

**A PICTORIAL KEY FOR THE IDENTIFICATION OF THE SUBFAMILIES OF
CULICIDAE, GENERA OF CULICINAE, AND SUBGENERA OF *Aedes*
MOSQUITOES OF THE AFROTROPICAL REGION (DIPTERA: CULICIDAE)**

YIAU-MIN HUANG

Department of Entomology, MRC 534, Smithsonian Institution, Washington, DC
20560-0534, U.S.A. (e-mail: huang.yiau-min@nmnh.si.edu)

Abstract.—A pictorial key is presented as a field aid for the identification of adult mosquitoes of 3 subfamilies of Culicidae, 15 genera of Culicinae, and 11 subgenera of *Aedes* occurring in the Afrotropical Region. Scanning electron micrographs demonstrate the taxonomic characters used in the key.

Key Words: pictorial key, identification, subfamilies, genera, mosquitoes, subgenera of *Aedes*, Afrotropical Region

To assist field workers in identifying mosquitoes in Africa, a pictorial key to adults (males and females) has been prepared. This pictorial key includes 3 parts: (1) Family Culicidae (key to subfamilies of Culicidae, p. 10), (2) subfamily Culicinae (key to genera of Culicinae, p. 14) and (3) genus *Aedes* Meigen (key to subgenera of *Aedes*, p. 34). An attempt was made to make the key precise and as simple as possible. A few additional characters indicated by a double asterisk (**) were added wherever necessary to facilitate identification.

Figures 1–9 illustrate the adult structures of the head, thorax, abdomen, leg and wing that are used in the key. The terminology follows Harbach and Knight (1980, 1982), with the exception of “tarsal claws,” which is retained for “ungues.” The venational terms follow those of Belkin (1962).

Knight and Stone (1977) in their world catalog of mosquitoes classified the family Culicidae into 3 subfamilies: Anophelinae, Culicinae and Toxorhynchitinae. However, see Harbach and Kitching (1998) who treat Toxorhynchites as a tribe of Culicinae. All 3 subfamilies are represented in the Afro-

tropical Region. The 3 subfamilies with their constituent genera known to occur in the Afrotropical Region are indicated in Table 1.

Afrotropical *Aedes* has not been studied as a group since Edwards (1941). Edwards (1941), in his “Mosquitoes of the Ethiopian Region,” divided the genus *Aedes* into 9 subgenera. Reinert (1987) removed *Aedes marshallii* (Theobald) from the *apicoannulatus* group of the subgenus *Aedimorphus* Theobald and defined a new subgenus, *Albuginosus* for that species and its relatives. Reinert (1999) removed *Aedes longipalpis* (Grunberg) from the *fulgens* group of the subgenus *Finlaya* Theobald and defined a new subgenus, *Zavortinkius* for that species and its relatives. Thus, the genus *Aedes* in the Afrotropical Region now consists of the following 11 subgenera:

1. *Aedimorphus* Theobald
2. *Albuginosus* Reinert
3. *Diceromyia* Theobald
4. *Finlaya* Theobald
5. *Mucidus* Theobald
6. *Neomelaniconion* Newstead (as *Bank-sinella* Theobald)

7. *Ochlerotatus* Lynch Arribalzaga
8. *Pseudarmigeres* Stone and Knight (as *Dunnius* Edwards)
9. *Skusea* Theobald
10. *Stegomyia* Theobald
11. *Zavortinkius* Reinert.

Edwards (1932) divided the subgenus *Stegomyia* into 4 groups which he designated A, B, C, and D. *Aedes vittatus* (Bigot) was assigned by Edwards to his Group D (*vittatus* group), a monotypic species group. Huang (1977) removed Group D (*vittatus* group), a monotypic species group (*Aedes vittatus* (Bigot)), from the subgenus *Stegomyia* and placed it in the subgenus *Aedimorphus* of the genus *Aedes*. Since the *Vittatus* Group is monotypic, the species name *Aedes vittatus* is used in the key.

Cornet (1974: 175) described *Aedes cozi*, a new species from Eastern Senegal, and placed it in the subgenus *Stegomyia*. Using

the subgeneric key, users will find that *Aedes cozi* Cornet is not in *Stegomyia*. The taxonomic status of this species will be treated in a separate paper.

This study is based on specimens accumulated by the Medical Entomology Project (MEP) and the Systematics of *Aedes* Mosquitoes Project (SAMP), Department of Entomology, National Museum of Natural History, Smithsonian Institution. Pinned adults were prepared for scanning electron microscopy using standard procedures by Mrs. Susann G. Braden, SEM Laboratory, National Museum of Natural History, Smithsonian Institution. Images of diagnostic characters directly taken from specimens using scanning electron microscopy are provided. The "cut-off" date is October 1999, and changes in taxonomic status since then are not included. Geographically, this key includes all of Africa south of Morocco, Algeria, Libya and Egypt.

Table 1. Classification of the family Culicidae in the Afrotropical Region.

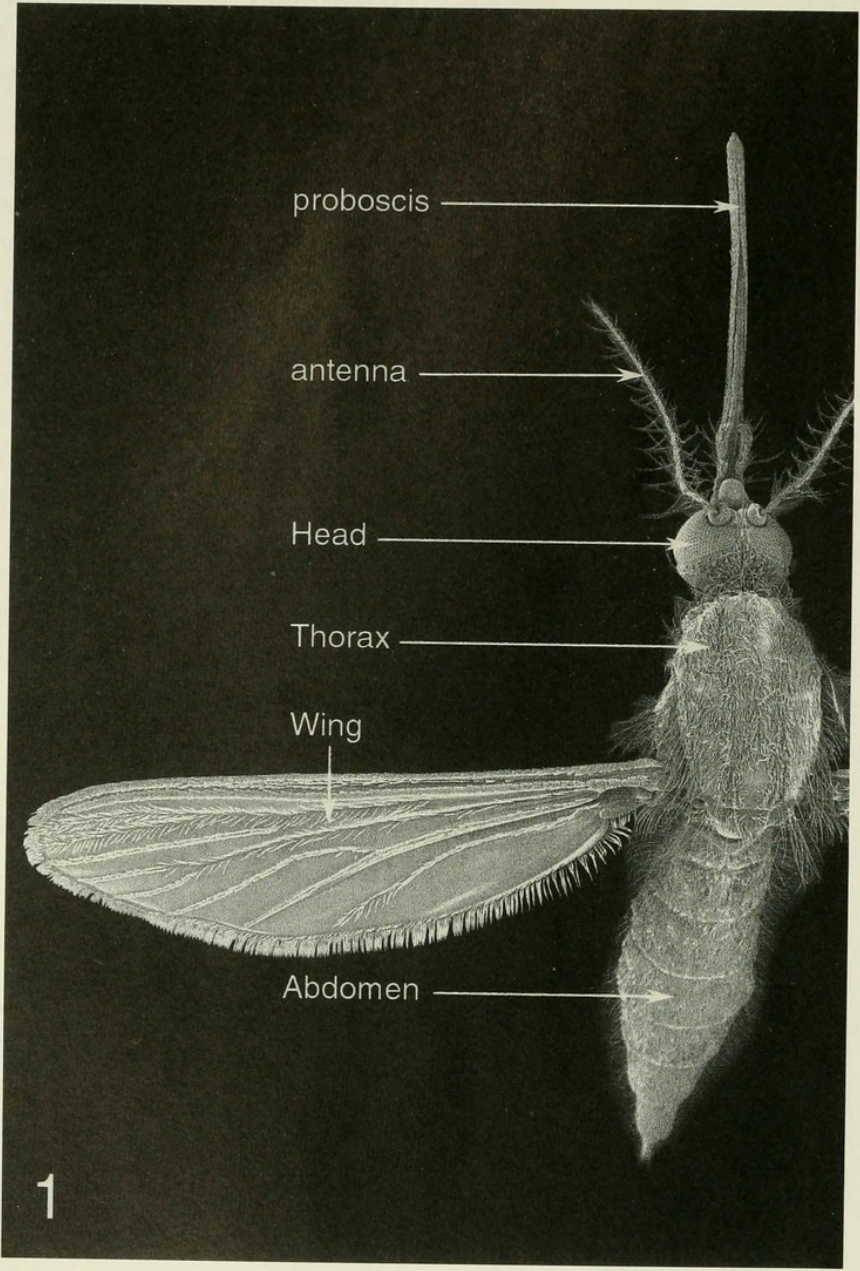
Subfamily	Genus
1. Anophelinae	1. <i>Anopheles</i> Meigen
	2. <i>Aedeomyia</i> Theobald
	3. <i>Aedes</i> Meigen
	4. <i>Coquillettidia</i> Dyar
	5. <i>Culex</i> Linnaeus
	6. <i>Culiseta</i> Felt
	7. <i>Eretmapodites</i> Theobald
	8. <i>Ficalbia</i> Theobald
	9. <i>Hodgesia</i> Theobald
	10. <i>Malaya</i> Leicester
	11. <i>Mansonia</i> Blanchard
	12. <i>Mimomyia</i> Theobald
	13. <i>Orthopodomyia</i> Theobald
	14. <i>Uranotaenia</i> Lynch Arribalzaga
2. Culicinae	
3. Toxorhynchitinae	15. <i>Toxorhynchites</i> Theobald

ACKNOWLEDGMENTS

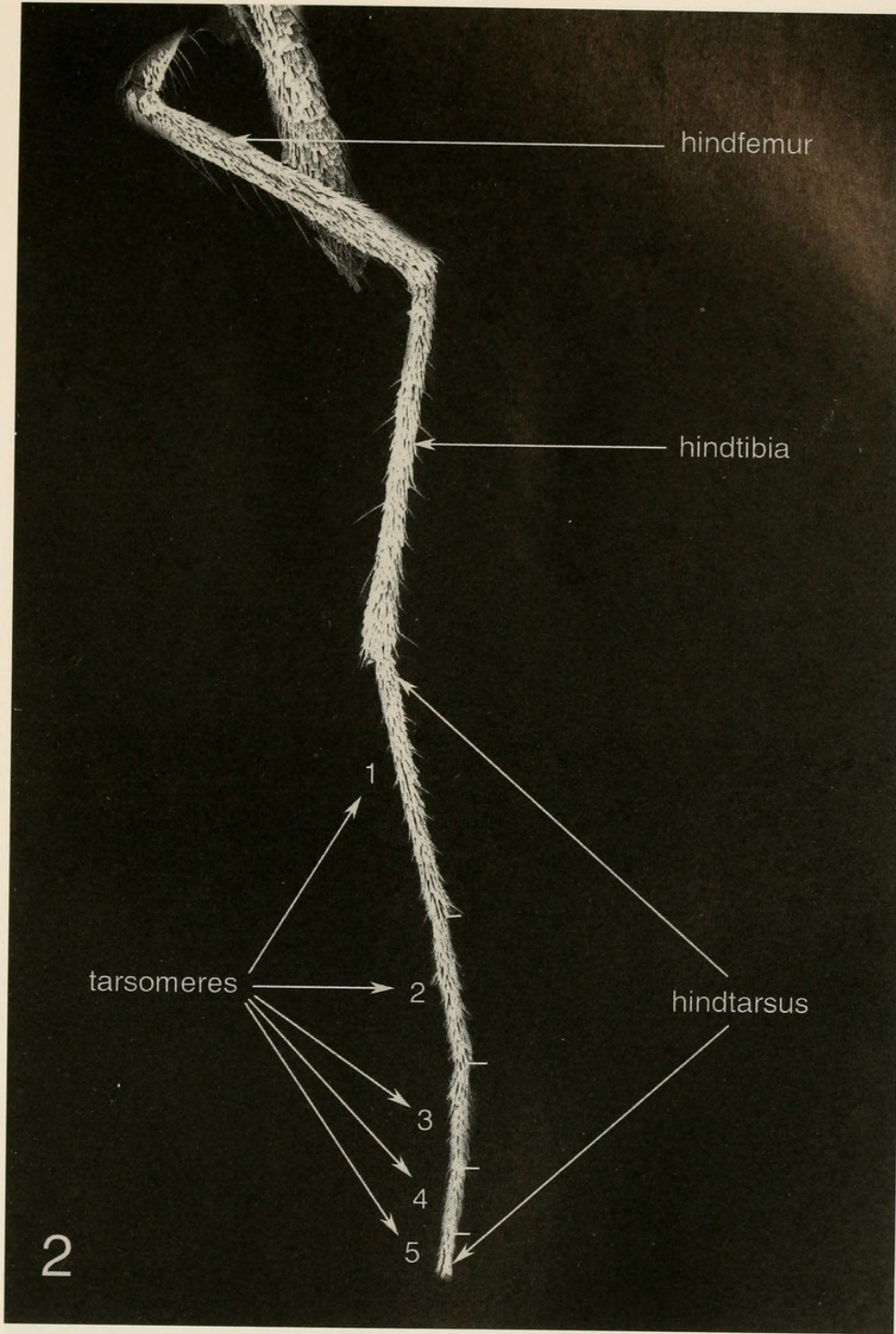
I express my sincere appreciation and gratitude to: Mr. Walter R. Brown and Mrs. Susann G. Braden, SEM Laboratory, National Museum of Natural History, Smithsonian Institution, for access to and assistance with a scanning electron microscope while conducting this study; to LTC Daniel A. Strickman, Chief, Department of Entomology, Walter Reed Army Institute of Re-

search (WRAIR), for providing funding for the publication; to Dr. Wayne N. Mathis, Department of Entomology, Smithsonian Institution, Drs. Daniel A. Strickman and Richard C. Wilkerson, Walter Reed Biosystematics Unit (WRBU) and Dr. Maria Anice Mureb Sallum, University of São Paulo, São Paulo, Brazil/Smithsonian Research Fellow, for critically reviewing this manuscript and for their valuable comments.

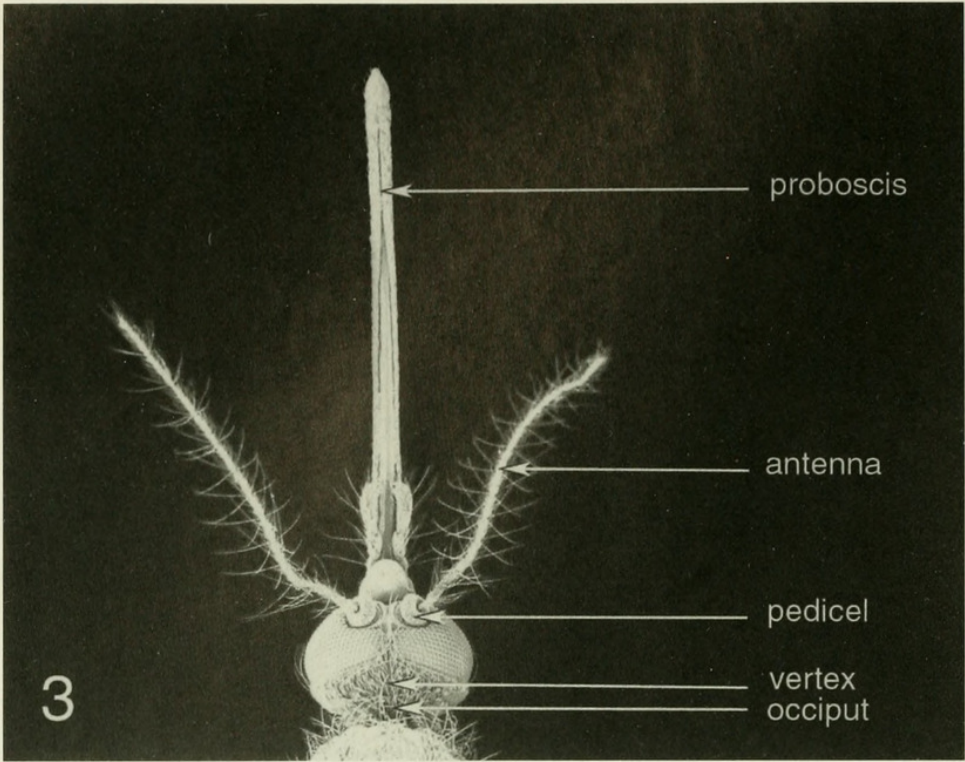
MORPHOLOGICAL FEATURES USED IN IDENTIFICATION



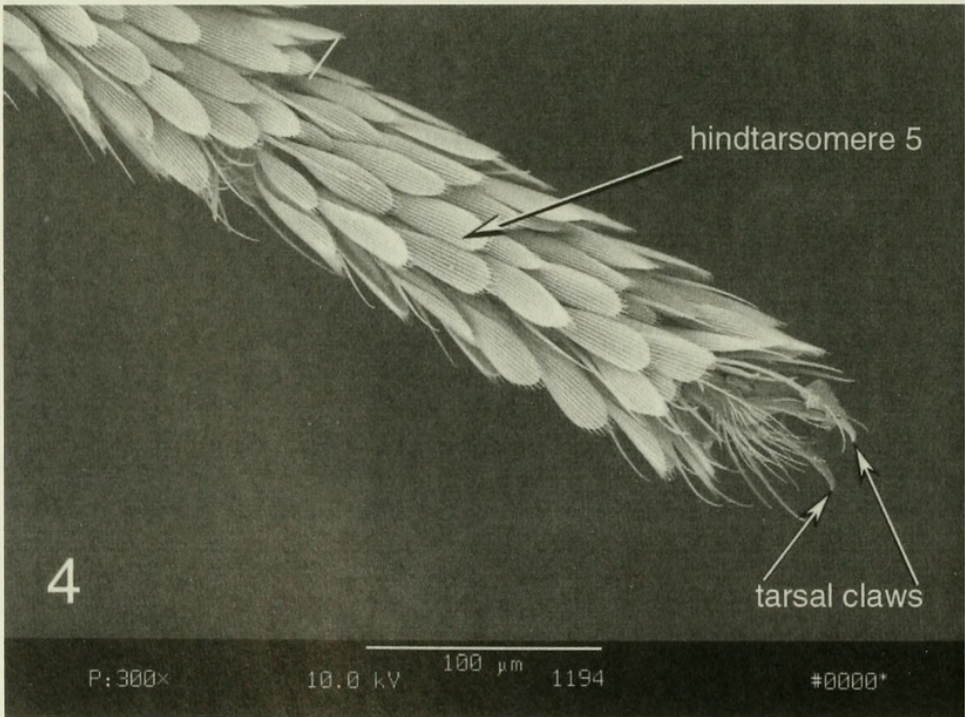
ADULT



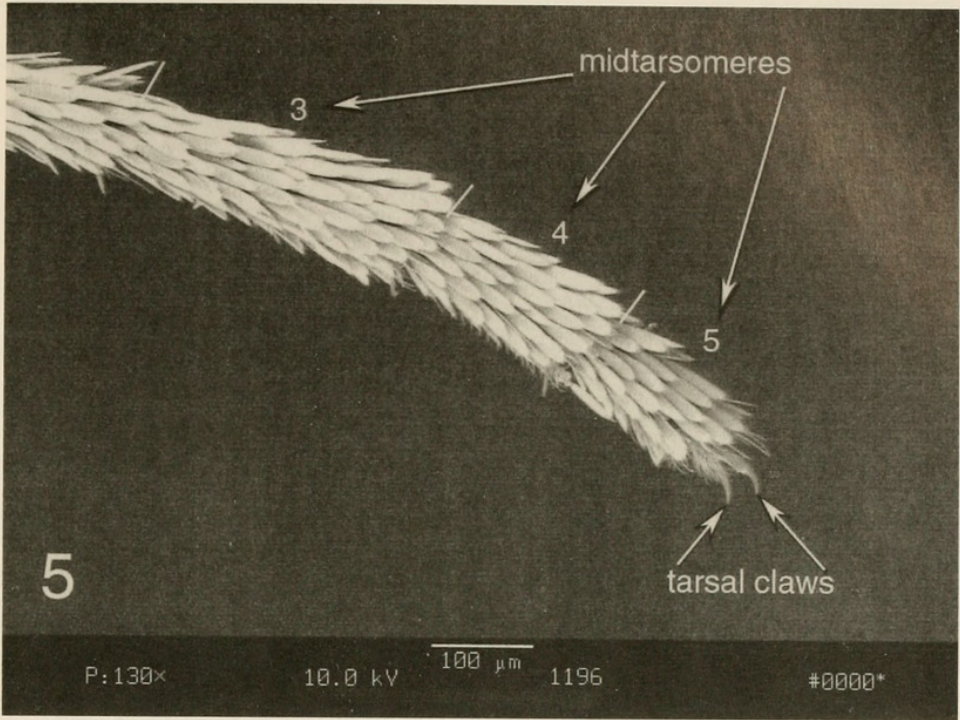
HINDLEG



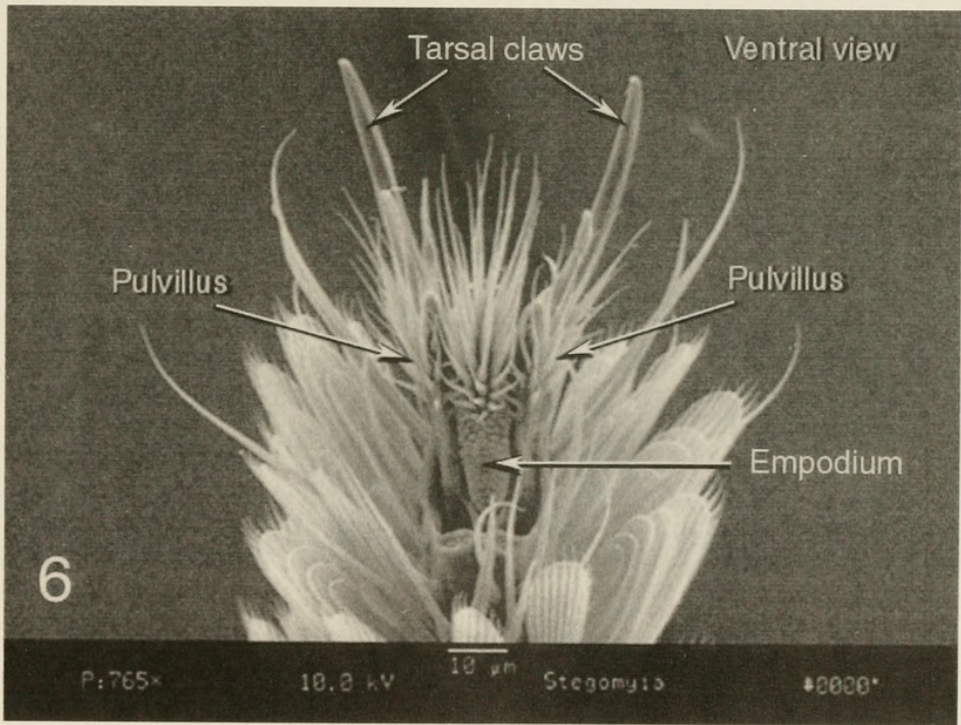
HEAD - DORSAL



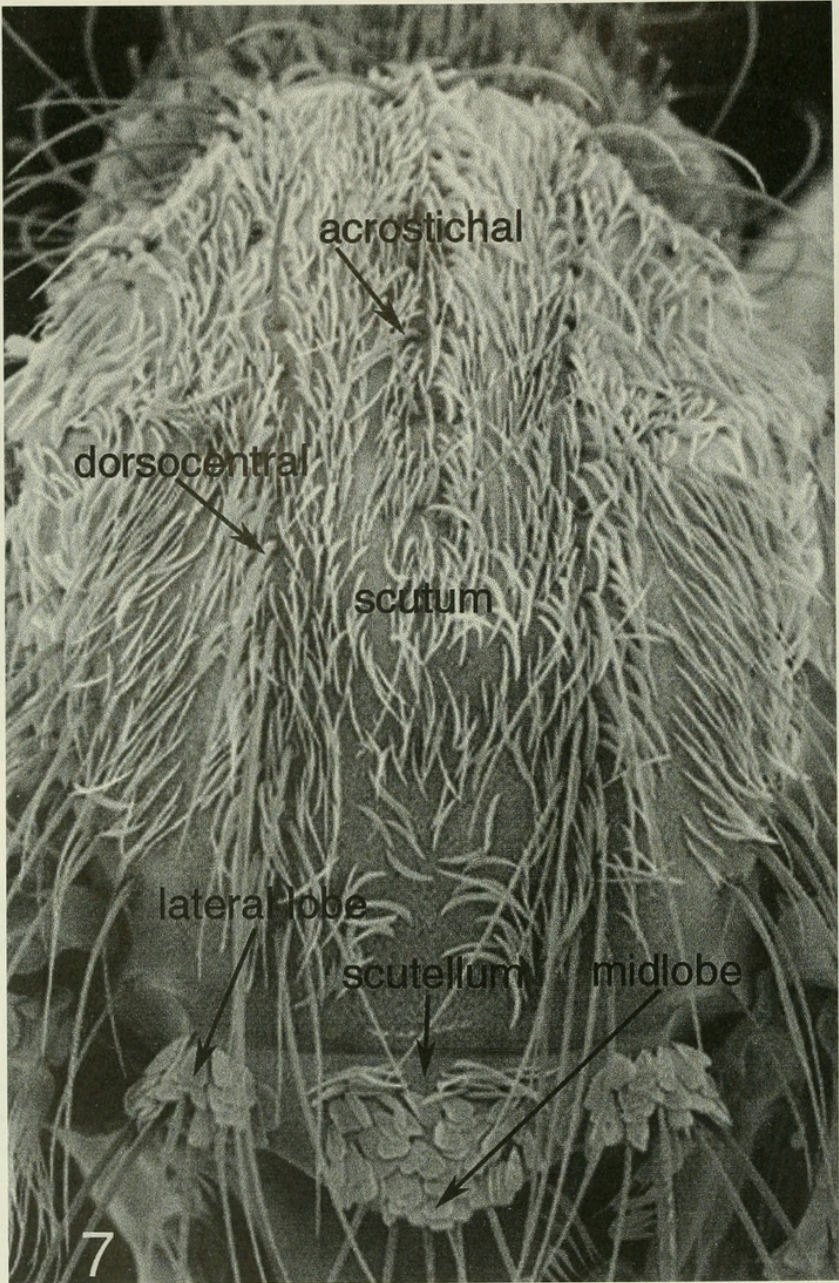
HINDTARSOMERE 5 WITH TARSAL CLAWS



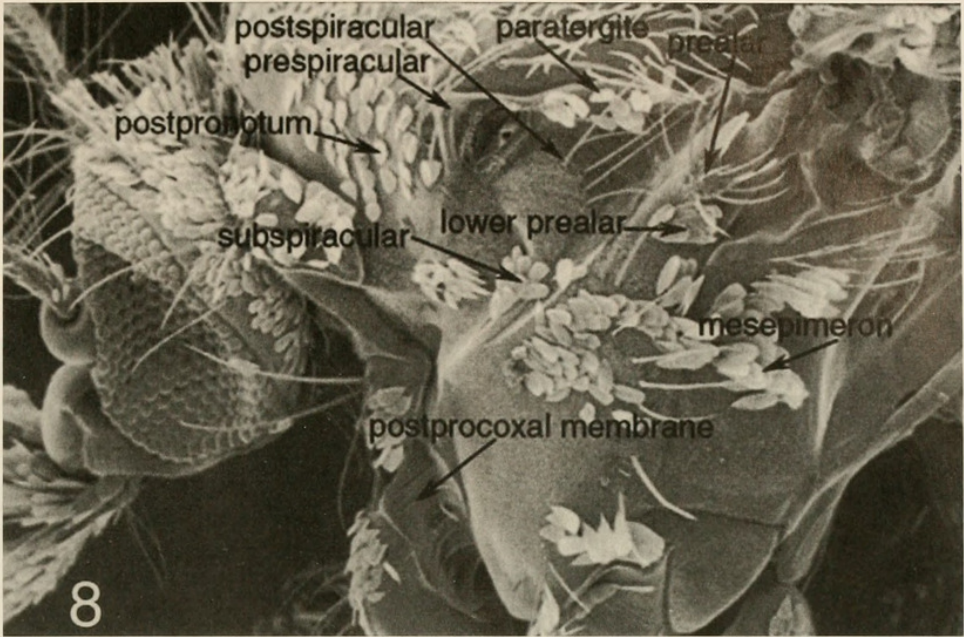
MIDLEG



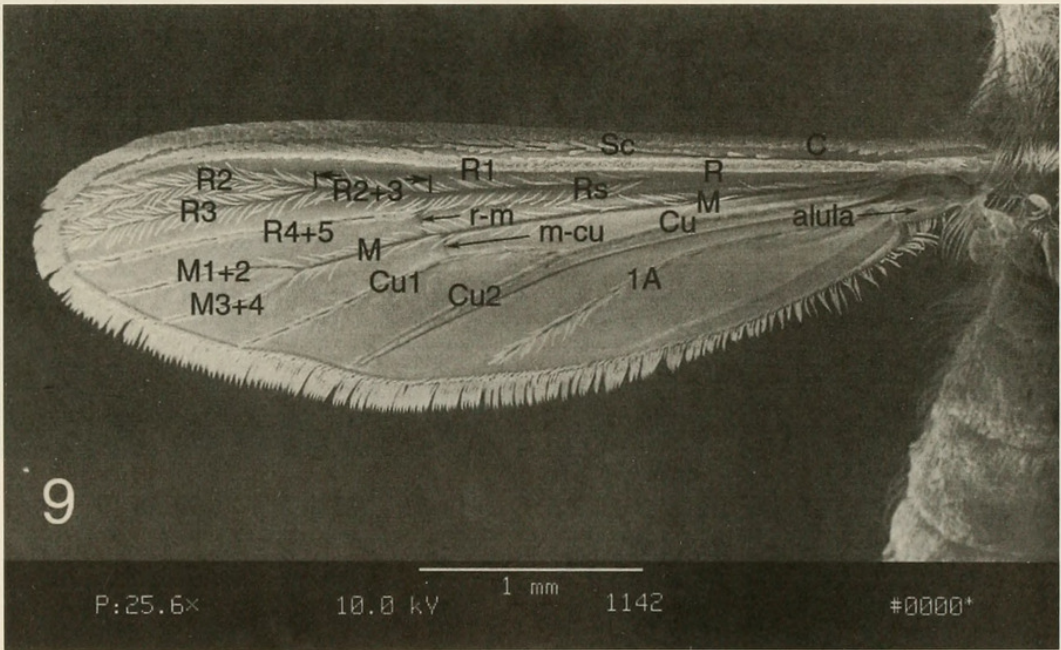
TARSAL CLAWS - VENTRAL



THORAX - DORSAL



THORAX - LATERAL



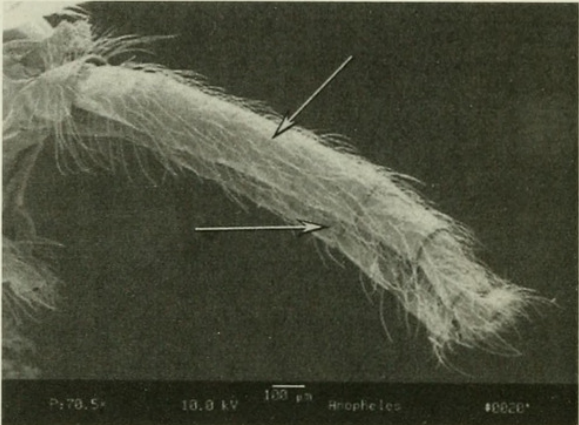
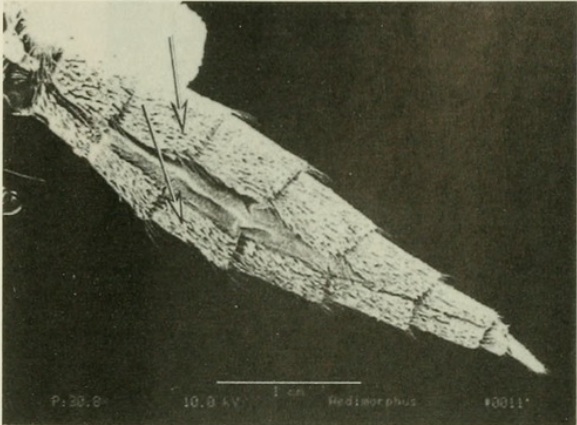
WING - DORSAL

Part 1. Key to Subfamilies of Culicidae

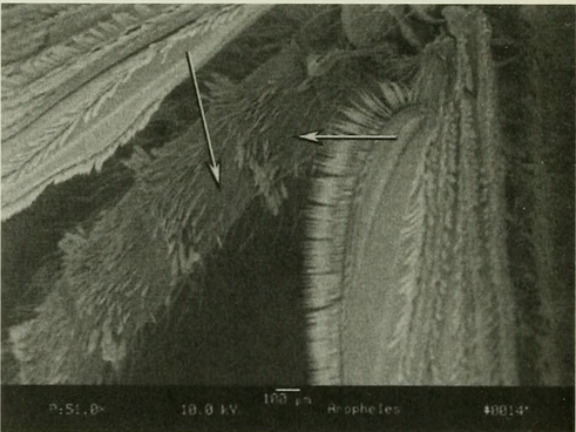
ADULTS

Abdomen. Completely or largely with
dense, uniform covering of scales

Abdomen. Completely or largely
without scales



to Page 11

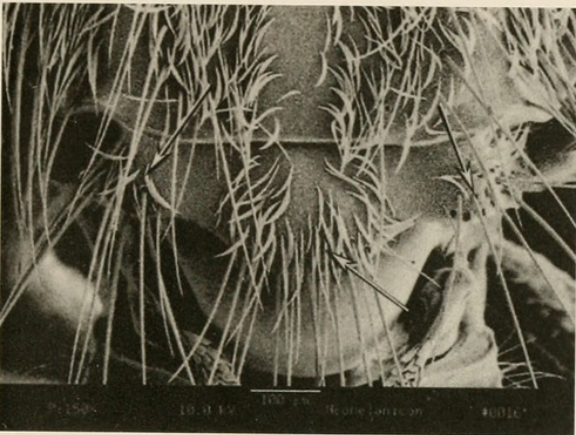


to Page 13

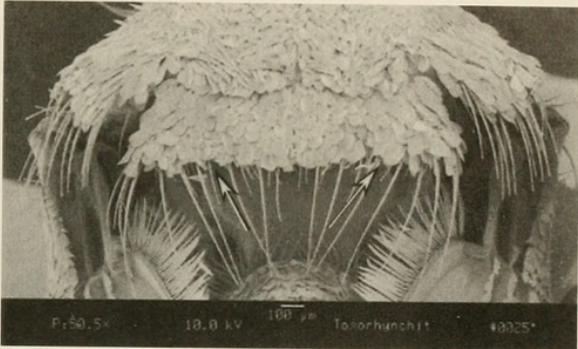
Part 1. (continued)

Page 11

Thorax. Posterior margin of scutellum trilobed, with setae in 3 groups on all lobes

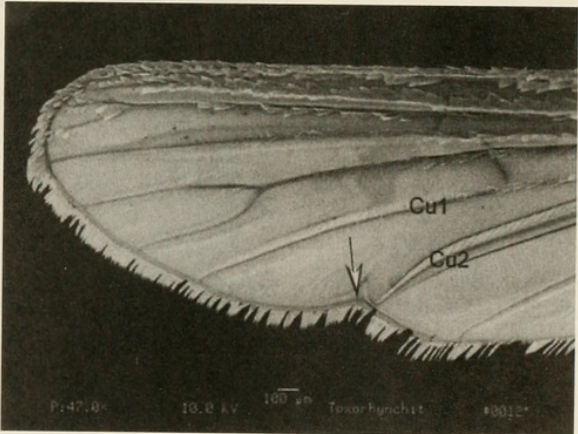


Thorax. Posterior margin of scutellum evenly rounded, with setae evenly distributed



Subfamily Culicinae
see Part 2

Wing. Posterior margin of wing emarginated near tip of vein Cu2



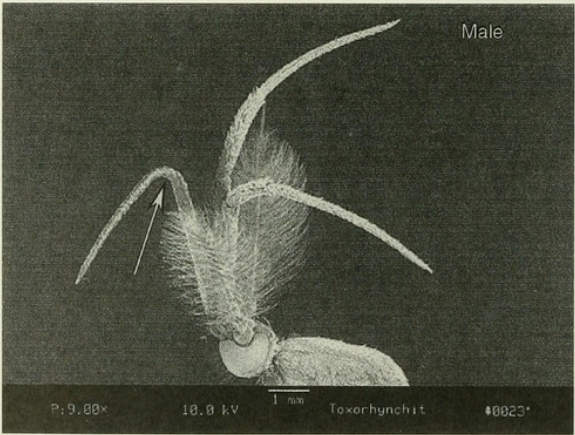
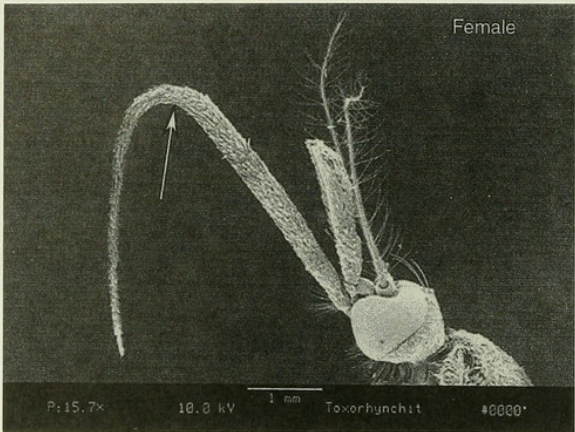
to Page 12

Part 1. (continued)

Page 12

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Head. Proboscis with apical half strongly recurved and more slender than basal half



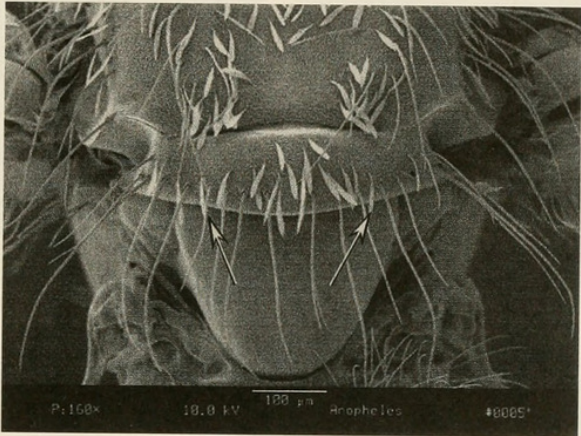
Subfamily Toxorhynchitinae
Genus *Toxorhynchites* Theobald

Part 1. (continued)

Page 13

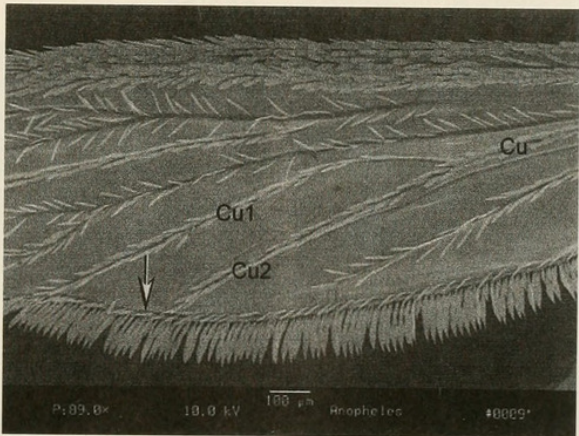
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Thorax. Posterior margin of scutellum evenly rounded or slightly trilobed, with setae more or less evenly distributed



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Wing. Posterior margin of wing not emarginated near tip of vein Cu2



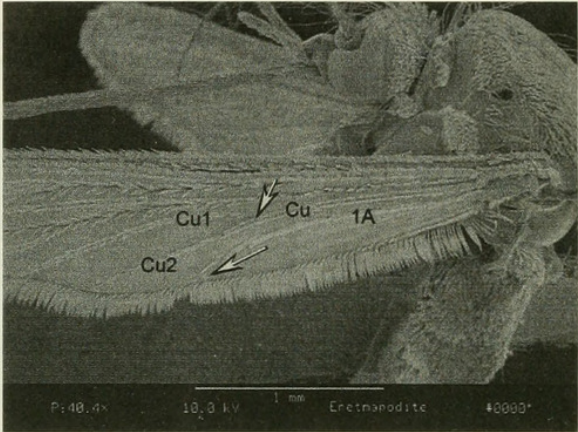
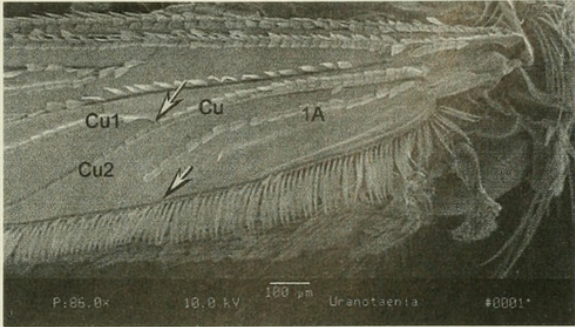
Subfamily Anophelinae
Genus *Anopheles* Meigen

Part 2. Key to Genera of Culicinae

ADULTS

Wing. Vein 1A ending before, or near base of fork of vein Cu

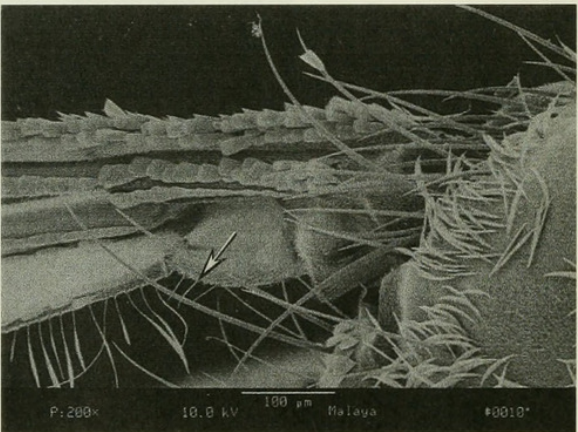
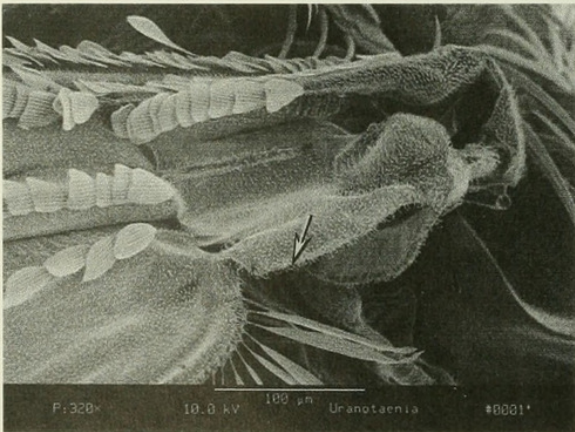
Wing. Vein 1A ending well beyond base of fork of vein Cu



to Page 16b

Wing. Alula without scales, or with broad decumbent scales

Wing. Alula with narrow fringe scales



to Page 15

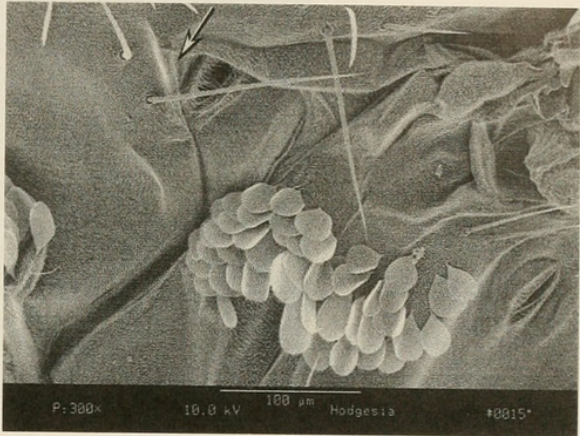
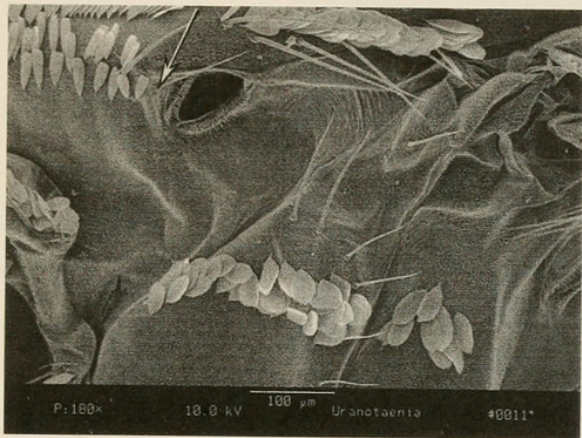
to Page 16a

Part 2. (continued)

Page 15

Thorax. Prespiracular setae
present

Thorax. Prespiracular setae
absent

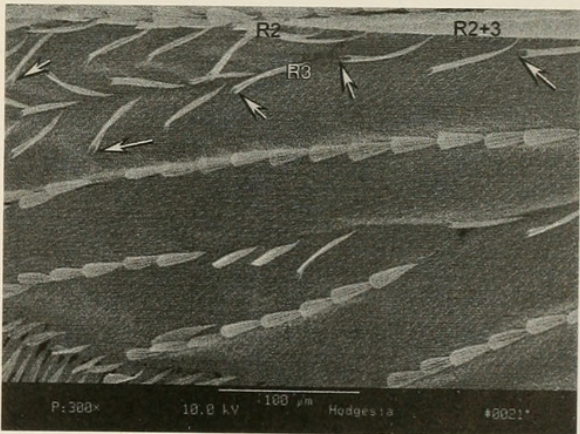
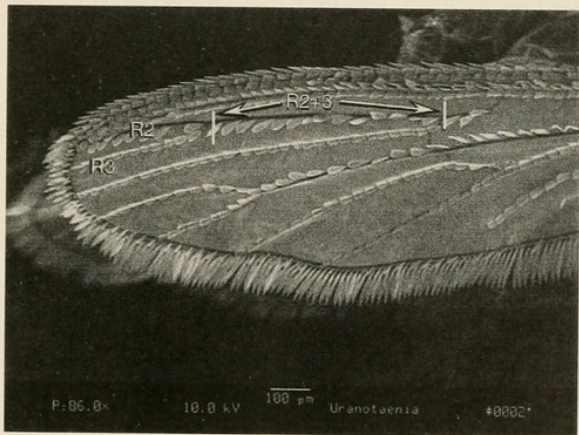


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Wing. Vein R2+3 much longer than
veins R2, R3

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Wing. Veins R2+3, R2, R3 with
outstanding scales emarginated at tip



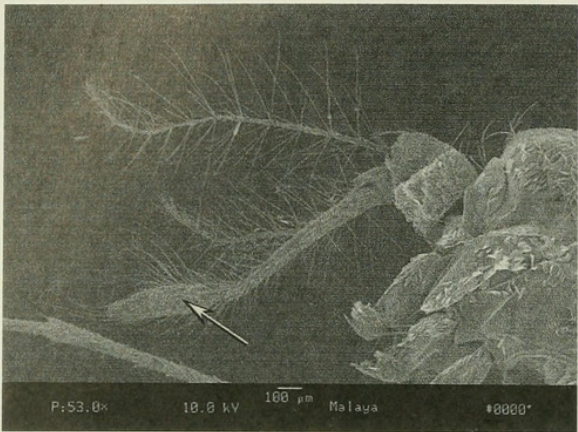
Uranotaenia

Hodgesia

Part 2. (continued)

Page 16a

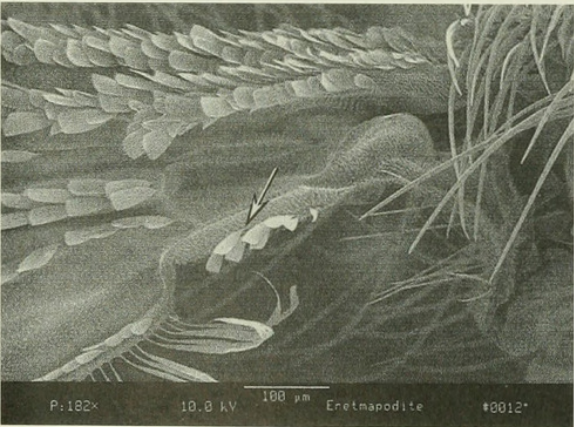
Head. Proboscis with apical part distinctly swollen, upturned and hairy



Malaya

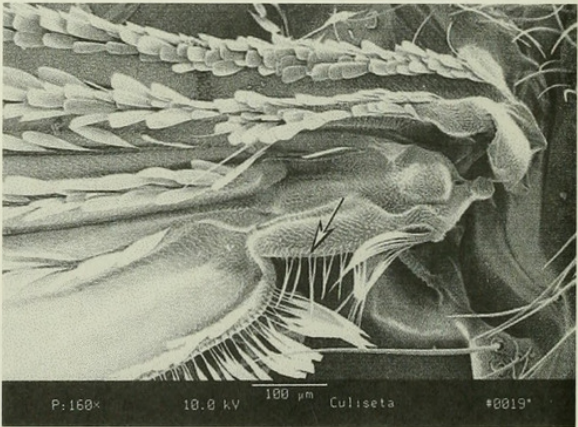
Page 16b

Wing. Alula without scales, or with broad decumbent scales



to Page 17

Wing. Alula with narrow fringe scales

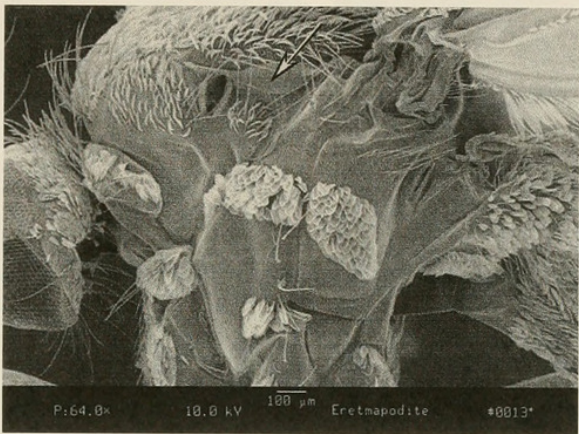


to Page 20b

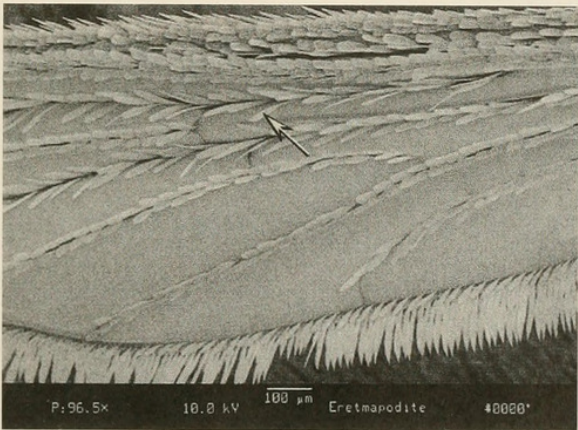
Part 2. (continued)

Page 17

**
Thorax. Paratergite without scales

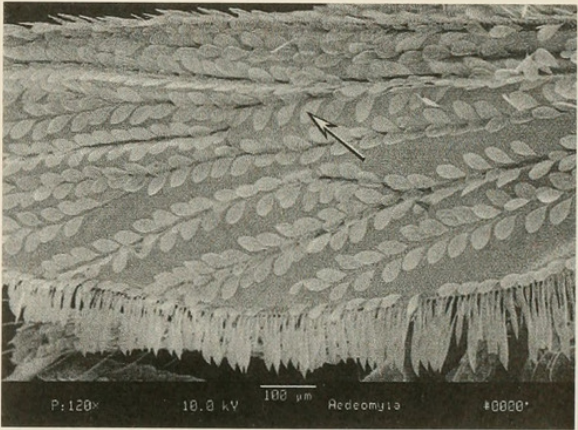


Wing. Plume scales all narrow



to Page 18a

Wing. Plume scales all broad



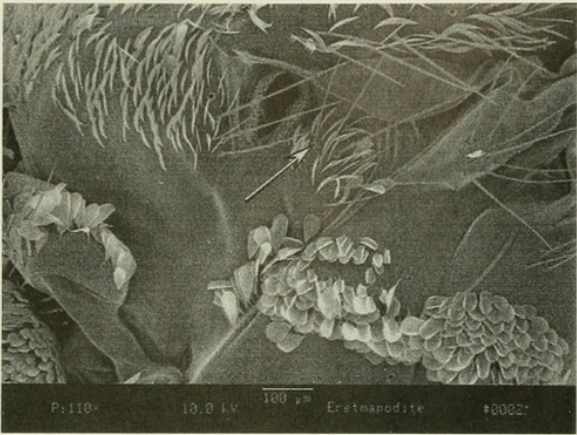
to Page 18b

Part 2. (continued)

Page 18a

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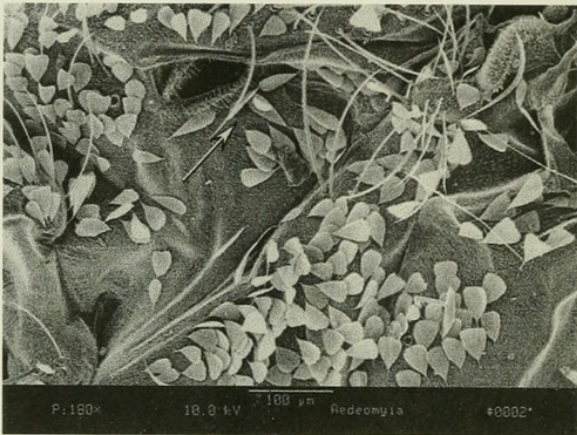
Thorax. Postspiracular setae
present



Page 18b

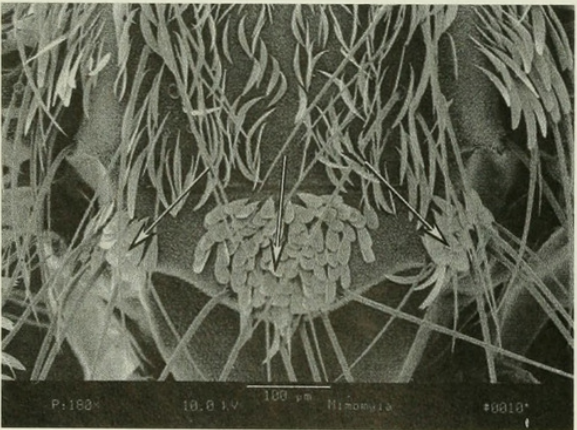
**

Thorax. Postspiracular setae
absent

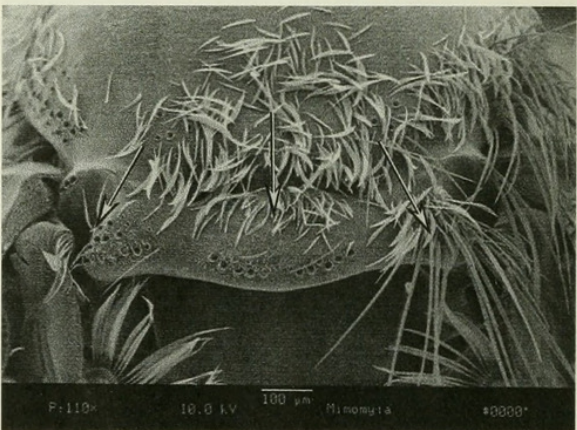


Eretmapodites

Thorax. Scutellum with all broad
scales



Thorax. Scutellum with all narrow
scales



to Page 19a

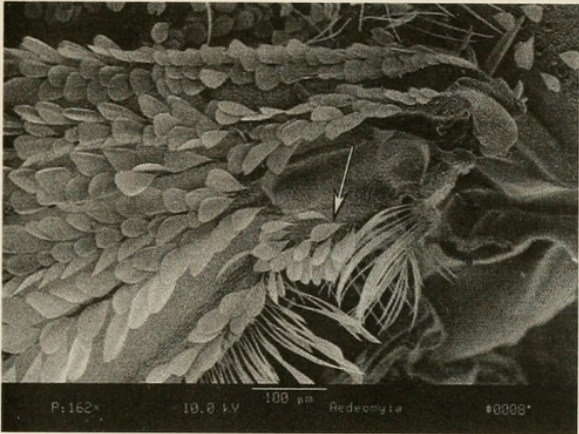
to Page 19b

Part 2. (continued)

Page 19a

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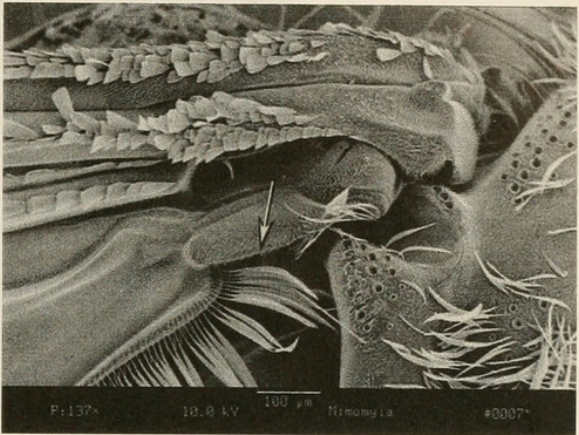
Wing. Alula with broad decumbent scales



Page 19b

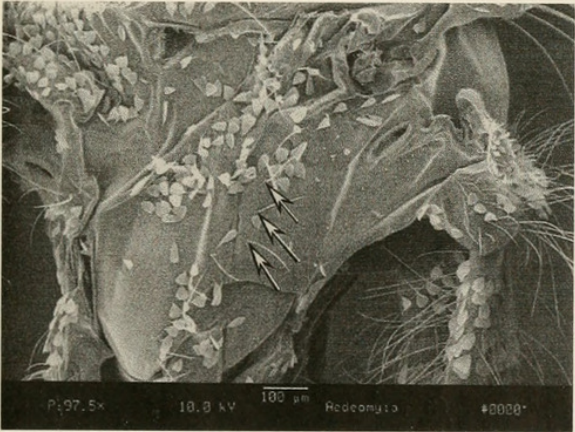
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Wing. Alula without scales

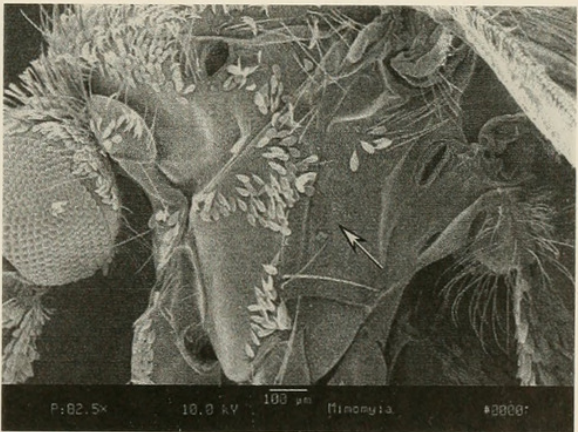


Mimomyia (in part)

Thorax. Lower mesepimeral setae present



Thorax. Lower mesepimeral setae absent



Mimomyia (in part)

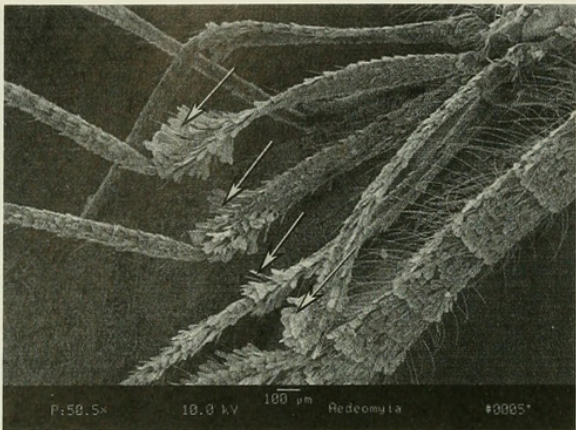
to Page 20a

Part 2. (continued)

Page 20a

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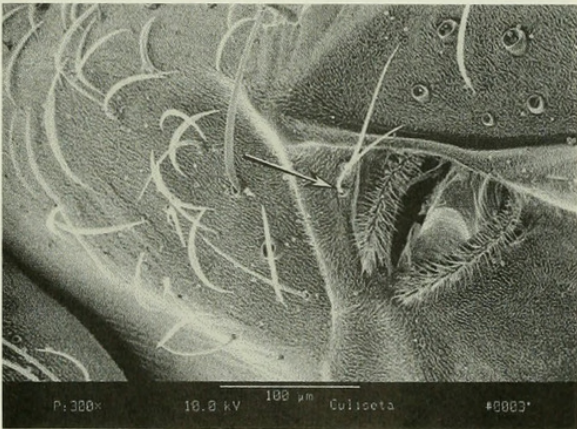
Legs. Mid- and hindfemora with large tufts of suberect scales at apex



Aedeomyia

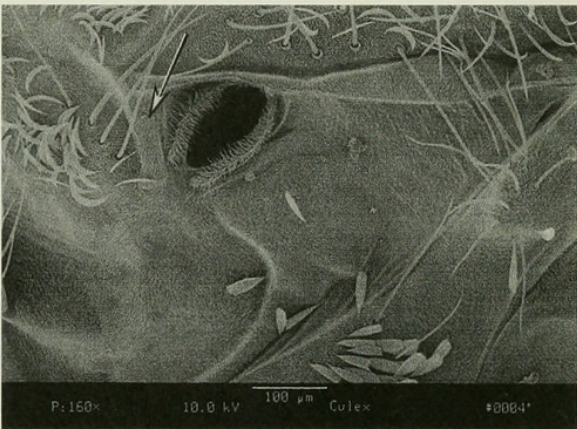
Page 20b

Thorax. Prespiracular setae present



to Page 21a

Thorax. Prespiracular setae absent

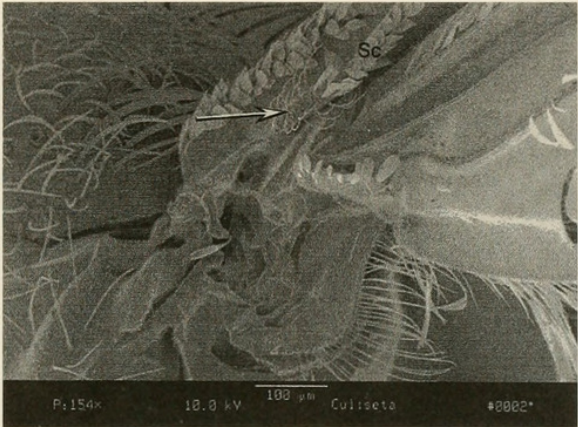


to Page 21b

Part 2. (continued)

Page 21a

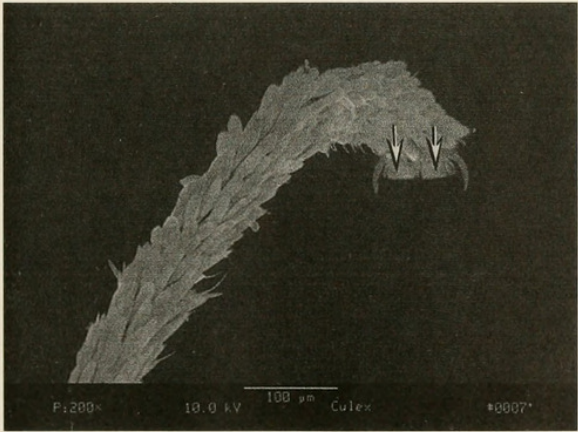
Wing. Base of vein Sc with a patch of
setae on ventral side



Culiseta

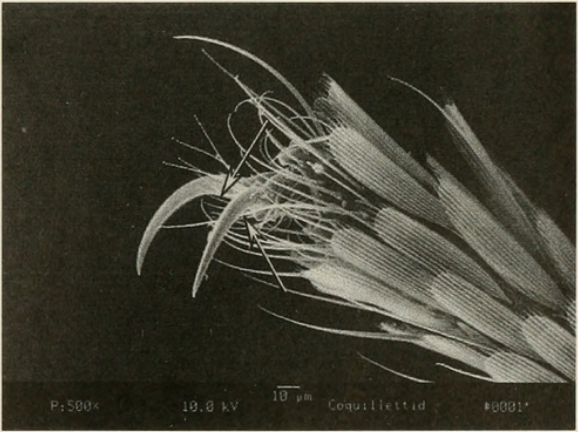
Page 21b

Leg. Pulvillus present, well
developed (pad-like)



to Page 22

Leg. Pulvillus absent, or not
well developed (hair-like)



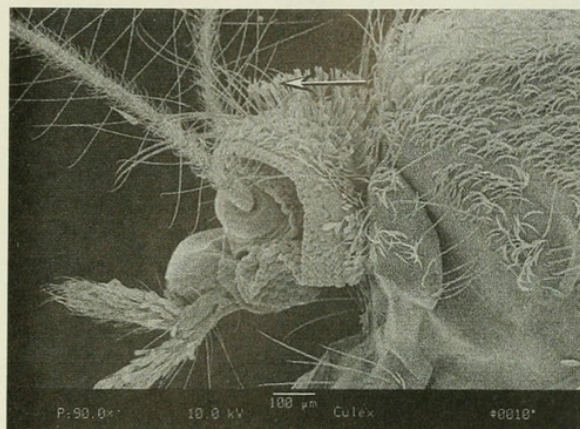
to Page 23

Part 2. (continued)

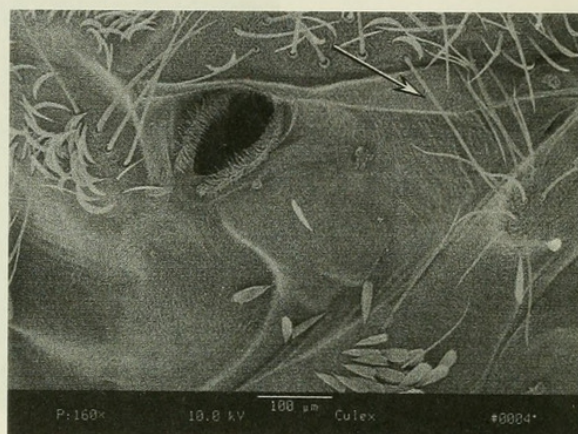
Page 22

**** 1**

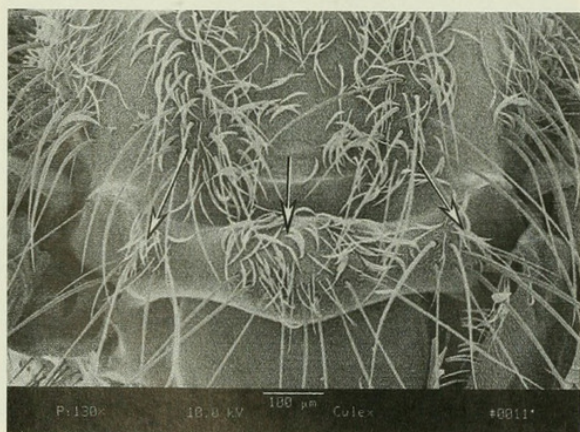
Head. Vertex with erect forked scales numerous, not restricted to occiput

**** 2**

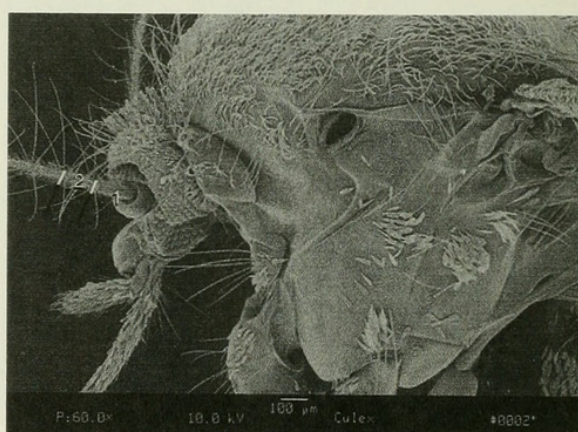
Thorax. Paratergite without scales

**** 3**

Thorax. Scutellum with all narrow scales

**** 4**

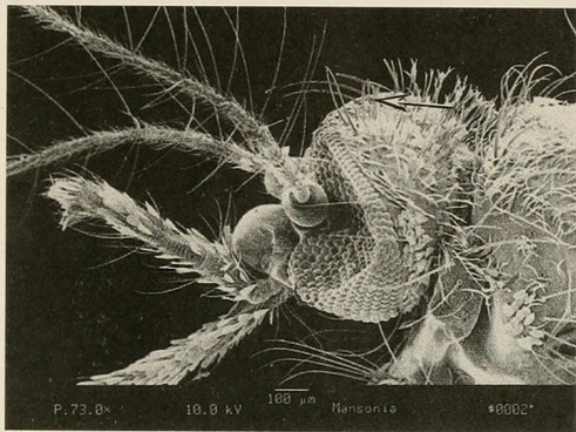
Head. Antenna with flagellomere 1 about as long as flagellomere 2

**Culex**

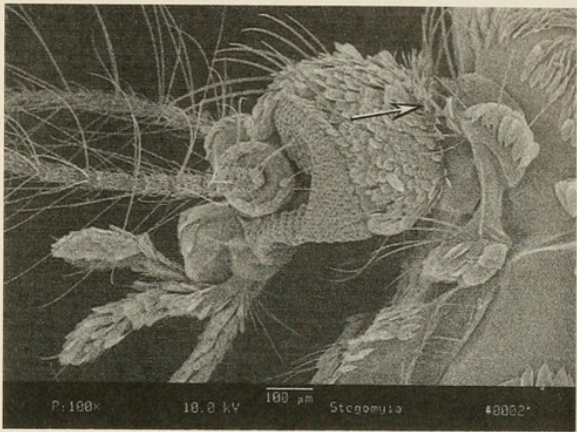
Part 2. (continued)

Page 23

Head. Vertex with erect forked scales numerous, not restricted to occiput

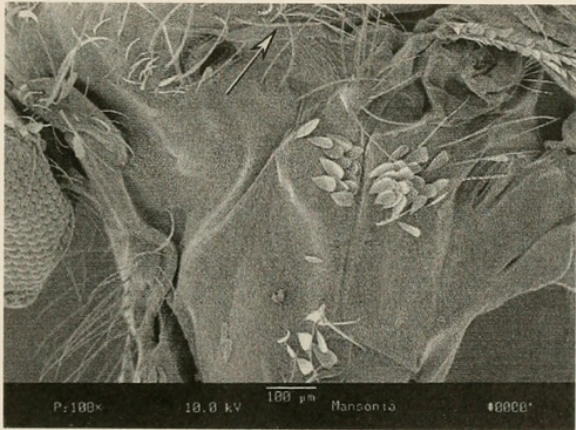


Head. Vertex with erect forked scales not numerous, restricted or not restricted to occiput



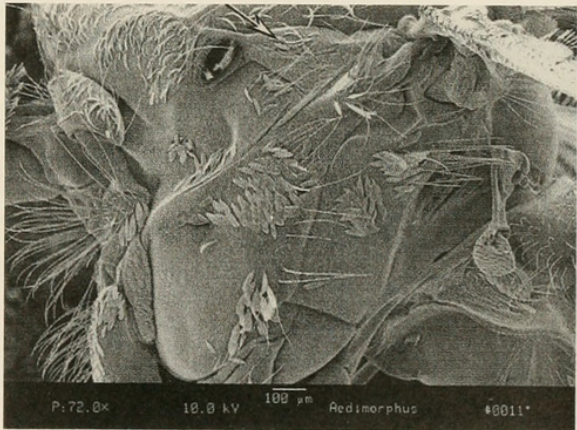
to Page 28b

Thorax. Paratergite without scales



to Page 24

Thorax. Paratergite with scales

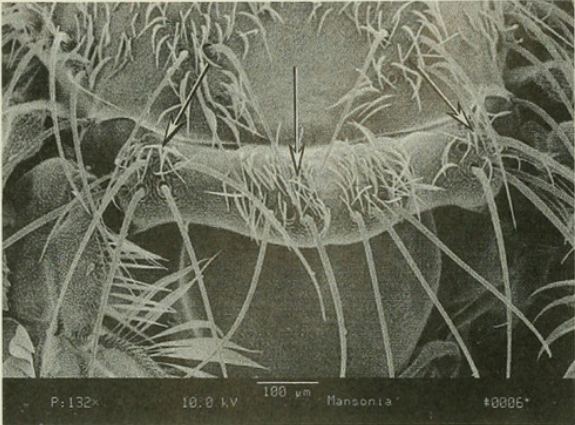


to Page 28a

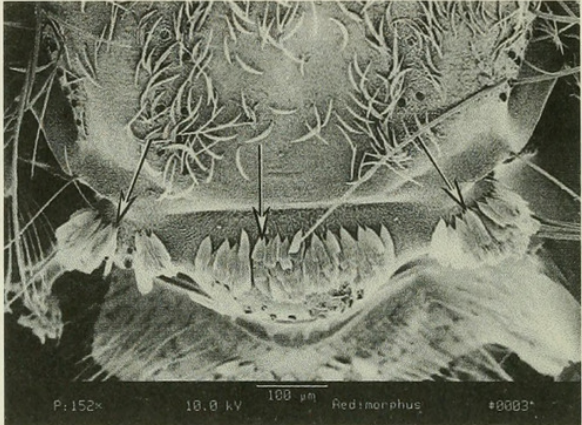
Part 2. (continued)

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Thorax. Scutellum with narrow scales

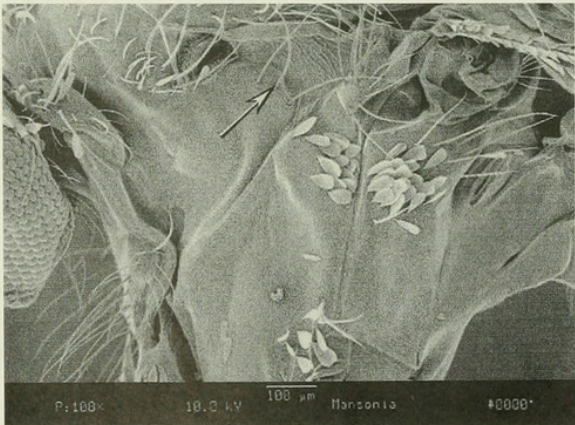


Thorax. Scutellum with broad scales

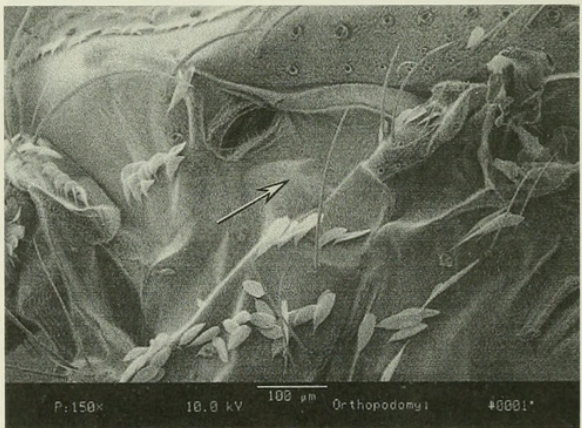


Aedes (in part) - see Part 3

Thorax. Postspiracular setae present



Thorax. Postspiracular setae absent



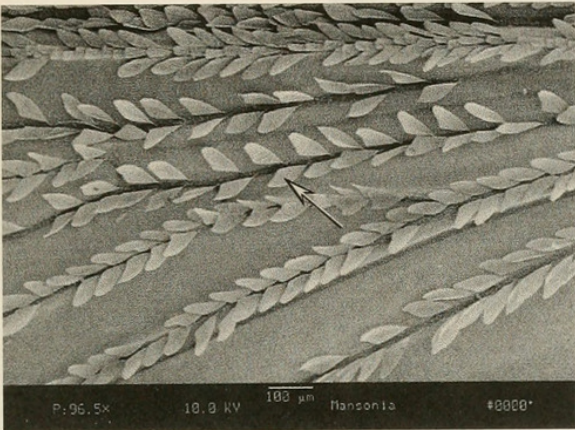
to Page 25

to Page 26b

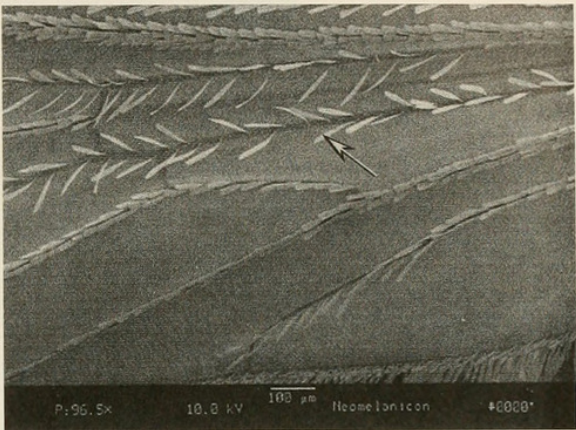
Part 2. (continued)

Page 25

Wing. Most plume scales very broad and asymmetrical



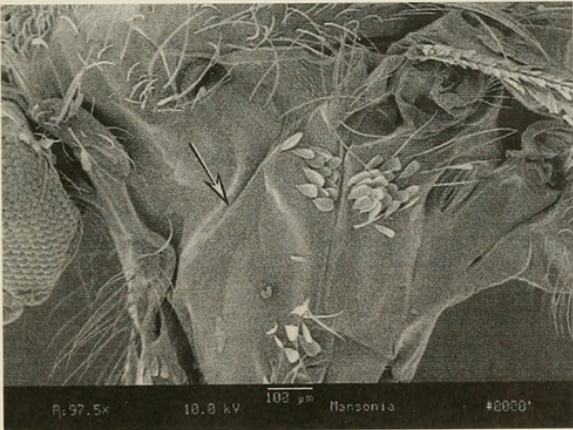
Wing. Plume scales all narrow



Aedes (in part) - see Part 3

**

Thorax. Subspiracular area without scales

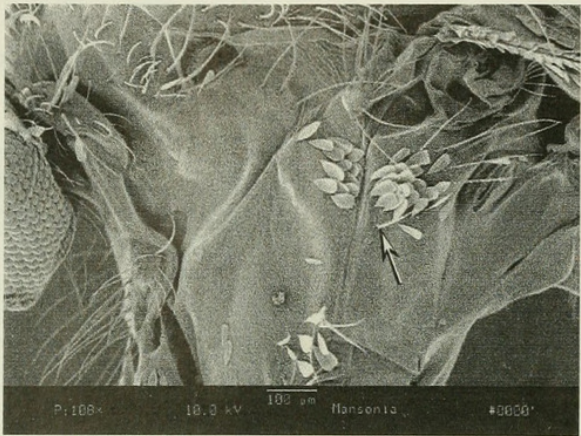


to Page 26a

Page 26a

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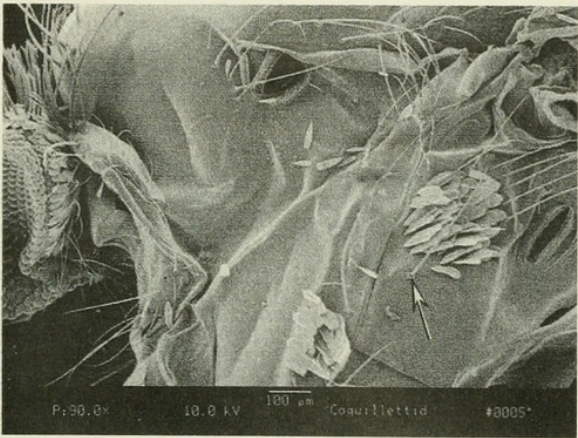
Thorax. Lower mesepimeral setae present



Mansonia

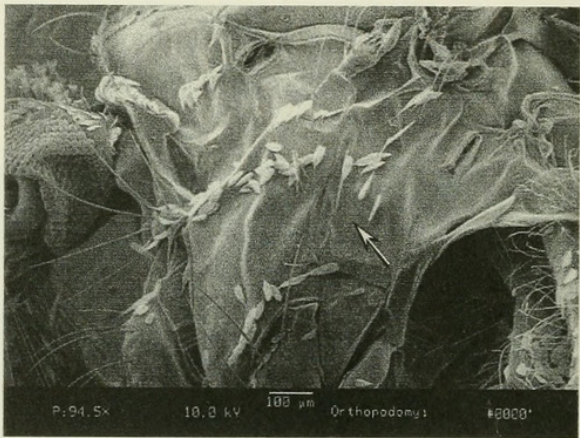
Page 26b

Thorax. Lower mesepimeral setae present



to Page 27a

Thorax. Lower mesepimeral setae absent



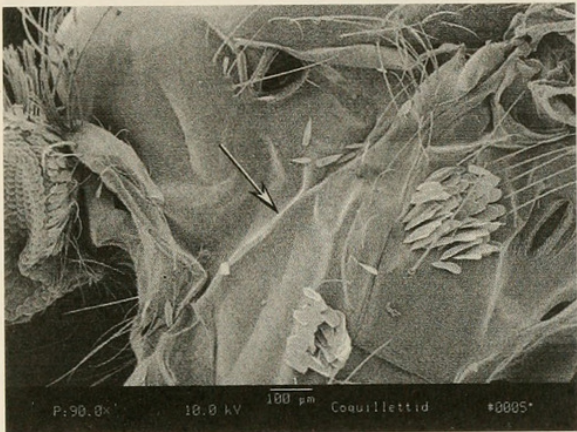
to Page 27b

Part 2. (continued)

Page 27a

**

Thorax. Subspiracular area without scales

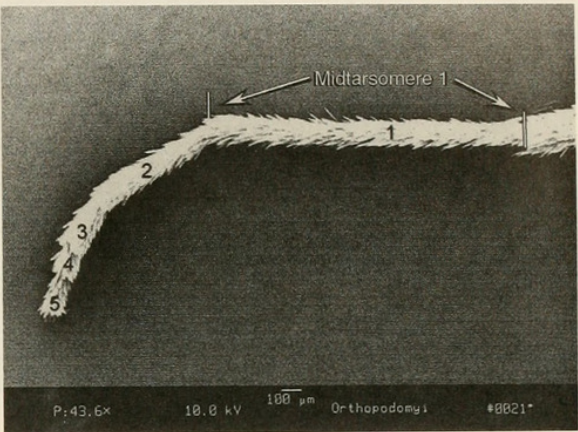


Coquillettidia

Page 27b

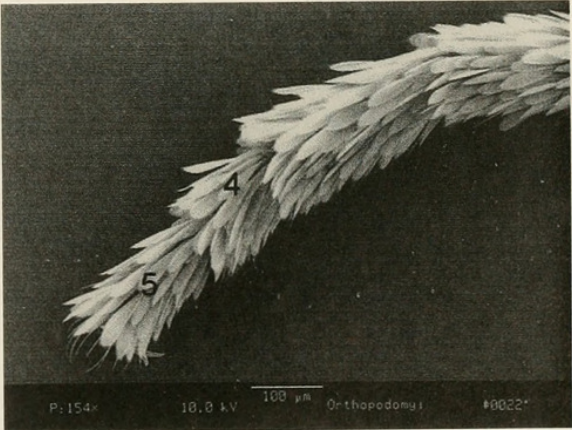
**

Leg. Midtarsomere 1 distinctly longer than tarsomeres 2-5 combined



**

Leg. Midtarsomere 4 shorter than midtarsomere 5



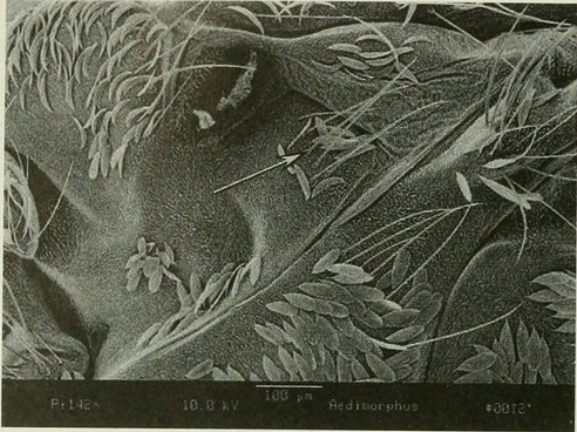
Orthopodomyia

Part 2. (continued)

Page 28a

**

Thorax. Postspiracular setae
present

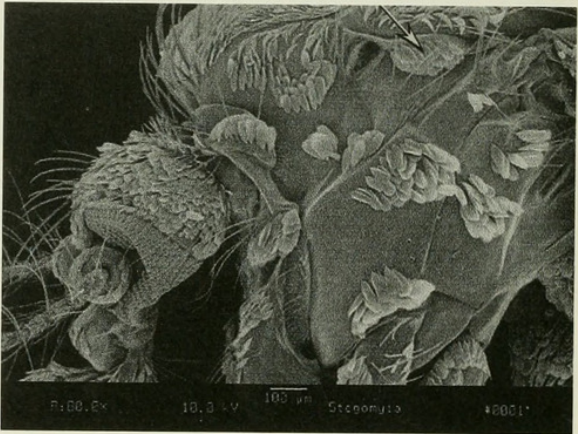
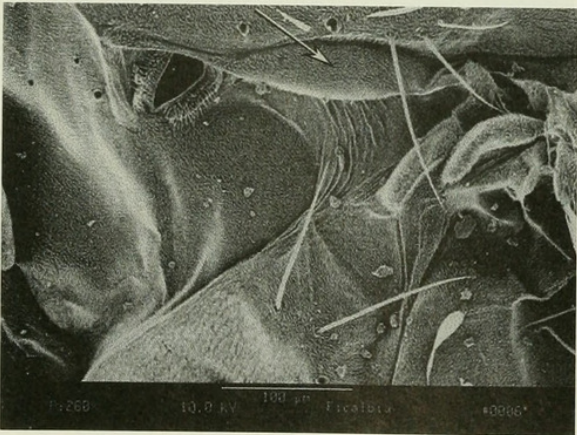


Aedes (in part) - see Part 3

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Thorax. Paratergite without scales

Thorax. Paratergite with scales



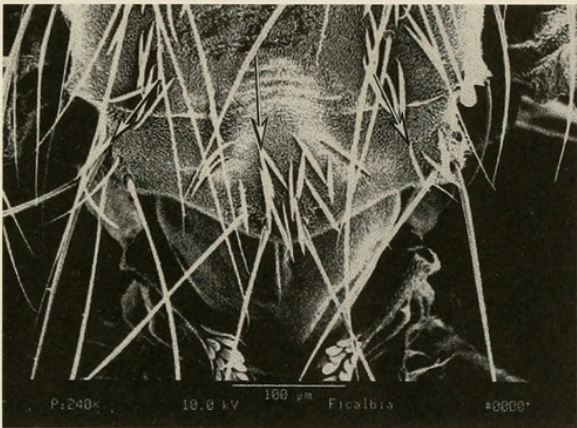
to Page 29

to Page 31

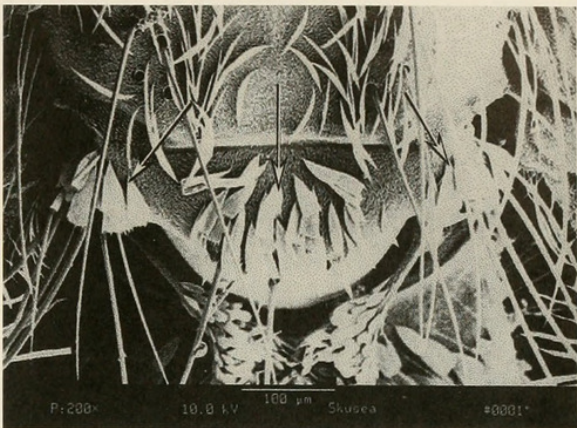
Part 2. (continued)

Page 29

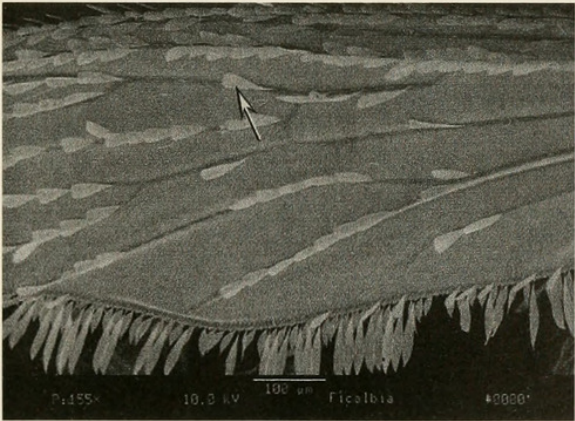
Thorax. Scutellum with narrow scales



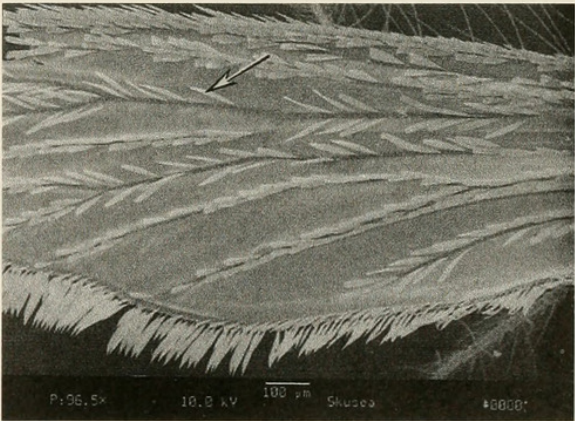
Thorax. Scutellum with broad scales



**
Wing. Plume scales all broad



**
Wing. Plume scales all narrow



to Page 30a

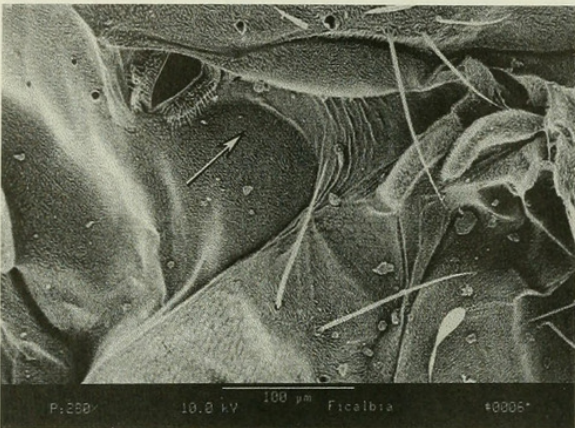
to Page 30b

Part 2. (continued)

Page 30a

**

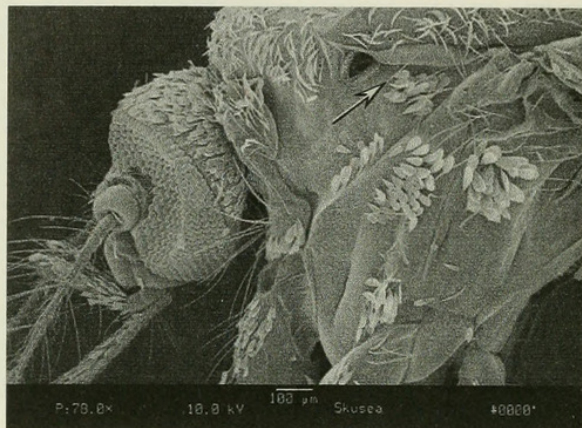
Thorax. Postspiracular setae
absent



Page 30b

**

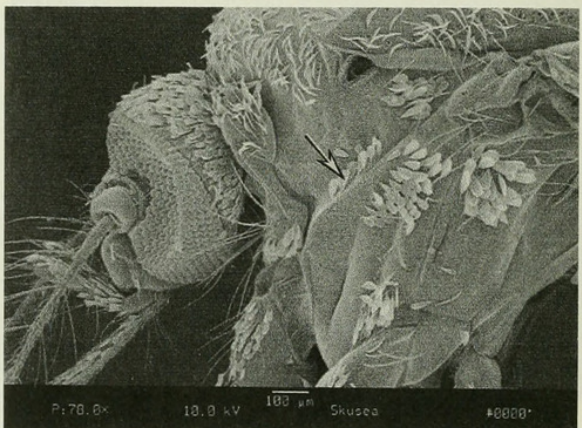
Thorax. Postspiracular setae
present



Ficalbia

**

Thorax. Subspiracular area with
scales

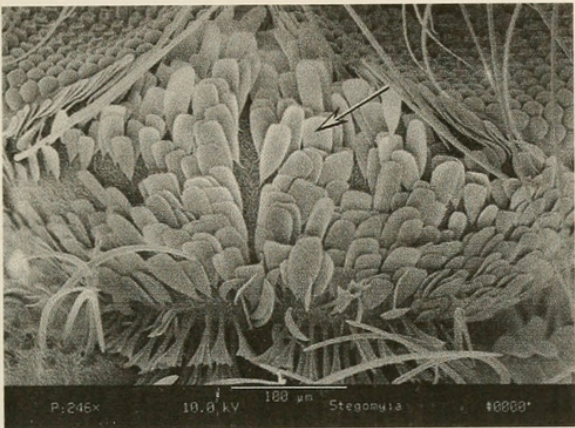


Aedes (in part) - see Part 3

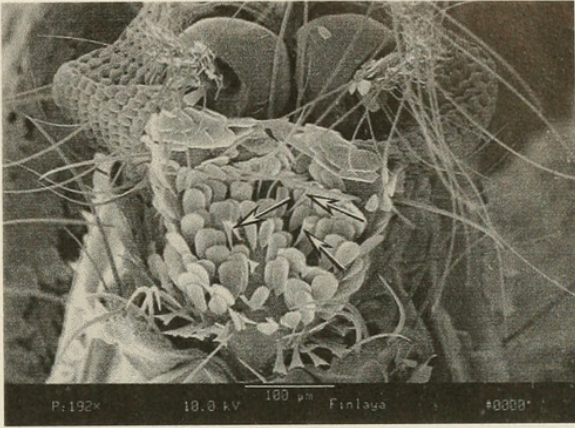
Part 2. (continued)

Page 31

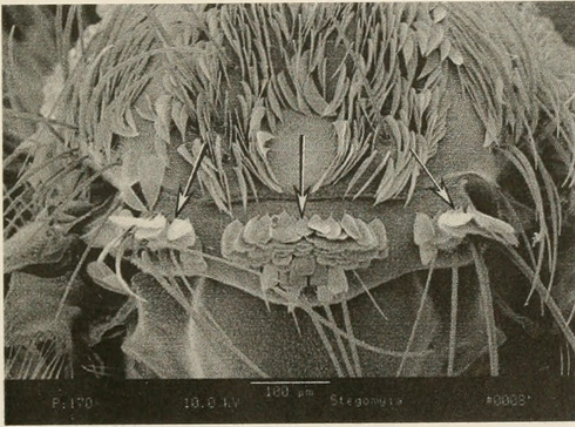
Head. Vertex with all broad flat decumbent scales



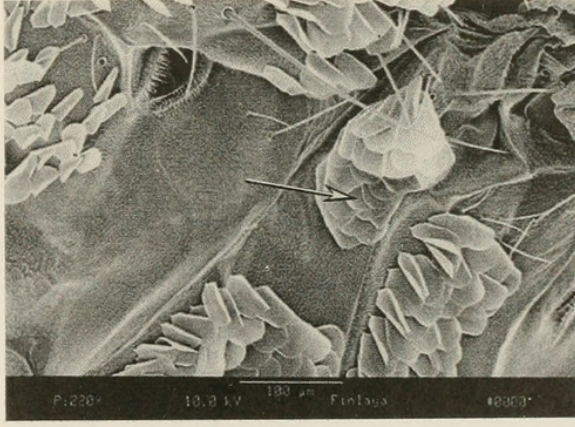
Head. Vertex with broad flat decumbent scales and some narrow forked scales



**
Thorax. Scutellum with broad scales



**
Thorax. Lower prealar scale patch present



to Page 32

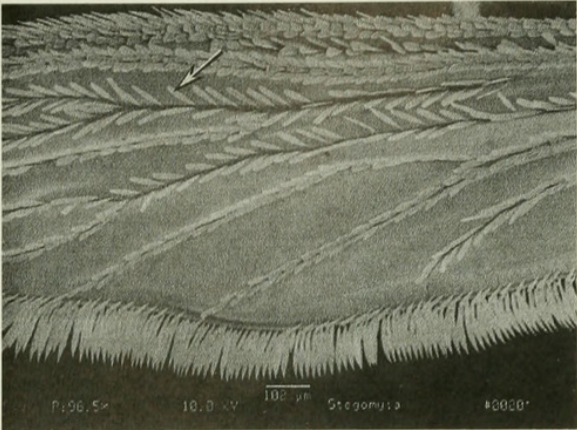
Aedes (in part) - see Part 3

Part 2. (continued)

Page 32

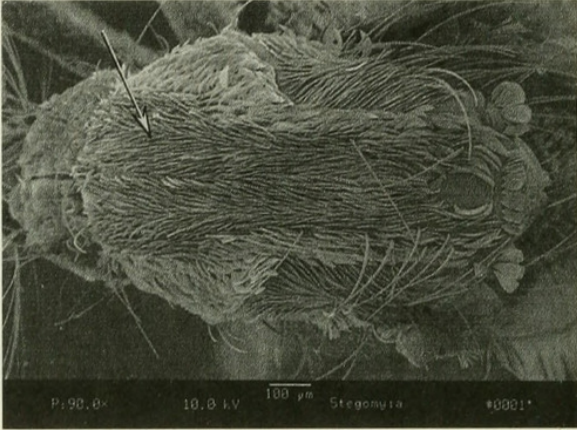
**** 1**

Wing. Plume scales all narrow



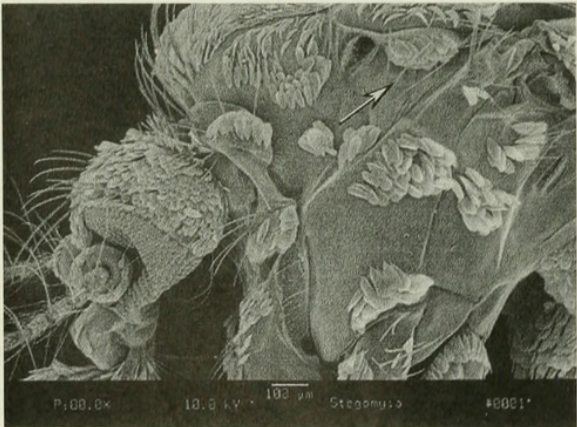
**** 2**

Thorax. Scutum with all, or mainly narrow curved scales



**** 3**

Thorax. Postspiracular setae present

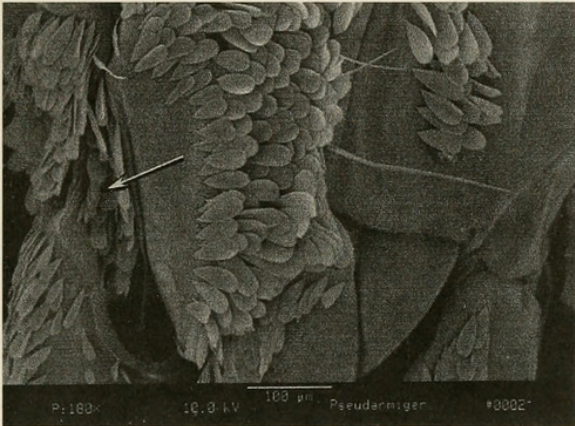


to Page 33

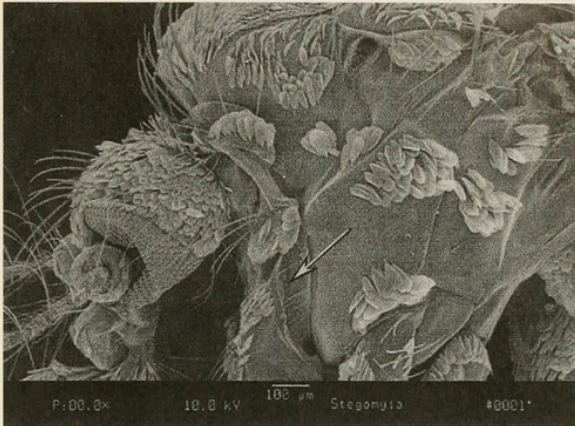
Part 2. (continued)

Page 33

Thorax. Postprocoxal
membrane with scales

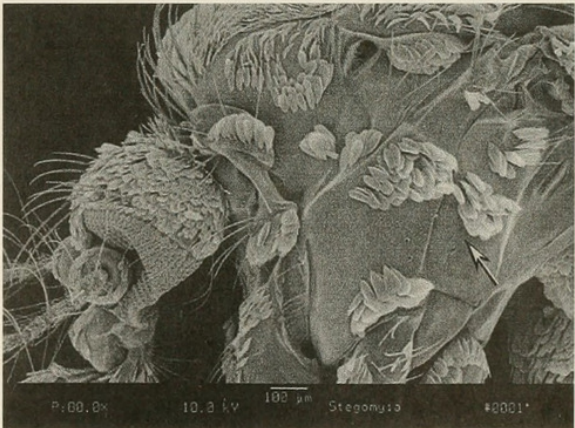


Thorax. Postprocoxal
membrane without scales



Aedes (in part) - see Part 3

Thorax. Lower mesepimeral setae
absent

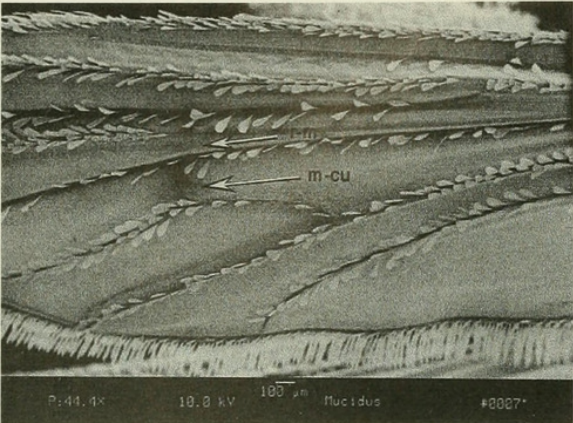


Aedes (in part) - see Part 3

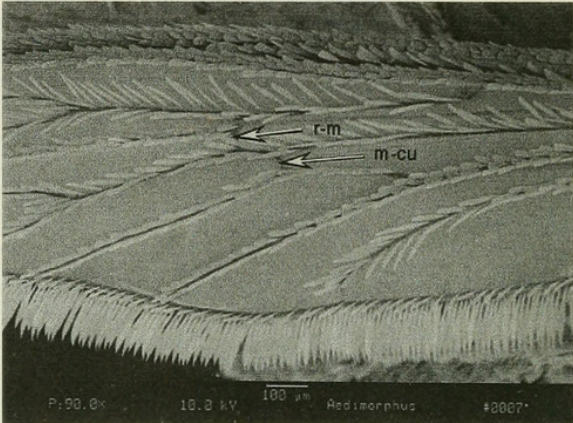
Part 3. Key to Subgenera of *Aedes*

ADULTS

Wing. Wing membrane clouded on crossveins r-m and m-cu

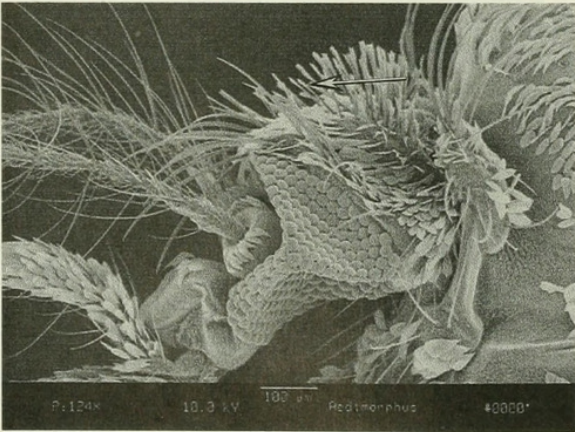


Wing. Wing membrane not clouded on crossveins r-m and m-cu

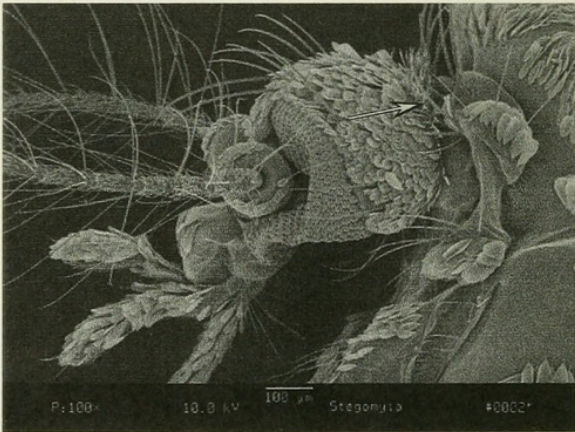


Mucidus

Head. Vertex with erect forked scales numerous, not restricted to occiput



Head. Vertex with erect forked scales not numerous, restricted or not restricted to occiput



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to Page 48

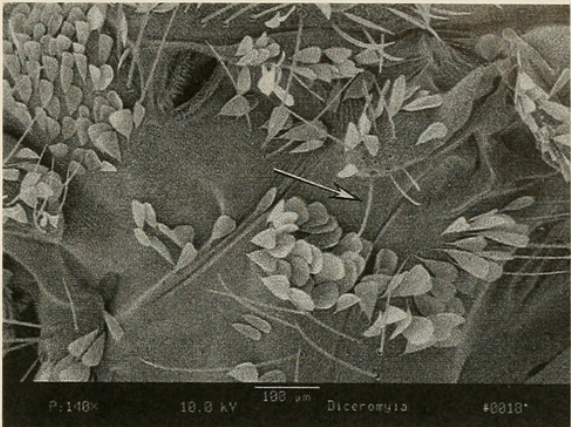
Part 3. (continued)

Page 35

Thorax. Lower prealar scale patch present



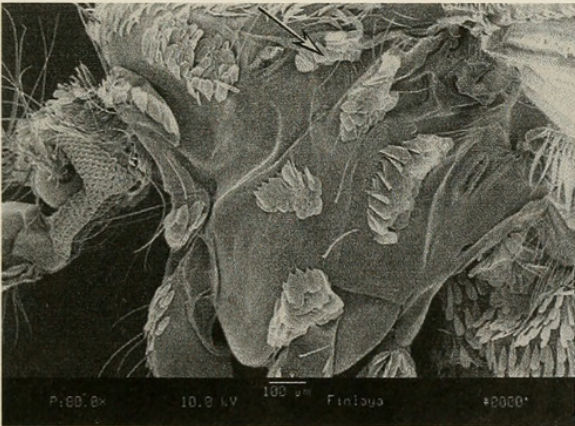
Thorax. Lower prealar scale patch absent



to Page 40

**

Thorax. Paratergite with scales

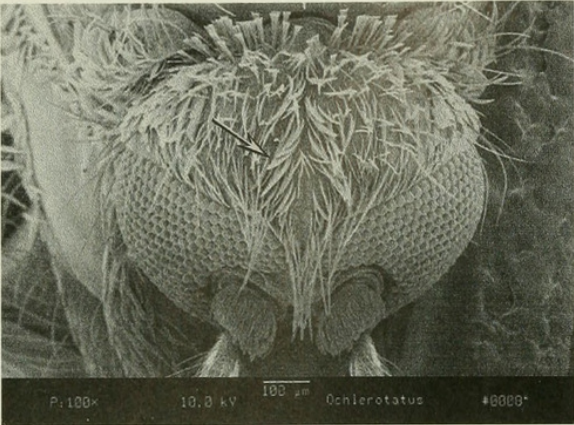


to Page 36

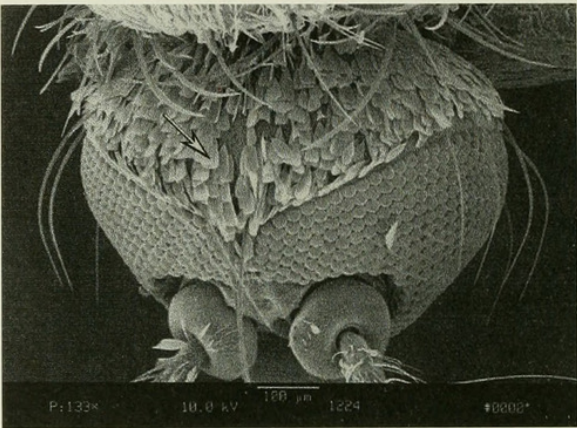
Part 3. (continued)

Page 36

Head. Vertex with decumbent scales largely narrow

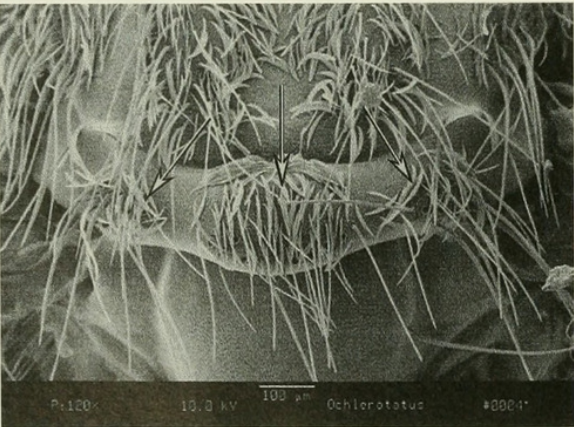


Head. Vertex with decumbent scales largely broad

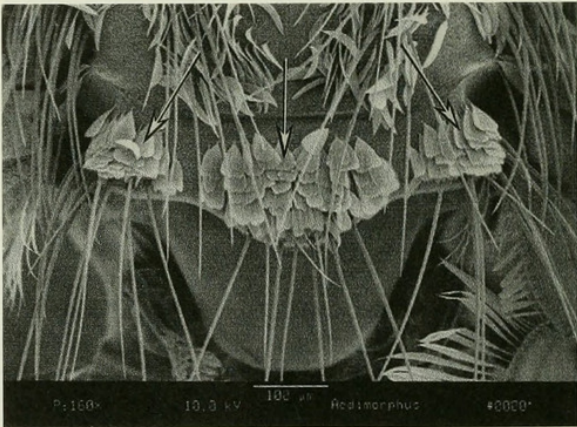


to Page 38

Thorax. Scutellum with all narrow scales



Thorax. Scutellum with all broad scales



Ochlerotatus

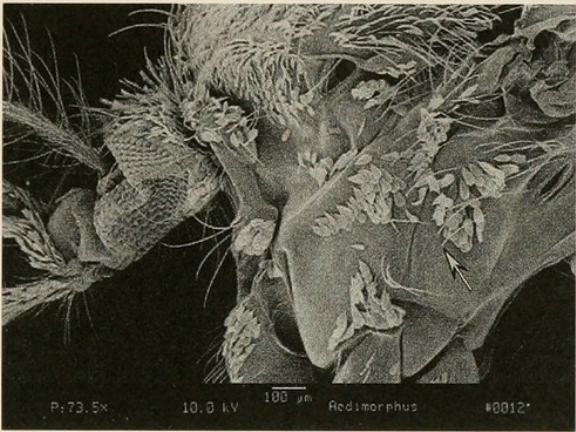
to Page 37

Part 3. (continued)

Page 37

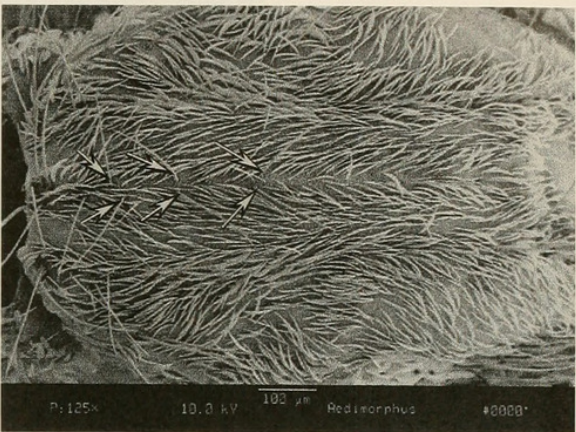
**** 1**

Thorax. Lower mesepimeral setae present



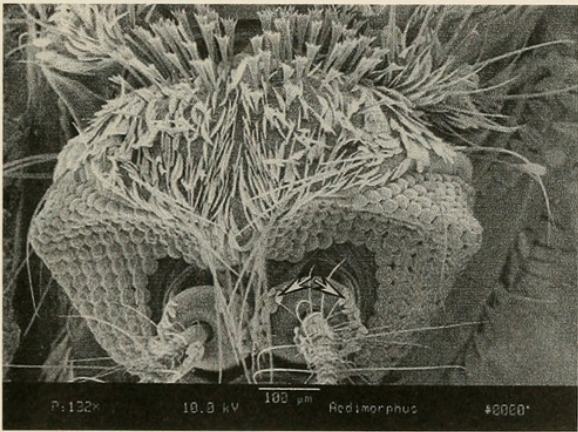
**** 2**

Thorax. Acrostichal setae present



**** 3**

Head. Pedicel with white broad scales on mesal and lateral surfaces

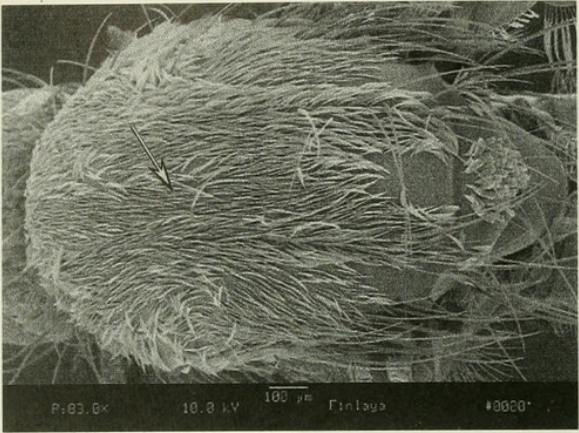


Aedimorphus (in part)
Vittatus Group
Aedes vittatus

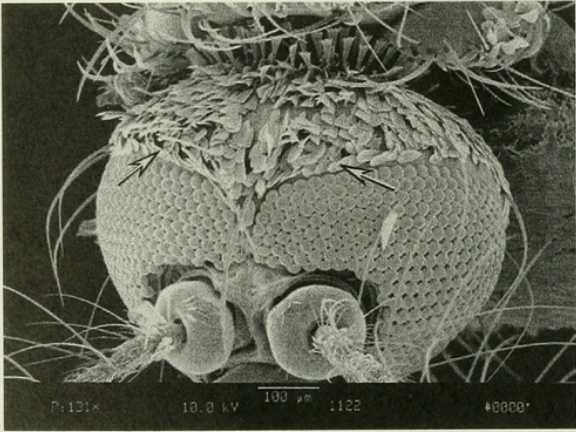
Part 3. (continued)

Page 38

Thorax. Acrostichal setae absent



Head. Vertex with broad scales along eye margins

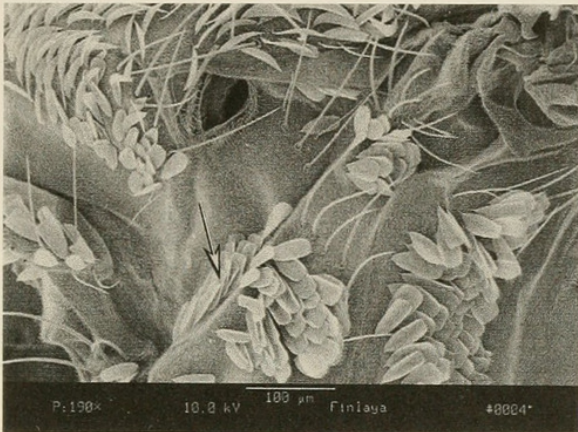


to Page 39

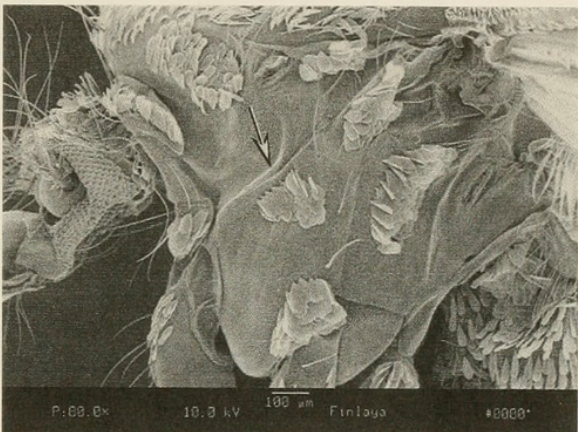
Part 3. (continued)

Page 39

Thorax. Subspiracular area with scales

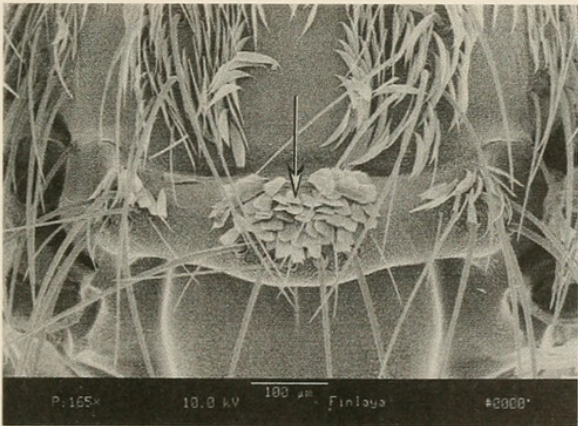


Thorax. Subspiracular area without scales



**

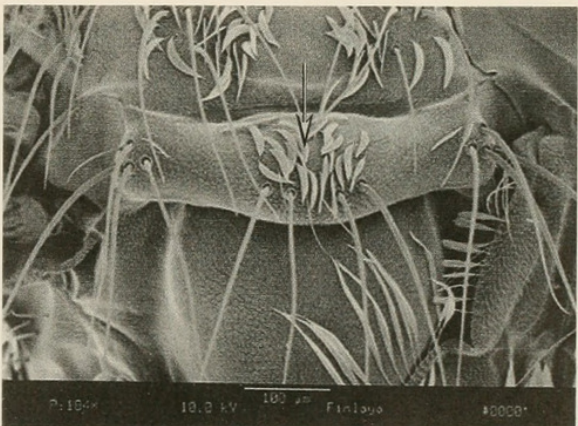
Thorax. Scutellum with broad scales on midlobe



Finlaya (in part)
Wellmani Group

**

Thorax. Scutellum with narrow scales on midlobe



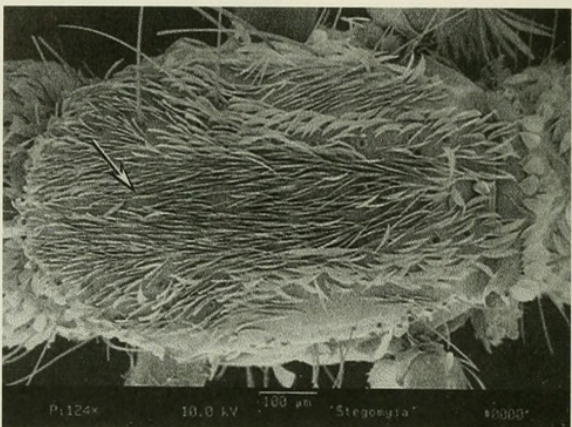
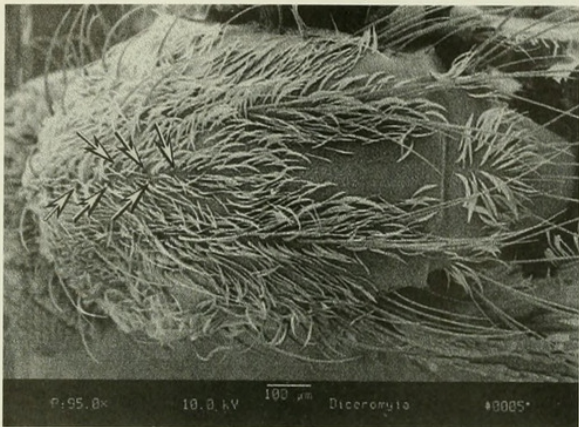
Finlaya (in part)
Pulchrithorax Group
Aedes pulchrithorax

Part 3. (continued)

Page 40

Thorax. Acrostichal setae present

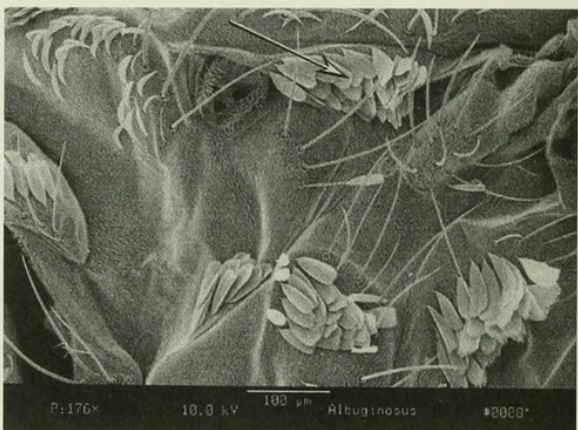
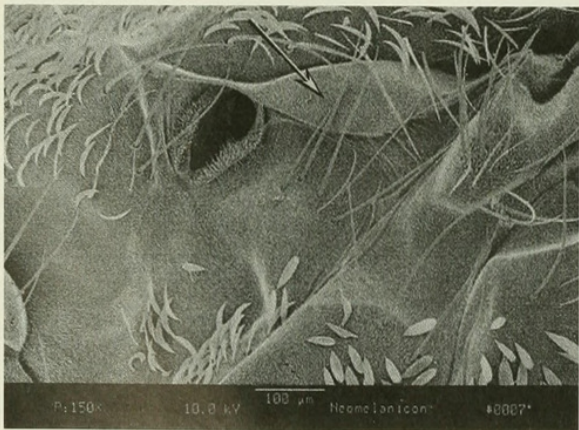
Thorax. Acrostichal setae absent



to Page 47b

Thorax. Paratergite without scales

Thorax. Paratergite with scales



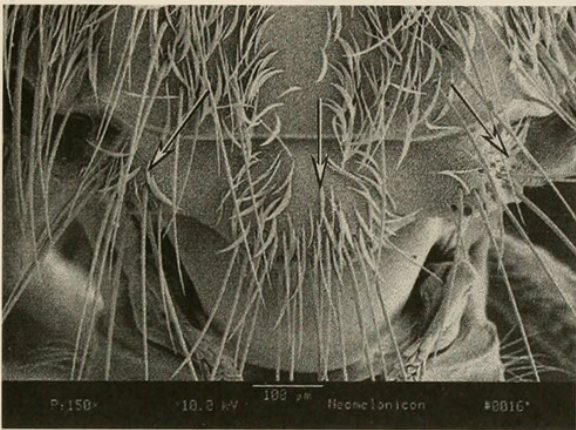
to Page 41

to Page 42b

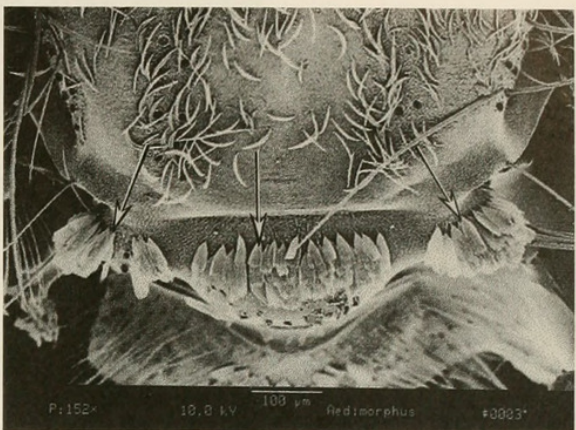
Part 3. (continued)

Page 41

Thorax. Scutellum with all narrow scales



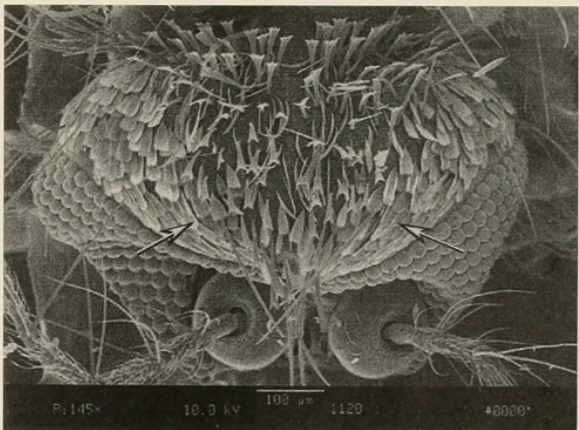
Thorax. Scutellum with all broad scales



Neomelaniconion

**

Head. Vertex with a pair of wedge-shaped patches of broad, flat scales on eye margins

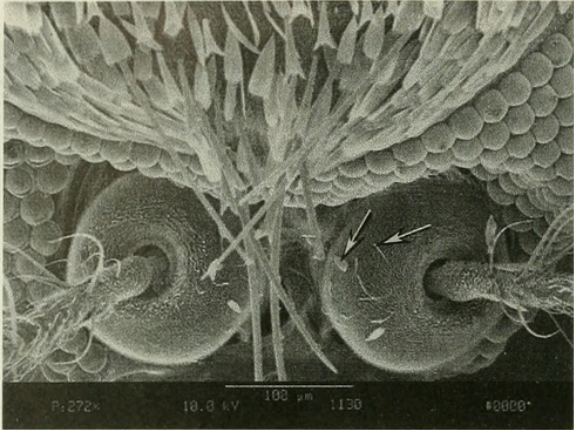


to Page 42a

Part 3. (continued)

Page 42a

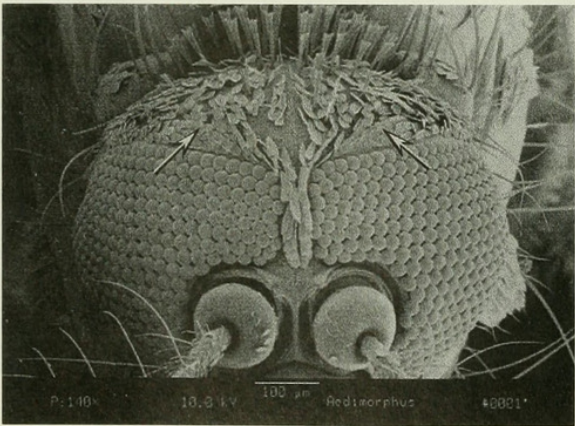
Head. Pedicel with a few small scales and short fine setae on mesal surface



Aedimorphus (in part)
Domesticus Group

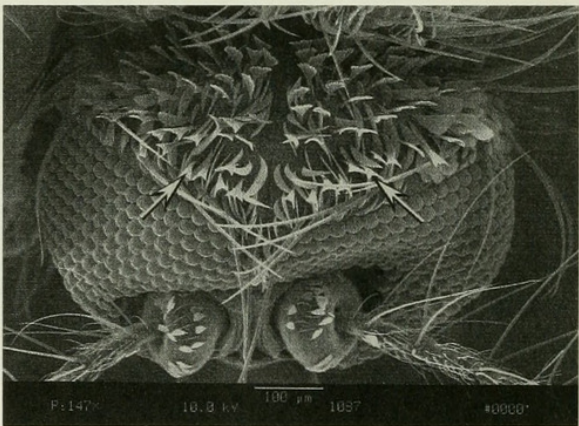
Page 42b

Head. Vertex with a pair of wedge-shaped patches of broad, flat scales on eye margins



to Page 43

Head. Vertex without a pair of wedge-shaped patches of broad, flat scales on eye margins

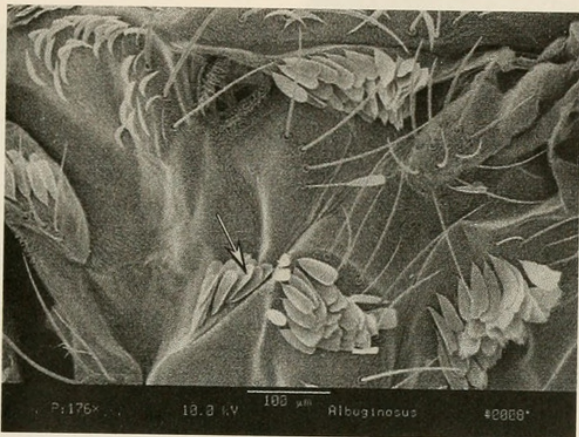


to Page 44b

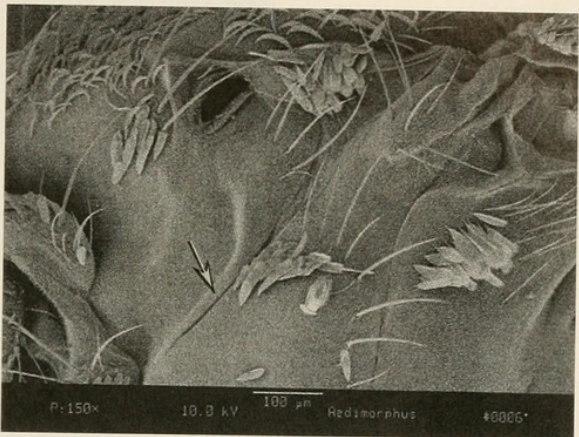
Part 3. (continued)

Page 43

Thorax. Subspiracular area with scales

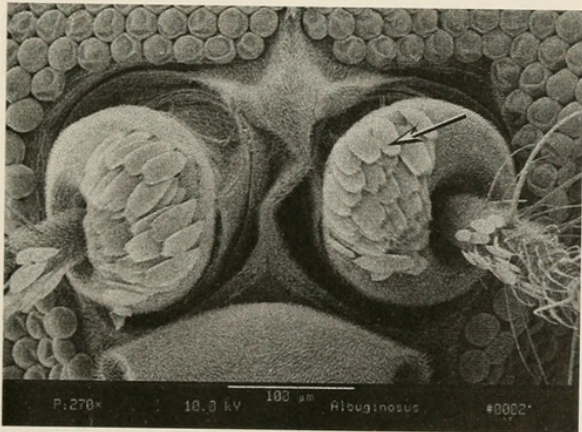


Thorax. Subspiracular area without scales



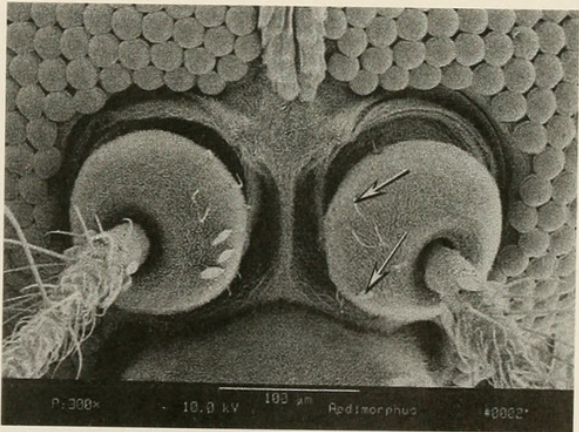
**

Head. Pedicel with a patch of white broad overlapping scales on mesal surface



**

Head. Pedicel with a few small scales and short fine setae on mesal surface



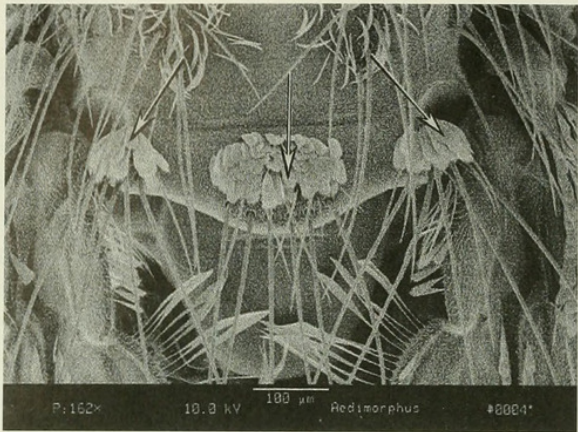
Albuginosus

to Page 44a

Part 3. (continued)

Page 44a

Thorax. Scutellum with all broad,
flat scales

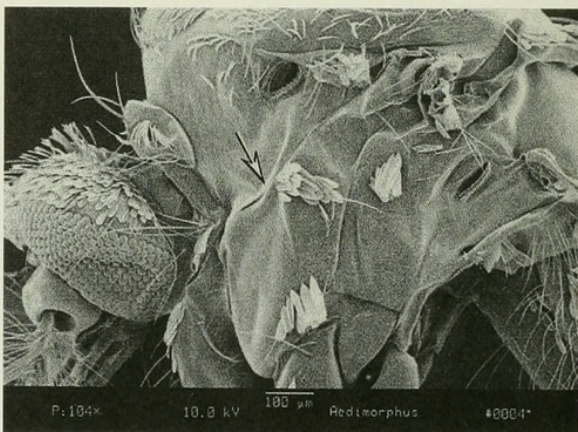
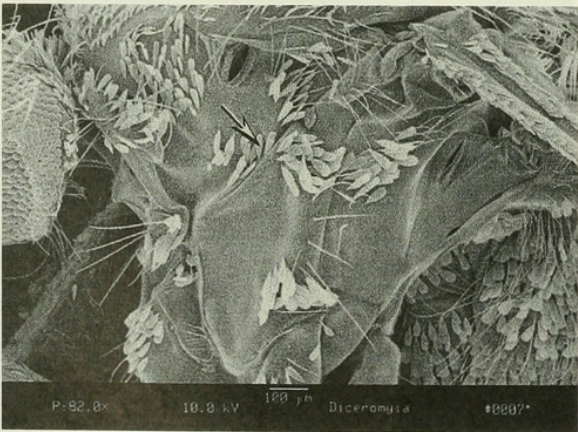


Aedimorphus (in part)
Argenteopunctatus Group

Page 44b

Thorax. Subspiracular area with
scales

Thorax. Subspiracular area without
scales



to Page 45

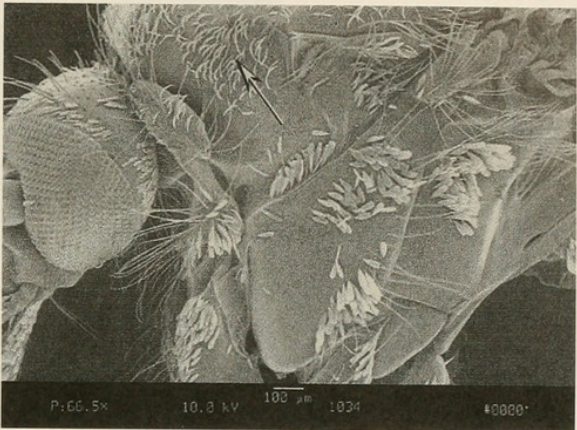
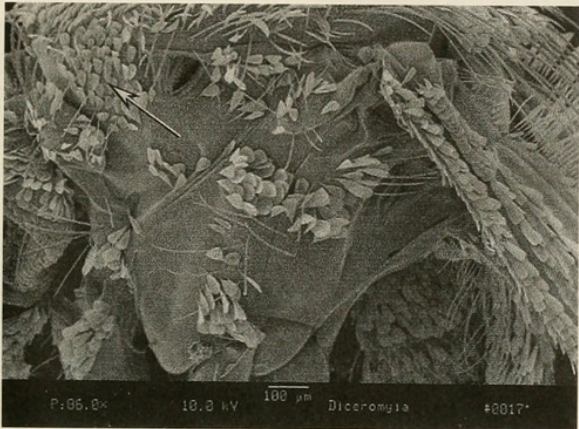
to Page 46b

Part 3. (continued)

Page 45

Thorax. Postpronotum with all or most scales broad and flat

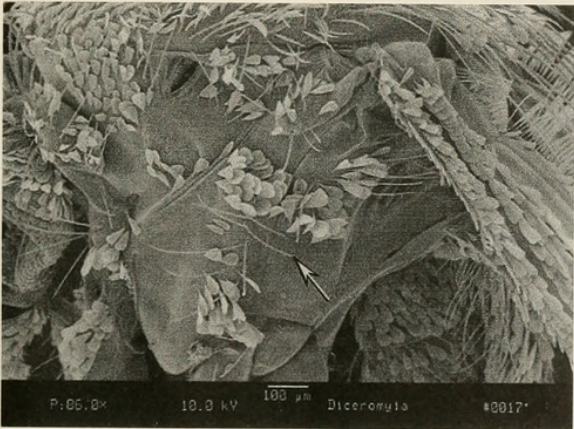
Thorax. Postpronotum with all or most scales narrow and curved



Aedimorphus (in part)

**

Thorax. Lower mesepimeral setae present

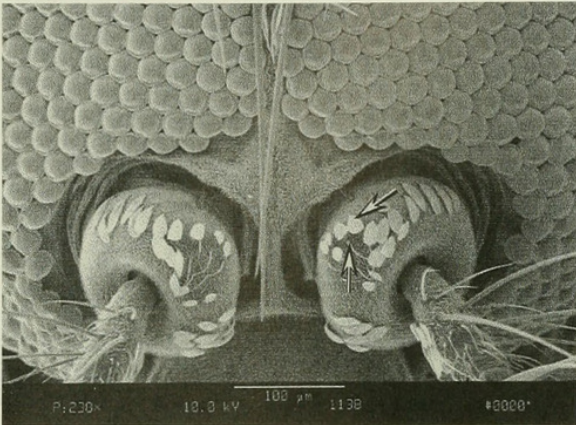


to Page 46a

Part 3. (continued)

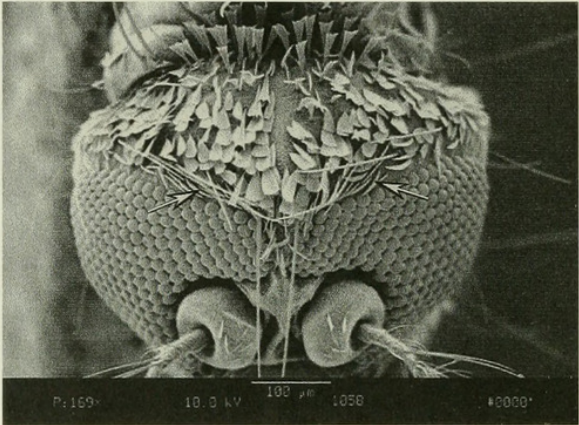
Page 46a

Head. Pedicel with setae mixed with many broad, flat scales on mesal surface

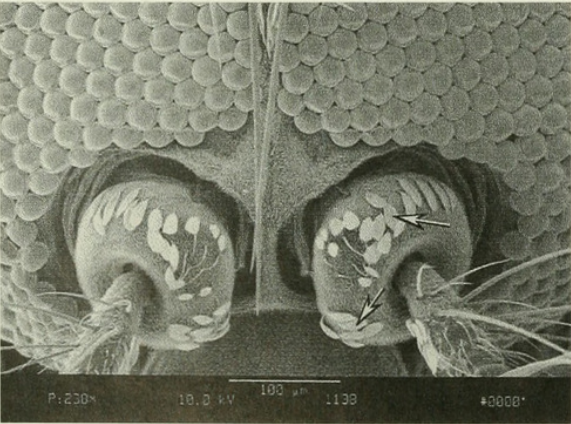


Page 46b

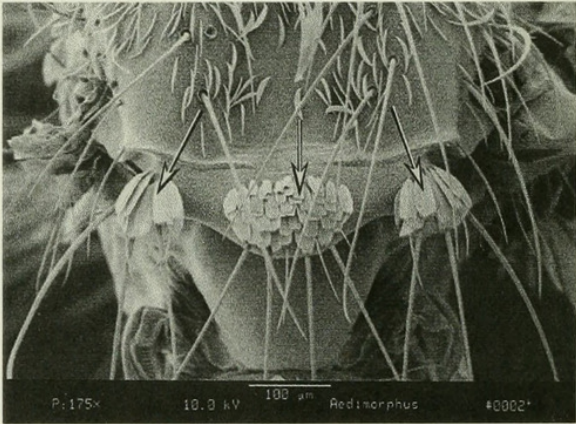
Head. Vertex with narrow scales along eye margins



Head. Pedicel with 2 patches of scales on mesal surface



Thorax. Scutellum with all broad scales



Diceromyia

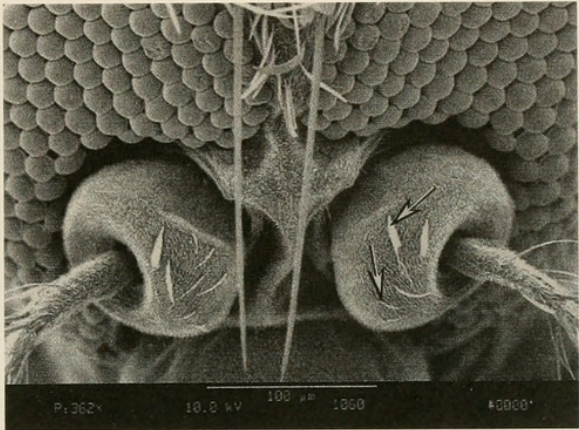
to Page 47a

Part 3. (continued)

Page 47a

**

Head. Pedicel with few setae and scales on mesal surface

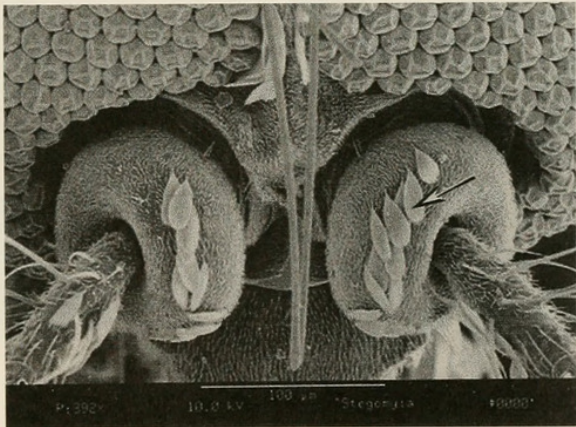


Aedimorphus (in part)
Apicoannulatus Group

Page 47b

**

Head. Pedicel with a long patch of white broad, flat scales on mesal surface

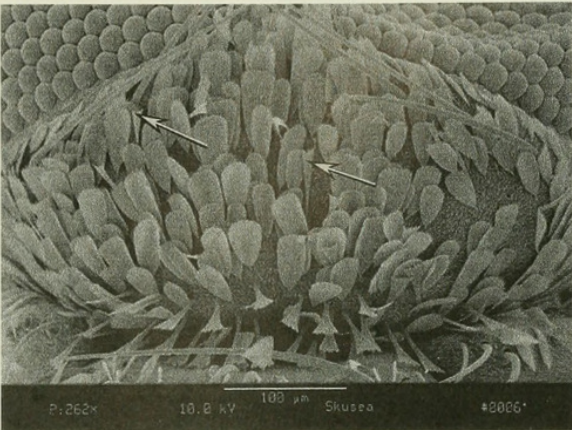


Aedes cozi

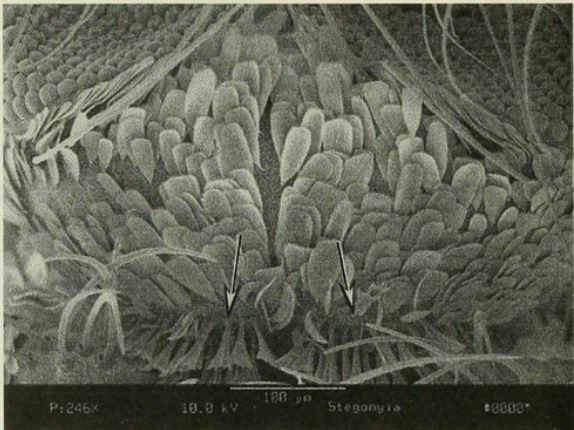
Part 3. (continued)

Page 48

Head. Vertex with erect forked scales
not numerous, not restricted to occiput



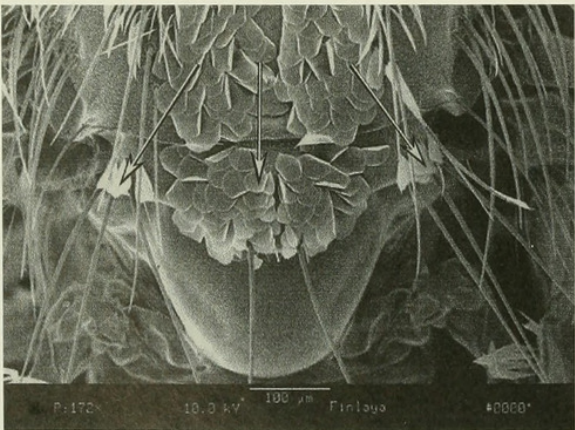
Head. Vertex with erect forked scales
not numerous, restricted to occiput



to Page 51

**

Thorax. Scutellum with all broad
scales



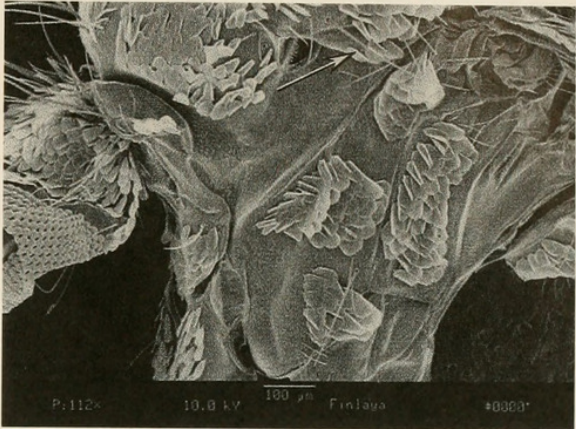
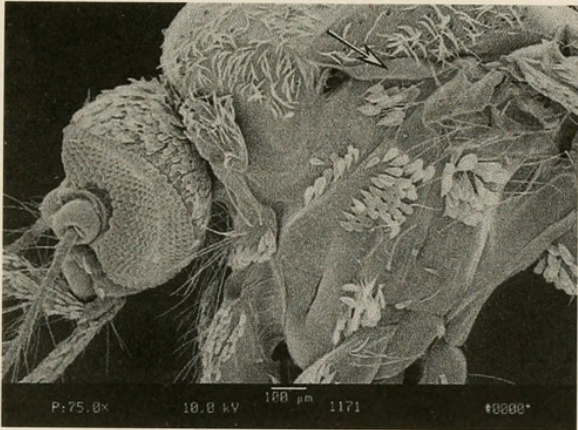
to Page 49

Part 3. (continued)

Page 49

Thorax. Paratergite without scales

Thorax. Paratergite with scales

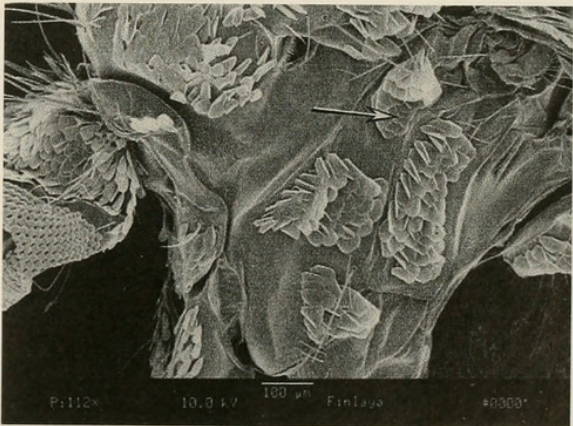
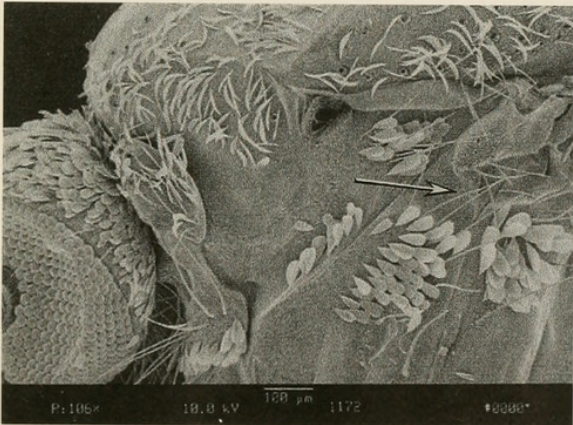


**

Thorax. Lower prealar scale patch absent

**

Thorax. Lower prealar scale patch present



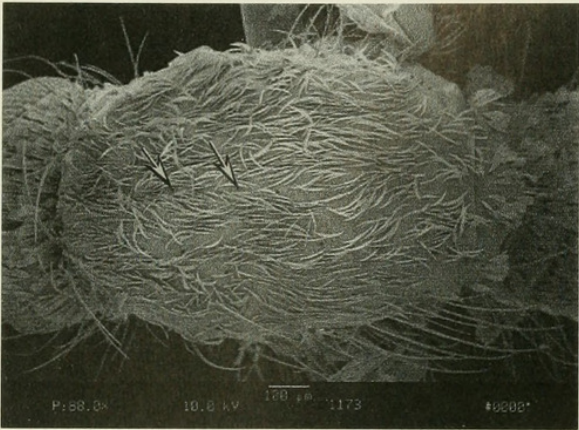
to Page 50a

to Page 50b

Part 3. (continued)

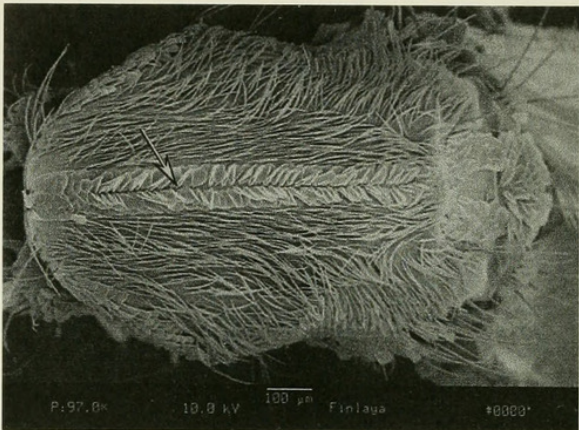
Page 50a

Thorax. Acrostichal setae present

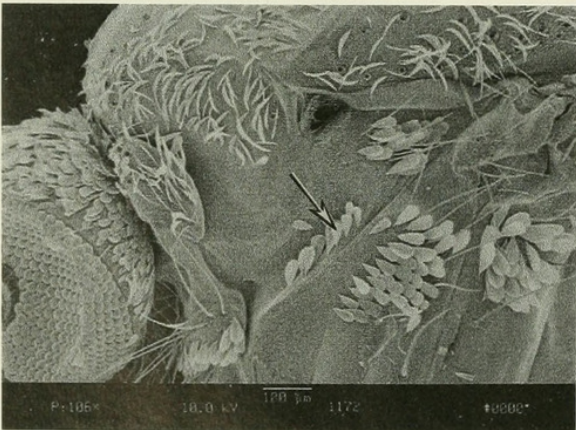


Page 50b

Thorax. Acrostichal setae absent

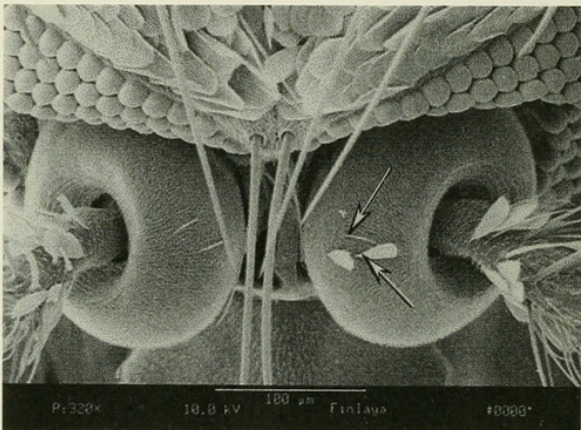


Thorax. Subspiracular area with scales



Skusea

Head. Pedicel with very few (1-3) scales and short fine setae on mesal surface



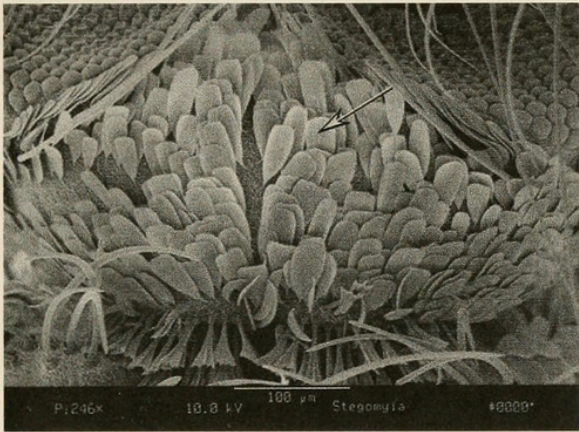
Zavortinkius

Part 3. (continued)

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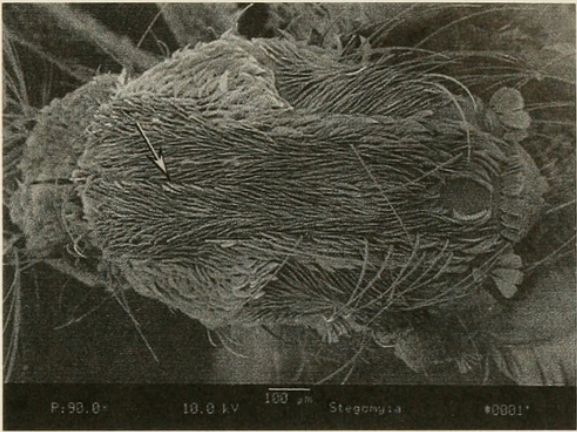
**** 1**

Head. Vertex with all broad, flat decumbent scales



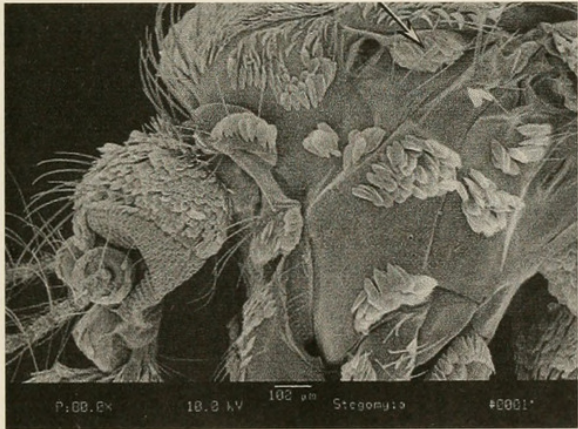
**** 2**

Thorax. Acrostichal setae absent



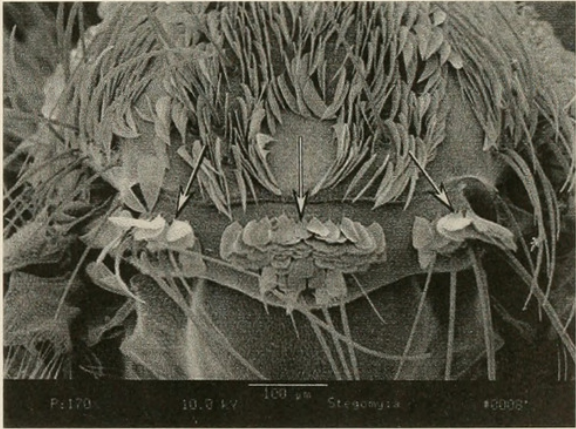
**** 3**

Thorax. Paratergite with scales



**** 4**

Thorax. Scutellum with all broad scales

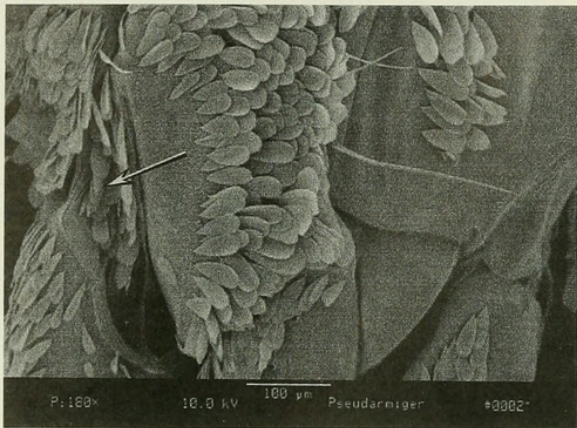


to Page 52

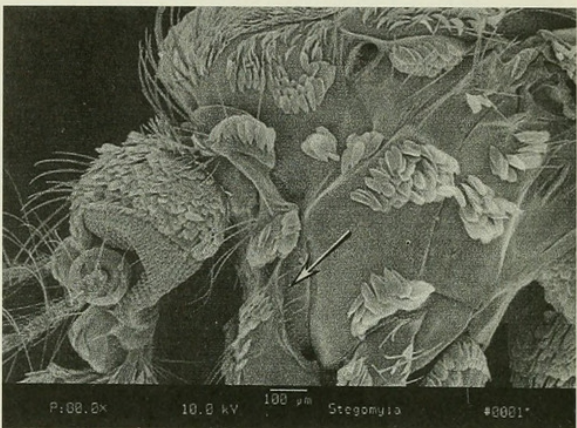
Part 3. (continued)

Thorax. Postprocoxal membrane
with scales

Thorax. Postprocoxal membrane
without scales



Pseudarmigeres



Stegomyia

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