STUDIES ON SOME SYNAPOMORPHIC CHARACTERS AMONG THREE MARGRODID TRIBES IN RELATION TO MARGARODID PHYLOGENY

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The structural features compared in Coelostomidia, Perissopneumon, and Drosicha include shape of the head, eyes and ocelli, insertion of antennae, the ridges, both primary and secondary in the cephalic and thoracic regions; humeolohalteres and wings; the shape of mesothoracic furea; trochanteral and tarsal segmentation; the genitalia and derm pores.

An elliptical unchitinized area is present in the mesotharacic region in the three tribes. The gap in the morphologies of these tribes however, is regarded to warrant a raise in the Drosichini to the level of sub-family Drosichinae *s.f. novum*. The genus *Perissopneumon* is included under Drosichinae and on account of a bifid post-scutellum its status is also to be raised to Perrisopneumoni *f. novum*. Similarly based on the features of wings, head, genitalia, abdominal tessels, a raise is also warranted in the tribes Icerynini and Llaveini; their respective new sub-family names Icerynnae *s.f.n.* and Llaveinae *s.f.n.* have been proposed.

INTRODUCTION

The evaluation of synapomorphic characters is a useful tool in settling the problems of higher systematics among organisms believed to be related by common descent (Hennig, 1966, Schlee, 1969).

While re-examining some workable criteria (see Quayyoom, 1961) for building up a taxonomically sound phylogenetic picture of Coccoidea Handlirsh, 1903, which aspect forms a part of the doctoral dissectation of the writer, it became apparent that among the morphologic characteristics studied usually some were of synapomorphic nature, and hence certainly of value. As such, these could be used with advantage in arriving at some more reliable conclusions in working out the phylogeny of some of the higher categories in

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Margarodidae sensu Morrison, 1927, as well. In the present paper, the phylogenetic inter-relations of the margarodid tribes Coelostomidiini Morrison, Monophlebini Cockerell and Drosichini Morrison, on account of their obvious similarities, have been worked out by basing observations mostly on the adult male structures of *Coelostomidia zealandica* (Maskell) & *Perissopneumon tamarindus* (Green) and then comparing them with the homologous structures found in *Drosicha stebbingi* (Green)*.

A re-examination of the question of phylogenetic placement of these tribes was also necessitated on account of the fact that in 1950, Rao declared *Drosichiella* to be a synonym of *Perissopneumon* Newstead, thus, he transferred a genus belonging originally to *Drosichini* to *Monophlebini*. It needs, therefore, to be established whether regarding *Perissopneumon* as a synonym of *Drosichiella* would be wholly warranted when the adult male structures in the two taxa are also compared. This last statement is of particular consequence when we see that the original descriptions both of *Perissopneumon* and *Drosichiella* were based on adult females (Morrison, 1928) which on account of their being neotenic in nature are currently (Theron, 1958) not much valued in reconstructing the higher taxanomy of Coccoidea in general. The male of *Drosichiella tamarindus* (Green) was discovered later on (Rehman and Latif 1944). Among features closely approaching *Drosicha* it differed in having four terminal tessels in the abdomen. In the meantime Green had also described several males (e.g. Green 1922, 1924) belonging to *Drosichini*. Of these *Monophlebus quadricaudatus*, which again was described without a referable female, seems to the writer possibily congeneric with the currently designated genus *Perissopneumon* because it also has four terminal abdominal tessels. This problem is to be tackled elsewhere. In the context of the present paper, however, it becomes all the more important to make a careful study of the male structures in *Perissopneumon* of which two slides prepared by Latif in July 1941 under the name *Drosichiella tamarindus* (Green)** are available to the writer.

As mentioned already, the adult male structures of the taxa given above and others are compared in order to confirm and elucidate the morphologic definitions of the three tribes viz. *Coelostomidiini*, *Monophlebini* and *Drosichini* with relation to each other. This comparison is being made also with a view to reaffirm the complexion of each taxon with regard to the possibility that some of them might be assignable to categories higher or

* Preferably to be written as *D. stebbingi* (Stebbing).

** Determined by V.P. Rao, 1941.

lower than the tribes in the light of the existing revisional approach, (Williams, 1969) which might neeessitate a rearrangement of other tribes as well (Fig. 20).

METHODS AND MATERIALS

Characters enumerated below were compared in the three entities under study for correspondence or otherwise of their size, shape and disposition :

The published material on *C. zealandica, D. contrahens, N. texana, X. betulae, M. crawfordi* and *U. assimile* by Morrison (1928) has been freely drawn upon.

Slide preparations with whole-mounts of the adult males of *D. stebbingi* (Green) were made with the usual methods (Theron, 1958). One of the acquired slides of *P. tamarindus* (Green) was remounted for study after the methods given by Afifi and Kosztarab (1967).

Illustrations of *Coelostomidia zealandica* and *Drosicha contrahens* and others mentioned above under para 2. were made by adapting from those drawn by Morrison (1928) while those of *D. stebbingi* and *P. tamarindus* were made with the help of a camera lucida by the writer.

The characters of the three taxa under study, considered for the above noted objectives are:

Head shape; Insertion and shape of antennae; Disposition and Development of the mid-cranial, pre-ocular and pre oral ridges; Cranial apophysis; Lateral ocelli and Compound eyes; Meso-thoracic unchitinized area; Pre-scutal, Scutellar and Post scutal areas; Post alarae; Wings and humolohalters; Meso-thoracic furca; Genitalia, Derm-pores and Abdominal tessela; Trochanteral and tarsal segmentation and General appearance.

RESULTS AND DISCUSSION

This paper deals with the phylogenetic inter-and intra-relations of three margarodid Tribes viz. Coelostomidiini, Drosichini and Perissopneumoni. These tribes are important for a study of the phyletic relations within Margarodidae, because:

These share a number of characters despite being placed under three different taxa.

The more pertinent for the present studies are:

(i) shape of the head (Figs. 1, 2 and 3; 10, 11, 12 and 13) which is consistent in the three entities, (ii) the pre-ocular (pocr), pre-oral (por) and mid-cranial ridges (mcr) are also similarly disposed in all the three, (iii) the

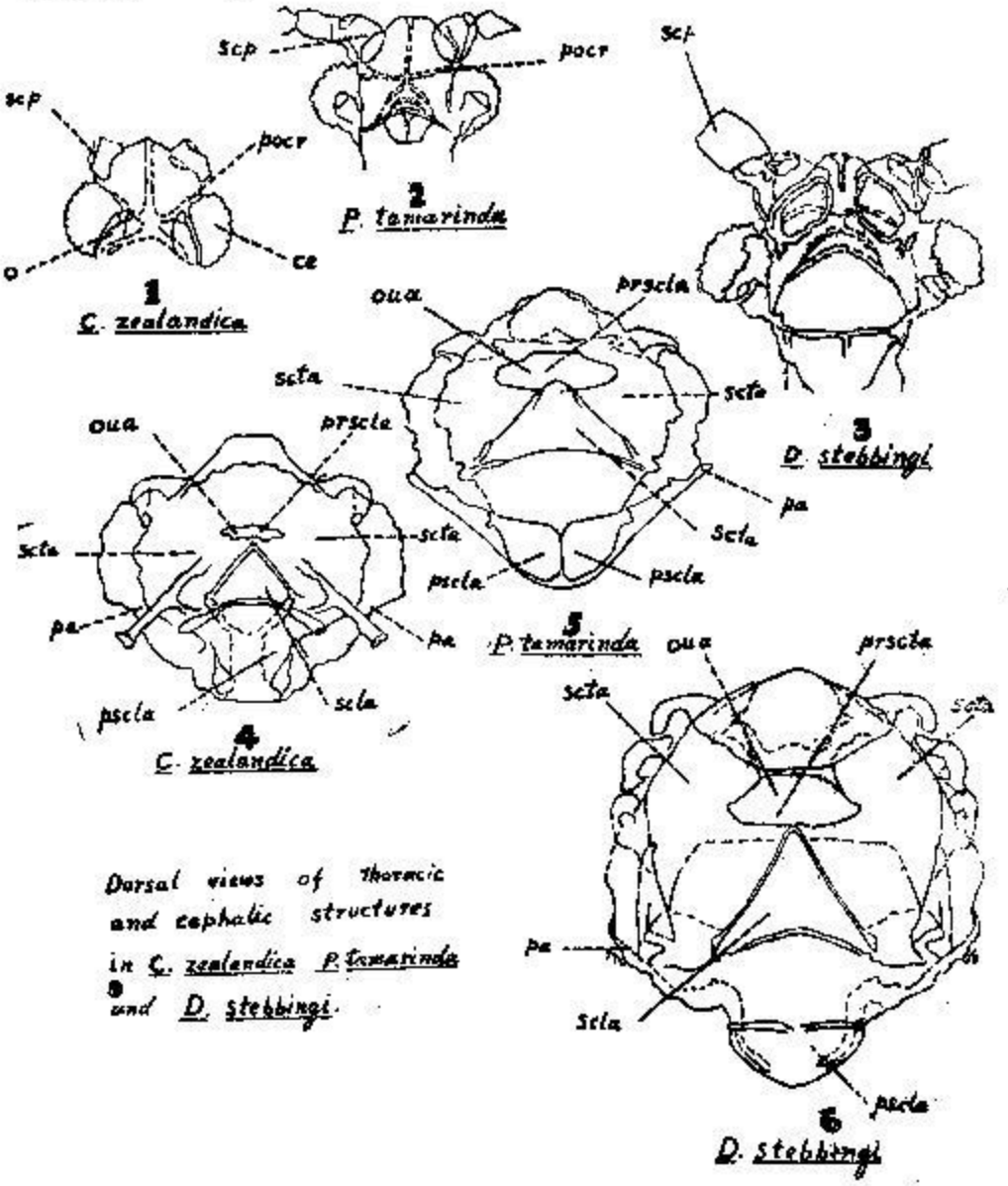
lateral ocelli (o) are located anteread in the three taxa, more so in Coelostomidiini. In this taxon these ocelli are borne on the human eye shaped oculata (ocu), which seem to be developed from part of the area normally taken by the compound eyes (ce), (iv) in the two other entities viz. Drosichini and Perissopneumoni, the lateral ocelli (o) are pedunculated and are borne anteriolaterally at the base of triangular ocalata (ocu); indistinct in Perissoneumoni but quite conspicuous in Drosichini, (v) these two latter tribes also possess a well differentiated cranial apophysis (ca) of the flattend type (Theron, 1958) which is ostensibly wanting in Coelostomidiini, and (vi) then also both these entities have a post-occipital suture (pos) alongwith somewhat bifid triangulated post-occiput (poc) in each case. These latter features also seem wanting in the Coelostomidiini.

The features mentioned in connection with Drosichini and Perissopneumoni associate them more closely but when we examine features of thorax particularly the shape of mesotharacic furca (Figs. 4, 5 and 6, furca$_2$) the possible origin (see also Quayyoom, 1973) of the three entities from a common source appears plausable (vii) the most note-worthy additional feature showing synapomorphism is an oval unchitinized area (oua) in the prescutum (prscla) of the three taxa: In so far as it could be determined it is a sub-family character (Morrison, 1928) shared by the sub-families Coelostomidiinae, Drosichinae and also Iceryinae: In a latter paper (Quayyoom 1974a) it would be shown that the last named sub-family has a number of apomorphlic as well as degnerative features.

In order to draw some general conclusions on the margarodid *inter*-relations, it was deemed necessary to compare features (See also Quayyoom 1974a) of antennae, wings and humlohalters (see Figs. 7, 8, 9, 14 and 18) genitalia (Figs, 15, 16, 17 and 22) and the abdominal tessels, in at least one representative of each taxon. A Close comparison of these characters, which are fairly constant in the taxa examined, revealed that the three taxa alluded to earlier represent a phase of primary dichotomy: Coelostomidiini on one side and both Drosichini and Perissopneumoni on the other. Further, on account of the fact that the former tribe has no abdominal tessles but the latter do have them (Drosichini 2-5 pairs; while Perissopneumoni only 2-pairs), the association pattern suggested above seems warranted. The postscutellum (Figs. 4 and 6) in Drosichini is entire; it is bifid in Perissopneumoni (Fig. 5). Moreover, the genitalic features (Fig. 22) compared in *Neosteingella taxana* (KUWANIINI), *Xylococculus betulae* (XYLOCOCCINI) *Monophlebulus crawfordi* (MONOPHLEBULINI), *Drosicha stebbingi* (DROSICHINI), *Perissopneumon tamarindi* (PERISSOPNEUMONI) and *Coelostomidia zealandica*

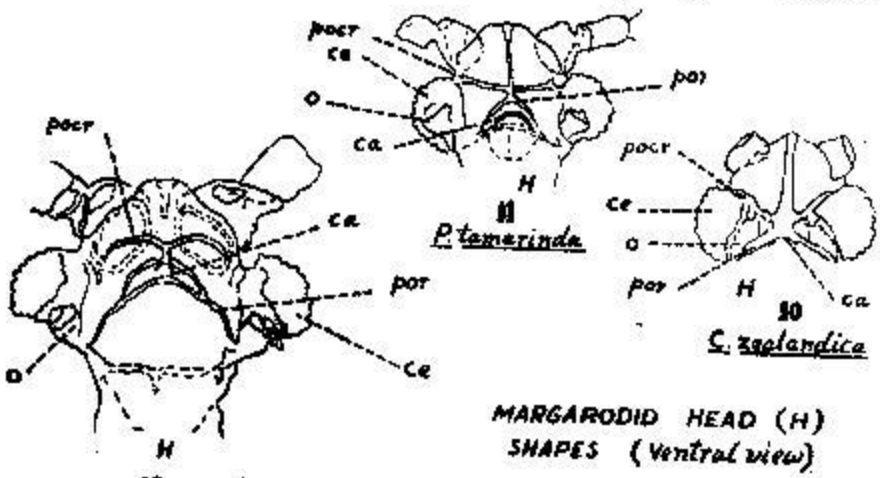
(COELOSTOMIDINI) yield the formulation of following arrangement:

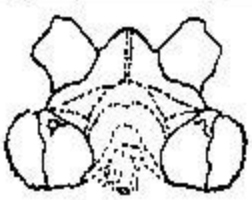
Neosteingelia (KUWANNIINI) represents a primitive pattern (Fig. 22a). The penis (p) is issued from an oval plate to be regarded as the precursor of the penis sheath (ps); eversibility not yet evolved. *Xylococulus* (XYLOCOCCINAE) indicates a furtherence of the same pattern (22c), the penis sheath (ps) takes a triangular shape, via, possibily *Coelostomidia* (22b) where it is



Dorsal views of thoracic and cephalic structures in C. zealandica P. tamarinda and D. stebbingi.

oval. From this pattern it may be seen that shape of the penis sheath (ps) in *Monoplebulus* (22c) *Drosicha* (22d) *Perissopneumon* (22f) is clearly apomorphoic. Acquisition of a tubular process of the penis-sheath (tpps) seems to be an additional feature acquired later in the evolution of margarodid genitalia. Based on the features of antenae (ant) and the abdominal tessels which are fairly constant and regarded as of sub-family level characteristics the sub-families are split into two groups viz, Margarodinae, Steigellinae, Matsucoc-





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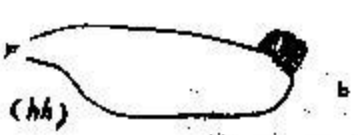
HEAD (H)

WING (W), HUMOLOHALTERES (hh)

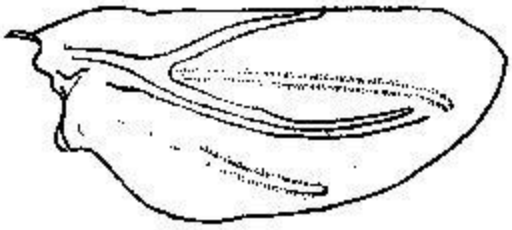
14

D. contrahens

Dorsal view of Medial, Humolo-haltere and wing.



MARGARODID WINGS (W) (DORSAL VIEW)



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D. stebbingi

7

C. zealandica

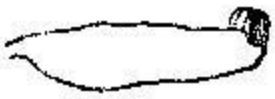
8

P. tamarinda

MARGARODID HUMOLD- HALTERES (hh)

c

D. stebbingi



a

C. zealandica

b

P. tamarinda

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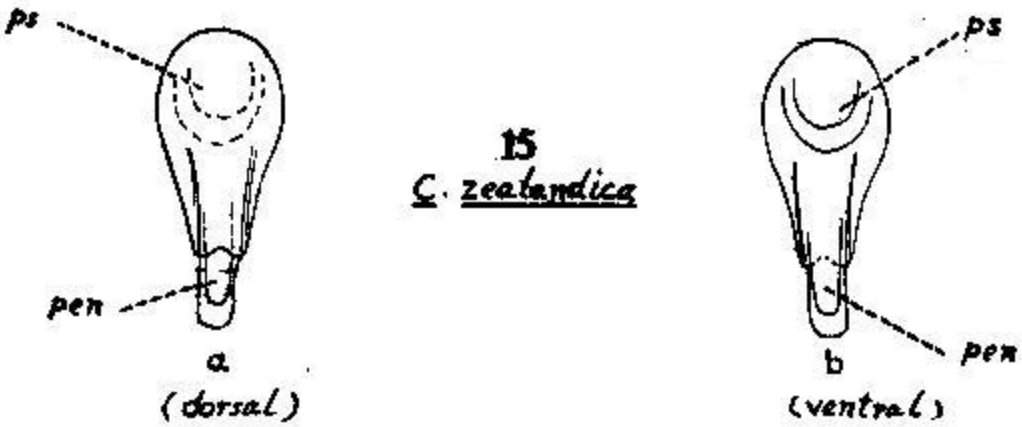
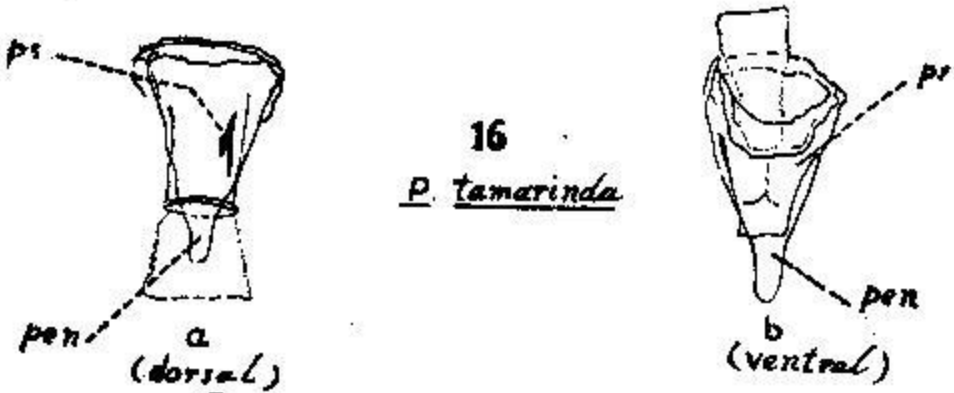
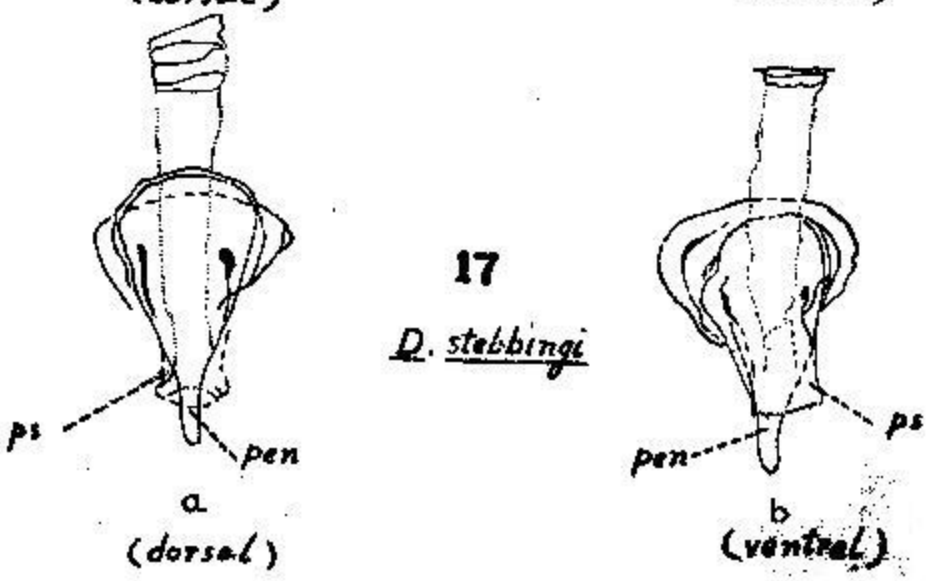
COMPARATIVE STRUCTURES IN MARGARODID GENITALIA

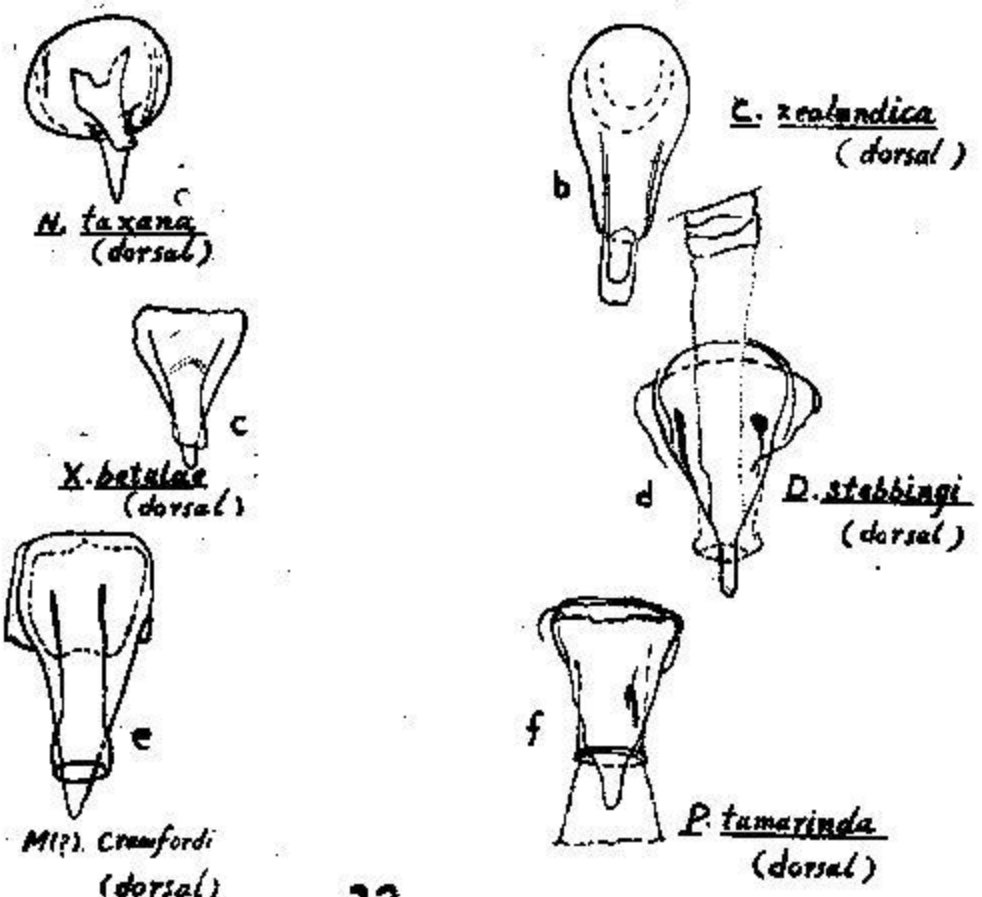




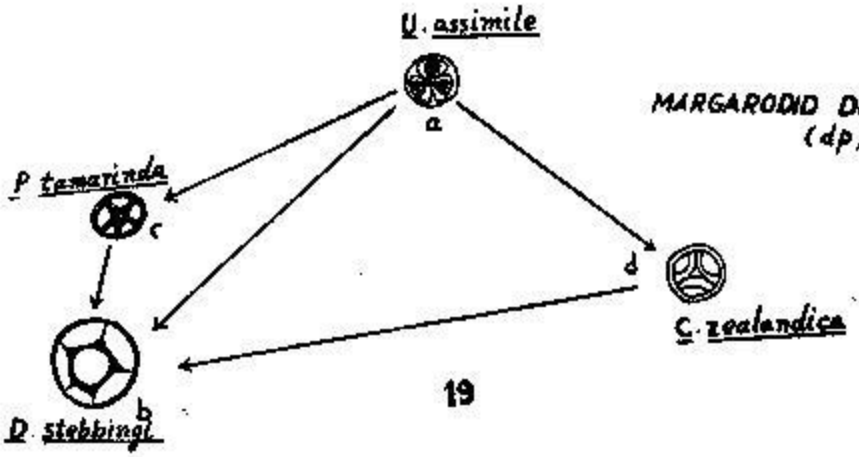


einae, Xylococcinae and Coelostomidiinae have generally non-nodulated antennae and possess no abdominal vessels. The sub-families Monophlebinae, Drosichinae s.f.n., Ilaveinae s.f.n. and Iceryinae s.f.n. have a variable number of fully formed or stunted abdominal vessels and generally nodulated antennae. Of the 22 characters compared (Table I) in the three tribes, 15 are shared between *Coelostomidia* and *Perissopneumon*, 14 between *Perissopneumon* and *Drosicha* and 14 between *Drosicha* and *Coelostomidia*. Mention needs here be

GENITALIA PATTERNS IN MARGARODID TRIBES



made of the evidence afforded by the derm-pores (dp Fig. 19) and the meso-thoracic furca, (Fig. 21). The coelostomid derm pores seem to be basic and those of drosichid genera derived; the meso thoracic furcae ($Furc_2$) in *Drosicha* and *Coelostomidia* share much more in common, while the features of this structure in *Perissopneumon* seem apomorphic. The pupa of *Perissopneumon*, however, has closely resembling morphological features (Quayyoom 1974b, under preparation) of the-thoracic furca when compared



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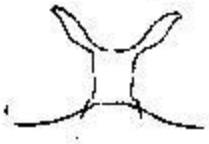
c

D. stebbingi

MARGARODID MESOFURCAE ($Furc_2$)



a

C. zealandica

b

P. tamarinda

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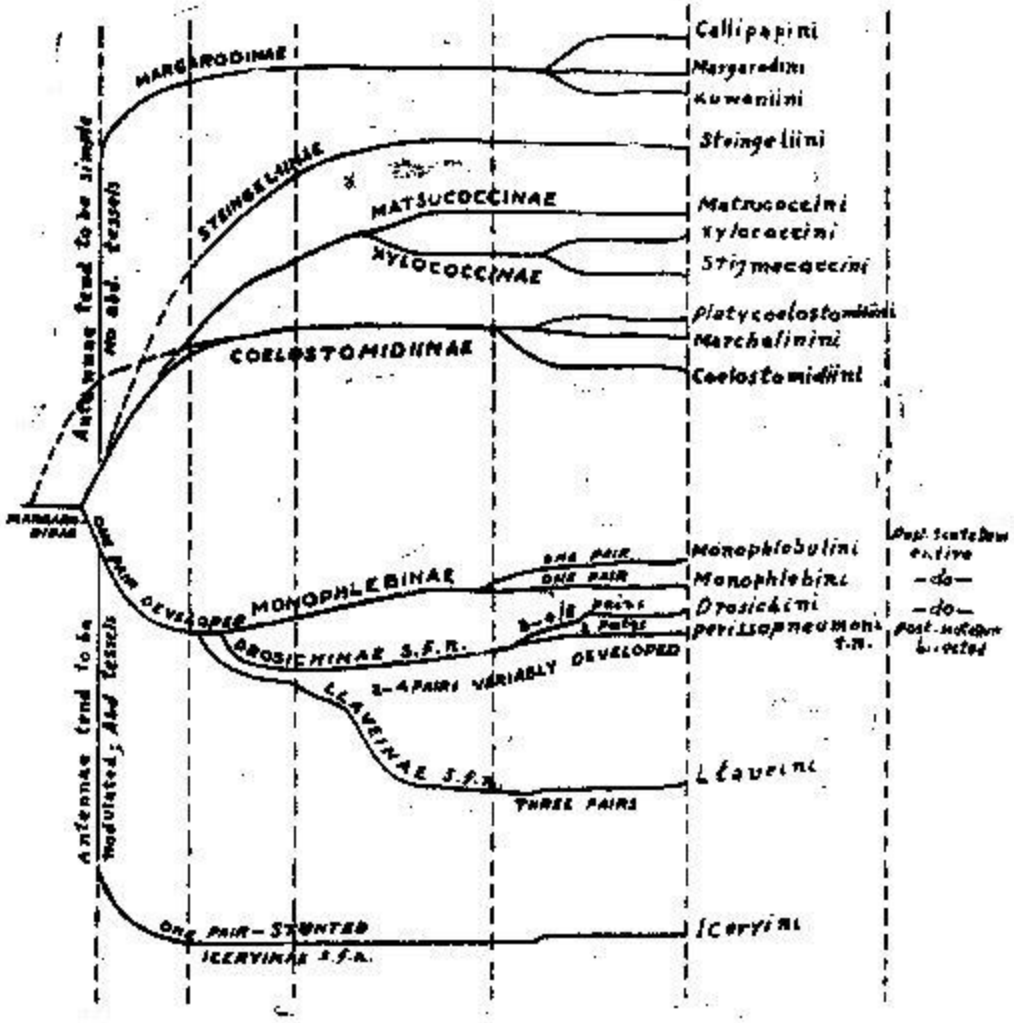
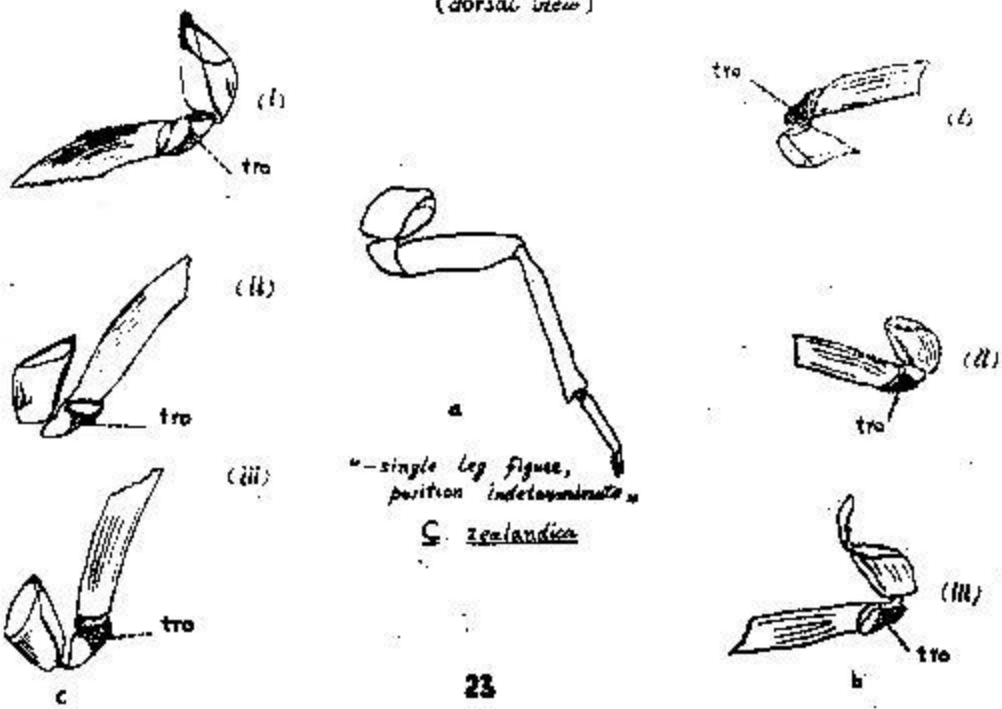
with the adult male in *Drosicha*. The inter-relations of the considered tribes are illustrated (Fig. 20) suitably.

FIG. 20



PHYLOGENETIC SCHEME OF MARGARODID TRIBES

TROCHANTERAL SEGMENTATION IN THREE MEALY BUGS
(dorsal view)



D. stebbingi — P. tamarindi

23

TARSAL SEGMENTATION IN THREE MARGARODIDS
(dorsal view)

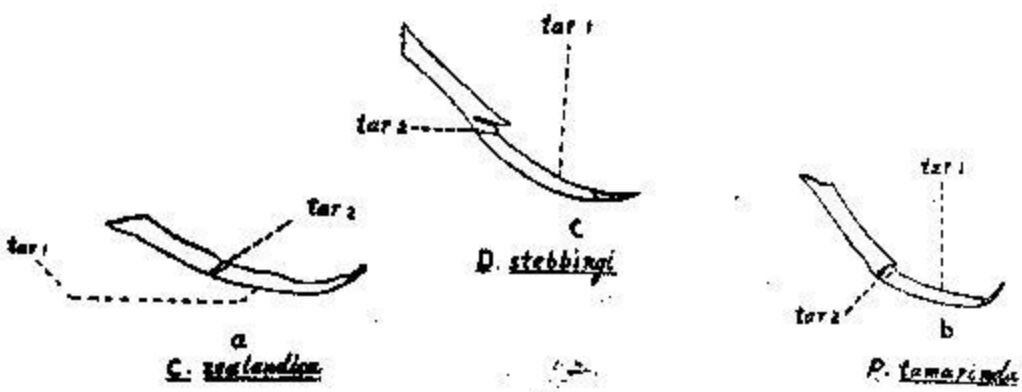


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TABLE-1 *Showing Sharing of Considered Characters*

+ = Presence and/or Similarity:	— = Absence or Dissimilarity	A C. zealandica	B P. tamarinda	C D. stebbingi
1.	Shape of head	+	+	—
2.	Insertion of Antennae	+	+	—
3.	Ridges: Mid-cranial	+	+	—
4.	Ridges: Preocular	+	+	—
5.	Ridges: Preoral	+	+	+
6.	Lateral Ocelli	—	+	+
7.	Compound Eyes	+	+	+
8.	Mesothor. Unchitinzed area	+	+	+
9.	Areas: Prescutal	+	+	+
10.	Areas: Scutal	+	+	+
11.	Areas: Scutellar	+	—	+
12.	Postalarae	+	—	+
13.	Wings	+	+	+
14.	Humolo -halteres	+	+	+
15.	Mesothoracic furca	+	—	+
16.	Trochenteral segmentation	+	+	+
17.	Tarsal segmentation	+	+	+
18.	Genitalia	—	+	+
19.	Derm pores	—	—	+
20.	General Appearance	+	+	+
21.	Cranial apophysis	—	+	+
22.	Abdominal tessels	—	+	+

A & B share 15 and do not share 7 characters
B & C share 14 and do not share 8 characters
C & A share 13 and do not share 9 characters

EXPLANATION OF ABBREVIATIONS USED IN TEXT FIGURES

ant	antennjaeal	pa	post alarae
ca	cranial apophysis	pn_2	meso-postnotum
ce	compound eyes	pocr	preocular ridge
dp	derm pores	por	preoral ridge
$furca_2$	mesothoracic furca	prscla	prescutellar area
Genit	Genitalia	ps	penis sheath
hh	humolo halteres	pscla	post-scultellar area
H	Head	scla	scutellar area
mcr	mid cranial ridge	scp	scape
mfn	marginal fold of notum	scta	scutal area
o	lateral ocellus	tar	tarsasl segmentation
ocu	oculata	tpps	tubular process of the penis sheath
oua	oval unchitinized area	tro	trochanteral segmentation
P	penis	W	Wing

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