

**CLADISTIC ANALYSIS OF THE TRIBE AELIINI
(HETEROPTERA: PENTATOMIDAE: PENTATOMINAE)
FROM THE ORIENTAL REGION**

RAEES HUSSAIN ZAIDI

Department of Zoology, University of Karachi, Karachi 75270, Pakistan

Vingnanam Journal of Science 9 : 1 - 14 (1994)

ABSTRACT: A cladistic analysis showing phylogenetic relationships of the tribe Aeliini Stal having five genera and ten species from the Oriental region is presented. The dendrogram shows that the genera *Aelia* Fabricius, *Bonacialis* Distant and *Gulielmus* Distant formed a group while *Adria* Stal and *Aeliomorpha* Stal show similarities and form another group.

Introduction

In Pentatomidae cladistic analysis has rarely been used. Recently Schaefer and Ahmed (1987) presented cladistic analysis of Lestonocorini and Ahmad *et al.* (1988a, b) used this method for determining the relationships of the genus *Mormidella* and of the tribe Carpocorini and genus *Canthecona* of Asopini of Pentatominae, on the basis of apomorphic characters. Presently this technique is used for showing relationships of five genera representing ten species of the tribe Aeliini from the Oriental region.

The characters are largely taken from the published works of Zaidi (1988), Ahmad and Zaidi (1988) and Zaidi and Ahmad (1989). Some of the characters were also examined from the specimens lodged in the Natural History Museum, Department of Zoology, University of Karachi and Natural History Museum, London. Seventeen characters were used to determine the polarities on the basis of out group comparison are used.

Key to the species of the tribe Aeliini

1. Paraclypei almost as long as and never enclosing clypeus in front.2
- Paraclypei remarkably longer than clypeus and enclosing it in front.7
2. Anterior margin of pronotum remarkably sinuate, meso- and metasterna is slightly sulcate; metathoracic scent gland complex with peritreme and evaporatoria indistinct.*Adria* Stal3
- Anterior margin of pronotum smoothly concave, meso- and metasterna slightly carinate; metathoracic scent gland with peritreme and evaporatoria distinct.*Aeliomorpha* Stal5
3. Head distinctly shorter than pronotum, antennae with 2nd segment as long as 3rd; anterior margin of pronotum smooth.*A. parvula*
- Head as long as pronotum, antennae with 2nd segment longer than 3rd; anterior margin of pronotum sinuate.4
4. Antennae with 3rd segment as long as 4th, pygophore broader than long, aedeagus with 2 pairs of membranous conjunctival appendages.*A. neoparvula*
- Antennae with 3rd segment shorter than 4th; pygophore almost as long as broad, aedeagus with a single pair of membranous conjunctival appendages.*A. sindellus*
5. Head length almost as long as pronotum, labium just passing beyond hind coxae; dorsoposterior margin of pygophore toothed.*A. fletcheri*
- Head length longer than pronotum, labium distinctly passing beyond hind coxae, reaching to 3rd abdominal venter; dorsoposterior margin of pygophore convex or medially concave.6
6. Scutellum almost as long as broad, more than 1 1/4 x longer than head length; pygophore quadrangular; proximal spermathecal duct more than 2 1/2 x longer than distal spermathecal duct.*A. pusana*
- Scutellum broader than long, distinctly shorter than head length; pygophore broader than long, proximal spermathecal duct.*A. lineaticollis*
7. Anterior margin of pronotum smooth or slightly concave; anterior angles small denticles - like; 9th paratergites elongated with narrow apex.8
- Anterior margin of pronotum deeply concave; anterior angles produced; 9th paratergites broader with broad apex.*Bonacialis dixonii*
8. Labium passing beyond middle coxae, but not reaching to the hind coxae; metathoracic scent gland complex poorly developed; humeral angles of pronotum acute.*Gulielmus* Distant9
- Labium passing beyond hind coxae; metathoracic scent gland complex well developed; humeral angles of pronotum broad.*Aelia baluchistanensis*
9. Head slightly longer than pronotum; labium with 1st segment longest, 3rd shortest; pygophore longer than broad.*G. marmoratus*

Head almost as long as pronotum; labium with 2nd segment longest, 4th shortest; pygophore broader than long.G. laterarius

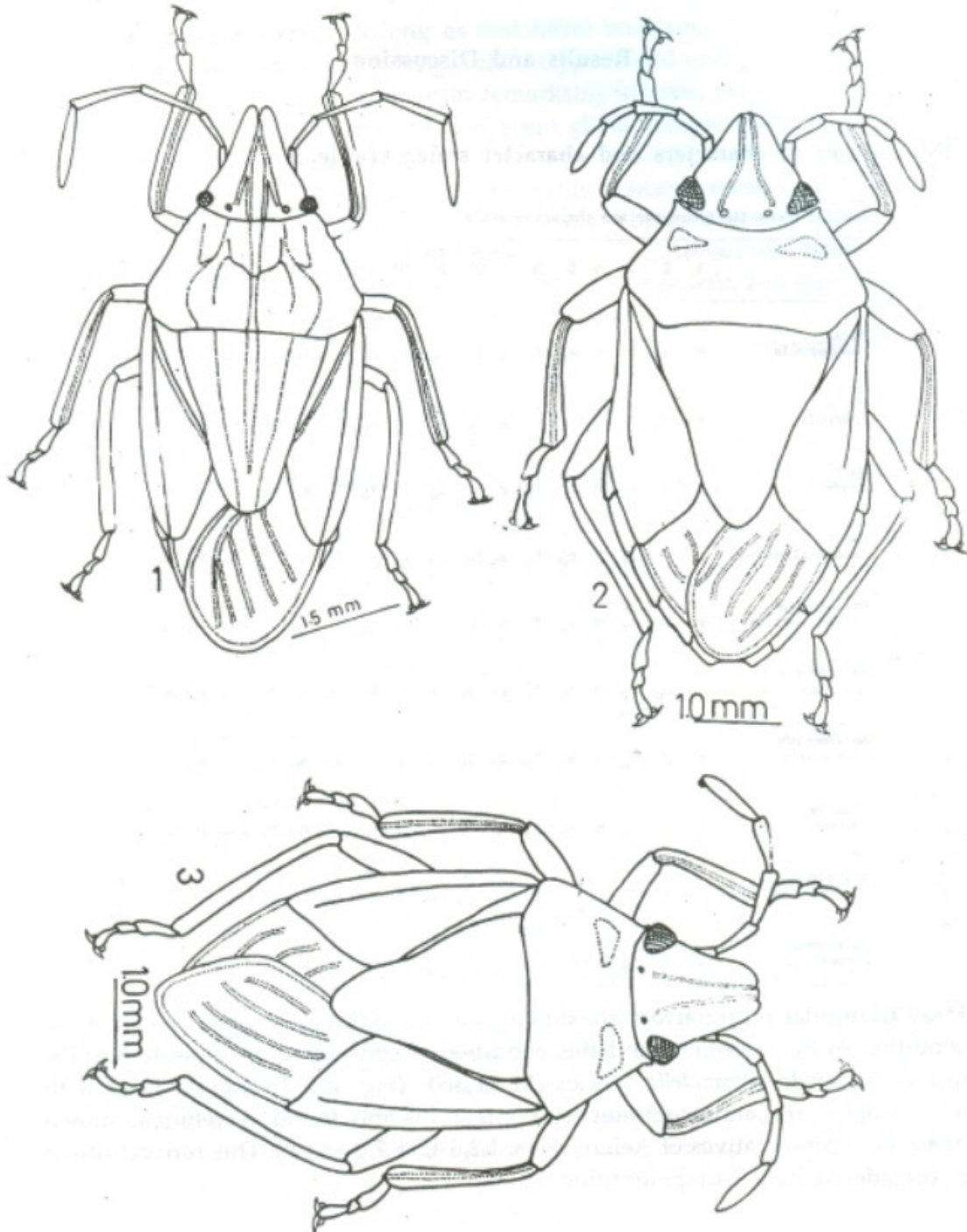
Results and Discussion

Description of characters and character states (Table 1)

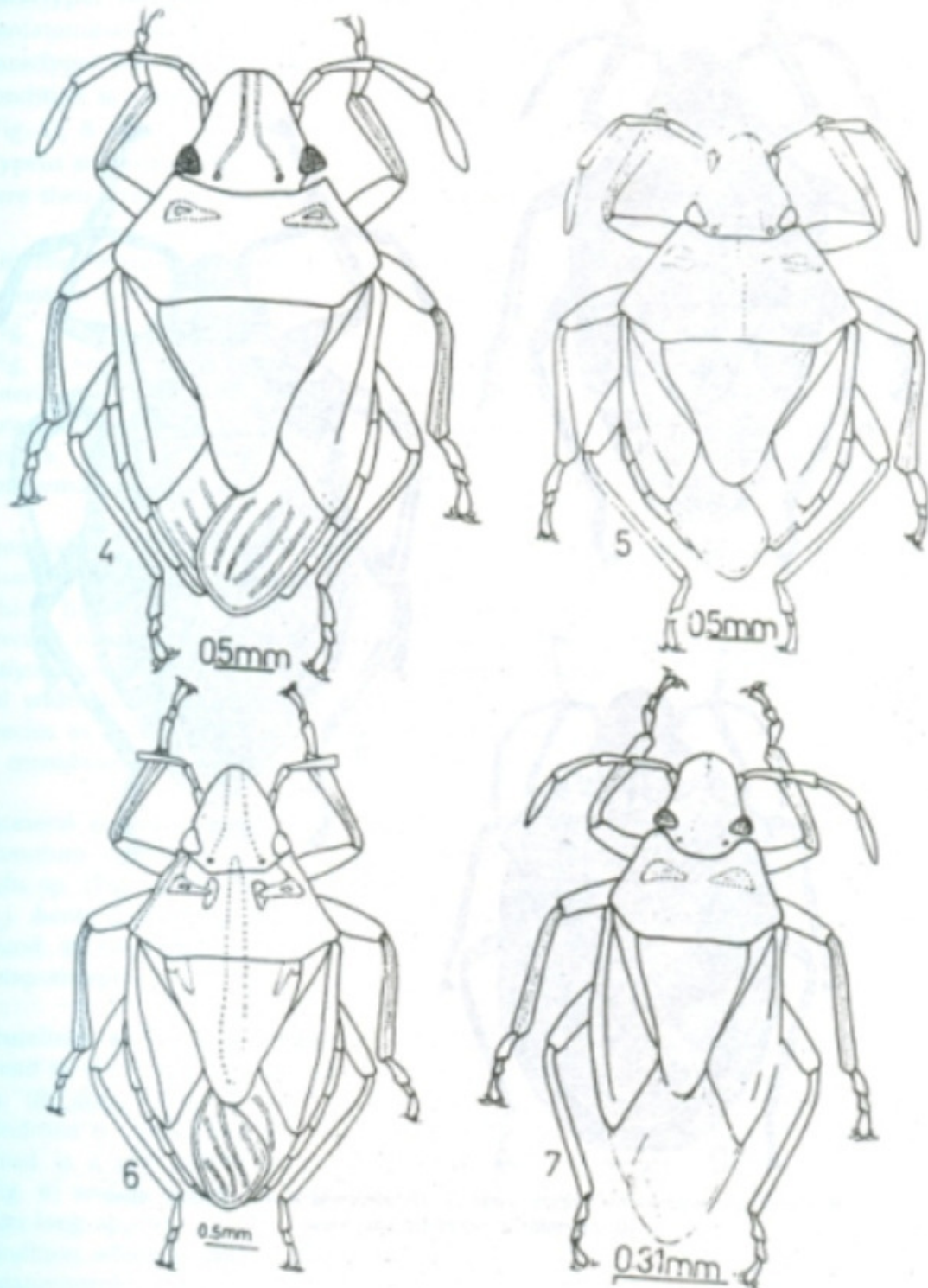
TABLE-1 shows the character and character state.

SPECIES	CHARACTERS																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
<i>Adria neoparvula</i>	a	b ₀	c	d	e ₀	f ₀	g	h	i ₀	j ₀	k ₀	l ₀	m ₁	n ₁	o ₁	p ₁	q
<i>Adria parvula</i>	a	b ₀	c ₀	d	e ₀	f ₀	g	h ₀	i ₀	j ₀	k ₀	l ₀	m ₁	n	o ₁	p ₁	q
<i>Adria sindellus</i>	a	b ₀	c ₁	d	e ₀	f ₀	g	h ₀	i ₀	j ₀	k ₀	l ₀	m ₀	n ₀	o ₁	p ₀	q
<i>Aelia baluchistanensis</i>	a	b	c ₀	d	e ₀	f ₀	g ₀	h ₀	i ₀	j ₀	k	l	m ₁	n ₁	o ₁	p ₁	q ₀
<i>Aeliomorpha lineaticollis</i>	a	b ₀	c ₀	d	e ₀	f	g ₀	h ₀	i ₀	j ₁	k ₀	l ₀	m ₁	n ₁	o ₁	p ₀	q
<i>Aeliomorpha pumna</i>	a	b ₀	c ₀	d	e ₀	f ₁	g ₀	h ₀	i ₀	j	k ₀	l ₀	m ₀	n ₁	o ₀	p ₀	q
<i>Aeliomorpha fletcheri</i>	a	b ₀	c ₀	d	e ₀	f ₀	g ₀	h ₀	i ₀	j	k ₁	l ₁	m ₀	n ₀	o	p ₀	q
<i>Evacillius dinori</i>	a	b	c ₀	d	e ₀	f ₀	g ₀	h ₀	i ₀	j ₁	k ₁	l ₁	m ₁	n ₁	o ₁	p	q ₁
<i>Gulielmus laterarius</i>	a	b	c ₀	d	e	f ₀	g ₀	h ₀	i ₁	j ₀	k	l ₀	m	n ₁	o ₁	p ₁	q ₁
<i>Gulielmus marmoratus</i>	a	b	c ₀	d	e	f ₀	g ₀	h ₀	i	j ₀	k	l ₀	m ₀	n ₁	o ₁	p	q ₀

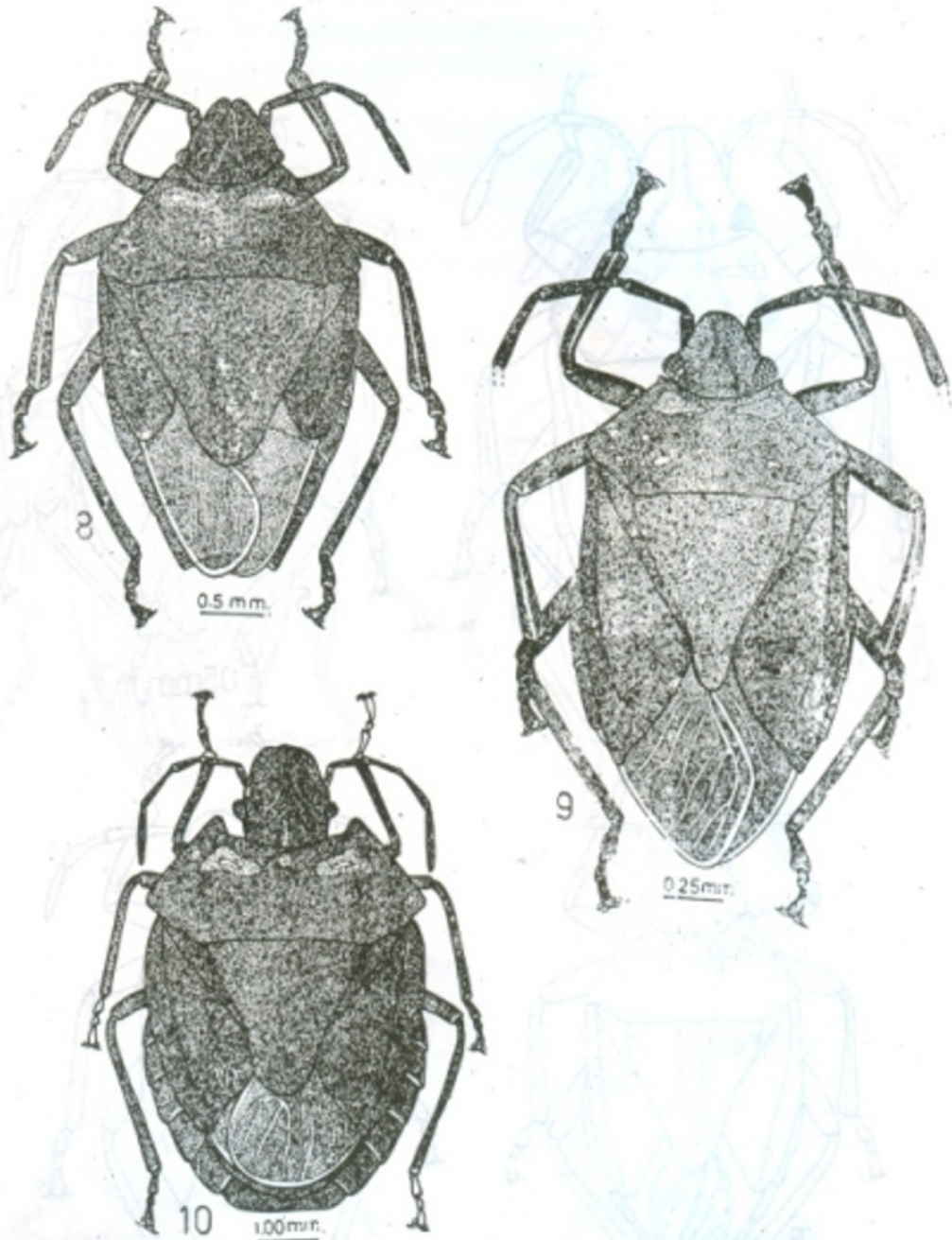
Head triangular with narrow apex: Elongate or quadrangular head is a common condition in Pentatominae and this condition is considered here plesiomorphic (a) as shown in *Mormidella* species (*M. hessei*) (Fig. 10). Triangular head with narrow apex (a) is an uncommon condition and is only found in Aeliini as shown in all the representatives of Aeliini (Figs. 1,2,3,4,5,6,7,8 and 9). This rare condition is considered here autapomorphic.



1. **Aelia baluchistanensis* Dorsal view 2. *Adria parvula* Dorsal view 3. *Adria neoparvula* Dorsal view



4. **Adria sindellus* Dorsal view 5. *Aeliomorpha pusana* Dorsal view
6. *Aeliomorpha lineaticollis* Dorsal view 7. *Bonacialis dixonii* Dorsal view



8. *Guleimus marmoratus* Dorsal view 9. *Halyomorpha murrea* Dorsal view
10. *Mormidella hessei* Dorsal view

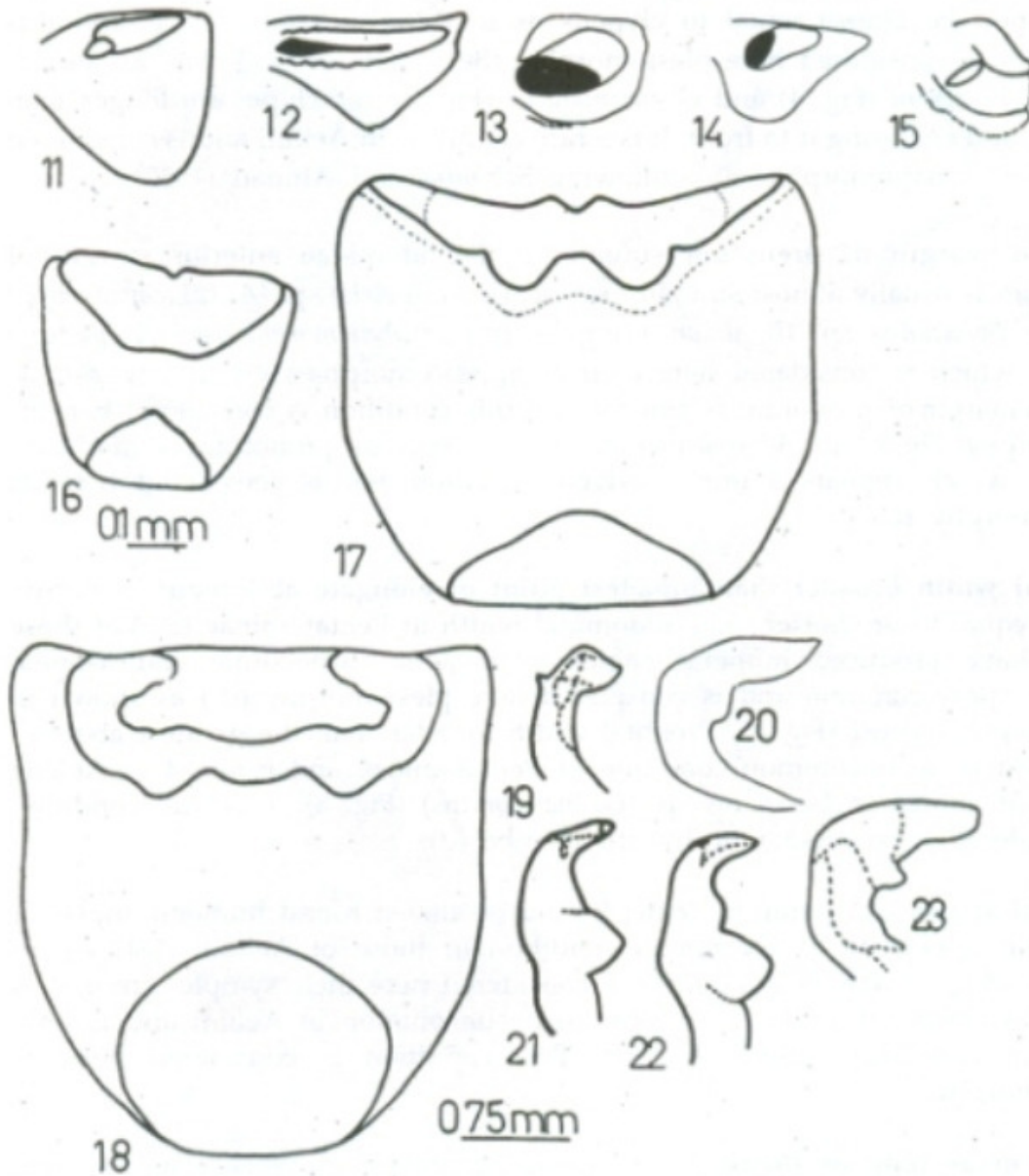
Paraclypei remarkably longer than clypeus and enclosing it in front: In Pentatominae the proportion of paraclypei and clypeus is variable but generally paraclypei are almost equal to clypeus as in *Adria* sp. (Figs. 2,3,4) and this condition is considered here plesiomorphic (Be). In those of *A. baluchistanensis* (Fig. 1), *B. dixonii* (Fig. 4) and *G. marmoratus* (Fig. 8) paraclypei are longer than clypeus and enclosing it to front. It is a rare condition in Aeliini and is considered here their synapomorphies (b) following Schaefer and Ahmad (1987).

Anterior margin of pronotum sinuate: In Pentatomidae anterior margin of pronotum is usually almost straight or concave as in *Aelia* sp. (*A. baluchistanensis*) (Fig. 1) *Bonacialus* sp. (*B. dixonii*) (Fig. 7) and in *Aeliomorpha* sp. (*A. pusana*) (Fig. 5) which is considered here their symplesiomorphies (c₀). In *A. neoparvula* anterior margin of pronotum is sinuate and this condition is considered here its autapomorphy (Fig 3). In *A. sindeilua* anterior margin of pronotum is markedly sinuate, which appears a more derived condition and is considered here its autapomorphy (c₁)

Pronotal width broader than broadest point of elongate abdomen: Pronotum usually equal to or shorter than abdominal width in Pentatominae (except those which have produced humeral angles as in some carpocorine and asopine species) appear common and is considered here plesiomorphy (d₀) as shown in *Halyomorpha murreea* (Fig. 9). Pronotal width broader than the greatest abdominal width is an uncommon condition in Pentatominae and is found in Aeliine species as shown in *Gulielmus* sp. (*G. marmoratus*) (Fig. 8). This rare condition is considered here autapomorphy of the tribe (d).

Humeral angles of pronotum acute: Round or almost round humeral angles of pronotum appear to be a common condition in those of Aeliini as shown in *Aelia* sp. (Fig. 1) and this condition is considered here their symplesiomorphies (e₀). Acute humeral angles (e) appear to be uncommon in Aeliini and is only found in *Gulielmus* species (Fig. 8). This condition is considered here its autapomorphy.

Scutellum as long as broad: In Aeliini the scutellum is usually longer than broad as in *Aelia* sp. (*A. baluchistanensis*) (Fig. 1), *Adria* sp. (Fig. 2,3,4), *Bonacialus* sp. (*B. dixonii*) (Fig. 4) and in *Gulielmus* sp. (*G. marmoratus*) (Fig. 8). This condition is considered here their symplesiomorphies (fo). Scutellum as long as broad is a rare condition in Aeliini (F) and is only found in *A. lineaticollis* (Fig. 6) and therefore is considered here its autapomorphy. Scutellum broader than long appears unique in Aeliini and therefore is considered a more derived condition which is only found in *A. pusana* (Fig. 6) which is considered here its autapomorphy (f1).

**Metathoracic Scent Gland**

11. *A. baluchistanensis* 12. *A. pusana* 13. *A. neoparvula* 14. *B. dixonii* 15. *G. marmoratus*

Pygophore

16. *A. baluchistanensis* 17. *A. pusana* 18. *G. marmoratus*

Paramere

19. *A. baluchistanensis* 20. *A. parvula* 21. *A. fletcheri* 22. *A. lineaticollis* 23. *G. marmoratus*

Evaporatoria of metathoracic scent gland complex indistinct: In the majority of Aeliini metathoracic scent gland complex is with a distinct evaporatoria as in *Aelia* sp. (*A. baluchistanensis*) (Fig. 11), *Aeliomorpha* sp. (*A. pusana*) (Fig. 12), *Bonacialus* sp. (*B. dxoni*) (Fig. 14) and in *Gulielmus* sp. (*G. marmoratus*) (Fig. 15) and this condition is considered here plesiomorphic (9_o). Indistinct evaporatoria in metathoracic scent gland complex (g) is an unique condition in Aeliini and is only found in *Adria* species (*A. neoparvula*) (Fig. 14) and is considered here autapomorphy of the genus.

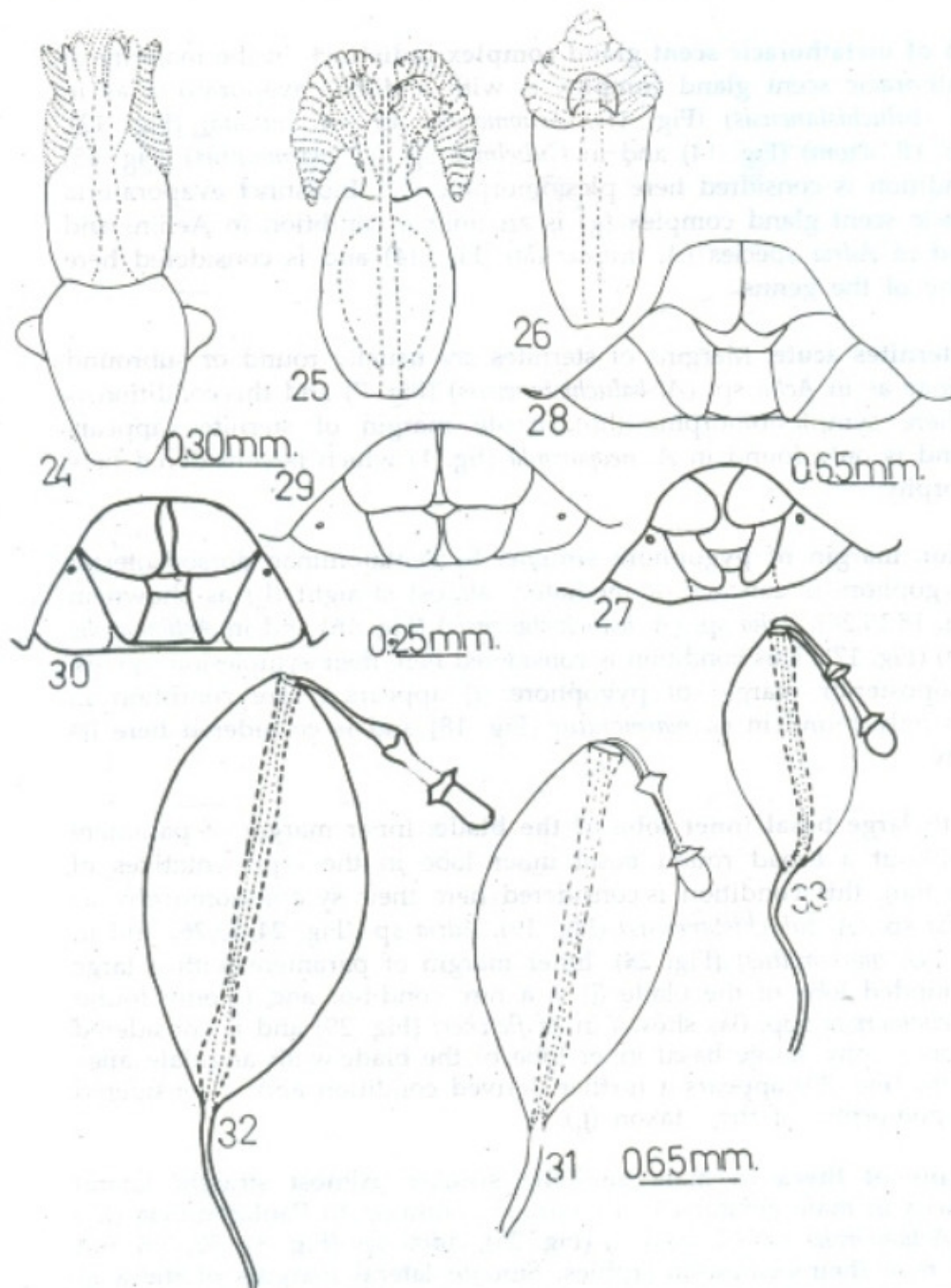
Margin of sternites acute: Margins of sternites are usually round or subround in Pentatominae as in *Aelia* sp. (*A. baluchistanensis*) (Fig. 7) and this condition is considered here symplesiomorphic (ho). Acute margin of sternites appears unique (h) and is only found in *A. neoparvula* (fig. 1) which is considered here its autapomorphy.

Dorsoposterior, margin of pygophore sinuate: In Pentatominae dorsoposterior margin of pygophore is concave or mediately almost straight (l_o) as shown in *Adria* sp. (Fig. 18,19,20), *Aelia* sp. (*A. baluchistanensis*) (Fig. 16) and in *Aeliomorpha* sp. (*A. pusana*) (Fig. 17). This condition is considered here their symplesiomorphies. Sinuate dorsoposterior margin of pygophore (i) appears a rare condition in Aeliini and is only found in *G. marmoratus* (Fig. 18) and is considered here its autapomorphy.

Paramere with large basal inner lobe of the blade: Inner margin of paramere is usually without a broad round basal inner lobe in the representatives of Pentatominae (9_{io}). this condition is considered here their symplesiomorphy as shown in *Aelia* sp. (*A. baluchistanensis*) (Fig. 19), *Adria* sp. (Fig. 24,25,26) and in *Gulielmus* sp. (*G. marmoratus*) (Fig. 28). Inner margin of paramere with a large basal inner rounded lobe of the blade (j) is a rare condition and is only found in those of *Aeliomorpha* spp. as shown in *A. fletcheri* (Fig. 29) and is considered here its autapomorphy. Large basal inner lobe of the blade with angulate apex in *A. lineaticollis* (Fig. 30) appears a further derived condition and is considered here the autapomorphy of the taxon (j₁).

Lateral margins of theca in male genitalia sinuate: Almost straight lateral margins of theca in male genitalia is a common condition to Pentatominae (k_o) as shown in *Aeliomorpha* sp. (*A. pusana*) (Fig. 25), *Adria* sp. (Fig. 31, 32, 33) and is considered here their symplesimorphies. Sinuate lateral margins of theca in male genitalia (k) is an uncommon condition and is only found in those of *Gulielmus* sp. as shown in *G. laterarius* (Fig. 26) and in *Aelia* species (*A. baluchistanensis*) (Fig. 34) which is considered here their synapomorphies.

Lateral thecal appendages present: In the representatives of the tribe Aeliini theca is without lateral thecal appendages as shown in *Aeliomorpha* sp. (*A. pusana*) (Fig. 35), *Adria* sp. (Figs. 31,32,33), and in *G. laterarius* (Fig. 26), and this

**Aedeagus**

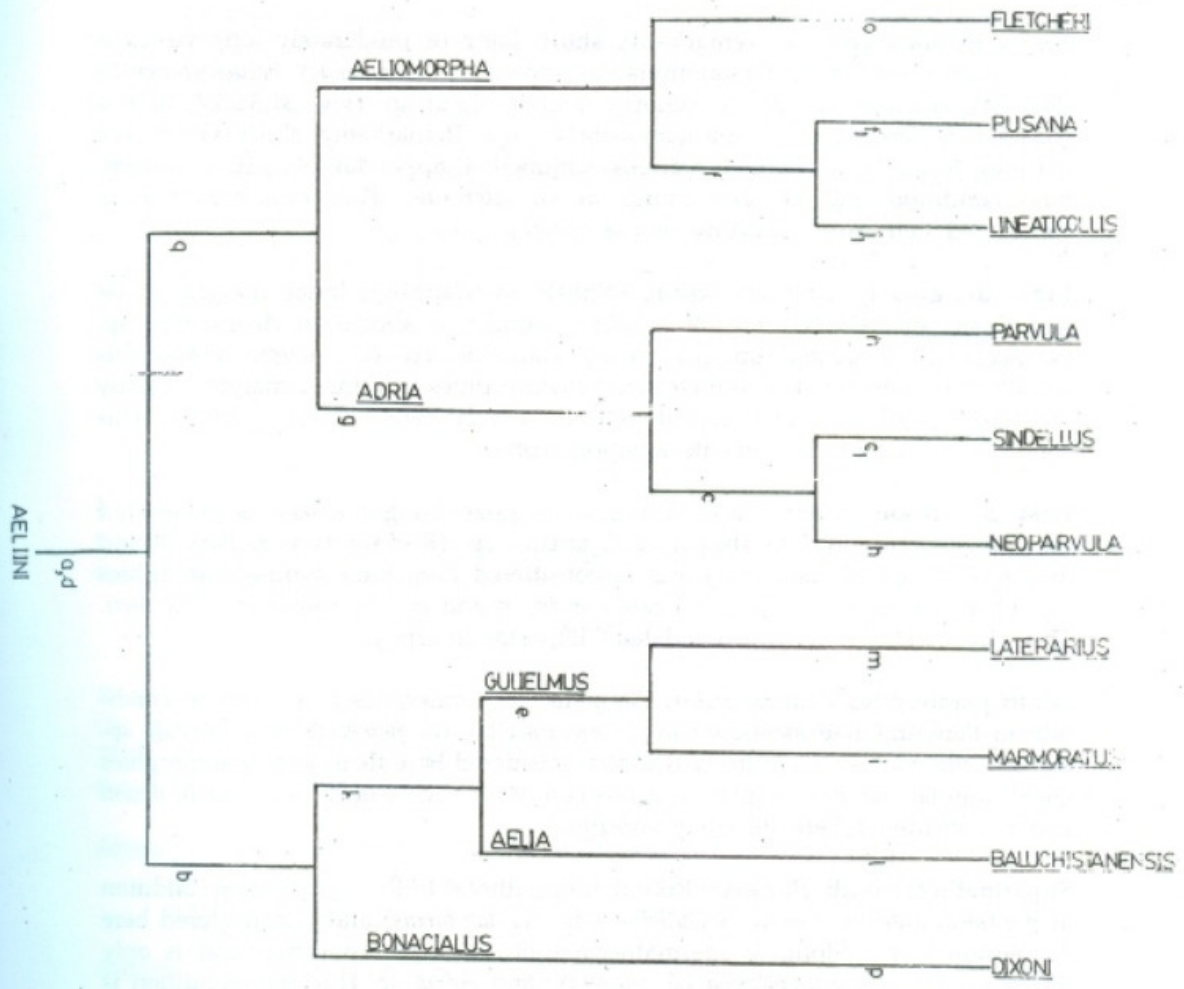
24. *A. baluchistanensis* 25. *A. pusana* 26. *G. laterarius*

Female Terminalia

27. *A. fletcheri* 28. *A. parvula* 29. *B. dixonii* 30. *G. laterarius*

Spermathecal bulb

31. *A. parvula* 32. *A. pusana* 33. *G. laterarius*



34 Dendrogram

condition is considered here their symplesiomorphies. (1_0). Lateral thecal appendages (1) are only found in *A. baluchistanensis* (Fig. 34). This unique condition is considered here its autapomorphy.

Vesica in male genitalia remarkably short: Long or moderately long vesica is a common condition in Pentatominae as shown in *Aelia* sp. (*A. baluchistanensis*) (Fig. 34), *Aeliomorpha* sp. (*A. pusana*) and in *Adria* sp. (Fig. 31,32,33), and is considered here their symplesiomorphies (m_0). Remarkably short vesica not reaching to half of dorsal membranous conjunctival appendage 9m) is an uncommon condition and is only found in *G. laterarius*. This rare condition is considered here autapomorphy of the species.

Inner margins of first gonocoxae slightly overlapping: Inner margin of 1st gonocoxae are seldom meeting in pentatominae as shown in *Aeliomorpha* sp. (*A. fletcheri*), *Bonacialis* sp. (*B. dixonii*), *Gulielmus* sp. (*G. laterarius*) and this condition is considered here their symplesiomorphies (n_0). Inner margins slightly overlapping (n) is a rare condition and is only found in *A. parvula*. This condition is considered here its autapomorphy.

First gonocoxae ovate: Broad and quadrangular 1st gonocoxae is generally found in pentatominae as shown in *Bonacialis* sp. (*B. dixonii*), in *A. parvula* and in *Gulielmus* sp. (*G. laterarius*) and is considered here their symplesiomorphies (o_0). Ovate 1st gonocoxae (o) is a rare condition and is only found in *A. fletcheri*. This rare condition is considered here its autapomorphy.

Ninth paratergites quadrangular: Elongate 9th paratergites is a common condition in Pentatominae as shown in *Aeliomorpha* sp. (*A. fletcheri*), in *A. parvula* sp. and in *Gulielmus* sp. (*G. laterarius*) and is considered here their symplesiomorphies. Quadrangular 9th paratergites is a rare condition and is only found in *B. dixonii* and is considered here its autapomorphy.

Supermathecal bulb elongate: Round spermathecal bulb is a common condition in pentatominae as shown in *Gulielmus* sp. (*G. laterarius*) and is considered here its plesiomorphy. Elongate spermathecal bulb is a rare condition and is only found in those of *Aeliomorpha* (*A. pusana*) and *Adria* sp. This rare condition is considered here their synapomorphies.

DISCUSSION OF CLADOGRAM

The members of the tribe Aeliini appear to follow two lines of evolution. The first line includes *Aelia*, *Benacialus* and *Gulielmus* species sharing the apomorphies of paraclypei longer than clypeus and enclosing it in front. *B. dixoni* appear, entirely isolated from other species of this group having the autapomorphy of 9th paratergites quadrangular. *Aelia* and *Gulielmus* spp. also share the characters of lateral margins of theca of male genitalia sinuate. *Aelia* sp appears isolated representing the apomorphy of lateral thecal appendages while *Gulielmus* spp. appear isolated representing the apomorphy of acute humeral angles of pronotum. The second group includes *Adria* and *Aeliomorpha* spp. sharing the apomorphies of elongate spermathecal bulb. *Adria* spp. appear isolated representing the apomorphy evaporatoria of metathoracic scent gland complex indistinct. *Aeliomorpha* spp. appear isolated having a broad inner basal lobe of the blade in paramere.

ACKNOWLEDGEMENTS

Author would like to express sincere thanks to his Ph.D. Supervisor Professor Dr. Imtiaz Ahmad of Department of Zoology, University of Karachi, Karachi-75270, Pakistan for review of the manuscript and for his guidance during this work.

REFERENCES

- Author would like to express sincere thanks to his Ph.D. Supervisor Professor Dr. Imtiaz Ahmad of Department of Zoology, University of Karachi, Karachi-75270, Pakistan for critical review of the manuscript and for his guidance during this work.
- Ahmad, I. and Zaidi, R.H., (1988). A new species of *Aelia* Fabricius (Hemiptera: Pentatomidae: Pentatominae: Aeliini) from Baluchistan: A potential pest of wheat and its relationships. *Sarhad Journal of Agriculture* 4 (4): 455 - 461.
- Ahmad, I., Zaidi, R.H. and Kamaluddin, S., (1988a.) A cladistic analysis of the genus *Mormidella* Horvath (Hemiptera: Pentatomidae: Pentatominae: Carpocorini). *Proceedings of 8th Pakistan Congress of Zoology*, 175-179.
- Ahmad, I., Rana, N.A. and Zaidi, R.H., (1988b). A cladistic analysis of the genus *Canthecona* Amyot et Serville (Hemiptera: Pentatomidae: Pentatominae: Asopini) from Indo-Pakistan subcontinent. *Proceedings of 8th Pakistan Congress of Zoology*, 147-153.
- Schaefer, C.W. and Ahmad, I., (1987). A cladistic analysis of the genera of the Lestonocorini (Hemiptera: Pentatomidae: Pentatominae). *Proceedings of Entomological Society, Washington* 89 (3): 444-447.

- Zaidi, R.H.,(1988). Aspects of morphology and taxonomy of Aeliini Stal, Carporcorini Stal (Pentatomidae: Pentatominae) of Indo-Pakistan subcontinent with their cladistic analysis. Ph.D. thesis, submitted to Department of Zoology, University of Karachi.
- Zaidi, R.H. and Ahmad, I., (1989). Redescription of a little known Aeliine genus *Guleilmus* Distant (Hemiptera: Pentatomidae: Pentatominae) with special reference to male and female genitalia. *Pakistant Journal of Scientific and Industrial Research*. 32 (2): 95-97.

Received for publication February 1994