.

Acanthaclisis distincta Rambur; Banks, 1911:5.

Acanthaclisis distinctae [sic!] Ramb.; Navas, 1911b:240.

Sogra perversa Navas, 1911b:240. "Congo Belge, Uerre". (Zaire). Type-MRAC. EXAMINED. Synonomised by Banks, 1913a:149.

Sogra distincta (Ramb.), Navas, 1912b:43.

Acanthaclisis distincta det. v.d.Weele nec Rambur; Navas, 1912f:147. Referred to *Sogra felina* (Gerstaecker), 1894:118.

Acanthaclisis distincta (partim) det. v.d.Weele nec Rambur; Navas, 1912f:155. Referred to *Sogra rixosa* Navas, 1912f:155.

Acanthaclisis distincta det. v.d.Weele nec Rambur; Navas, 1912f:156 Referred to *Sogra pertinax* Navas, 1912f:156.

Sogra iracunda Navas, 1912f:159. "Africa oriental Pangani". (Tanzania). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1916:14.

Acanthaclisis distincta (partim) det. v.d.Weele nec Rambur; Navas, 1912f:161. Referred to *Sogra superba* Navas, 1912f:161.

Acanthaclisis distincta (Rambur); Navas, 1912g:26.

Sogra distincta (Rbr.); Banks, 1913a:149.

Sogra nigrata Navas, Banks, 1913a:149. Incorrect synonomy.

Centroclisis distincta (Ramb.), Esben-Petersen, 1916:13.

Centroclisis distincta (Rambur) var. lineatipennis Péringuey, Esben-Petersen, 1916:15.

Centroclisis distincta (Rambur); Esben-Petersen, 1920a:194.

Centroclisis distincta (Rambur); Banks, 1920:22.

Sogra distincta (Ramb.) var. obliqua Navas, 1921b:225. "Colonie du Cap, Steynsburg". (Cape Province). Type-MP. EXAMINED.

Centroclisis distincta det. Esben-Petersen nec Rambur; Navas, 1921b:226. Referred to Sogra mordax Navas, 1912f:151.

Sogra distincta (Ramb.); Navas, 1927a:7.

Sogra distincta (Ramb.); Navas, 1930a:305.

Sogva [sic!] distincta (Ramb.); Navas, 1931b:261.

Sogra distincta (Ramb.); Navas, 1931c:124.

Centroclisis distincta (Rb.); Markl, 1954:202.

*Centroclisis felina (Gerstaecker, 1894).

Acanthaclisis felina Gerstaecker, 1894:118. "Lindi, Afrique orient.". (Tanzania). Type-ZIMG. Not examined,

Acanthaclisis felina Gerstaecker; Kolbe, 1898a:15.

Acanthaclisis felina Gerstaecker; v.d.Weele, 1907:264. Referred to Acanthaclisis distincta Rambur. Incorrect synonomy.

Acanthaclisis felina Gerstaecker; v.d.Weele, 1908:60.

Sogra felina (Gerst.), Navas, 1912f:147.

Acanthaclisis distincta det. v.d.Weele nec Rambur; Navas, 1912f:147. Synonomised by Navas, 1912f:147.

Sogra superba Navas, 1912f:161. "Madagascar, Mahabo costa occidental". Type-MP. EXAMINED, Synonomised by Banks. 1913a:149.

Acanth[aclisis] felina Gerst.; Banks, 1913a:149.

Centroclisis felina (Gerstaecker), Esben-Petersen, 1916:15.

Centroclisis felina (Gerstaecker); Esben-Petersen, 1928b:77.

Sogrossa [sic!] superba (Navas), Fraser, 1951:352.

Sograssa superba (Nav.); Markl, 1954:204.

Acanthaclisis lineatipennis Péringuey = Centrolcisis distincta (Rambur).

Centroclisis maligna (Navas, 1912).

Sogra maligna Navas, 1912f:152. "Africa meridional. Steynsburg". (Cape Province). Type-MP. EXAMINED.

[Sogra] malignae [sic!] Nav.; Navas, 1912b:45.

Sogra maligna Nav.; Navas, 1923:433.

Sogra maligna Nav,; Navas, 1927a:11.

Centroclisis maligna (Navas), Esben-Petersen, 1928a:217.

Acanthaclisis mashunensis Péringuey = Centroclisis distincta (Rambur).

Centroclisis mendax (Navas, 1912).

Sogra mendax Navas, 1912f:158. "Africa occidental, Damara". (South West Africa). Type-NMV. Not examined.

Centroclisis mendax (Navas), Esben-Petersen, 1928a:217.

Centroclisis odiosa (Navas, 1932).

Sogra nefasta Navas, 1927a [nec 1912f]; 11. "Africa. Mozambique, Delagoa". Type-MP ?. Not examined.

Sogra nefasta Navas; Esben-Petersen, 1928a:216.

Sogra odiosa Navas, Navas, 1932c:? . *nom. nov.* for *Sogra nefasta* Navas, 1927a, junior homonym of *Sogra nefasta* Navas, 1912f.

Centroclisis odiosa (Navas), *comb. nov.*

**Centroclisis vitanda* (Navas, 1912).

Sogra vitanda Navas, 1912f:154. "Africa Damara. Steynsburg, Col del Cabo". (Cape Province). Type-♀ NMV. Type-♂ MP. Type ♂ EXAMINED. [♂ & ♀ belong to different species.]

Sogra vitanda Nav.; Navas, 1912g:26.

Sogra vitanda Navas; Esben-Petersen, 1920a:195.

Sogra vitanda [♀] Navas; Esben-Petersen, 1920a:195. Referred to *Centroclisis distincta* (Rambur).

Sogra vitanda Navas; Esben-Petersen, 1928:216.

Genus *CRAMBOMORPHUS* MacLachlan, 1867.

Crambomorphus MacLachlan, 1867:243. Type species by original designation = *Palpares haematogaster* Gerstaecker, 1863:184.

Crambomorphus MacLachlan; Hagen, 1887:133.

Crambomorphus MacLachlan; Kolbe, 1898a:4. 6.

Crambomorphus MacLachl.; v.d. Weele, 1907:251.

Crambomorphus MacLachlan; Banks, 1911:2. Referred to *Stenares* Hagen. Incorrect synonomy

Crambomorphus MacLachlan; Navas 1912d:203.

Crambomorphus MacLachlan; Banks, 1913b:189.

Crambomorphus McL.; Markl, 1954; 215, 216.

**Crambomorphus sinuatus* (Olivier, 1811).

Myrmeleon sinuatum Olivier, 1811:121. Reference not seen. Type not located.

Myrmeleon sinuatus Oliv.; Walker, 1853:404.

M[yrmeleon] sinuatus Oliv.;, Hagen, 1860:368.

Palpares haematogaster Gerstaecker, 1863:184. "Caffraria" (Cape Province). Type-ZIMG?. Not examined. Synonomised by MacLachlan, 1867:243.

Myrmeleon sinuatus Oliv.; Hagen, 1866:447.

Palpares haematogaster Gerst.; Hagen, 1866:456.

Myrmeleon sinuatum Oliver; Brauer, 1867:519, 520.

Myrmeleon sinuatus Oliv.; Brauer, 1867:519, 520.

Palpares haematogaster Gerstaecker; Brauer, 1867:520.

Myrmeleon sinuatum Oliv.; Hagen, 1887:133.

Palp[ares] haematogaster Gerst.; Hagen, 1887:133.

Crambomorphus haematogaster (Gerst,), Kolbe, 1898a:6.

Crambomorphus sinuatus (Ol.), Kolbe, 1898a:6.

Myrmeleon sinuatum Oliv.; v.d. Weele, 1903:168.

[Palpares] haematogaster Gerstaecker; v.d. Weele, 1903:168.

Crambomorphus sinatus [sic!] (Oliv.); v.d. Weele, 1907:252.

Stenares (Crambomorphus) sinuatus (Oliv.), Banks, 1913b: 189, 190.

Genus CREAGRIS Hagen = CREOLEON Tillyard

Creagris angustipennis Péringuey = Nemoleon angustipennis (Péringuey)

Creagris bechuanus Péringuey = Cueta trivirgata (Gerstaecker)

Creagris damarinus Péringuey = Furgella damarinus (Péringuey)

Creagris inclitus Péringuey = Creoleon diana (Kolbe)

Creagris interrupta Navas = Creoleon interruptus (Navas)

Creagris junodi Esben-Petersen = Creoleon nubifer (Kolbe)

Creagris mashunus Péringuey = Creoleon mashunus (Péringuey)

Creagris nigro-strigatus MacLachlan = Creoleon mortifer (Walker)

Creagris nubifer Kolbe = Creoleon nubifer (Kolbe)

Creagris proximus Péringuey = Creoleon nubifer (Kolbe)

Creagris pseudoplumbeus Péringuey = Creoleon africanus (Rambur)

Creagris venosa Navas = Creoleon venosus (Navas)

Genus CREOLEON Tillyard, 1918.

Creagris Hagen, 1860:364. Type species not designated.

Creoleon Tillyard, 1918:436. nom. nov. for Creagris Hagen preoccupied by Creagris Nietner, 1857, Coleoptera.

Creagris Hagen; Hagen, 1866:372, 401.

Creagris Hagen; MacLachlan, 1867:245.

Creagris Hagen; Kolbe, 1898a:23.

Creagris Hagen; v.d. Weele, 1907:272.

Creagris Hagen; v.d. Weele, 1910:14, 17.

Creagris Hagen; Banks, 1911:14, 22.

Creagris Hagen; Navas, 1912b:57.

Gama Navas, 1912b:57. Type species by original designation = Creagris inclytus [sic!] Péringuey, 1910:445. Synonomised by Esben-Peterson, 1916:15.

Gama Navas; Navas, 1912d:233.

Creagris Ramb. [sic!] ; Navas, 1912d:233.

Creagris Hagen; Navas, 1912d:95.

Creagris Hagen; Navas, 1914e:20.

Creagris Hagen; Esben-Petersen, 1916:15, 16, 19.

Creagris Hagen; Banks, 1920:23, 27.

Creoleon Till.; Navas, 1925a:206.

Creoleon Tillyard; Esben-Petersen, 1925:339.

Creoleon Tillyard; Kimmins, 1943:148.

Creagis [sic!] Hagen; Fraser, 1951:354.

Creoleon Till.; Fraser, 1951:354.

Creoleon Till.; Markl, 1954:211, 241, 242.

Creoleon Tillyard; Hölzel, 1972:60.

Creoleon africanus (Rambur, 1842).

Myrmeleon africanus Rambur, 1842:395. "Senegal" (West Africa). Type- Not located.

Myrmeleon Africanus [sic!] Ramb.; Walker, 1853:352.

M[yrmeleon] Africanus [sic!] Ramb.; Hagen, 1860:364. Referred to *M. luteipennis* Burm. Incorrect synonomy.

Creagris Africanus [sic!] (Rbr.), Hagen, 1866:401.

Myrmeleon Africanus [sic!] Rbr.; Hagen, 1866:435.

Myrmeleon africanus Rambur; MacLachlan, 1873a:135.

Creagris nubifer Kolbe, 1898a:25. Synonomised by v.d. Weele, 1907:273. Incorrect synonomy.

Creagris africanus (Rambur); v.d. Weele, 1907:273.

Creagris litteratus Navas, 1908:23. "Tamatave" (Madagascar). Type not located. Synonomised by v.d. Weele, 1909a:66.

Creagris africanus (Rbr.); v.d. Weele, 1909a:66.

Creagris africanus (Rambur); Péringuey, 1910:447.

Creagris africanus (Rambur); Banks, 1911:15.

Creagris pseudoplumbeus Péringuey, 1910:446. "Cape Colony (Worcester, Stellenbosch), (Prieska) (Little Namaqualand), (Burghersdorp) (Humansdorp), King Williams' Town." Type-SAM. EXAMINED. Synonomised by Banks 1911:15.

Creagris africanus (Ramb.); Navas, 1911a:241.

Creagris africanus (Ramb.); Navas, 1911b:241.

Creagris africanus (Ramb.); Navas, 1912a:406.

Creagris africanus (Ramb.); Navas, 1912f:169.

Myrmeleon africanus Rbr.; Banks, 1913a:153.

Creagris africanus (Rbr.); Banks, 1913a:153.

Creagris africana [sic!] (Rambur); Banks, 1920:24.

Creoleon africanus (Ramb.), Navas, 1921a:304.

Creoleon africanus (Ramb.); Navas, 1930b:130.

Creagis [sic!] africanus (Ramb.); Fraser, 1951:354.

*Creoleon diana (Kolbe, 1898a).

Creagris diana Kolbe, 1898a:24. "Dar-es-Salaam" (Tanzania).
Type-MB. Not examined.

Creagris inclitus Péringuey, 1910:445. "Natal, Maritzburg".
Type-SAM. EXAMINED.
Synonomised by Banks, 1911:15.

Creagris Diana [sic!] Kolbe; Navas, 1912b:57.

Creagris inclytus [sic!] Péringuey; Navas, 1912b:57.

Gama inclytus [sic!] Péring., Navas, 1912b:57.

Creagris diana Kolbe; Esben-Petersen, 1916:15.

Gama Dianae [sic!] (Kolbe), Navas, 1931a:105.

Creoleon diana (Kolbe), comb. nov.

Creoleon interruptus (Navas, 1914).

Creagris interrupta Navas, 1914a:646. "Mocambique".
Type-CUM. Not examined.

Creoleon interruptus (Navas), comb. nov.

Creoleon luteipennis (Burmeister, 1839)

Myrmecoleon luteipennis Burmeister, 1839:992. "Kaplande".
(Cape Province). Type-ZIH?.
Not examined.

Myrmeleon luteipennis (Burm.), Walker, 1853:402.

Myrmeleon luteipennis (Burm.); Hagen, 1860:364.

Myrmeleon Africanus [sic!] Ramb., Hagen, 1860:364.
Incorrect synonomy.

Creagris luteipennis (Br.); Hagen, 1866:401, 443.

Creagris luteipennis (Burmeister); MacLachlan, 1873:135.

Creagris luteipennis (Burmeister); Banks, 1911:15.

Creagris luteipennis (Burm.); Banks, 1913a:153.

Creoleon luteipennis (Burmeister), comb. nov.

Creoleon mashunus (Péringuey, 1910).

Creagris mashunus Péringuey, 1910:449. "Southern Rhodesia
(Salisbury)". Type-SAM. EXAMINED.

Creoleon mashunus (Péringuey), comb. nov.

*Creoleon mortifer (Walker, 1853).

Myrmeleon mortifer Walker, 1853:353. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED.

Myrmeleon pervigil Walker, 1853:354. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED. Synonomised by Banks, 1913a:153.

Myrmeleon mortifer Walk.; Hagen, 1860:364.

Creagris mortifer (Walk.), Hagen, 1866:401, 444.

Creagris nigro-strigatus MacLachlan, 1867:245. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED. syn. nov.

Creagris mortifer (Walker); MacLachlan, 1867:246.

M[yrmeleon] mortifer Walker; MacLachlan, 1873a:135.

Myrmeleon pervigil Walker; MacLachlan, 1873a:135.

Creagris nigro-strigatus MacLachlan; MacLachlan, 1873a:135.

Creagris litteratus Navas, 1906:3. Reference not seen. Synonomised by Esben-Petersen, 1920a:192.

Creagris mortifer (Walk.); Banks, 1911:14, 16.

Creagris nigrostrigatus MacL.; Banks, 1911:14.

Creagris mortifer (Walk.); Navas, 1911a:242.

Creagris infirmus Navas, 1912b:58. "Senegal, Dakar". (West Africa). Type-MP. EXAMINED. Synonomised by Banks, 1913a:153.

Creagris mortifer (Walk.); Banks, 1913a:153.

Creagris plagatus Navas, 1912h:39. "Afrique orientale anglaise". (East Africa). Type-MP. EXAMINED. Synonomised by Banks, 1913a:153.

Creagris nigrostriatus [sic!] McLach.; Banks, 1913a:154.

[Creagris] mortiferae [sic!] (Walk.); Navas, 1914a:645.

Creagris mortifera [sic!] (Walker); Navas, 1914e:21.

Creagris plagata Navas; Navas, 1914e:21.

Creoleon nigritarsis Navas, 1921a:304. "Bechuanaland: Gaberones". (Botswana). Type-MP. EXAMINED. syn. nov.

Creagris mortifer (Walker); Esben-Petersen, 1920a:192.

Creoleon mortifer (Walk.), Navas, 1925c:132.

Creoleon mortifer (Walker), Esben-Petersen, 1928c:444.

Gama mortifer (Walker), Banks, 1938b:8.

Creoleon nigritarsis Navas = Creoleon mortifer (Walker).

*Creoleon nubifer (Kolbe, 1898a).

Creagris nubifer Kolbe, 1898a:25. "Insel Sansibar". (Zanzibar). Type-MB. Not examined.

Creagris nubifer Kolbe; v.d. Weele, 1907:273. Referred to Creoleon africanus (Rambur). Incorrect synonomy.

Creagris proximus Péringuey, 1910:446. "Natal (Maritzburg) Transvaal (Rustenburg)". Type-SAM. EXAMINED. Synonomised by Banks, 1911:15

Creagris nubifer Kolbe; Banks, 1911:15.

Creagris proximus Péringuey; Navas, 1911a:241.

Creagris nubifer Kolbe; Navas, 1911a:241.

Creagris nubifer Kolbe; Navas, 1912a:406.

Creagris nubifera [sic!] Kolbe; Navas, 1914e:21.

Creagris junodi Esben-Petersen, 1916:16. "Botchabelo, South Africa". Type-ZMCU. EXAMINED. syn. nov.

Creagris nubifer Kolbe; Banks, 1920:23.

Creoleon nubifer (Kolbe); Esben-Petersen, 1928a:209

Creagris damarinus Péringuey, Esben-Petersen, 1928a:209. Incorrect synonomy .

Creoleon venosus (Navas, 1914).

Creagris venosa Navas, 1914a:645. "Afrimer. Bloemfontein". (South Africa). Type-CUM. Not examined.

Creoleon venosus (Navas), comb. nov.

Genus CUETA Navas, 1911.

Cueta Navas, 1911a:242. Type species by original designation = Cueta trilineata Navas, 1911a:243.

Cueta Navas; Navas, 1914e:17.

Polancus Navas, Navas, 1914e:19. Type species by original designation = Polancus secretus Navas, 1914e:19. Synonomised by Markl, 1954:229.

Cueta Navas; Banks, 1920:22, 28.

Cueta Nav. Navas, 1931c:124.

Cueta Navas; Kimmins, 1943:152.

Cueta Navas; Markl, 1954:229.

Cueta Navas; Hölzel, 1969:308.

Cueta Navas; Hölzel, 1972:27.

Cueta damarensis Navas = Cueta trivirgata (Gerstaecker)

Cueta dissimulata Navas = Cueta trivirgata (Gerstaecker)

Cueta heynei Navas = Cueta mysteriosa (Gerstaecker).

***Cueta* *infima* Navas, 1914.

Cueta infima Navas, Navas, 1914a:641. "S. Africa, Port Elizabeth". Type-NMV. Photograph of type EXAMINED.

Cueta infirma [sic!] Navas; Esben-Petersen, 1920a:192. Referred to *Cueta* *trivirgata* (Gerst.). Incorrect synonomy.

Cueta infirma [sic!] Navas; Esben-Petersen, 1928a:214. Referred to *Nesoleon* *trivirgatus* (Gerst.). Incorrect synonomy.

***Cueta* *mossambica* Navas, 1914.

Cueta mossambica Navas, 1914e:637. "Mozambique" Type-CUM. Not examined. Is probably *C.* *mysteriosa* (Gerst.).

***Cueta* *mysteriosa* (Gerstaecker, 1894).

Myrmeleon mysteriosus Gerstaecker, 1894:141. "Lindi Afrique orientalis". (Tanzania). Type-ZIMG. Not examined.

Myrmeleon mysteriosus Gerstaecker; Kolbe, 1898a:19.

Myrmeleon mysteriosus Gerstaecker; v.d. Weele, 1909a:66. Referred to *Myrmeleon* *variegatus* Klug. Incorrect synonomy.

Myrmeleon mysteriosus Gerstaecker; v.d. Weele, 1910:16. Referred to *Myrmecaelurus* *variegatus* (Klug). Incorrect synonomy.

Nesoleon mysteriosus (Gerst.), Banks, 1911:7. 8.

Nesoleon mysteriosus (Gerst.); Navas, 1911a:242.

Nesoleon mysteriosus (Gerst.); Banks, 1913a:155, 156.

Myrmeleon mysteriosus Gerst.; Navas, 1914a:639.

Myrmeleon mysteriosus Gerstaecker; Navas, 1914e:17.

Cueta mysteriosa (Gerstaecker), Navas, 1914e:17.

Cueta Heynei [sic!] Navas, 1915a:26. "Baie Delagoa" (Mocambique). Type-MP. EXAMINED. *syn.* *nov.*

Cueta mysteriosa (Gerstaecker); Banks, 1920:22, 28.

Cueta mysteriosa (Gerst.); Navas, 1926b:86.

Cueta mysteriosa (Gerst.); Navas, 1929a:95.

Cueta mysteriosa (Gerst.); Navas, 1933b:310.

Cueta mysteriosa (Gerstaecker); Navas, 1936b:106.

Cueta mysteriosa (Gerst.); Banks 1938b:8.

*Cueta punctatissima (Gerstaecker, 1894).

Myrmeleon punctatissimus Gerstaecker, 1894:142. "Lindi Africae orientalis". (Tanzania). Type-ZIMG. Photograph of type EXAMINED.

Myrmeleon punctatissimus Gerstaecker; Kolbe, 1898a:19.

Nesoleon punctatissimus (Gerst.), Banks, 1911:7, 8.

[Nesoleon] punctatissimus (Gerst.); Navas, 1912d:235.

[Cueta] punctatissimae [sic!] (Gerst.); Navas, 1914a:639, 641.

Cueta punctatissima (Gerst.); Navas, 1914c:372.

Cueta punctatissimae [sic!] (Gerst.); Navas, 1915b:176.

Cueta punctatissima (Gerstaecker); Banks, 1920:28.

Cueta punctatissima (Gerst.); Esben-Petersen, 1920a:192.

Cueta punctatissima (Gerst.); Navas, 1921a:296.

Cueta punctatissima (Gerst.); Navas, 1926a:81.

Cueta punctatissima (Gerst.); Navas, 1926b:86.

Cueta punctatissima (Gerst.); Navas, 1929a:95.

Cueta punctatissima (Gerst.); Navas, 1931a:102.

Cueta punctatissima (Gerst.); Navas, 1931b:262.

Cueta punctatissimus (Gerst.); Navas, 1932a:272.

Cueta punctatissimus (Gerst.); Navas, 1934a:50.

Nesoleon punctatissimus (Gerstaecker); Esben-Petersen, 1936:206.

Cueta punctatissima (Gerst.); Navas, 1936a:338.

Cueta transvaalensis Navas 1914.

Cueta transvaalensis Navas, 1914a:638. "Transvaal". (South Africa). Type-MG. Not examined.

Cueta transvaalensis Navas; Navas, 1927a:13.

*Cueta trivirgata (Gerstaecker, 1885).

Myrmeleon trivirgatus Gerstaecker, 1885:32. "Transvaal" (South Africa). Type-ZIMG. Photograph of type EXAMINED.

Myrm[eleon] trivirgatus Gerst.; Gerstaecker, 1894:142.

Creagris bechuanus Péringuey, 1910:447. "Bechuanaland (Mochudi)". (Botswana) Type-SAM. EXAMINED. *syn. nov.*

Nesoleon trivirgatus (Gerst.), Banks, 1911:7, 8.

Creagris bechuanus Péringuey; Banks, 1911:16.

Cueta dissimulata Navas, 1913c:269. "Pretoria". (South Africa). Type-BMNH. EXAMINED. *syn. nov.*

Cueta damarensis Navas, 1914a:636. "Damara". (South West Africa). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1920a:192.

Cueta infima Navas, Esben-Peterson, 1920a:192. Incorrect synonomy .

Cueta trivirgata (Gerst.); Esben-Petersen, 1920a:192.

Nesoleon trivirgatus (Gerstaecker), Esben-Petersen, 1928a:214.

Genus *CYMOTHALES* Gerstaecker, 1894.

Cymothales Gerstaecker, 1894:127. Type species by original designation = *Cymothales mirabilis* Gerstaecker, 1894:128.

Cymothales Gerstaecker, Kolbe, 1898a:5, 16.

Cymothales Gerst.; v.d. Weele 1907:267.

Cymothales Gerstaecker; v.d. Weele, 1908:61.

Cymothales Gerst.; Banks, 1911:26.

Mironus Navas, 1913a:497. Type species by original designation = *Mironus illustris* Navas, 1913a:497. Synonomised by Esben-Petersen, 1916:17.

Cymothales Gerstaecker; Esben-Petersen, 1916:17.

Cymothales Gerstaecker; Banks, 1920:24, 28.

Cymothales Gerstaecker; Fraser, 1951:353.

Cymothales Gerst.; Markl, 1954:187, 195, 221.

Mironus Navas; Markl, 1954:221.

**Cymothales eccentros* (Walker, 1860)

Myrmeleon eccentros Walker, 1860:193. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED.

Myrmeleon eccentros Walker; Hagen, 1866:405, 438.

Glenurus eccentros (Walk.), Hagen, 1866:405.

Myrm[eleon] eccentros Walk.; Gerstaecker, 1888:105.

Cymothales eccentros (Walker), Gerstaecker, 1894:127.

Cymothales eccentros (Wlk.); Kolbe, 1898a:16.

Cymothales eccentros (Walker); Banks, 1911:26.

Cymothales eccentros (Walk.); Banks, 1913a:155.

*Cymothales illustris (Navas, 1913),

Mironus illustris Navas, 1913a:497. "Frasburg". (Fraserburg, Cape Province). Type-BMNH. EXAMINED.

Mironis speciosus Navas, 1913a:498. Locality not cited. Type-BMNH. EXAMINED. syn. nov.

Cymothales illustris (Navas), comb. nov.

*Cymothales mirabilis (Gerstaecker, 1894).

Cymothales mirabilis Gerstaecker, 1894:128. "Camerun". (Cameroun, West AFrica). Photograph of type EXAMINED.

Cymothales mirabilis Gerst.; Kolbe, 1898a:16.

Cymothales mirabilis Gerst.; v.d. Weele, 1905:5.

Cymothales mirabilis Gerst.; v.d. Weele, 1908:61.

Cymothales mirabilis Gerst.; Banks, 1911:26, 27.

Cymothales mirabilis Gerstaecker; Esben-Petersen, 1916:17.

Cymothales mirabilis Gerstaecker; Banks, 1920:28.

Cymothales mirabilis Gerst.; Navas, 1921a:304.

Cymothales mirabilis Gerst.; Markl, 1954:195.

Genus ECHTHROMYRMEX MacLachlan, 1867. [Does not occur in southern Africa]

Echthromyrmex fascipennis Banks = Palparidius fascipennis (Banks).

Genus EXAETOLEON Kimmins, 1948.

Exaetoleon Kimmins, 1948:236. Type species by original designation = Myrmeleon obtabilis Péringuey, 1910:444.

Exaetoleon Kimmins; Markl, 1954:243.

*Exaetoleon obtabilis (Péringuey, 1910).

Myrmeleon obtabilis Péringuey, 1910:444. "Cape Colony (Caledon)". Type-SAM. EXAMINED.

Exaetoleon obtabilis (Péringuey), Kimmins, 1948:236.

Genus FORMICALEO Leach = FORMICALEON Banks and MACRONEMURUS Costa (partim)

Formicaleo atomarius Navas = Formicaleon atomarius (Navas)

Formicaleo fictus Navas = Macronemurus fictus (Navas)

Formicaleo natalicus = Formicaleon natalicus (Navas)

Formicaleo perlatus Gerstaecker = Macronemurus perlatus (Gerstaecker)

Formicaleo leucospilos Hagen = Banyutus lethalis (Walker)

Genus FORMICALEON Banks, 1911.

Formicaleon Banks, 1911:16. Type species by original designation = Myrmeleon tetragrammicus Fabricius [cited by Banks, 1911:16].

Formicaleon Banks; Banks, 1913a:153.

Formicaleon Banks; Banks, 1920:23, 27.

Formicaleon Banks; Markl, 1954:237, 238.

Formicaleon Banks; Hölzel, 1970:134.

Formicaleon atomarius (Navas, 1912)

Formicaleo atomarius Navas, 1912b:64. "Blocksberg, Johannesburg". (Boksburg, South Africa). Type-BMNH. EXAMINED.

Formicaleo atomarius Navas; Banks, 1913a:152. Referred to Macronemurus tinctus Kolbe. Incorrect synonomy.

Formicaleon natalicus (Navas, 1912).

Formicaleo natalicus Navas, 1912d:247. [No additional data.]

*Formicaleon pondoensis Kimmins, 1948.

Formicaleon pondoensis Kimmins, 1948:236. "S. Africa, Pondoland, Port St. John". Type-BMNH. EXAMINED.

Genus FURGELLA Markl, 1953.

Furgella Markl, 1953:227. Type species by original designation and monotypy = Furgella intermedia Markl, 1953:278.

Furgella Markl; Markl, 1954:228.

Furgella Markl; Hölzel, 1969:307.

**Furgella* *damarinus* (Péringuey, 1910)

Creagris damarinus Péringuey, 1910:448. "Damaraland". (South West Africa). Type-SAM. EXAMINED.

Creagris damarinus Péringuey; Banks, 1911:16.

Creagris damarinus Péringuey; Esben-Petersen, 1928a:209. Referred to *Creoleon* *nubifer* Kolbe Incorrect synonomy.

Furgella intermedia Markl, 1953:278. "Asab, S.W. Afr., Wanetsi Riv. Mozambique, Kiries S.W. Afr." Type-SAM. EXAMINED. *syn*. *nov*.

Furgella damarinus (Péringuey), *comb*. *nov*.

Genus *GAMA* Navas = *CREOLEON* Tillyard

Genus *GANDULUS* Navas, 1912.

Gandulus Navas, 1912b:73. Type species by original designation and monotypy = *Gandulus* *leptogaster* Navas, 1912b:73.

Gandulus Navas; Esben-Petersen, 1916:18.

Gandulus Navas; Markl, 1954:239.

**Gandulus* *filiformis* (Gerstaecker, 1885).

Myrmeleon filiformis Gerstaecker, 1885:31. "Abo (Camaroons)". Type-ZIMG. Photograph of type EXAMINED.

Myrmeleon filiformis Gerst.; v.d. Weele, 1905:5.

Nemoleon filiformis (Gerst.), Banks, 1911:20, 22.

Neuroleon filiformis (Gerst.), Banks, 1913a:155.

Gandulus leptogaster Navas, 1912b:73. "Africa del Sur inglesa, Salisbury". Type-BMNH. EXAMINED. Synonomised by Banks, 1913a:155.

Gandulus filiformis (Gerst.), Esben-Petersen, 1916:19.

Neuroleon filiformis (Gerst.); Banks, 1920:23.

Gandulus filiformis (Gerst.); Esben-Petersen, 1931:93.

Gandulus filiformi [sic!] (Gerst.); Navas, 1936a:339.

Gandulus leptogastro [sic!] Gerst.; Navas, 1936a:342.

Nemoleon filiformis (Gerst.); Markl, 1954:239.

Gandulus leptogaster Navas = Gandulus filiformis (Gerstaecker).

Gandulus risi Esben-Petersen, 1916.
Gandulus risi Esben-Petersen, 1916:20. "Shilomane, Transvaal". (Shiluvane). Type-ZMCU. EXAMINED.

Genus GOLAFRUS Navas, 1912.
Golafrus Navas, 1912b:86. Type species by original designation = Palpares oneili Péringuey, 1911:35.
Golafrus Navas; Banks, 1913b:180.
Golafrus Navas; Markl, 1954:215, 216.

*Golafrus oneili (Péringuey, 1911).
Palpares oneili Péringuey, 1911:35. "Cape Colony (Oudtshoorn)". Type-SAM. EXAMINED.
Palpares Oneili [sic!] Péringuey; Navas, 1912e:86.
Golafrus oneili Péringuey, Navas, 1912e:86.
Palpares oneili Péring.; Banks, 1913b:180.
Golafrus oneili (Péringuey); Esben-Petersen, 1928a:209.
Golafrus oneili (Péringuey); Markl, 1954:207.

Genus GROCUS Navas = MYRMELEON Linnaeus

Grocus fulvinervus Navas = Myrmeleon lanceolatus Rambur

Grocus melanurus Navas = Myrmeleon melanurus (Navas)

Grocus pallescens Navas = Myrmeleon pallescens (Navas)

Grocus uniformis Navas = Myrmeleon uniformis (Navas)

Genus HAGENOMYIA Banks, 1911.
Hagenomyia Banks, 1911:8. Type species by original designation = Myrmeleon tristis Hagen [sic!] [cited by Banks, 1911:8].
Hagenomyia Banks; Navas, 1912d:244.
Hagenomyia Banks; Navas, 1914e:16.
Hagenomyia Banks; Banks, 1920:26.
Hagenomyia Banks; Navas, 1921b:227.

Nelees Navas, 1911b:244. Type species by original designation = Myrmeleon tristis Walker, 1853:373. Synonomised by Kimmins, 1938:366.

Hagenomyia Banks; Kimmins, 1938:366.

Hagenomyia Banks; Markl, 1954:233.

Hagenomyia Banks; Stange, 1970:21.

*Hagenomyia lethifer (Walker, 1853).

Myrmeleon lethifer Walker, 1853:374. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED.

Myrmeleon lethifer Walker; Hagen, 1860:368.

Myrmeleon lethifer Walker; Hagen, 1866:412.

Myrmeleon lethifer Walker; MacLachlan, 1867:279.

Myrmeleon nigridorsis Kolbe, 1898a:18. "Kitui in Ukamba". (East Africa, Kenya). Type-MB. Not examined. Synonomised by Banks, 1911:10.

Myrmeleon lethifer Walker; Banks, 1911:9, 10.

Hagenomyia luctosa Navas, 1912d:245. "Transvaal, Tongaat, Natal". Type-BMNH. EXAMINED. Synonomised by Banks, 1913a:151.

Myrmeleon lethifer Walk.; Banks, 1913a:151.

Hagenomyia lethifera (Walk.); Navas, 1914e:17.

Hagenomyia lethifera (Walk.); Navas, 1926b:86.

Hagenomyia lethifera (Walk.); Navas, 1934a:50.

Hagenomyia luctosa Navas = Hagenomyia lethifer (Walker)

*Hagenomyia tristis (Walker, 1853).

Myrmeleon tristis Walker, 1853:373. "Congo". (Zaire). Type-BMNH. EXAMINED.

M[yrmeleon] tristis Walk.; Hagen, 1860:367.

Myrmeleon tristis Walk.; Hagen, 1866:433, 449.

Myrmecaelurus tristis (Walk.), Hagen, 1866:433, 449.

Myrmeleon tristis Walker; MacLachlan, 1867:279.

Myrmeleon tristi [sic!] Wlk.; Kolbe, 1898a:18.

Myrmeleon tristis Walker; v.d. Weele, 1907:271.

Myrmecaelurus tristis (Walker); v.d. Weele, 1909a:63.

Myrmecaelurus tristis (Walker); v.d. Weele, 1910:16.

Hagenomyia tristis Hagen [sic!] , Banks, 1911:9.

Nelees tristis Hagen [sic!] , Navas, 1911b:244.

Hagenomyia tristis (Walk.); Navas, 1912a:406.
Myrmeleon tristis Walk.; Navas, 1912d:244.
Hagenomyia tristis (Walk.); Navas, 1912i:95.
Hagenomyia tristis Hag. [sic!] ; Navas, 1914c:372.
Hagenomyia tristis (Walk.); Navas, 1914d:93.
Hagenomyia tristis (Walker); Navas, 1914e:16.
Hagenomyia tristis (Walk.); Esben-Petersen, 1928a:214.
Hagenomyia tristis (Hagen) [sic!] ; Banks, 1920:26.
Hagenomyia tristis (Walk.); Navas, 1921a:296.
Hagenomyia tristis Hag. [sic!] ; Navas, 1921b:227.
Hagenomyia tristis (Walk.); Navas, 1926b:86.
Hagenomyia tristis (Walk.); Navas, 1929a:95.
Hagenomyia tristis Hag. [sic!] ; Navas, 1931a:102.
Hagenomyia tristis (Walk.); Navas, 1931b:261.
Hagenomyia tristis (Walk.); Navas, 1931c:126.
Hagenomyia tristis (Walk.); Navas, 1933b:311.
Hagenomyia tristis (Walk.); Navas, 1936a:338.
Hagenomyia tristis (Walk.); Markl, 1954:200.

Genus *ISONEMURUS* Esben-Petersen, 1928

Isonemurus Esben-Petersen, 1928a:210. Type species by original designation and monotypy = *Isonemurus longipalpis* Esben-Petersen, 1928a:211.

Isonemurus Esben-Petersen; Markl, 1954:218, 219.

**Isonemurus longipalpis* Esben-Petersen, 1928a:211. "Usakos". (South West Africa). Type-HM?. Not examined.

Genus *JAYA* Navas = *CENTROCLISIS* Navas

Genus *LADRUS* Navas, 1929.

Ladrus Navas, 1929b:24. Type species by original designation and monotypy = *Ladrus variipennis* Navas, 1929b:24.

Ladrus Navas; Markl, 1954:239.

Ladrus variipennis Navas, 1929.

Ladrus variipennis Navas, 1929b:24. "Karabib, S.W. Afr."
Type-NCOLL. Not examined.

Genus LACHLATHETES Navas, 1926.

Symmathetes MacLachlan, 1867:237. Type species not designated.
Symmathetes MacLachlan; Hagen, 1887:133.
Symmathetes MacLachlan; Gerstaecker, 1888:95.
Symmathetes MacLachlan; v.d. Weele, 1907:252.
Symmathetes MacLachlan; Navas, 1912d:203.
Symmathetes MacLachlan; Esben-Petersen, 1916:2.
Symmathetes MacLachlan; Navas, 1926e:155.
Lachlathetes Navas, Navas, 1926e:155. Nom. nov. for Symmathetes MacLachlan, 1867, nec Symmathetes Schoenherr 1848 .
Lachlathetes Navas; Markl, 1954:216.

*Lachlathetes moestus (Hagen, 1853).

Palpares moestus Hagen, 1853:482. "Mocambique". Type - not located.
Palpares moestus Hagen; Hagen, 1860:360.
Palpares moestus Hagen; Hagen, 1862:96.
Palpares moestus Hagen; Gerstaecker, 1863:187.
Palpares moestus Hagen; Hagen, 1866:457.
Palpares moestus Hagen; MacLachlan, 1867:237.
Symmathetes moestus (Hagen), MacLachlan, 1873b:144.
P[alpares] moestus Hagen; Hagen, 1887:133.
Palp[ares] moestus Hag.; Gerstaecker, 1888:95.
Palpares moestus Hagen; Kolbe, 1898a:7.
Palpares moestus Hag.; Kolbe, 1898a:229.
P[alpares] moestus Hagen; Péringuey, 1910:434.
Palpares moestus Hagen; Banks, 1911:3.
Palpares moestus Hag.; Stitz, 1912:113.
Symmathetes moestus (Hag.); Navas, 1912d:205.
Symmathetes moestus (Hag.); Navas, 1912g:24.
Palpares moestus Hag.; Banks, 1913b:177.
Symmathetes moestus (Hag.) var. Joannisi [sic!] , Navas, 1921a:295.
Lachlathetes moestus (Hag.), Navas, 1931a:101.
Palpares moestus Hagen; Mansell, 1974:80.

Genus MACROLEON Banks = MYRMELEON Linnaeus

Genus MACRONEMURUS Costa, 1855.

Macronemurus Costa, 1855:10. Original reference not seen.

Macronemurus Costa; Hagen, 1860:359, 366.

Macronemurus Costa; Hagen, 1866:372, 432.

Macronemurus Costa; MacLachlan, 1867:274.

Macronemurus Costa; MacLachlan, 1873a:133.

Macronemurus Costa; Hagen, 1873:383, 393.

Macronemurus Costa; Hagen, 1887:152.

Macronemurus Costa; Kolbe, 1898a:21.

Macronemurus Costa; v.d. Weele, 1909a:65.

Macronemurus Costa; Navas, 1911a:242.

Macronemurus Costa; Banks, 1911:22.

Macronemuro [sic!] Costa; Navas, 1912e:96.

Macronemurus Costa; Banks, 1913a:152.

Macronemurus Costa; Navas, 1914e:25.

Macronemurus Costa; Esben-Petersen, 1925:337, 339.

Macronemurus Costa; Navas, 1930b:122.

Macronemurus Costa; Markl, 1954:237.

Macronemurus Costa; Hölzel, 1972:44.

*Macronemurus chloranthe Banks, 1911.

Macronemurus chloranthe Banks, 1911:23. "Okahanda, S.W.Afrika". Type-MB?.

Nelees modestus Navas, 1912b:68. "Africa, Dahomey, cerca de Porto Novo". Type-MP. EXAMINED. Synonomised by Banks, 1913a:152.

Macronemurus cloranthe [sic!] Banks; Banks, 1913a:152.

Macronemurus chloranthe Banks; Esben-Petersen, 1925:337.

Macronemurus chloranthe Banks; Esben-Petersen, 1928a:210.

Macronemurus euanthe Banks, 1911.

Macronemurus euanthe Banks, 1911:24. "Rietfontein D.S.W. Afrika". (South West Africa). Type-MB?.

Macronemurus euanthe Banks; Banks, 1913a:152.

Formicaleo inaequalis Navas, 1912b:66. "Qualaba R." (Lualaba River, Zaire). Type-BMNH. EXAMINED. Synonomised by Banks, 1913a:152.

[Macronemurus] euanthe Banks; Navas, 1913c:270.

Macronemurus euanthe Banks; Esben-Petersen, 1928a:10.

Macronemurus fictus (Navas, 1913).

Formicaleo fictus Navas, 1913c:270. "Pretoria". (South Africa). Type-BMNH. EXAMINED.

Macronemurus fictus (Navas), comb. nov.

Macronemurus nuncius Navas, 1913.

Macronemurus nuncius Navas, 1913c:270. "Barbeton". (South Africa). Type-BMNH. EXAMINED.

*Macronemurus perlatus (Gerstaecker, 1885).

Formicaleo perlatus Gerstaecker, 1885:14. "Transvaal". (South Africa). Type-ZIMG. Not examined.

Formicaleo perlatus Gerstaecker; Gerstaecker, 1894:133, 134.

Macronemurus perlatus (Gerstaecker), Esben-Petersen, 1928a:210.

Macronemurus perlatus (Gerstaecker); Esben-Petersen, 1928c:445.

*Macronemurus striola Kolbe 1898.

Macronemurus striola Kolbe, 1898a:21. "Insel Sansibar und Festland Sansibar". Type-MB. Photograph of type EXAMINED.

Macronemurus striola Kolbe; Banks, 1911:22, 23.

Macronemurus striola Kolbe; Banks, 1913a:152.

Nelees Mayeri [sic!] Navas, 1914b:83. "D.O. Afrika; Dar es Salam". Type-NMV. Photograph of type EXAMINED. Synonomised by Esben-Petersen, 1920a:191.

Nelees impar Navas, 1914b:84. "Zanzibar, Zanguebar". Type-NMV. Cotypes EXAMINED. Synonomised by Esben-Petersen, 1920a:191.

Macronemurus striola Kolbe; Esben-Petersen, 1920a:191.

Macronemurus tinctus Kolbe, 1898

Macronemurus tinctus Kolbe, 1898a:22. "Kitui in Ukamba und Ndi, Kakoma in Ugunda, Delagoa-Bay". Type-MB. Photograph of type EXAMINED.

Macronemurus tinctus Kolbe; Banks, 1911:23.

Macronemurus tinctus Kolbe; Navas, 1914e:25.

Macronemurus tinctus Kolbe; Navas, 1936a:344.

Genus _MAULA_ Navas, 1912.

Maula Navas, 1912i:96. Type species by original designation and monotypy = _Maula_ _stigmatus_ Navas, 1912i:96.

Maula Navas; Banks, 1920:28.

Maula Navas; Markl, 1954:218, 219.

*_Maula_ _stigmatus_ Navas 1912.

Maula stigmatus Navas, 1912i:96. "Kalengua". (Zaire). Type-MRAC. EXAMINED.

Maula stigmatus Navas; Banks, 1920:28.

Maula stigmata [sic!] Navas; Markl, 1954:199, 219.

Genus _MIRONUS_ Navas = _CYMOTHALES_ Gerstaecker

Mironus illustris Navas = Cymothales illustris (Navas)

Mironus speciosus Navas = Cymothales illustris (Navas)

Genus _MOCHUS_ Navas, 1925.

Mochus Navas, 1925a:206. Type species by original designation and monotypy = _Mochus_ _capensis_ Navas, 1925a:206.

Mochus Navas; Markl, 1954:242.

Mochus _capensis_ Navas, 1925a:206. "Sud-Kapkolonie: Jan Dutoit's Kloof (Waaihoek Berge)". (Cape Province). Type-DEIE. Not examined.

Genus _MORTER_ Navas = _MYRMELEON_ Linnaeus

Genus _MYRMECOLEON_ Burmeister = _MYRMELEON_ Linnaeus

Myrmecoleon caffer Burmeister = Palpares caffer (Burmeister).

Myrmecoleon conspurcatus Burmeister = Pamexis conspurcatus (Burm.)

Myrmecoleon luteipennis Burmeister = Creoleon luteipennis (Burmeister).

Myrmecoleon pardalinus Burmeister = Palpares bifasciatus (Olivier)

Myrmecoleon venosus Burmeister = Pamexis luteus (Thunberg).

Genus *MYRMELEODES* Navas = *MYRMELEON* Linnaeus

Myrmeleodes medius Navas = Myrmeleon doralice Banks

Genus *MYRMELEON* Linnaeus, 1767.

Myrmeleon Linnaeus, 1767:913. Type species *Myrmeleon formicarius* Linnaeus, 1767:914.

Myrmeleon Linn.; Latreille, 1807:29.

Myrmecoleon Burmeister, 1839:989. Type species not designated. Synonomised by Hagen, 1866:433.

Myrmeleon Fabricius [sic!] ; Rambur, 1842:382.

Myrmeleon Linn.; Walker, 1853:300, 328.

Myrmeleon Linnaeus; Hagen, 1860:359, 360.

Myrmeleon Linné; Hagen, 1862:101.

Myrmeleon Linnaeus; Hagen, 1866:372, 434.

Myrmeleon Linnaeus; MacLachlan, 1867:273, 274.

Myrmeleon Linnaeus; MacLachlan, 1873a:133.

Myrmeleon Linnaeus; Redtenbacher, 1884:345, 359.

Myrmeleon Linnaeus; Kolbe, 1898a:5, 18.

Myrmeleon Linné; v.d. Weele, 1907:273.

Myrmeleon L.; v.d. Weele, 1909b:16.

Macroleon Banks, 1909:4. Type species by original designation = *Myrmeleon validus* MacLachlan, 1894:515. Placed as a sub-genus by Banks, 1911:9.

Myrmeleon Linné; v.d. Weele, 1910:13.

Myrmeleon Linn,; Péringuey, 1910:443.

Myrmeleon Linnaeus; Banks, 1911:2, 9.

Myrmeleon Linnaeus; Navas, 1911a:242.

Myrmeleon L.; Navas, 1912b:30.

Myrmeleodes Navas, 1912d:242. Type species by original designation and monotypy = *Myrmeleodes medius* Navas, 1912d:243. Synonomised by Banks, 1913a:150.

Myrmeleon Linnaeus; Navas, 1912d:242, 244.

Macroleon Banks; Navas, 1912d:244.

Myrmeleon Linné; Navas, 191 e:14.

Macroleon Banks; Navas, 1914e:16.

Morter Navas, 1915c:466. Type species *Myrmeleon hyalinum* Oliver, 1811:126. Placed as a sub-genus by Esben-Petersen, 1928a:214.

Myrmeleon Linné; Esben-Petersen, 1918:124.

Myrmeleon Linné; Banks, 1920:22, 27.

Macroleon Banks; Banks, 1920:27.

Myrmeleon L.; Navas, 1925b:185.

Grocus Navas, 1925b:185. Type species by original designation = *Grocus Gerstaeckeri* [sic!] Navas, 1925b:185. Synonomised by Hölzel, 1972:37.

Myrmeleon L.; Navas, 1926d:58.

Morter Nav.; Navas, 1926d:58.

Afroleon Navas, 1927a:13. Type species by original designation and monotypy = *Afroleon basutus* Navas, 1927a:13. *syn. nov.*

Grocus Navas; Navas, 1927a:13.

Myrmeleodes Navas; Esben-Petersen, 1928a:214.

Morter Navas; Esben-Petersen, 1928a:214.

Myrmeleon L.; Navas, 1934b:500.

Macroleon Banks; Navas, 1936a:335, 336.

Myrmeleon L.; Navas, 1936a:337.

Myrmeleon L.; Navas, 1936b:103, 105.

Grocus Navas; Navas, 1936b:104, 105.

Grocus Navas; Navas, 1936c:165.

Myrmelodes [sic!] Navas; Banks, 1941:5.

Myrmeleon Linné; Markl, 1954:233.

Macroleon Banks; Markl, 1954:233.

Myrmeleodes Navas; Markl, 1954:233.

Morter Navas; Markl, 1954:233.

Grocus Navas; Markl, 1954:233.

Myrmeleon Linné; Hölzel, 1972:36.

Morter Navas; Hölzel, 1972:37.

Grocus Navas; Hölzel, 1972:37.

*_Myrmeleon alcestris_ Banks 1911

Myrmeleon alcestris Banks, 1911:11. "Rietfontein, D.S.W. Afrika". (South West Africa). Type-MB. Not examined.

Myrmeleon sciopterus Navas, 1914b:93. "Damara". (South West Africa). Type-NMV. Photograph of type EXAMINED. Synonomised by Esben-Petersen, 1928a:215.

Myrmeleon alcestris Banks; Esben-Petersen, 1928a:215.

Myrmeleon bifasciatum Olivier = Palpares bifasciatus (Olivier)

Myrmeleon boschimanus Péringuey = Nesoleon boschimanus (Péringuey)

Myrmeleon callidus Walker = Nemoleon callidus (Walker)

Myrmeleon capensis Rambur = Myrmeleon obscurus Rambur

*Myrmeleon doralice Banks, 1911:10. "Windhoek, D.S.W. Afrika". (South West Africa). Type-MB. Not examined.

Myrmeleodes medius Navas, 1912d:243. "Colonie du Cap, Steynsburg". (Cape Province). Type-MP. EXAMINED. Synonomised by Banks, 1913a:150.

Myrmeleon doralice Banks; Banks, 1913a:150.

Myrmeleon praetor Navas, 1914a:634. "Transvaal, Pretoria". Type-BMNH. EXAMINED. Synonomised by Esben-Petersen, 1928a:214.

Myrmeleon doralice Banks; Esben-Petersen, 1916:15.

Morter Doralice [sic!] (Banks), Navas, 1921a:296.

Morter doralice (Banks); Esben-Petersen, 1928a:214.

Myrmeleon doralice Banks; Banks, 1941:5.

Myrmeleodes medius Navas; Markl, 1954:195.

Myrmeleon eccentros Walker = Cymothales eccentros (Walker)

Myrmeleon fusiformis Esben-Petersen = Myrmeleon obscurus Rambur

Myrmeleon inclemens Walker = Palpares inclemens (Walker)

Myrmeleon insperatus Navas, 1914.

Myrmeleon insperatus Navas, 1914a:633. "Cabo de Buena Esperanza". (Cape of Good Hope, South Africa). Type-MG. Not examined.

*Myrmeleon lanceolatus Rambur, 1842.

Myrmeleon lanceolatus Rambur, 1842:401. "d'Afrique". (Africa). Type-MP. EXAMINED.

Myrmeleon ochronevrus Rambur, 1842:404. "du Cap". (Cape Province). Type-IRSN. EXAMINED. syn. nov.

Myrmeleon lanceolatus Ramb.; Walker, 1853:369.

Myrmeleon ochroneurus [sic!] Ramb.; Walker, 1853:370.

Myrmeleon lanceolatus Ramb.; Hagen, 1860:367.

Myrmeleon ochroneurus [sic!] Ramb.; Hagen, 1860:367.

Myrmeleon lanceolatus Rbr.; Hagen, 1862:104.

Myrmeleon lanceolatus Rbr.; Hagen, 1866:442.

Myrmeleon ochroneurus [sic!] Rbr.; Hagen, 1866:445.

Myrmeleon lanceolatus Rambur; MacLachlan, 1867:278.

M[yrmeleon] lanceolatus Rambur; MacLachlan, 1873a:137, 138.

Myrmeleon ochroneurus [sic!] Rambur; MacLachlan, 1873a:138.

C[reagris] lanceolatus (Ramb.), Péringuey, 1910:447.

Myrmeleon lanceolatus Rambur; Banks, 1911:8, 15.

Myrmeleon ochroneurus [sic!] Rbr.; Banks, 1913a:151.

Afroleon basutus Navas, 1927a:13. "Basoutoland, Leribé" (Lesotho). Type-MP. EXAMINED. syn. nov.

Grocus fulvinervis Navas, 1934a:49. "Africa, Basoutoland". (Lesotho). Type-MP. EXAMINED. syn. nov.

Myrmeleon lethalis Walker = Banyutus lethalis (Walker)

Myrmeleon lethifer Walker = Hagenomyia lethifera (Walker)

Myrmeleon medialis Banks, 1911.

Myrmeleon medialis Banks, 1911:11. "Natal and Georgetown Cape Colony". (Cape Province). Type-MB. Not examined.

Myrmeleon medialis Banks: Navas, 1921a:295.

Myrmeleon medialis Banks; Banks, 1913a:151.

Morter medialis (Banks), Esben-Petersen, 1928a:215.

Myrmeleon medialis Banks; Youthed & Moran, 1969a:868.

Myrmeleon melanurus (Navas, 1936).

Grocus melanurus Navas, 1936c:164. "S.W. Afrika, Farm Okaundua bei Okahandja". (South West Africa). Type-HM. Destroyed.

Myrmeleon melanurus (Navas), comb. nov.

Myrmeleon mortifer Walker = Creoleon mortifer (Walker).

*_Myrmeleon obscurus_ Rambur, 1842.

Myrmeleon obscurus Rambur, 1842:403. "L'ile Maurice"
(Mauritius). Type-Not located.

Myrmeleon capensis Rambur, 1842:404. "du Cap". (Cape Prcvince).
Type-IRSN. EXAMINED. Synonomised
by Esben-Petersen, 1928a:215.

Myrmeleon obscurus Ramb.; Walker, 1853:370.

Myrmeleon capensis Ramb.; Walker, 1853:370.

Myrmeleon secretus Walker, 1853:375. "Port Natal". (Durban,
Natal). Type-BMNH. EXAMINED.
Synonomised by Banks, 1913a:151.

Myrmeleon fictus Walker, 1853:380. "Congo". (Zaire).
Type-BMNH. Not examined.
Synonomised by Banks, 1913a:151.

M[yrmeleon] obscurus Rbr.; Hagen, 1860:367.

M[yrmeleon] Capensis [sic!] Rbr.; Hagen, 1860:367.

Myrmeleon inconspicuus Hagen (nec Rambur). 1862:104.
Synonomised by v.d. Weele, 1910:14.

Myrmeleon obscurus Rbr.; Hagen, 1866:445.

Myrmeleon obscurus Rambur; MacLachlan, 1873a:138.

Myrmeleon capensis Rambur; MacLachlan, 1873a:138.

Myrmeleon obscurus Rambur; v.d. Weele, 1907:275.

Myrmeleon obscurus Rambur; v.d. Weele, 1909a:66.

Myrmeleon obscurus Rambur; v.d. Weele, 1910:14.

Myrmeleon obscurus Rambur; Banks, 1911:9, 10.

Myrmeleon obscurus Ramb.; Navas, 1911b:244.

Myrmeleon obscurus Ramb.; Navas, 1912a:406.

Myrmeleon obscurus Ramb.; Navas, 1912d:242.

Myrmeleon stigmalis Navas, Banks, 1913a:150.
Incorrect synonomy .

Myrmeleon obscurus Ramb.; Navas, 1912g:89.

Myrmeleon fusiformis Esben-Petersen, 1912:268. "Swakopmund,
German South West Africa".
Type-MB. Not examined.
Synonomised by Esben-Petersen, 1925:338.

Myrmeleon obscurus Rbr.; Banks, 1913a:150, 151.

Myrmeleon capensis Rbr.; Banks, 1913a:151.

Myrmeleon obscurus Rambur; Navas, 1914e:14.

Myrmeleon obscurus Rambur; Esben-Petersen, 1915b:81.

Myrmeleon obscurus Rambur; Banks, 1920:22.

Morter obscurus (Ramb.), Navas, 1921a:296.

Myrmeleon obscurus Rbr. forma capense Rbr., Esben-Petersen, 1925:337.

Myrmeleon obscurus Rbr.; Esben-Petersen, 1925:338.

Morter obscurus (Ramb.); Navas, 1925c:130.

Morter obscurus (Ramb.); Navas, 1926b:86.

Morter obscurus (Ramb.); Navas, 1927a:13.

Myrmeleon obscurus Rambur; Esben-Petersen, 1928a:215.

Morter obscurus (Ramb.); Navas, 1929a:95.

Morter obscurus (Ramb.); Navas, 1930a:305.

Morter obscurus (Ramb.); Navas, 1930b:121.

Morter obscurus (Ramb.); Navas, 1931a:102.

Morter obscurus (Ramb.); Navas, 1931c:124.

Myrmeleon obscurus Ramb.; Esben-Petersen, 1931:94.

Morter obscurus (Ramb.); Navas, 1933b:310.

Morter obscurus (Ramb.); Navas, 1936a:337.

Myrmeleon obscurus Rambur; Fraser, 1951:356.

Myrmeleon obscurus Ramb.; Youthed & Moran, 1969a:867.

Myrmeleon obscurus Ramb.; Youthed & Moran, 1969b:1103.

Myrmeleon obscurus Ramb.; Youthed & Moran, 1969c:1259.

Myrmeleon obtabilis Péringuey = Exaetoleon obtabilis (Péringuey)

Myrmeleon ochronevrus Rambur = Myrmeleon lanceolatus Rambur

Myrmeleon orestes Banks, 1941.

Myrmeleon orestes Banks, 1941:4. "Pretoria and Kimberly, South Africa". Type-AMNH. Not examined.

*Myrmeleon pallescens (Navas, 1934).

Grocus pallescens Navas, 1934b:501. "S.W. Afrika, Farm Okaundua 15km. s.w. Okahandja". Type-HM. Destroyed.

Myrmeleon pallescens (Navas), comb. nov.

Myrmeleon pervigil Walker = Creoleon mortifer (Walker)

Myrmeleon praetor Navas = Myrmeleon doralice Banks

*Myrmeleon quinquemaculatus Hagen, 1853.

Myrmeleon quinquemaculatus Hagen, 1853:482. "Mocambique".
Type-Not located.

M[yrmeleon] 5-maculatus [sic!] Hagen; Hagen, 1860:366.

Myrmeleon quinquemaculatus Hagen; Hagen, 1862:103.

Myrmeleon quinquemaculatus Hagen; Hagen, 1866:405, 417.

Formicaleo quinquemaculatus (Hag.); Hagen, 1866:405.

Myrmeleon 5-maculatus [sic!] Hagen; MacLachlan, 1873a:138.

Myrm[eleon] quinquemaculatus Hagen; Gerstaecker, 1885:21.

Myrmeleon polyzonus Gerstaecker, 1885:21. "Camaroons".
(West Africa). Type-ZIMG?.
Not examined. Synonomised by
v.d. Weele, 1910:14.

Myrmeleon rapax Kolbe, 1898a:20. "Kafuro in Karugue,
westlich von Victoria-Nyansa".
(Tanzania). Type-MB. Photograph
of type EXAMINED. Synonomised
by v.d. Weele, 1910:14.

Myrmeleon quinquemaculatus Hagen; v.d. Weele, 1907:273.

Myrmeleon quinquemaculatus Hagen; v.d. Weele, 1910:14.

Myrmeleon quinquemaculatus Hagen; Banks, 1911:9, 12.

Macroleon quinquemaculatus (Hagen), Navas, 1911a:242.

Macroleon 5-maculatus [sic!] (Hagen); Navas, 1912a:407.

Macroleon quinquemaculatus (Hagen); Navas, 1912d:244.

Macroleon quinquemaculatus (Hag.); Navas, 1914a:635.

Macroleon quinquemaculatus (Hagen); 1914e:16.

Macroleon 5-maculatus [sic!] (Hag.); Navas, 1921a:296.

Macroleon 5-maculatus [sic!] (Hag.); Navas, 1926b:86.

Macroleon 5-maculatus [sic!] (Hag.); Navas, 1929a:95.

Macroleon 5-maculatus [sic!] (Hag.); Navas, 1931b:261.

Macroleon quinquemaculatus (Hag.); Navas, 1931c:124.

Macroleon quinquemaculatus (Hag.); Navas, 1933b:310.

Macroleon quinquemaculatus (Hag.); Navas, 1936a:335.

Myrmeleon sciopterus Navas = Myrmeleon alcestris Banks

Myrmeleon secretus Walker = Myrmeleon obscurus Rambur

Myrmeleon sinuatum Olivier = Crambomorphus sinuatus (Olivier)

*Myrmeleon stigmalis Navas, 1912.

Myrmeleon stigmalis Navas, 1912e:90. "Mozambique, Valle de Pungoue". Type-MP. EXAMINED.

Myrmeleon stigmalis Navas; Banks 1913a:150. Referred to Myrmeleon obscurus Ramb. Incorrect synonomy.

Myrmeleon translatus Walker = Pamexis translatus (Walker).

Myrmeleon tristis Walker = Hagenomyia tristis (Walker)

Myrmeleon trivirgatus Gerstaecker = Cueta trivirgata (Gerstaecker)

Myrmeleon uniformis (Navas, 1936).

Grocus uniformis Navas, 1936c:163. "S.W. Africa, Farm Okaundua bei Okahandja". Type-HM. Destroyed.

Genus NANNOLEON Esben-Petersen, 1928.

Nannoleon Esben-Petersen, 1928a:212. Type species by original designation and monotypy = Nannoleon michaelseni Esben-Petersen, 1928a:212.

Nannoleon Esben-Petersen; Markl, 1954:221.

*Nannoleon michaelseni Esben-Petersen, 1928.

Nannoleon michaelseni Esben-Petersen, 1928a:212. "Karabib". (South West Africa). Type-MB. Not examined.

Genus NELEES Navas = HAGENOMYIA Banks, NEUROLEON Navas (Partim).

Nelees basutinus Navas = Neuroleon basutinus (Navas)

Nelees braunsi Navas = Neuroleon ? braunsi (Navas)

Nelees guttatus Navas = Neuroleon guttatus (Navas)

Nelees mossambicus Navas = Neuroleon ? mossambicus (Navas)

Nelees muzanus Navas = Neuroleon muzanus (Navas)

Genus *NEMOLEON* Navas, 1909.

Nemoleon Navas, 1909:147. Original reference not seen.

Nemoleon Navas; Banks, 1911:20.

Nemoleon Navas; Navas, 1911a:242.

Nemoleon Navas; Banks, 1920:27.

Nemoleon Navas; Markl, 1954:239.

**Nemoleon* *angustipennis* Péringuey, 1910.

Creagris angustipennis Péringuey, 1910:448. "Cape Colony (King William's Town)". (Cape Province). Type-SAM. EXAMINED.

Creagris angustipennis Péringuey; Banks, 1911:16.

Nemoleon angustipennis (Péringuey), *comb*. *nov*.

Nemoleon *callidus* (Walker, 1853).

Myrmeleon callidus Walker, 1853:384. "Port Natal". (Durban, Natal). Type-BMNH. EXAMINED.

M[yrmeleon] callidus Walk.; Hagen, 1860:368.

Myrmeleon callidus Walk.; Hagen, 1866:436.

Macronemurus callidus (Walker), MacLachlan, 1867:280.

Macronemurus callidus (Wlk.); Kolbe, 1898a:21.

Neuroleon callidus (Walk.); Banks, 1913a:154.

Nemoleon callidus (Walker), *comb*. *nov*.

Genus *NESOLEON* Banks, 1909

Nesoleon Banks, 1909:4. Type species by original designation and monotypy = *Nesoleon* *braunsi* Banks 1909:4.

Nesoleon Banks; Banks, 1911:6, 7.

Nesoleon Banks; Navas, 1911a:243.

Peringus Navas, 1934b:500. Type species by original designation = *Myrmeleon* *boschimanus* Péringuey, 1910:443.
Synonomised by Markl, 1954:229.

Nesoleon Banks; Kimmins, 1943:152.

Nesoleon Banks; Markl, 1954:229.

Nesoleon Banks; Hölzel, 1969:308.

*Nesoleon boschimanus (Péringuey, 1910).

Myrmeleon boschimanus Péringuey, 1910:443. "Cape Colony
Carnarvon District. Bushmanland.
Damaraland". (Cape Province,
South West Africa). Type-SAM.
EXAMINED.

Nesoleon boschimanus (Péringuey), Banks, 1911:7.

Nesoleon boschimanus (Péring.); Navas, 1912g:91.

Nesoleon boschimanus (Péringuey); Esben-Petersen, 1928a:213.

Myrmeleon boschimanus Pér.; Navas, 1934b:501.

*Nesoleon braunsi Banks 1909.

Nesoleon braunsi Banks, 1909:4. "Willomore, Cape Colony".
(Cape Province). Type-Not located.

Nesoleon braunsi Banks; Banks, 1911:7.

Nesoleon braunsi Banks; Navas, 1923:433.

Nesoleon braunsi Banks; Navas, 1931c:124.

Nesoleon braunsi Banks; Kimmins, 1943:152.

Nesoleon braunsi Bnks; Markl, 1954:199, 229.

Nesoleon kriegi Navas, 1937.

Nesoleon Kriegi [sic!] Navas, Navas 1937:1473. "Africa,
S.W. Africa Farm Okaundua".
Type-HM. Destroyed.

Nesoleon lunatus Navas, 1912.

Nesoleon lunatus Navas, 1912g:91. "Swakopmund Deutsch.-
S,W,-Afrika". Type-SM. Not examined.

Genus NEUROLEON Navas, 1909.

Neuroleon Navas, 1909:148. Original reference not seen.

Neuroleon Navas; Navas, 1912b:73.

Neuroleon Navas; Navas, 1912d:233.

Neuroleon Navas; Navas, 1912e:95.

Neuroleon Navas; Banks, 1913a:154.

Neuroleon Navas; Navas, 1914e:23.

Neuroleon Navas; Banks, 1920:23, 28.

Neuroleon Navas; Markl, 1954:237.

Neuroleon Navas; Hölzel, 1972:49.

Neuroleon basutinus (Navas, 1927).

Nelees basutinus Navas, 1927a:14. "Africa, Basoutoland, Leribe". (Lesotho). Ty e-MP. EXAMINED.

Nelees basutinus Navas; Navas, 1934a:51.

Neuroleon basutinus (Navas), *comb. nov.*

Neuroleon braunsi (Navas, 1923).

Nelees braunsi Navas, 1923:433. "George, Cape Colony". (Cape Province). Type-NCOLL. Not examined.

Neuroleon extraneus Navas = Campestretus lepidus (Kolbe)

**Neuroleon guttatus* (Navas, 1914).

Nelees guttatus Navas, 1914b:85. "Damara". (South West Africa). Type-NMV. Photograph of type EXAMINED.

Nelees guttatus Navas; Esben-Petersen, 1928a:210.

Neuroleon guttatus (Navas), *comb. nov.*

Neuroleon lesnei Navas, 1931.

Neuroleon Lesnei [sic!] Navas, 1931a:102. "Zambeze, Nova Choupanga". (Mocambique). Type-MP. EXAMINED.

Neuroleon mozambicus (Navas, 1913)

Nelees mozambicus Navas, 1913a:490. "Africa Oriental portuguesa. Beira". (Mocambique). Type-UMO. Not examined.

Neuroleon muzanus (Navas, 1922).

Nelees muzanus Navas, 1922:252. "Bassin inf. du Zambeze Vallee du Muza. 32° long.E 18° lat.S". (Mocambique). Type-MP. EXAMINED.

Neuroleon stenopterus (Navas, 1933).

Neuroleon stenoptersu Navas, 1933a:102. "Zambeze Nova Chupanga". (Mocambique). Type-MP. EXAMINED.

Genus NOHOVEUS Navas, 1919.

Nohoveus Navas, 1919:169. Original reference not seen.

Nohoveus Navas; Esben-Petersen, 1936b:72.

Nohoveus Navas; Markl, 1954:227. Referred to Myrmecaelurus
Costa. [Incorrect synonomy according
to Hölzel, 1969:284.]

Nohoveus Navas; Hölzel, 1969:284.

Nohoveus Navas; Hölzel, 1972:17.

Nohoveus apicalis Navas, 1929b:16. "Africa, Karibab,
S.W. Afr.".
Type-NCOLL. Not examined.

Genus OBUS Navas, 1912.

Obus Navas, 1912b:59. Type species by original designation and
monotypy = Obus arenosus Navas,
1912b:60.

Gymnoleon Banks, 1911:12. [Partim.] Synonomised by Markl, 1954:243.

Obus Navas; Navas, 1912d:233.

Obus Navas; Esben-Petersen, 1925:336.

Obus Navas; Banks, 1938a:126.

Obus Navas; Markl, 1954:243.

Obus arenosus Navas = Obus elizabethae (Banks)

*Obus elizabethae (Banks, 1911).

Gymnoleon elizabethae Banks, 1911:13. "Port Elizabeth,
Cape Colony". (Cape Province).
Type-MB. Not examined.

Gymnoleon elizabethae Banks; Banks, 1913a:153.

Obus arenosus Navas, 1912b:60. "Africa meridional,
Deelfontein". (Cape Province).
Type-BMNH. EXAMINED.
Synonomised by Banks, 1913a:153.

Obus elizabethae (Banks), Esben-Petersen, 1928a:209.

Obus Elizabethae [sic!] (Banks); Navas, 1921a:304.

Obus Elizabethae [sic!] (Banks); Navas, 1929b:25.

Obus elizabethae (Banks); Banks, 1941:4.

Obus elizabethae (Bnks); Markl, 1954:243.

Obus infirmus Navas, 1929.

Obus infirmus Navas, 1929b:25. "Africa, Karibib, S.W. Afr.". Type-NCOLL. Not examined.

Obus infirmus Navas; Banks, 1941:4.

Genus PALPARELLUS Navas = PALPARES Rambur

Palparellus excelsus Navas = Palpares nyassanus Navas

Palparellus mistis Navas = Palpares nyassanus Navas

Palparellus roratus Navas = Palpares festivus Gerstaecker

Genus PALPARES Rambur, 1842.

Palpares Rambur, 1842:365. Type species not designated .

Palpares Ramb.; Walker, 1853:300.

Palpares Rambur; Hagen, 1860:359.

Palpares Rambur; Hagen, 1862:94.

Palpares Ramb.; Gerstaecker, 1863:180.

Palpares Rambur; Hagen, 1866:372, 455.

Palpares Rambur; MacLachlan, 1867:236.

Palpares Rambur; Brauer, 1867:519, 520.

Palpares Rambur; MacLachlan, 1873a:128.

Palpares Rambur; Redtenbacher, 1884:344, 346.

Palpares Rambur; Kolbe, 1898a:4, 6.

Palpares Rambur; Kolbe, 1898b:229.

Palpares Rambur; v.d. Weele, 1907:252.

Palpares Rambur; v.d. Weele, 1908:57.

Palpares Rambur; v.d. Weele, 1909b:17.

Palpares Rambur; v.d. Weele, 1910:13.

Palpares Rambur; Péringuey, 1910:433.

Palpares Rambur; Péringuey, 1911:31.

Palpares Rambur; Banks, 1911:3.

Palpares Rambur; Stitz, 1912:104.

Palpares Rb.; Navas, 1912d:204.

Palparellus Navas, 1912d:255. Type species by original designation = Palpares spectrum Rambur, 1842:376. Synonomised by Esben-Petersen, 1916:11.

Palpares Rambur; Banks, 1913b:171.

Palparellus Navas; Banks, 1913b:172.

Palpares Rambur; Navas, 1914e:12.

Palpares Rambur; Esben-Petersen, 1916:2.

Palpares Rambur; Banks, 1920:21.

Palpares Rambur; Navas, 1926d:57.

Palpares Rambur; Fraser, 1951:347.

Palpares Rambur; Markl, 1954:193, 198, 215.

Palpares Rambur; Hölzel, 1972:4, 6.

Palpares aemulus Péringuey = Palpares nyicanus Kolbe

Palpares annulatus Stitz, 1912.

Palpares annulatus Stitz, 1912:108. "Südafrika (Betschuanenland)". (Botswana). Type-MB?. Not examined.

Palpares annulatus Stitz; Banks 1913b:183. Referred to *Palpares tesselatus* Rambur. Incorrect synonomy.

Palpares bifasciatus (Oliver, 1811).

Myrmeleon bifasciatum Oliver, 1811:122. Reference not seen.

Myrmecoleon pardalinus Burmeister, 1839:997. "Süd-Afrika, von Orange Fluss". (Orange River). Type-ZIH. Photograph of type EXAMINED. Synonomised by v.d. Weele, 1903:168.

Palpares pardalinus (Burm.), Rambur, 1842:377. [Incorrect identification].

Myrmeleon bifasciatus Oliv.; Walker, 1853:405.

Myrmeleon pardalinus (Burm.), Walker, 1853:314.

M[yrmeleon] pardalinus (Burm.); Hagen, 1860:361.

M[yrmeleon] bifasciatus Oliv.; Hagen, 1860:368.

Palpares pardalinus (Burm.); Hagen, 1862:96.

Myrmeleon bifasciatus Oliv.; Hagen, 1866:436, 457.

Palpares pardalinus (Burm.); Hagen, 1866:434, 446, 457.

Myrmeleon pardalinus Burm. det. Walker ; MacLachlan, 1867:275.

Palpares ? brachypterus MacLachlan, 1867:275. New name for *Myrmeleon pardalinus* Burmeister as det. Walker, 1853:314, nec Rambur 1842:377. Synonomised by Banks, 1913b:186.

Palpares pardalinus (Burm.); MacLachlan 1873a:131. Incorrect identification by Rambur 1842:377.

Palpares pardalinus (Burm.); Taschenberg 1879:184.

Palpares pardalinus (Burm.); Hagen, 1887:111, 135.

Palpares brachypterus McLachlan; Hagen 1887:111.

Myrmeleon bifasciatum Oliv.; v.d. Weele, 1903:167.

Palpares pardalinus (Burm.); v.d. Weele, 1903:168.

Palpares brachypterus MacLachlan; v.d. Weele 1903:168.

Palpares bifasciatus (Oliv.); Banks 1913b:185.

Palpares pardalinus (Burm.); Banks, 1913a:186.

Palpares brachypterus MacLachlan; Banks 1913b:186.

Palpares pardalinus (Burm.); Navas 1912g:21.

Palpares brachypterus MacLachlan = Palpares bifasciatus (Olivier)

Palpares *caffer* (Burmeister, 1839).

Myrmecoleon caffer Burmeister, 1839:998. "sudostliche Afrika". (South East Africa). Type-ZIH. Photograph of type EXAMINED.

M[yrmeleon] Caffer [sic!] (Burm.), Hagen, 1860:361.

Palpares caffer Burm.; Hagen, 1862:101.

Palpares Caffer [sic!] (Burm.); Hagen, 1866:433, 456.

Palpares caffer (Burm.); MacLachlan, 1867:275.

Palpares Caffer [sic!] (Burm.); Hagen, 1887:110, 133.

Palpares caffer (Burm.); Gerstaecker, 1888:95.

Palpares caffer (Burm.); Kolbe, 1898a:12.

Palpares caffer (Burm.); Kolbe 1906:140.

Palpares caffer (Burm.); v.d. Weele, 1907:257.

Palpares caffer (Burm.); Péringuey, 1911:34.

Palpares caffer (Burm.); Banks, 1911:4.

Palpares varius Navas, 1911a:240. "Lady Smith". (Ladismith, Natal). Type-Not located. *syn. nov.*

Palpares caffer (Burm.); Navas, 1912d:209.

Palpares caffer (Burm.); Stitz, 1912:107.

Palpares caffer (Burm.); Banks, 1913b:184.

Palpares caffer (Burm.); Navas, 1923:432.

Palpares caffer (Burm.); Navas, 1931b:261.

Palpares campani Navas = Palpares sobrinus Péringuey

Palpares carpentieri Navas, 1925.

Palpares Carpentieri [sic!] Navas, 1925b:182. "Transvaal".
Type-MZB. EXAMINED.

*Palpares cataractae Péringuey, 1910.

Palpares cataractae Péringuey, 1910:433. "Southern Rhodesia,
(Victoria Falls)".
Type-SAM. EXAMINED.

Palpares cataractae Péringuey; Banks, 1911:4.

Palpares inclemens Walk. var. obscuratus Stitz, 1912:105.
Synonomised by Banks, 1913b:178.

Palpares cataractae Péring.; Banks, 1913b:176, 178.

Palpares cataractae Pér.; Navas, 1914c:369, 370.

Palpares cataractae Pér.; Navas, 1925b:182.

Palpares cataractae Péringuey; Esben-Petersen, 1931:91.

Palpares cataractae Péringuey; Navas, 1936a:334.

Palpares comes Hagen = Palpares immensus MacLachlan.

Palpares compositus Navas = Palpares elegantulus Péringuey.

*Palpares damarensis MacLachlan, 1867.

Palpares damarensis MacLachlan, 1867:241. "Damara Land".
(South West Africa).
Type-BMNH. EXAMINED.

Palpares damarensis McLach.; Banks, 1911:5.

Palpares damarensis MacLach.; Navas, 1912d:211.

Palpares formosus Banks var. bifasciatus Stitz, 1912:107.
Synonomised by Banks, 1913b:185.

Palpares damarensis McLach.; Banks, 1913a:185.

Palpares damariensis [sic!] MacLachlan; Esben-Petersen,
1928a:208.

*Palpares dubiosus Péringuey, 1910.

Palpares dubiosus Péringuey, 1910:440. "Touw's River,
Clanwilliam, Bushmanland, Kimberley".
(Cape Province).
Type-SAM. EXAMINED.

Palpares dubiosus Péringuey; Banks, 1911:4.

Palpares formosus Banks, 1911:4. "Willomore, Cape Colony".
(Cape Province). Type-Banks Coll.
Not examined. Synonomised by
Esben-Petersen, 1922:620.

Palpares formosus Banks var, bifasciatus Stitz, 1912:107.
Referred to *Palpares* *damarensis*
MacLachlan by Banks, 1913b:185.

Palpares formosus Banks; Navas, 1912d:216.

Palpares dubiosus Péring.; Banks, 1913b:184.

Palpares formosus Banks; Banks, 1913b:185.

Palpares formosus Banks; Navas, 1912e:85.

Palpares dubiosus Péringuey; Esben-Petersen, 1922:620.

Palpares dubiosus Pér,; Navas, 1923:432.

**Palpares* *elegantulus* Péringuey, 1910

Palpares elegantulus Péringuey, 1910:436. "Cape Colony,
(Fraserburg, Beaufort West)".
(Cape Province).
Type-SAM. EXAMINED.

Palpares elegantulus Péringuey; Banks, 1911:3.

Palpares compositus Navas, 1912d:210. "Afrique meridionale ?".
(South Africa). Type-NMV. Not
Examined. Synonomised by Esben-Petersen, 1928a:206.

Palpares elegantulus Péring.; Banks, 1913b:185.

Palpares compositus Navas; Banks, 1913b:185.

Valignanus compositus (Navas), Esben-Petersen, 1916:11.

Palpares elegantulus Péringuey; Esben-Petersen, 1928a:206.

**Palpares* *festivus* Gerstaecker, 1894.

Palpares festivus Gerstaecker, 1894:115. "Delagoa-Bai".
(Mocambique).
Type-ZIMG. Not examined.

Palpares festivus Gerst.; Kolbe, 1906:139.

Palpares festivus Gerst.; v.d. Weele, 1907:255.

Palpares festivus Gerst.; v.d. Weele, 1908:58.

Palpares mossambicus Péringuey, 1910:434. "Mozambique
(Lourenco Marques)".
Type-SAM. EXAMINED.
Synonomised by Banks, 1913b:185.

Palpares latro Navas, 1911b:238. No locality.
Type-BMNH. EXAMINED.
Synonomised by Banks, 1913b:185.

Palparellus latro Navas, Navas, 1912d:225.

Palpares festivus Gerst.; Banks, 1913b:185.

Palparellus roratus Navas, 1913a:496. "Mozambique".
Type-BMNH. EXAMINED.
syn. *nov*.

Palpares festivus Gerstaecker; Esben-Petersen, 1916:11.
Palpares latro Navas; Banks, 1920:22.
Palpares festivus Gerstaecker; Banks, 1920:22.
Palpares festivus Gerst.; Fraser, 1951:349.

*Palpares flavofasciatus MacLachlan, 1867.

Palpares flavo-fasciatus MacLachlan, 1867:242. "Damara-Land". (South West Africa). Type-BMNH. EXAMINED.

T [omatares] flavofasciatus (MacLachlan), MacLachlan, 1873a:130.

Palp [ares] flavo-fasciatus Lachl.; Gerstaecker, 1894:116.

Palpares flavofasciatus MacLachl.; v.d. Weele, 1908:59.

Palpares genialis Péringuey, 1910:438. "Limpopo River". (Rhodesia). Type-SAM. EXAMINED. Synonomised by Banks, 1913b:185.

Palpares nyassensis [sic!] Navas, Banks, 1913b:185. Incorrect synonomy .

Palpares flavofasciatus MacLachlan; Banks, 1911:3.

Palpares genialis Péringuey; Banks, 1911:3.

Palparellus flavofasciatus (MacLachlan), Navas, 1912d:225.

Palparellus genialis (Péring.), Navas, 1912d:225.

Palparellus flavofasciato [sic!] (MacLachl.); Navas, 1912d:226.

Tomatares guttatus Stitz, 1912:115. "Deutsch-Südwestafrika". (South West Africa). Type-MB. Not examined. Synonomised by Banks, 1913b:185.

Palpares flavofasciatus MacLach.; Banks, 1913b:185.

Palparellus excelsus Navas, Esben-Petersen, 1916:10. Incorrect synonomy.

Palpares flavofasciatus MacLachlan; Esben-Petersen, 1916:10.

Palpares flavo-fasciatus MacLachlan; Esben-Petersen, 1928a:207.

Palpares formosus Banks = Palpares dubiosus Péringuey

Palpares genialis Péringuey = Palpares flavofasciatus MacLachlan

*Palpares gratiosus Navas, 1929.

Palpares gratiosus Navas, 1929b:15. "Africa, Karibib S.W. Afr.". Type-MZB. EXAMINED.

*Palpares immensus MacLachlan, 1867.

Palpares immensus MacLachlan, 1867:239. "Damara-Land".
(South West Africa).
Type-BMNH. EXAMINED.

Palpares comes Hagen, 1866:456. "Nagami-See". (Botswana).
Type-Not located.
Synonomised by Hagen, 1887:110.

Palpares immensus MacLachl.; Hagen, 1887:110.

Palpares immensus MacLachlan; Banks, 1911:4.

Palpares immensus MacLachl.; Navas, 1912d:215.

Palpares immensus MacLach.; Navas, 1912g:21.

Palpares immensus Lachl.; Stitz, 1912:112.

Palpares immensus McLach.; Banks, 1913b:180.

Palpares kalahariensis Stitz, Banks, 1913b:180.
Incorrect synonomy.

Palpares immensus MacLachlan; Esben-Petersen, 1916:4, 9.

Palpares immensus MacLachlan; Esben-Petersen, 1928a:207.

Palpares immensus McL.; Markl, 1954:187.

*Palpares inclemens (Walker, 1853).

Myrmeleon inclemens Walker, 1853:303. "Port Natal".
(Durban, Natal).
Type-BMNH. EXAMINED.

M[yrmeleon] inclemens Walk.; Hagen, 1860:361.

Palpares inclemens (Walk.), Hagen, 1866:440,456.

Palpares inclemens (Walker); MacLachlan, 1867:275.

Palpares inclemens (Walk.); Hagen, 1887:89, 90.

Palp[ares] inclemens (Walk.); Gerstaecker, 1894:111.

Palpares inclemens (Walker); Kolbe, 1898a:7.

Palpares inclemens Hag. [sic!] ; Kolbe, 1898b:229.

Palpares inclemens (Walker); Kolbe, 1906:139.

Palpares inclemens (Walker); v.d. Weele, 1907:260.

Palpares inclemens (Walk.); Navas, 1911a:240.

Palpares inclemens (Walk.); Navas, 1911b:236. Referred
to Palpares latipennis Rambur.
Incorrect synonomy.

Palpares inclemens (Walker); Banks, 1911:4.

Palpares inclemens (Walk.); Navas, 1912g:21.

Palpares inclemens (Walk.) var. obscuratus Stitz, 1912:105.
Referred to Palpares cataractae
Péringuey by Banks, 1913b:178.

Palpares inclemens (Walk.); Banks, 1913b:179.

Palpares inclemens (Walk.); Navas, 1929a:94.

Palpares inclemens (Wlk.); Markl, 1954:211, 208.

Palpares inclemens (Walker); Bouček, 1974:337.

**Palpares kalahariensis* Stitz, 1912.

Palpares kalahariensis Stitz, 1912:110. "Sudafrika
(Kalahari)". (South Africa).
Type-MB. Not examined.

Palpares kalahariensis Stitz; Banks, 1913b:180. Referred
to *Palpares immensus* MacLach.
Incorrect synonomy.

Palapres kalahariensis Stitz; Esben-Petersen, 1916:4.

Palpares kalahariensis Stitz; Esben-Petersen, 1928a:208.

**Palpares karrooanus* Péringuey, 1910.

Palpares karrooanus Péringuey, 1910:435. "Cape Colony
(Fraserburg, Beaufort West)".
(Cape Province).
Type-SAM. EXAMINED.

Palpares karrooanus Péringuey: Banks, 1911:3.

Palpares karroanus [sic!] Péring.; Stitz, 1912:111.

Palpares karrooanus Péringuey; Banks, 1913b:180.

Palpares karroanus [sic!] Péringuey; Esben-Petersen, 1928a:208.

Palpares karroanus [sic!] Péringuey; Navas, 1934b:499.

Palpares latro Navas = Palpares festivus Gerstaecker

**Palpares lentus* Navas, 1912.

Palpares lentus Navas, 1912d:217. "Kalahar Desert (Afrique)".
(South Africa).
Type-BMNH. EXAMINED.

Palpares lentus Navas; Banks, 1913b:181.

Palpares lento [sic!] Navas; Navas, 1929b:15.

Palpares mossambicus Péringuey = Palpares festivus Gerstaecker.

Palpares moestus Hagen = Lachlathetes moestus (Hagen)

Palpares nudatus Navas = Palpares sparsus MacLachlan

*Palpares nyassanus Navas, 1911.

Palpares nyassanus Navas, 1911b:237. "Environs du lac Nyassa". (Malawi). Type-BMNH. EXAMINED.

Palparellus nyassanus (Navas), Navas, 1912d:225.

Palparellus mistus Navas, 1912d:226. "Afrique meridionale?". (South Africa). Type-NMV. Not examined. syn. nov.

Palpares nyassensis [sic!] Navas; Banks, 1913b:185. Referred to Palpares flavofasciatus McLachl. Incorrect synonomy.

Palparellus excelsus Navas, 1913b:89. "E. Rhodesia, Mpudri River, Manica". Type-UMO. Not examined. syn. nov.

Palpares mistus Navas, Banks, 1913b:185.

Palparellus excelsus Navas; Esben-Petersen, 1916:10.

Palpares nyassanus Navas; Esben-Petersen, 1916:10. Referred to Palpares flavofasciatus McLach. Incorrect synonomy.

Palpares mistus Navas; Esben-Petersen, 1916:11.

Palpares nyicanus Kolbe, 1898

Palpares nyicanus Kolbe, 1898a:11. "Farhani in Usagara". (Tanzania). Type-MB. Photograph of type EXAMINED.

Palpares nyicanus Kolbe: Kolbe 1898b:229.

Palpares nyicanus Kolbe; Banks 1911:4.

Palpares aemulus Péringuey, 1911:31. "Natal (Maritzburg) Zululand". Type-SAM. EXAMINED. Synonomised by Banks, 1913b:178.

Palpares nyicanus Kolbe: Navas, 1912d:220, 221.

Palpares nyicanus Kolbe; Banks, 1913b:178,

Palpares nyicanus Kolbe; Esben-Petersen, 1916:3. Referred to Palpares sparsus MacLachlan. Incorrect synonomy.

Palpares aemulus Péringuey; Esben-Petersen, 1916:3.

Palpares aemulus Péringuey; Esben-Petersen, 1928a:208.

Palpares nyicanus Kolbe; Esben-Petersen, 1928a:208.

Palpares oneili Péringuey = Golafrus oneili (Péringuey)

Palpares ovampoanus Péringuey

Palpares ovampoanus Péringuey, 1910:439. "Ovampoland, Omrramba". (South West Africa). Type-SAM. EXAMINED.

Palpares ovampoanus Péringuey; Banks, 1911:3.

Palparellus ovampoanus Péring., Navas, 1912d:225.

Palpares ovampoanus Péring.; Banks, 1913b:186.

Palpares ovampoanus Péringuey; Esben-Petersen, 1931:90, 91.

*Palpares pulchellus Esben-Petersen, 1922.

Palpares pulchellus Esben-Petersen, 1922:618. "Deelfontein, South Africa". Type-BMNH. EXAMINED.

*Palpares sobrinus Péringuey, 1911.

Palpares sobrinus Péringuey, 1911:33. "Cape Colony (Dunbrody)". (Cape Province). Type-SAM. EXAMINED.

Palpares sobrinus Péring.; Banks 1913b:178.

Palpares Campani [sic!] Navas, 1915a:9. "Angola, Huilla". Type-MP. EXAMINED. Synonomised by Esben-Petersen, 1928a:207.

Palpares sobrinus Péringuey; Esben-Petersen, 1916:3. Referred to Palpares sparsus MacLachlan. Incorrect synonomy.

Palpares sobrinus Pér.; Navas, 1921a:293.

Palpares sobrinus Péringuey; Esben-Petersen, 1928a:207.

Palpares sparsus MacLachlan ♀ [nec ♂], 1867:241. "Damara Land". (South West Africa). Type-BMNH. EXAMINED. Synonomised by Esben-Petersen, 1928a:207.

*Palpares sparsus MacLachlan, 1867.

Palpares sparsus MacLachlan, 1867:240. "Daka River, Zambezi Valley". (Rhodesia). Type-[♂] BMNH. EXAMINED.

Palpares sparsus MacLachlan; ♀ [nec ♂], 1867:241. "Damara Land". (South West Africa). Type-BMNH. EXAMINED. Referred to Palpares sobrinus Péringuey, by Esben-Petersen, 1928a:207.

Palpares sparsus Hagen [nec MacLachlan], 1887:111. "Pniel Station, Damaraland". (South West Africa). Synonomised by Hagen, 1887:111.

Palpares sparsus MacLachlan; Banks, 1911:3.

Palpares sparsus MacLachlan; Péringuey, 1911:33.

Palpares sparsus Lachl.; Stitz, 1912:107.

Palpares nudatus Navas, 1912d:221. "Afrique Orientale, Ikona". (Tanzania, Ikoma). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1916:3.

Palpares nudatus Navas; Banks, 1913b:178.

Palpares sparsus McLach.; Banks, 1913b:179.

Palpares sparsus MacLach. var. Jeanneli [sic!] Navas, 1914e:12.

Palpares sparsus MacLachlan; Esben-Petersen, 1916:3.

Palpares sparsus MacLachlan: Esben-Petersen, 1920:190.

Palpares nudatus Navas; Esben-Petersen, 1920:190.

Palpares sparsus MacLachl.; Navas, 1921a:293.

Palpares sparsus MacLach.; Navas, 1925b:183.

Palpares sparsus MacLach,; Navas, 1925c:128.

Palpares sparsus MacLachlan; Esben-Petersen, 1928a:207.

*Palpares speciosus (Linnaeus, 1758).

Hemerobius speciosum Linnaeus, 1758:551. Original reference not seen. Type-LSL. EXAMINED.

Myrmeleon speciosum (Linnaeus), Linnaeus, 1767:912.

Hemerobium speciosum Linnaei, Latrielle, 1807:191.

Myrmecoleon speciosus (Linn.), Burmeister, 1839:998.

M[yrmeleon] maculatum de Geer, [Cited by Burmeister, 1839:998]. Synonomised by Burmeister, 1839:998.

M[yrmeleon] leopardus Dalman, [Cited by Burmeister, 1839:998]. Synonomised by Burmeister, 1839:998.

Palpares speciosus (Linné), Rambur, 1842:370.

Myrmeleon speciosus (Linn.); Walker, 1853:306.

M[yrmeleon] speciosus (L.); Hagen, 1860:360.

Palpares speciosus (L.); Hagen, 1862:98.

Palpares speciosus (L.); Hagen, 1866:457.

Palpares speciosus (L.); MacLachlan, 1867:275.

Palpares speciosus (Linné); MacLachlan, 1873a:129.

Palpares speciosus (L.); Hagen, 1887:110.

Palp[ares] speciosus (Lin.); Gerstaecker, 1888:95.

Palp[ares] speciosus (Lin.); Gerstaecker, 1894:115.

Palpares speciosus (L.); v.d. Weele, 1907:260, 261.

Palpares speciosus (Linnaeus); Banks, 1911:4.

Palpares speciosus (L.); Navas, 1912g:21.

Palpares speciosus (Linnaeus); Banks, 1913b:178, 184, 185.

Palpares speciosus (L.); Navas, 1921a:293.

Palpares speciosus (L.) subsp. capensis Navas, 1923:243.

Palpares speciosus (Linnaeus); Esben-Petersen, 1931:92.

Palpares speciosus (Linnaeus); Skaife, 1953:133.

Palpares varius Navas = Palpares caffer (Burmeister)

*Genus *PALPARIDIUS* Péringuey, 1910.

Palparidius Peringuey, 1910:440. Type-species by original designation = *Palparidius* *capicola* Péringuey, 1910:441.

Palparidius Péringuey; Banks, 1911:28. Referred to *Echthromyrmex* MacLachlan. Incorrect synonomy.

Palparidius Péring.; Navas, 1912d:204, 228.

Palparidius Pér.; Markl, 1954:213.

Palparidius *capicola* Péringuey, 1910.

Palparidius capicola Péringuey, 1910:441. "Cape Colony Carnarvon (Wyk's Vlei) Beaufort West". (Cape Province). Type-SAM. EXAMINED.

Palparidius capicola Péringuey; Banks, 1911:29.

Palparidius capicola Péring.; Navas, 1912d:228.

Palparidius festivus Navas, 1912d:228. "Damara (S. Afr.)". (South West Africa). Type-NMV. Not examined. Synonomised by Esben-Petersen, 1920:190.

Palparidius nycterinus Navas, 1913b:90. "Zambeze. O.R.C. a 20 milles au-dessus du fleuve Orange, Station Baviaan Krantz". (Orange Free State). Type-UMO. Not examined. *syn.* *nov.*

Palparidius alpicola [sic!] Péring.; Esben-Petersen, 1920:190.

Palparidius capicola Péringuey; Esben-Petersen, 1928a:209.

Palparidius capicola Pér.; Markl, 1954:211, 214.

*Palparidius concinnus Péringuey, 1910.

Palparidius concinnus Péringuey, 1910:441. "Transvaal,
Bechuanaland".
Type-SAM. EXAMINED.

Palparidius concinnus Péringuey; Banks, 1911:29.

Palparidius concinnus Péring.; Navas, 1912d:228.

Palparidius concinnus Pér.; Navas, 1921a:295.

Palparidius fascipennis (Banks, 1911)

Echthromyrmex fascipennis Banks, 1911:29. "Okahanda
Deutsch Sud-West Afrika".
(South West Africa).
Type-MB. Not examined.

Palparidius fascipennis (Banks), Navas, 1912d:228.

Palparidius festivus Navas = Palparidius capicola Péringuey

Palparidius nycterinus Navas = Palparidius capicola Péringuey

Genus PAMEMA Navas = PAMEXIS Hagen

Genus PAMEXIS Hagen, 1866.

Pamexis Hagen, 1866:372. Type-species not designated.

Pamexis Hagen; Hagen, 1887:133.

Pamexis Hagen; Kolbe, 1898a:14.

Pamexis Hagen; Navas, 1912d:204.

Pamema Navas, 1913a:483. Type-species by original designation
= Myrmeleon translatus Walk., 1853:398.
Synonomised by Markl, 1954:216.

Pamexis Hagen; Markl, 1954:194, 215, 216.

Pamexis conspurcatus (Burmeister, 1839).

Myrmecoleon conspurcatus Burmeister, 1839:997. "Sud-Afrika".
Type-Not located.

Palpares conspurcatus (Burmeister), Rambur, 1842:377.

Myrmeleon conspurcatus (Burm.), Walker, 1853:315.

M[yrmeleon] conspurcatus (Burm.); Hagen, 1860:362.

P[alpares] conspurcatus (Burm.); Hagen, 1862:96.

Pamexis conspurcatus (Br.), Hagen, 1866:449, 457.

Pamexis conspurcatus (Burmeister); MacLachlan, 1867:275, 281.

P[alpares] conspurcatus (Burmeister); MacLachlan, 1873a:131.

M[yrmeleon] conspurcatus (Burm.); Hagen, 1887:112. Referred to Pamexis luteus (Thunberg). Incorrect synonomy ?

Pamexis conspurcatus (Burm.); Kolbe, 1898a:14.

P[amexis] conspurcatus (Burm.); Banks, 1913b:186.

Pamexis conspurcatus (Burmeister); Navas, 1925b:184.

Pamexis contaminatus Hagen = Pamexis luteus (Thunberg)

Pamexis insperatus (Navas, 1925).

Pamema insperatus Navas, 1925a:206. "Süd-Kapkolonie: Jan Dutoits Kloof (Waaihoek Berge)". (Cape Province). Type-DEIE. Not examined.

Pamexis insperatus Navas, comb. nov.

*Pamexis luteus (Thunberg, 1784).

Myrmeleon luteum Thunberg, 1784:198. Original reference not seen. Photograph of type EXAMINED.

Myrmecoleon venosus Burmeister, 1839:998. No locality. Type-Not located. Synonomised by Hagen, 1860:362.

[Myrmecoleon] conspurcatus Burmeister, 1839:997. Synonomised by Hagen 1887:112. Incorrect synonomy ?

Palpares venosus (Burmeister), Rambur, 1842:376.

Palpares pardalinus (Burm.) det. Rambur, 1842:337. Synonomised by Hagen, 1887:112.

Myrmeleon luteus Thunb.; Walker, 1853:404.

Myrmeleon venosus (Burm.); Walker, 1853:313.

Myrmeleon translatus Walker, 1853:398. Synonomised by MacLachlan 1873:130. Incorrect synonomy ?

[Myrmecoleon] conspurcatus Burmeister, 1839:997. Synonomised by Hagen 1887:112. Incorrect synonomy ?

Palpares luteus (Thunberg), Hagen, 1862:96.

Pamexis luteus (Thunb.), Hagen, 1866:434, 443, 457.

Pamexis contaminatus Hagen, 1866:433, 457. [Record of Burmeister's undescribed specimen from Winthem's collection. Synonomised by Hagen 1887:112].

Pamexis luteus (Thunberg); MacLachlan 1873a:130.

P[amexis] contaminatus Hagen; MacLachlan 1873a:130.

Pamexis luteus (Thunb.); Hagen 1887:112.

Pamexis contaminatus Burm. [sic!] ; Hagen 1887:112. New name for Palpares pardalinus (Burm.) det. Rambur, nec. P. pardalinus Burm.

Pamexis contaminatus Burm. [sic!] ; Kolbe, 1898a:14.

Pamexis luteus (Thunb.); Kolbe, 1898a:14.

Palpares contaminatus (Hagen), Banks, 1913b:186.

Pamexis luteus (Thunb.); Navas, 1912e:87.

Palpares (Pamexis) luteus (Thunberg); Banks, 1913b:186.

Pamexis lutea [sic!] (Thunb.); Navas, 1925b:184.

Pamexis translatus (Walker, 1853).

Myrmeleon translatus Walker, 1853:398. "Cape". (Cape Province). Type-BMNH. EXAMINED.

M[yrmeleon] translatus Walk.; Hagen, 1860:362. Referred to Myrmeleon conspurcatus Burm. Incorrect synonomy ?

Myrmeleon translatus Walk.; Hagen, 1866:449. Referred to Pamexis conspurcatus Br. Incorrect synonomy ?

Myrmeleon translatus Walker; MacLachlan, 1867:281. Referred to Pamexis conspurcatus Burm. Incorrect synonomy ?

P[amexis] translatus Walker, MacLachlan, 1873:130. Referred to Pamexis luteus Thunberg. Incorrect synonomy ?

Myrmeleon translatus Walker; Navas, 1913a:483.

Pamema translatus (Walker), Navas, 1913a:483.

Pamema translatus Walk.; Navas, 1923:433.

Genus PERINGUS Navas = NESOLEON Banks

Genus SOGRA Navas = CENTROCLISIS Navas

Sogra maligna Navas = Centroclisis maligna (Navas)

Sogra mendax Navas = Centroclisis mendax (Navas)

Sogra nefasta Navas 1927 (nec Navas 1912) = Centroclisis odiosa Navas

Sogra odiosa Navas = Centroclisis odiosa (Navas)

Sogra vitanda Navas = Centroclisis vitanda (Navas)

Genus SOGRASSA Navas = CENTROCLISIS Navas

Genus SUCA Navas, 1921.

Suca Navas, 1921a:299. Type-species by original designation = Suca delicata Navas 1921a:299.

Suca Navas; Markl, 1954:248.

Suca delicata Navas, 1921.

Suca delicata Navas, 1921a:299. "Colonie du Cap: Steynsburg". (Cape Province). Type-MP. EXAMINED.

Genus SYMMATHETES MacLachlan = LACHLATHETES Navas

Genus SYNGENES Kolbe, 1898

Syngenes Kolbe, 1898a:15. Type-species by original designation and monotypy = Acanthaclisis debilis Gerstaecker, 1888:100.

Syngenes Kolbe; v.d. Weele, 1907:266.

Syngenes Kolbe; Banks, 1911:5.

Syngenes Kolbe; Navas, 1912b:51

Syngenes Kolbe; Esben-Petersen, 1916:15.

Syngenes Kolbe; Esben-Petersen, 1920:26.

Syngenes Kolbe; Fraser, 1951:352.

Syngenes Kolbe; Markl, 1954:230, 231.

Syngenes longicornis (Rambur, 1842)

Acanthaclisis longicornis Rambur, 1842:382. No locality. Type-IRSN. EXAMINED.

Myrmeleon longicornis (Ramb.), Walker, 1853:320.

Acanthaclisis longicornis Ramb.; Hagen, 1860:363.

Acanthaclisis longicornis Rbr.; Hagen, 1866:379.

Acanthaclisis longicornis Rambur; MacLachlan, 1873a:132.

Acanth[aclisis] longicornis Ramb.; Gerstaecker, 1885:13.

Acanthaclisis inquinata Gerstaecker, 1885:11. "Congo". (Zaire). Type-ZIMG. Photograph of type EXAMINED. Synonomised by v.d. Weele, 1907:267.

Syngenes longicornis (Rambur), v.d. Weele, 1907:266.

Acanthaclisis longicornis Ramb.; Banks, 1911:5.
Acanthaclisis longicornis Ramb.; Navas, 1912f:166.
Acanthaclisis longicornis Rbr.; Banks, 1913a:150.
Syngenes longicornis (Rambur); Esben-Petersen, 1916:15.
Syngenes longicornis (Rambur); Banks, 1920:26.
Syngenes longicornis (Rbr.); Esben-Petersen, 1920:196.
Syngenes longicornis (Ramb.); Banks, 1931:62.
Syngenes longicornis (Rambur); Kimmins, 1943:155.
Syngenes longicornis (Rambur); Fraser, 1951:352.

Genus _TOMATARES_ Hagen, 1866.
Tomatares Hagen, 1866:372. Type-species not designated.
Tomatares Hagen; MacLachlan, 1867:242.
Tomatares Hagen; Kolbe, 1898a:13.
Tomatares Hagen, v.d. Weele, 1909b:17.
Tomatares Hag,; Navas, 1912d:204.
Tomatares Hagen; Kimmins, 1952:34.
Tomatares Hagen; Markl, 1954:215, 216.

Tomatares _citrinus_ (Hagen, 1853).
Palpares citrinus Hagen, 1853:481. Original reference not seen.
Palpares citrinus Hagen; Hagen, 1860:362.
Palpares citrinus Hagen; Hagen, 1862:94.
Tomatares citrinus Hagen, Hagen, 1866:461.
Tomatares citrinus Hagen; Kolbe, 1898a:14.
Tomatares citrinus Hagen var. vinacea Kolbe, 1898a:14.
Tomatares citrino [sic!] Hag.; Navas, 1912g:24.
Tomatares citrinus Hag.; Navas, 1921a:295.
Tomatares citrinus Hagen; Sharp, 1922:454.
Tomatares citrinus Hag.;; Navas, 1923:433.
Tomatares citrinus Hag.; Navas, 1925c:129.
Tomatares citrinus Hagen; Esben-Petersen, 1928a:209.

Tomatares guttatus Stitz = Palpares flavofasciatus MacLachlan

Genus TRICHOLEON Esben-Petersen, 1925.

Tricholeon Esben-Petersen, 1925:334. Type-species by original designation and monotypy = Tricholeon hirtellus Esben-Petersen, 1925:335.

Tricholeon Esben-Petersen; Markl, 1954:221.

Tricholeon Esben-Petersen; Stange, 1970:5.

*Tricholeon hirtellus Esben-Petersen, 1925.

Tricholeon hirtellus Esben-Petersen, 1925:335. "Keurboom River". (Cape Province). Type-BMNH. EXAMINED.

*Tricholeon nigripes Kimmins, 1948.

Tricholeon nigripes Kimmins, 1948:237. "S. Africa, Pondoland, Port St. John. Cape Prov. Ceres". (Cape Province). Type-BMNH, EXAMINED.

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The first record of a larval nemopterid from southern Africa (Neuroptera: Nemopteridae: Nemopterinae)

by

M. W. MANSELL

Department of Zoology & Entomology, Rhodes University, Grahamstown

The first larvae of the family Nemopteridae (Order Neuroptera) to be recorded from southern Africa, were recently collected near Nossob Camp in the Kalahari Gemsbok National Park, South Africa.

One larva pupated and upon emergence, the adult was identified as *Derhynchia vansoni* Tjeder. An account of the morphology and aspects of the biology of the final instar larva of *D. vansoni* is given.

INTRODUCTION

The Nemopteridae of southern Africa have been monographed by Tjeder (1967), but his account deals exclusively with adult specimens as the larvae were unknown. Recently, three larvae belonging to the Nemopteridae were discovered in the sand dunes near Nossob Camp in the Kalahari Gemsbok National Park. One larva pupated and upon emergence of the adult it was identified as *Derhynchia vansoni* Tjeder. Two adult males of the same species, which is figured by Tjeder (1967), were collected at the same locality. The adults of this species are characterized by complete lack of a rostrum, highly reduced mouthparts and short antennae.

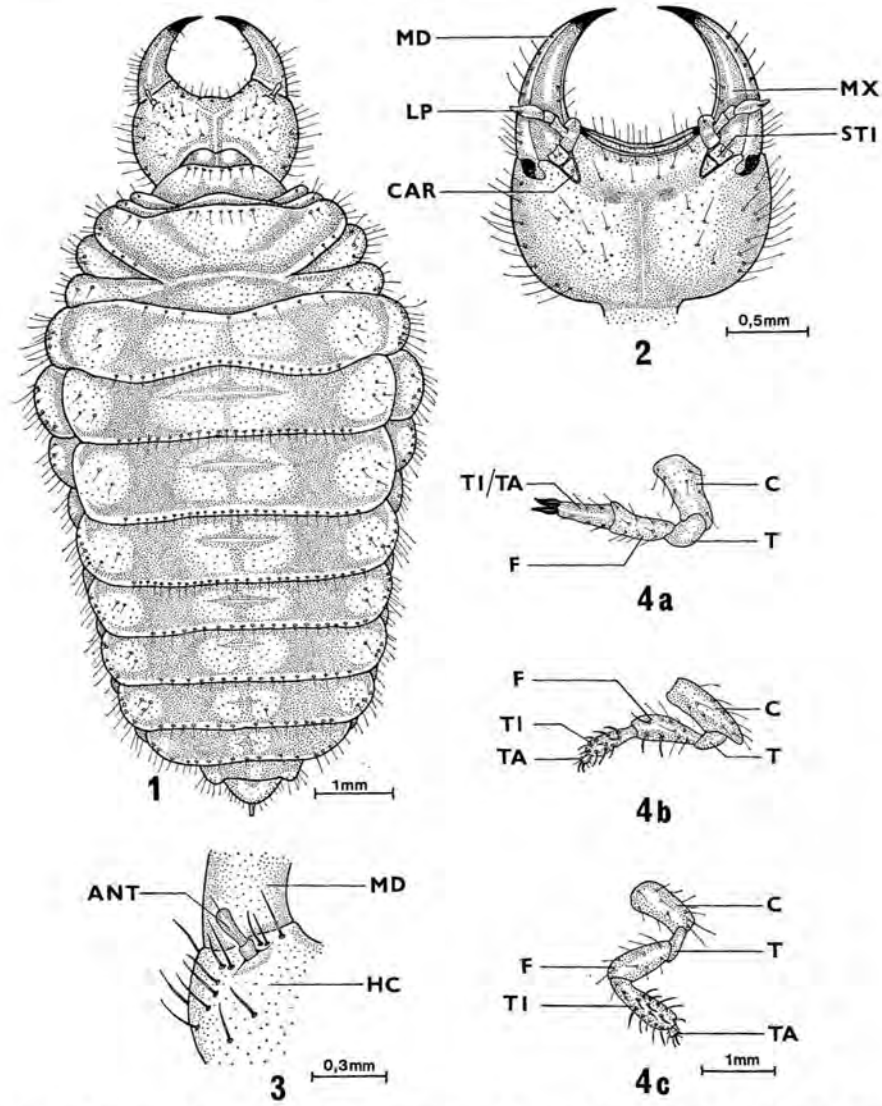
According to Tjeder (1967), the only information on the immature stages of the sub-family Nemopterinae, which includes *D. vansoni*, is a description of the egg and first instar larva of the Pyrenean *Nemoptera bipennis* (Illiger), and a description of, what is possibly, the third instar larva of the Australian *Chasmoptera hutti* (Westwood). There is no information on the biology of the Nemopterinae. Much is known about the immature stages of the other sub-family, the Crocinae, including species which occur in Egypt and this information has been reviewed by Tjeder (1967). Nothing is known concerning the immature stages of the Crocinae occurring in southern Africa.

The following account of the morphology and aspects of the biology of *D. vansoni* larvae is the first for immature nemopterids from Africa, south of the Sahara.

THE FINAL INSTAR LARVA OF *DERHYNCHIA VANSONI* TJEDER

Length of body 10 mm, width at metathorax 5 mm, width of head 1,7 mm, length of head 1 mm. Thorax and abdomen creamy white with four longitudinal flavous bands dorsally and one laterally, anterior region of prothorax unpigmented, head uniformly pale fuscous.

Head (figs 1 & 2) oval, about one and a half times as wide as long. A Y-shaped epicranial suture visible on dorsal surface. Anterior margin smooth, with irregularly arranged, slender setae. Dorsal surface smooth, convex, with sparsely arranged setae. Lateral margins covered with long, slender setae. Ventral surface smooth, convex, covered with long, slender setae. A clearly visible suture present along the ventral



Figs 1–4. *Derhynchia vansoni* Tjeder; final instar larva. 1. Dorsal aspect of larva. 2. Ventral aspect of head. 3. Portion of dorsal aspect of head to show structure of antenna. 4 a, b & c. Pro-, meso- and metathoracic legs. Most of the setae are omitted from the drawings for clarity. ANT—Antenna; C—Coxa; CAR—Cardo; F—Femur; HC—Head Capsule; LP—Labial Palp; MD—Mandible; MX—Maxilla; T—Trochanter; TA—Tarsus; TI—Tibia; TI/TA—Fused Tibia and Tarsus; STI—Stipes.

mid-line. Eyes absent. Antennae (fig. 3) two segmented, basal segment short and cylindrical, terminal segment longer, clavate and bearing a delicate terminal bristle. Mandibles (figs 1 & 2) as long as head, evenly curved, stout and bulbous at bases, tapering acutely near apices. Proximal two thirds of mandibles light fuscous, apices black. Devoid of teeth or papillae. Maxillae (fig. 2) reduced to single blades fitting into ventral grooves of mandibles to form suctorial tubes. Labium (fig. 2) appears to be reduced to single plate, possibly due to fusion of gula, mentum and submentum (Crampton, 1921). Sutures indistinct. Labial palps four segmented situated laterally on plate. Basal segment large, terminal segment elongated, fusiform with pit-shaped sense organ near apex.

THORAX. Prothorax (fig. 1) with narrow anterior region bearing legs. Posterior region wider. Spiracles absent. Meso and methathorax (fig. 1) both superficially similar, much wider than long. Mesothorax lacking spiracles, metathorax with laterally placed, circular spiracles. Legs (figs 4a, b & c) short, stout with elongated coxae. Prothoracic legs (fig. 4a) with well developed claws and fused tibia and tarsus. Meso- and metathoracic legs (figs 4b & 4c) with distinct tibia and tarsi but tarsi much reduced, claws very weakly developed. Tibia and tarsi of all legs bearing spines. Coxae of metathoracic legs with projections overlying trochanters. All tarsi lack empodia.

ABDOMEN (fig. 1) ten segmented, tapering posteriorly. Segments 1 to 6 morphologically similar with laterally placed spiracles. Segment 7 narrow, bilobed and closely associated with segment 8 which is coniform and covered ventrally with short, stout setae. Segments 9 and 10 much reduced and telescoped into segment 8; together forming the spinneret. Dolichasters absent.

MATERIAL EXAMINED. Three final instar larvae, near Nossob Camp, Kalahari Gemsbok National Park, 9.ii.1972 (1) and 23.xi.1972 (2) M. W. Mansell. One (9.ii.1972) pupated and adult emerged. 2 larvae preserved. All material deposited in Albany Museum, Grahamstown.

HABITAT AND BEHAVIOUR

The larvae were collected by sieving sand on the crests of sparsely vegetated dunes in the Kalahari Gemsbok Park, an area which receives between 150 and 300 mm of rainfall per annum (Leistner, 1967). Fig. 5 shows the habitat in which the larvae were found. According to Leistner (1967), the highest mean soil temperatures at a depth of 30 cm occur during January and February when temperatures reached between 30 and 32°C and the lowest during July (11 to 12°C). When the air temperature was in the region of 40°C, the surface heated up to 70°C but at a depth of 2,5 cm the temperature was about 10°C lower. The larvae were all encountered living freely in the sand 15 to 25 cm beneath the surface in the vicinity of the grass tufts shown in fig. 5. The particle size of the sand in which the larvae were found measured between 0,02 and 2,0 mm in diameter (Leistner, 1967), and the sand was characteristically red in colour.

The most remarkable behavioural feature of *D. vansoni* larvae is the manner in which they burrow into the sand. Unlike myrmeleontid larvae which burrow backwards, these larvae enter the sand head first. The head and prothoracic legs are used to tunnel into the sand until the prothorax is covered, the ventral surface of the 8th abdominal segment is brought into contact with the sand by a contraction of the body. When the body is expanded the 8th abdominal segment exerts a thrusting force which

Fig. 5. The habitat (arrow) in which the larvae of *D. vansoni* were collected, near Nossob Camp in the Kalahari Gemsbok Park. The grasses are *Stipagrostis amabilis* and *S. uniplumis.*

propels the larva deeper into the sand. When placed upon sand the larvae will burrow immediately. When placed upon a hard surface, the larvae are able to walk forwards but unlike myrmeleontids, appear to be incapable of moving backwards. The 8th abdominal segment plays a major role in locomotion by propelling the larva forwards, the movement being similar to that described for burrowing.

Although feeding was not observed, it is probable that this takes place entirely beneath the surface. The main factor which supports this statement is the inability of the larvae to move backwards; in the Myrmeleontidae, prey is captured on the surface and is rapidly dragged under the surface by the larva moving backwards into the sand. During this process the prey is held secure by the tips of the mandibles and the mandibular teeth and the body of the larva is usually out of the reach of the prey. Because of the mode of burrowing in *D. vansoni* however, the prey, if captured upon the surface, would have to be pushed rather than dragged under the sand. This would impede burrowing and also the larva would be susceptible to retaliatory attacks by the prey as the abdomen is exposed above the surface during most of the burrowing process. Burrowing in *D. vansoni* is also very slow and therefore does not facilitate rapid subdual of the prey as is the case in myrmeleontid larvae.

Pupation takes place in a silken, spherical, sand covered cocoon which is usually located at the base of a grass tuft, 5 to 10 cm beneath the surface. The cocoons measured about 7,5 mm in diameter. Several vacated cocoons were encountered in such locations.

DISCUSSION

The larvae of *D. vansoni* represent an interesting departure from the known larval nemopterid mode of existence, in that unlike larval Crocinae, these larvae are not cavernicolous but live freely in sand. They are morphologically well adapted to a completely subterranean mode of existence. The antennae are reduced to two segments and are held close to the head. Eyes appear to be completely absent but may be reduced to a state where they are not visible under the light microscope. Unfortunately, paucity of material precluded the use of scanning electron microscope studies. The long setae prevent sand particles from impinging upon the body surface and ensure that a layer of air surrounds the larva. This may function as an insulating layer.

The legs are well adapted to a burrowing habit in that it is the prothoracic legs which are the principal digging appendages, a situation similar to that found in other burrowing insects. An interesting comparison may be drawn with the Myrmeleontidae in which all the known larvae burrow backwards into the sand and utilize the metathoracic legs as the principal digging appendages. In this case the tibia and tarsi of the metathoracic legs are fused whereas in *D. vansoni*, this particular adaptation is manifest in the prothoracic legs.

The habitat of larval *D. vansoni* is also occupied by several non-pit building larval myrmeleontid species, but it is unlikely that they compete for food as the myrmeleontids live near the surface and feed on surface dwelling insects whereas *D. vansoni* larvae are found well below the surface.

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The larva of *Laurhervasia setacea* (Klug), (Neuroptera: Nemopteridae: Crocinae) from southern Africa

by

M. W. MANSELL

Department of Zoology & Entomology, Rhodes University, Grahamstown

The larva of *Laurhervasia setacea*, which possesses a strikingly elongated prothorax, is described from southern Africa. This is the first record of crocin larvae from the region and a brief account is given of their biology.

INTRODUCTION

The first crocin larvae to be recorded from southern Africa, were found in a small cave in the Aurus mountains of South West Africa during October, 1974; the larvae were reared and the adults identified as *Laurhervasia setacea* (Klug). Additional larval material has subsequently been collected from several localities in South, and South West, Africa. Like the larvae of *Pterocroce storeyi* With. and *Klugina aristata* (Klug) from Egypt, *Pterocroce troglophilus* Pierre from Algeria and *Dielcroce joppana* (With.) from Israel, the larvae of *L. setacea* have an elongated prothorax, long, slender legs and a cave dwelling habit. Subsequent to the initial discovery, at least four other species of larval Crocinae have been collected in southern Africa, ranging from a species resembling *Croce filipennis* (Westw.) with a short prothorax, through to a species with a prothorax longer than that of *P. storeyi*.

These remarkable insects have been known since 1833, when Roux (cited by Tjeder 1967) published an illustration of a larva which he found living in a rock tomb near Giseh in Egypt. He named the insect *Necrophilus arenarius*, but did not associate it with the Nemopteridae, placing it instead in the 'Aptères hexapodes' (Tjeder 1967). Westwood (1840) (cited by Tjeder 1967) first suggested that the larva belonged to the Nemopteridae, and subsequent authors, whose work is reviewed by Tjeder (1967), have confirmed this and have added considerably to the information on crocin larvae from the middle eastern countries and India.

Although *adult* Crocinae are known from southern Africa, Australia, South America and Socotra Island, nothing was known of their larvae and in his monograph on the southern African Nemopteridae, Tjeder (1967) described six species belonging to the Crocinae, but based this only on adult specimens.

The following account of the morphology and aspects of the biology of larval *L. setacea* is derived from observations on 117 specimens from eight localities and deals mainly with third instar larvae, although reference is also made to the earlier instars.

THE LARVA OF *LAURHERVASIA SETACEA*

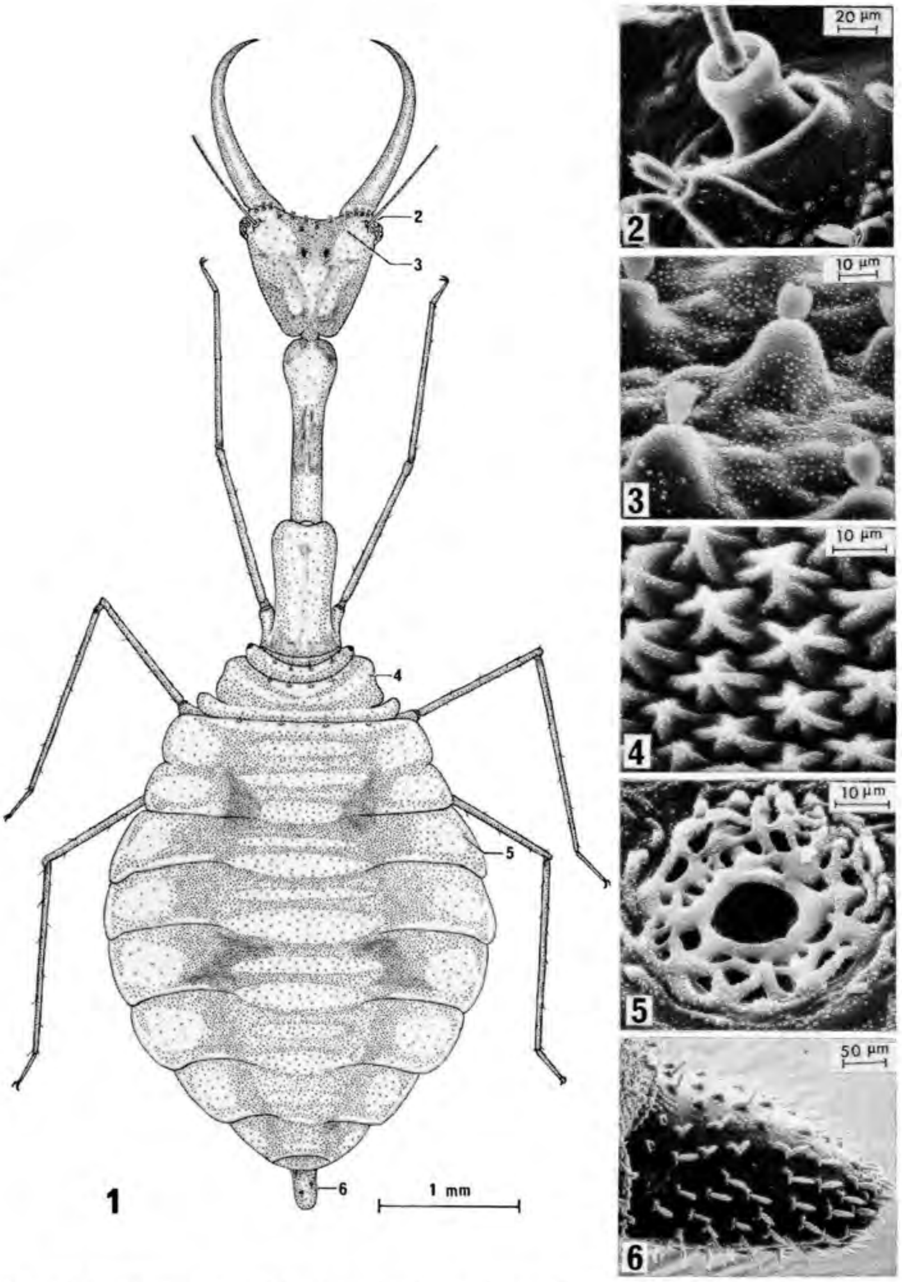
The three larval instars are morphologically similar, differing only in size (Table 1) and coloration.

TABLE 1. Mean measurements (mm) for *L. setacea* larvae. The range is given in brackets.

Instar	1st	2nd	3rd
Number of larvae	5	12	100
Head width	0,36 (0,36)	0,59 (0,56–0,60)	0,97 (0,88–1,08)
Head length	0,35 (0,32–0,36)	0,56 (0,52–0,60)	0,93 (0,84–0,96)
Mandible length	0,49 (0,48–0,52)	0,75 (0,68–0,80)	1,31 (1,16–1,40)
Prothoracic length	0,62 (0,60–0,64)	1,26 (1,20–1,36)	2,50 (2,28–2,84)
Body width*	0,96 (0,86–1,06)	1,43 (1,20–1,60)	2,90 (2,16–3,48)
Body length*	2,86 (2,52–3,0)	4,53 (4,16–5,28)	8,60 (7,20–10,72)

* Variable, dependent on feeding and state of maturity within the instar.

HEAD (figs 1–3). Triangular in shape, slightly wider than long, tapering posteriorly. Surface covered with raised papillae each bearing a dolichaster and interspersed with smaller papillae (fig. 3). Well-defined tentorial pits situated on the dorsal surface. Third instar larvae (fig. 1) characterized by conspicuous brown triangular marking on the dorsal surface, lateral and posterior regions usually light brown and ventral surface pale buff. Second instar with dorsal surface mainly brown, triangular marking not discernible, but with a well-defined epicranial suture. First instar with dorsal surface of head uniformly brown and with a well-defined epicranial suture. Eyes, each comprising seven facets, six lateral and one ventral. Antennae (fig. 2) consisting of a stout basal segment supporting a delicate, segmented flagellum of which the proximal and distal segments are long, the latter bearing three delicate apical bristles. The intermediate segments are short and vary in number from five to seven. Mandibles, longer than head, devoid of teeth, curved near the apices and bearing dolichasters along the basal third. Maxillae reduced to a single blade, fitting into the ventral surfaces of the mandibles to form the suctorial tubes. Maxillary palps absent but cardo and stipes distinguishable. Labium reduced to a single median plate, bearing three-segmented labial palps on each side; basal segment large and flattened (probably the palpiger), middle segment short, dilating apically, terminal segment fusiform, tapering to an acute tip bearing an oval pit sense-organ on the dorsal surface.



Figs 1–6. *Laurhervasia setacea* (Klug). 1. Third instar larva. 2. Basal segment of antenna. 3. Portion of dorsal surface of head showing dolichasters. 4. The cuticle of the mesothorax, showing the stellate conformation. 5. Spiracular opening on the first abdominal segment. 6. Lateral aspect of eighth abdominal segment. The positions of the structures depicted on the scanning electron micrographs are indicated by numbers 2 to 6 in fig. 1. Dolichasters omitted from drawing for clarity.

THORAX (figs 1 & 4). Prothorax markedly elongate, composed of three distinct regions. Anterior region elongated with two lateral fuscous streaks in the centre, and dilating apically with two fuscous markings on the dorsal surface of the dilated area. Mid region wider, divided into tergite and sternite (this division not being discernible in the anterior region); articulating with the anterior region and bearing the prothoracic legs; fuscous markings on the posterior surfaces. The posterior region short, unsclerotized and incorporated with the rest of the body and bearing two spiracles laterally. Dolichasters and sensory hairs are present on the posterior region of the prothorax which has the cuticle thrown into stellate folds (fig. 4). Anterior and middle regions of the prothorax with rows of sparsely arranged dolichasters. Mesothorax quadrate in shape, metathorax similar but wider. Two large fuscous markings present on the meta-tergites with smaller irregular markings on either side of the midline. Ventral surface of thorax pale creamy white. Cuticle of stellate conformation, similar to the posterior region of the prothorax. A spiracle is present between the meso- and metathorax, but is difficult to discern. Legs, long and slender, light brown in colour with the proximal regions of the tibiae slightly darker. Sparse rows of dolichaster-bearing papillae present on the legs and sensory setae occur at the articulations. Tarsi one-segmented terminating in claws. Ventral surface of tarsi with two rows of four spines each.

ABDOMEN (figs 1, 5 & 6). Ten-segmented. Segments one to seven similar to each other, becoming progressively smaller with segment seven short and broad; each bearing lateral spiracles, similar to the prothoracic spiracles, with minute openings covered by a complex structure (fig. 5). Segment eight cone-shaped, bearing numerous fusiform dolichasters on the tergite and sternite (fig. 6). Segments nine and ten telescoped into segment eight, together forming the spinneret. Segments seven and eight almost completely fuscous dorsally and the abdominal sternites uniformly pale.

MATERIAL EXAMINED. 117 larvae, SOUTH WEST AFRICA, Aurus mountains, 27° 27'S., 16° 05'E., 19 larvae, 23.x.1974; Ai Ais, 27° 56'S., 17° 31'E., 21 larvae, 1.i.1975; near Fish River Canyon, 27° 52'S., 17° 45'E., 1 larva, 15.vii.1975, all M. W. Mansell. CAPE PROVINCE, 20 km south of Twee Rivieren, 26° 39'S., 20° 37'E., 10 larvae, 23.xii.1974; 'Kromrivier' farm, Cedarberg, 32° 32'S., 19° 18'E., 11 larvae, 4/5.i.1975; Seven Weeks Poort, 32° 25'S., 21° 24'E., 5 larvae, 9.i.1975; 10 km north of Prieska, 29° 40'S., 22° 30'E., 8 larvae, 17.vii.1975, all M. W. Mansell; 'De Hoek' farm, Oudtshoorn Dist., 33° 23'S., 22° 11'E., 42 larvae, 31.viii.1975, A. J. Urban & S. B. Malcolm.

BIOLOGY

The larvae of *L. setacea* were all found in small, low (*c.* 1 m high), shallow caves or under rock overhangs, the feature of their habitats being that they offer complete protection from rain, direct sunlight and wind. Crocin larvae have not been found in habitats subjected to wind or draughts. In the field and the laboratory larvae will move away if an airstream is directed towards them, and only caves in which there is no through draught appear to be inhabited by these larvae. The larvae live among accumulated sand, dust and debris on the floors of the caves. The caves were usually inhabited by animals such as bats, hyraxes, porcupines, small carnivores, etc., and the debris which they provide harbours and attracts small invertebrates. Insects such as

Psocoptera, Thysanura, Coleoptera (Dermestidae), Hymenoptera (Formicidae), Isoptera and arthropods including Isopoda and Acari are abundant in caves occupied by crocin larvae and probably constitute their principal source of prey.

The larvae of *L. setacea*, like the larvae of other Crocinae, are able to move both backwards and forwards with great agility and are also capable of climbing vertical cave walls, often using this ability to escape when disturbed. Normally they lie concealed among the dust and debris in the cave with the abdomen buried in the substrate, leaving the head and thorax exposed. The whole insect is covered with a layer of fine dust, which enhances concealment, making the larvae very difficult to detect as long as they remain motionless. They only appear to move when disturbed or if in pursuit of prey. In the laboratory, they remain motionless for long periods of time, sometimes up to a week or more, similar to other species described by Tjeder (1967).

Unlike mymeleontid larvae, which rely on a fast strike and rapid subdual of their prey, *L. setacea* larvae approach sluggish or immobile prey cautiously and then slowly insert the mandibles as described for *K. aristata* by Hafez & El-Moursy (1964). Sudden movement of the prey will usually elicit a rapid retreat by the crocin larva. In the laboratory, they have been fed on Isoptera (*Trinervitermes trinervoides* (Sjöst.)), Psocoptera, Diptera (*Drosophila*), larvae of Dermestidae, Formicidae and small Homoptera such as Aphididae. They will often feed upon prey much larger than themselves provided it has been immobilized, and this seems to indicate that they do not rely upon their own ability to subdue and kill prey, but could be regarded mainly as scavengers. They can, however, detect moving prey and will sometimes leave their places of concealment to pursue it. These larvae do not 'overfeed' if presented with excess food, as is often the case in myrmeleontids, and this supports the supposition that they are scavengers. The duration of the three larval instars is from two to three years depending upon availability of food.

Pupation takes place in a spherical, silken cocoon (diameter 5 mm) which is impregnated with sand grains on the exterior surface. During cocoon spinning, the long prothoracic region of the larva is gradually resorbed, thereby facilitating its accommodation within the cocoon. The extremely long hind wings are coiled and folded across the body of the pupa as described by Pierre (1952) for *P. troglophilus*. In the field, cocoons were found lying freely on, or just below the substrate surface or sometimes attached to the walls of the caves. At eclosion the cocoon is breached by the pupa biting a hole through the silk and forcing the head and thorax through the opening. Once the head and thorax of the exarate pupa protrude from the cocoon, the pupa moults into the adult, leaving the pupal exuvium wedged in the eclosion aperture. The meconium is then voided and the adult seeks a vertical surface to cling to while the wings expand and harden.

There are close parallels between *L. setacea* from southern Africa and the northern species, *P. storeyi*, *P. troglophilus*, *K. aristata* and *D. joppana*. They are all cave dwellers, living in shallow caves or at the entrances of deeper caves and they subsist on comparable prey. The behaviour of *L. setacea* larvae is also similar to that described for *K. aristata* by Hafez & El-Moursy (1964) and for *P. storeyi* by Eltringham (1923).

Although Crocinae have not been recorded previously from central Africa (Tjeder 1967), it is possible that the northern and southern populations are linked through species occurring down the Rift Valley as evidenced by the recent discovery of crocin larvae at Nkudzi Bay (14° 24'S., 35° 12'E.) on Lake Malawi. This could account for the similarities between the two populations.

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I am grateful to the Department of Agricultural Technical Services, and in particular to Dr H. D. Brown, for financing and arranging the expedition which led to the initial discovery of these larvae, and to Drs Brown and R. H. Watmough for inviting me to participate in the expedition and for valuable advice and discussions. The General Manager of Consolidated Diamond Mines of S.W.A. Ltd., allowed us to undertake research in Diamond Area No. 1 and his co-operation is gratefully acknowledged.

I wish to express my deep gratitude to Dr Bo Tjeder for the invaluable information and inspiration he has given me during my studies on the Neuroptera. Dr V. C. Moran has read and commented upon the manuscript and his valued suggestions are much appreciated. The electron micrographs were prepared by Mr R. H. M. Cross and Miss L. Cadle of the Rhodes University Electron Microscope Unit. Several people have assisted in the search for crocin larvae and in particular I wish to thank Messrs A. J. Urban and S. B. Malcolm for the larvae from Oudtshoorn and Mr B. H. Gunn for the Nkudzi Bay specimens.

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A new genus and species in the Crocinae (Neuroptera: Nemopteridae) from southern Africa

by

M. W. MANSELL

Plant Protection Research Institute, c/o Department of Zoology and
Entomology, Rhodes University, Grahamstown, 6140

A new genus and species, *Tjederia namaquensis*, is established for an undescribed crocin reared from larvae collected in the Cedarberg mountains, from Namaqualand and from South West Africa. This new taxon is compared with other Crocinae from southern Africa, and an account is given of the egg and larval stages.

INTRODUCTION

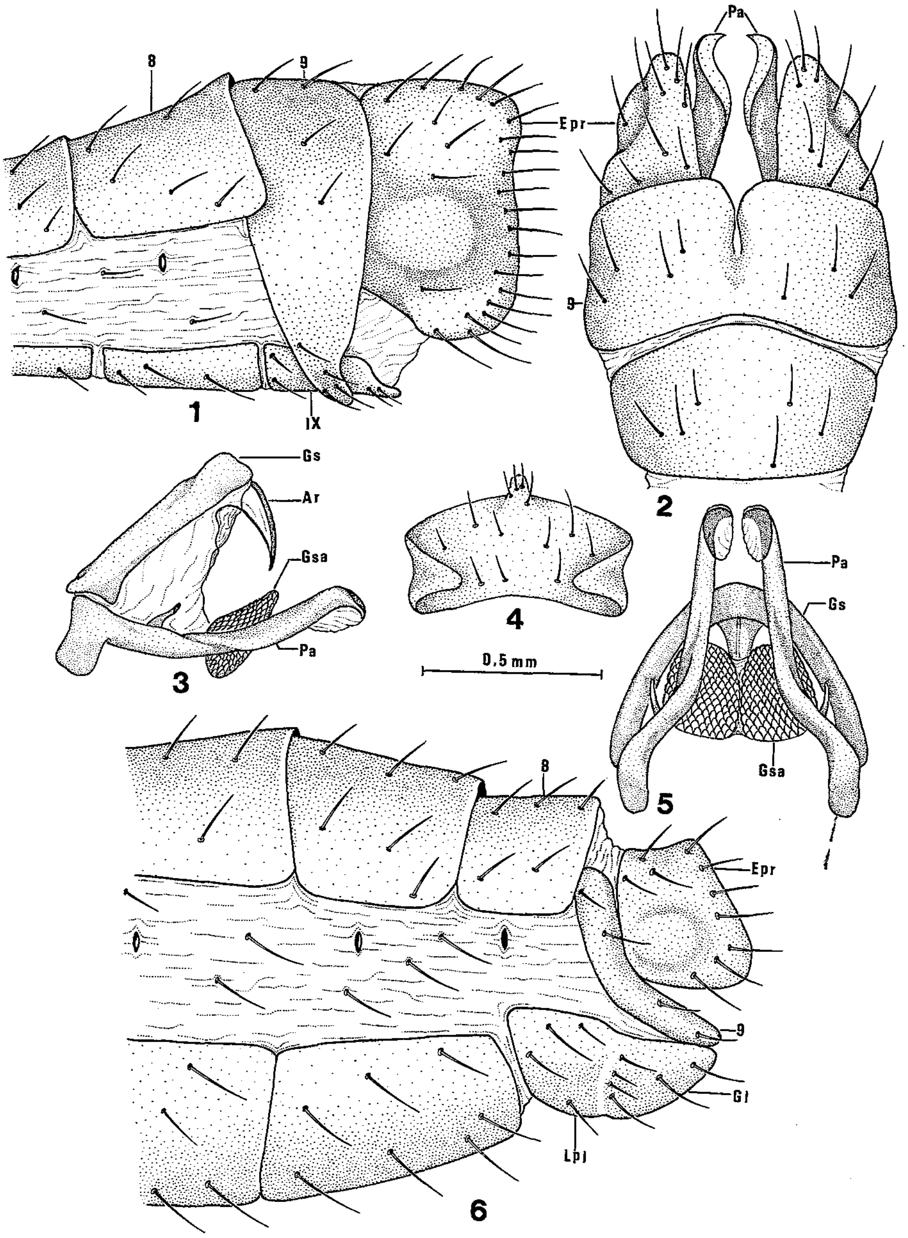
In his monograph on the Nemopteridae of southern Africa, Tjeder (1967) described six species in two genera, *Laurhervasia* Navas and *Concroce* Tjeder, within the sub-family Crocinae. These descriptions were based on adult specimens only, as the larvae of the southern African species were unknown. Larval Crocinae have subsequently been found in the sub-region (Mansell 1976) and several undescribed species have now been reared from field-collected larvae. The adults of *Tjederia namaquensis* gen. et spec. nov., differ from those of the two established genera in several respects and the larvae also differ from those of *Laurhervasia* and *Concroce*. Although larval characters have not been widely used in the definition of genera, they are probably of considerable importance. In addition to descriptions of the adults and larvae of *T. namaquensis*, this account deals with the morphology and hatching of the egg.

The name *Tjederia* is proposed in recognition of the invaluable contribution made to our knowledge of southern African Neuroptera, in particular the Nemopteridae, by the great Swedish neuropterist, Bo Tjeder.

TJEDERIA gen. nov.

Type-species: *Tjederia namaquensis* spec. nov.

Rostrum long; antennae about one third the length of the forewing. Males lacking bullae in the wings. Both sexes usually have two cross-veins between R and M before Rs in the forewings, and 9 or 10 radial cross-veins. Veins 1A and Cu2 unite and do not fuse with Cu1a before reaching the hind margin of the wing; pterostigma distinct; hindwings about 3 times longer than the forewings. Pleuritocavae absent. Males with tergite 9 entire, not divided dorsally. Females with lateral plates of sternite 8 fused with gonapophyses laterales. Larva with an extremely elongated prothorax (about 3,5 times the length of the head) and strongly tapered head.



Figs 1–6. *Tjederia namaquensis* gen. et spec. nov. 1–5. Male specimen from Graafwater. 1. Apex of abdomen, lateral view. 2. Apex of abdomen, dorsal view. 3. Gonarcus and parameres, lateral view. 4. Sternite 9, ventral view. 5. Gonarcus and parameres, ventral view. 6. Female specimen from Pakhuis Pass: apex of abdomen, lateral view.
Ar – arcessus; Epr – ectoproct; Gl – Gonapophyses laterales; Gs – gonarcus; Gsa – gonosaccus; Lpl – lateral plate of sternite 8; Pa – paramere; IX – sternite; 8, 9 – tergites.

Tjederia namaquensis spec. nov. figs 1–13

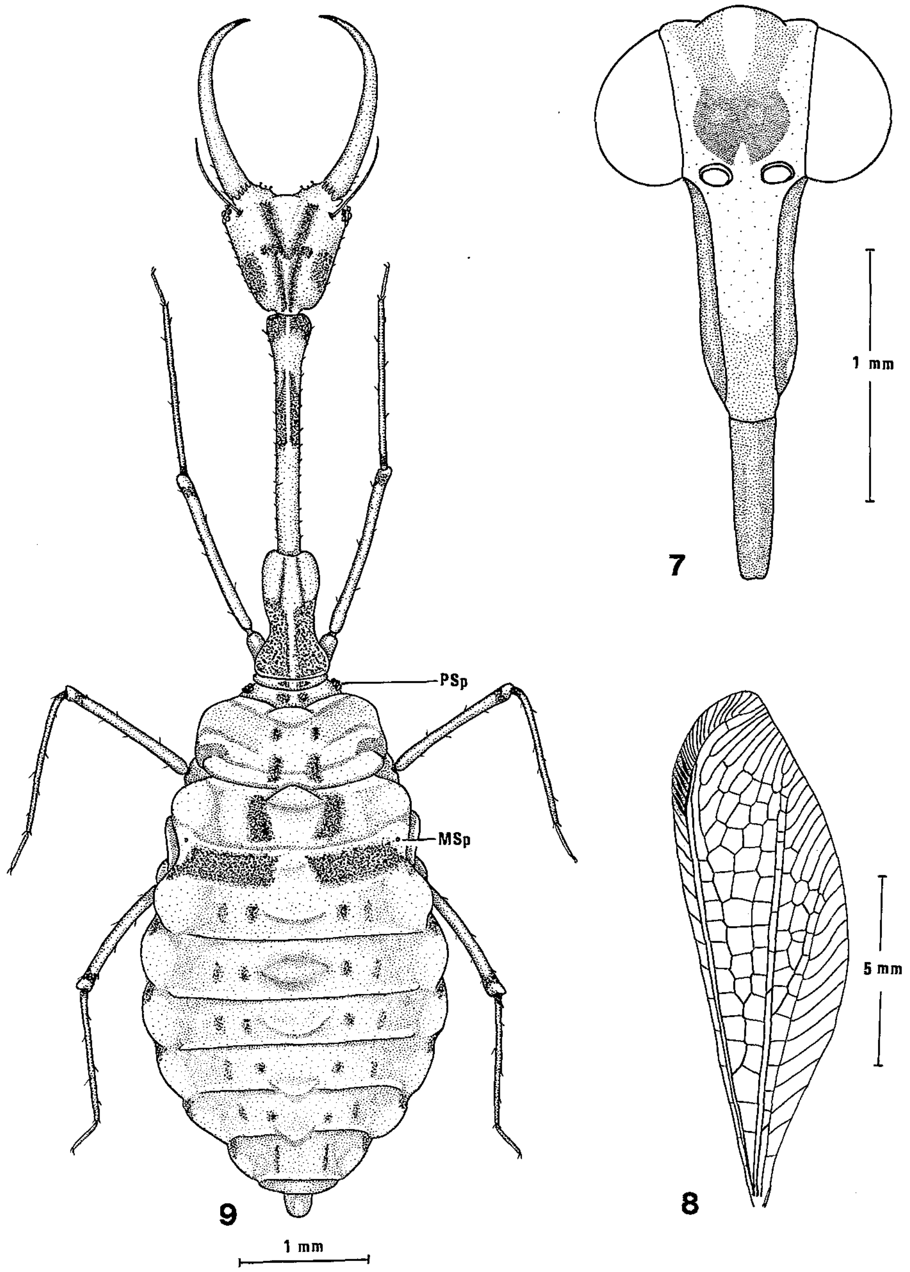
ADULTS. (figs 1–8). Sexes alike, males usually with narrower forewings than females. Size (mean measurements in mm from 21 specimens – range in brackets): length of body 7,9 (6,7–9,0); forewing 12,8 (11,5–14,0); hindwing 35,3 (31,0–43,0); antennae 3,6 (3,0–4,4); rostrum 1,6 (1,4–1,9). Holotype ♂ 7,7; 12,2; 36,0; 3,2; 1,4 respectively. Allotype ♀ 8,3; 13,4; 37,0; 4,2; 1,8 respectively.

Head (fig. 7). Creamy white with a shiny black macule (but pale in holotype) covering the raised portion of the frons above the antennae, diverging posteriorly to form a lighter V-shaped marking. Mouthparts pale yellow, clypeus pale proximally, light brown distally, genae and labrum dark brown. Antennae uniformly brown, darker towards apex with scape and pedicel diffusely light brown. Flagellar setae black.

Thorax. Uniformly brown, paler ventrally. Prothorax with long black setae along margins and shorter setae on dorsum. Meso- and metathorax with sparsely arranged short black setae on dorsum. Legs yellowish with brown annulations proximally on tibiae. Tarsi five-segmented with proximal tarsomere longer than the combined length of the other four. Paired claws pale brown. Legs densely covered with short black setae. Forewings (fig. 8) with distinct pterostigma formed by incrassate veins, brown proximally, creamy distally. Veins pale brown with black setae. Two cross-veins usually present between R and M before Rs and 9 (rarely 8–13) radial crossveins between R and Rs before the clear area below the pterostigma. Vein 1A fused with Cu2 for almost its entire length. Hindwings narrow, without dilations, pale brown proximally, becoming paler towards extremities. Bullae absent from wings of males.

Abdomen light brown with tergites darker along the posterior margins; sternites pale. Setae sparsely arranged, short and black. Pleuritocavae absent. Male (figs 1–5) with tergite 9 undivided but with median cleft in posterior margin, and narrowing to acute apices overlapping sternite 9 which has a short acute apex (fig. 4). Ectoprocts almost rectangular in shape with posterior ventral apex somewhat rounded. Gonarcus arch-shaped with well developed arcessus but with entoprocesses lacking. Parameres slender, slightly curved, about 0,8 mm in length, with a single sclerotized lobe in the distal region. Proximal region of parameres with a long, slender projection and a flattened quadrate area orientated at right angles to the length of the paramere. Gonosetae absent, spinellae present. Female (fig. 6) with tergite 9 divided dorsally, the two halves curving downwards and posteriorly, becoming closely adpressed to the dorsal margins of the gonapophyses laterales which are fused with the lateral plates of sternite 8. Ectoprocts almost quadrate, with posterior ventral margins projecting slightly.

MATERIAL EXAMINED. Adults, SOUTH AFRICA. ♂ holotype, 2 ♂ and 5 ♀ paratypes Stadsaal caves, Cedarberg (32° 31′ S 19° 19′ E), 6.i.1975. ♀ allotype, 2 ♂ and 2 ♀ paratypes, near Graafwater (32° 09′ S 18° 41′ E), 3.i.1975. 3 ♂ and 4 ♀ paratypes, Pakhuis Pass near Clanwilliam (32° 08′ S 19° 03′ E), 5.ix.1976. SOUTH WEST AFRICA, 1 ♂ paratype near Ai Ais (27° 57′ S 17° 31′ E), 1.i.1975. All reared from larvae collected by M. W. Mansell. Larval collection dates given above. Holotype and allotype deposited in National Collection of Insects, Plant Protection Research Institute, Pretoria. Paratypes: British Museum (Nat. Hist.), London, England; Entomological Museum, Zoological Institute, University Lund, Sweden; Musée Royale de L'Afrique Centrale, Tervuren, Belgium; Albany Museum, Grahamstown, South Africa.



Figs 7–9. *Tjederia namaquensis* gen. et spec. nov. 7–8. Female specimen from Pakhuis Pass. 7. Head, frontal view. 8. Right forewing. 9. Third instar larva from Graafwater.
PSp – prothoracic spiracle; MSp – metathoracic spiracle.

LARVA (fig. 9). Characterised by extremely long prothorax, markedly triangular head and medially-interrupted black band across the meta-tergites.

TABLE 1. Mean measurements (mm) for *T. namaquensis* larvae. The range is given in brackets.

	1st Instar	2nd Instar	3rd Instar
Number of larvae measured	1	3	21
Head width	0,32	0,60 (0,60)	0,96 (0,88–1,08)
Head length	0,36	0,60 (0,56–0,62)	0,97 (0,88–1,08)
Mandible length	0,44	0,79 (0,76–0,80)	1,49 (1,24–1,64)
Prothoracic length	0,64	1,52 (1,44–1,56)	3,13 (2,80–3,60)
Body width*	0,68	1,70 (1,60–1,80)	2,87 (2,20–3,60)
Body length*	3,20	5,18 (4,90–5,50)	9,50 (7,60–11,60)

*Variable, depending on feeding and state of maturity within the instar.

Head triangular in shape, longer than wide, tapering acutely towards the occipital region. Surface has raised dolichaster-bearing papillae interspersed with smaller papillae. Anterior tentorial pits present dorsally. Third instar larva with diffuse dark markings covering most of the head, a pattern comprising two triangular markings often discernible. Heads of first and second instar larvae uniformly brown with well defined epicranial suture present on the dorsal surface. Eyes each comprising one ventral and six dorsal facets. Antennae consisting of a stout, black pedicel, supporting a delicate segmented flagellum of eight segments. Proximal and distal segments of flagellum long; intermediate six segments short. Terminal flagellar segment bearing three delicate, apical bristles. Mandibles longer than head, uniformly brown, devoid of teeth, curved near the apices with dolichasters on the basal third. Maxillae each reduced to a single blade fitting into the ventral surfaces of the mandibles to form the typical planipennian suctorial tubes. Cardo and stipes distinguishable, but maxillary palps absent. Labium reduced to a single median plate, bearing three-segmented labial palps on either side; basal segment large and flattened, middle segment short, dilating apically, terminal segment fusiform, tapering to an acute tip bearing an oval pit-sense organ on the dorsal surface.

Prothorax greatly elongated, comprising three regions. Anterior region elongated, narrow and dilating apically; bearing sensory setae at articulation with head, two fuscous markings on dorsal surface of dilated area and a lighter fuscous band, divided by a pale narrow midline, behind these markings. Mid-region of prothorax shorter, wider, divided into tergite and sternite and bearing the prothoracic legs; a fuscous marking covers most of the posterior two-thirds of this region, with only the apical third and narrow midline pale. The anterior and mid-regions of the prothorax uniformly brown in first and second instar larvae. Posterior region of prothorax short, unsclerotized, incorporated with the rest of the body and bearing two spiracles laterally (PSp fig. 9), sensory setae and dolichasters present, and two light brown stripes occur on either side of the dorsal midline. The cuticle is of stellate conformation (Mansell 1976, fig. 4). Mesothorax pale buff in colour, heavily overlain with irregular, rusty-brown markings and two fuscous markings on either side of the midline, diverging posteriorly. Metathorax similar to mesothorax but shorter and wider, bearing a characteristic, prominent black band across the posterior part of the meta-tergite. This band, interrupted in the midline, is also discernible in first and second instar larvae. Ventral surface pale creamy white with cuticle of stellate conformation. A fairly prominent spiracle (MSp fig. 9) is situated dorsally on the metathorax. Legs long, slender, brown in colour with coxae partly black; femora pale with black annulations distally; tibiae with dark markings proximally. Longitudinal rows of dolichaster-bearing papillae on legs, with sensory setae occurring at articulations. Tarsi one-segmented, terminating in paired claws.

Abdomen ten segmented, segments 1–7 all similar, but becoming progressively narrower, each bearing a pair of lateral spiracles. Segment 8 conical, bearing setae and fusiform dolichasters. Segments 9 and 10 telescoped into segment 8, together forming the spinneret. Coloration of abdomen similar to that of the thorax but with smaller fuscous markings on either side of the dorsal midline in segments 1–6. Segment 8 light brown in colour.

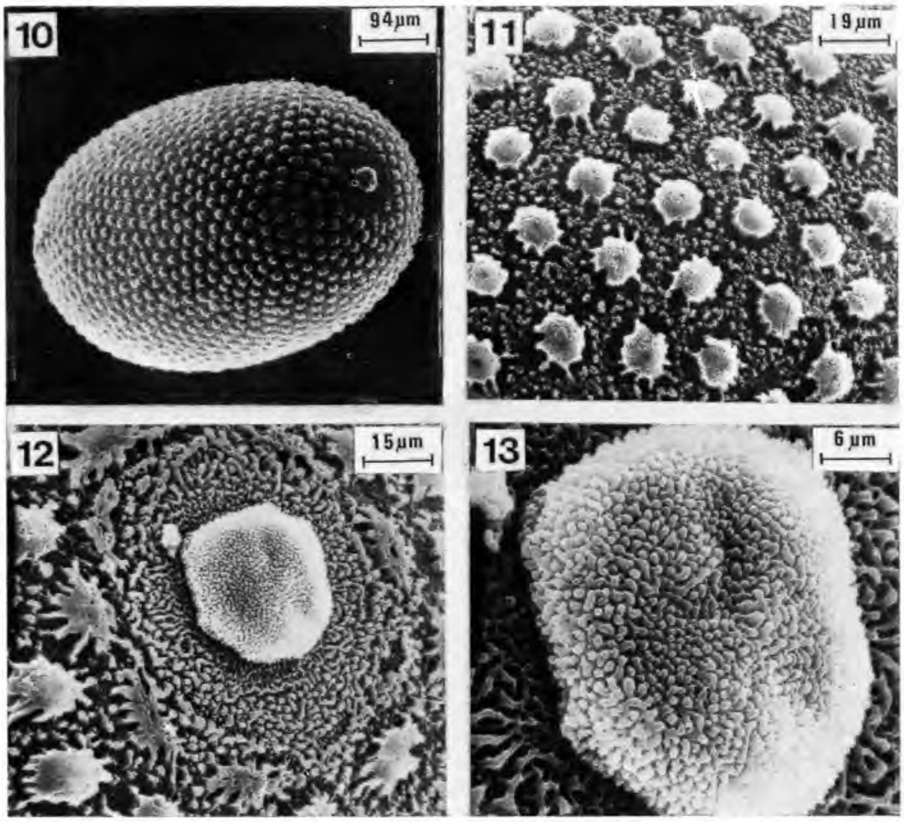
MATERIAL EXAMINED. Larvae. SOUTH AFRICA, Stadsaal Caves, Cedarberg (32° 31′ S 19° 19′ E), 10 larvae, 6.i.1975. Near Graafwater (32° 09′ S 18° 41′ E), 8 larvae, 3.i.1975. Pakhuis Pass, Clanwilliam (32° 08′ S 19° 03′ E), 10 larvae, 5.ix.1976. SOUTH WEST AFRICA, near Ai Ais (27° 57′ S 17° 31′ E), 1 larva, 1.i.1975. All collected by M. W. Mansell. In addition, 16 larvae were reared from eggs laid by females in the laboratory.

EGG (figs 10–13). Oval in shape, 0,72–0,74 mm in length. Surface of chorion (fig. 11) covered with aeropyles (Hinton 1970); a complex plastron-like structure (figs 10, 12, 13) situated over the micropyle at the cephalic end. Eggs translucent white when newly laid, with two black dots (the larval eyes) appearing through the cuticle at the cephalic end in the mature egg.

Prior to hatching the larva is orientated in the egg with the head folded ventrally under the body. On hatching, the chorion is ruptured at the cephalic end by the larva pushing against it with the thorax. Then the body of the larva straightens, the abdomen extruding through the ruptured chorion whilst the head remains temporarily within the eggshell. This manoeuvre results in the larva coming to rest on its dorsal surface enabling the soft legs to expand and harden before having to support the larva.

BIOLOGY. The biology of *Tjederia namaquensis* larvae is similar to that described for *L. setacea* by Mansell (1976). They occupy similar habitats and have been found living in the same shelter. In the laboratory, the two species have been reared on the same prey, mainly the worker caste of the termite *Trinervitermes trinervoides* Sjöst. There are three larval instars in *T. namaquensis* and cocoon spinning and pupation resembles that in *L. setacea*, although the cocoons are slightly larger (diameter 6 mm).

Adults reared from larvae in the laboratory, were placed in gauze cages and were provided with pollen (flowers) and a sugar solution as food. Although feeding and mating was not observed, three of the females laid eggs, the number of eggs varying between 26 and 30 per batch. The eggs were all fertile and the incubation period lasted about 21 days at room temperature during summer.



Figs 10 – 13. Egg of *Tjederia namaquensis* gen. et spec. nov. 10. Lateral view. 11. Aeropyles on chorion. 12–13. Plastron-like structure covering the micropyle.

DISCUSSION

A new genus *Tjederia* has been created for *T. namaquensis* spec. nov., because although the genus resembles *Laurhervasia*, there are several differences. The most important of these is the lack of bullae in the wings of the males which is one of the main characters used to distinguish genera by Tjeder (1967) and Hölzel (1975 a & b). Also, in the forewings there are usually only two cross-veins between R and M before

Rs in *Tjederia*, whereas in *Laurhervasia* there are invariably three. In the males of *T. namaquensis* the structure of the distal portions of the parameres is simple (figs 3 and 5), in contrast to the enlarged and fairly complex structures occurring in *Laurhervasia* (Tjeder 1967, figs 1992, 2001, 2010). The females of the genera *Tjederia* and *Laurhervasia* are similar to each other but are distinguishable by the wing venation. Males of *Tjederia* resemble those of the other southern African genus, *Concroce*, in the lack of bullae, but differ in the larger number of radial cross-veins in the forewings and the longer rostrum. Also, in the males of *T. namaquensis*, tergite 9 is entire and not divided into two plates as is the case in the males of *Concroce* (Tjeder 1967, fig. 2017). The females of *Tjederia* have the lateral plates of sternite 8 fused with the gonapophyses laterales but in the genus *Concroce* they are separate (Tjeder 1967, fig. 2016).

T. namaquensis adults can be distinguished from the other southern African *species* of Crocinae described by Tjeder (1967) by the markings on the head and the structure of the male genitalia. The markings on the head of *T. namaquensis* could be confused with that of *L. rhodesiae* but differ in that the macule above the antennae is entire in *T. namaquensis* but divided in *L. rhodesiae* (Tjeder 1967, fig. 2006). The males of *T. namaquensis* resemble those of *L. damarae, C. capensis* and *C. walkeri* in the lack of entoprocesses on the gonarcus but differ in the presence of proximal projections on the parameres; the males of *L. setacea* and *L. rhodesiae* have proximal projections on the parameres and also have entoprocesses on the gonarcus (Tjeder 1967, figs 2001, 2019, 2021, 1992, 2010). Tergite 9, sternite 9 and the ectoprocts are characteristically shaped for each of the six known species in the southern African fauna.

The *larvae* of *T. namaquensis* differ from those of *Laurhervasia* and *Concroce* in three respects; (a) the prothorax of *T. namaquensis* is about three and a half times the length of the head; in *L. setacea* (and other undescribed *Laurhervasia* larvae) the prothorax is about two and a half times the head length, and in *Concroce* larvae (as yet undescribed) the prothoraxes are short – only slightly longer than the head: (b) *T. namaquensis* has an acutely tapered head; in *Laurhervasia* the heads do not taper markedly and *Concroce* larvae have heads which are almost quadrate in shape: (c) the legs of *Tjederia* and *Laurhervasia* are long and slender whereas in *Concroce* they are shorter and stouter.

The three genera are sympatric for part of their distribution in the south western Cape and Namaqualand and are sometimes found in the same habitat. At present, nothing is known of microhabitat preferences for the larvae of the different species.

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