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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)

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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 Afrotropical 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 *Banksinella* 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.

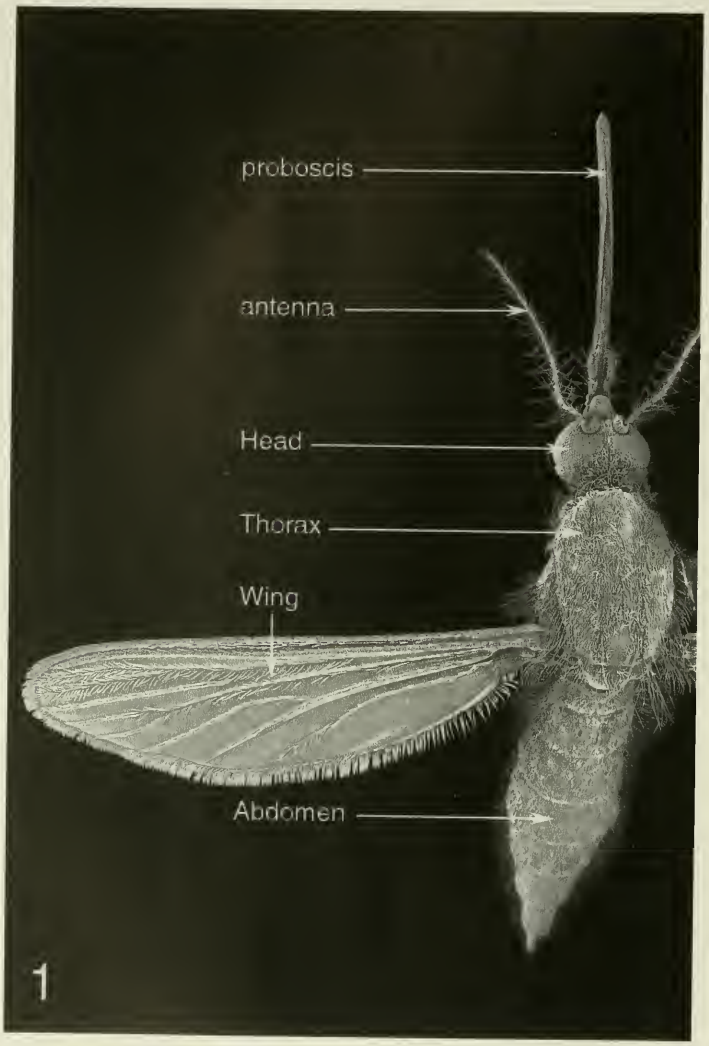
Table 1. Classification of the family Culicidae in the Afrotropical Region.

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

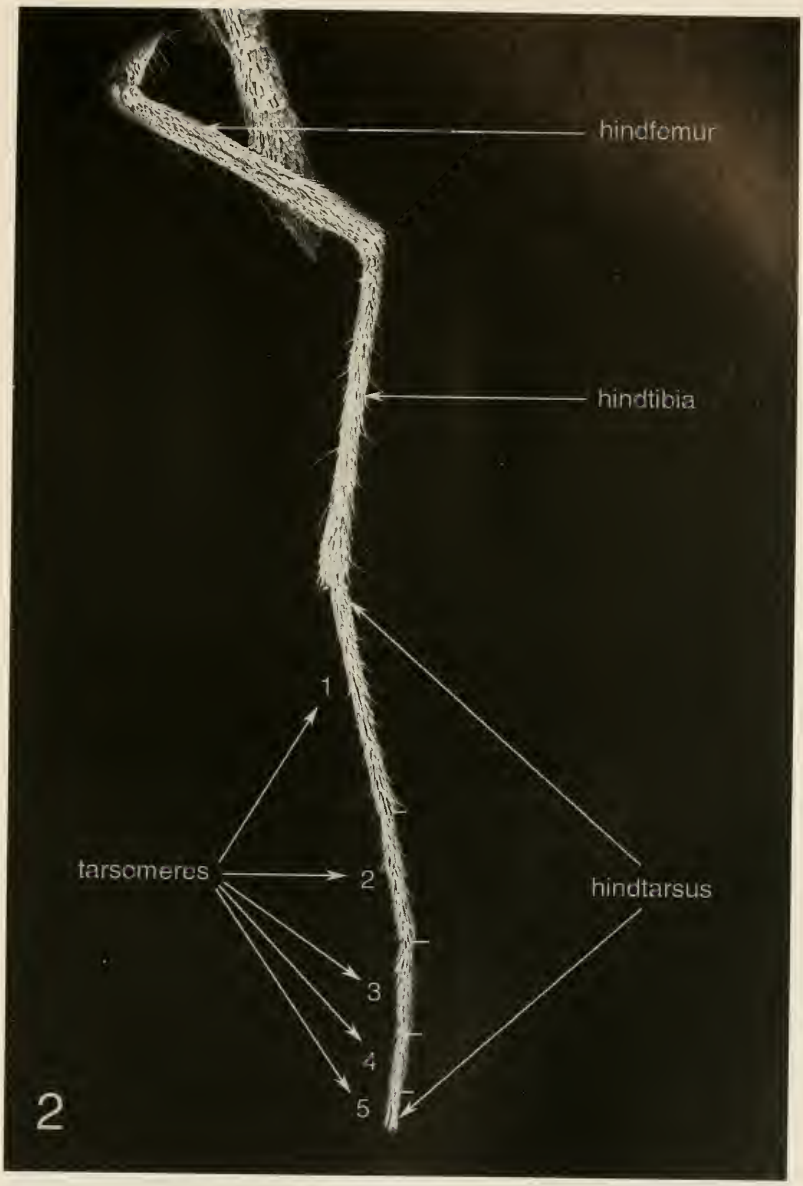
ACKNOWLEDGMENTS

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 Research (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.

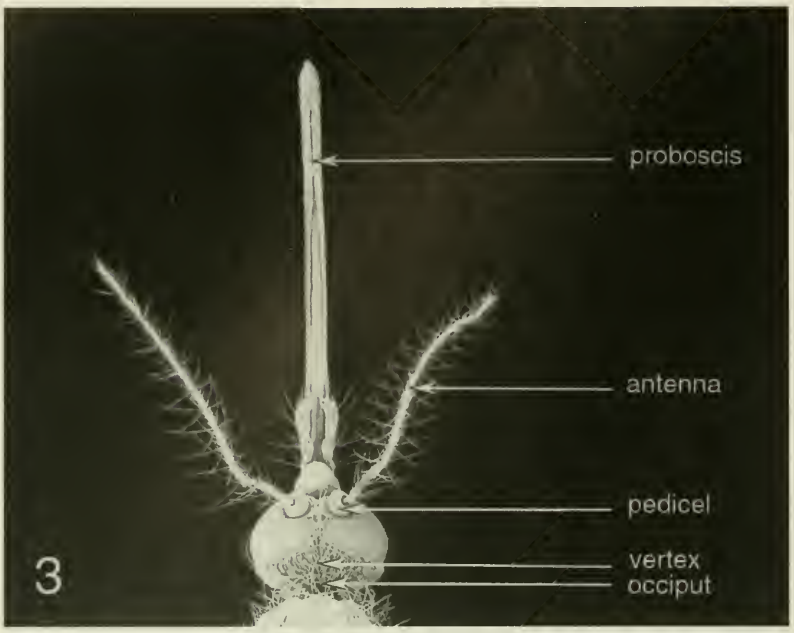
MORPHOLOGICAL FEATURES USED IN IDENTIFICATION



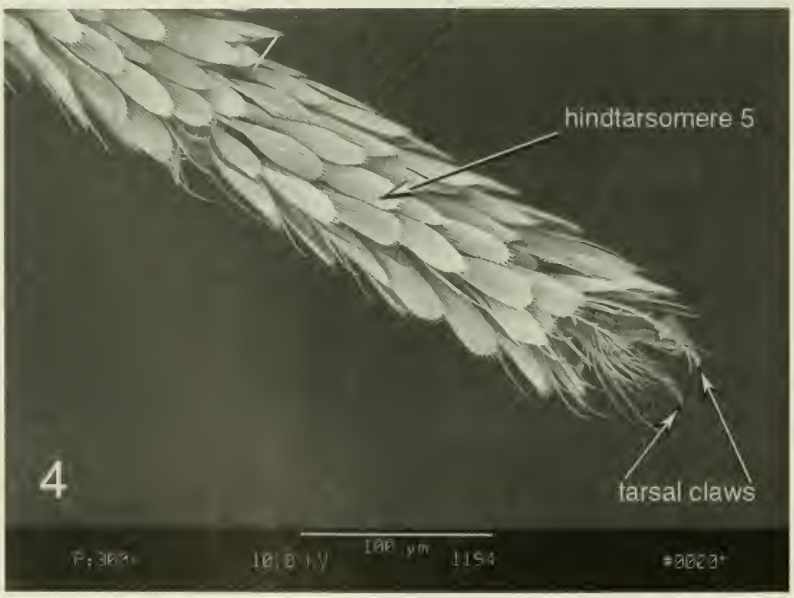
ADULT



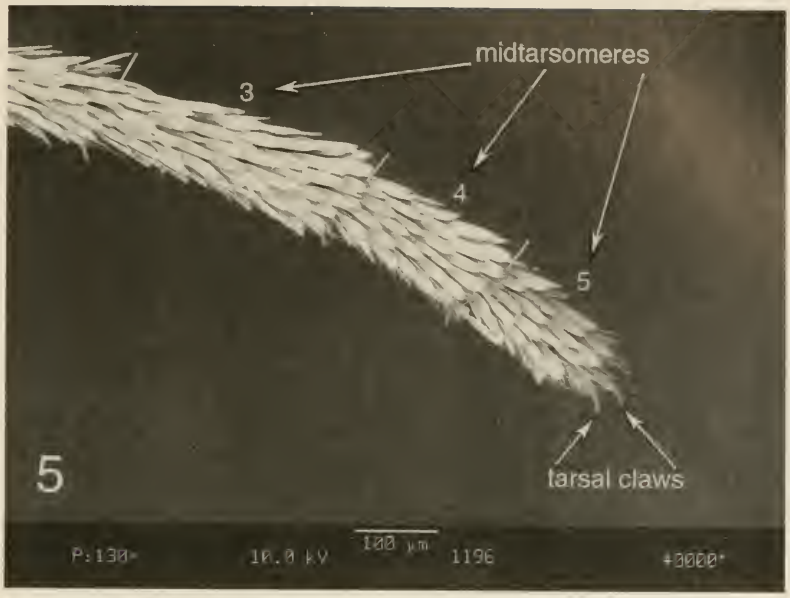
HINDLEG



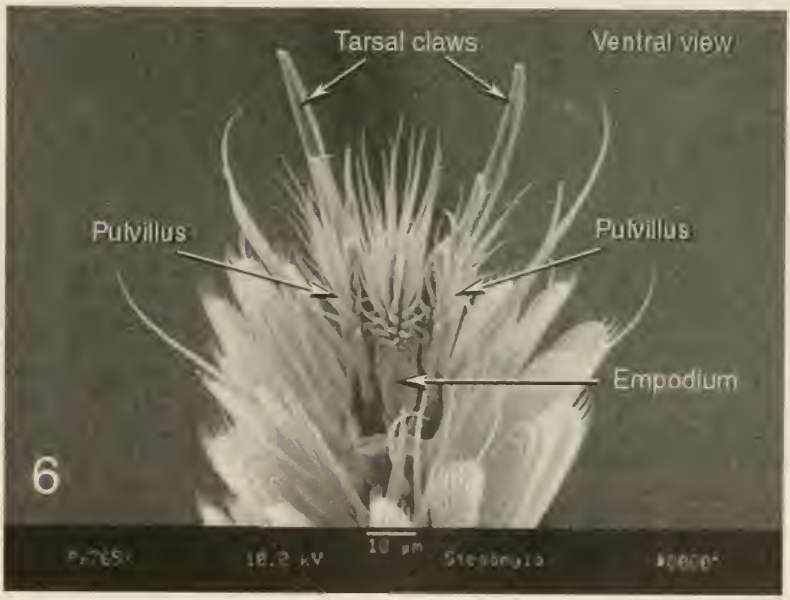
HEAD - DORSAL



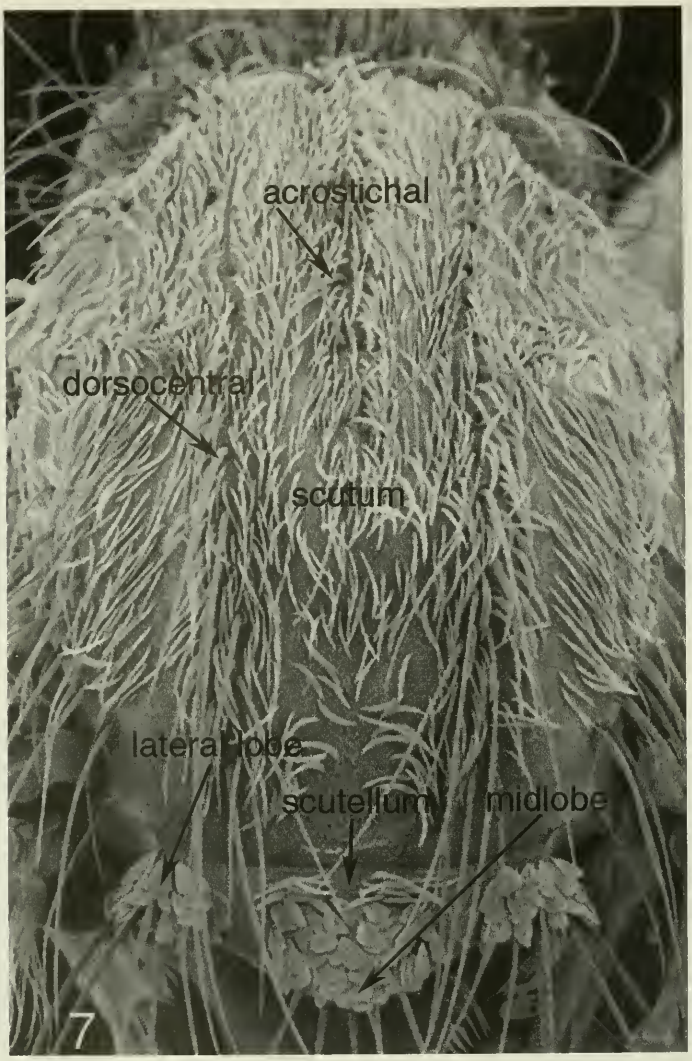
HINDTARSOMERE 5 WITH TARSAL CLAWS



MIDLEG

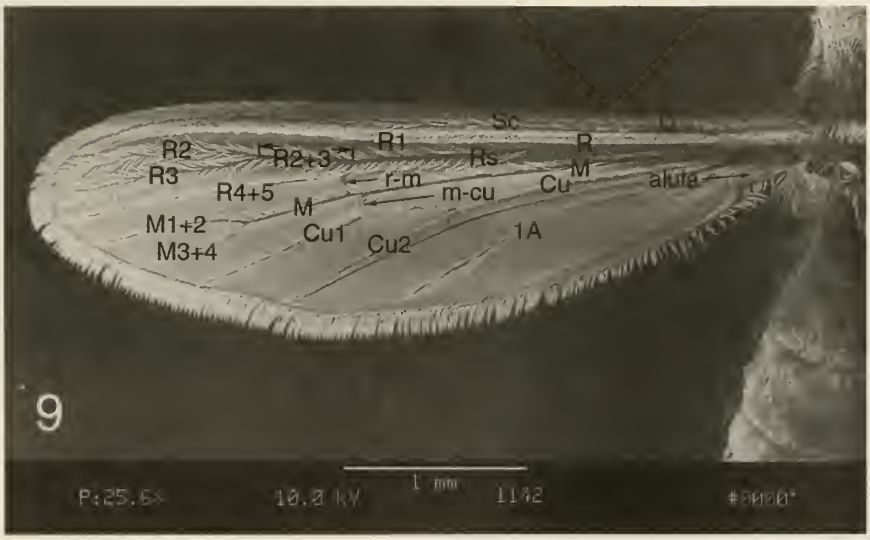


TARSAL CLAWS - VENTRAL



THORAX - DORSAL

THORAX - LATERAL



WING - DORSAL

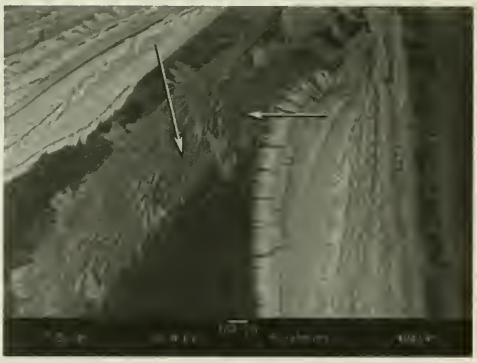
Part 1. Key to Subfamilies of Culicidae

ADULTS

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

to Page 11

Abdomen. Completely or largely without scales

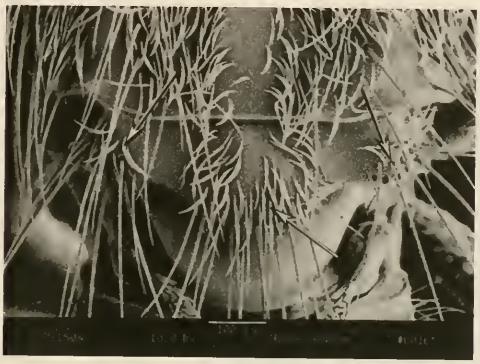


to Page 13

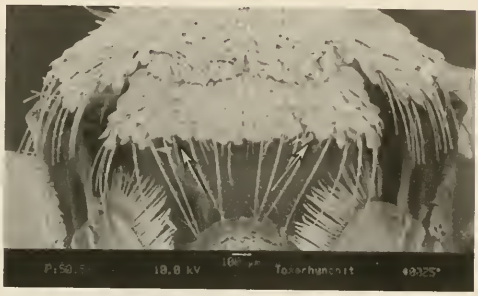
Part 1. (continued)

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

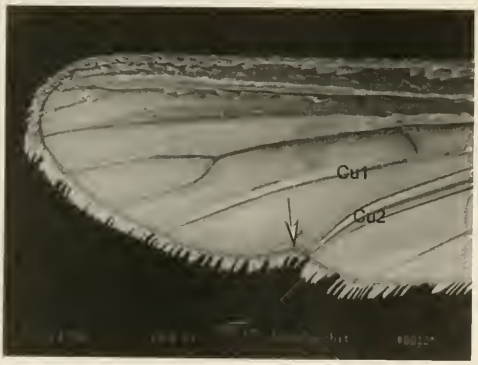


Subfamily Culicinae

see Part 2

**

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



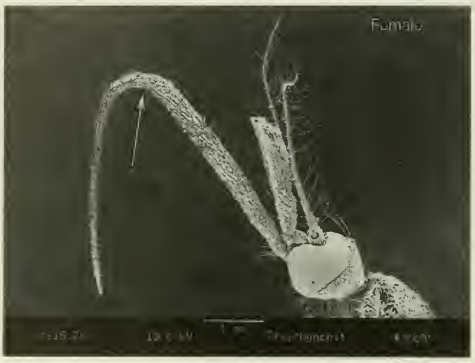
to Page 12

Part 1. (continued)

Page 12

**

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



Subfamily Toxorhynchitinae
Genus *Toxorhynchites* Theobald

Part 1. (continued)

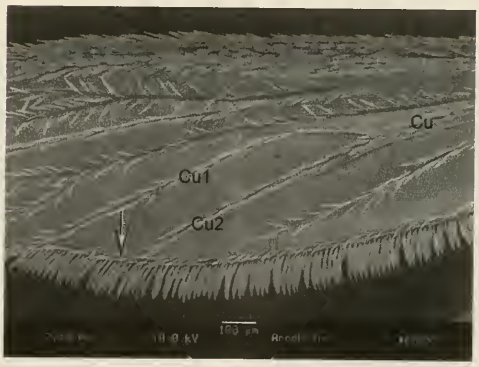
Page 13

**

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

**

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



Subfamily Anophelinae

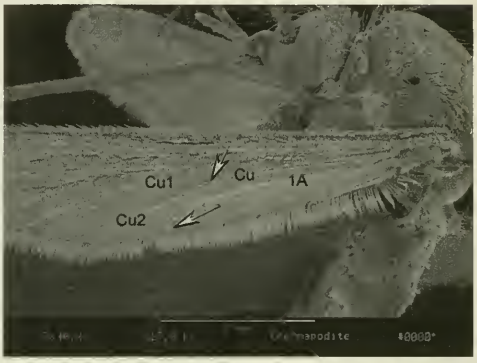
Genus *Anopheles* Meigen

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

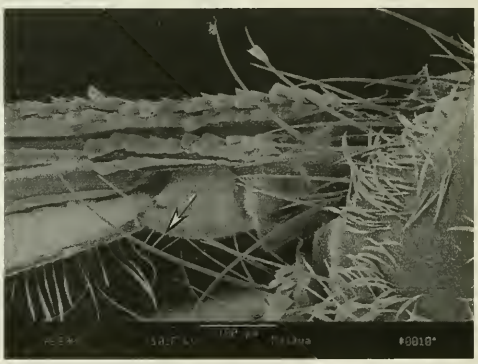


to Page 16b

Wing. Alula without scales, or with broad decumbent scales

to Page 15

Wing. Alula with narrow fringe scales



to Page 16a

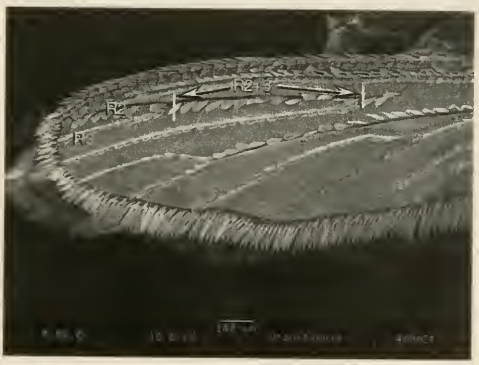
Part 2. (continued)

Page 15

Thorax. Prespiracular setae present

**

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



Uranotaenia

Thorax. Prespiracular setae absent

**

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

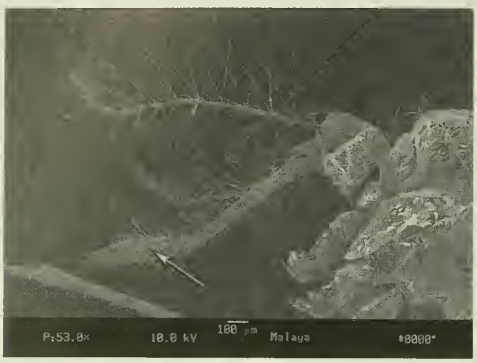
Hodgesia

Part 2. (continued)

Page 16a

**

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



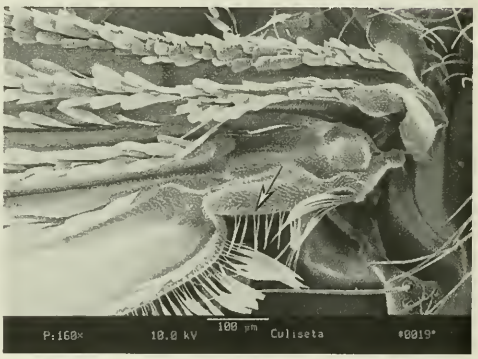
Malaya

Page 16b

Wing. Alula without scales, or with broad decumbent scales

to Page 17

Wing. Alula with narrow fringe scales



to Page 20b

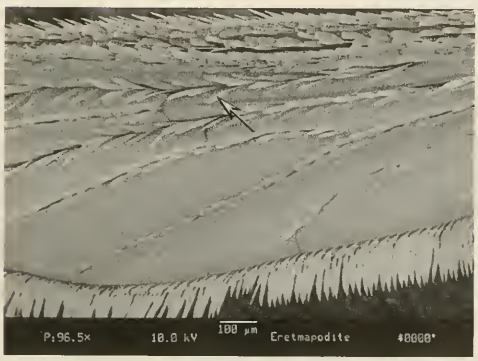
Part 2. (continued)

Page 17

**

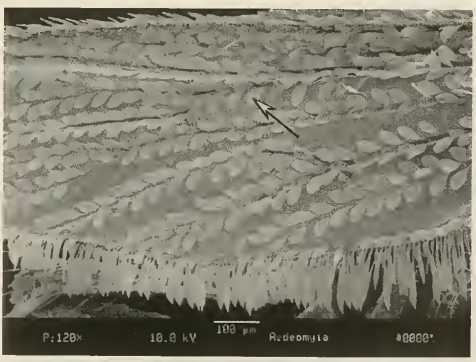
Thorax. Paratergite without scales

Wing. Plume scales all narrow



to Page 18a

Wing. Plume scales all broad



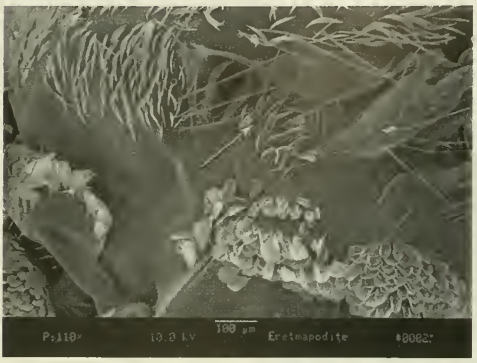
to Page 18b

Part 2. (continued)

Page 18a

**

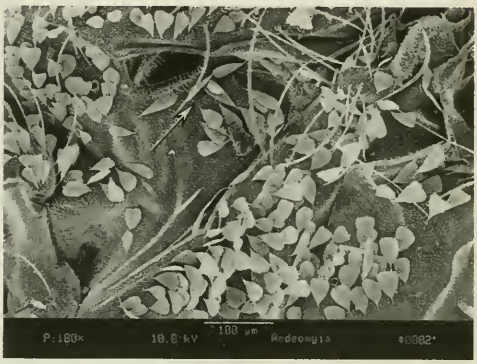
Thorax. Postspiracular setae present



Page 18b

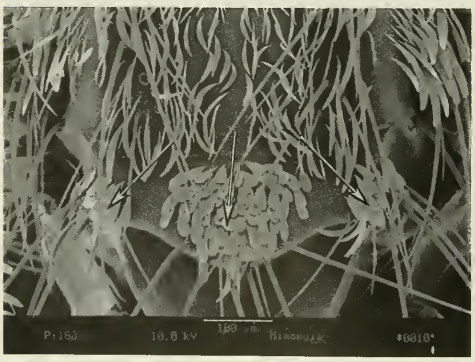
**

Thorax. Postspiracular setae absent



Eretmapodites

Thorax. Scutellum with all broad scales



Thorax. Scutellum with all narrow scales

to Page 19a

to Page 19b

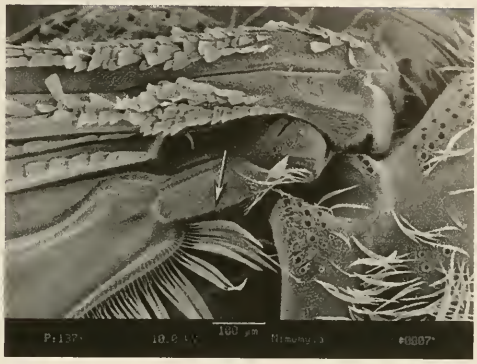
Part 2. (continued)

Page 19a

**
Wing. Alula with broad decumbent scales

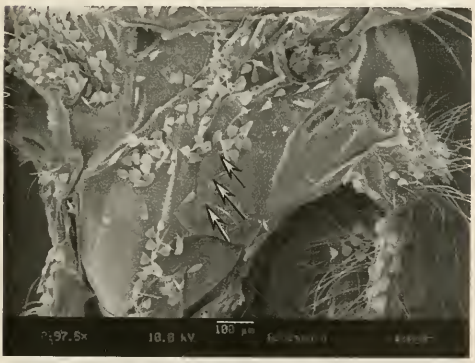
Page 19b

**
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

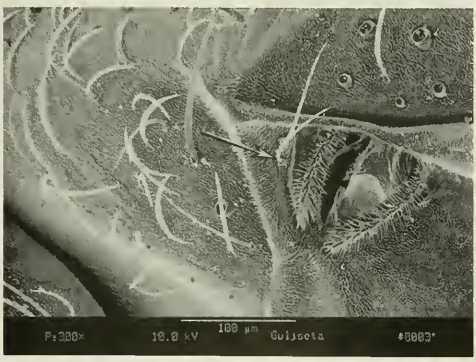
**

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

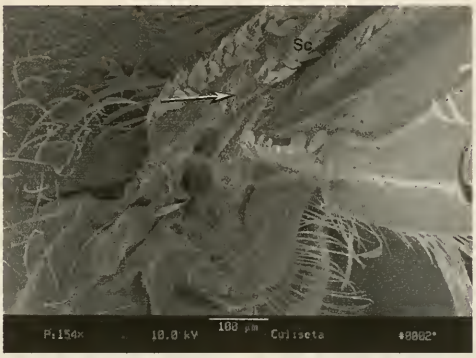
to Page 21b

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)

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

to Page 22

to Page 23

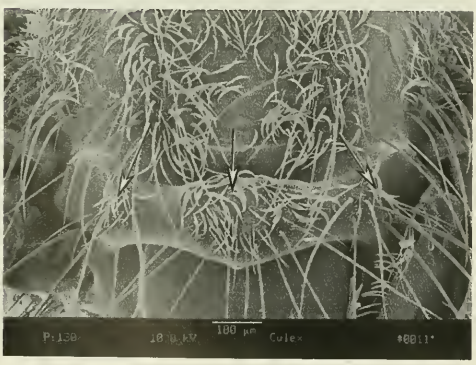
Part 2. (continued)

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



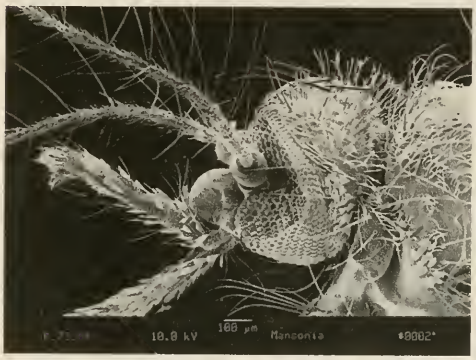
** 4
Head. Antenna with flagellomere 1 about as long as flagellomere 2

Culex

Part 2. (continued)

Page 23

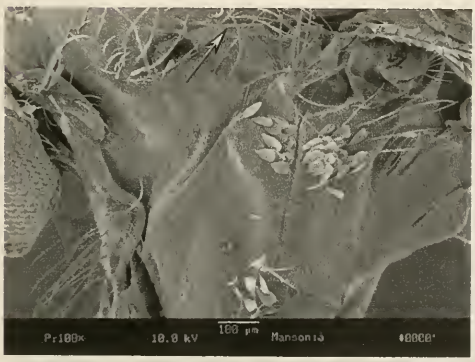
Head. Vertex with erect forked scales numerous, not restricted to occiput



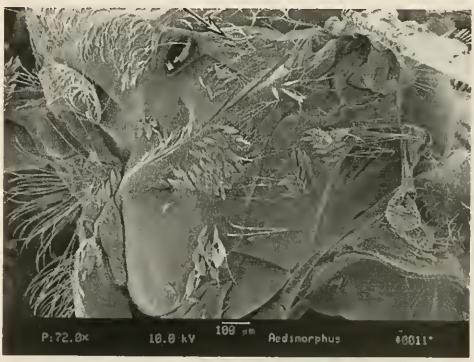
Head. Vertex with erect forked scales not numerous, restricted or not restricted to occiput

to Page 28b

Thorax. Paratergite without scales



Thorax. Paratergite with scales



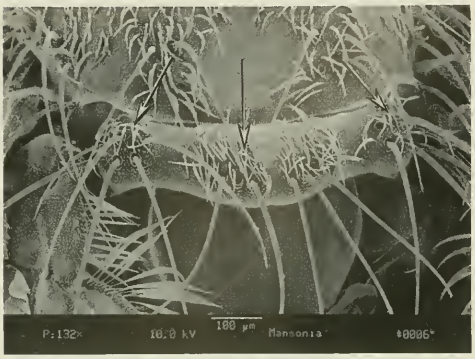
to Page 24

to Page 28a

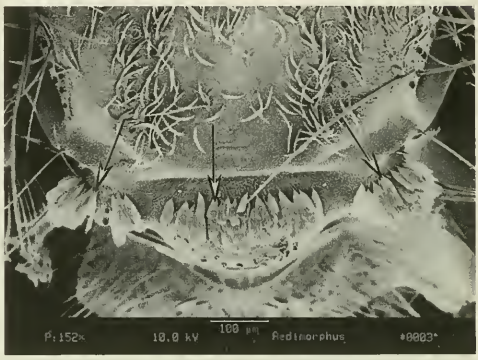
Part 2. (continued)

Page 24

Thorax. Scutellum with narrow scales



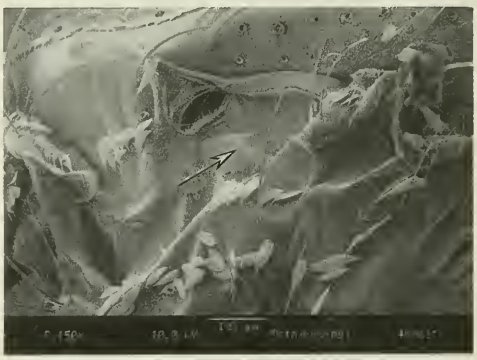
Thorax. Scutellum with broad scales



Aedes (in part) - see Part 3

Thorax. Postspiracular setae present

Thorax. Postspiracular setae absent



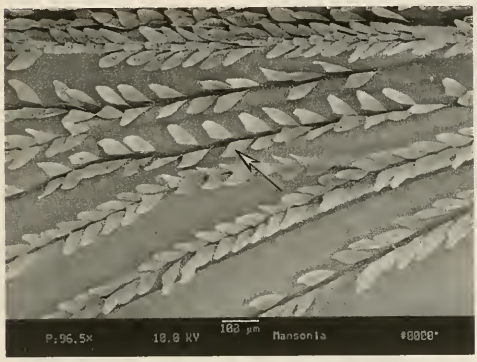
to Page 25

to Page 26b

Part 2. (continued)

Page 25

Wing. Most plume scales very broad and asymmetrical

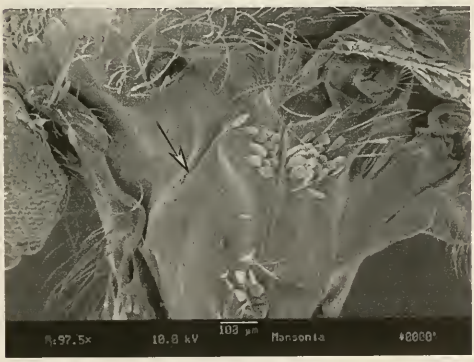


Wing. Plume scales all narrow

Aedes (in part) - see Part 3

**

Thorax. Subspiracular area without scales



to Page 26a

Page 26a

**

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)

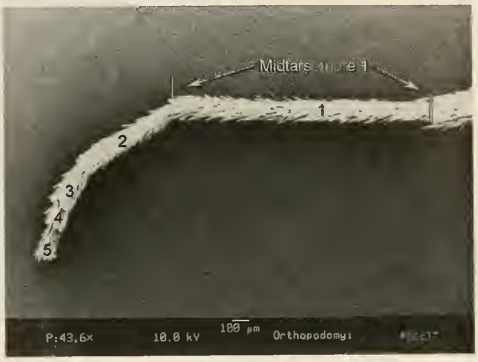
Page 27a

**
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

Page 28b

Thorax. Paratergite without scales

to Page 29

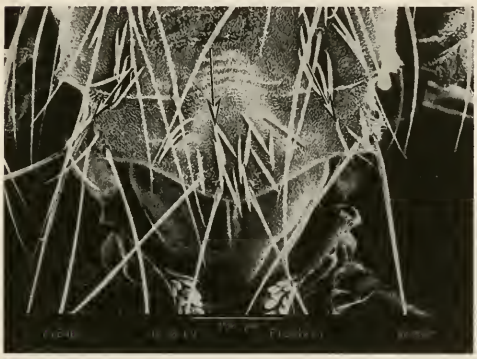
Thorax. Paratergite with scales

to Page 31

Part 2. (continued)

Page 29

Thorax. Scutellum with narrow scales

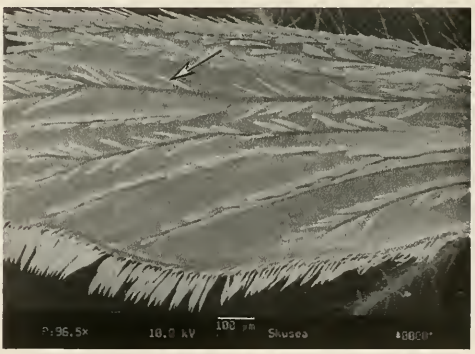


Thorax. Scutellum with broad scales

** Wing. Plume scales all broad

to Page 30a

** Wing. Plume scales all narrow



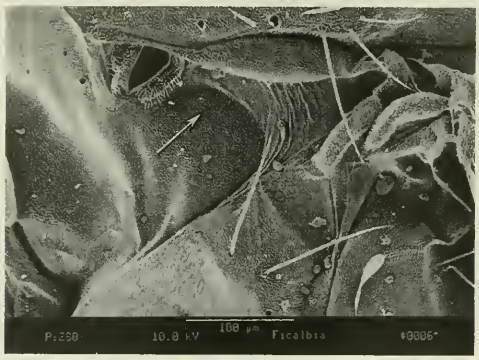
to Page 30b

Part 2. (continued)

Page 30a

**

Thorax. Postspiracular setae absent



Ficalbia

Page 30b

**

Thorax. Postspiracular setae present

**

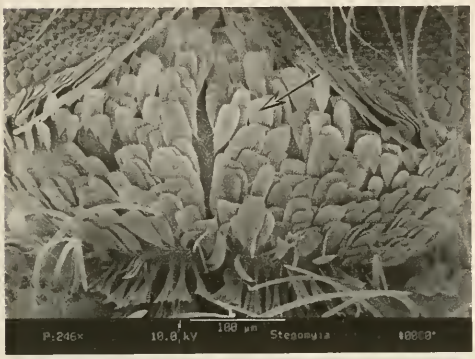
Thorax. Subspiracular area with scales

Aedes (in part) - see Part 3

Part 2. (continued)

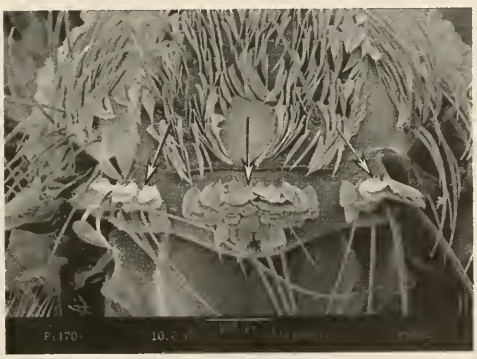
Page 31

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

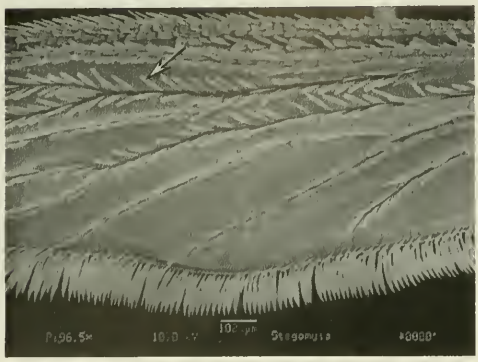
to Page 32

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

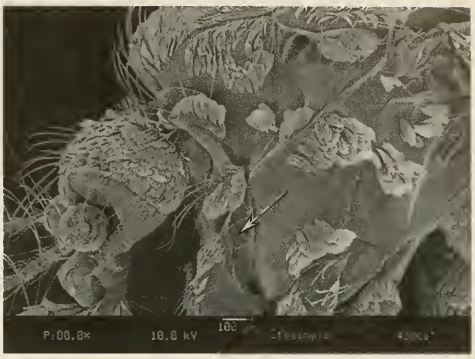
to Page 33

Part 2. (continued)

Page 33

Thorax. Postprocoxal membrane with scales

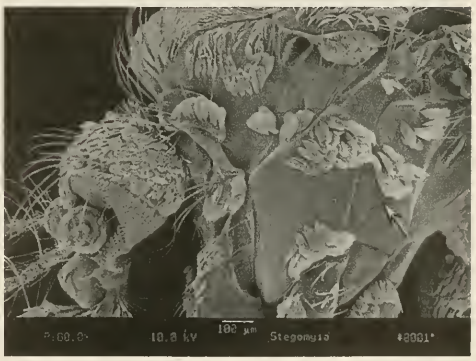
Thorax. Postprocoxal membrane without scales



Aedes (in part) - see Part 3

**

Thorax. Lower mesepimeral setae absent

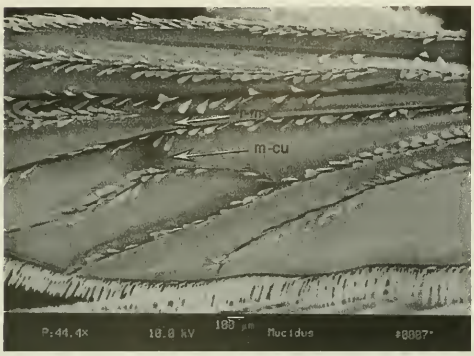


Aedes (in part) - see Part 3

Part 3. Key to Subgenera of *Aedes*

ADULTS

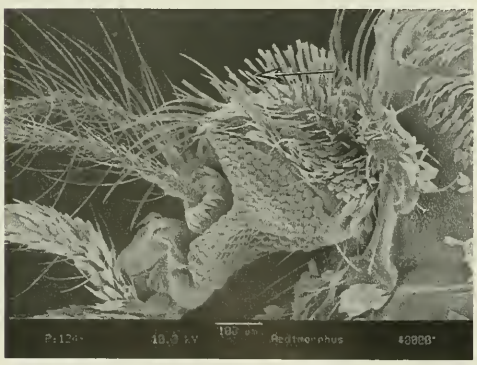
Wing. Wing membrane clouded on crossveins r-m and m-cu



Mucidus

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

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



to Page 35

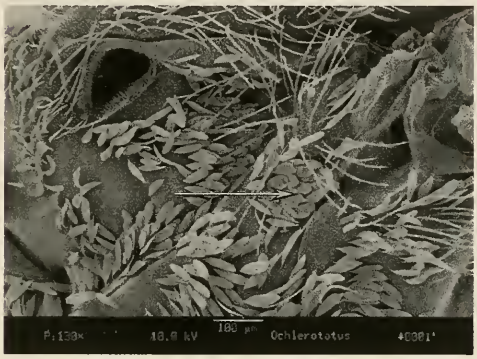
Head. Vertex with erect forked scales not numerous, restricted or not restricted to occiput

to Page 48

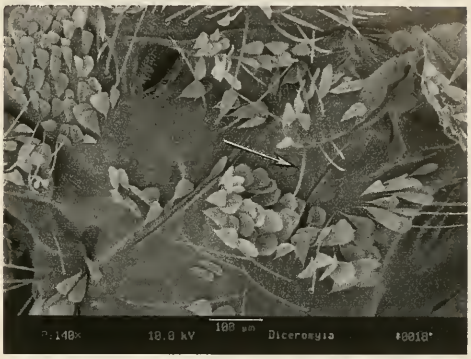
Part 3. (continued)

Page 35

Thorax. Lower prealar scale patch present



Thorax. Lower prealar scale patch absent



to Page 40

**

Thorax. Paratergite with scales

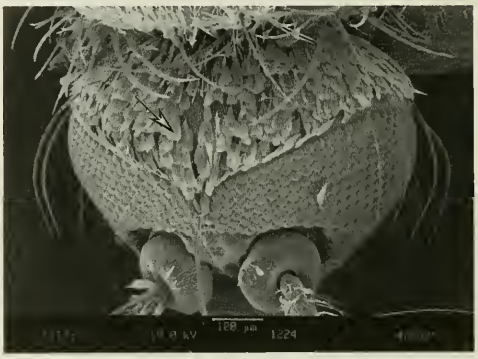
to Page 36

Part 3. (continued)

Page 36

Head. Vertex with decumbent scales largely narrow

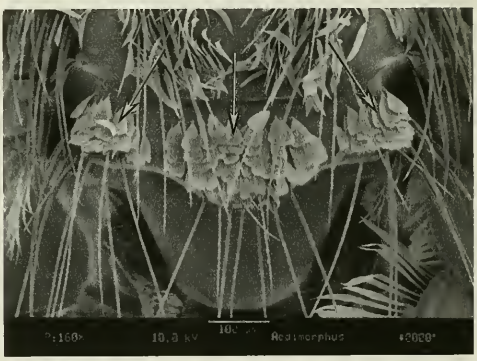
Head. Vertex with decumbent scales largely broad



to Page 38

Thorax. Scutellum with all narrow scales

Thorax. Scutellum with all broad scales



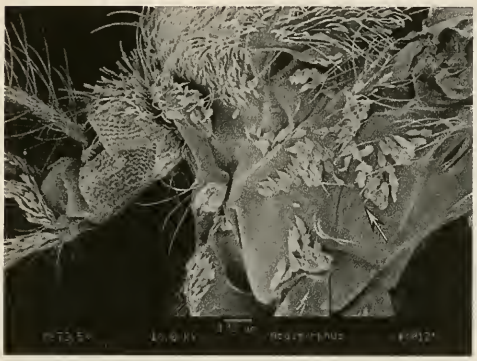
Ochlerotatus

to Page 37

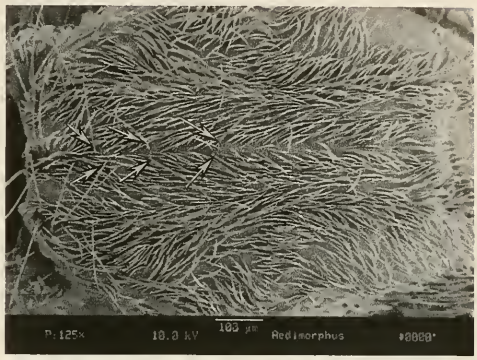
Part 3. (continued)

Page 37

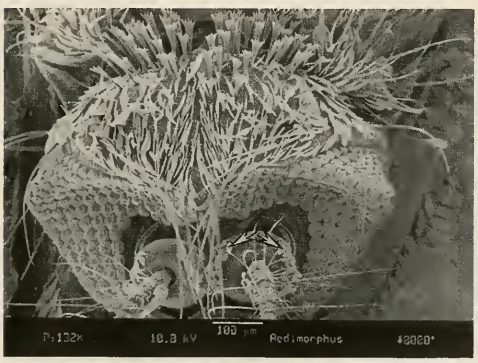
** 1
Thorax. Lower mesepimeral setae present



** 2
Thorax. Acrostichal setae present



** 3
Head. Pedicel with white broad scales on mesal and lateral surfaces



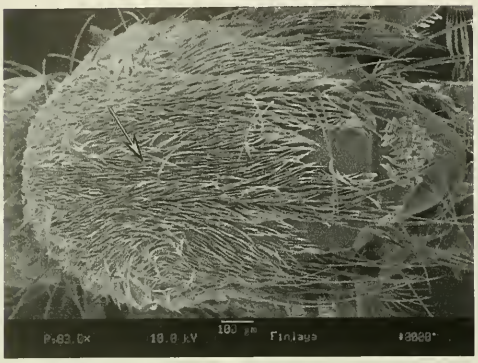
Aedimorphus (in part)
Vittatus Group
Aedes vittatus

Part 3. (continued)

Page 38

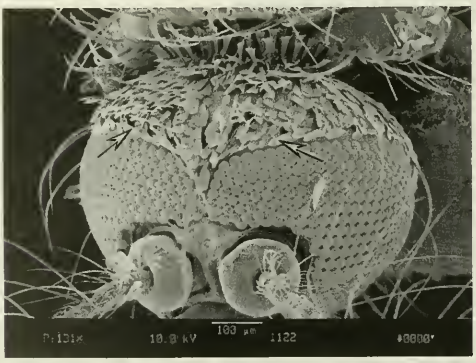
**

Thorax. Acrostichal setae absent



**

Head. Vertex with broad scales along eye margins

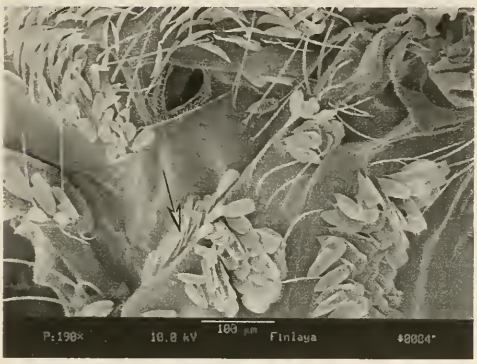


to Page 39

Part 3. (continued)

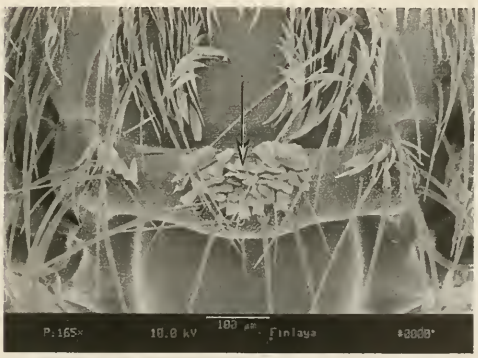
Page 39

Thorax. Subspiracular area with scales



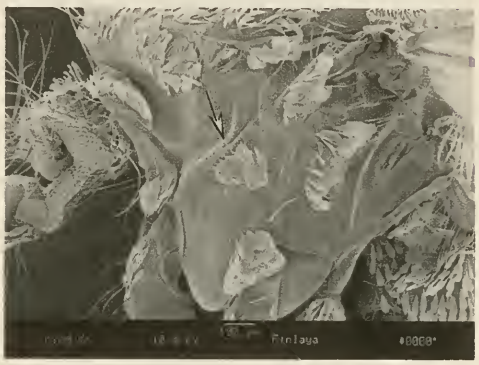
**

Thorax. Scutellum with broad scales on midlobe



Finlaya (in part)
Wellmani Group

Thorax. Subspiracular area without scales



**

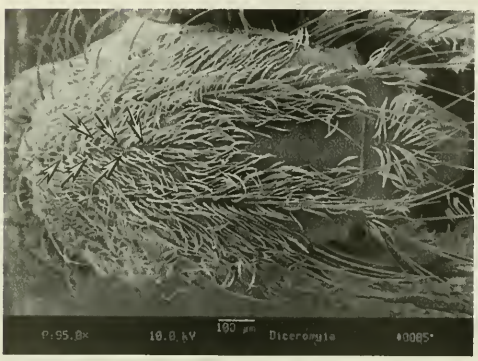
Thorax. Scutellum with narrow scales on midlobe

Finlaya (in part)
Pulchrithorax Group
Aedes pulchrithorax

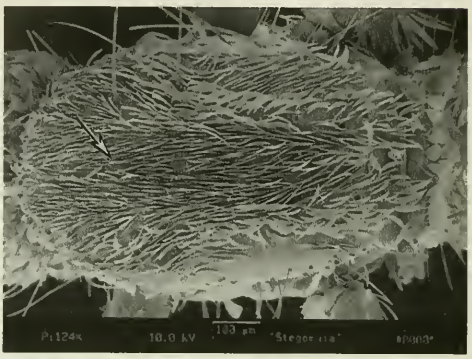
Part 3. (continued)

Page 40

Thorax. Acrostichal setae present



Thorax. Acrostichal setae absent



to Page 47b

Thorax. Paratergite without scales

Thorax. Paratergite with scales

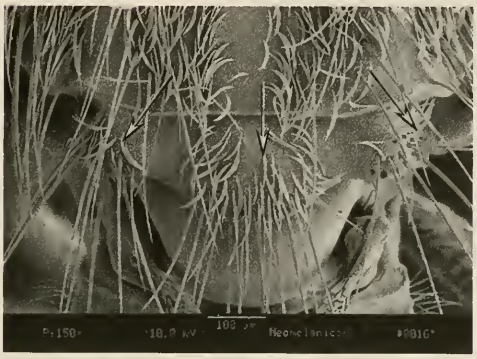
to Page 41

to Page 42b

Part 3. (continued)

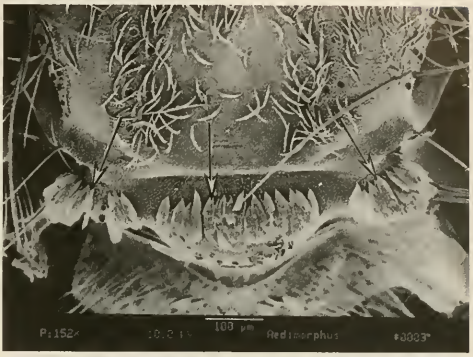
Page 41

Thorax. Scutellum with all narrow scales



Neomelaniconion

Thorax. Scutellum with all broad scales



**

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

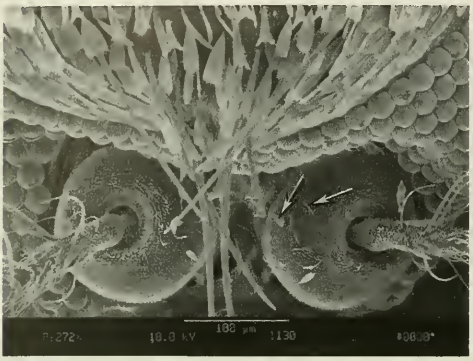
to Page 42a

Part 3. (continued)

Page 42a

**

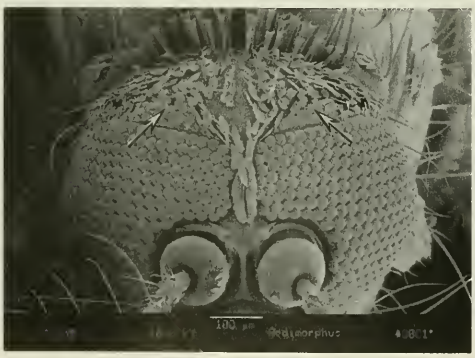
Head. Pedicel with a few small scales and short fine setae on mesal surface



Aedimorphus (in part)
Domesticus Group

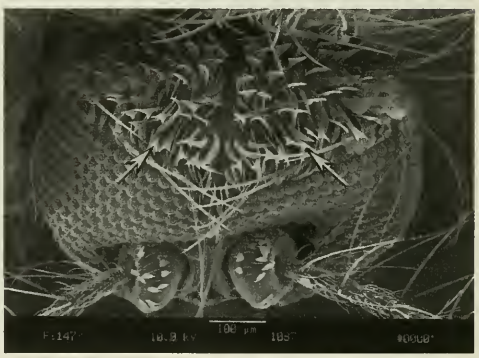
Page 42b

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

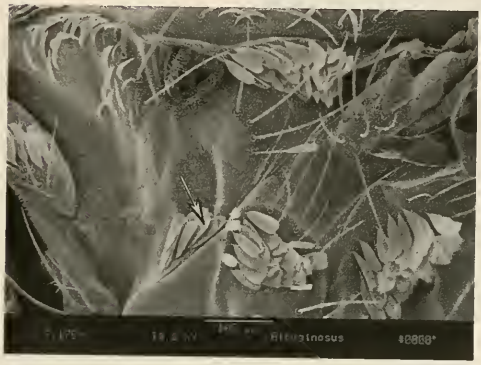


to Page 44b

Part 3. (continued)

Page 43

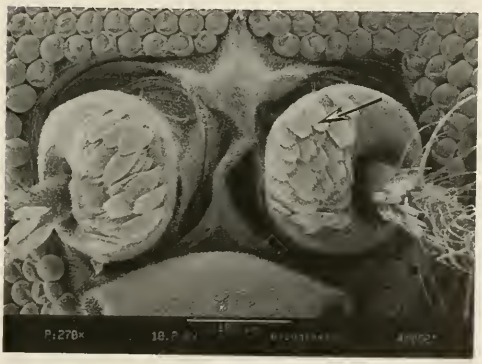
Thorax. Subspiracular area with scales



Thorax. Subspiracular area without scales

**

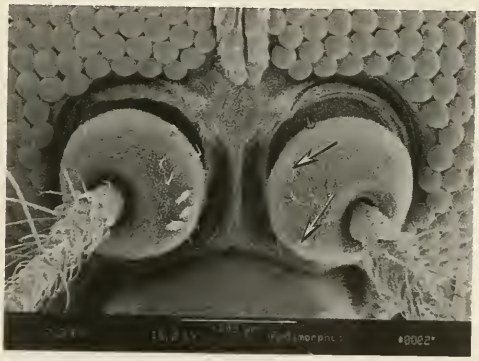
Head. Pedicel with a patch of white broad overlapping scales on mesal surface



Albuginosus

**

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



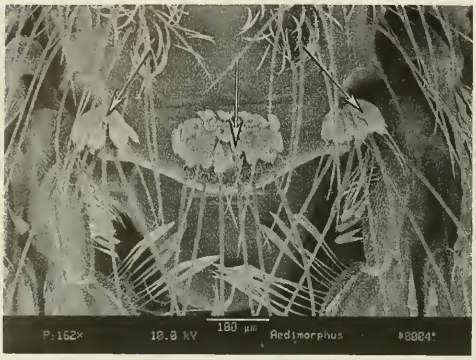
to Page 44a

Part 3. (continued)

Page 44a

**

Thorax. Scutellum with all broad, flat scales

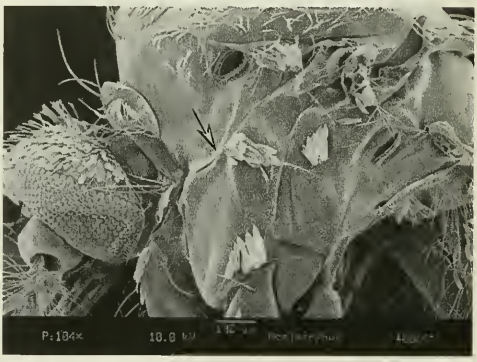


Aedimorphus (in part)
Argenteopunctatus Group

Page 44b

Thorax. Subspiracular area with scales

Thorax. Subspiracular area without scales



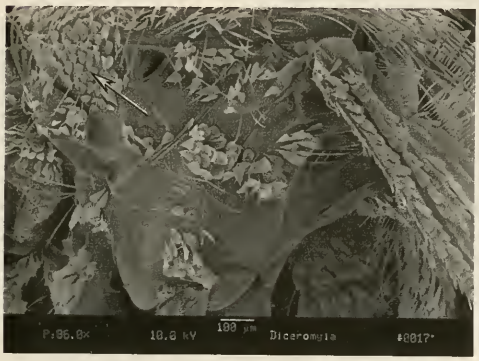
to Page 45

to Page 46b

Part 3. (continued)

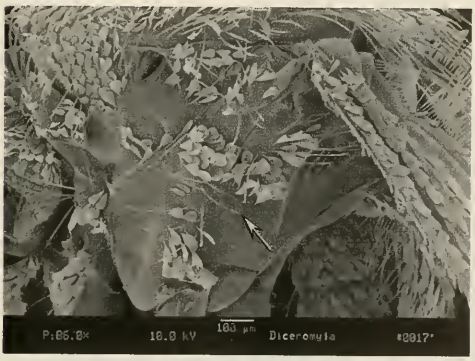
Page 45

Thorax. Postpronotum with all or most scales broad and flat



**

Thorax. Lower mesepimeral setae present



to Page 46a

Thorax. Postpronotum with all or most scales narrow and curved

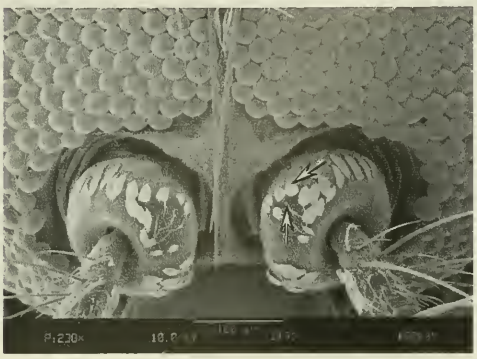
Aedimorphus (in part)

Part 3. (continued)

Page 46a

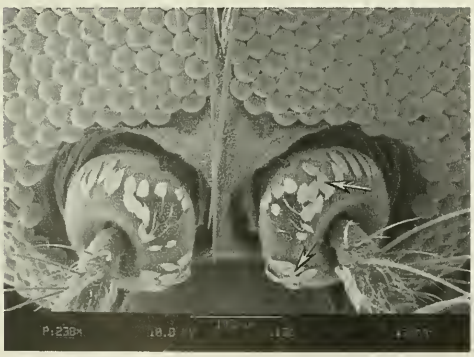
**

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



**

Head. Pedicel with 2 patches of scales on mesal surface

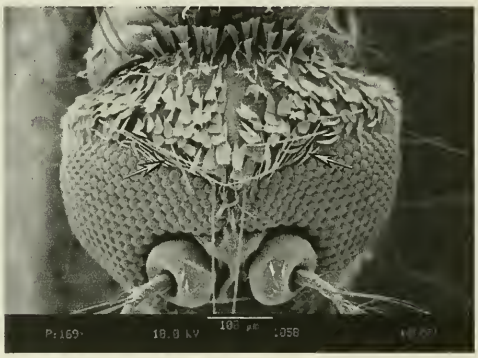


Diceromyia

Page 46b

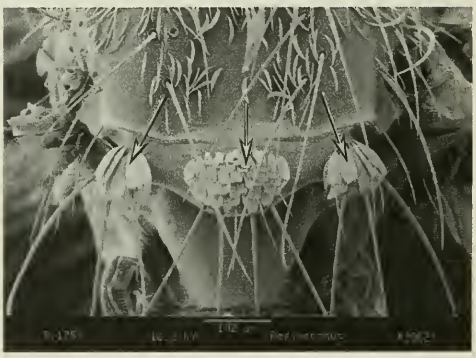
**

Head. Vertex with narrow scales along eye margins



**

Thorax. Scutellum with all broad scales



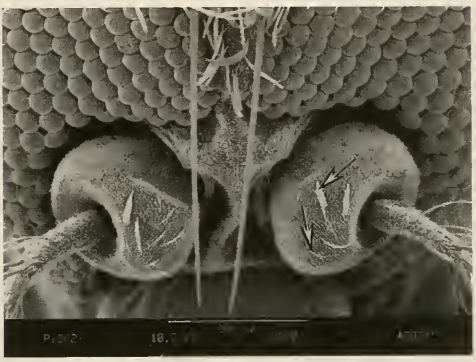
to Page 47a

Part 3. (continued)

Page 47a

**

Head. Pedicel with few setae and scales on mesal surface

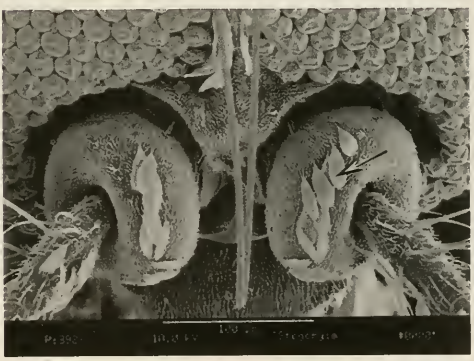


Aedimorphus (in part)
Apicoannulatus Group

Page 47b

**

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

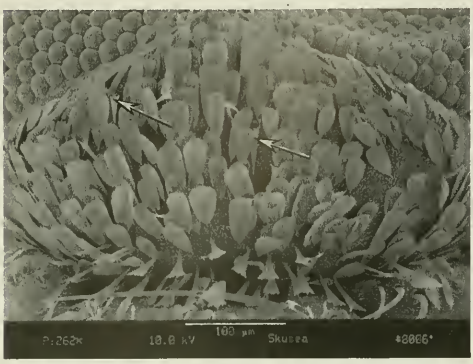


Aedes cozi

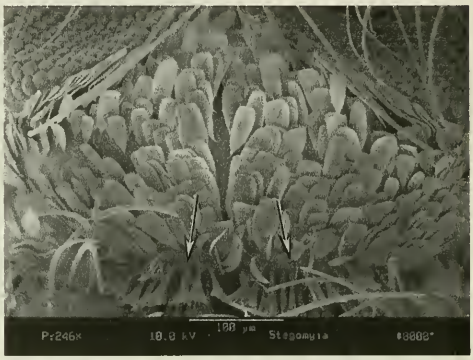
Part 3. (continued)

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

**

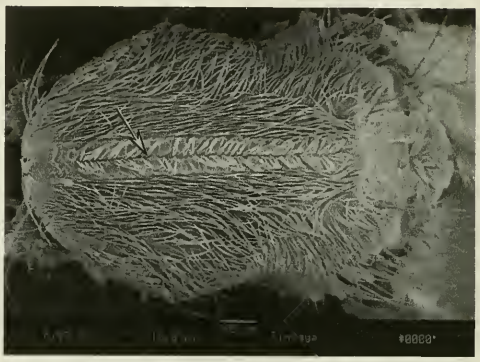
Thorax. Subspiracular area with scales

Skusea

Page 50b

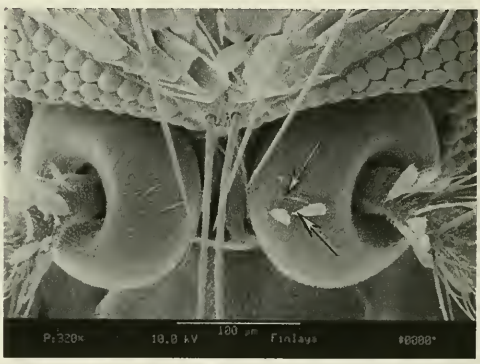
**

Thorax. Acrostichal setae absent



**

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

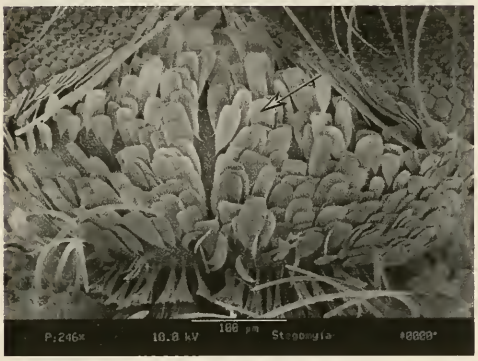


Zavortinkius

Part 3. (continued)

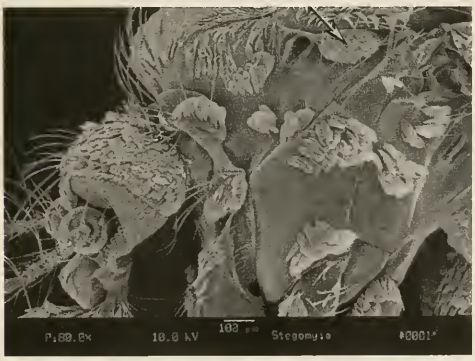
Page 51

** 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

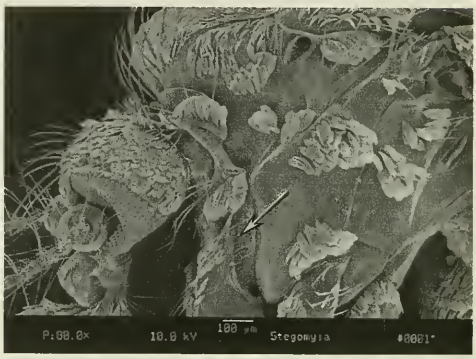
Part 3. (continued)

Page 52

Thorax. Postprocoxal membrane with scales

Pseudarmigeres

Thorax. Postprocoxal membrane without scales



Stegomyia

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