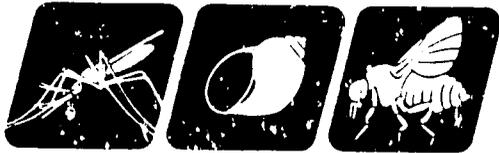


MS-APP-612 755 11-18



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TRIP REPORT

**A VISIT TO USAID/NEPAL
TO STUDY AND IDENTIFY CULICINE FAUNA
NOVEMBER 14 - DECEMBER 27, 1987**

by

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and

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AR-061

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Acknowledgements

Preparation of this document was sponsored by the Vector Biology & Control Project under Contract No. DPE-5948-C-00-5044-00 to Medical Service Corporation International, Arlington, Virginia, U.S.A., for the Agency for International Development, Office of Health, Bureau of Science and Technology.

The authors are indebted to Dr. David Calder for his foresight in fostering the study and his encouragement, to Dr. K.M. Dixit, Chief, NMEQ, and R.G. Baidya, Chief, Entomology Section, NMEQ, for assigning the entomological team, K. Kadaka, H.P. Poudyal and N.P. Shrestha, for their assistance and diligence in searching for mosquitoes; to P. Karna and A. Singh for providing accommodations for the study; to N.K. Gurung for assistance in the use of the piggeries, and to M. Chamlin for logistical support.

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I. INTRODUCTION

A. Briefings at USAID and NMEO

To explain the purpose of the visit and the proposed work plan during the next two months, the following meetings were held:

- USAID/HFP with Dr. David Calder, Chief, HFP; Drs. Lerry Lacey and Barry Silverman, Vector Biology & Control (VBC) Project; and Mr. S.P. Pradhan, HFP Entomologist.
- USAID Deputy Director, Mr. William Stacey Rhodes, with Dr. Calder and Mr. Pradhan.
- NMEO/GON with Dr. K. Dixit, Chief, NMEO; Drs. Lacey and Silverman; Mr. Riddi Gopal Baidya, Chief, and Mr. Jitendra Shrestha of the NMEO Entomology Section; and Mr. S.P. Pradhan.
- Ministry of Health (MOH), GON, Acting Secretary, Mr. Basu Dev Pradhan, with Drs. Lacey and Silverman, Dr. K. Dixit and Mr. S.P. Pradhan.

A full report of the trip and its results can be seen in Annex 1.

B. Background

Since 1978, outbreaks of mosquito-borne Japanese encephalitis (JE) have occurred in the terai zone of Nepal (Pradhan, 1981; Khatri et al., 1983; Leake et al. 1983). From that year until 1984, a total of 2508 cases with 886 deaths (35.3%) were recorded in Nepalese hospital case records (Khatri et al. 1984). An additional 275 cases were reported just from Sunsari and Morang Districts of Eastern Nepal in 1985 by Leake et al. (1985). Therefore, there is no doubt that JE is a serious problem in Nepal.

Studies of epidemics of this disease and subsequent investigations on its epidemiology have confirmed that it is transmitted by mosquitoes. The principal vectors are species belonging to the genus Culex. In fact, Cx. tritaeniorhynchus, a species very common in Nepal at the lower altitudes has been most often incriminated as the main carrier.

Despite the knowledge of vectors of JE in other countries, no species has yet been incriminated in Nepal. Nor is there any reliable means of identifying candidate mosquitoes, for they belong to the subfamily Culicinae. Over the past 25 years, the development of keys and the recognition of species have been concentrated in subfamily Anophelinae because it has been malaria and its vectors that have received major attention.

VBC was asked to employ a consultant to study the local mosquito fauna and develop the capacity to identify species belonging to the culicine fauna.

C. Preparing a List of Mosquitoes of Nepal

By means of a preliminary review of the literature, including a scientific article coauthored by the writer (Joshi et al. 1965), a list of 98 species was compiled. The list was not finalized until after a field trip had been made to Eastern Nepal by S.P. Pradhan and R.F. Darsie. Results of field collections and identification of specimens, which had been collected and preserved by Mr. Pradhan since 1980 after JE had become a disease problem in Nepal, augmented the list. As a consequence, 16 new country records have been established. The revised list of the mosquitoes known to occur in Nepal is included in Annex 2.

It must be said here that Mr. Shreedhar Pradhan deserves considerable credit for maintaining the original collection on which our 1965 report was based and by his dedication and interest in mosquito taxonomy, his continuing efforts to collect and preserve specimens and keep them in good condition. When JE was recognized in Nepal and the need to identify culicine mosquitoes arose, Mr. Pradhan was able to fill that need through his own private and unofficial work on the culicine fauna over the years.

II. ACTIVITIES IN NEPAL

A. Field Trip to Eastern Nepal - Nov. 23 - Dec. 1, 1987

A full report of this trip and its results can be seen in Annex 1. Collections of mosquitoes were primarily concentrated in piggeries at the Tarahara Agricultural Farm, Sunsari District, because pigs are known reservoirs of JE virus. By sampling the mosquitoes attracted to and feeding on these hosts, one has indirect evidence of which species could (1) maintain the zoonotic cycle of JE in nature and (2) act as vectors to spread the disease to humans. At this season, the species most numerous in the pig pens were Cx. fuscocephala, and second Cx. tritaeniorhynchus, a recognized vector of JE in other countries. Among the accomplishments on this trip was the trapping of five different species which proved to be new country records, two in Culex and three in Uranotaenia.

Another purpose of the trip was to demonstrate to the Nepalese entomologists the individual rearing technique, a method which provides the best possible specimens for identification. With it one has the larva, pupa and adult of the same individual mosquito which offers three chances to identify it. A total of 55 rearings were completed.

B. Keys for the Identification of Nepal Mosquitoes

The main effort of the visit has been to develop reliable keys for the identification of adult females and fourth instar larvae. This has been accomplished, and a copy is attached in Annex 2. By the use of my own rather extensive library, it has been possible to formulate keys to all 114 species.

One problem which always arises when devising such keys is the number of species in which a stage to be keyed has never been described. Surprisingly few species in the Nepal fauna present this problem. All of the adult females have adequate descriptions, while only five species have larvae unknown.

Besides the keys, a glossary was prepared and morphology of both adults and larvae was illustrated and appended to the document for the better understanding of the users.

C. Preparation of a Manuscript on New Records

It seemed advisable to write up for publication a manuscript detailing the 13 new country records (Annex 3). Locality data, dates of collection and biological notes on many of these species

were largely in the head of Mr. Pradhan. Now we have the information written down and voucher specimens properly labelled and ready for me to carry to the Smithsonian Institution. Eventually the manuscript will be submitted to the Journal of the American Mosquito Control Association for publication.

One redeeming feature of these collections, especially those which were made in Eastern Nepal during this visit, is that now only three species of Culex, our target genus, which are supposed to occur in Nepal, have yet to be collected. This has been determined by reviewing the Culex literature and noting the known distribution of the species.

D. Preparation of Keys with Illustrations

Funds were provided by VBC to hire an artist to prepare illustrations for some of the important keys. It was deemed important to work on the generic keys first. Both the adult female and fourth instar larval keys have been finished; see Annexes 4-7.

Then the keys to the genus Culex were worked on. It was gratifying to realize that it was possible to find good illustrations for all the key characters in the subgeneric Culex key and for the 19 species included in the subgenus Culex, both adults and larvae. Time did not allow for the preparation of other illustrated keys.

It must be noted that many of the drawings have been copied from existing publications, so that these keys are only for local use in Nepal.

E. Training Course in Use of New Keys

It was hoped that during this visit time would permit some training of the senior entomological staff at NMEO in the use of these new keys, but unfortunately there was not. New nomenclature was adopted, with the publication of Harbach and Knight (1980), by most of the entomologists devising identification keys, and these keys to the mosquitoes of Nepal are no exception. Structures of the mosquito body were given new names to correspond to other families in Order Diptera, and new methods of referring to their location on the body proposed. I do not think the NMEO entomologists are familiar with these developments. It will be a natural follow-up to schedule a training course on the use of these keys as applied to the Nepal fauna. I suggest that this be scheduled sometime in 1988.

F. Literature Cited

In addition to the references cited below there are bibliographies included with the manuscript on new country records and also main keys for the identification of all the Nepal mosquitoes.

Henderson, A., C. J. Leake and D. S. Burke. (1983). Japanese encephalitis in Nepal. *Lancet*, No. 8363, pp. 1359-1360.

Khatri, I. B., D. D. Joshi, T. M. S. Pradhan and S. Pradhan. (1983). Status of viral encephalitis (Japanese encephalitis) in Nepal. *JNMA* 21(1):97-110.

Khatri, I. B., D. N. Regmi and D. D. Joshi. (1985). Epidemiological surveillance report on Japanese encephalitis from 1978-1984. Zoonotic Disease Control Section, Epidemiology and Statistics Division, Nepal Ministry of Health, Kathmandu, 91 pp.

Leake, C. J., et al. (1985). Studies on the epidemiology and aetiology of acute viral encephalitis in the Koshi Zone of Eastern Nepal during the 1985 epidemic period. London: Royal Army Medical College, 17 pp.

Pradhan, S. P. (1981). Role of mosquitoes in the transmission of Japanese encephalitis virus. *Siddhartha Jaycees Souvenir* 23 Jestha, 2038, pp. 6-8.

G. Addendum - Training of Mr. Shreedhar P. Pradhan

It became abundantly clear during my visit that Mr. Pradhan plays a very important role in the control of mosquito-borne diseases in Nepal. He acts as the moving force to get action on disease outbreaks, and he is the link between adopting new methods for understanding the epidemiology and for the control of those diseases.

His present position is most peculiar in that he is not now an official GON employee. Instead, he is employed as an advisor by HFP/USAID/NEPAL. As such, he has the advantage of being outside the bureaucracy and is able to exert influence where needed to get the job done. Since his primary interest over the long term of his government service with the Ministry of Health (MOH) has been in the field, he knows Nepal and its disease problems intimately.

The benefits which would accrue to Nepal by training in the USA would be much greater than have occurred by other Nepal officials who have had the opportunity to receive training there.

Therefore, I am recommending that funding is sought to finance his training in the next available course in English at the International Center for Public Health Research, "The Wedge" (September 19 - October 28, 1988). I believe it would be very profitable for him to spend an additional two weeks in Washington, D.C. to receive instruction at Walter Reed Institute of Research in the ELISA technique and at the Walter Reed Bio-systematics Unit, Smithsonian Institution, where he and I will have a chance to continue work on a monograph of the mosquitoes of Nepal.

ANNEX 1

REPORT ON FIELD TRIP TO EASTERN NEPAL
NOVEMBER 23 - DECEMBER 1, 1987A. Objectives

- To make mosquito collections in an area endemic for Japanese encephalitis (JE) to assess the status of potential vectors.
- To demonstrate the individual rearing technique for obtaining the best possible specimens for identification.
- To contact officials at the Dharan British Gurkha Recruitment Camp to obtain information about investigations on JE carried out by the Royal Army Medical College personnel in Eastern Nepal.

B. Contacts

- Mr. Mana Chamlin, Regional Malaria Officer, Eastern Region, NMEO, Biratnagar;
- Mr. Janak Das Shrestha, District Public Health Officer, Morang District, Biratnagar;
- Dr. Ramananda Prashad Sinha, Chief Civil Surgeon, CEO, Koski Zonal Hospital, Biratnagar;
- Mr. Parsuram Lall Karna, Plant Pathologist and Director, Tarahara Agricultural Farm, Tarahara, Sunsari District, Koshi Zone;
- Mr. N. K. Gurung, Chief, Animal Husbandry Section, Tarahara Agricultural Farm, Tarahara, Sunsari District, Koshi Zone;
- Mr. P. Thakur, Entomologist, Tarahara Agricultural Farm;
- Mr. Arjun Singh, Scientific Officer, Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone;

ANNEX 1 cont.

- Mr. Rajat Rai, Administrator, British Army Hospital, British Gurkha Recruitment Camp, Dharan, Sunsari District, Koshi Zone;
- NMEO Entomological Team, Hg., Kathmandu:

Kamal Khadaka
Hem Prashad Poudaya
Narayan Prashad Shrestha

C. Preparations for Field Work

Through the kindness of Dr. K. Dixit, Chief, NMEO, and Mr. Riddi Gopal, Chief, Entomology Section, NMEO, the NMEO entomological team was dispatched to Biratnagar to assist in the field work. With the cooperation of Messrs. Mana Chamlin, Parsuram Karna and Arjun Singh, we were provided with the necessary accommodations for the conduct of our study.

D. Collections in Piggeries

Since pigs are a recognized reservoir of JE, we concentrated on collecting mosquitoes from that host. At the Tarahara Agricultural Farm, two large buildings housed 25 adult pigs and 22 new-borne piglets. We spent 48 man-hours collecting by hand aspirator those mosquitoes feeding on pigs and resting in their stalls and runways. A total of 895 adult females were captured and of that number 351, or 39% were mounted and identified. They are as follows:

<u>Cx. tritaeniorhynchus</u>	- 151
<u>Cx. fuscocephala</u>	- 114
<u>Ma. indiana</u>	- 20
<u>Cx. quinquefasciatus</u>	- 16
<u>Ar. subalbatus</u>	- 14
<u>Cx. bitaeniorhynchus</u>	- 13
<u>Cx. pseudovishnui</u>	- 10
<u>Cx. vagans</u>	- 7
<u>Cx. gelidus</u>	- 2
<u>Ae. lineatopennis</u>	- 2
<u>Cx. fuscanus</u>	- 1
<u>Cx. scatophagoides</u>	- 1

ANNEX 1 cont.

Cx. tritaeniorhynchus, representing 43% of the total mounted and identified, is certainly one of the abundant species attacking pigs, but it was not the most numerous during our visit. Cx. fuscocephala was, although not as many were mounted as tritaeniorhynchus, due to our prejudicial interest in the latter, since it has been incriminated as the principal vector of JE in other countries. On the other hand, a report written by staff of British Royal Army Medical College, following an investigation of JE in Eastern Nepal in 1985 concluded that Cx. gelidus must be involved in JE transmission in Nepal because it was the most prevalent kind in piggeries during their study.

E. Larval Collections

Sampling the breeding sites at both the Herbal Farm and the Agricultural Farm was undertaken during four days. No attempt was made to identify larvae on this field trip. However, pupae dipped at the same time were reared to adults and identified. The following species were found:

<u>Cx. bitaeniorhynchus</u>	-	89
<u>An. splendidus</u>	-	17
<u>An. aconitus</u>	-	3
<u>An. tessellatus</u>	-	1

We were unable to locate extensive breeding sites for Cx. tritaeniorhynchus, but considering that the rice paddies were dry and most rice was being harvested, it was not surprising. Rice fields are one of the principal breeding sources of the species.

F. Results of CDC Miniature Light Trap Sampling

This type of trap is usually operated with dry ice hanging nearby, which practice has been demonstrated to increase the catches. However, it was not available locally so the traps were used without it. What the trap catches lacked in quantity they made up for in quality.

One trap was operated on the Herbal Farm above a deep ditch with flowing water and in an area which was very swampy. It actually was located at the fringe of a tropical hardwood forest which was just 500 feet to the north. It was placed there for six nights and only caught a total of 25 mosquitoes as follows:

ANNEX 1 cont.

<u>Ur. macfarlanei</u>	-	8	NEW COUNTRY RECORD
<u>Ur. testacea</u>	-	4	NEW COUNTRY RECORD
<u>Ur. recondita</u>	-	2	NEW COUNTRY RECORD
<u>Ur. annandalei</u>	-	2	
<u>Cx. tritaeniorhynchus</u>	-	2	
<u>Ma. indiana</u>	-	2	
<u>Cx. nigropunctatus</u>	-	1	NEW COUNTRY RECORD
<u>Cx. bitaeniorhynchus</u>	-	1	
<u>Cx. pseudovishnui</u>	-	1*	
<u>Cx. tritaeniorhynchus</u>	-	1*	
<u>Ar. subalbatus</u>	-	1	

* Denoted males

A second trap was placed inside the tropical forest for two nights. Each night it captured only one adult female of the same species, but those two, Cx. edwardsi, also constituted a new country record. It was gratifying to have two Culex among the new records for it makes the list of species belonging to the target genus involved in the transmission of JE more complete. In that regard, a review of Barraud's (1934) monograph on the mosquitoes of India reveals that, on the basis of his distribution, only three species of Culex known from surrounding areas have not been found in Nepal.

For one night a trap was placed in a piggery where we did hand collections. It caught 19 mosquitoes as follows:

<u>Cx. tritaeniorhynchus</u>	-	6
<u>Cx. quinquefasciatus</u>	-	4
<u>Cx. edwardsi</u>	-	2
<u>Cx. fuscocephala</u>	-	2
<u>An. maculatus</u>	-	2
<u>Cx. vagans</u>	-	1
<u>Ar. subalbatus</u>	-	1
<u>Ae. scatophagoides</u>	-	1

G. Individual Rearing of Mosquitoes

The technique involves isolating fourth instar larvae individually in vials and rearing them to adult, saving the cast skins of the larva and pupa, for they contain the necessary structures for identification. So with each specimen, not one as with a single adult female, for example. They constitute the surest means of identification and this method was recommended by

ANNEX 1 cont.

Reuben (1969, Bull. Ent. Res. 58:643) as the one of choice to be applied to the members of vishnui complex, to which tritaeniorhynchus belongs, for accurate identification. On November 24, larvae were collected from breeding sites in the ditches of the Herbal Farm and taken to the laboratory where 55 were set up in individual 21x70 mm shell vials. By far the most common species reared was Cx. bitaeniorhynchus, but two other species were also successfully reared. Included were:

<u>Cx. bitaeniorhynchus</u>	-	27 females
<u>Cx. bitaeniorhynchus</u>	-	22 males
<u>Cx. fuscanus</u>	-	5 females
<u>Cx. tritaeniorhynchus</u>	-	1 female

No opportunity was found to demonstrate mounting of the larval and pupal exuviae, but it is hoped to be able to do it upon return to Kathmandu. More individual rearings are planned by the local staff in the future.

H. Visit to British Gurkha Recruitment Camp, Dharan

On November 25, we visited the British Gurkha Recruitment Camp in Dharan, Sunsari District, for the purpose of obtaining reports of studies carried out in Eastern Nepal by the Royal Army Medical College staff on JE. USAID/HFP was given a report entitled, "Studies on the epidemiology of acute viral encephalitis in the Koshi Zone of east Nepal during the 1985 epidemic period", which failed to incriminate any mosquito species as vector, but tests on pools of mosquitoes were pending, according to the report. It also mentioned that further work was planned for the succeeding years. So it was out hope to have made available this additional information to help clear up some of the present enigmas surrounding JE in Nepal.

(Note: One of us (RFD) plans to visit the Royal Army Medical College, Millbank, London, UK to try to obtain referenced reports).

ANNEX 2

KEYS TO THE MOSQUITO SPECIES
KNOWN TO OCCUR IN NEPAL
(Diptera, Culicidae)

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INTRODUCTION

This present work has resulted from the need to identify mosquitoes of Nepal belonging to the subfamily Culicinae. Beginning in 1978, outbreaks of Japanese encephalitis have occurred regularly in the terai districts. It is a mosquito-borne viral disease transmitted principally by species of the genus Culex, subgenus Culex.

Consequently, the authors have undertaken the task of writing identification keys for the total mosquito fauna of Nepal. There are now known 114 species in the country. This number has been increased from 98 by collections and identifications made recently by the authors, resulting in the addition of 16 new country records (see Pradhan and Darsie, 1987, Annex 3). Keys for the adult females and fourth instar larvae have been completed. Fortunately, the females of all species have been previously described and are placed in the keys; however, the larvae of 6 species are unknown. They are noted in the footnotes under the keys.

This document contains a list of the mosquitoes known to occur in Nepal, keys to the adult females and fourth instar larvae, arranged in alphabetical order, a bibliography of 47 pertinent references, a glossary containing the definitions of 147 entomological terms, 85 pertaining to the adult female and 62 relating to the mosquito larva. In addition, illustrations of the morphological structures of mosquitoes are appended to aid the user in interpreting the parts of the body employed in the keys. The user is also referred to Harbach and Knight (1980) for further information related to mosquito anatomy.

The proper use of the larval keys depends on a knowledge of the method employed for designating the parts of the larval body and the setae found on them. The following abbreviations for the parts of the body are in common use in modern larval keys:

A - antenna	III - abdominal segment III
C - head	IV - abdominal segment IV
P - prothorax	V - abdominal segment V
M - mesothorax	VI - abdominal segment VI
T - metathorax	VII - abdominal segment VII
I - abdominal segment I	VIII - abdominal segment VIII
II - abdominal segment II	X - abdominal segment X
	S - siphon

The reference in the keys to a particular seta is done by first giving the seta number, followed by the abbreviation of the segment or part of the body to which it is attached; for example, seta 1-A is seta 1 on the antenna; or seta 6-VI is seta 6 on abdominal segment VI.

Richard F. Darsie, Jr.
Shreedhar P. Pradhan

REVISED LIST OF THE MOSQUITOES OF NEPAL

AEDES Meigen

- Subg. Aedimorphus Theobald
 - caecus (Theobald)
 - pallidostriatus (Theobald)
 - pipersalatus (Giles)
 - punctifemoris (Ludlow)
 - vittatus (Bigot)
- Subg. Christophersiomyia Barraud
 - annulirostris (Theobald)
 - thomsoni (Theobald)
- Subg. Finlaya Theobald
 - albolateralis (Theobald)
 - assamensis (Theobald)
 - aureostriatus var. greenii (Theobald)
 - chrysolineatus (Theobald)
 - dissimilis (Leicester)
 - gubernatoris (Giles)
 - pseudotaeniatus (Giles)
- Subg. Mucidus Theobald
 - scatophagoides (Theobald)
- Subg. Verrallina Theobald
 - indicus Theobald
- Subg. Neomelaniconion Newstead
 - lineatopennis (Ludlow)
- Subg. Stegomyia Theobald
 - albopictus (Skuse)
 - gardnerii imitator (Leicester)
 - unilineatus (Theobald)
 - w-albus (Theobald)

ANOPHELES Meigen

- Subg. Anopheles Meigen
 - ahomi Chowdhury
 - aitkenii James
 - annandalei Prashad
 - barbirostris Van der Wulp
 - bengalensis Puri
 - gigas gigas Giles
 - gigas var. baileyi Edwards
 - gigas var. simplensis (James)
 - interruptus Puri
 - lindesayi lindesayi Giles

lindesavi nilgiricus Christophers
nigerrimus Giles
peditaeniatus Leicester
sinensis Wiedeman
Subg. Cellia Theobald
aconitus Donitz
annularis Van der Wulp
culicifacies Giles
dirus Peyton & Harrison
fluviatilis James
jamesii Theobald
jeyporiensis James
karwari (James)
kochi Donitz
maculatus Theobald
majidi Young & Majid
minimus Theobald
pallidus Theobald
philippinensis Ludlow
pseudojamesi Strickland & Chowdhury
pseudowillmori (Theobald)
splendidus Koizumi
stephensi Liston
subpictus Grassi
tessellatus Theobald
theobaldi Giles
turkhuđi Liston
vagus Donitz
varuna Iyengar
willmori (James)

ARMIGERES Theobald
Subg. Armigeres Theobald
kuchingensis Edwards
subalbatus (Coquillett)

COQUILLETIDIA Dyar
Subg. Coquillettidia Dyar
crassipes (Van der Wulp)

CULEX Linnaeus
Subg. Culex Linnaeus
barraudi Edwards
bitaeniorhynchus Giles
edwardsi Barraud
epidesmus (Theobald)
fuscocephala Theobald

- gelidus Theobald
- hutchinsoni Barraud
- jacksoni Edwards
- mimeticus Noe
- mimulus Edwards
- pseudovishnui Colless
- quinquefasciatus Say
- sinensis Theobald
- theileri Theobald
- tritaeniorhynchus Giles
- vagans Wiedemann
- vishnui Theobald
- whitei Barraud
- whitmorei (Giles)
- Subg. Culiciomyia Theobald
 - nigropunctatus Edwards
 - pallidothorax Theobald
 - viridiventer Giles
- Subg. Eumelanomyia Theobald
 - brevipalpus (Giles)
 - foliatus Brug
 - malavi (Leicester)
- Subg. Lophoceraomyia Theobald
 - infantulus Edwards
 - minor (Leicester)
- Subg. Lutzia Theobald
 - fuscans Wiedemann
 - halifaxii Theobald

CULISETA Felt

- Subg. Culiseta Felt
 - niveitaeniatus (Theobald)

HEIZMANNIA Ludlow

- Subg. Heizmannia Ludlow
 - himalayensis Edwards
 - indica (Theobald)

MALAYA Leicester

- genurostris Leicester

MANSONIA Blanchard

- Subg. Mansonioides Theobald
 - annulifera (Theobald)
 - indiana Edwards
 - uniformis (Theobald)

MIMOMYIA Theobald

- Subg. Etorleptiomyia Theobald
luzonensis (Ludlow)
- Subg. Mimomyia Theobald
chamberlaini Ludlow
hybrida (Leicester)

ORTHOPODOMYIA Theobald

- anopheloides (Giles)

TOPOMYIA Leicester

- Subg. Topomyia Leicester
aureoventer (Theobald)

TOXORHYNCHITES Theobald

- Subg. Toxorhynchites Theobald
splendens (Wiedemann)

URANOTAENIA Lynch Arribalzaga

- Subg. Pseudoficalbia Theobald
luteola Edwards
maculipleura Leicester
recondita Edwards
stricklandi Barraud
- Subg. Uranotaenia Lynch Arribalzaga
annandalei Barraud
campestris Leicester
edwardsi Barraud
macfarlanei Barraud
spp. near testacea Theobald

KEYS TO THE ADULT FEMALE MOSQUITOES
OF NEPAL

KEY TO THE GENERA OF ADULT FEMALE MOSQUITOES
OF NEPAL*

1. Proboscis long, strongly recurved; posterior border of wing emarginated just beyond tip of vein Cu_2
.....Toxorhynchites splendens
Proboscis not so long and only slightly curved, if at all; posterior border of wing evenly rounded or only slightly emarginated.....2

- 2(1). Scutellum evenly rounded, with setae evenly distributed; maxillary palpi about as long as proboscis.Anopheles
Scutellum trilobed, with setae in 3 distinct groups; maxillary palpi shorter than proboscis.....3

- 3(2). Proboscis with flexible joint, tip swollen, with long setae.....Malaya genurostris
Tip of proboscis only slightly swollen, if at all, with neither flexible joint nor long setae apically.....4

- 4(3). Scutum with longitudinal stripe of broad, flat scales; usually white or silvery; prespiracular setae present.....Topomyia aureoventer
Scutum with other pattern; prespiracular setae present or absent.....5

- 5(4). Cell R_2 of wing always shorter than vein R_{2+3} ; anal vein ending apically before fork of veins Cu_1 and Cu_2Uranotaenia
Cell R_2 at least as long as vein R_{2+3} ; anal vein ending apically distal to fork of veins Cu_1 and Cu_26

- 6(5). Prespiracular area with setae; subcostal vein with group of setae basally on ventral aspect.....
.....Culiseta niveitaeniata
Prespiracular area and ventral aspect of subcostal vein bare.....7

- 7(6). Mesopostnotum with setae; scutum clothed with bright, metallic decumbent scales.....Heizmannia
Mesopostnotum without setae; scutum with other type of scales.....8

*Adapted from Mattlingly (1971).

24

- 8(7). Fore- and midtarsomeres 1 distinctly longer than other 4 tarsomeres combined, tarsomere 4 on fore- and midlegs short, about as long as wideOrthopodomvia anopheloides
Fore- and midtarsomeres 1 shorter than other 4 tarsomeres combined, tarsomere 4 of fore- and midlegs much longer than wide.....9
- 9(8). Postspiracular setae present.....10
Postspiracular setae absent.....12
- 10(9). Dorsal surface of wing with scales broad; abdomen bluntly rounded apically.....Mansonia
Dorsal surface of wing with scales narrow; abdomen more or less pointed apically.....11
- 11(10). Proboscis rather stout, laterally compressed and curved; occiput with broad decumbent scalesArmigeres
Proboscis fairly slender, not compressed nor notably curved; occiput usually with at least some decumbent scales narrow.....Aedes
- 12(9). Alula bare or with flat decumbent scales.....Mimomyia
Alula fringed with narrow scales.....13
- 13(12). Pulvilli present; tarsal claws unusually small....Culex
Pulvilli absent; tarsal claws prominent.....
.....Coquillettidia crassipes

KEY TO THE ADULT FEMALES OF GENUS AEDES

1. Hind tarsi without pale-scaled bands.....2
At least some hind tarsi with basal and/or apical pale-scaled bands.....7
- 2(1). Proboscis almost entirely pale-scaled; hindtarsi with longitudinal stripes of pale scales..pallidostriatus
Proboscis entirely dark-scaled or at most with pale scales ventrally; hind tarsi without pale stripe...3

*Adapted from Barraud (1934), Huang (1977), Knight (1968), Reinert (1973, 1984) and Tyson (1970).

- 3(2). Scutum with broad longitudinal stripes of golden scales sublaterally; lower mesanepimeral setae present.....lineatopennis
Scutum with other pattern; lower mesanepimeral setae absent.....4
- 4(3). Scutum with 2 pairs of distinct submedian spots of broad white scales, 1 pair on anterior promontory and other on scutal angle; mid- and hindfemora and tibiae speckled.....punctifemoris
Scutum without distinct white-scaled spots, with other pattern; mid- and hindfemora and tibiae not speckled, with other pattern of dark and pale scales.....5
- 5(4) Abdominal terga II-IV, and occasionally V, with dorsomedian, transverse pale-scaled bands; scutum largely covered with dark scales.....indicus
Abdominal terga II-V dark-scaled, or with narrow basal pale bands dorsally; scutum with patches of silvery or golden scales.....6
- 6(5). Scutum with patch of silvery scales on anterior 0.66, sometimes divided by median black-scaled stripe; hindfemur with apical 0.33 entirely dark-scaled
.....albolateralis
Scutum with dark scales mixed with golden scales dorsally, with patches of broad, flat, silvery scales in front of wing root; hindfemur with apical ring of silvery scales.....dissimilis
- 7(1). Some hindtarsomeres with both basal and apical pale-scaled bands.....8
Hindtarsomeres with basal pale-scaled bands on at least some segments.....10
- 8(7). Abdominal terga without transverse basal pale-scaled bands.....assamensis
Abdominal terga II-VII with narrow to moderately broad, transverse basal bands.....9
- 9(8). Scutum with golden scales varying from large anterior patch to longitudinal lines, background of dark brown scales; fore- and midfemora broadly pale in basal 0.5.....aureostriatus var. greeni
Scutum with white to creamy scales forming lyre-shaped pattern; fore- and midfemora with narrow longitudinal lines of pale scales.....pseudotaeniatus

- 10(7). Proboscis with distinct pale-scaled band near middle.....11
Proboscis entirely dark-scaled or at most pale-scaled ventrally.....16
- 11(10). Scutum with distinct spots of pale scales on dark-scaled background; femora with preapical pale-scaled bands.....vittatus
Scutum with other scale pattern; femora without preapical pale bands.....12
- 12(11). Abdomen mostly covered with pale yellow scales; scutum with tufts of brown and white scales mixed.....scatophagoides
Abdomen dark-scaled with white to golden scales in various patterns; scutum without scale tufts.....13
- 13(12). Scutum with narrow median and submedian longitudinal stripes of golden scales; hindtarsomeres 4,5 all dark-scaled.....chrysolineatus
Scutum ornamented with pattern of gray-white to silvery scales; at least hindtarsomere 4 with pale scales.....14
- 14(13). Wings with spots of pale scales; all femora and fore- and midtibiae with many white-scaled bands pipersalatus
Wings without pale-scaled spots; femora and fore- and midtibiae with at most subbasal white-scaled band.....15
- 15(14). Hindtibiae with pale-scaled band in basal 0.5; metameron with white scales.....thomsoni
Hindtibiae mostly dark-scaled, without basal pale band; metameron bare.....annulirostris
- 16(10). Hindtarsomeres with narrow basal pale-scaled bands on at least some segments; fore- and midlegs with claws toothed.....17
Hindtarsomeres with broad basal pale-scaled bands on at least some segments; fore- and midlegs with claws simple.....18

- 4(3). Hindfemur with broad white-scaled band.....5
Hindfemur without broad white band.....6
- 5(4). Hindfemora with pale scales ventrally on basal 0.33;
apical portion of at least 3 wing veins pale
(veins R₂, anal and at least one other).....
.....lindesayi lindesayi
Hindfemora not pale ventrally on basal 0.33, at most
with narrow circular band at base; apical portion
of only wing veins R₂ and anal veins
pale-scaled.....lindesayi nilgiricus
- 6(4). Abdominal sterna with scattered pale scales.barbirostris
Abdominal sterna without pale scales.....ahomi
- 7(3). Hindfemoro-tibial joint with prominent tuft of black
and white scales.....8
Hindfemoro-tibial joint without such a tuft.....9
- 8(7). Subcostal pale spot absent on wing.....annandalei
Subcostal pale spot present.....interruptus
- 9(7). Basal 0.25 of costa with pale spots interrupting black
scales.....10
Basal 0.25 of costa completely dark-scaled or at most
with scattered pale scales (hyrcanus Pallas group)12
- 10(9). Wing vein A with pale scales in apical 0.5; midfemur
without large pale-scaled spot dorsally near
apex.....gigas gigas
Wing vein A entirely dark-scaled; midfemur with large
pale-scaled spot dorsally near apex.....11
- 11(10). Pale spots in wing fringe opposite apices of R₄₊₅,
usually vein M₁ and sometimes other veins, but
variable, in addition to the usual large pale
spot between veins Cu₂ and A....gigas var. simlensis
Wing fringe dark opposite vein R₄₊₅ and with no other
pale spots except the large one between veins Cu₂
and A.....gigas var. baileyi
- 12(9). Basal dark spot on wing vein Cu small, separated by
its own length from middle dark spot on anal vein;
pale-scaled bands on hindtarsi narrow, tarsomere
4 without basal pale band.....sinensis

- Basal dark spot on vein Cu large, separated from middle dark spot on anal vein by less than its own length; pale-scaled bands on hindtarsi moderately to very broad, tarsomere 4 usually with basal pale band...13
- 13(12). Pale band on apex of hindtarsomere 3 and base of 4 seldom longer than length of hindtarsomere 5; abdominal tergum VIII usually with narrow scalesnigerrimus
Pale band on apex of hindtarsomere 3 and base of 4 longer than length of hindtarsomere 5; abdominal tergum VIII seldom with scales.....peditaeniatus
- 14(1). Femora and tibiae speckled with pale and dark scales..15
Femora and tibiae not speckled.....25
- 15(14). Some or all of hindtarsomeres 3-5 pale scaled.....16
Hindtarsomeres 3-5 entirely dark-scaled.....23
- 16(15). Hindtarsomere 5 with basal dark-scaled band; abdominal sterna with row of conspicuous black-scaled tufts; palpi with 4 distinct pale-scaled bands, including apical band.....kochi
Hindtarsomere 5 completely pale-scaled; abdominal sterna without such tufts; palpi with 3 distinct pale bands, including apical band.....17
- 17(16). Hindtarsomere 5 and part of 4 completely pale-scaled..18
Hindtarsomere 5, all of 4 and at least part of 3 completely pale-scaled.....20
- 18(17). Abdominal terga II,III largely or posteriorly covered with pale scales; dark scales usually on posterolateral corners of terga IV-VIII.....willmori
Abdominal terga II,III without scales or with some pale falcate and/or few narrow spatulate scales medio-posteriorly; dark scales usually only on posterolateral corners of terga VII and/or VIII.....19
- 19(18). Abdominal terga V-VII without scales, except infrequently VII with 1-3 pale scales laterally; point of branching of vein R₂₊₃ distally at level of proximal end of preapical dark spot on vein R₁, occasionally within proximal 0.33; vein R₂ long, usually more than 2.0 length of vein R₂₊₃.....pseudowillmori

- Abdominal terga V-VII with numerous pale scales, but occasionally only on VII; point of branching of vein R_{2+3} distally at level of or apical to proximal 0.33 of preapical dark spot on vein R_1 ; vein R_2 short, usually less than 2.0 length of vein R_{2+3}maculatus
- 20(17). Hindtarsomere 5, all of 4 and part of 3 pale-scaled
.....theobaldi
Hindtarsomeres 3-5 completely pale-scaled.....21
- 21(20). Palpi speckled, apical and subapical pale-scaled
bands equal in length.....splendidus
Palpi unspeckled, apical and subapical pale-scaled
bands unequal.....22
- 22(21). Abdominal terga VII,VIII covered with golden scales;
wing with basal 0.25 and apical 0.33 of costa
mostly pale-scaled.....jamesii
Abdominal terga VII,VIII with dark scales only; wing
with basal 0.25 and apical 0.33 chiefly dark-
scaled.....pseudojamesi
- 23(15). Palpi with 3 pale-scaled bands, usually speckled, the
apical and subapical pale bands equal.....stephensi
Palpi with 4 pale-scaled bands, apical and subapical
pale bands unequal.....24
- 24(23). Hindlegs with tibiotarsal joint broadly and
conspicuously banded with white scales.....dirus
Hindlegs without such tibiotarsal band.....tessellatus
- 25(14). Some or all of hindtarsomeres 3-5 completely pale-
scaled.....26
Hindtarsomeres 3-5 not pale-scaled.....30
- 26(25). Only hindtarsomere 5 and part of 4 completely pale-
scaled.....27
Hindtarsomeres 3-5 completely pale-scaled.....28
- 27(26). Palpi with 3 pale-scaled bands.....majidi
Palpi with 4 pale-scaled bands.....karwari
- 28(26). Wing vein Cu mainly dark-scaled, with dark spot at
bifurcation of Cu_1 and Cu_2annularis
Vein Cu mainly white-scaled, with no dark spot at
bifurcation of Cu_1 and Cu_229

- 29(28). Apical part of hindtarsomere 1 dark-scaled;
abdominal sterna with scattered broad white
scales; scales present on abdominal terga III-
VII; scales also on mesokatepisternum; wing
scales paler, dark spot at apex of vein R₄₊₅
about as long as fringe scales.....pallidus
- Apical part of hindtarsomere 1 with some pale scales;
few or no pale scales on abdominal sterna,
except on VI,VIII and occasionally V; scales
present on abdominal terga VI,VII and sometimes V;
mesokatepisternum without scale patch; wing
scales darker, dark spot at apex of vein R₄₊₅
about 2.0 length of fringe scales.....philippinensis
- 30(25). Tarsomeres of forelegs with broad, pale-scaled
bands.....31
Tarsomeres of forelegs entirely dark-scaled, or
with very narrow pale bands.....32
- 31(30). Palpi with preapical dark band subequal to apical
pale band; presector dark spot on wing with
part on vein Sc more than 0.5 length of that on
costa.....subpictus
Palpi with preapical dark band not more than 0.5
length of apical pale band; presector dark spot
with part on vein Sc less than 0.5 length of that
on costa.....vagus
- 32(30). Palpomere 1 dark-scaled.....turkhudi
Palpomere 1 pale-scaled.....33
- 33(32). Wing vein R₄₊₅ mainly dark-scaled.....culicifacies
Wing vein R₄₊₅ mainly pale-scaled.....34
- 34(33). Palpi with apical pale-scaled band subequal to
subapical pale band.....35
Palpi with apical pale-scaled band much longer
than sub-apical pale band.....37
- 35(34). Wing vein A with 3 dark-scaled spots and pale
fringe spot opposite apex; proboscis with apical
0.5 yellow-scaled.....aconitus
Vein A with only 2 dark-scaled spots and no pale
fringe spot opposite apex; proboscis with at most
ventral pale-scaled patch.....36

- 36(35). Wing with basal 0.25 of costa without pale-scaled
interruption.....varuna
Basal 0.25 of costa with at least presector
pale spot on at least 1 wing.....minimus
- 37(34). Wing with basal 0.25 of costa entirely dark-scaled
.....fluviatilis
Wing with basal 0.25 of costa with presector and
sometimes humeral pale spots present...jeyporiensis

KEY TO THE ADULT FEMALES OF GENUS ARMIGERES*

- Sterna II-VI entirely pale-scaled.....kuchingensis
Sterna III-VI dark-scaled, with subapical bands
of pale scales.....subalbatus

*Adapted from Thurman (1959).

KEY TO THE ADULT FEMALES OF THE SUBGENERA
OF THE GENUS CULEX*

1. Four or more strong lower mesanepimeral setae present;
relatively large species.....Lutzia
Mesanepimeral setae absent, or if present, with
only 1,2 weak setae; small to medium species.....2
- 2(1). Pleuron with distinct scale patches at least on
upper and lower mesokatepisternum and anterior
mesanepimeron.....Culex
Pleuron without distinct scale patches.....3
- 3(2). Acrostrichal setae well developed.....
.....(in part) Eumelanomyia
Acrostrichal setae not well developed except at
extreme anterior promontory and rarely near
prescutellar space.....4

*Adapted from Bram (1967).

- 4(3). Lower mesanepimeral seta absent; decumbent scales
on occiput narrow.....(in part) Eumelanomyia
Lower mesanepimeral seta present; decumbent scales
on occiput broad, if only on ocular line.....5
- 5(4). Pleural area with broad dark integumental band
extending from postpronotum to mesanepimeron or
with prominent dark spots.....Culiciomyia
- Pleural area concolorous, without broad dark
integumental band.....Lophoceraomyia

KEY TO THE ADULT FEMALES OF GENUS CULEX
SUBGENUS CULEX*

1. One or 2 lower mesanepimeral setae present;
proboscis without distinct pale-scaled band;
tarsomeres without pale bands at joints.....2
Lower mesanepimeral setae absent; proboscis with
distinct pale-scaled band; tarsomeres with
basal and apical pale bands.....6
- 2(1). Anterior surface of midfemur without median
longitudinal pale-scaled stripe.....3
Anterior surface of midfemur with median longitudinal
pale-scaled stripe.....5
- 3(2). Abdominal terga without basal transverse, pale-
scaled bands; pleuron with striking pattern of
dark and pale integumental stripes.....fuscocephala
Abdominal terga with basal transverse pale-scaled
bands; pleuron without striking pattern of
dark and pale integumental stripes.....4
- 4(3). Pleural integument with dark stripe across
mesokatepisternum and mesanepimeron; scutal
integument reddish brown.....hutchinsoni
Pleural integument without dark stripe; scutal
integument yellowish or pale brown..quinquefasciatus

*Adapted from Sirivanakarn (1976).

- 5(2). Postspiracular area and base of prealar knob
without scale patches.....vagans
Postspiracular area and base of prealar knob with
distinct scale patches.....theileri
- 6(1). Wing without pattern of pale-scaled spots or
streaks.....7
Wing with pattern of pale-scaled spots or streaks
on at least 2 areas of costa and 1 area on
other veins.....18
- 7(6). Abdominal terga II-VII largely clothed with
yellowish or golden scales.....epidesmus
Abdominal terga dark-scaled, with or without
pale-scaled bands.....8
- 8(7). Abdominal terga II-VI entirely dark-scaled, without
pale bands or apicolateral pale patches.....
.....(in part) whitei
Abdominal terga II-VI with basal or basal and
apical pale-scaled band, or basal, median, pale
patches or with apicolateral pale patches.....9
- 9(8). Abdominal terga II-VI with apical and basal
pale-scaled bands.....10
Abdominal terga II-VI with basal pale-scaled bands
only.....11
- 10(9). Wing with dark scales on all veins; abdominal terga
II-VI with dark areas not sprinkled with pale
scales.....sinensis
Wing with mixed pale and dark scales; abdominal terga
II-VI with dark areas sprinkled with pale
scales.....bitaeniorhynchus
- 11(9). Erect scales in center of vertex of head whitish;
anterior 0.7 of scutum covered with white scales..12
Erect scales in center of vertex pale yellow,
dingy white or all dark; anterior 0.7 of scutum
covered with beige, yellow, golden or dark scales.13
- 12(11). Anterior surface of fore- and midfemora without
speckling of pale scales; white-scaled patch on
scutum dense, extending to wing root, posterior
to that, all dark-scaled; wing veins R₁, R₄₊₅
and Cu with narrow scales.....gelidus

- Anterior surface of fore- and midfemora extensively speckled with pale scales; pale-scaled patch on scutum thinner, grayish-white, extending posterior to wing root in 4 lines; wing veins R₁, R₄₊₅ and Cu with broad scales.....whitmorei
- 13(11). Midfemur with longitudinal stripe of pale scales on anterior surface; postspiracular area with small patch of semierect scales on lower anterior aspect.....14
Midfemur entirely dark-scaled or speckling of pale scales not forming definite stripe; postspiracular area without scales on lower anterior aspect.....15
- 14(13). Longitudinal pale-scaled stripe on anterior surface of midfemur broken into small spots at middle; costal vein entirely dark-scaled.....barraudi
Longitudinal pale-scaled stripe on anterior surface of midfemur complete; pale scales present on base of costal vein at least to humeral crossveinedwardsi
- 15(13). Anterior surface of fore- and midfemora with speckling of several pale scales at least on apical dorsal surface.....(in part) whitei
Anterior surface of fore- and midfemora entirely dark-scaled.....16
- 16(15). Erect scales on vertex mostly dark; anterior surface of hindfemur pale-scaled with narrow black-scaled ring apically; scutum covered with dark coppery gold scales.....tritaeniorhynchus
Erect scales on vertex pale yellow in center, dark-scaled posterolaterally; hindfemur marked otherwise; scutum with scales paler.....17
- 17(16). Speckling of pale scales usually present on femora and proboscis; scutum with scales brown and pale mixed in varying degrees; hindfemur without dark-scaled apical band, usually with dark subapical band extending basally to form stripe...
.....vishnui
- Femora and proboscis never speckled with pale scales; scutum with yellow to silvery scales; hind femur with dark band apically, contrasting with pale-scaled areas.....pseudovishnui

- 18(6). Second pale-scaled costal spot involves C, Sc, R, and sometimes Rs and Cu; basal pale bands of abdominal terga narrow, usually less than 0.25 length of segment.....mimulus
Second pale-scaled costal spot involves only veins C and Sc; basal pale bands of abdominal terga broad, at least 0.25 length of segment.....19
- 19(18). Scutal scales predominantly brownish; midtibia with longitudinal stripe of pale scales on anterior surface.....jacksoni
Scutal scales predominantly pale; midtibia without longitudinal pale stripe on anterior surface..mimeticus

KEY TO THE ADULT FEMALES OF GENUS CULEX
SUBGENUS CULICIOMYIA*

1. Integument of pleuron with prominent dark spot dorsally on mesanepimeron; light brown spot on integument dorsally on mesokatepisternum..
.....nigropunctatus
Integument of pleuron with brown stripe extending from postpronotum to mesanepimeron.....2
- 2(1). Narrow scales on vertex of head brown in color; cell R₂ of wing about 2.25 length of vein R₂₊₃.....
.....pallidothorax
Narrow scales on vertex creamy in color; cell R₂ about 3.0 length of vein R₂₊₃.....viridiventer

*Adapted from Barraud (1934) and Bram (1967).

KEY TO ADULT FEMALES OF THE GENUS CULEX
SUBGENUS EUMELANOMYIA*

1. Acrostichal setae and lower mesanepimeral seta absent.....brevipalpus
Acrostichal setae and usually lower mesanepimeral seta present.....2

*Adapted from Sirivanakarn (1972).

- 2(1). Decumbent scales on anterior dorsal margin of vertex broad, white or gray, those in central part broad and dark in color.....malayi
Decumbent scales on vertex narrow, fine, mostly pale yellow in color.....foliatus

KEY TO THE ADULT FEMALES OF GENUS CULEX
SUBGENUS LOPHOCERAOMYIA*

- Decumbent scales on vertex mostly narrow, linear; scales on veins R₂ and R₃ of wing narrow, linear.....minor
Decumbent scales on vertex mostly broad; scales on veins R₂ and R₃ usually broad, clavate...infantulus

*Adapted from Sirivanakarn (1977).

KEY TO THE ADULT FEMALES OF GENUS CULEX
SUBGENUS LUTZIA*

- Abdominal terga V-VIII entirely pale-scaled, or with very broad apical pale-scaled bands; terga II-VI entirely dark-scaled, or with very narrow apical pale bands; median pale band of proboscis broad, extending to near apex.....fuscanus
Abdominal terga entirely dark-scaled, or with apical pale bands narrow, of about same width; median pale band on proboscis restricted to basal 0.6..
.....halifaxii

*Adapted from Bram (1967).

KEY TO THE ADULT FEMALES OF GENUS HEIZMANNIA*

- Cell R₂ 2.0-2.5 length of vein R₂₊₃; hindfemur
with dark dorsal stripe reaching to base.....indica
Cell R₂ 3.0-3.5 length of vein R₂₊₃; hindfemur
with dark dorsal stripe not reaching to base....
.....himalayensis

*Adapted from Mattingly (1970).

KEY TO THE ADULT FEMALES OF GENUS MANSONIA*

1. Scutum with at least 4 distinct pale-scaled spots;
rather broad flat pale scales on midlobe of
scutellum.....annulifera
Scutum without distinct pale spots, if present,
only faint and lightly colored; midlobe of
scutellum with narrow scales.....2
- 2(1). Scutum with sublateral longitudinal lines of
greenish scales; basal pale-scaled bands on
hindtarsomeres complete; middle group of spines
on abdominal tergum VIII separated from
lateral groups.....uniformis
Scutum with at most ill-defined spots of pale
scales; basal pale-scaled bands on hind-
tarsomeres incomplete; middle group of spines
on abdominal tergum VIII continuous with
lateral spines.....indiana

*Adapted from Wharton (1978).

KEY TO THE ADULT FEMALES OF GENUS MIMOMYIA*

1. Wing with numerous scattered yellow scales; cell
R₂ at least 4.0 length of vein R₂₊₃ (subgenus
Etorleptiomyia).....luzonensis

*Adapted from Mattingly (1957a)

- Wing scales dark, except sometimes pale scales
at base of vein Sc; cell R₂ at most 2.0 length
of vein R₂₊₃ (subgenus Mimomyia).....2
- 2(1). Hindtarsomeres without pale-scaled bands, except
occasionally at base of tarsomere 1; dorso-
central setae on scutum few but strongly
developed.....hybrida
Hindtarsomeres with prominent pale-scaled bands at
joints; dorsocentral setae weak, more numerous..
.....chamberlaini

KEY TO THE ADULT FEMALES OF GENUS URANOTAENIA*

1. Alula bare; prealar area separated from mesokatepisternum by suture; erect scales on dorsum of head usually absent, when present, linear in shape, restricted to few on vertex and few on occiput (subgenus Uranotaenia).....2
Alula with few dorsomarginal scales or erect scales on dorsum of head expanded apically, numerous, covering most of vertex; prealar area not separated from mesokatepisternum by suture (subgenus Pseudoficalbia).....6
- 2(1). Hindtarsomeres with some pale scales present.....3
Hindtarsomeres entirely dark-scaled.....4
- 3(2). No pale scales on wings; hindtarsomeres 4,5 and part of 3 with pale scales.....spp. near testacea
Pale scales present on wings; hindtarsomere 5 entirely pale-scaled, 2-4 with basal pale patches only.....edwardsi
- 4(2). No pale or blue broad flat scales along lateral margin of scutum.....annandalei
Some pale or blue broad flat scales along lateral margin of scutum.....5

*Adapted from Barraud (1934) and Peyton (1977).

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- 5(4). Abdominal terga II-IV, VI with lateral patches of
pale scales; scutum with mixed dark brown and
ochraceous scales.....macfarlanei
Abdominal terga II-IV, VI without lateral patches of
of pale scales; scutum covered with bronzy dark
brown scales.....campestris
- 6(1). Abdominal terga with bands of yellow to ochraceous
scales on II-VII.....7
Abdominal terga entirely dark-scaled.....8
- 7(6). Integument of pleura uniformly light brown.....luteola
Integument of pleura yellowish, marked with
conspicuous dark brown patches.....stricklandi
- 8(6). Pleural integument with conspicuous dark markings...
.....maculipleura
Pleural integument uniformly pale yellow in color,
except for postpronotum and small spot on upper
mesokatepisternum.....recondita

KEYS TO THE FOURTH INSTAR LARVAE
OF THE MOSQUITOES OF NEPAL

KEY TO THE GENERA OF FOURTH INSTAR MOSQUITO LARVAE
OF NEPAL*

1. Respiratory siphon absent; seta 1 usually palmate
on some abdominal terga.....Anopheles
Respiratory siphon present; seta 1 on abdominal terga
not palmate.....2
- 2(1). Siphon short, attenuated, with saw-toothed process
near apex, adapted for piercing plant tissue.....3
Siphon not so modified, with cylindrical shape, but
if attenuated apically, then without saw-
toothed process.....4
- 3(2). Setae 2,3-A about same length as flagellar segment;
saddle bearing 3,4 robust setae ventrally...Mansonia
Setae 2,3-A much shorter than length of flagellar
segment; saddle with at most 2 small, weak
setae.....Coquillettidia crassipes
- 4(2). Seta 4-X (ventral brush) with single pair of setae.....5
Seta 4-X consisting of 3 or more pairs of setal tufts..6
- 5(4). Abdominal segments IV-VI with stellate setae OR
maxillae with horns OR siphon index at least
6.0.....Topomyia aureoventer
Abdominal segments IV-VI without stellate setae;
maxillae without horns; siphon index at most
4.0.....Malava genurostris
- 6(4). Siphon without pecten.....7
Siphon with pecten.....9
- 7(6). Lateral palatal brushes composed of few curved stout
rods; comb scales absent....Toxorhynchites splendens
Lateral palatal brushes usually composed of numerous
thin, simple or pectinate filaments; comb scales
present.....8
- 8(7). Abdominal segment VIII with transverse sclerotized
plate; siphon index 3.5 or more; seta 1-A much
longer than width of antenna at point of attach-
ment.....Orthopodomyia anopheloides

*Adapted from Mattingly (1971); the larva of Heizmannia indica is unknown.



- Abdominal segment VIII without such plate; siphon index 3.2 or less; seta 1-A no longer than width of antenna at point of attachment.....Armigeres
- 9(6). Siphon with subventral pair of setae.....
.....Culiseta niveitaeniatus
Siphon with setae attached distally, usually distal to pecten.....10
- 10(9). Distal segment of antenna freely articulating, setae 2,3-A attached at joint.....Mimomyia
Antenna without articulating joint distally; seta 1,2-A attached apically or subapically.....11
- 11(10). Siphon with 2 or more pairs of setae.....Culex
Siphon with single pair of setae.....12
- 12(11). Comb scales usually attached to comb plate; head longer than wide; setae 5,6-C often spine like...
.....Uranotaenia
Comb scales not attached to comb plate; head wider than long; setae 5,6-C normal setae, not spine-like.....13
- 13(12). Seta 4-C well developed, multibranched, almost equal in size to seta 7-C....Heizmannia himalayensis
Seta 4-C small, less than 0.5 length of seta 7-C, variously branched.....Aedes

KEY TO THE FOURTH INSTAR LARVAE OF GENUS AEDES

1. Pecten with some apical spines detached, widely spaced.2
Pecten with spines more or less evenly spaced.....7
- 2(1). Siphon spiculate apically and sometimes with patches of aculeae dorsally and ventrally.....caecus
Siphon smooth.....3
- 3(2). Setae 5,6-C single; comb scales numbering 50 or more.....scatophagoides
Setae 5,6-C with 4 or more branches; comb scales usually numbering no more than 25.....4

*Partially adapted from Barraud (1934) and Reinert (1973,1984).

- 4(3). Siphon short, index 3.0 or less; comb scales numbering 6-8.....5
Siphon long, index at least 5.0; comb scales numbering 14 or more.....6
- 5(4). Setae 5,6-C with 1 branch noticeably longer and stouter, others shorter, weaker, 3-branched..indicus
Setae 5,6-C with branches about equal in length and thickness, usually with 4 or more branches....
.....lineatopennis
- 6(4). Comb scales evenly fringed with subequal spinules; siphon index 5.0-5.6.....pipersalatus
Comb scales with prominent apical spine and small basolateral spinules; siphon index 7.0 or greater..
.....pallidostriatus
- 7(1). Comb scales with prominent apical spine.....8
Comb scales fringed apically with subequal spinules...12
- 8(7). Seta 1-A with 4-6 branches, well developed; seta 1-X shorter than saddle.....vittatus
Seta 1-A simple, short, usually stout; seta 1-X longer than saddle.....9
- 9(8). Seta 4-C long, almost as long as seta 6-C.....10
Seta 4-C small, much shorter than seta 6-C.....11
- 10(9). Seta 4-X attached to poorly developed grid, basal-most seta short, about 0.5 length of seta 1-X
.....gardnerii imitator
Seta 4-X attached to well developed grid, basal-most seta almost as long as seta 1-X.....w-albus
- 11(9). Abdominal segments with some stellate setae present
.....unilineatus
Abdominal segments without stellate setae.....albopictus
- 12(7). Comb scales numbering fewer than 16, in single row....13
Comb scales numbering 22 or more, in double row or triangular patch.....15
- 13(12). Seta 6-C with 4-10 branches; comb scales with apical spine more than 10 times length of subapical spinules.....albolateralis
Seta 6-C with 2-3 branches; comb scales with apical spine only 2-4 times length of subapical spinules.....14

- 14(13). Seta 6-C simple, 2.0 or more length of seta 5-C;
 seta 10-VII double; median filaments of lateral
 palatal brush pectinate.....annulirostris
 Seta 6-C double or triple, less than 2.0 length
 of seta 5-C; seta 10-VII single; median fila-
 ments of lateral palatal brushes simple.....thomsoni
- 15(12). Siphon with seta 1-S arising within pecten.....16
 Siphon with seta 1-S arising distal to pecten.....17
- 16(15). Seta 1-A single; comb scales numbering 40 or more...
pseudotaeniatus
 Seta 1-A with 2-3 branches; comb scales numbering
 27 or fewer.....chrysolineatus
- 17(15). Siphon index 3.0-5.0; with 60 or more comb scales.....18
 Siphon index less than 3.0; comb scales numbering
 no more than 45.....19
- 18(17). Siphon index about 3.0; seta 7-C with 7-8 branches..
dissimilis
 Siphon index 4.0 or greater; seta 7-C with 2-3
 branches.....aureostriatus var. greenii
- 19(17). Seta 1-C stout, blunt apically; seta 2-X double, more
 than 2.0 length of anal segment.....assamensis
 Seta 1-C fine, attenuated apically; seta 2-X with
 8-10 branches, about as long as anal segment....
gubernatoris

KEY TO THE FOURTH INSTAR LARVAE OF GENUS ANOPHELES*

1. Setae 2-C more or less close together, distance
 between their alveoli less than that between
 those of setae 2 and 3; seta 1-A single or
 branched (subgenus Anopheles).....2
 Setae 2-C well separated, distance between their
 alveoli much more than that between those of
 setae 2 and 3; seta 1-A simple (subgenus Cellia)..15

*The larva of An. pseudowillmori is unknown.

- 2(1). Seta 1-A simple, arising from dorsoexternal surface
of antenna; most of setae 5-7-C very short, some-
times simple.....3
Seta 1-A branched, arising from inner surface of
antenna; setae 5-7-C always long and branched.....4
- 3(2). Setae 9,10-M and setae 9,10-T simple.....annandalei
Setae 9,10-M and setae 9,10-T sparsely barbed.....
.....interruptus
- 4(2). Seta 3-C denticulate.....5
Seta 3-C simple, double or with few short branches.....9
- 5(4). Seta 1-P with 6-8 branches, arising from near base.....6
Seta 1-P simple, bifid or trifid in outer 0.5
(hyrcanus Pallas group).....7
- 6(5). Seta 2-C always simple.....barbirostris
Seta 2-C aciculate.....ahomi
- 7(5). Seta 4-M sinuate, with horizontally spreading
branches arising from base, small, 0.33 length
of seta 3-M.....peditaeniatus
Seta 4-M with branches erect, not sinuate, at
least 0.5 length of seta 3-M.....8
- 8(7). Setae 5,7-VI with 6-11 branches; setae 8,9-C with
8-13 branches.....sinensis
Setae 5,7-VI with 2-5 branches; setae 8,9-C with
12-24 branches.....nigerrimus
- 9(4). Seta 2-C with 2-5 branches, bases not so close
together.....10
Seta 2-C simple, bases nearly touching.....11
- 10(9). Seta 2-C with 2 branches from near base.....aitkenii
Seta 2-C with 3-5 branches from about middle.benqalensis
- 11(9). Setae 1-II-VII well developed palmates; seta 3-T
a well developed palmate.....12
Setae 1-III-VII well developed palmates; seta 3-T
not palmate.....13
- 12(11). Seta 1-P with about 10 branches; seta 6-III plumose,
with well developed branches.....lindesavi lindesavi
Seta 1-P with 13-15 branches; seta 6-III aciculate
without long branches.....lindesavi nilgiricus

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- 13(11). Seta 6-V simple.....gigas var. baileyi
Seta 6-V with 2-5 branches.....14
- 14(13). Seta 3-C with 2-6 branches; seta 4-C simple, rarely
bifid.....gigas gigas
Seta 3-C usually single; seta 4-C with 2-5
branches.....gigas var. simlensis
- 15(1). Anterior tergal plates on abdominal terga III-VII
very broad, with convex posterior border, extend-
ing to about middle of segment, at least on V-VII,
enclosing accessory tergal plate.....16
Anterior tergal plate of moderate size, with concave
posterior border, never enclosing accessory
tergal plate.....18
- 16(15). Setae 2,3-C with short scattered branches; seta4-C
branched from base.....aconitus
Setae 2,3,4-C simple.....17
- 17(16). Seta 0-II-VII not arising from anterior tergal plate,
located posterior to it.....minimus
fluviatilis
Setae 0-II-VII arising within anterior tergal
plate.....varuna
- 18(15). Setae 2,3-C simple or finely aciculate.....19
Setae 2,3-C with conspicuous lateral branches.....28
- 19(18). Seta 1 only palmate on abdominal terga III-VII;
setae 9,10-M and 9,10-T simple on both sides.....20
Seta 1 palmate on more or fewer abdominal terga
than III-VII; setae 9,10-M and 9,10-T simple,
pectinate or plumose.....21
- 20(19). Seta 1-P with 2-4 branches, not attached to setal
support plate; seta 3-M a poorly developed
palmate seta.....tessellatus
Seta 1-P with 11-18 branches, attached to setal
support plate; seta 3-T not palmate.....dirus
- 21(19). Seta 1 only palmate on IV-VI, small; setae 9,10-M
plumose.....turkhudi
Seta 1 palmate on more than abdominal terga IV-VI;
setae 9,10-M simple or pectinate.....22

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- 22(21). Setae 1-I-VII palmate, those on I,II often smaller;
setae 9,10-M both simple, occasionally bifid or
pectinate.....23
Setae 1-II-VII palmate, those on II often smaller;
seta 9-M simple, seta 10-M pectinate.....27
- 23(22). Setae 9,10-M and 9,10-T simple; filaments of
leaflets of palmate setae blunt; seta 2-C faintly
aciculate, about 4.0 length of seta 3-C.....kochi
Some of setae 9,10-M and 9,10-T pectinate; filaments
of leaflets of palmate setae sharply pointed;
seta 2-C less than 4.0 length of seta 3-C.....24
- 24(23). Seta 3-T not palmate; setae 9,10-P simple or occas-
ionally 2,3-branched; setae 9-10-T pectinate;
seta 1-P not attached to setal support plate.....25
Seta 3-T a well developed palmate; seta 9-P
plumose; setae 10-P, 9-T simple; seta 10-T
pectinate; seta 1-P attached to setal
support plate.....26
- 25(24). Setae 3,4-C about 0.33 length of seta 2-C; setae 4-C
located medially close to setae 2-C.....vagus
Setae 3,4-C more than 0.33 length of seta 2-C;
setae 4-C not close to setae 2-C.....subpictus
- 26(24). Setae 2-C exceptionally long, about 0.5 length
of dorsal apotome; filament of leaflets of
palmate setae only about 0.25 length of blade.majidi
Setae 2-C not long, less than 0.5 length of dorsal
apotome; filaments of leaflets of palmate
setae about 0.5 or more length of blade.culicifacies
- 27(22). Seta 3-C always and seta 2-C usually simple;
seta 4-I with 3-5 branches; seta 3-T never
palmate.....stephensi
Setae 2,3-C finely aciculate; seta 4-I with
6-8 branches; seta 3-T palmate or not
.....(in part) maculatus
willmori
theobaldi
- 28(18). Seta 3-C with long branches, often about as long as
shaft.....29
Seta 3-C with short branches, never more than 0.25
length of shaft.....32

- 29(28). Seta 8-C simple or forked near tip.....30
Seta 8-C with 2-8 branches from near base.....31
- 30(29). Seta 1-I a well developed palmate; live larvae
usually appear dark green, often with 2-3
silvery spots.....annularis
Seta 1-I hair-like, not palmate; live larvae usually
dirty pale yellow, without conspicuous spots.....
.....jamesii
- 31(29). Seta 4-C with 2-5 branches; filaments of leaflets of
palmate setae about 0.5 length of blade; setae
1-3-P on common setal support plate.....pallidus
Seta 4-C with 4-10 branches; filaments of leaflets
of palmates about 0.25 length of blade; setae
1-3-P not attached to common setal support
plate.....philippinensis
- 32(28). Seta 3-C pinnate or plumose; seta 9-T simple;
seta 3-T well developed palmate.....jevporiensis
Seta 3-C with few scattered branches; setae 9,10-T
plumose; seta 3-T not palmate, if so, poorly
developed.....33
- 33(32). Seta 2-C exceptionally long, about 0.5 length of
dorsal apotome; seta 11-P stout, somewhat
truncate, with lateral spine-like branches.....
.....pseudojamesi
Seta 2-C much shorter than 0.5 length of dorsal
apotome; seta 11-P hair-like, with 2-4 branches...34
- 34(33). Seta 8-C with 2-4 branches; seta 3-C often branched
distally, with 3-7 short lateral branches;
filament of leaflets of palmates very broad at
base, with blunt apex, about 0.33 length of
blade.....splendidus
Seta 8-C simple; seta 3-C with few fine lateral
branches; filament of leaflets of palmates not
broad at base, may be blunt or sharp-pointed at
apex.....35
- 35(34). Setae 6-V-VI with 6-10 long branches; filament of
leaflet of palmates blunt.....karwari
Setae 6-V-VI with 3-5 branches from near base;
filament of palmate leaflets with sharp
points.....(in part) maculatus
willmori
theobaldi

KEY TO THE FOURTH INSTAR LARVAE OF GENUS ARMIGERES*

- Seta 1-X simple, stout, equal in length to saddle,
inserted on saddle sclerite.....kuchingensis
Seta 1-X minute, about 8-branched, arising from
integument posterior to saddle.....subalbatus

*Adapted from Thurman (1959).

KEY TO THE FOURTH INSTAR LARVAE OF THE SUBGENERA
OF THE GENUS CULEX*

1. Pecten extending to near apex of siphon; mouth
brushes composed of laminated plates; seta
1-A short, simple, inserted in proximal 0.5 of
antenna.....Lutzia*
(halifaxii, fuscans)

Pecten restricted to basal 0.5 of siphon; mouth
brushes filamentous; seta 1-A usually multi-
branched, inserted in distal 0.3.....2

2(1). Seta 4-X with 4 pairs of setal tufts inserted
on grid; seta 1-C fine; seta 3-P much thinner
than seta 1-P, usually 0.5 its length OR if seta
1-C stout, then seta 1-P bifid or trifid and seta
3-P with 2 or more branches.....Culiciomyia
Seta 4-X with 5 or more pairs of setal tufts
inserted on grid; if seta 1-C fine, then setae
1,3-P single and subequal in size OR if seta 1-C
robust, then seta 3-P usually shorter than
seta 1-P, simple.....3

3(2). Seta 3-P always single and subequal to seta 1-P....Culex
Seta 3-P single or branched, thinner than and usually
0.5 length of seta 1-P.....4

*Adapted from Bram (1967); larvae of Cx. halifaxii and Cx. fuscans are similar and cannot be separated.

- 4(3). Seta 5-C shorter than seta 6-C.....Eumelanomyia
Seta 5-C as long as or longer than seta 6-C.....
.....Lophoceraomyia

KEY TO THE FOURTH INSTAR LARVAE OF GENUS CULEX
SUBGENUS CULEX

1. Preclypeus of head capsule with distinct transverse
bar, separated from dorsal apotome.....2
Preclypeus not developed as distinct from dorsal
apotome.....16
- 2(1). Seta 1-C slender, distally strongly tapering,
filamentous.....3
Seta 1-C dark, stout, spiniform or foliform,
pointed or blunt apically.....5
- 3(2). Setae 5,6-C double; mental plate with 6 or 7
denticles on either side of median tooth.....
.....fuscocephala
Setae 5,6-C multibranching; mental plate with 10-12
denticles on either side of median tooth.....4
- 4(3). Setae 2,3-A apical in position or nearly so;
siphon index about 4.0.....quinquefasciatus
Setae 2,3-A distinctly subapical; siphon index
5.0 or more.....vagans
- 5(2). Siphon fusiform, with strong subapical spine
dorsally; setae 1-M,T long multibranching, 1-M
as long as seta 3-M, 1-T as long as seta 2-T.....
.....hutchinsoni
Siphon usually cylindrical, tapering apically,
without subapical spine; setae 1-M,T short,
weak, usually single to triple.....6
- 6(5). Seta 7-I double.....7
Seta 7-I single.....10

*Adapted from Sirivanakarn (1976); the larva of Cx. epidesmus is unknown.

- 7(6). Comb scales with strong apical spine.....theileri
Comb scales fringed apically with subequal spinules....8
- 8(7). Seta 6-C double; ventral valve of spiracular
apparatus small, brown.....tritaeniorhynchus
Seta 6-C triple; ventral valve of spiracular
apparatus broad, black.....9
- 9(8). Setae 1-III-V strong, single, as long as setae
6-III-V; siphonal setae small, inconspicuous..whitei
Setae 1-III-V with 2-4 branches, much shorter than
setae 6-III-V; siphonal setae larger, conspicuous.
.....barraudi
edwardsi
- 10(6). Siphon short, index 3.0-4.0, fusiform, slightly
swollen in middle.....gelidus
Siphon long, index at least 5.0, more or less
cylindrical.....11
- 11(10). Seta 4-P double or multibranchd.....12
Seta 4-P single.....14
- 12(11). Comb with 16-20 or more small scales in triangular
patch.....vishnui
Comb with 4-8 large spiniform scales in single row....13
- 13(12). Siphon strongly tapering distally, setae well
developed, 4-5X width of siphon at point of
attachment, with 2 or 3 branches; seta 4-P always
double, as long as seta 2-P.whitmorei
Siphon only slightly tapering distally, setae weaker,
only slightly longer than width of siphon
at point of attachment, with 4-6 branches;
seta 4-P variable, often shorter than seta 2-P
with 2-15 branches.....pseudovishnui
- 14(11). Siphon with prominent spines on subventral surface
in apical 0.5.....jacksoni
Siphon without such spines.....15
- 15(14). Comb scales with strong median spine; proximal
4 pairs of siphonal setae very strong, closely
spaced, 2-3X width of siphon at point of
attachment.....mimeticus

Comb scales fringed apically with subequal spinules or with weak apical spine; siphonal setae weak, widely separated, no longer than width of siphon at point of attachment.....mimulus

- 16(1). Seta 2,3-A located 0.5 distance from attachment of seta 1-A to apex of antenna; seta 4-P short, weak.....sinensis
Seta 2,3-A located near to apex of antenna; seta 4-P long, strong.....bitaeniorhynchus

KEY TO THE FOURTH INSTAR LARVAE OF GENUS CULEX
SUBGENUS CULICIOMYIA*

1. Siphon with false joint, an irregular ring distal to middle due to lack of sclerotization.....nigropunctatus
Siphon without such false joint.....2
- 2(1). Siphon swollen in middle; pecten spines numbering 7-10.....pallidothorax
Siphon not swollen, tapering gradually from base to apex; pecten spines numbering 14-18.....viridiventer

*Adapted from Barraud (1934) and Bram (1967).

KEY TO THE FOURTH INSTAR LARVAE OF GENUS CULEX
SUBGENUS EUMELANOMYIA*

1. Setae 2,3-A in apical position; siphon index greater than 7.0, setae small, no longer than width of siphon at point of attachment.....brevipalpus
Setae 2,3-A in subapical position; siphon index about 6.0, setae long, longer than width of siphon at point of attachment.....2

*Adapted from Sirivanakarn (1972).

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- 2(1). Some comb scales with apical spine, others fringed apically with subequal spinules; seta 4-P strong, subequal to seta 3-P.....malayi
Comb scales all fringed with subequal spinules; seta 4-P weak, not as long nor as strong as seta 3-P.....foliatus

KEY TO THE FOURTH INSTAR LARVAE OF GENUS CULEX
SUBGENUS LOPHOCERAOMYIA*

- Seta 1-M 0.5 or less length of seta 3-M; basal 1 or 2 denticles of pecten spines not enlarged, smaller than others.....infantulus
Seta 1-M subequal to seta 3-M; basal 1 or 2 denticles of pecten spines enlarged, much larger than others.....minor

*Adapted from Sirivanakarn (1977).

KEY TO THE FOURTH INSTAR LARVAE OF GENUS MANSONIA*

1. Basal 0.5 of antenna darkly pigmented, apical 0.5 light in color; precratal setae on saddle single.....annulifera
Antenna with narrow dark band at base and another at level of seta 1-A; precratal setae on saddle mostly double.....2
2(1). Saddle length 2 times width; seta 4-P with about 10 branches.....indiana
Saddle length less than 2 times width; seta 4-P with about 4 branches.....uniformis

*Adapted from Wharton (1978).

KEY TO THE FOURTH INSTAR LARVAE OF GENUS MIMOMYIA*

1. Siphon attenuated, adapted for piercing plant tissue; flagellar segment of antenna long, about 0.75 length of basal segment.....hybrida
Siphon normal cylindrical shape; flagellar segment of antenna about 0.25 length of basal segment.....2
- 2(1). Siphon index 6.0-7.0; lobes of spiracular apparatus small, without long setae; pecten absent; seta 4-X with 6 pairs of setal tufts.....luzonensis
Siphon index 5.0; lobes of spiracular apparatus large, with long setae; pecten present; seta 4-X with 8 pairs of setal tufts.....chamberlaini

*Adapted from Mattingly (1957a).

KEY TO THE FOURTH INSTAR LARVAE OF GENUS URANOTAENIA*

1. Setae 5,6-C very stout, spike-like, attached posteriorly on head, 5-C approaching middle of head; grid of abdominal segment X joined to saddle (subgenus Uranotaenia).....2
Setae 5,6-C not stout nor spike-like, usually attached far forward on head; grid of X not joined to saddle (subgenus Pseudoficalbia).....3
- 2(1). Seta 1-A foliform; comb plate on abdominal segment VIII continuous over dorsum.....annandalei
Seta 1-A hair-like; comb plates on VIII separated...
.....macfarlanei
.....campestris
- 3(1). Seta 1-C minute, often inapparent, inserted on rounded apical process of labrum; comb scales with apical point devoid of spinules.....maculipleura
Seta 1-C prominent, blade-like or foliform, on less prominent apical process of labrum; comb scales with apex fringed with spinules.....4

* Adapted from Barraud (1934 and Peyton (1977); larvae of Ur. edwardsi and Ur. luteola are unknown.

db

- 4(3). Seta 1-C blade-like, not widening apically...stricklandi
 Seta 1-C foliform, widening apically.....recondita

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GLOSSARY OF TERMS EMPLOYED IN THE
KEYS TO THE MOSQUITOES OF NEPAL*

ADULT FEMALE STRUCTURES

- Acicula - minute spine-like process.
Acrostichal setae - setae located in the mid-longitudinal line of the scutum.
Alula - a lobe on the posterior basal portion of the wing between the upper calypter and the base of the anal vein.
Anal vein - the sixth longitudinal vein of the wing; see wing illustration.
Antealar area - the part of the scutum laterally just in front of the wing root.
Anterior promontory - a broad median area at the extreme anterior end of the scutum.
Apex - the terminal end of a structure.
Apical - refers to the apex or free end of a structure.
Apicolateral - toward the apex and on the side of any structure.
Basal - refers to the part of a structure nearest the body or nearest the center of the body.
Basal dark spot - area of the costal vein of the wing at its base.
Base - the part of a structure attached to the body, or nearest the center of the body.
Cell R2 - anterior forked cell
Clavate - form of a structure which gradually thickens toward the distal end.
Claw - the hook-like structure at the apices of the legs. They can be toothed or simple. They are also called unguis.
Costa - the longitudinal vein on the anterior edge of the wing.
Costal vein - see costa.
Decumbent scales - those which are lying flat against the body surface.
Distal - part of a structure farthest from the base or body.
Dorsal - refers to the uppermost part of a structure.
Dorsum - the upper surface of a structure.
Dorsocentral setae - the setae located on submedial longitudinal lines on either side of the acrostichal setae.
Emarginated - having a notch or indentation.
Femora - plural of femur; see femur.
Femorotibial joint - the part of the leg around the union of the femur and tibia.

*Reference: Torre Bueno, J. R. 1978. A glossary of entomology. New York Ent. Soc., 336 pp.

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- Femur - the third division of the leg, attached basally to the trochanter and apically to the tibia.
- Flagellomere - name for the segments of the flagellum of the antenna.
- Fossa - a gentle depression; usually referring to the scutal fossa, an anterolateral depression of the scutum.
- Hindtarsomere - refers to the tarsal segments of the hind leg.
- Integumental - adjectival form of integument; see integument.
- Integument - the exoskeleton of an insect, that is the outer covering, usually partially or entirely covered with scales or setae or both in mosquitoes.
- Lateral - refers to the sides of a structure.
- Linear - having a form long and narrow with parallel sides.
- Maxillary palpus - appendages of the maxillae located on either side of the base of the proboscis.
- Medial - refers to the middle of a structure.
- Median - same as medial.
- Mesanepimeral - adjectival form of mesanepimeron; see mesanepimeron.
- Mesanepimeron - sclerite of the mesothoracic pleuron posterior to the mesokatepisternum, rectangular in shape (formerly called mesepimeron).
- Mesokatepisternum - a large, pear-shaped sclerite on the pleuron of the mesothorax (formerly called sternopleuron).
- Mesomeron - a small triangular sclerite between the mid- and hind coxae.
- Occiput - the posterior part of the dorsum of the head just posterior to the vertex but not distinctly separated from it.
- Palpomere - name for the segments of the palpus.
- Palpus - refers to the maxillary palpus; see maxillary palpus.
- Palpi - plural of palpus.
- Pleuron - the lateral aspect of the thoracic segments, composed of several sclerites.
- Postpronotum - a sclerite of the prothorax, just ventral to the scutum and anterior to the mesothoracic spiracle.
- Postspiracular area - part of the anterior mesanepisternum just posterior to the mesothoracic spiracle.
- Postspiracular seta - seta occurring on the postspiracular area.
- Prealar area - a knob-like structure just above the mesokatepisternum and just anterior to the wing root.
- Preapical - refers to a location just before the apex of a structure.
- Preapical dark spot - area of dark scales on the costal vein just behind its apex.
- Presector dark spot - refers to a spot of dark scales on the anterior edge of the wing just behind the sector pale spot.
- Prespiracular area - a small triangular area just anterior to the mesothoracic spiracular and just posterior to the postpronotum.
- Prespiracular seta - seta occurring in the prespiracular area.

- Prescutellar - refers to the medial part of the scutum just anterior to the scutellum.
- Proboscis - the appendage on the front of the head which contains the mouthparts extended into stylets encased in the labial sheath.
- Pulvillus - pad-like structures attached to the terminus of the legs, one arising below the base of each claw.
- Pulvilli - plural of pulvillus.
- Scale - a modified seta composed of a slender stalk and a flattened distal part, usually widest apically.
- Sclerite - a sclerotized plate of the exoskeleton limited by sutures, or divisions between sclerites.
- Scutal angle - the angular projection of the scutal margin about in the middle of the scutum.
- Scutal fossa - a depression in the scutum in the anterolateral third of the sclerite.
- Scutellum - the strap-like division of the dorsum of the mesothorax, just posterior to the scutum.
- Scutum - the largest sclerite of the dorsum of the mesothorax, preceded by the antepronota and followed by the scutellum.
- Seta - a projection from the integument, arising from an alveolus and usually becoming thinner apically.
- Simple - means single, or without branches or aciculae.
- Squama - see upper calypter.
- Sternum - the ventral sclerite of a body segment.
- Sterna - plural of sternum.
- Subcosta - the subcostal or second vein of the wing.
- Subcostal pale spot - spot of pale scales at the junction of costal and subcostal veins.
- Tarsi - plural of tarsus.
- Tarsomere - name for the segments of the tarsus.
- Tarsus - collective name for the 5 tarsal segments of the leg.
- Tergum - refers to the dorsal sclerite of a body segment.
- Terga - plural of tergum.
- Tibia - segment of the leg between the femur and tarsus.
- Tibiotarsal joint - the junction of the tibia and tarsus.
- Toothed - refers to a projection from a structure, especially the tarsal claw.
- Transverse - term meaning extending across a structure from side to side, from the middle to the lateral borders.
- Upper calypter - lobe of the base of the wing, basal to the alula.
- Vein - the longitudinal thickenings of the wing.
- Vein Cu - the fifth longitudinal or cubital vein.
- Vein R₂₊₃ - basal part of the second longitudinal vein.
- Vertex - the anterior part of the dorsum of the head, bordering the occiput behind, with no visible division between them.
- Wing root - the base of the wing where it is attached to the thorax.

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FOURTH INSTAR LARVA STRUCTURES

- Abdomen - the third major body region, consisting of 10 segments.
- Acicula - a small, slender thorn-like spicule.
- Accessory tergal plate - in anopheline larvae, small median or submedian sclerites located posterior to the tergal plate on some abdominal segments.
- Alveoli - plural of alveolus.
- Alveolus - a socket surrounded by a ring, bearing a seta.
- Anal segment - the tenth segment of the abdomen.
- Antenna - the appendage of the head attached anterolaterally, lateral to the mouth brushes, in some genera consisting of 2 segments.
- Articulating - refers to segments united by moveable joints.
- Attenuated - becoming very slender toward apex.
- Bifid - with 2 branches.
- Blade - the flat surface of a leaflet of a palmate seta.
- Comb scale - specialized spicule on the lateral aspect of abdominal segment VIII forming a comb, of varying forms.
- Comb plate - a sclerotized plate located on the lateral aspect of abdominal segment VIII, to which comb scales are attached.
- Concave - the border is curved inward.
- Convex - the border is curved outward like a sphere.
- Dendritic - branching resembling the branching of a tree, having a main stem and many irregular or dichotomous branches.
- Denticle - a tooth-like projection.
- Dorsal apotome - the large sclerite on the dorsal aspect of the larval head (formerly called frontoclypeus).
- Dorsoexternal - externally on the dorsal side of a structure.
- Filament of leaflet - the apical projection from the blade of a leaflet of a palmate seta.
- Filamentous - thread-like
- Flagellar segment - the second segment of the larval antenna, found in certain genera.
- Foliform - leaf-like.
- Frontoclypeus - see dorsal apotome.
- Fusiform - swollen in the middle and tapering toward base and apex.
- Grid - the network of sclerotized bars which make up the support for the attachment of the setal tufts of the ventral brush.
- Head - the first main body division, composed of 6 united segments.
- Head capsule - the sclerotized exoskeleton forming the integument of the head.

- Lateral palatal brush - the pair of brushes composed of numerous filaments, borne anterolaterally on the head (formerly called mouth brushes).
- Leaflet of palmate seta - the flattened branches of the palmate seta, composed of the blade and the filament.
- Maxilla - appendage of the mouthparts, usually bearing a lobe-like palpus, or sometimes a prominent "horn."
- Mesothorax - the second segment of the thorax.
- Metathorax - the third segment of the thorax.
- Mouth brush - see lateral palatal brush.
- Palmate - a seta with flattened branches, radiating from a common stem.
- Pecten - a row of short spines on the ventroalateral aspect of the siphon.
- Pectinate - having branches only on one side of a setal stem, like the teeth of a comb.
- Pinnate - having branches on both sides of a setal stem, like a feather.
- Plumose - having branches on both sides of a setal stem, but not so many as in a pinnate seta.
- Preclypeus - median labral plate anterior to the dorsal apotome.
- Preclatal seta - seta of the ventral brush (seta 4-X) attached anterior to the grid, not actually attached to the grid.
- Prothorax - the first segment of the thorax.
- Respiratory siphon - see siphon.
- Saddle - a prominent sclerite in abdominal segment X, sometimes completely encircling the segment.
- Sclerotization - see sclerotized.
- Sclerotized - the part of the integument or any structure which is hardened to create a plate-like form.
- Setal support plate - a small sclerotized plate to which one or more setae are attached.
- Shaft of seta - the main stem.
- Siphon - the appendage attached to abdominal segment VIII in culicine mosquitoes, used for respiration and bearing the spiracular apparatus apically.
- Siphon index - the length divided by the width at the base.
- Siphonal seta - seta attached to the siphon.
- Spiculate - bearing spicules
- Spicule - a projection on the integument continuous with the cuticle.
- Spike-like - in the form of a spike (large nail).
- Spiniform - thick, spine-like, usually not sharp-pointed apically.
- Spinule - a minute spine-like spicule.

Spiracular apparatus - a structure consisting of 5 valves which surround the spiracular openings; sessile in anophelines and located at the apex of the siphon in culicines.

Stellate - seta with numerous branches radiating from a single base.

Tergal plate - in anopheline larvae a small plate located in the dorsal midline of abdominal segments.

Trifid - with 3 branches.

Truncate - structure which is square at apex, not sharp pointed.

Ventral brush - group of setal tufts located ventrally on abdominal segment X, composed of cratal setae attached to the grid and sometimes precratal setae not on the grid but attached anterior to it (seta 4-X).

Ventral valve - posterolateral lobe of the spiracular apparatus.

ILLUSTRATIONS OF MOSQUITO MORPHOLOGY

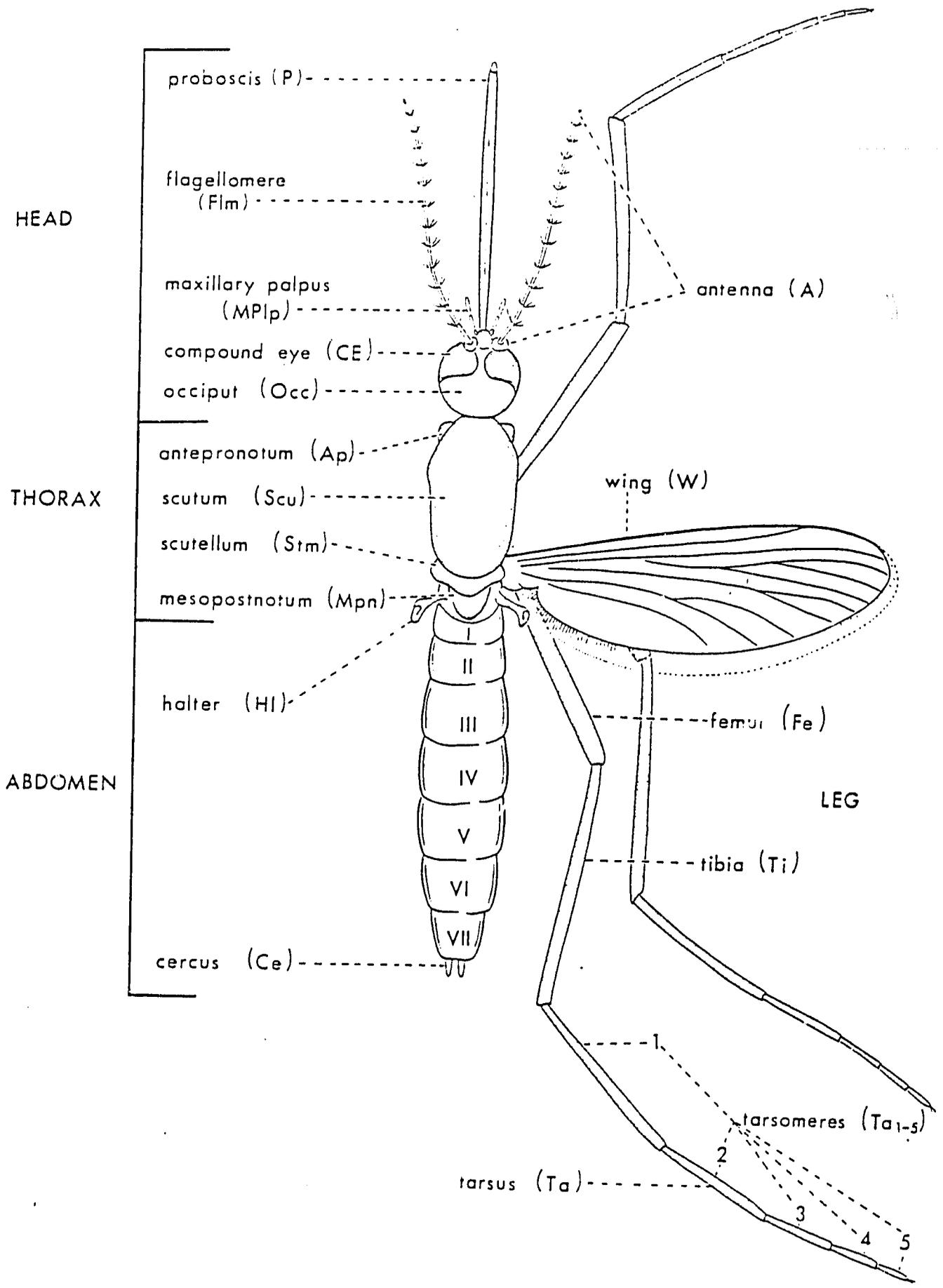


Plate 1. Diagram of adult female mosquito.

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ABBREVIATIONS OF ADULT FEMALE MORPHOLOGY IN PLATES

Plate 2

A - antenna	Lb - labium
C - coxa	MPlp - maxillary palpus
CE - compound eye	Occ - occiput
Cl - claw	OL - ocular line
Clp - clypeus	P - proboscis
CoF - corneal facet	Pe - pedicel
Fe - femur	Plp - palpomere
Fl - flagellum	Sc - scape
Flm - flagellomere	Ta - tarsus
Fr - frons	Ta _{1,3} - tarsomere
IS - interocular space	Ti - tibia
La - labellum	Tr - trochanter
	V - vertex

Plate 3

Illustrations A and B

AcS - acrostichal setae	PeSU - upper proepisternal setae
Ap - antepnotum	Ppn - postpronotum
ApS - antepnotal setae	PpS - postpronotal setae
C-I - forecoxa	PrA - prescutellar area
Cv - cervix	Ps - proepisternum
DS - dorsocentral setae	SaS - supraalar setae
LSS - lateral scutellar setae	Scu - scutum
Mpn - mesopostnotum	SF - scutal fossa
MSS - median scutellar setae	SFS - scutal fossal setae
Mtn - metanotum	Stm - scutellum
	W - wing.

Illustration C (Wing)

A - anal vein	M ₁₊₂ - anterior branch of medial vein
A - anal cell	M ₂ - medial ₂ cell
C - costal vein	M ₃₊₄ - posterior branch of medial vein
C - Costal cell	M ₄ - medial ₄ cell
Cu - cubital vein	m-cu - mediocubital crossvein
Cu ₁ - anterior branch of cubital vein	R - radial vein
Cu ₁ - cubital cell	R - radial cell
Cu ₂ - posterior branch of cubital vein	R ₁ - anteriormost branch of radial vein
Cu ₂ - cubital ₂ cell	R ₁ - radial ₁ cell
FS - fringe scales	R ₁ - radial sector vein
h - humeral crossvein	R ₂ - anterior branch of radial sector vein
M - medial vein	
M - medial cell	

R_2 - radial₂ cell
 R_{2+3} - connector vein (stem)
of radial sector vein
 R_m - median branch of
radial sector vein
 R_1 - radial₁ cell

R_{1+3} - posterior branch of
radial sector vein
 R_3 - radial₃ cell
r-m - radiomedial crossvein
Sc - subcostal vein
Sc - subcostal cell

Plate 4

Ab-I - abdominal segment I
AMas - anterior mesanepisternum
Ap - antepnotum
ApS - antepnotal setae
C-I - forecoxa
C-II - midcoxa
C-III - hindcoxa
Ce - cercus
Cv - cervix
DS - dorsocentral setae
H - head
HI - halter
HyA - hypostigmal area
LSS - lateral scutellar setae
Mam - mesanepimeron
Mem - metameron
MeSL - lower mesanepimeral setae
MeSU - upper mesanepimeral setae
Mks - mesokatepisternum
MkSL - lower mesokatepisternal setae
MkSU - upper mesokatepisternal setae
Mpn - mesopostnotum
MS - mesothoracic spiracle
Msm - mesomeron
MSS - medial scutellar setae

Mtm - metepimeron
Mtn - metanotum
Mtpn - metapostnotum
Mts - metepisternum
MtS - metathoracic spiracle
PA - postspiracular area
PaS - prealar setae
PeSU - upper proepisternal setae
PGL - postgenital lobe
PM - postprocoxal membrane
PMas - posterior mesanepisternum
Ppn - postpronotum
PpS - postpronotal setae
Ps - proepisternum
PS - postspiracular setae
PsS - prespiracular setae
PsA - prespiracular area
S - sternum of abdomen
SA - subspiracular area
SaS - supraalar setae
Scu - scutum
SF - scutal fossa
SFS - scutal fossal setae
Stm - scutellum
Te - tergum of abdomen
W - wing

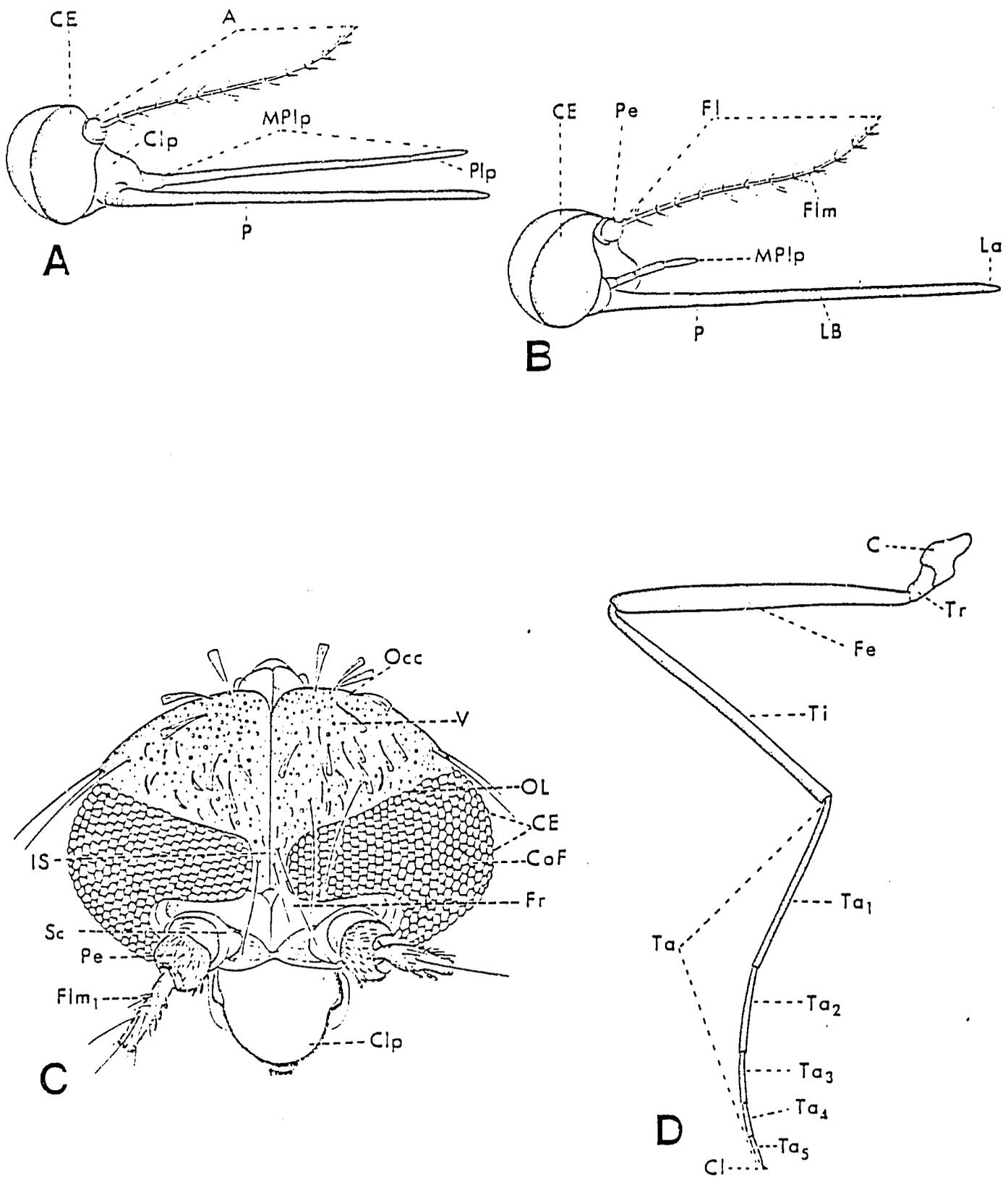


Plate 2. Head and leg of adult female mosquito. A. Lateral view of anopheline head; B. Lateral view of culicine head; C. dorsal view of culicine head; D. lateral view of leg.

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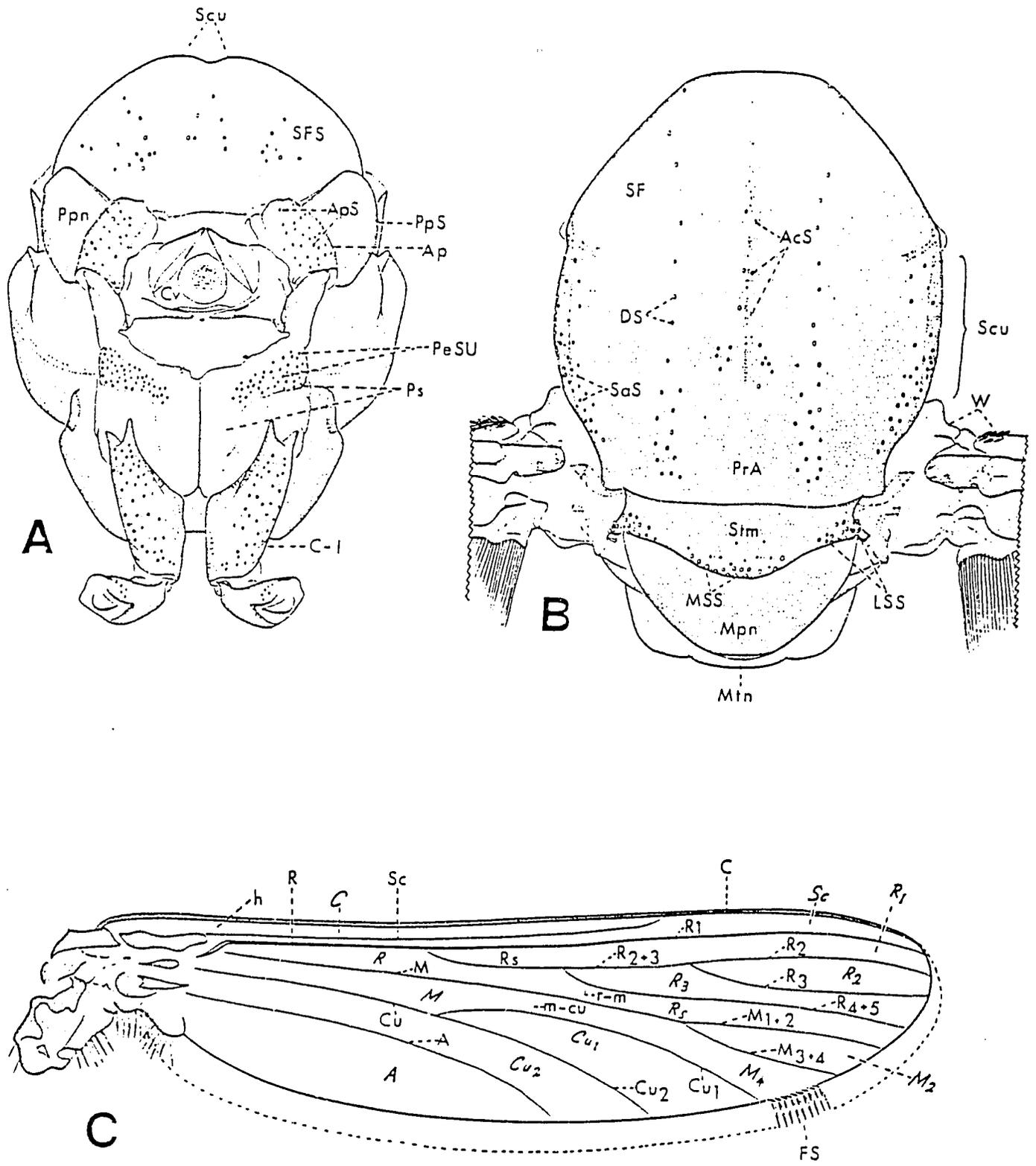
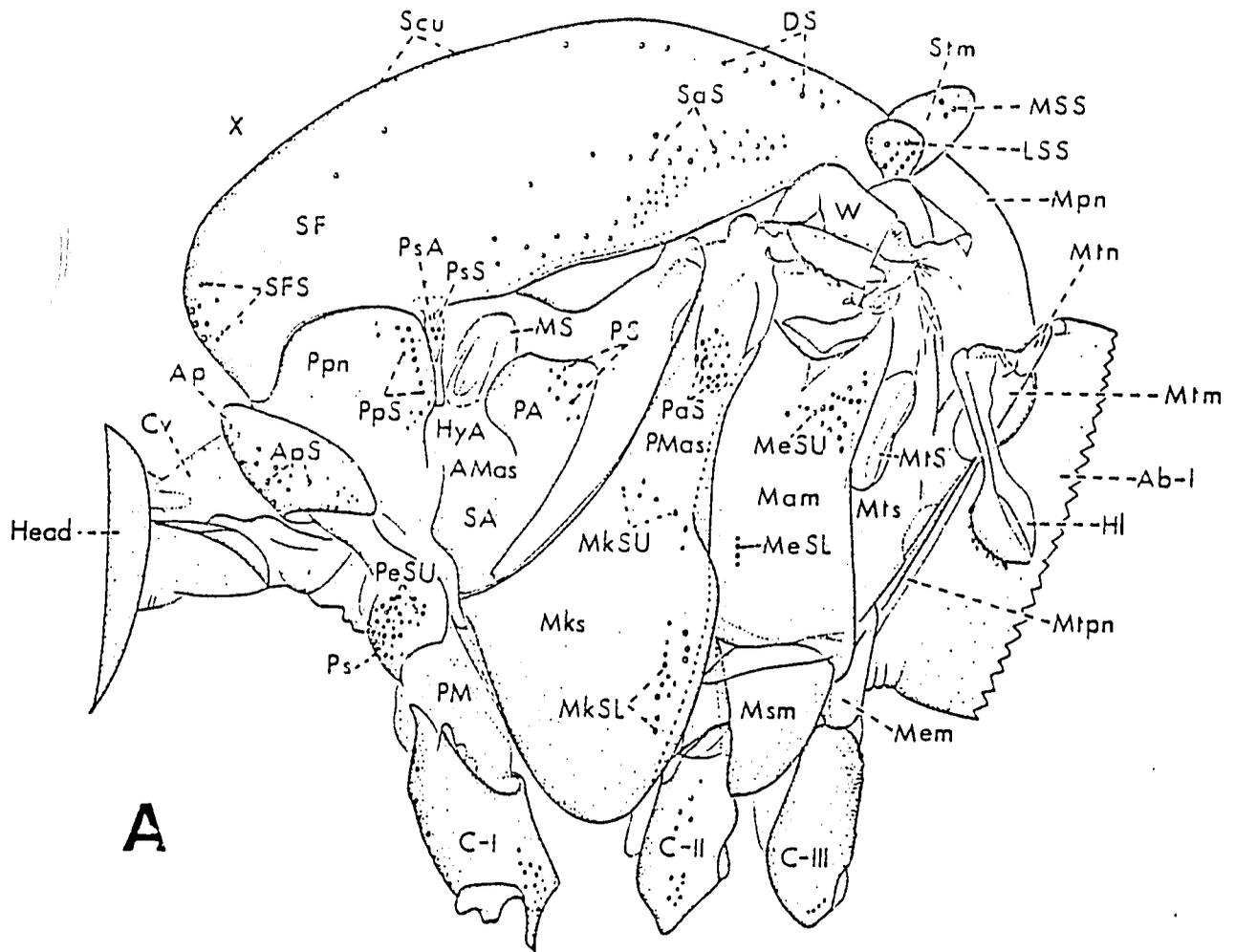
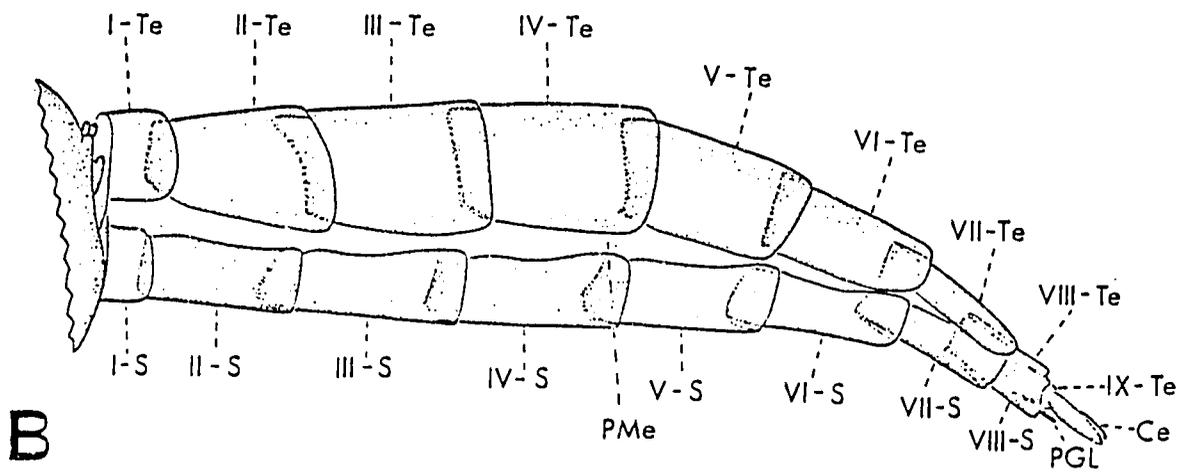


Plate 3. Thorax and wing of adult female mosquito. A. Anterior view of thorax; B. Dorsal view of thorax; C. Dorsal view of wing; longitudinal veins designated by gothic letters, cells by italics.

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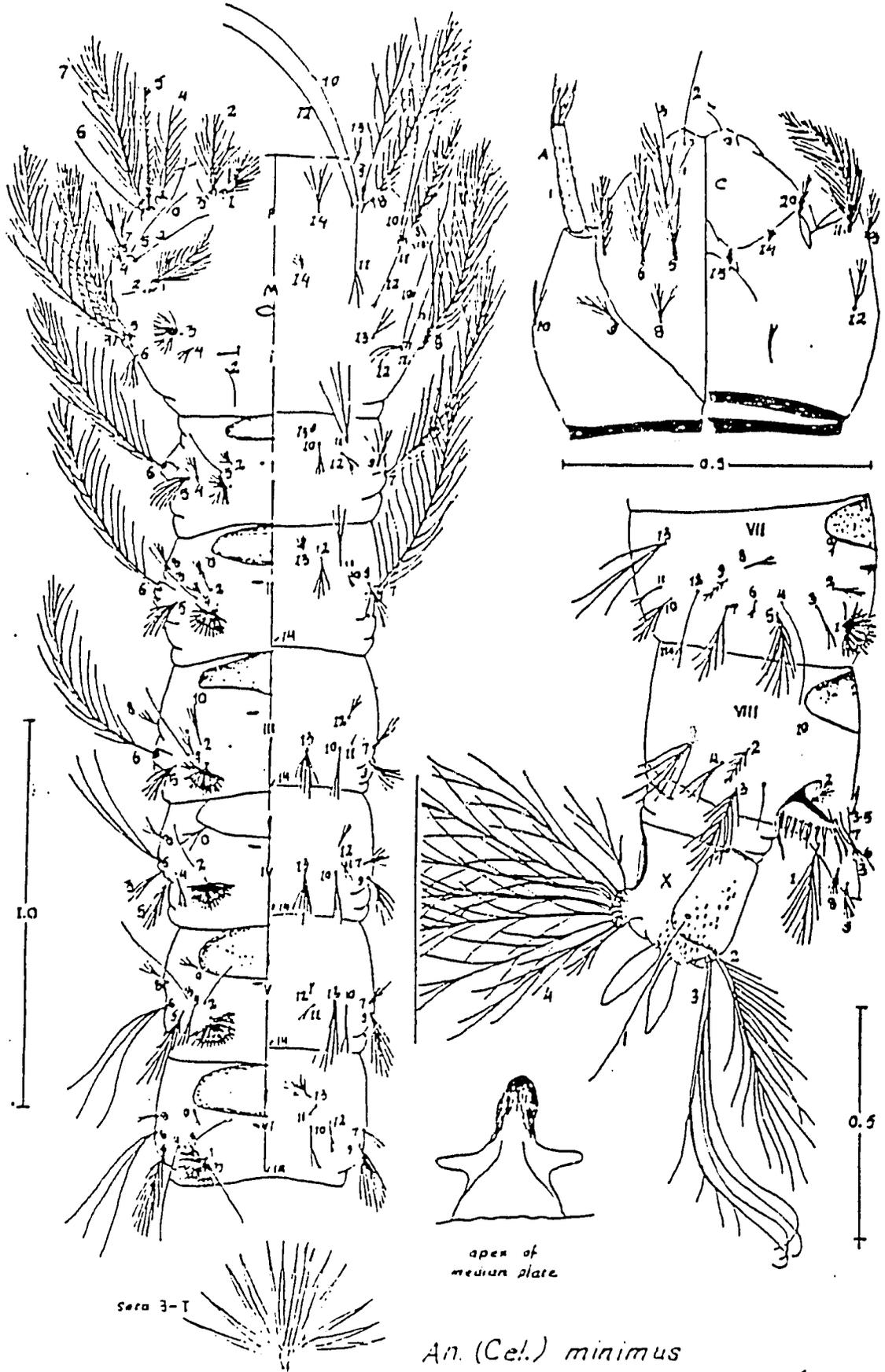
A



B

Plate 4. Thorax and abdomen of adult female mosquito. A. Lateral view of thorax; B. Lateral view of abdomen.

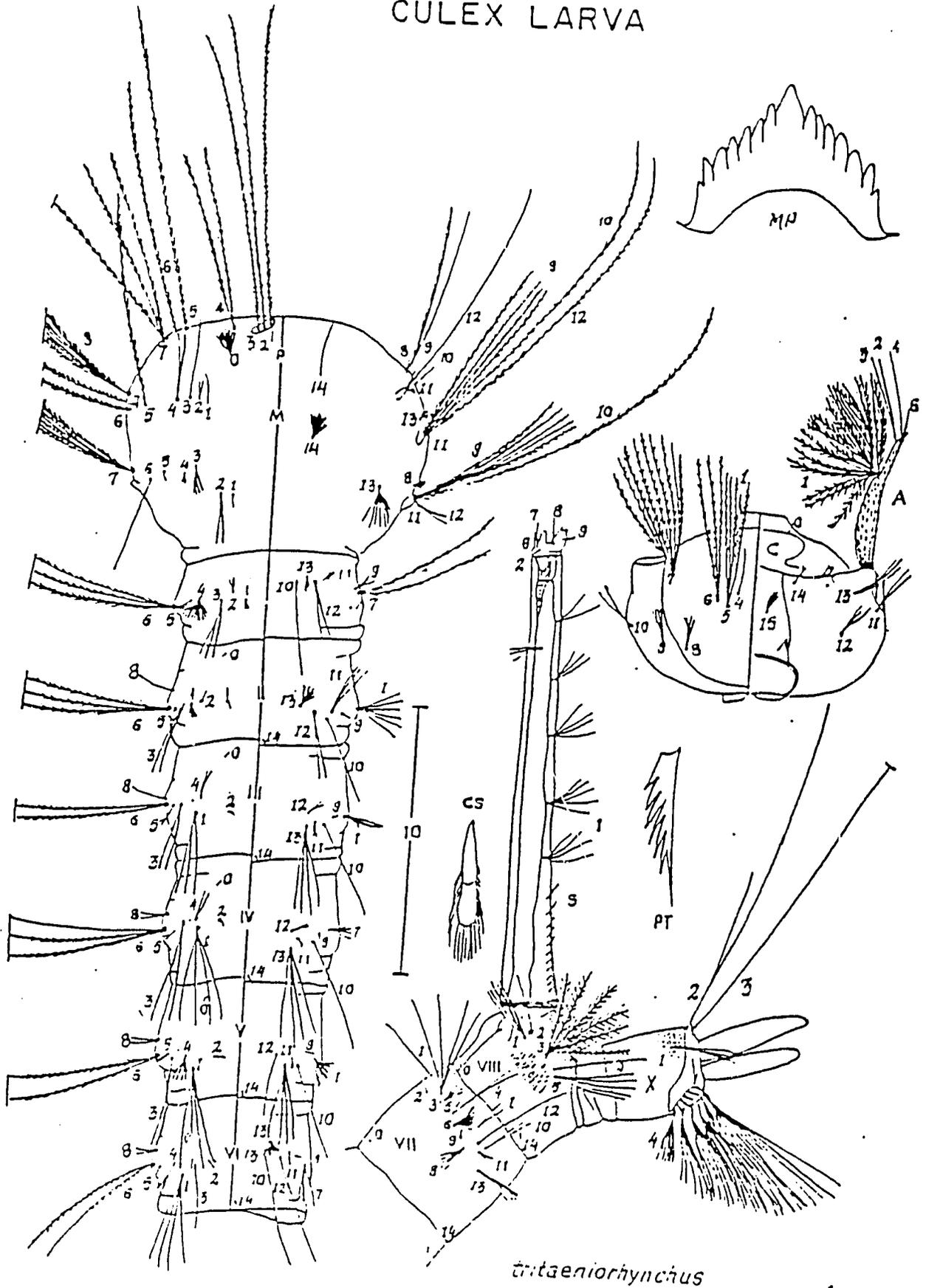
NUMBER AND POSITION OF HAIRS
ON FOURTH INSTAR
ANOPHELES LARVA



An. (Cel.) minimus

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NUMBER AND POSITION OF HAIRS
ON FOURTH INSTAR
CULEX LARVA



tetraeniorhynchus

Plate 6

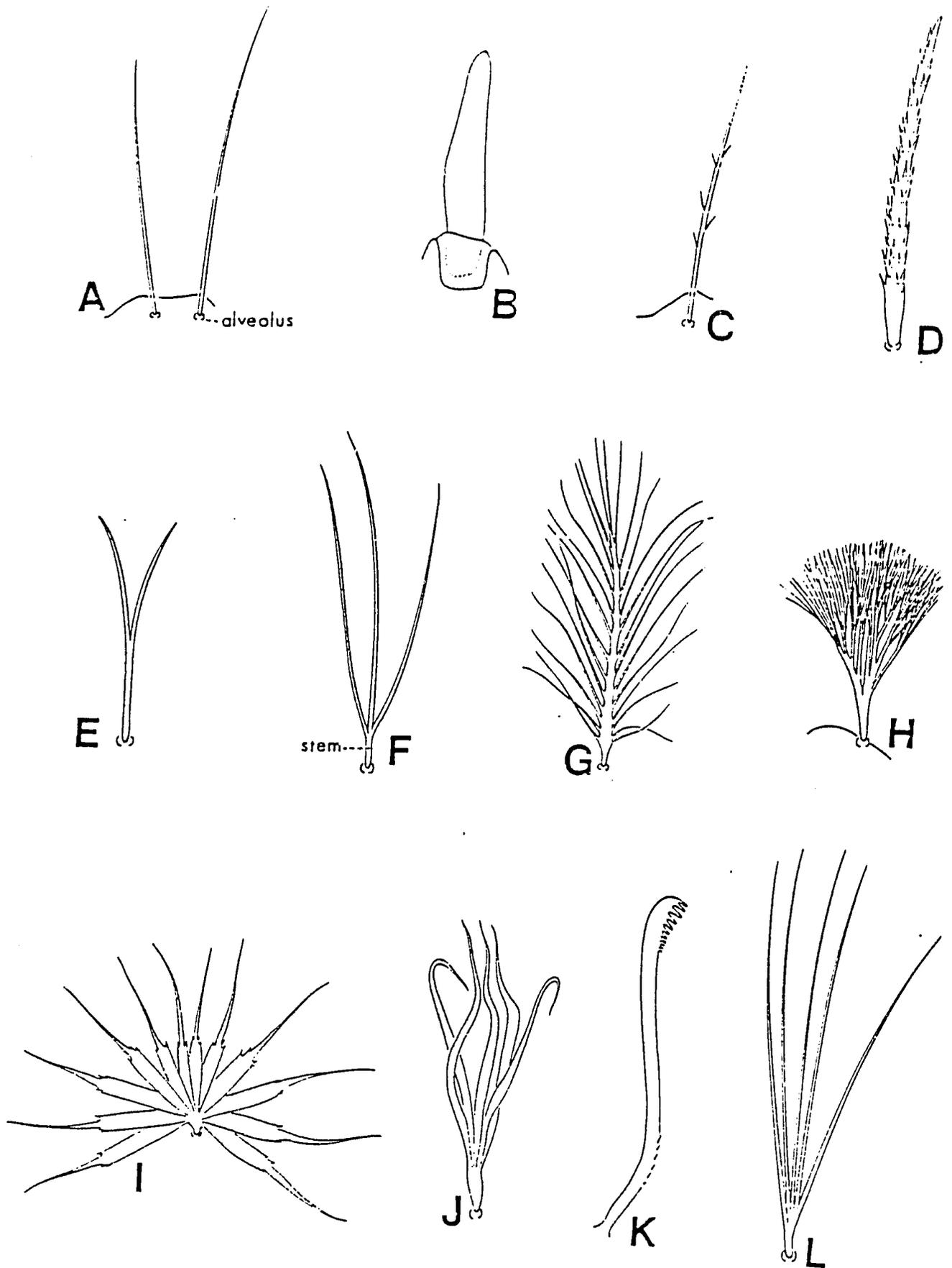


Plate 7. Examples of kinds of setae found in mosquito larvae. A. Unbranched smooth setae: B. Spiniform seta: C. Unbranched aciculate seta: D. Spinulate spiniform seta: E. Forked seta: F. Branched seta: G. Plumose seta: H. Dendritic seta: I. Palmate seta, fully developed: J. Palmate seta, 0.5 developed: K. Comb-tipped filament: L. Fanlike seta of ventral brush.

ABBREVIATIONS IN PLATE 8

APP - anal papilla	PSLP - posterolateral spiracular lobe plate
ASL - anterior spiracular lobe	PSP - posterior spiracular plate
ASLP - anterior spiracular lobe plate	Pt - pecten
C - comb	S - siphon
CS - comb scales	Sa - saddle
G - grid	SA - siphon acus
IST - inner spiracular teeth	SaA - saddle acus
LGB - lateral grid bar	SAd - spiracular apodeme
LSL - anterolateral spiracular lobe	SAP - spiracular apparatus
LSLP - anterolateral spiracular lobe plate	SAW - saw
MdP - median plate	SOp - spiracular opening
OSt - outer spiracular teeth	TGB - transverse grid bar
PP - pecten plate	VII - abdominal segment VII
PS - pecten spines	VIII - abdominal segment VIII
PSL - posterolateral spiracular lobe	X - abdominal segment X (anal segment)
	2-S seta 2 of siphon

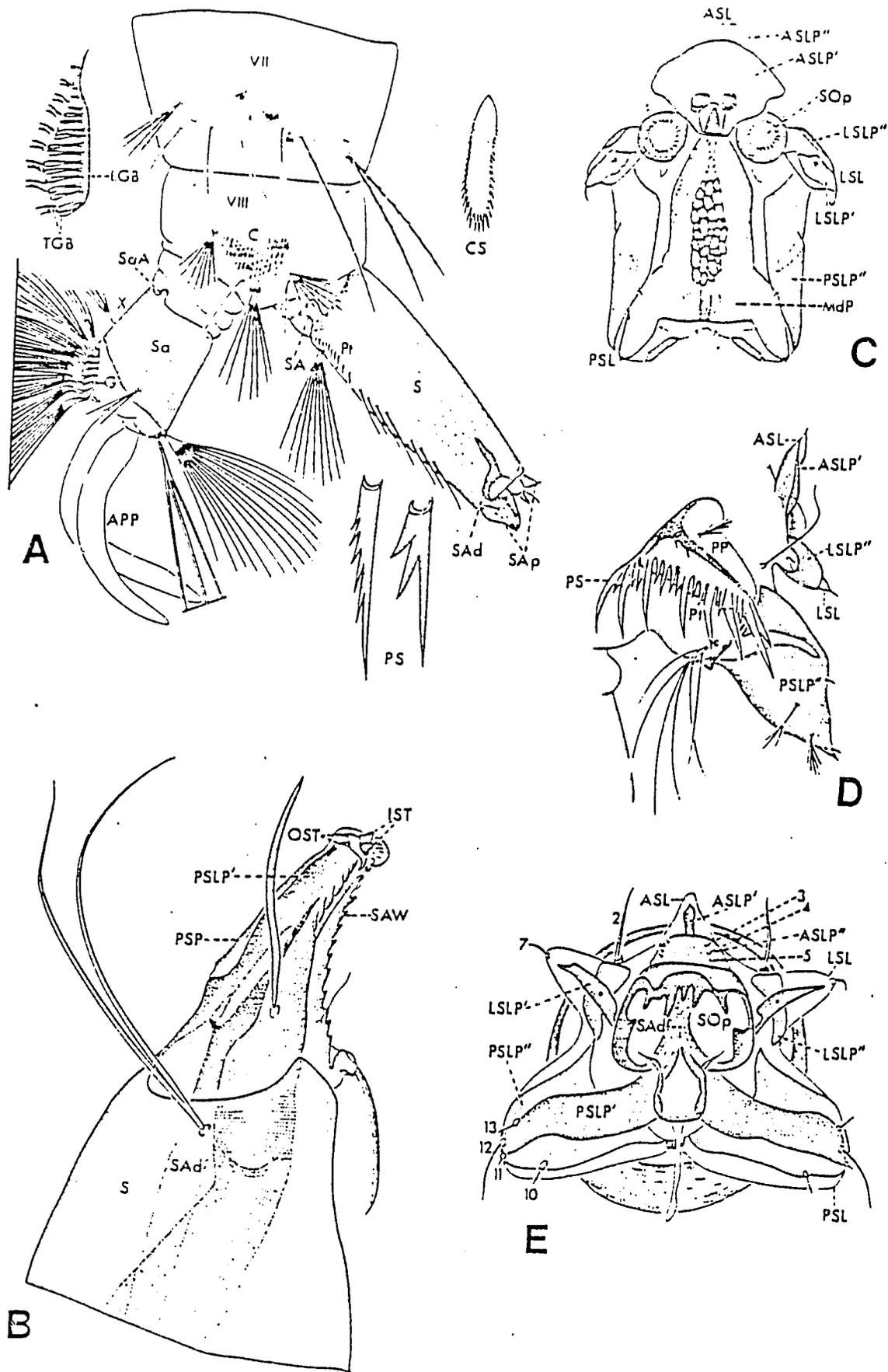


Plate 8. Morphology of terminal abdominal segments of mosquito larvae. A. segments VII-X of *Culiseta*; B. Siphon and spiracular apparatus of *Mansonia*; C, D. Spiracular apparatus of *Anopheles*: C. dorsal view, D. lateral view; E. Dorsal view of spiracular apparatus of *Culex*.

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ANNEX 3

NEW MOSQUITO RECORDS FOR NEPAL
(Diptera, Culicidae)

NEW MOSQUITO RECORDS FOR NEPAL
(Diptera, Culicidae)

Shreedhar P. Pradhan and Richard F. Darsie, Jr.*

Abstract. An additional 13 mosquito species of the genera Aedes, Culex, Mimomyia and Uranotaenia are reported from Nepal for the first time. Taking into account taxonomic changes in the original list (Joshi et al., 1965), 70 species of culicine (i.e., non-anopheline) mosquitoes are now known from Nepal.

In 1965, Joshi et al. published a list of 59 species of culicine, sabethine and toxorhynchitine mosquitoes occurring in Nepal. This original list has been reduced by 2 with the synonymizing of Cx. fuscifurcatus Edwards under Cx. jacksoni Edwards (Sirivanakarn, 1976) and by discounting the doubtful record of Cx. minutissimus (Theobald) (Sirivanakarn, 1977). Additional collections made, mainly by the senior author, have resulted in the discovery of 13 species and 1 genus, Mimomyia Theobald, new to Nepal, which are being reported here for the first time.

One event which increased interest in the culicine fauna of Nepal was the appearance of Japanese encephalitis (Khatri et al., 1983), a disease transmitted primarily by mosquitoes of the genus Culex. Outbreaks have occurred periodically since 1978 and surveys have been conducted in the affected districts of the terai belt (the southern part at low elevation bordering India).

In this connection, the authors visited an endemic area in Tarahara, Sunsari District, Koshi Zone, from Nov. 23 to Dec. 1, 1987, for the purpose of making intensive collections in and around 2 Nepal Government Field Stations, the Tarahara Agricultural Farm, Ministry of Agriculture, and the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation. Nightly hand aspirator collections in piggeries and trapping with a CDC miniature light trap without dry ice on the 2 farms resulted in the recovery of 5 species new to Nepal, as noted below.

Unless otherwise indicated, Barraud (1934) was used during the identifications and voucher specimens have been deposited in the National Museum of Natural History, Smithsonian Institution.

DESCRIPTION OF LOCALITIES

The sites from which mosquito specimens, which constitute new country records for Nepal, were collected have some interesting and significant topographical features. They are as follows:

Footnote, page 1

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NEW MOSQUITO RECORDS FOR NEPAL
(Diptera, Culicidae)

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Musepani, Haldu Khal and Badaipur are all villages in Kanchanpur District, located in the extreme southwestern corner of the country, bordering India. Musepani and Haldu Khal are situated in forest clearings near the foothills of the Churia Range (southernmost low range of mountains in the Himalaya Mountain chain). They are surrounded by limited areas of rice paddies. Some corn and vegetables are also grown there. Haldu Khal was just recently established. Badaipur, on the other hand, is 12 km. south of the Churia Range in open plains surrounded by extensive rice culture. However, just 3 km. away is the Sukla Phanta National Park, a forest preserve.

Kailali District borders Kanchanpur to the east. The village of Geeta Gate is 6 km. N of the districts largest town, Dhanghari Bazar, and is in open plain terai supporting rice growing. However, the collections were made at the Kailali military barracks, situated near Geeta Gate in a small patch of forest.

Mahottari District is east-centrally located and the village of Pipara is along the Janakpur-Jaleswor highway in the open terai. It is semi-rural and completely surrounded by rice paddies.

Tarahara is a relatively small town on the main highway from Biratnagar to Dharan Bazar. Within its borders is the large Tarahara Agriculture Farm of the Nepal Ministry of Agriculture. It has diverse agricultural research projects, including several aquaculture fish ponds, rice and grain plots and animal husbandry, mostly for raising swine. An extensive tropical hardwood forest begins less than 1 km. to the north. At its fringe is located the Herbal Farm of the Department of Medicinal Plants, Nepal Ministry of Forests and Soil Conservation. It is a low, swampy area, partially arable supporting the cultivation of medicinal herbs. Mosquito collections were made at both of these government facilities.

Kalimati is a suburb of Kathmandu, the country's capital. It is completely urban but most of the land not occupied by buildings is used for vegetable gardens. The gardens near where Cx. hutchinsoni was collected are irrigated by highly polluted water from a nearby stream. There are ground pools in the vicinity. Washington, D.C., U.S.A.

NEW COUNTRY RECORDS

Aedes (Aedimorphus) pallidostriatus (Theobald, 1907)

Two females were collected in Pipara, Mahottari District, Janakpur Zone, VII-7-84, resting in a cattle shed; 14 females and

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2 males in Haldu Khal, Kanchanpur District, Mahakali Zone, VIII-3-86, feeding on cattle at night; 16 females and 7 males in Musepani, Kanchanpur District, Mahakali Zone, VIII-13-87, resting on vegetation near human dwellings; and 17 females in Lohandra, Morang District, Koshi Zone, VII-12-87, inside human dwellings. Its identity was confirmed by Dr. Bruce Harrison, Walter Reed Biosystematics Unit, Smithsonian Institution, Washington, D.C. (in litt.).

Aedes (Aedimorphus) pipersalatus (Giles, 1902)

Three females were collected in Badaipur, Kanchanpur District, Mahakali Zone, VIII-14-87, feeding on carabao at night; 8 females and 3 males in Musepani, Kanchanpur District, Mahakali Zone, VIII-25-87, attracted to humans diurnally. Identities were confirmed using Reinert (1973).

Aedes (Aedimorphus) punctifemoris (Ludlow, 1921)

Two females were collected at the military barracks in Geeta Gate, Kailali District, Seti Zone, IX-10-83, feeding on pigs; 22 females in Haldu Khal, Kanchanpur District, Mahakali Zone, VIII-19-86, caught feeding on cattle at night; 7 females in Musepani, Kanchanpur District, Mahakali Zone, VIII-13-87, attracted to humans and resting on vegetation near human dwellings. Identities were confirmed using Reinert (1973).

Aedes (Christophersomyia) thomsoni (Theobald, 1905)

One female was collected at the military barracks in Geeta Gate, Kailali District, Seti Zone, IX-10-83, feeding on pigs. Its identity was confirmed by Dr. R. Rajagopal, National Institute of Communicable Diseases, Delhi, India (in litt.).

Aedes (Verrallina) indicus (Theobald, 1907)

One female was collected in the military barracks in Geeta Gate, Kailali District, Seti Zone, IX-30-87, attracted to humans at night. This record represents the first time a species of the subgenus Verrallina Theobald was taken in Nepal. Reinert (1984) was consulted during its identification.

Culex (Culex) edwardsi Barraud, 1923

Two females were collected at the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone, XI-27-87, captured in a CDC miniature light trap located at the edge of a tropical forest; 2 females, at Tarahara Agricultural Farm, Tarahara, Sunsari District, Koshi Zone, XI-29-87, in a CDC light trap hung

in a piggery. Identities were confirmed using Sirivanakarn (1976).

Culex (Culex) hutchinsoni Barraud, 1924

One female was collected in Kalamati, Kathmandu District, Bagmati Zone, VIII-12-86, attracted to humans indoors at night in a completely urbanized area where vegetable gardens surrounded the houses. Its identity was confirmed using Sirivanakarn (1976).

Culex (Culicomyia) nigropunctatus Edwards, 1926

One male was collected at the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone, XI-26-87, captured in a CDC miniature light trap hanging over a ditch in the fringe of the forest. Its identity was confirmed using Bram (1967)

Mimomyia (Etorleptomyia) luzonensis (Ludlow, 1905)

One female was collected at Tarahara Agricultural Farm, Ministry of Agriculture, Tarahara, Sunsari District, Koshi Zone, XI-25-87, at night feeding on pigs. Its identity was confirmed using Mattingly (1957).

Uranotaenia (Pseudoficalbia) recondita Edwards, 1922

One female was collected at the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone, XI-26-87, in a CDC miniature light trap hanging over a ditch at the fringe of the tropical forest.

Uranotaenia (Pseudoficalbia) stricklandi Barraud, 1926

One female was collected in Haldu Khal, Kanchanpur District, Mahakali Zone, VIII-19-86, resting in a cattle shed at night. Its identity was confirmed using Peyton (1977).

Uranotaenia (Uranotaenia) macfarlani Edwards, 1914

Eight females were collected at the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone, XI-25 to 28-87, in a CDC miniature light trap hanging over a ditch at the fringe of the forest.

Uranotaenia (Uranotaenia) spp. near testacea Theobald, 1905

Three females and 1 male were collected at the Herbal Farm, Department of Medicinal Plants, Ministry of Forests and Soil Conservation, Tarahara, Sunsari District, Koshi Zone, XI-26-87, in a CDC miniature light trap hanging over a ditch in the fringe of the tropical forest. These specimens belong to an undescribed species. Other specimens of this taxon have been collected in India (Assam), Burma, Thailand, Kampuchea, Vietnam, East and West Malaysia (E. L. Peyton, personal communication).

Acknowledgments

The authors are indebted to L. A. Lacey for initiating and supporting the project; to D. Calder for his foresight in fostering the study and his encouragement; to K. M. Dixit, Chief, NMEO, and R. G. Vaidya, Chief, Entomology Section, NMEO, for assigning the entomological team, K. Kadaka, H. P. Poudyal and N. P. Shrestha, to assist and for their diligence in searching for mosquitoes; to P. Karna and A. Singh for providing accommodations for the study; to N. P. Gurung for assistance in the use of the piggeries; to M. Chamlin for logistical support and to E. L. Peyton, Y. M. Huang and J. F. Reinert for checking identifications.

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ANNEX 4

ILLUSTRATED KEYS TO THE GENERA OF
ADULT FEMALE MOSQUITOES OF NEPAL

KEY TO THE GENERA OF ADULT FEMALE MOSQUITOES
OF NEPAL*

1. Proboscis long, strongly recurved (Fig. 1); posterior border of wing emarginated just beyond tip of vein C_{u2} (Fig. 3).....Toxorhynchites splendens
 Proboscis not so long and only slightly curved, if at all (Fig. 2); posterior border of wing evenly rounded or only slightly emarginated (Fig. 4).....2

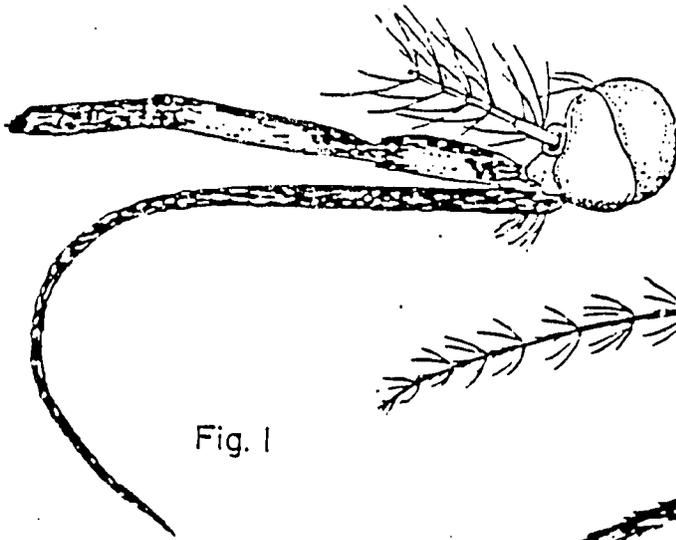


Fig. 1

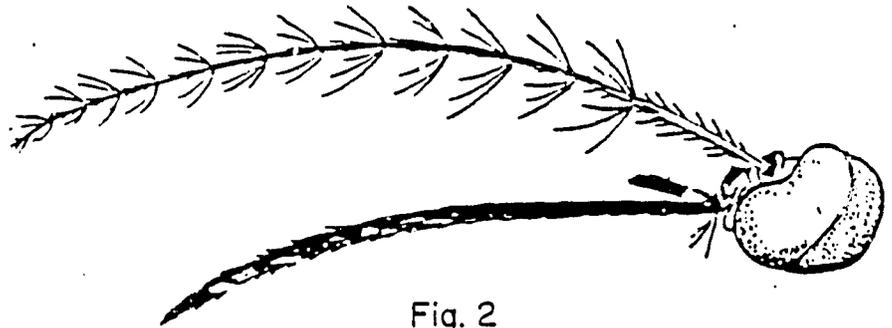


Fig. 2

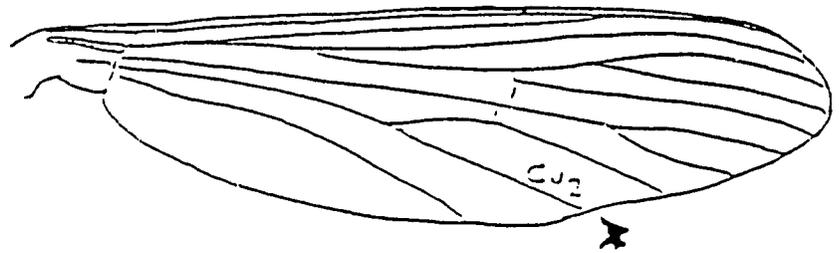
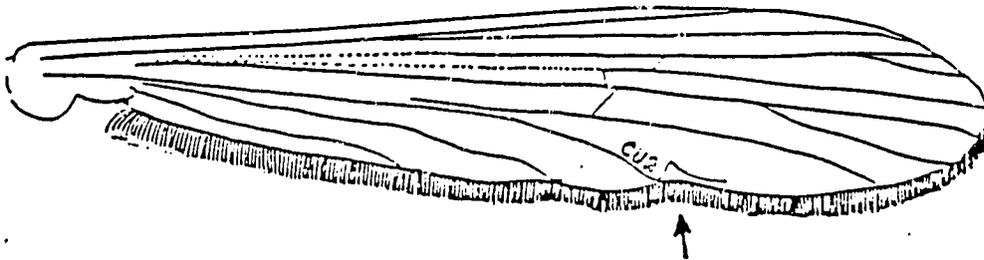


Fig. 4

- 2(1). Scutellum evenly rounded, with setae evenly distributed (Fig. 5); maxillary palpi about as long as proboscis (Fig. 7).....Anopheles
Scutellum trilobed, with setae in 3 distinct groups (Fig. 6); maxillary palpi shorter than proboscis (Fig. 8).....3

Fig.5

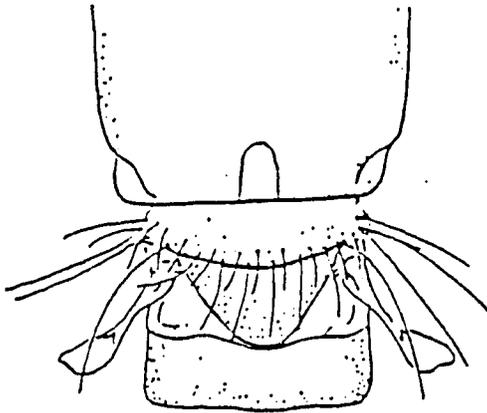


Fig.6

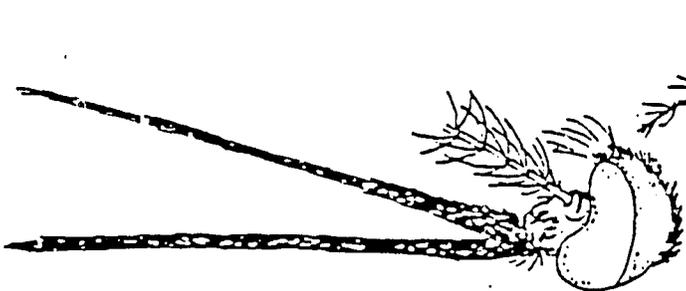
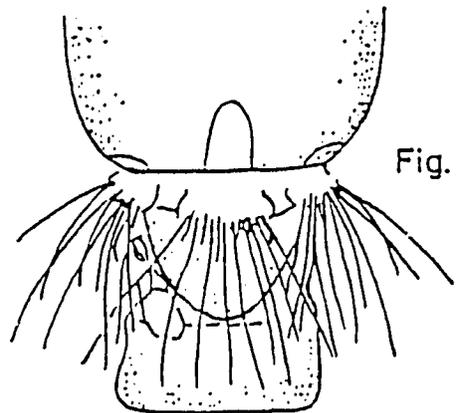


Fig. 7

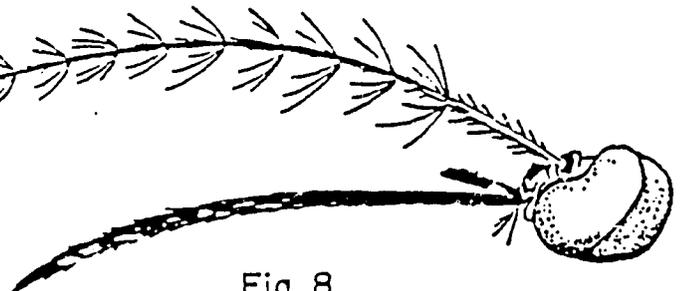


Fig. 8

- 3(2). Proboscis with flexible joint, tip swollen, with long setae (Fig. 9).....Malaya genurostris
Tip of proboscis only slightly swollen, if at all, with neither flexible joint nor long setae apically (Fig. 10).....4

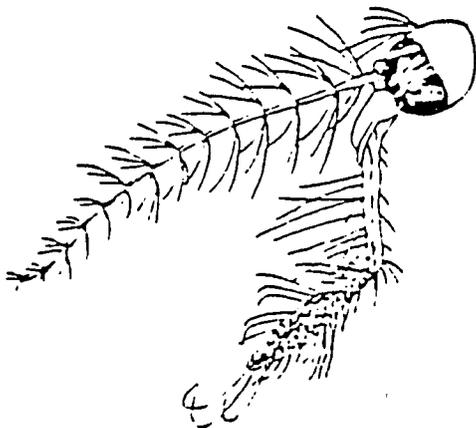


Fig. 9



Fig. 10

- 4(3). Scutum with longitudinal stripe of broad, flat scales usually white or silvery (Fig. 11); prespiracular setae present (Fig. 13).....Topomyia aureoventer
Scutum with other pattern (Fig. 12); prespiracular setae present or absent (Fig. 14).....5

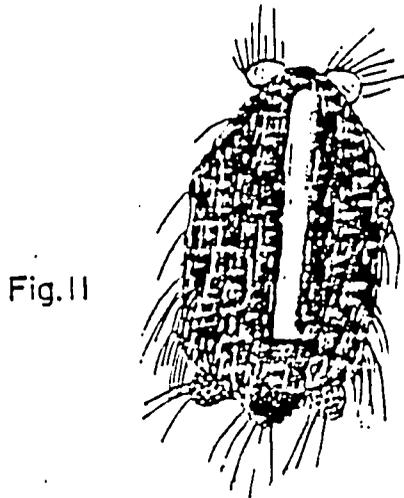


Fig. 11



Fig. 12

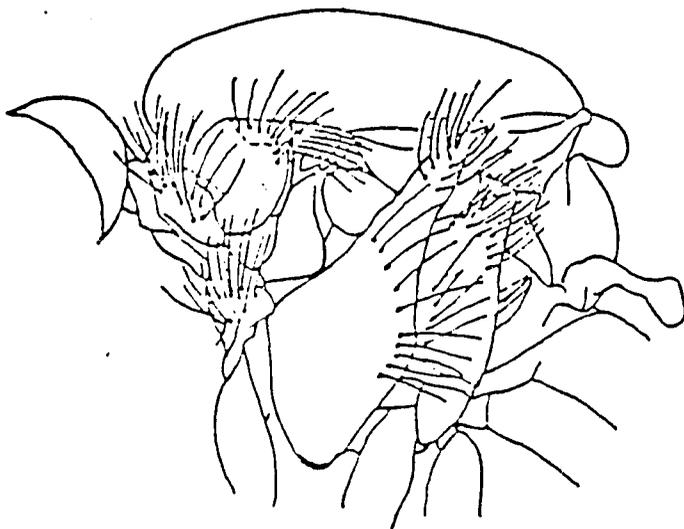


Fig. 13

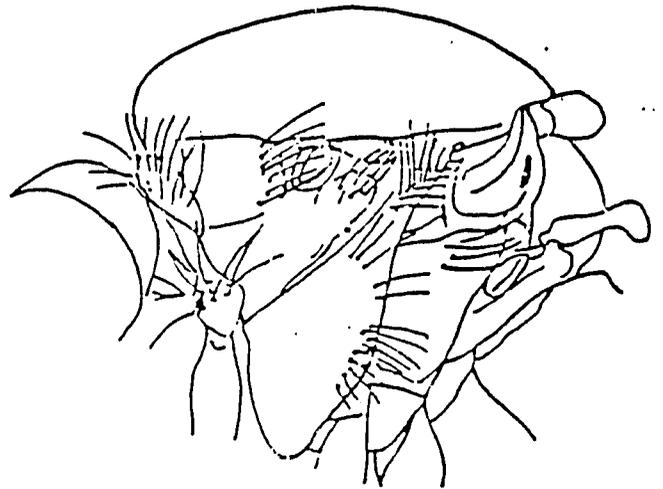


Fig. 14

- 5(4). Cell R_2 of wing always shorter than vein R_{2+3} ; anal vein ending apically before fork of veins Cu_1 and Cu_2 (Fig. 15)..... Uranotaenia
Cell R_2 at least as long as vein R_{2+3} ; anal vein ending apically distal to fork of veins Cu_1 and Cu_2 (Fig. 16).....6

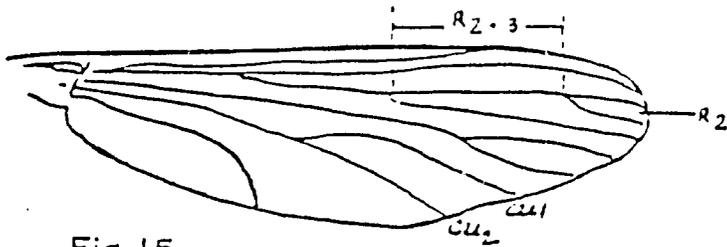


Fig. 15

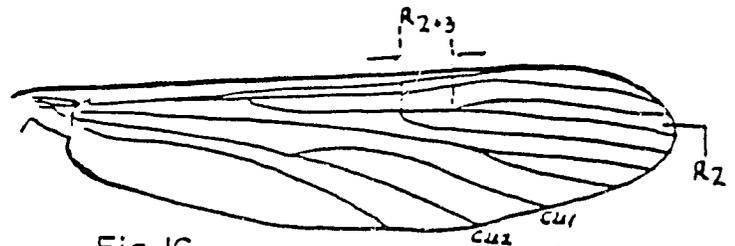


Fig. 16

- 6(5). Prespiracular area with setae (Fig. 17); subcostal vein with group of setae basally on ventral aspect (Fig. 19)..... Culiseta niveitaeniata
Prespiracular area and ventral aspect of subcostal vein bare (Figs. 18,20).....7

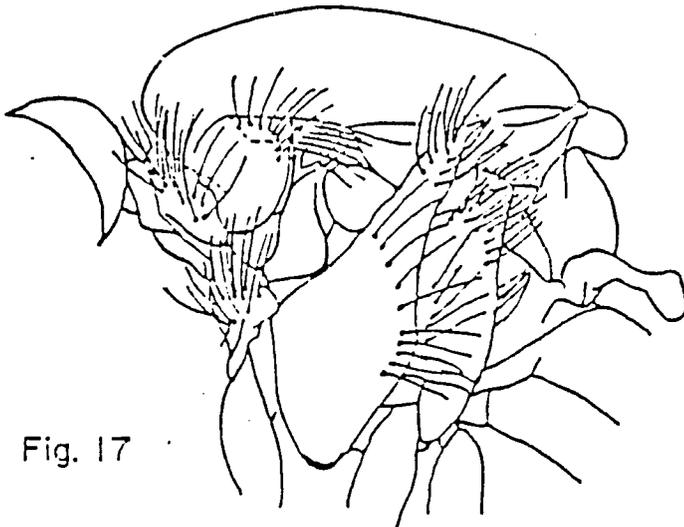


Fig. 17

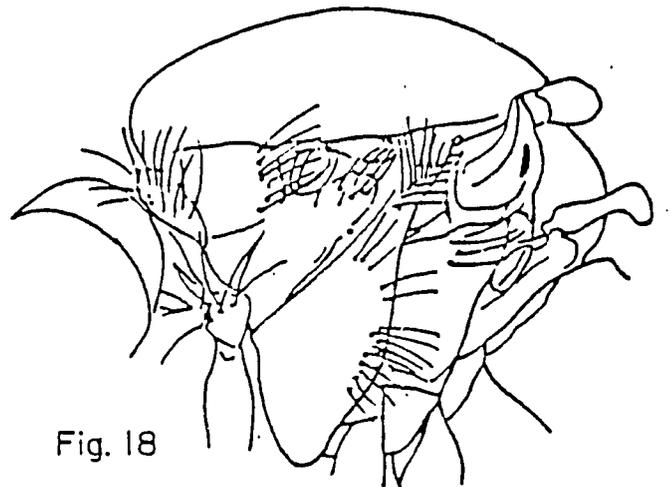


Fig. 18

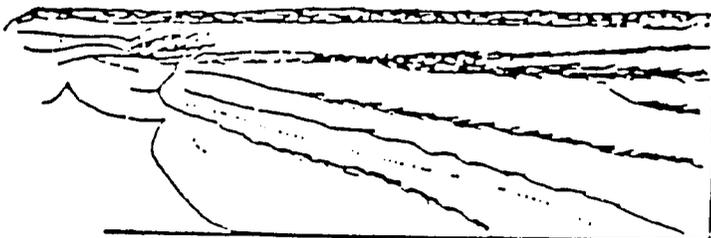


Fig. 19

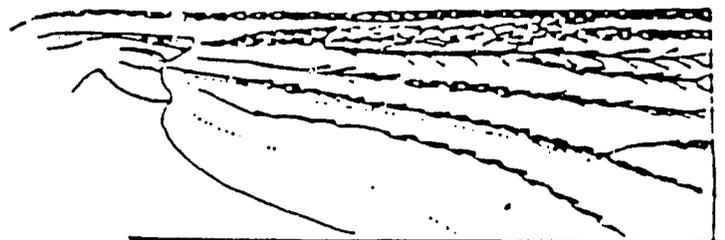


Fig. 20

- 7(6). Mesopostnotum with setae (Fig. 21); scutum clothed with bright, metallic decumbent scales (Fig. 23)..
Heizmannia
 Mesopostnotum without setae (Fig. 22); scutum with other type of scales (Fig. 24).....8

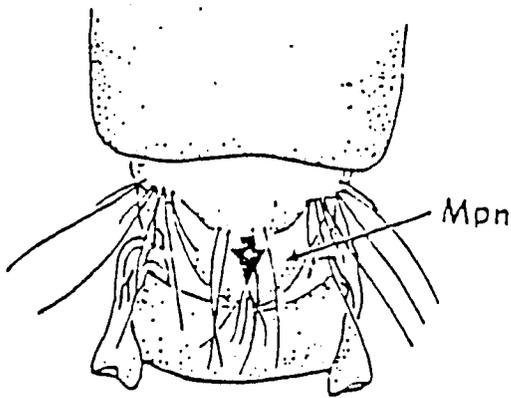


Fig. 21

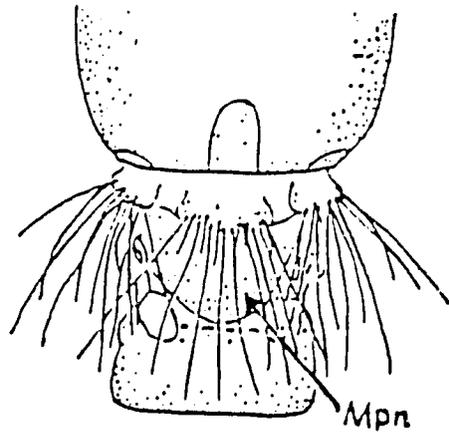


Fig. 22

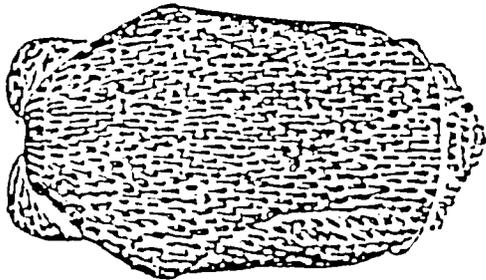


Fig. 23

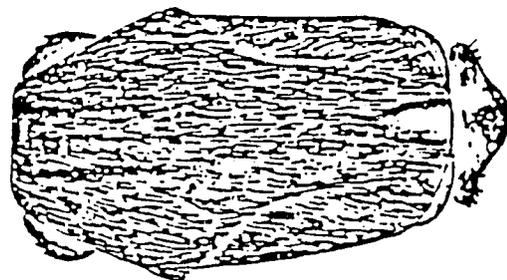


Fig. 24

- 8(7). Fore- and midtarsomeres 1 distinctly longer than other 4 tarsomeres combined, tarsomere 4 on fore- and midlegs short, about as long as wide (Fig. 25).....Orthopodomyia anopheloides
 Fore- and midtarsomeres 1 shorter than other 4 tarsomeres combined, tarsomere 4 of fore- and midlegs much longer than wide (Fig. 26).....9

Fig. 25

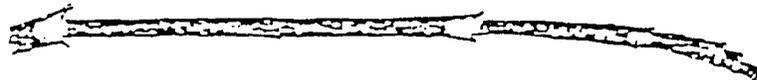
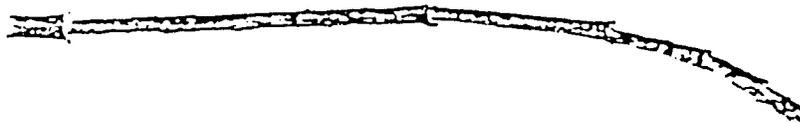


Fig. 26



- 9(8). Postspiracular setae present (Fig. 27).....10
Postspiracular setae absent (Fig. 28).....12

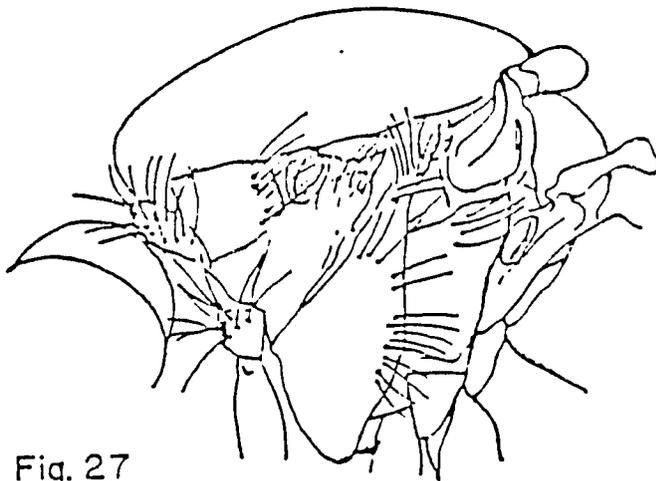


Fig. 27

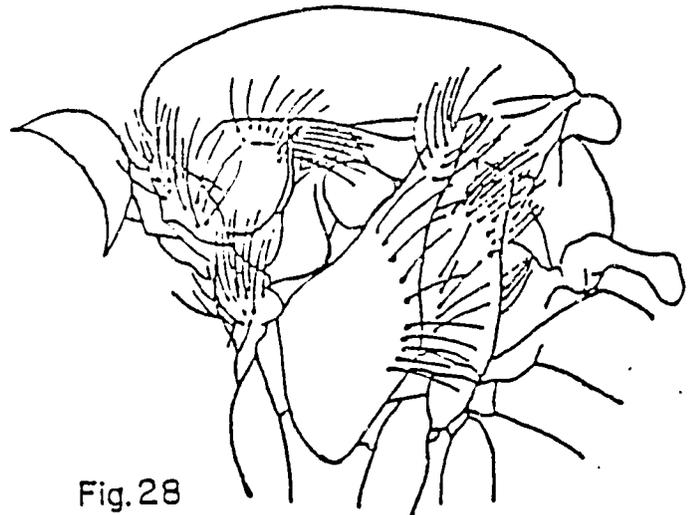


Fig. 28

- 10(9). Dorsal surface of wing with scales broad (Fig. 29);
abdomen bluntly rounded apically (Fig. 31)..Mansonia
Dorsal surface of wing with scales narrow (Fig. 30);
abdomen more or less pointed apically (Fig. 32)...11

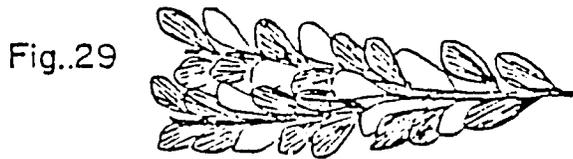


Fig. 29

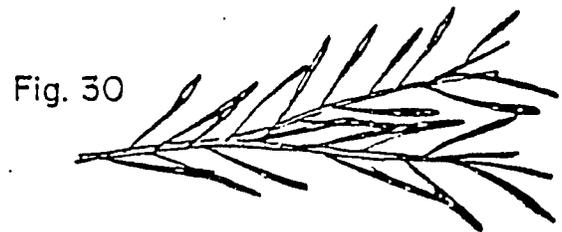


Fig. 30

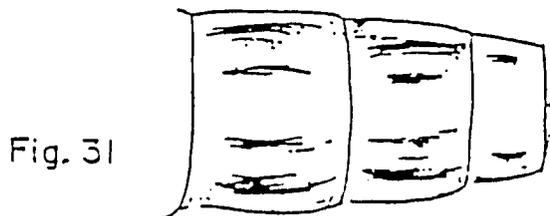


Fig. 31

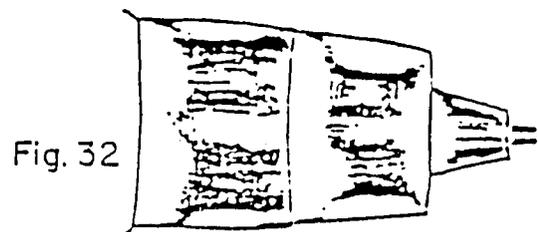


Fig. 32

11(10). Proboscis rather stout, laterally compressed and curved (Fig. 33); occiput with broad decumbent scales (Fig. 35).....Armigeres
Proboscis fairly slender, not compressed nor notably curved (Fig. 34); occiput usually with at least some decumbent scales narrow (Fig. 36).....Aedes

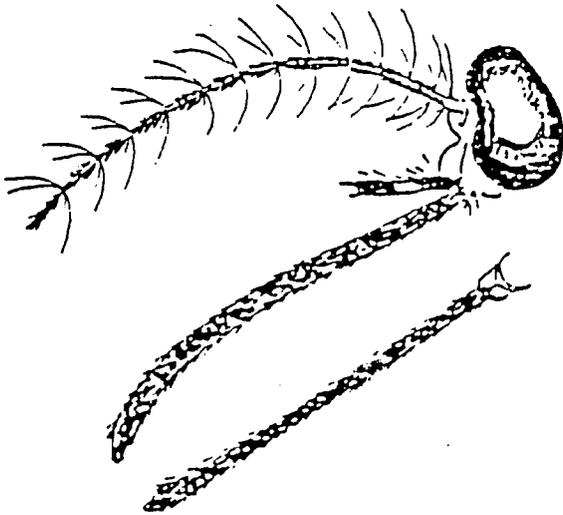


Fig. 33



Fig. 34



Fig. 35



Fig. 36

- 12(9). Alula bare or with flat decumbent scales (Fig. 37,38)
.....Mimomyia
Alula fringed with narrow scales (Fig. 39).....13

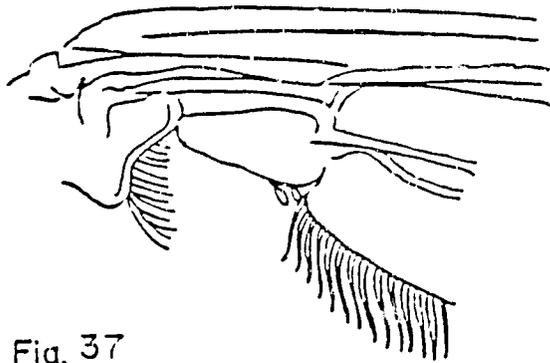


Fig. 37

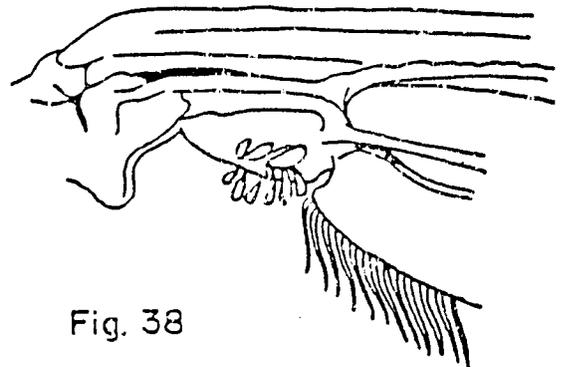


Fig. 38

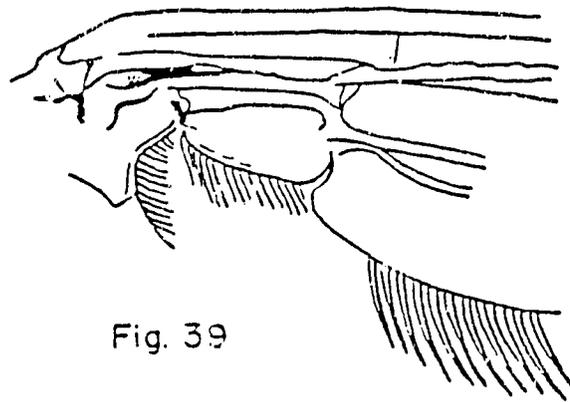


Fig. 39

- 13(12). Pulvilli present; tarsal claws unusually small
(Fig. 40).....Culex
Pulvilli absent; tarsal claws prominent (Fig. 41)....
.....Coquillettidia crassipes

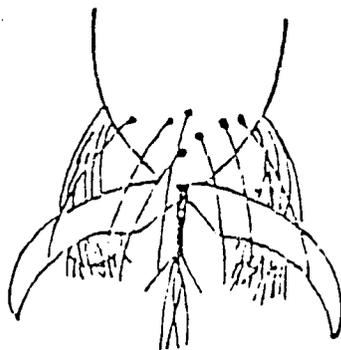


Fig. 40

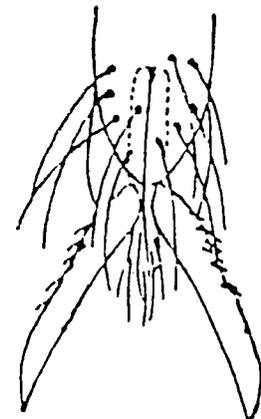


Fig. 41

ANNEX 5

ILLUSTRATED KEYS TO THE GENERA OF
FOURTH INSTAR LARVAE OF THE MOSQUITOES OF NEPAL

KEY TO THE GENERA OF FOURTH INSTAR MOSQUITO LARVAE
OF NEPAL*

1. Respiratory siphon absent (Fig. 1); seta 1 usually palmate on some abdominal terga (Fig. 2)...Anopheles
Respiratory siphon present (Fig. 3); seta 1 on abdominal terga not palmate (Fig. 4).....2

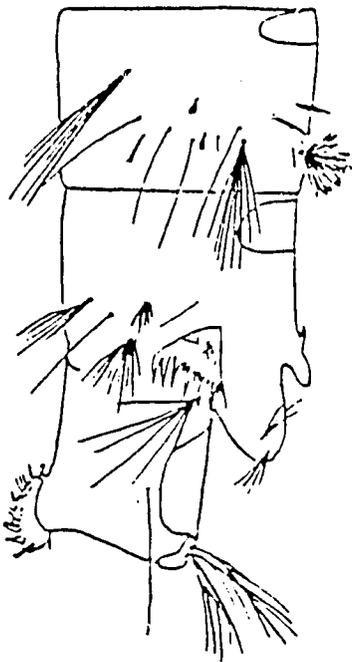


Fig. 1

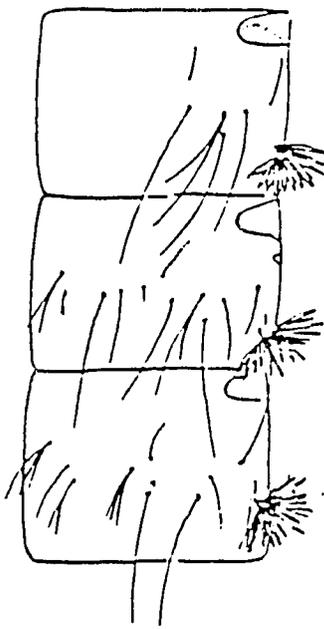


Fig. 2

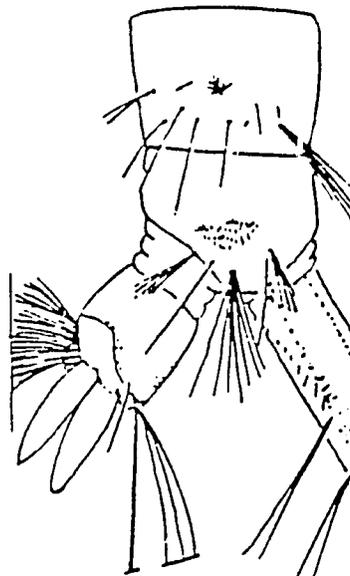


Fig. 3

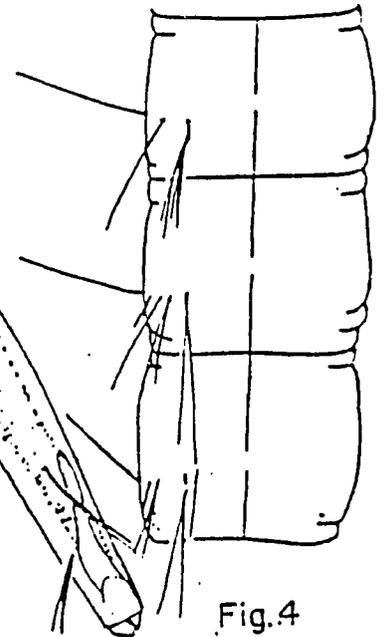


Fig. 4

- 2(1). Siphon short, attenuated, with saw-toothed process near apex, adapted for piercing plant tissue (Fig. 5).....3
Siphon not so modified, with cylindrical shape, but if attenuated apically, then without saw-toothed process (Fig. 6).....4

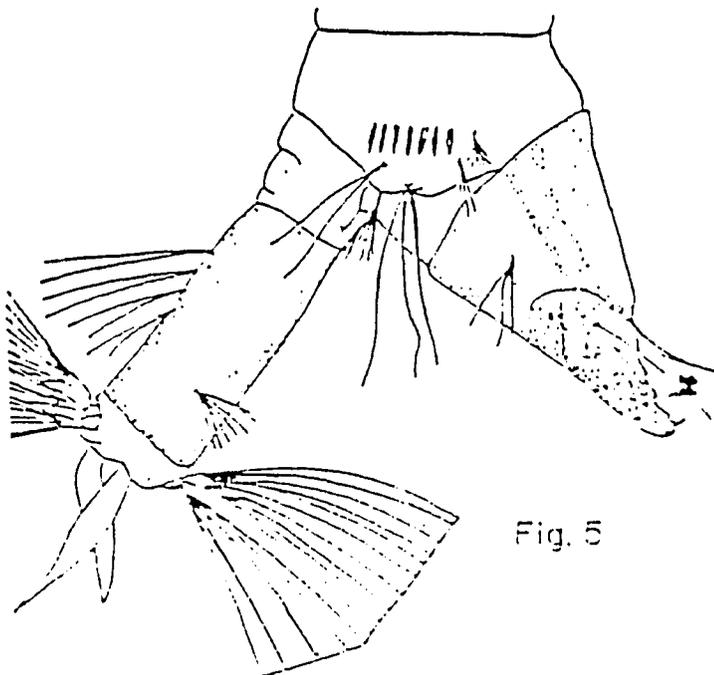


Fig. 5

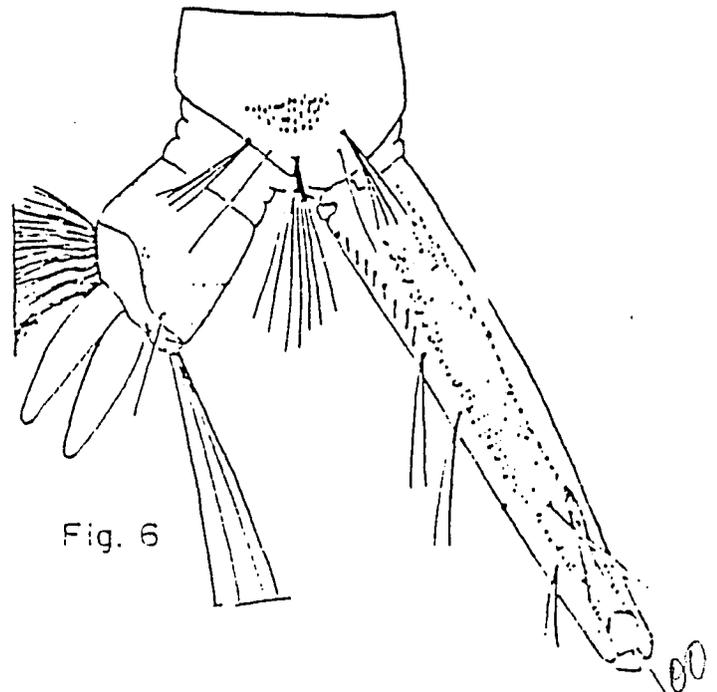
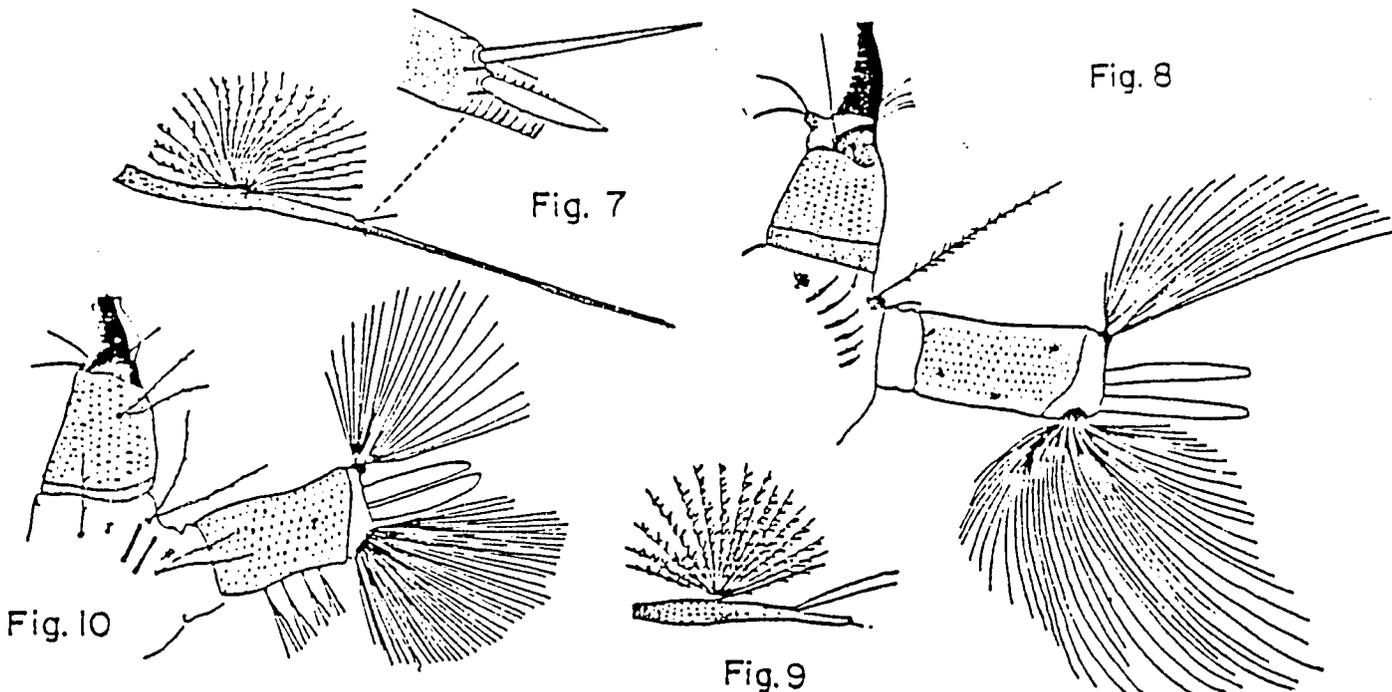
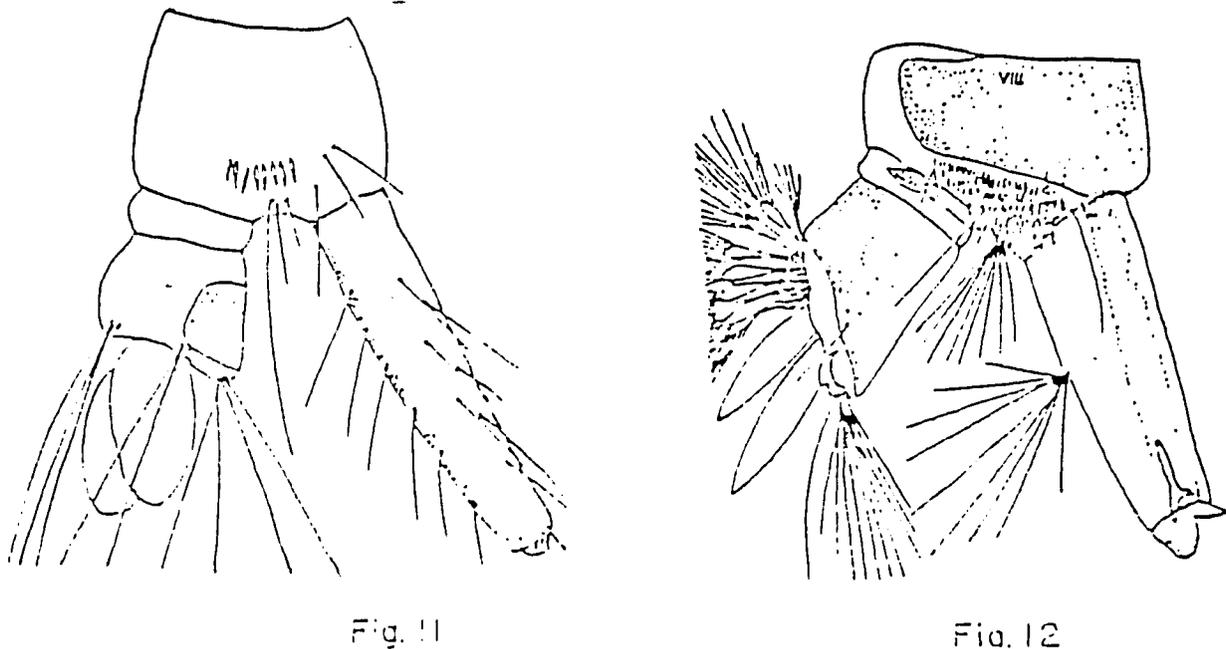


Fig. 6

- 3(2). Setae 2,3-A about same length as flagellar segment (Fig. 9); saddle bearing 3,4 robust setae ventrally (Fig. 10).....Mansonia
 Setae 2,3-A much shorter than length of flagellar segment (Fig. 7); saddle with at most 2 small, weak setae (Fig. 8).....Cocquillettidia crassipes



- 4(2). Seta 4-X (ventral brush) with single pair of setae (Fig. 11).....5
 Seta 4-X consisting of 3 or more pairs of setal tufts (Fig. 12).....6



- 5(4). Abdominal segments IV-VI with stellate setae OR
maxillae with horns OR siphon index at least
6.0 (Figs. 13-15).....Topomyia aureoventer
Abdominal segments IV-VI without stellate setae;
maxillae without horns; siphon index at most
4.0 (Figs. 16-18).....Malaya genurostris

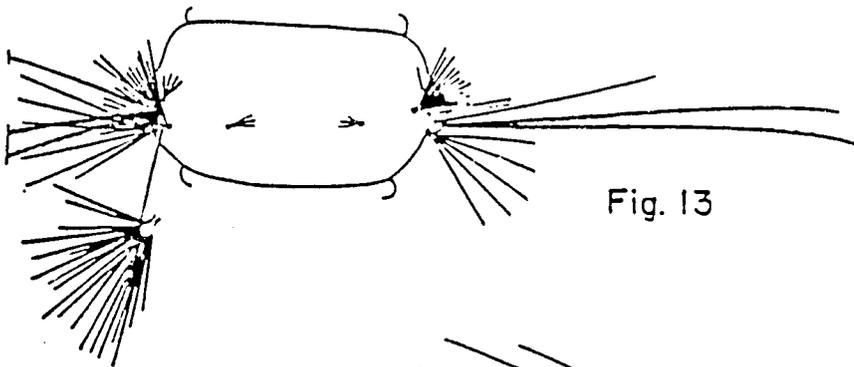


Fig. 13

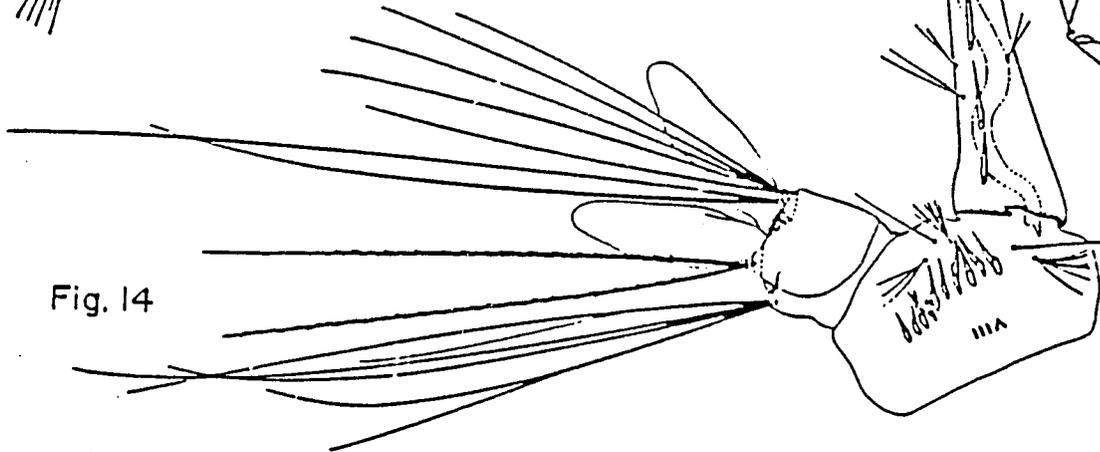


Fig. 14



Fig. 15

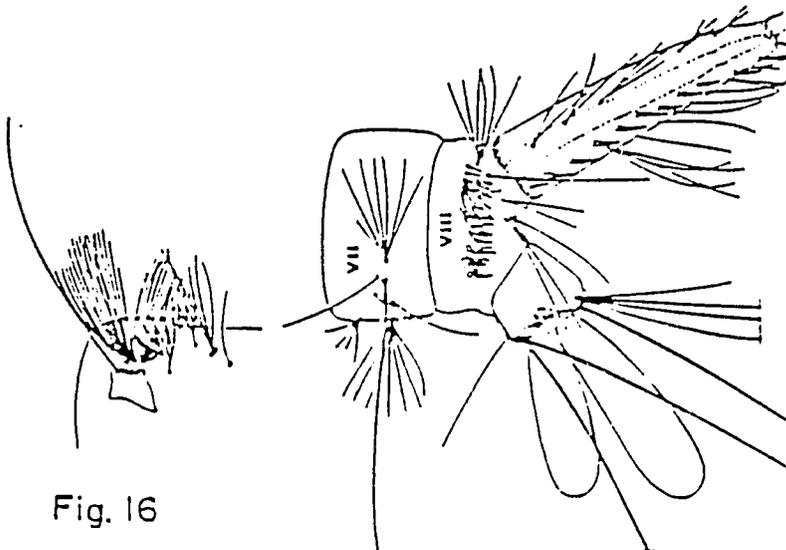


Fig. 16

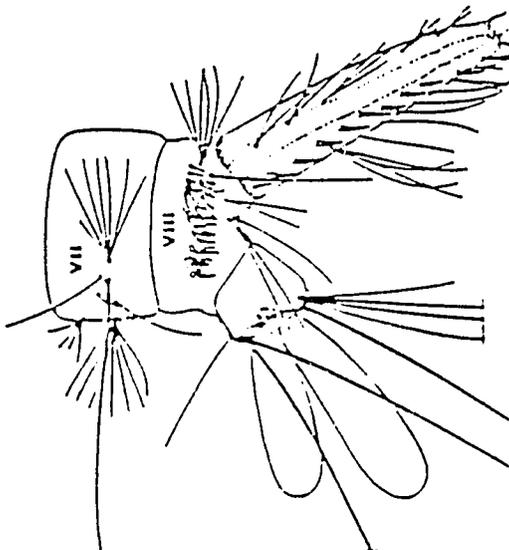


Fig. 17

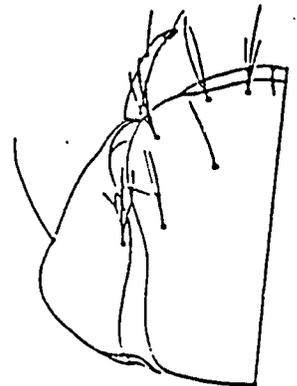
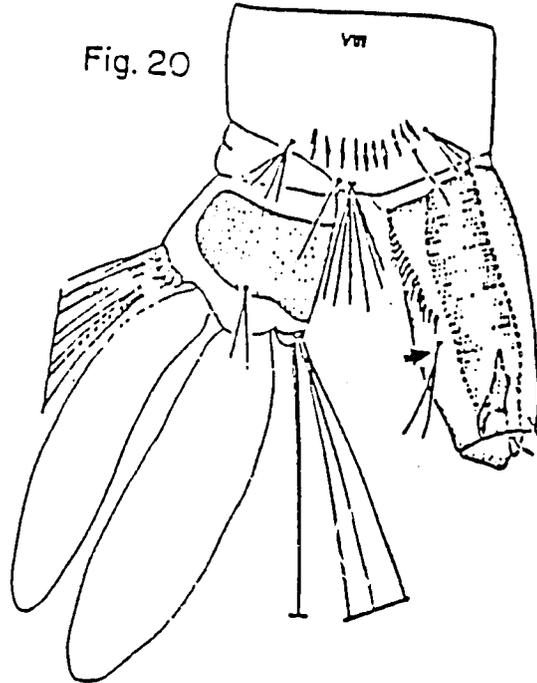
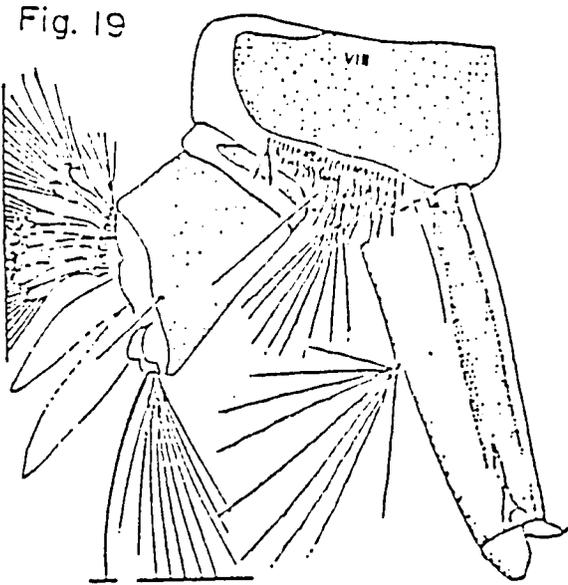


Fig. 18

- 6(4). Siphon without pecten (Fig. 19).....7
- Siphon with pecten (Fig. 20).....9



- 7(6). Lateral palatal brushes composed of few curved stout rods (Fig. 21); comb scales absent (Fig. 23)Toxorhynchites splendens
- Lateral palatal brushes usually composed of numerous thin, simple or pectinate filaments (Fig. 22); comb scales present (Fig. 24).....8

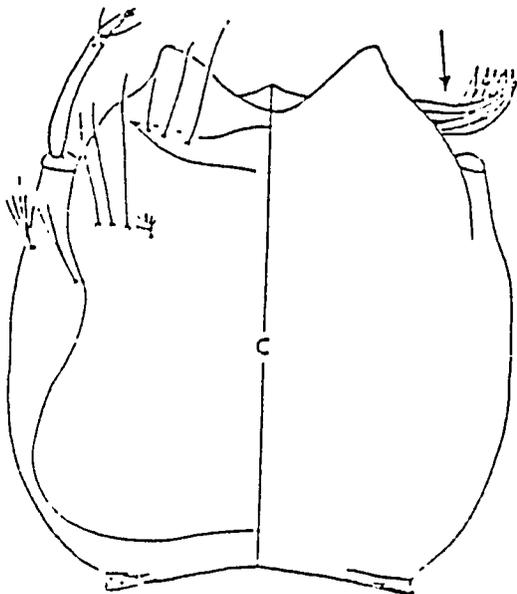


Fig. 21

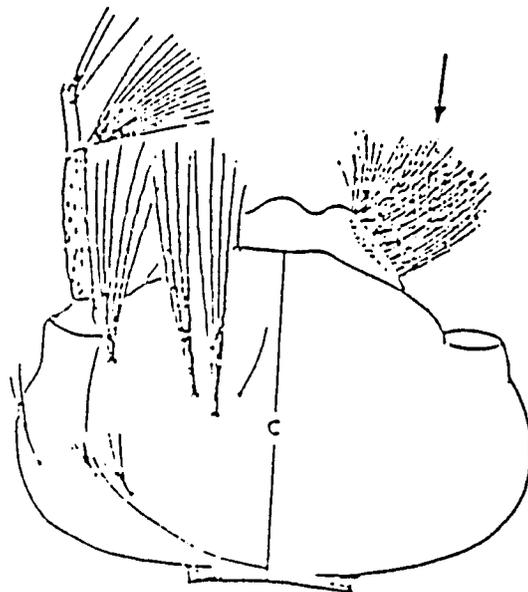


Fig. 22

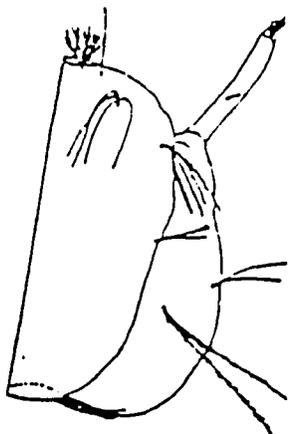


Fig. 27

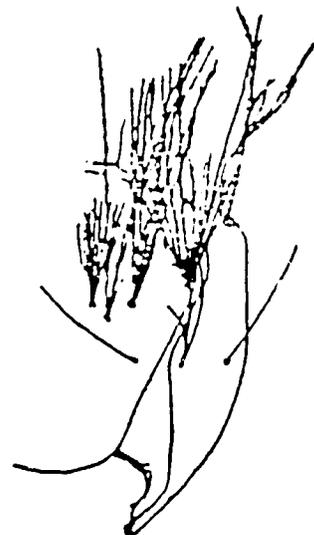


Fig. 28

- 9(6). Siphon with subventral pair of setae (Fig. 29).....
.....Culiseta niveitaeniatus
Siphon with setae attached distally, usually distal
to pecten (Fig. 30).....10

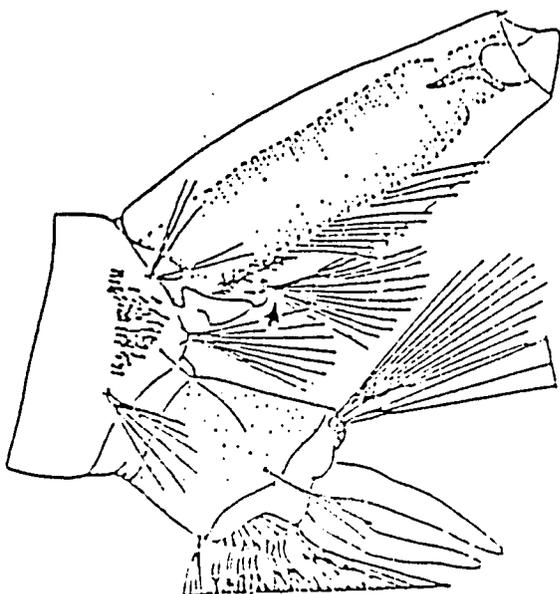


Fig. 29

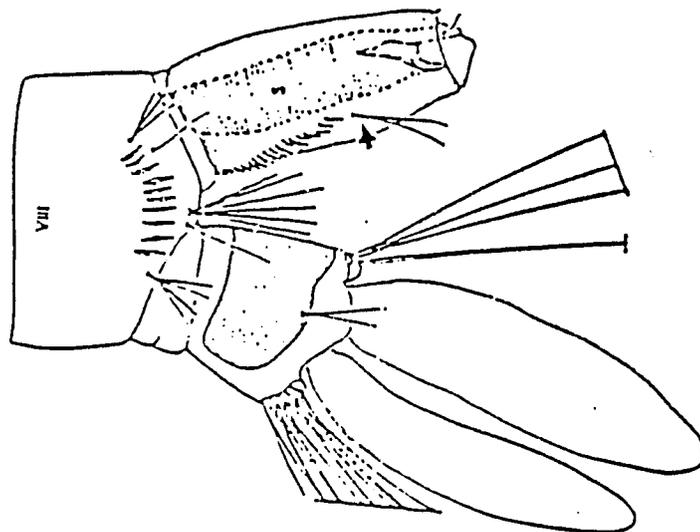


Fig. 30

106

- 10(9). Distal segment of antenna freely articulating, setae
2,3-A attached at joint (Fig. 31).....Mimomyia
Antenna without articulating joint distally; seta
1,2-A attached apically or subapically (Fig. 32)...11

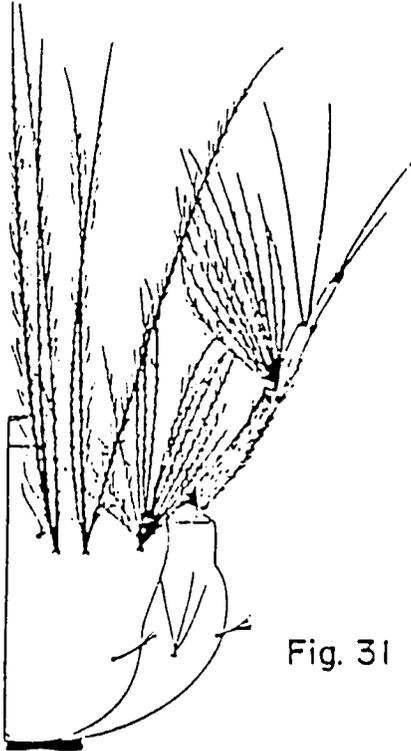


Fig. 31

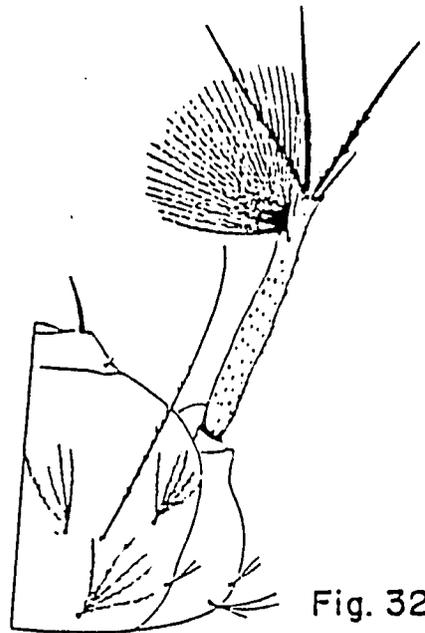


Fig. 32

- 11(10). Siphon with 2 or more pairs of setae (Fig. 33).....Culex
Siphon with single pair of setae (Fig. 34).....12

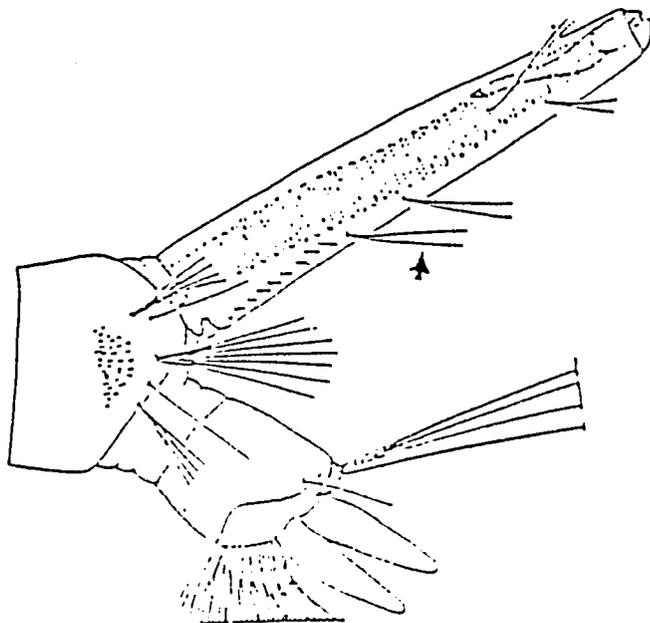


Fig. 33

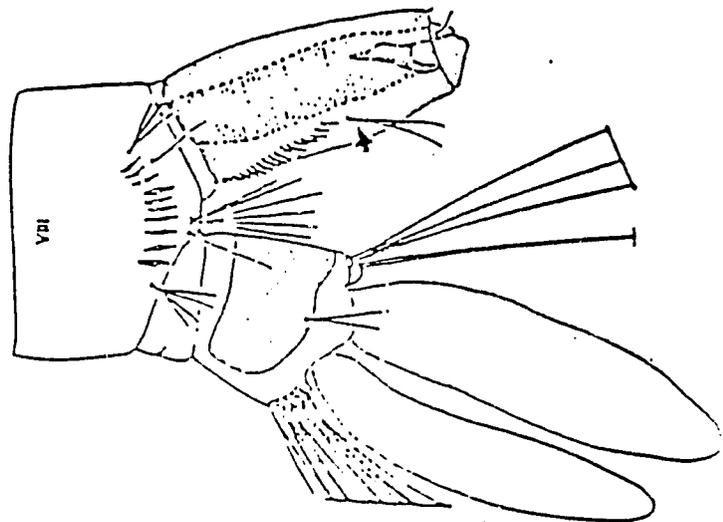


Fig. 34

- 12(11). Comb scales usually attached to comb plate (Fig. 35);
head longer than wide; setae 5,6-C often
spine-like (Fig. 37).....Uranotaenia
Comb scales not attached to comb plate (Fig. 36);
head wider than long; setae 5,6-C normal setae,
not spike-like (Fig. 38).....13

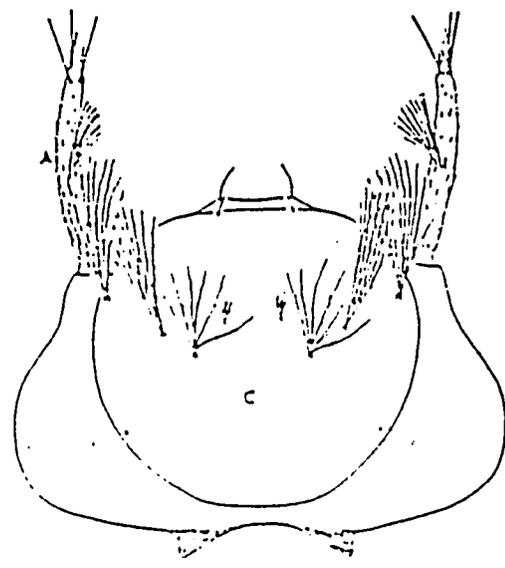
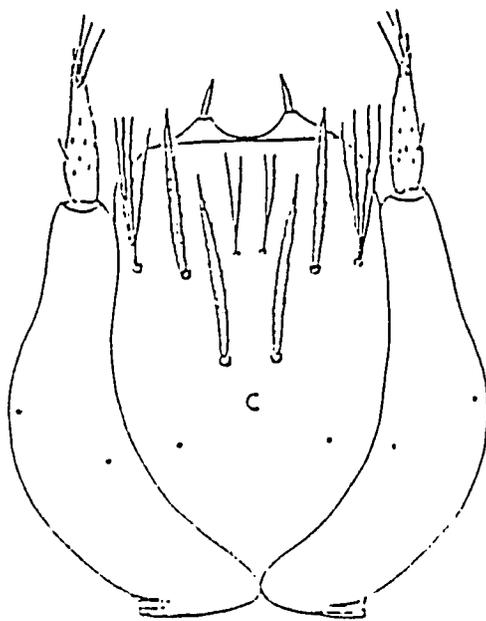
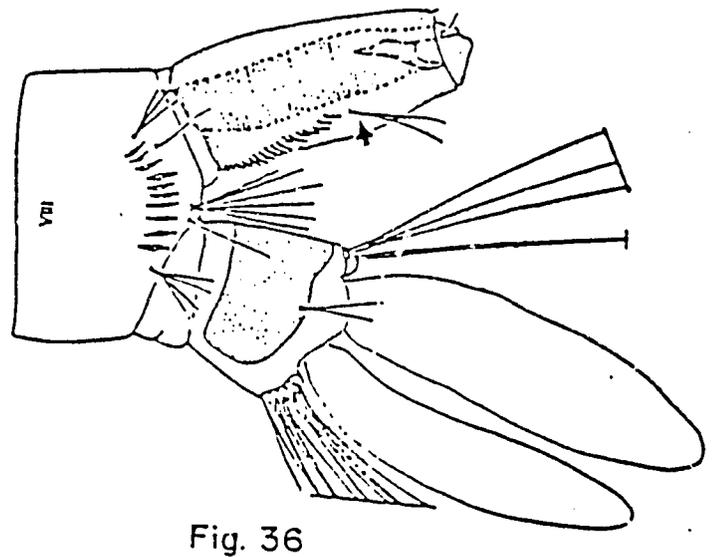
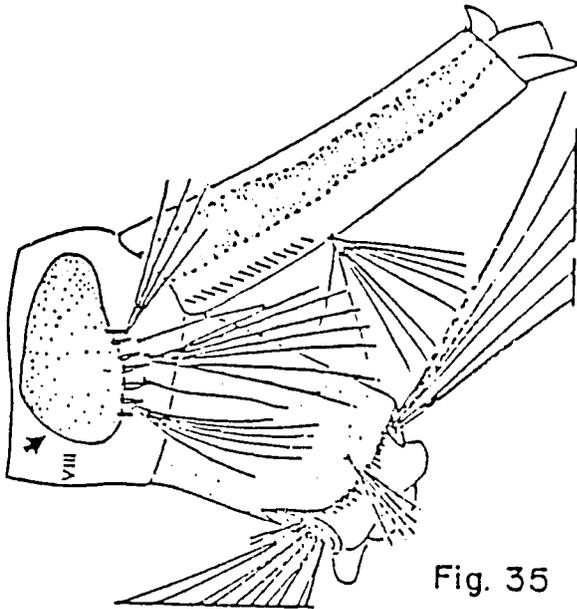


Fig. 37

Fig. 38

104

- 13(12). Seta 4-C well developed, multibranchd, almost
equal in size to seta 7-C (Fig. 39).....
.....Heizmannia himalayensis
Seta 4-C small, less than 0.5 length of seta 7-C,
variously branched (Fig. 40).....Aedes

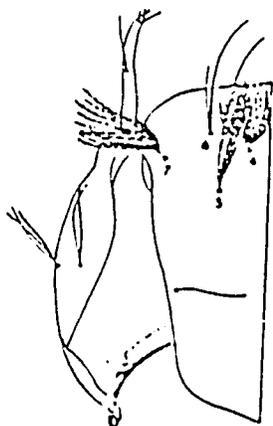


Fig. 39

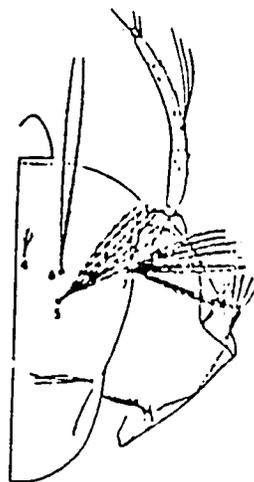


Fig. 40

ANNEX 6

ILLUSTRATED KEYS TO THE ADULT FEMALES
OF THE SUBGENERA OF CULEX AND SPECIES
OF THE SUBGENUS CULEX

KEY TO THE ADULT FEMALES OF THE SUBGENERA
OF THE GENUS CULEX*

1. Four or more strong lower mesanepimeral setae present (Fig. 1); relatively large species....Lutzia
Mesanepimeral setae absent, or if present, with only 1,2 weak setae (Fig. 2); small to medium species.....2

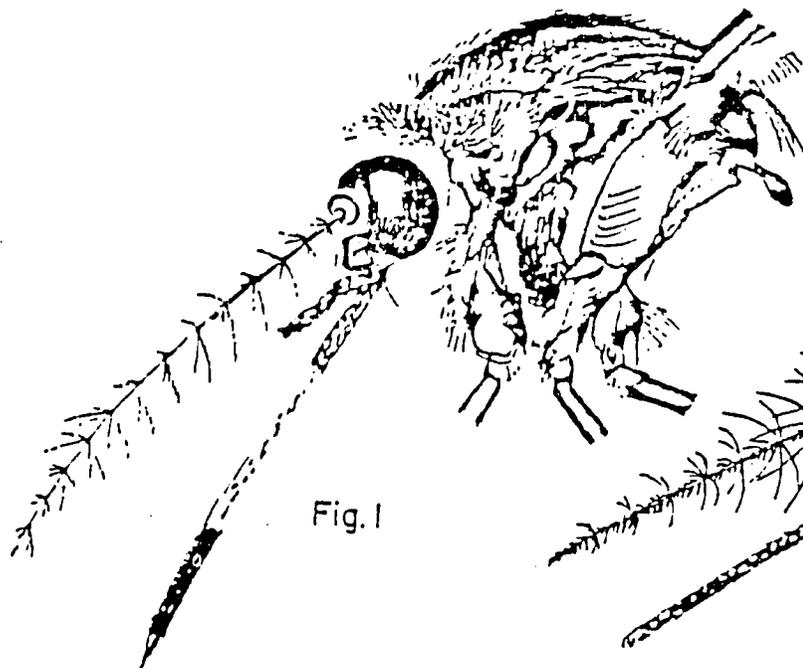


Fig. 1

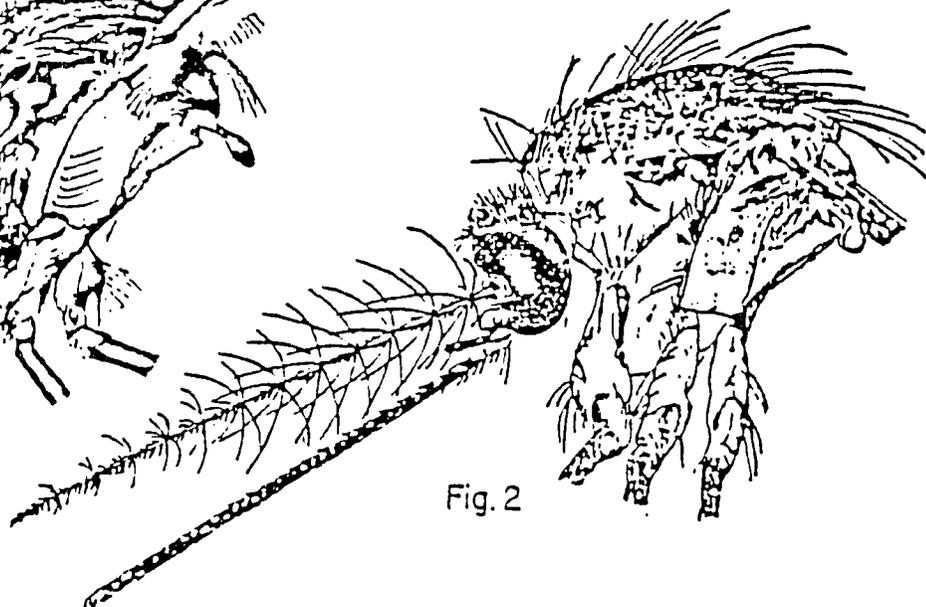


Fig. 2

- 2(1). Pleuron with distinct scale patches at least on upper and lower mesokatepisternum and anterior mesanepimeron (Fig. 3).....Culex
Pleuron without distinct scale patches (Fig. 4).....3

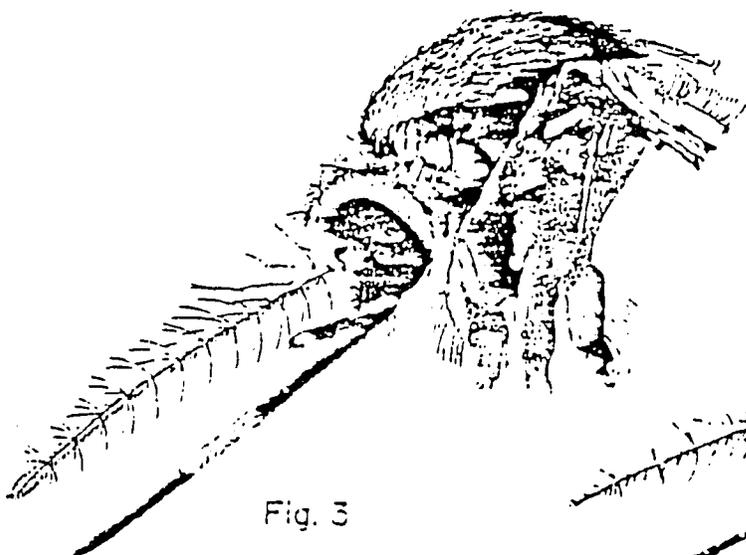


Fig. 3

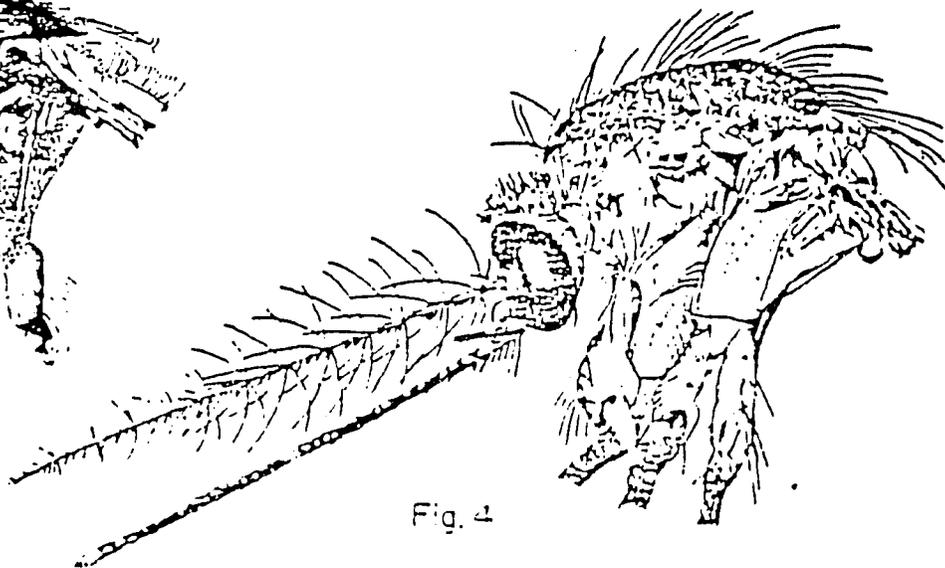


Fig. 4

- 3(2). Acrostrichal setae well developed (Fig. 5).....
.....(in part) Eumelanomvia
Acrostrichal setae not well developed except at
extreme anterior promontory and rarely near
prescutellar space (Fig. 6).....4

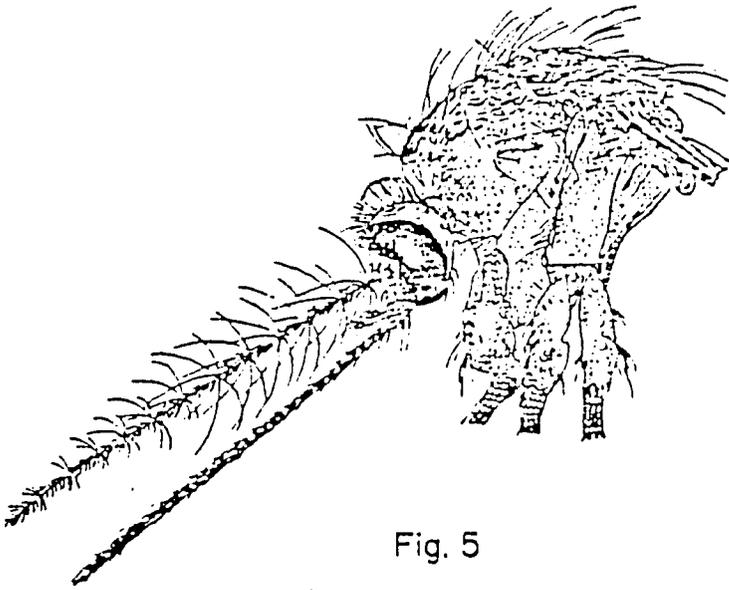


Fig. 5

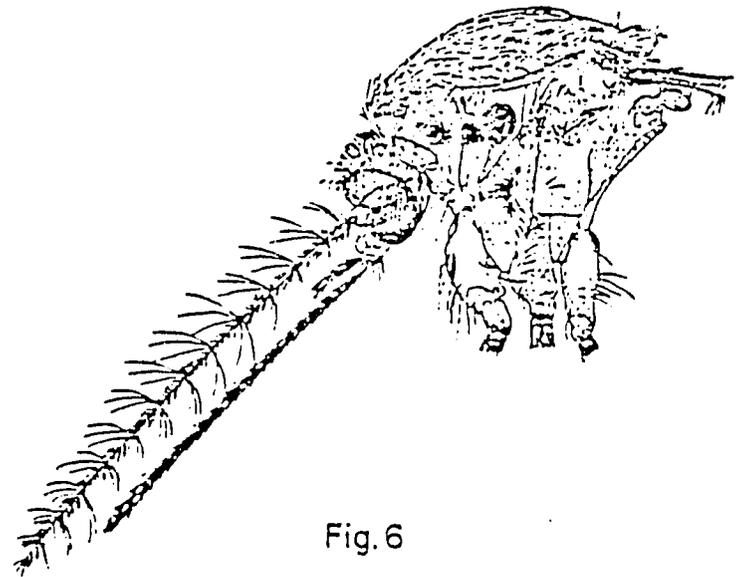


Fig. 6

- 4(3). Lower mesanepimeral seta absent (Fig. 7); decumbent
scales on occiput narrow (Fig. 9).....
.....(in part) Eumelanomvia
Lower mesanepimeral seta present (Fig. 8); decumbent
scales on occiput broad, if only on ocular line
(Fig. 10).....5

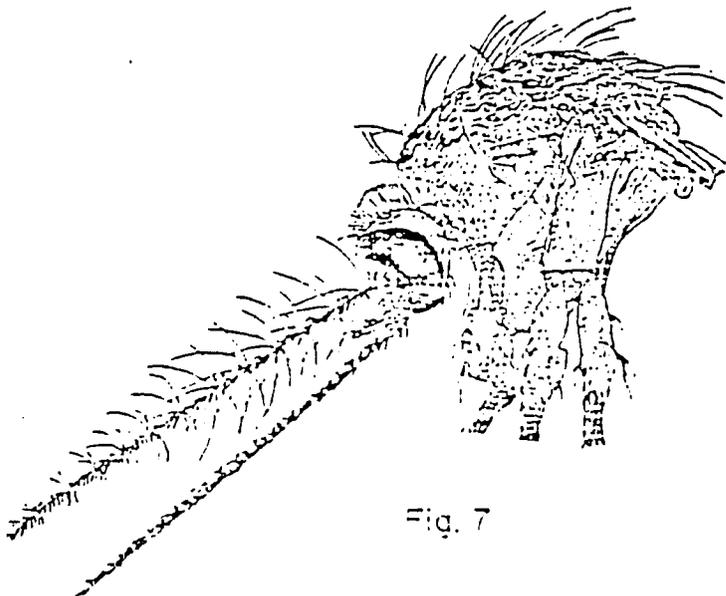


Fig. 7

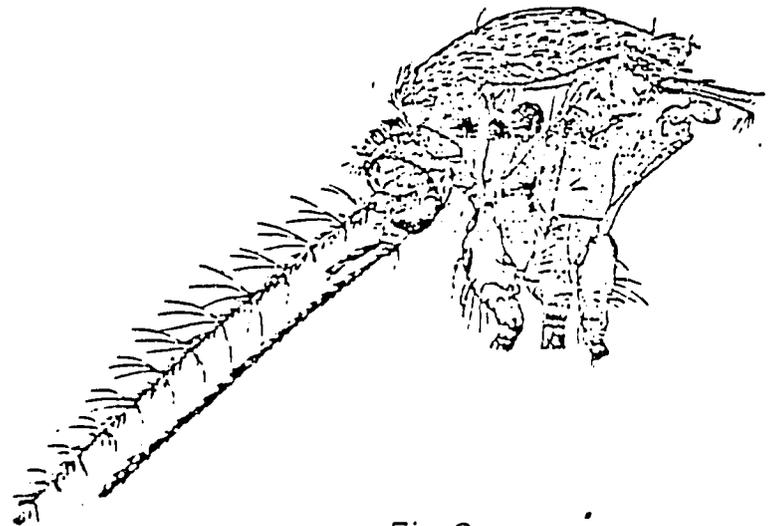


Fig. 8



Fig. 9



Fig. 10

5(4). Pleural area with broad dark integumental band extending from postpronotum to mesanepimeron or with prominent dark spots (Fig. 11).....Culiciomyia

Pleural area concolorous, without broad dark integumental band (Fig. 12).....Lophoceraomyia

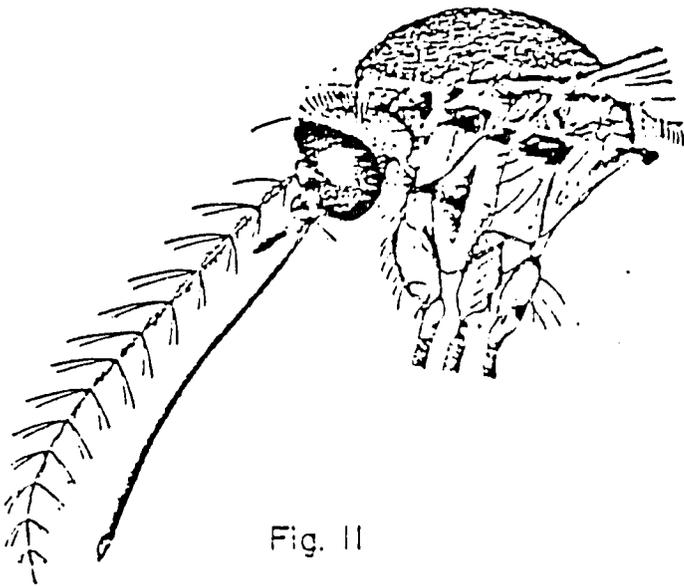


Fig. 11

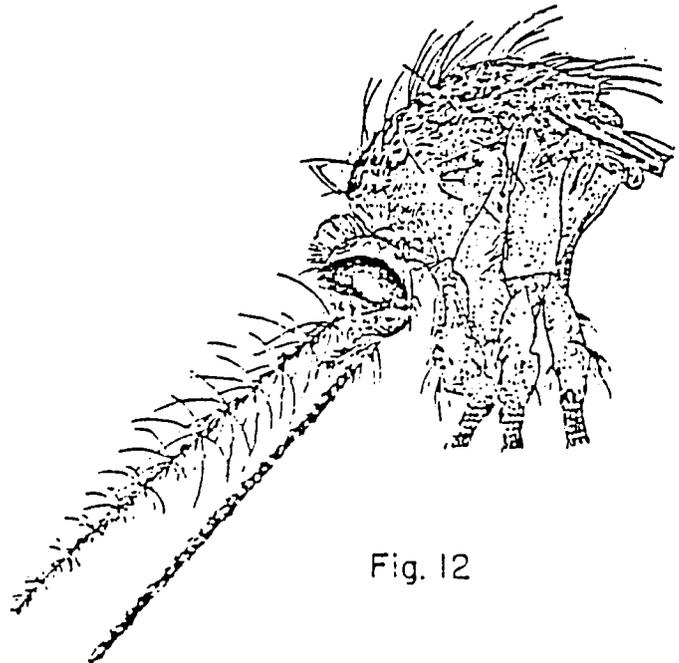


Fig. 12

KEY TO THE ADULT FEMALES OF GENUS CULEX
SUBGENUS CULEX*

1. One or 2 lower mesanepimeral setae present;
proboscis without distinct pale-scaled band
(Fig. 13); tarsomeres without pale bands at
joints (Fig. 15).....2
Lower mesanepimeral setae absent; proboscis with
distinct pale-scaled band (Fig. 14); tarsomeres
with basal and apical pale bands (Fig. 16).....6

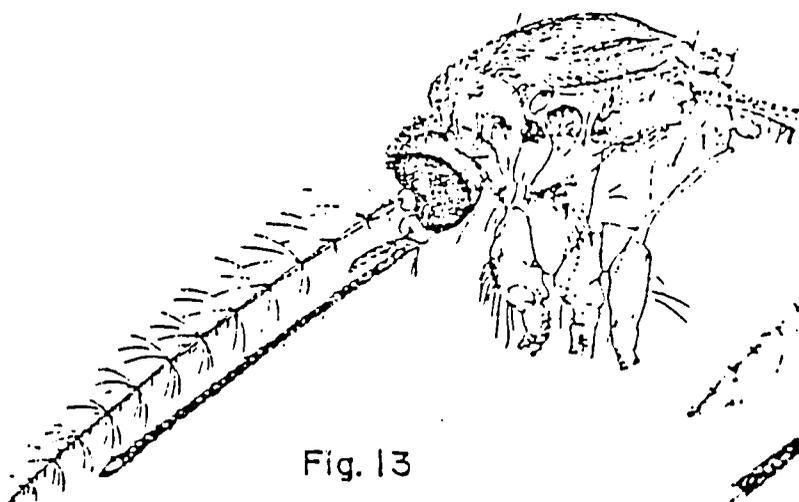


Fig. 13

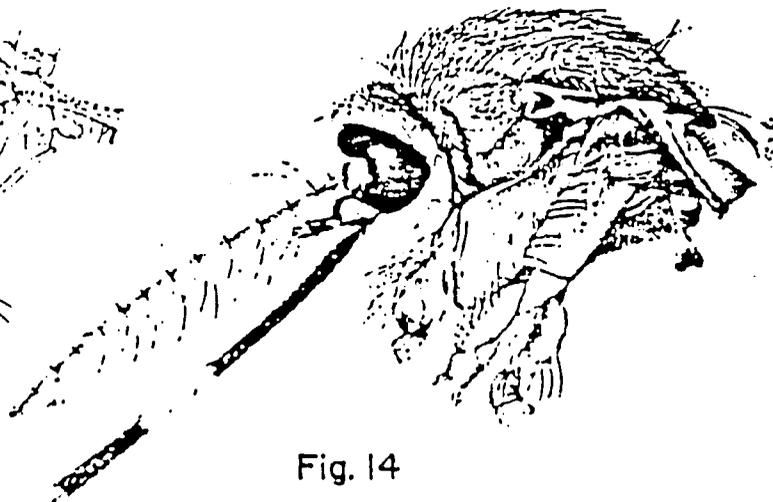


Fig. 14

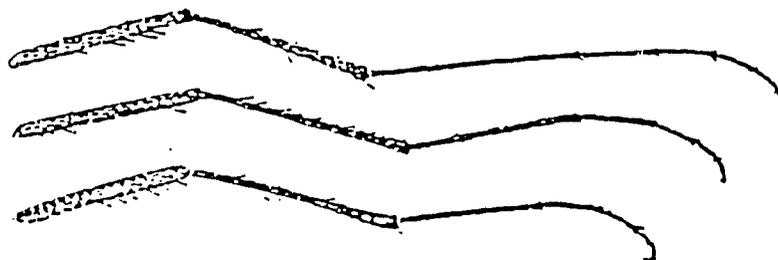


Fig. 15

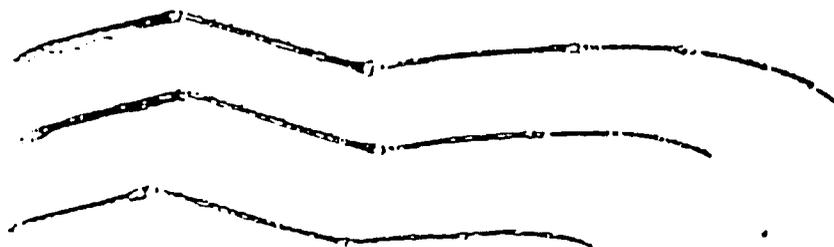


Fig. 16

112

- 2(1). Anterior surface of midfemur without median longitudinal pale-scaled stripe (Fig. 17).....3
 Anterior surface of midfemur with median longitudinal pale-scaled stripe (Fig. 18).....5



Fig. 17

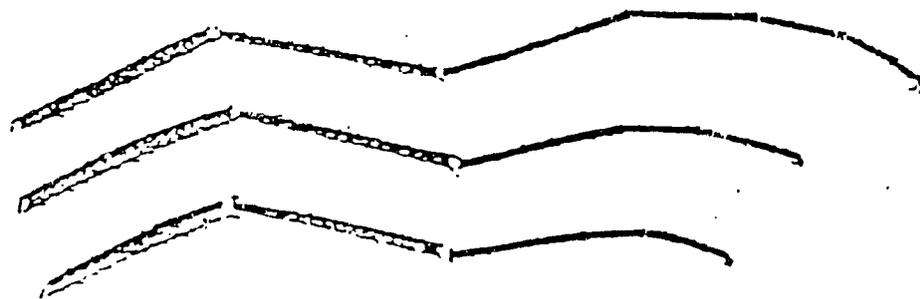


Fig. 18

- 3(2). Abdominal terga without basal transverse, pale-scaled bands (Fig. 20); pleuron with striking pattern of dark and pale integumental stripes (Fig. 22).....fuscocephala
 Abdominal terga with basal transverse pale-scaled bands (Fig. 19); pleuron without striking pattern of dark and pale integumental stripes (Fig. 21).....4



Fig. 19

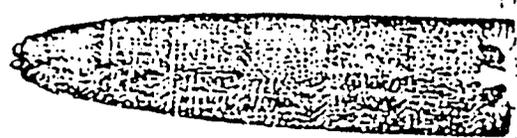


Fig. 20

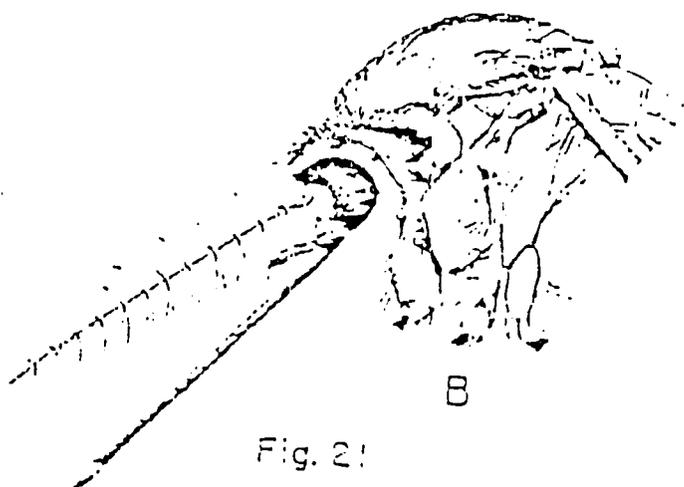


Fig. 21

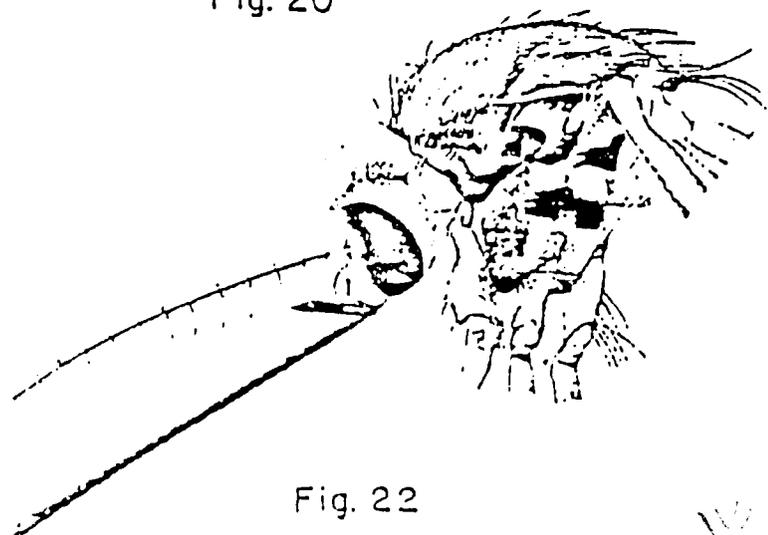


Fig. 22

- 4(3). Pleural integument with dark stripe across mesokatepisternum and mesanepimeron; scutal integument reddish brown (Fig. 23).....hutchinsoni
Pleural integument without dark stripe; scutal integument yellowish or pale brown (Fig. 24)
.....quinquefasciatus

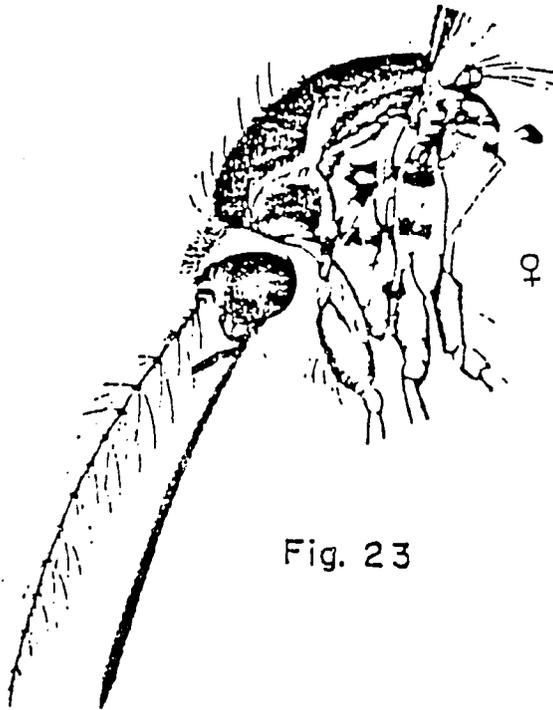


Fig. 23

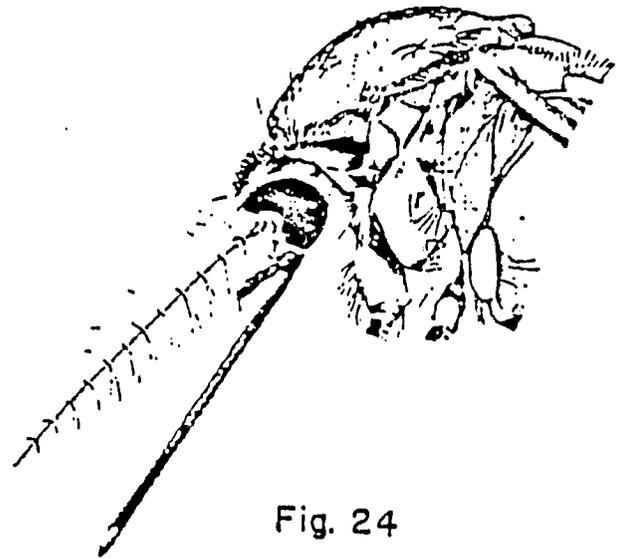


Fig. 24

- 5(2). Postspiracular area and base of prealar knob without scale patches (Fig. 25).....vagans
Postspiracular area and base of prealar knob with distinct scale patches (Fig. 26).....theileri



Fig. 25

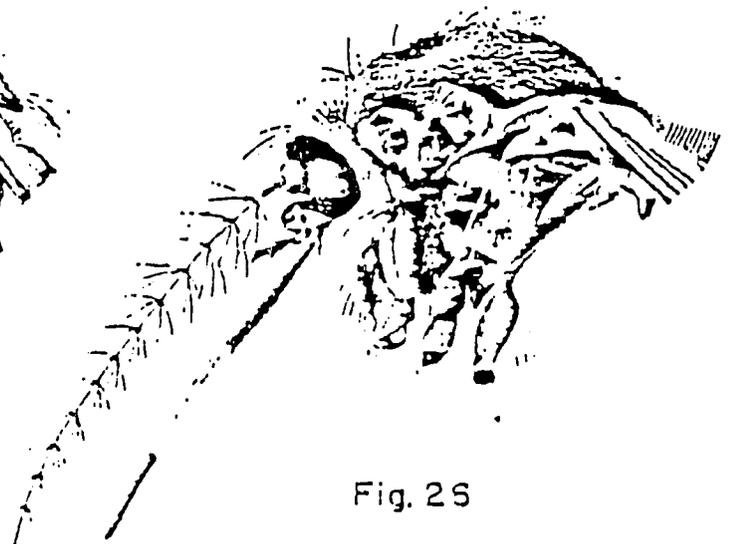


Fig. 26

- 6(1). Wing without pattern of pale-scaled spots or streaks (Fig. 27).....7
Wing with pattern of pale-scaled spots or streaks on at least 2 areas of costa and 1 area on other veins (Fig. 28).....18

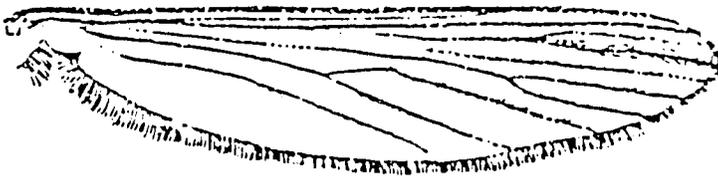


Fig. 27



Fig. 28

- 7(6). Abdominal terga II-VII largely clothed with yellowish or golden scales (Fig. 29).....epidesmus
Abdominal terga dark-scaled, with or without pale-scaled bands (Fig. 30).....8

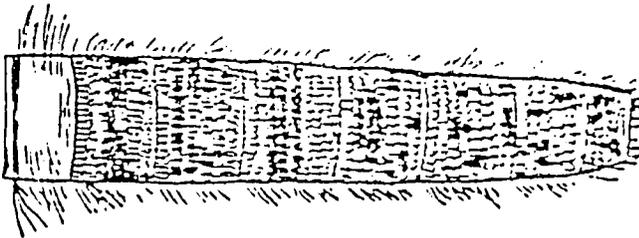


Fig. 29

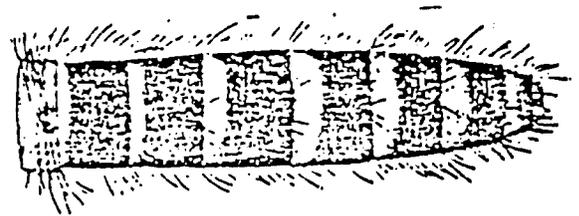


Fig. 30

- 8(7). Abdominal terga II-VI entirely dark-scaled, without pale bands or apicolateral pale patches (Fig. 31)(in part) whitei
Abdominal terga II-VI with basal or basal and apical pale-scaled band, or basal, median, pale patches or with apicolateral pale patches (Figs. 32,33).....9

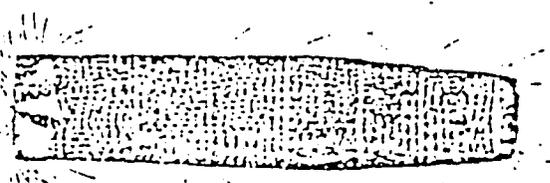


Fig. 31

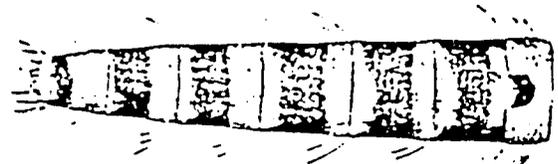


Fig. 32

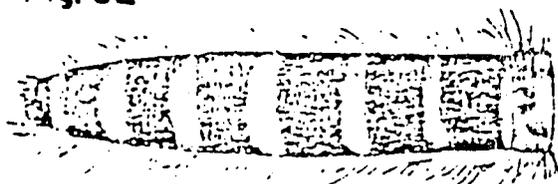


Fig. 33

- 9(8). Abdominal terga II-VI with apical and basal pale-scaled bands (Fig. 34).....10
Abdominal terga II-VI with basal pale-scaled bands only (Fig. 35).....11



Fig. 34

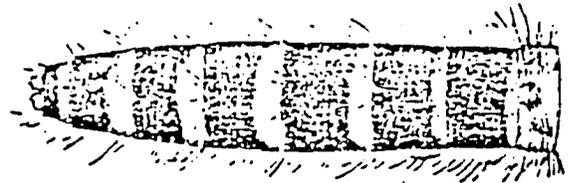


Fig. 35

- 10(9). Wing with dark scales on all veins (Fig. 36);
abdominal terga II-VI with dark areas not sprinkled with pale scales (Fig. 38).....sinensis
Wing with mixed pale and dark scales (Fig. 37);
abdominal terga II-VI with dark areas sprinkled with pale scales (Fig. 39).....bitaeniorhynchus

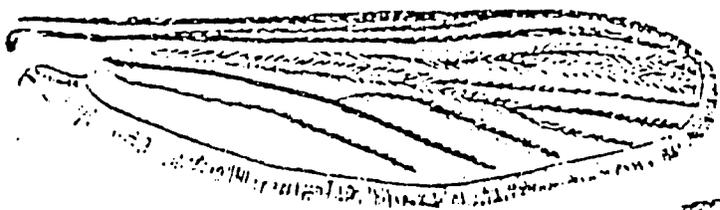


Fig. 36



Fig. 37

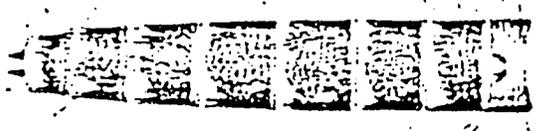


Fig. 38

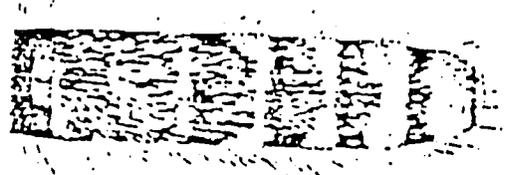


Fig. 39

- 11(9). Erect scales in center of vertex of head whitish (Fig. 40); anterior 0.7 of scutum covered with white scales (Fig. 42).....12
 Erect scales in center of vertex pale yellow, dingy white or all dark (Fig. 41); anterior 0.7 of scutum covered with beige, yellow, golden or dark scales (Fig. 43).....13

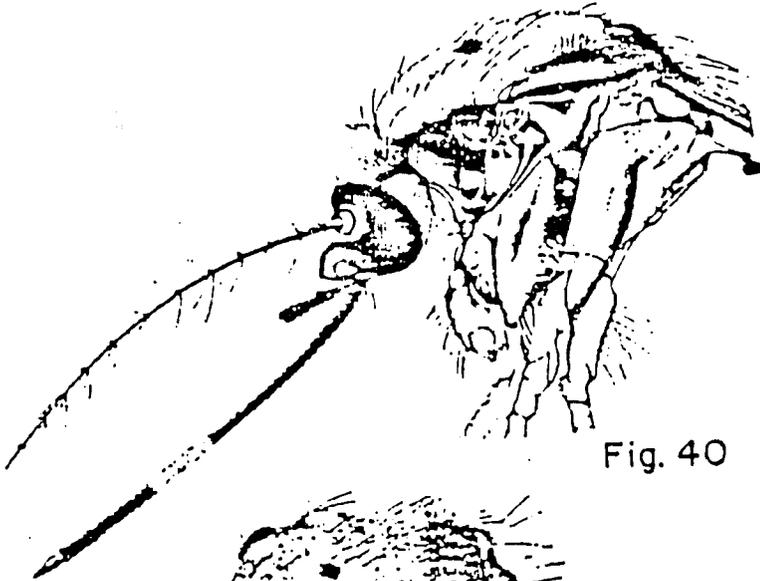


Fig. 40

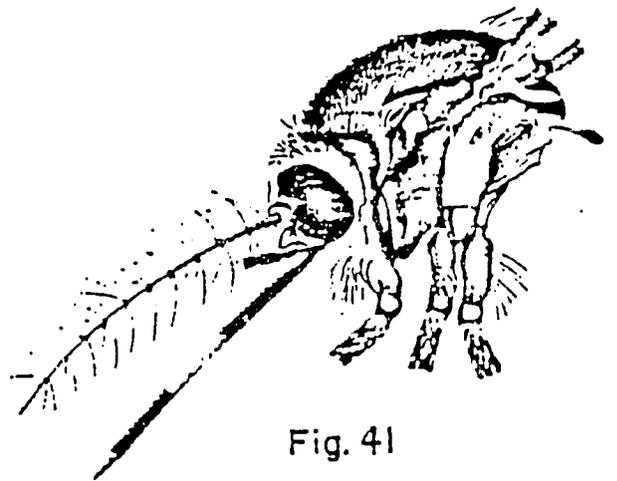


Fig. 41



Fig. 42

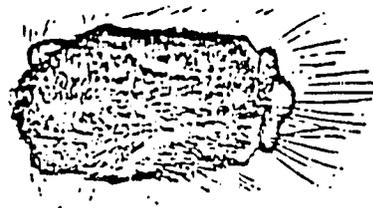


Fig. 43

- 12(11). Anterior surface of fore- and midfemora without speckling of pale scales (Fig. 44); white-scaled patch on scutum dense, extending to wing root, posterior to that, all dark-scaled; wing veins R_1 , R_{4+5} and Cu with narrow scales (Fig. 45).....gelidus
 Anterior surface of fore- and midfemora extensively speckled with pale scales (Fig. 46); pale-scaled patch on scutum thinner, grayish-white, extending posterior to wing root in 4 lines; wing veins R_1 , R_{4+5} and Cu with broad scales (Fig. 47).....whitmorei

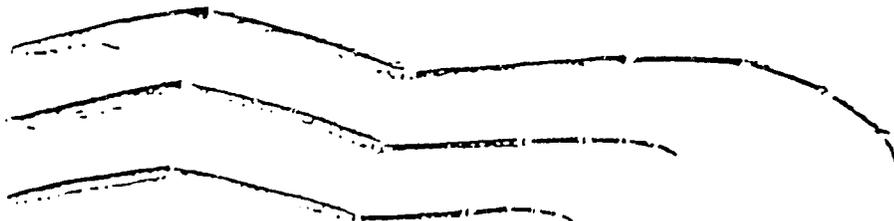


Fig. 44



Fig. 45

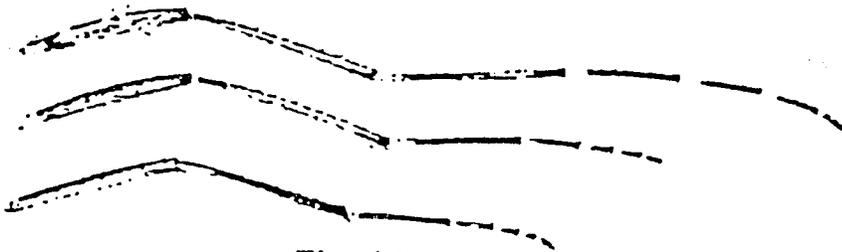


Fig. 46

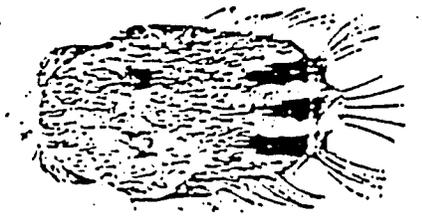


Fig. 47

- 13(11). Midfemur with longitudinal stripe of pale scales on anterior surface (Fig. 48); postspiracular area with small patch of semierect scales on lower anterior aspect (Fig. 50).....14
- Midfemur entirely dark-scaled or speckling of pale scales not forming definite stripe (Fig. 49); postspiracular area without scales on lower anterior aspect (Fig. 51).....15

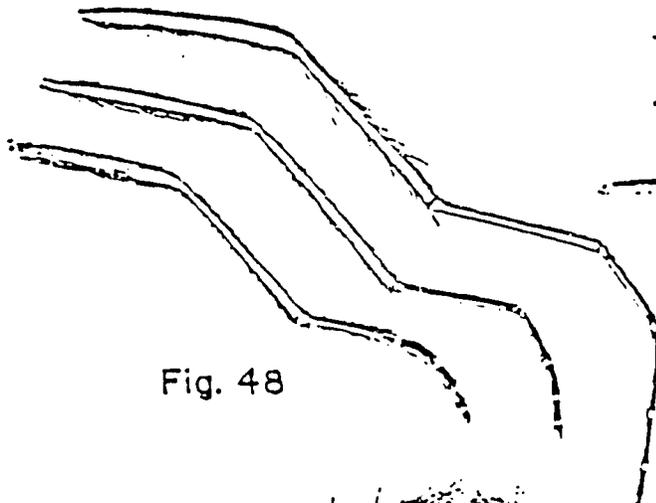


Fig. 48



Fig. 49



Fig. 50

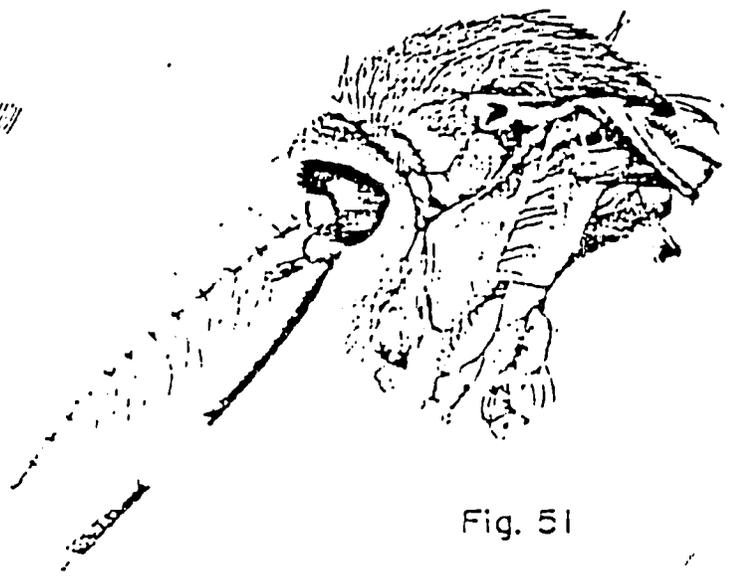


Fig. 51

- 14(13). Longitudinal pale-scaled stripe on anterior surface of midfemur broken into small spots at middle (Fig. 52); costal vein entirely dark-scaled (Fig. 54).....barraudi
Longitudinal pale-scaled stripe on anterior surface of midfemur complete (Fig. 53); pale scales present on base of costal vein at least to humeral crossvein (Fig. 55).....edwardsi

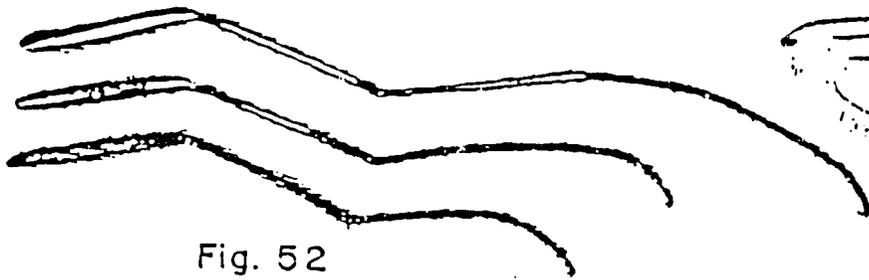


Fig. 52



Fig. 54

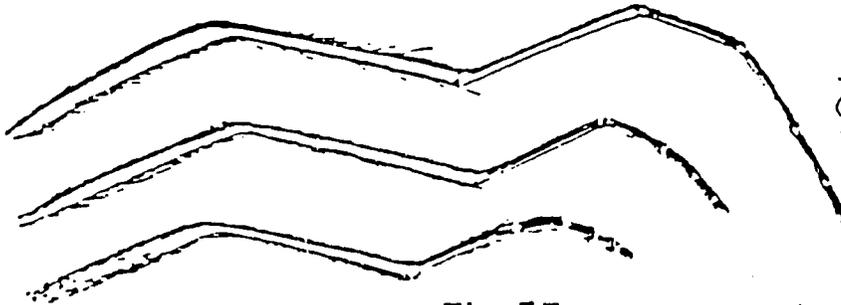


Fig. 53

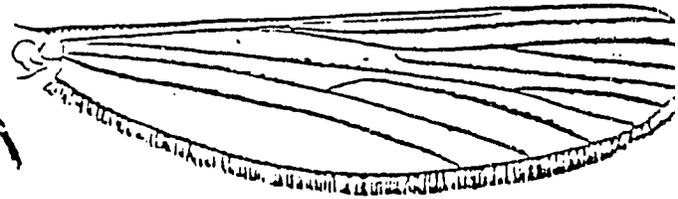


Fig. 55

- 15(13). Anterior surface of fore- and midfemora with speckling of several pale scales at least on apical dorsal surface (Fig. 56).....(in part) whitei
Anterior surface of fore- and midfemora entirely dark-scaled (Fig. 57).....16

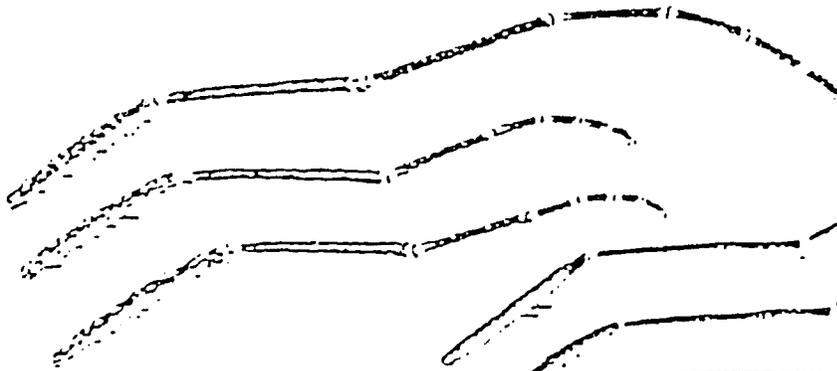


Fig. 56

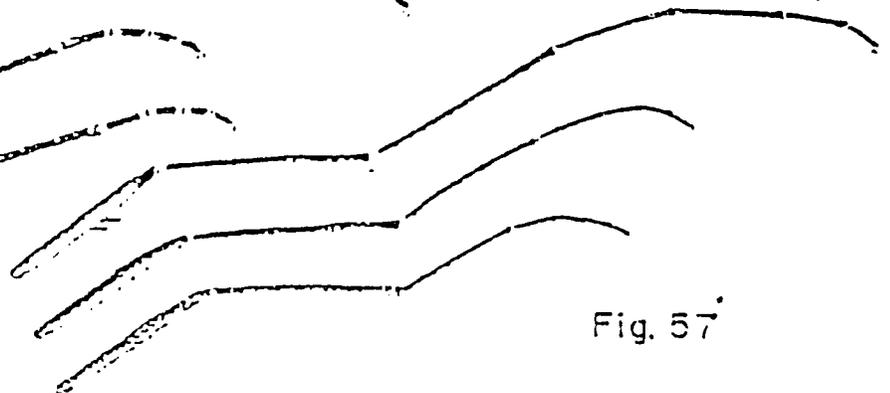


Fig. 57

- 16(15). Erect scales on vertex mostly dark (Fig. 58); anterior surface of hindfemur pale-scaled with narrow black-scaled ring apically (Fig. 60); scutum covered with dark coppery-gold scales.....
.....tritaeniorhynchus
Erect scales on vertex pale yellow in center, dark-scaled posterolaterally (Fig. 59); hindfemur marked otherwise (Fig. 61); scutum with scales paler.....17

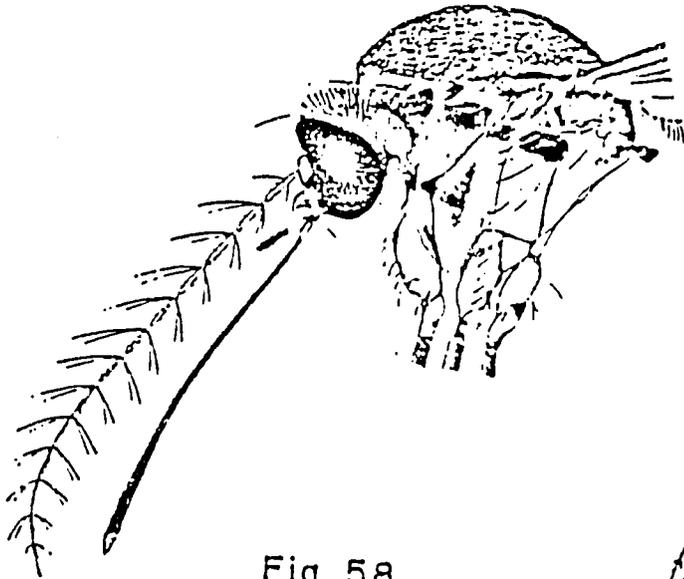


Fig. 58

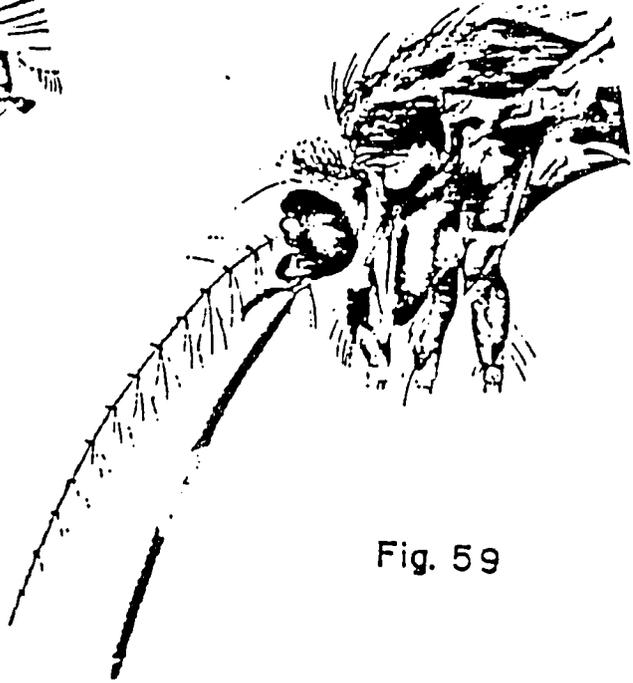


Fig. 59

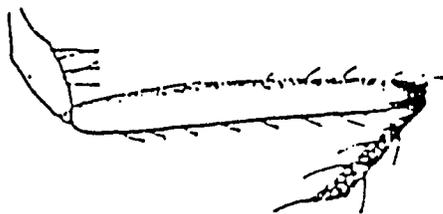


Fig. 60



Fig. 61

17(16). Speckling of pale scales usually present on femora and proboscis (Fig. 62); scutum with scales brown and pale mixed in varying degrees (Fig. 64); hind-femur without dark-scaled apical band, usually with dark subapical band extending basally to form stripe (Fig. 64).....vishnui
Femora and proboscis never speckled with pale scales (Fig. 63); scutum with yellow to silvery scales (Fig. 65); hind femur with dark band apically, contrasting with pale-scaled areas (Fig. 63).....pseudovishnui



Fig. 62



Fig. 63

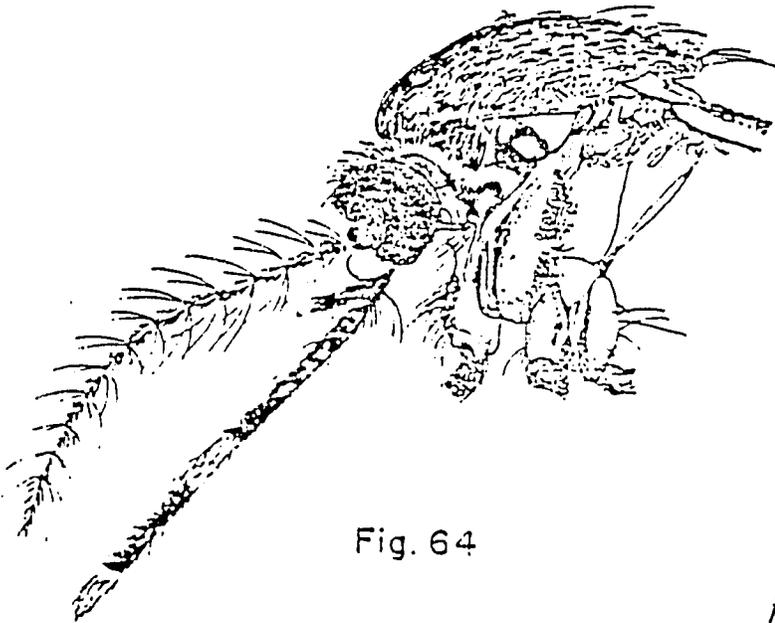


Fig. 64

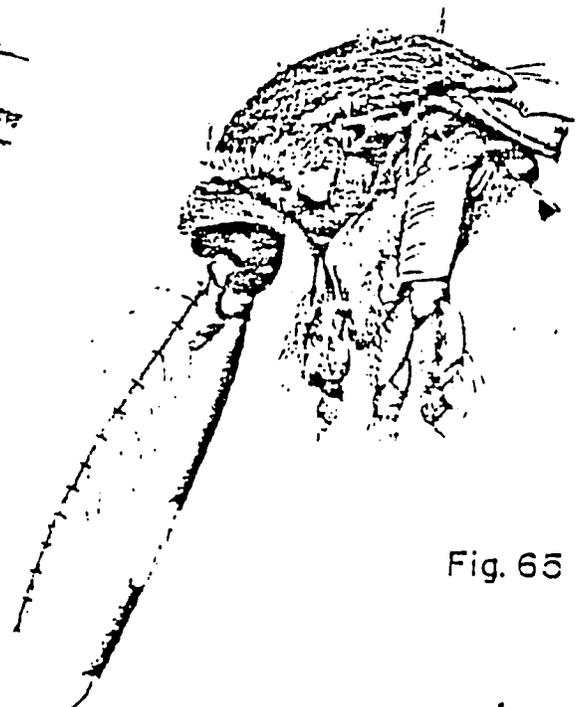


Fig. 65

- 18(6). Second pale-scaled costal spot involves C, Sc, R, and sometimes Rs and Cu (Fig. 66); basal pale bands of abdominal terga narrow, usually less than 0.25 length of segment (Fig. 68)...mimulus
 Second pale-scaled costal spot involves only veins C and Sc (Fig. 67); basal pale bands of abdominal terga broad, at least 0.25 length of segment (Fig. 69).....19



Fig. 66

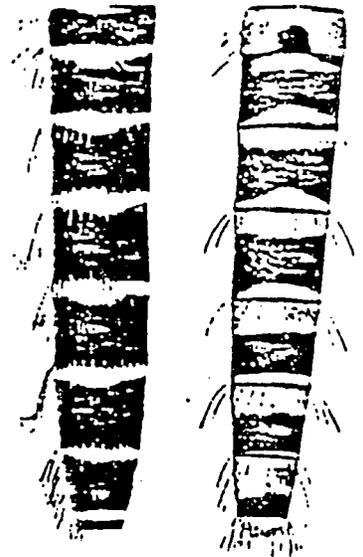


Fig. 68

Fig. 69

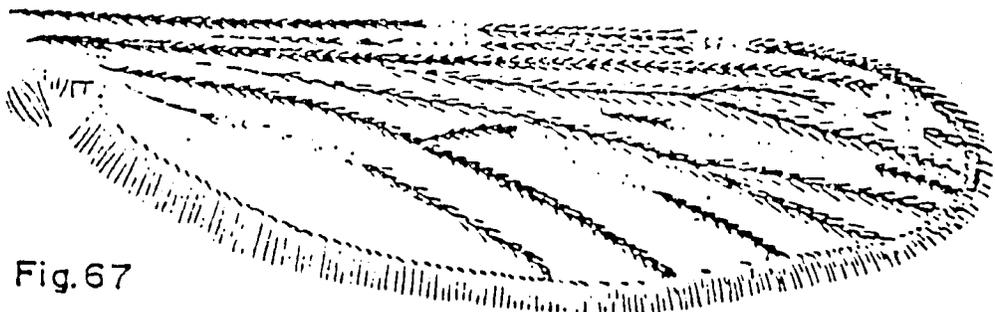


Fig. 67

- 19(18). Scutal scales predominantly brownish (Fig. 70); mid-tibia with longitudinal stripe of pale scales on anterior surface (Fig. 72).....jacksoni
 Scutal scales predominantly pale (Fig. 71); midtibia without longitudinal pale stripe on anterior surface (Fig. 73).....mimeticus

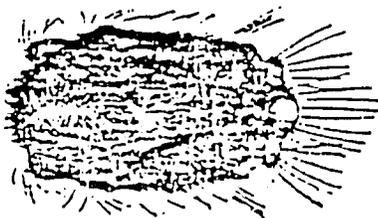


Fig. 70

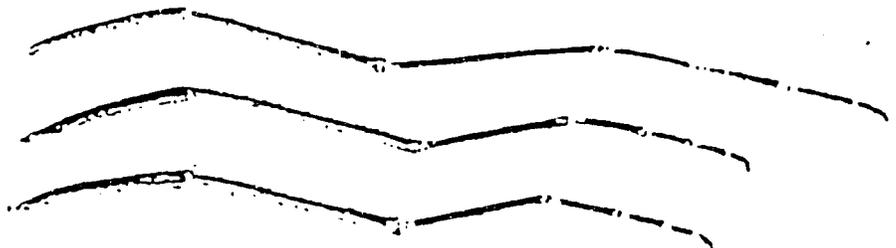


Fig. 72



Fig. 71

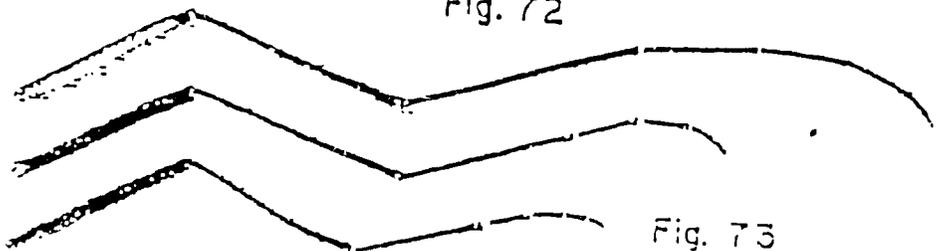


Fig. 73

ANNEX 7

ILLUSTRATED KEYS TO THE FOURTH INSTAR LARVAE
OF THE SUBGENERA OF CULEX AND THE SPECIES
OF THE SUBGENUS CULEX
OF NEPAL

KEY TO THE FOURTH INSTAR LARVAE OF THE SUBGENERA
OF THE GENUS CULEX*

1. Pecten extending to near apex of siphon (Fig. 1);
mouth brushes composed of laminated plates;
seta 1-A short, simple, inserted in proximal
0.5 of antenna (Fig.3).....Lutzia*
(halifaxii, fuscanus)
- Pecten restricted to basal 0.5 of siphon (Fig. 3);
mouth brushes filamentous; seta 1-A usually
multibranched, inserted in distal 0.3 (Fig. 4).....2

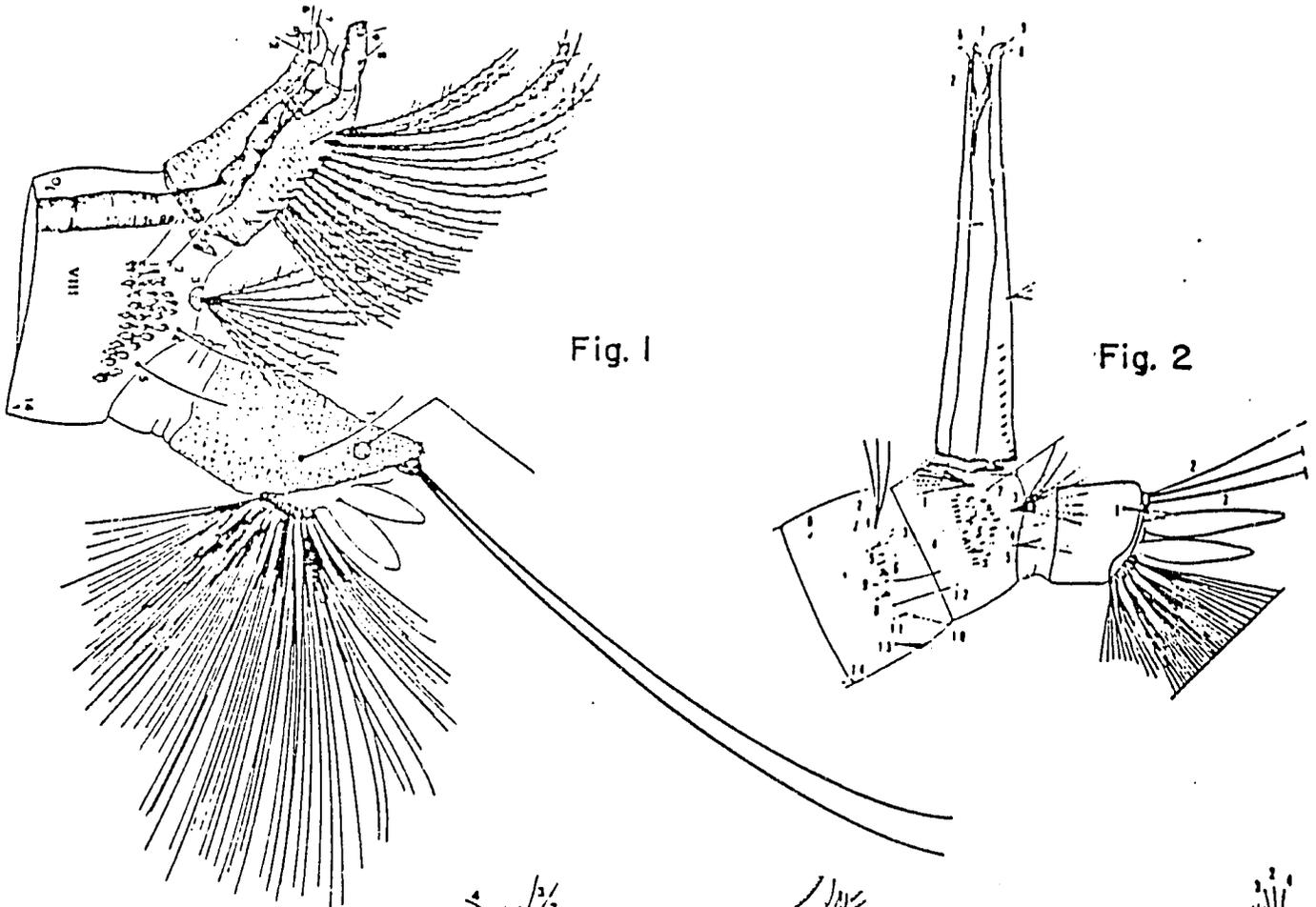


Fig. 1

Fig. 2

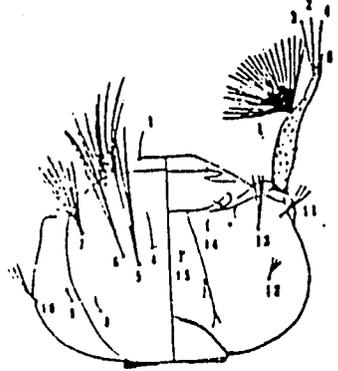
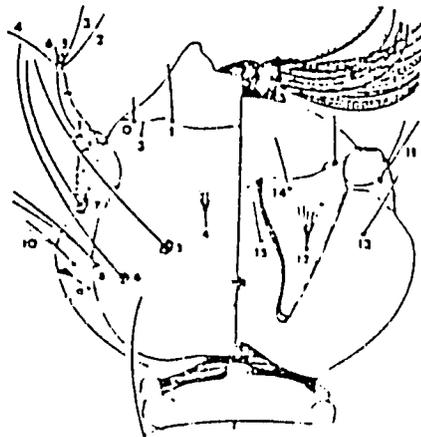


Fig. 3

Fig. 4

- 2(1). Seta 4-X with 4 pairs of setal tufts inserted on grid (Fig. 5); seta 1-C fine; seta 3-P much thinner than seta 1-P, usually 0.5 its length OR if seta 1-C stout, then seta 1-P bifid or trifid and seta 3-P with 2 or more branches (Figs. 7,9).....Culiciomyia
- Seta 4-X with 5 or more pairs of setal tufts inserted on grid (Fig. 6); if seta 1-C fine, then setae 1,3-P single and subequal in size OR if seta 1-C robust, then seta 3-P usually shorter than seta 1-P, simple (Figs. 8,10).....3

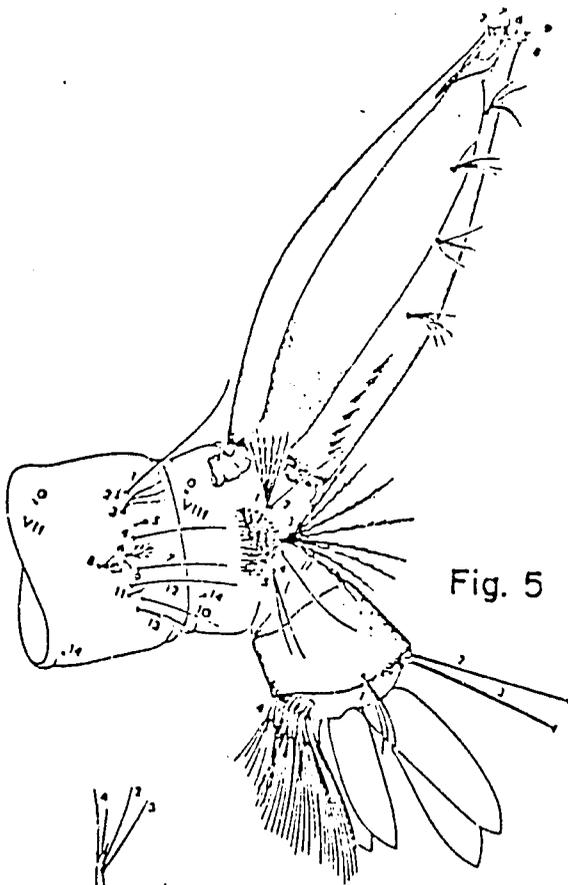


Fig. 5

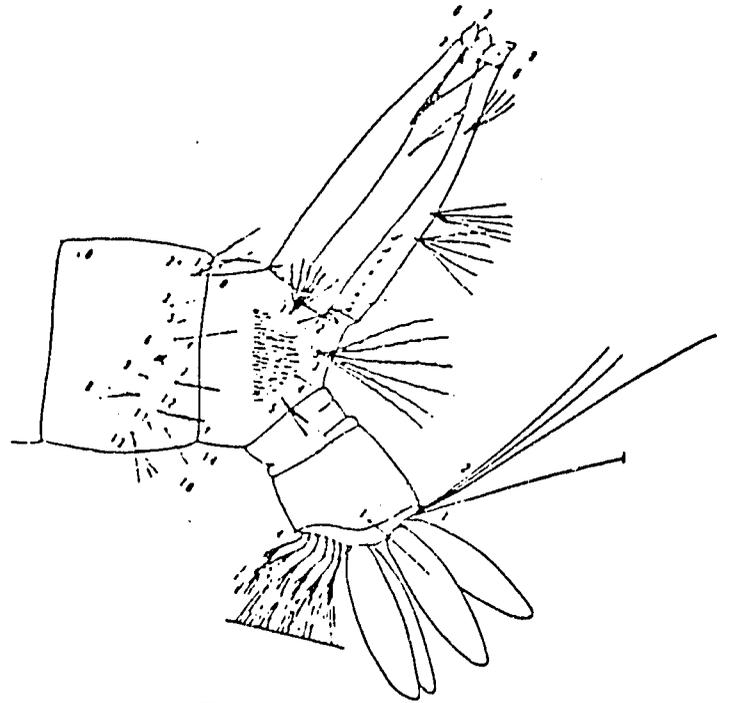


Fig. 6

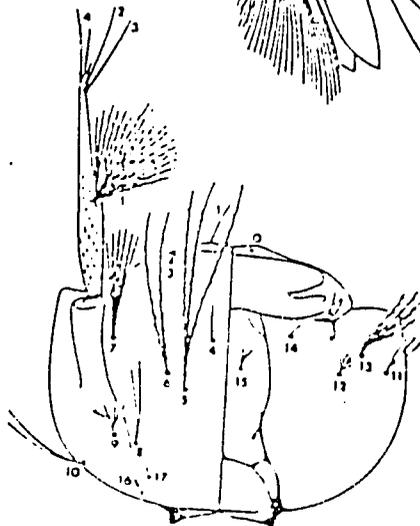


Fig. 7

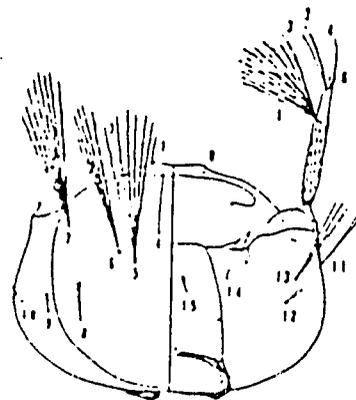


Fig. 8

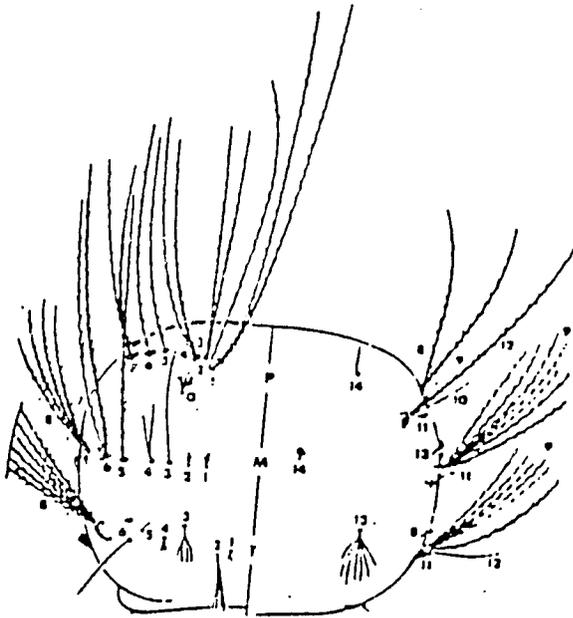


Fig. 9

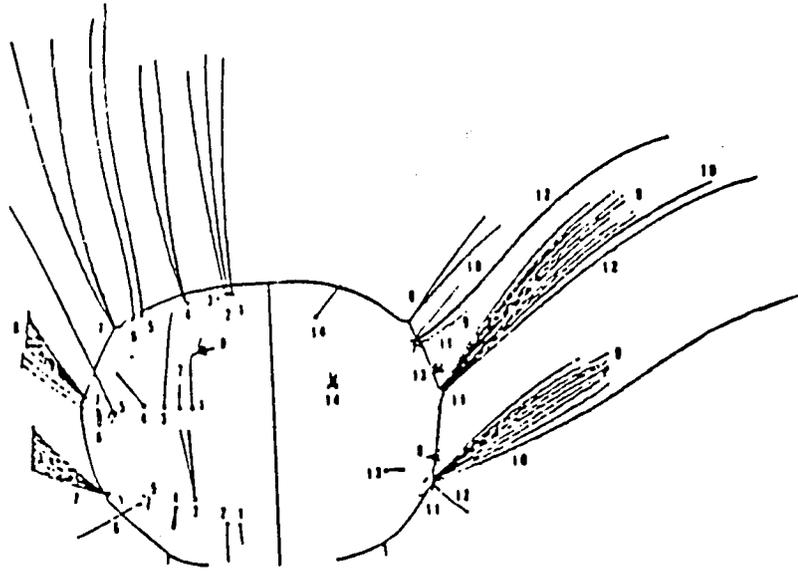


Fig. 10

- 3(2). Seta 3-P always single and subequal to seta 1-P.
 (Fig. 11).....Culex
 Seta 3-P single or branched, thinner than and usually
 0.5 length of seta 1-P (Fig. 12).....4

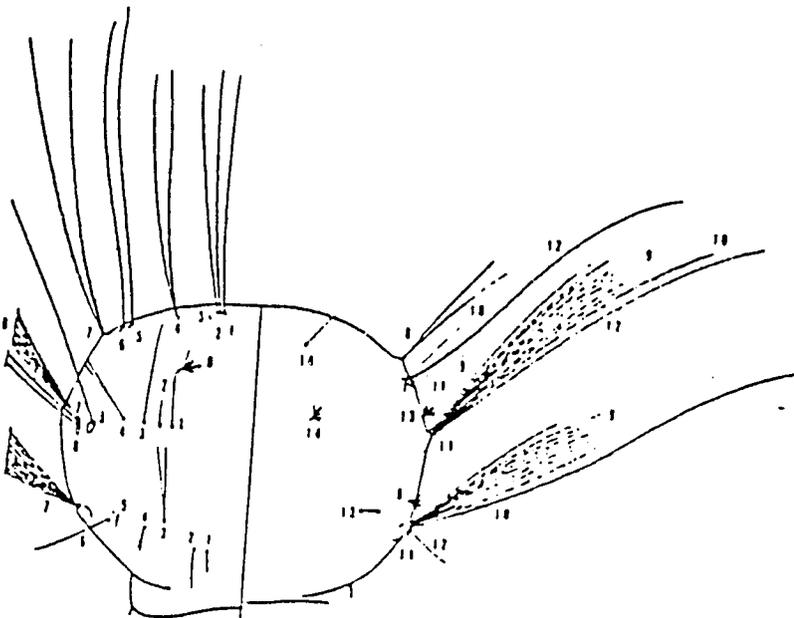


Fig. 11

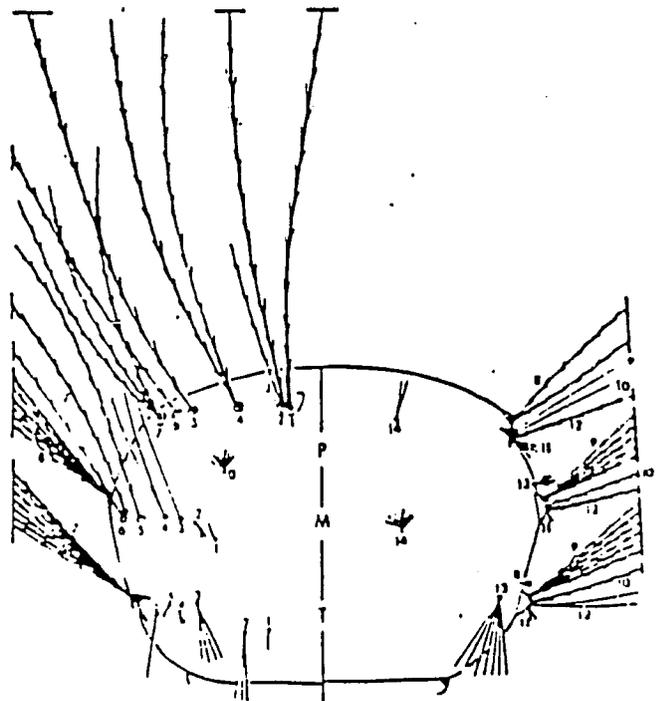


Fig. 12

- 4(3). Seta 5-C shorter than seta 6-C (Fig. 13).....Eumelanomvia
 Seta 5-C as long as or longer than seta 6-C (Fig. 14).....Lophoceraomvia

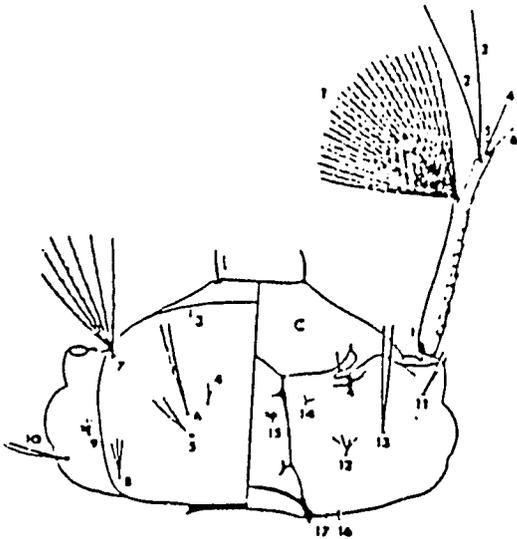


Fig. 13

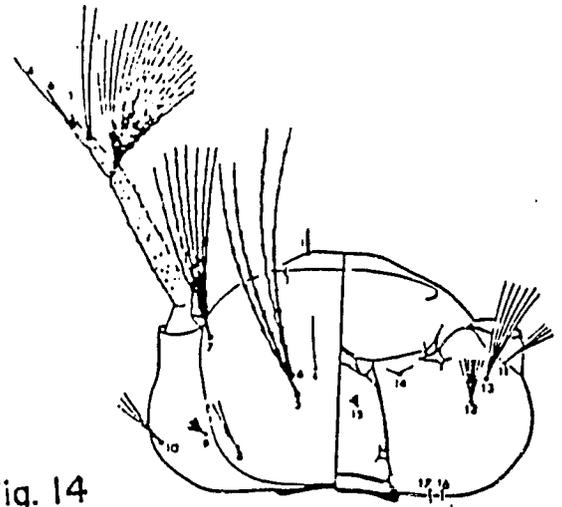


Fig. 14

KEY TO THE FOURTH INSTAR LARVAE OF GENUS CULEX
 SUBGENUS CULEX

1. Preclypeus of head capsule with distinct transverse bar, separated from dorsal apotome (Fig. 15).....2
 Preclypeus not developed as distinct from dorsal apotome (Fig. 16).....16

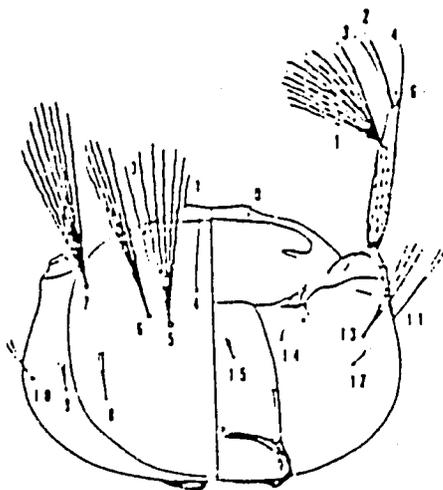


Fig. 15

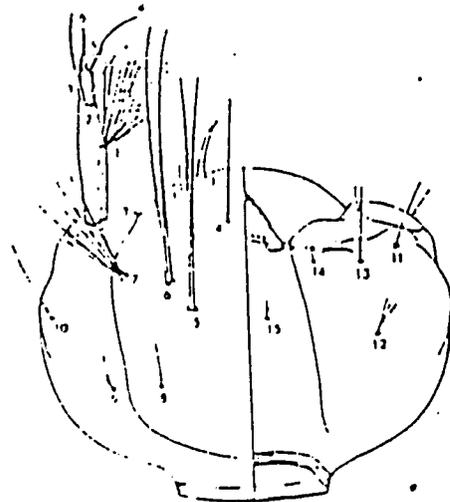


Fig. 16

- 2(1). Seta 1-C slender, distally strongly tapering, filamentous (Fig. 17).....3
 Seta 1-C dark, stout, spiniform or foliiform, pointed or blunt apically (Fig. 18).....5

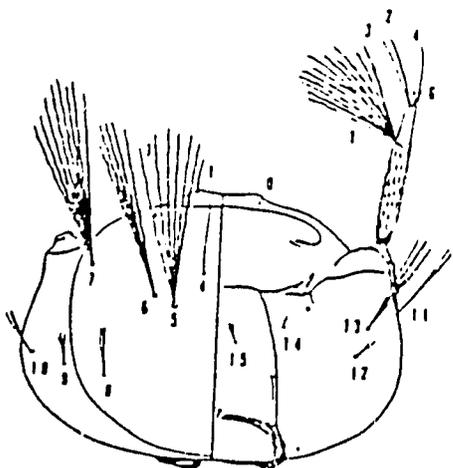


Fig. 17

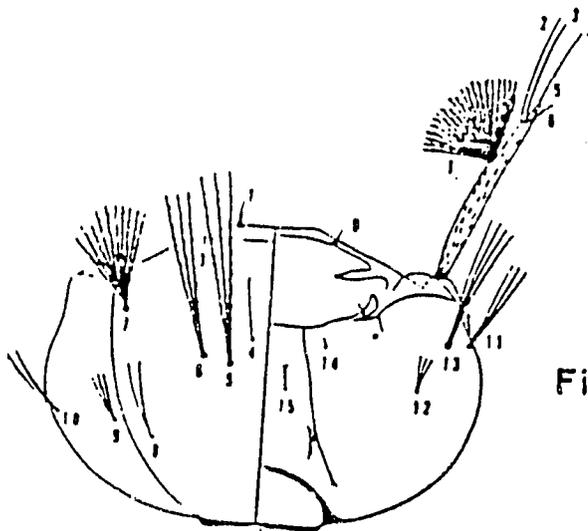


Fig. 18

- 3(2). Setae 5,6-C double (Fig. 19); mental plate with 6 or 7 denticles on either side of median tooth (Fig. 21).....fuscocephala
 Setae 5,6-C multibranching (Fig. 20); mental plate with 10-12 denticles on either side of median tooth (Fig. 22).....4

Fig. 19

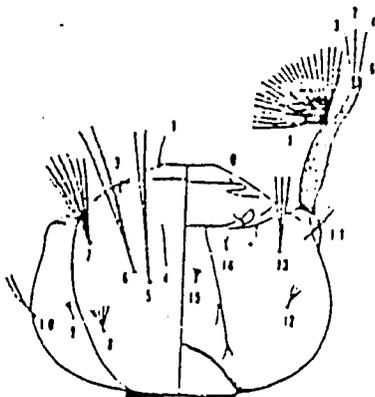


Fig. 20

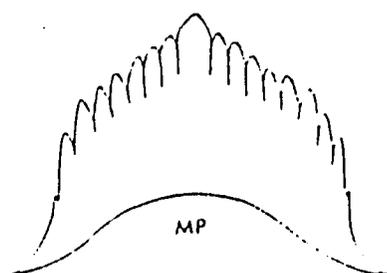
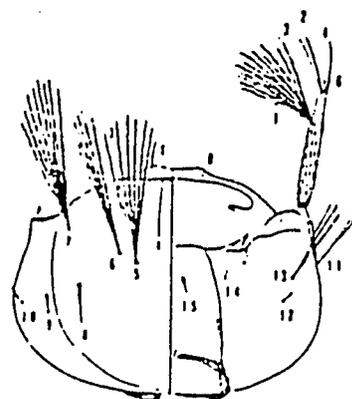


Fig. 21

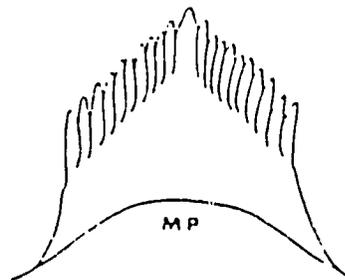


Fig. 22

128

- 4(3). Setae 2,3-A apical in position or nearly so (Fig. 23);
 siphon index about 4.0 (Fig. 25)....quinquefasciatus
 Setae 2,3-A distinctly subapical (Fig. 24); siphon
 index 5.0 or more (Fig. 26).....vacans

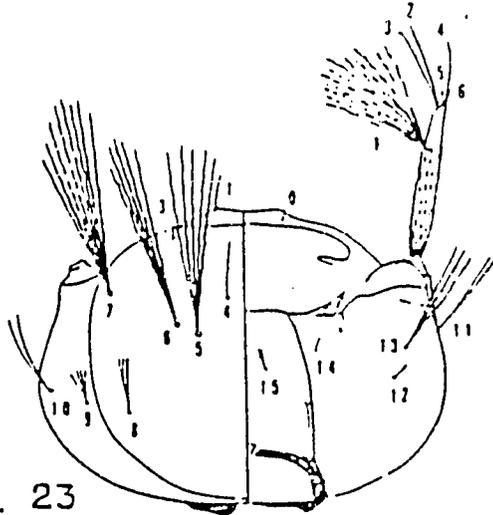


Fig. 23

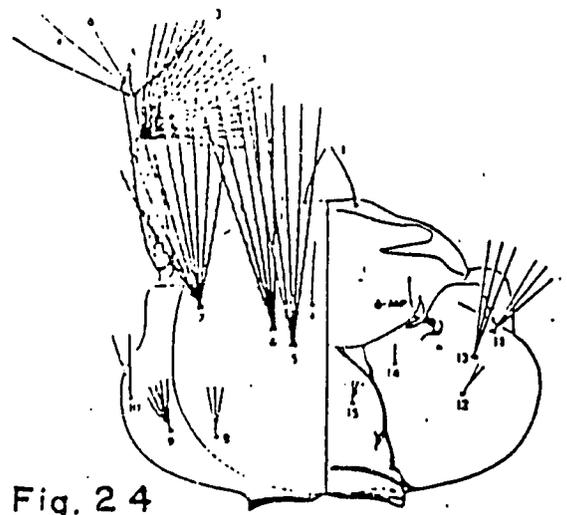


Fig. 24

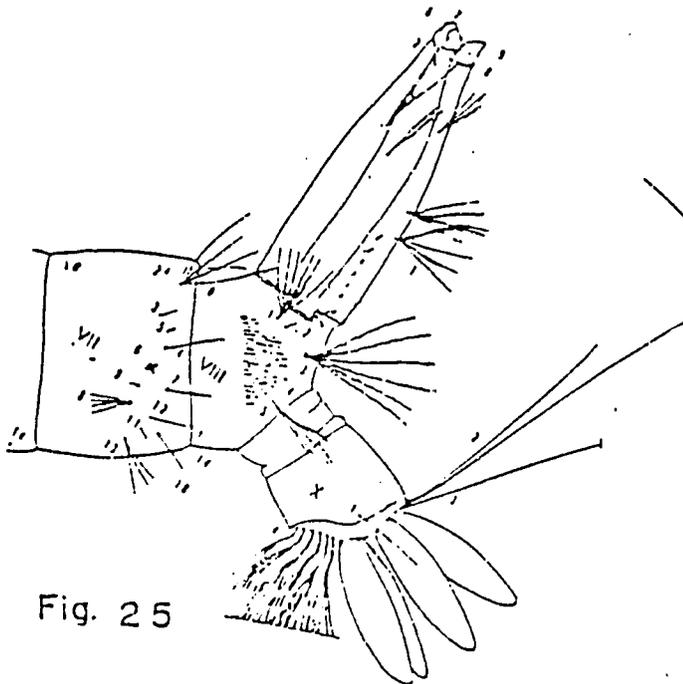


Fig. 25

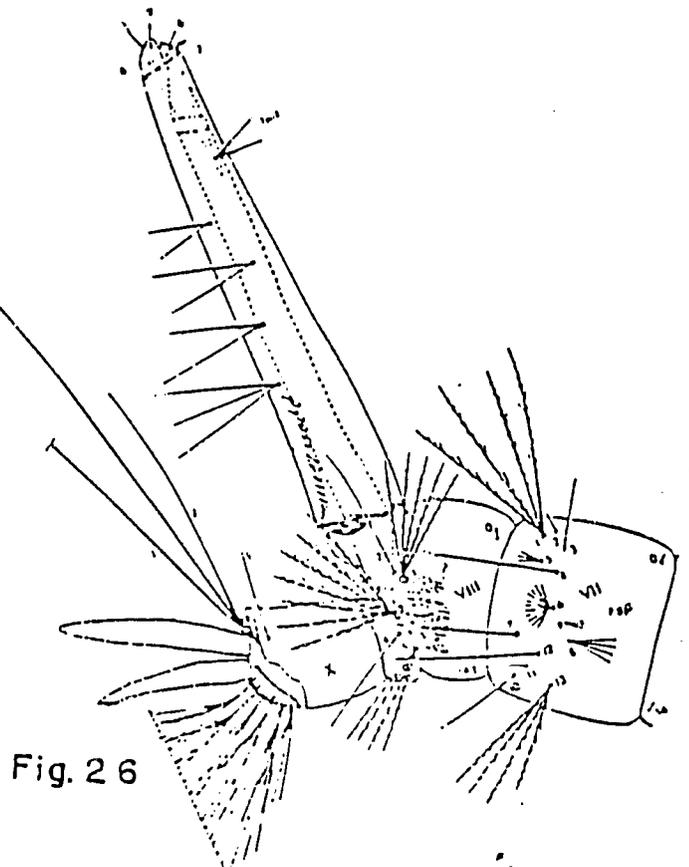


Fig. 26

- 5(2). Siphon fusiform, with strong subapical spine dorsally (Fig. 27); setae 1-M,T long multi-branched, 1-M as long as seta 3-M, 1-T as long as seta 2-T (Fig.30).....hutchinsoni
Siphon usually cylindrical, tapering apically, without subapical spine (Fig. 28); setae 1-M,T short, weak, usually single to triple (Fig. 29)....6

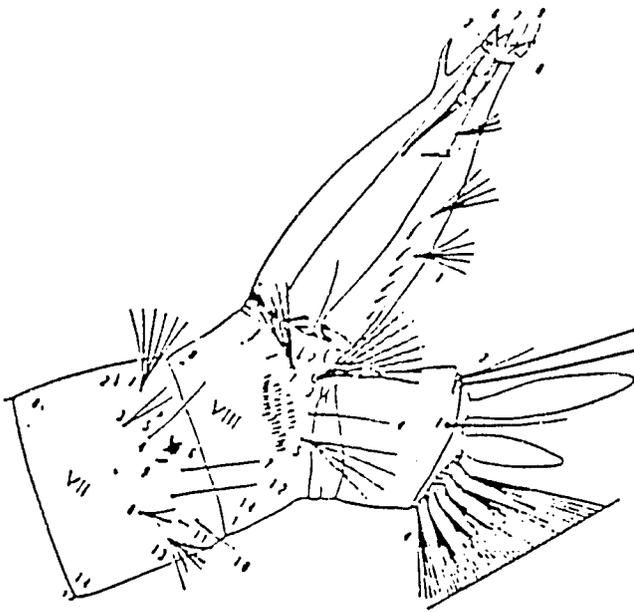


Fig. 27

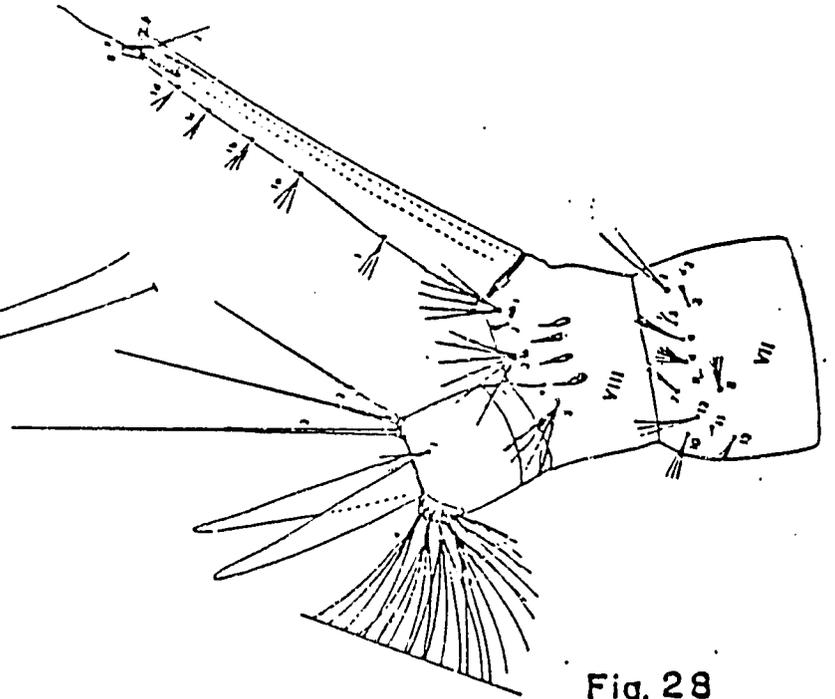


Fig. 28

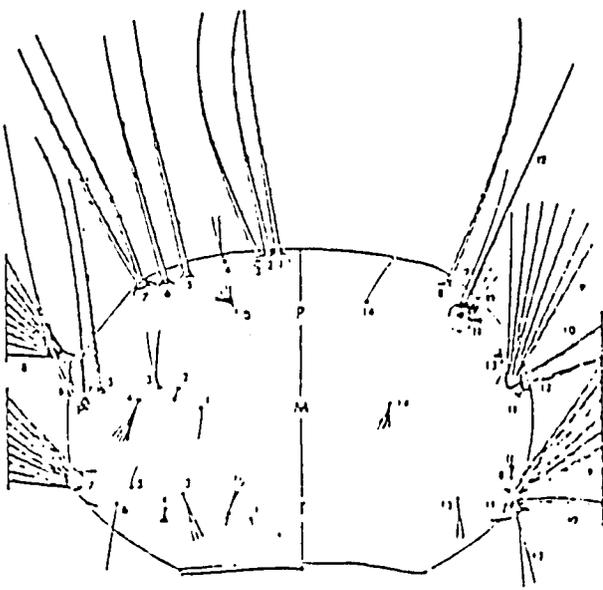


Fig. 29

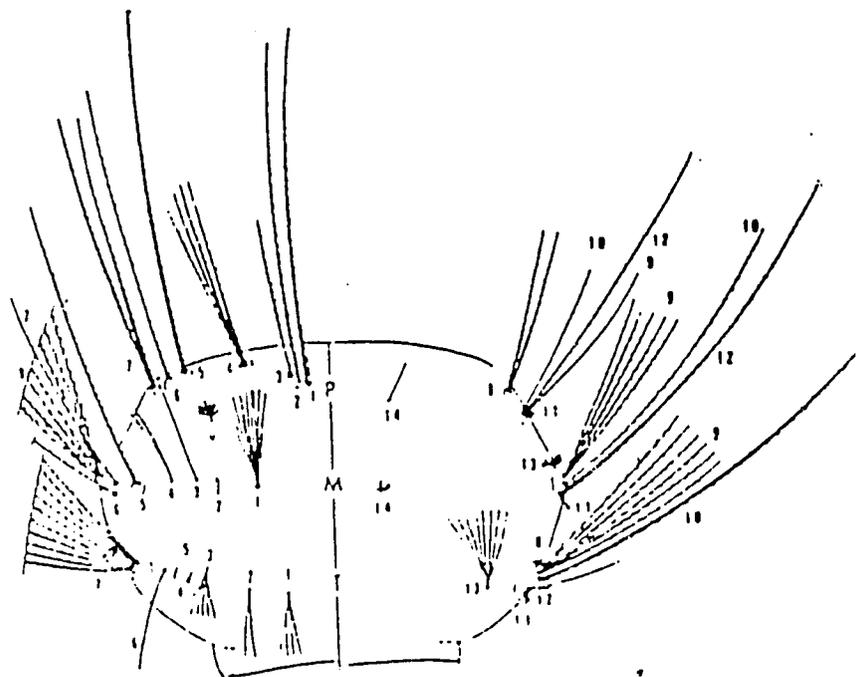


Fig. 30

- 6(5). Seta 7-I double (Fig. 31).....7
 Seta 7-I single (Fig. 32).....10

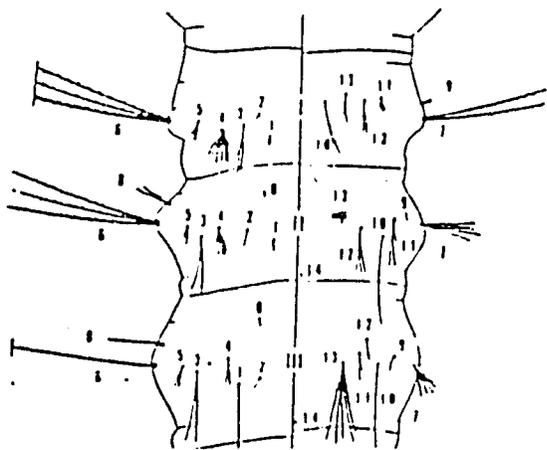


Fig. 31

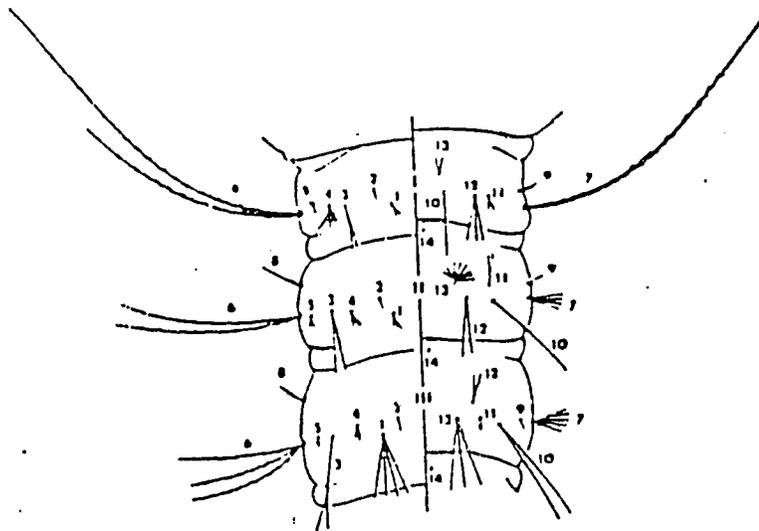


Fig. 32

- 7(6). Comb scales with strong apical spine (Fig. 33)..theileri
 Comb scales fringed apically with subequal spinules
 (Fig. 34).....8

Fig. 33



Fig. 34



- 8(7). Seta 6-C double (Fig. 35); ventral valve of
 spiracular apparatus small, brown (Fig. 37)
tritaeniorhynchus
 Seta 6-C triple (Fig. 36); ventral valve of
 spiracular apparatus broad, black (Fig. 38).....9

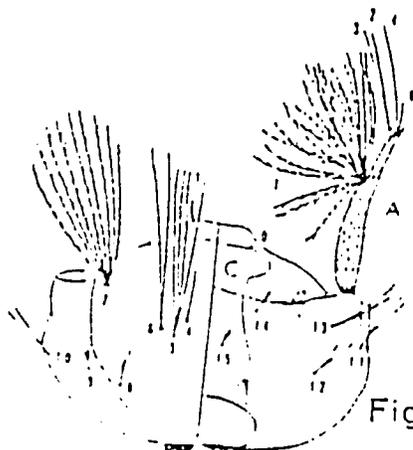


Fig. 35

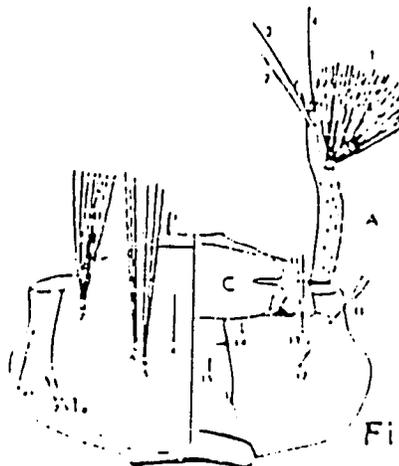


Fig. 36

12

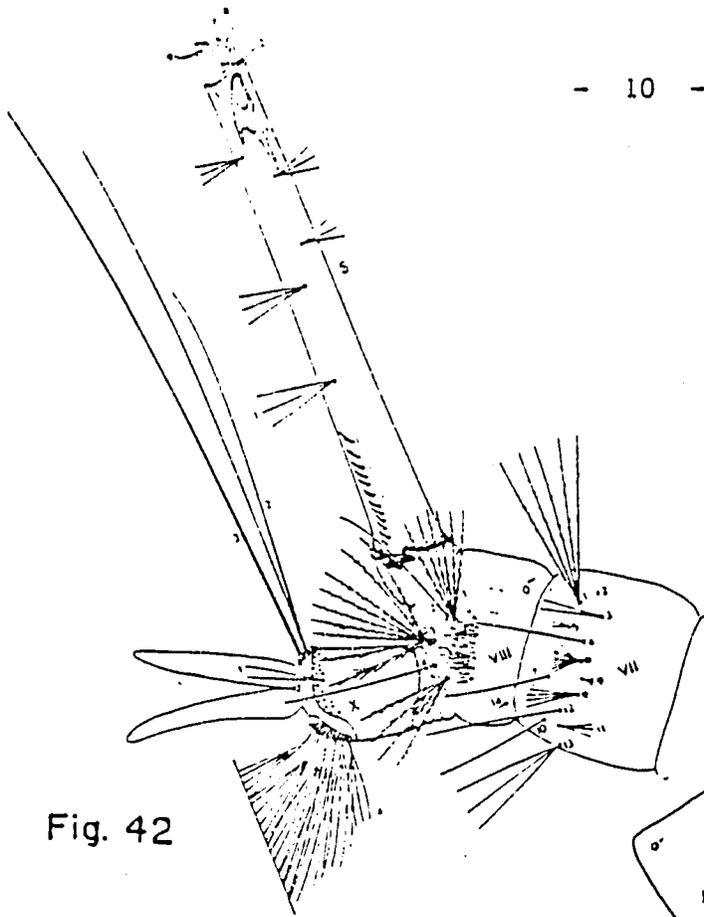


Fig. 42

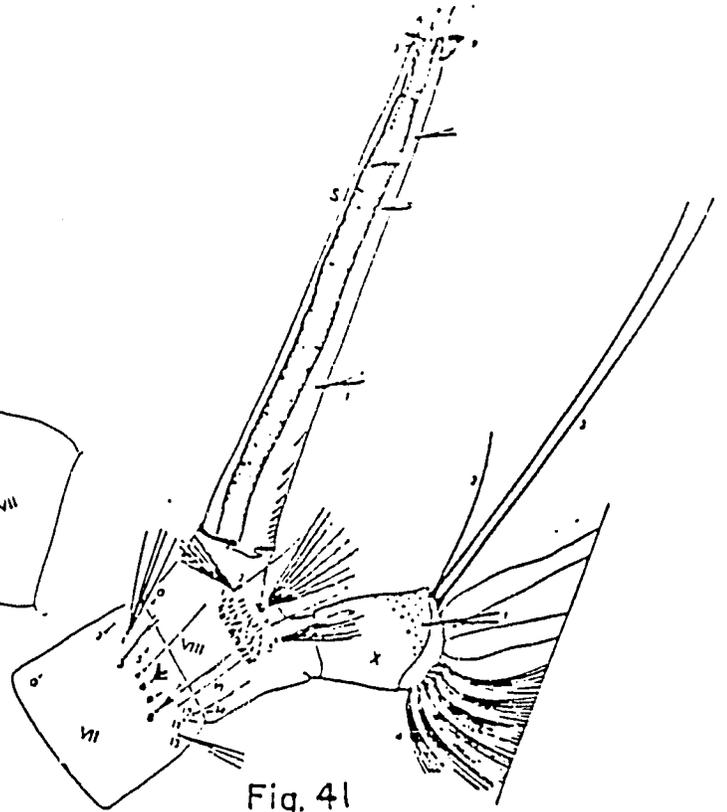


Fig. 41

- 10(6). Siphon short, index 3.0-4.0, fusiform, slightly swollen in middle (Fig. 43).....gelidus
 Siphon long, index at least 5.0, more or less cylindrical (Fig. 44).....11

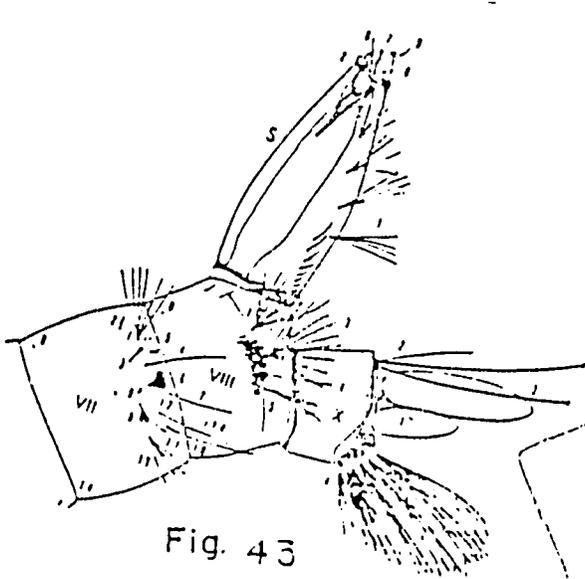


Fig. 43

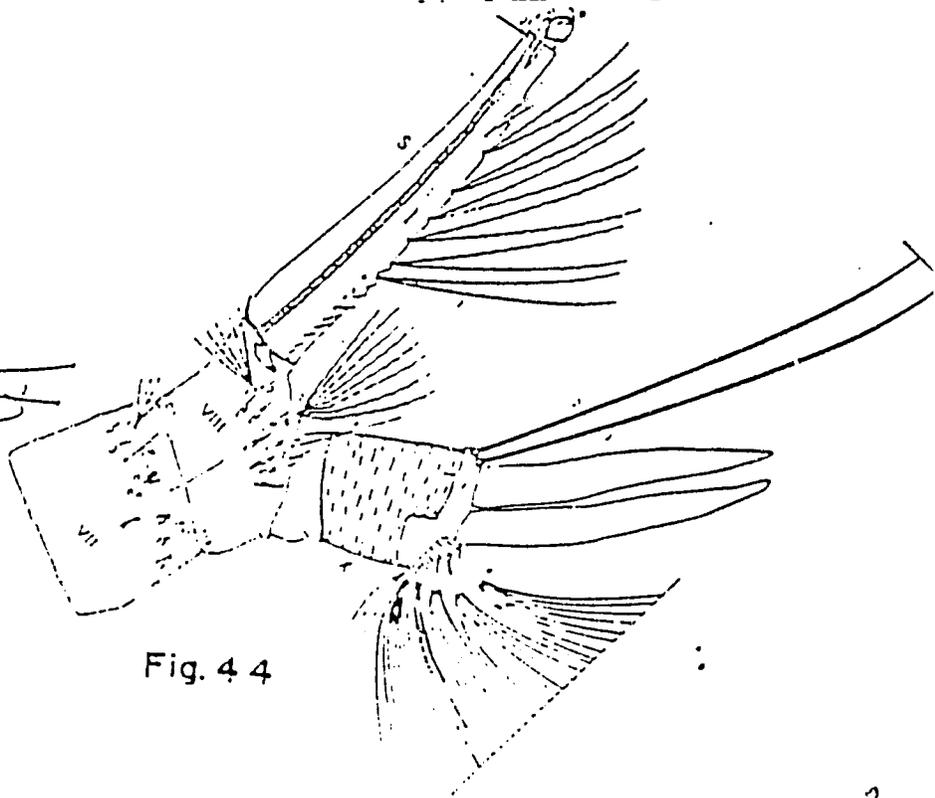


Fig. 44

- 11(10). Seta 4-P double or multibranched (Fig. 45).....12
Seta 4-P single (Fig. 46).....14

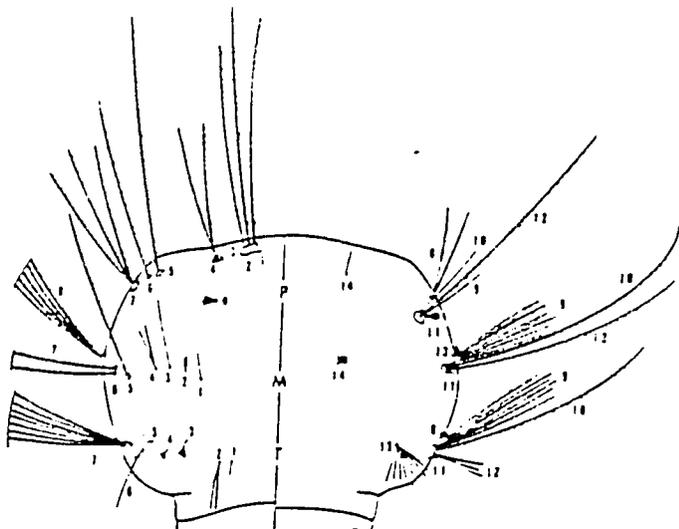


Fig. 45

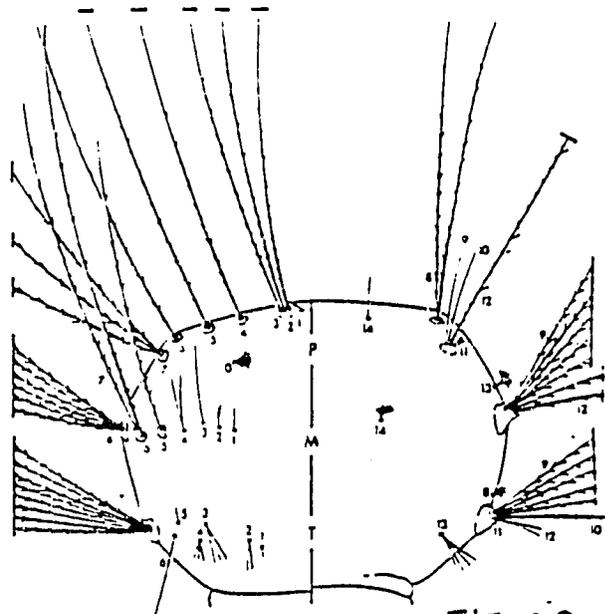


Fig. 46

- 12(11). Comb with 16-20 or more small scales in triangular patch (Fig. 47).....vishnui
Comb with 4-8 large spiniform scales in single row (Fig. 48).....13

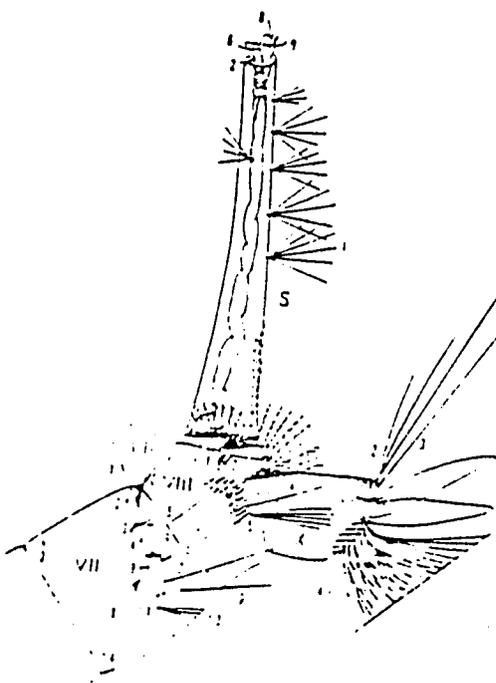


Fig. 47

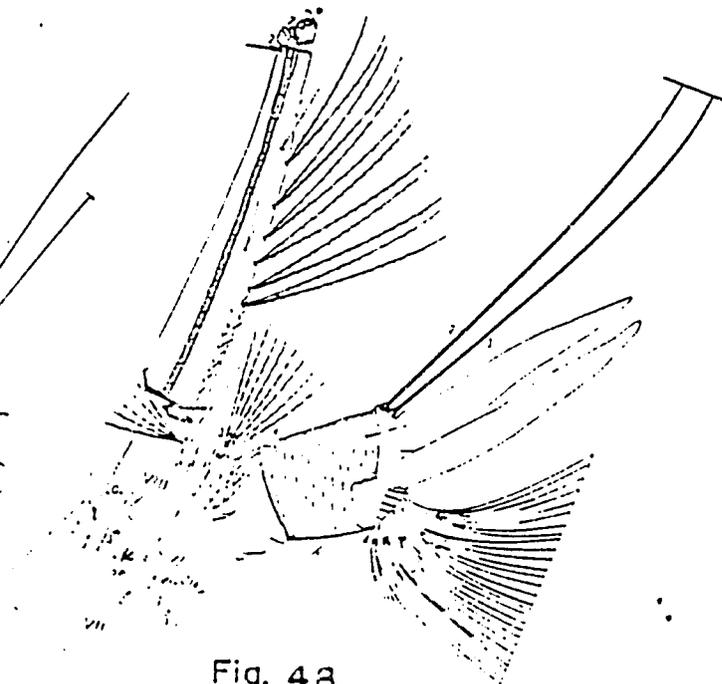


Fig. 48

13(12). Siphon strongly tapering distally, setae well developed, 4-5X width of siphon at point of attachment, with 2 or 3 branches (Fig. 49); seta 4-P always double, as long as seta 2-P (Fig. 51).....whitmorei
Siphon only slightly tapering distally, setae weaker, only slightly longer than width of siphon at point of attachment, with 4-6 branches (Fig. 50); seta 4-P variable, often shorter than seta 2-P, with 2-15 branches (Fig. 52).pseudovishnui

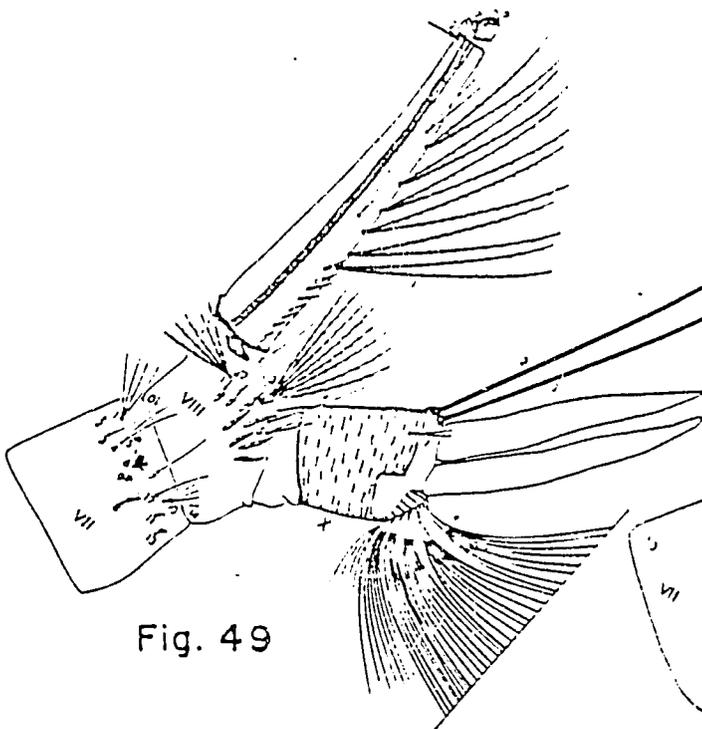


Fig. 49

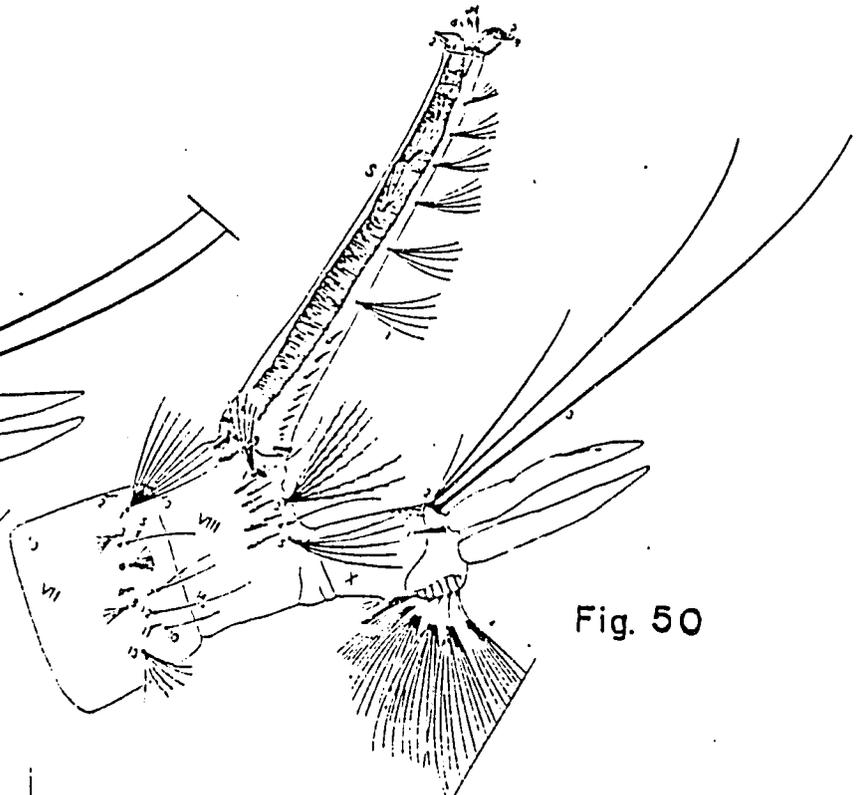


Fig. 50

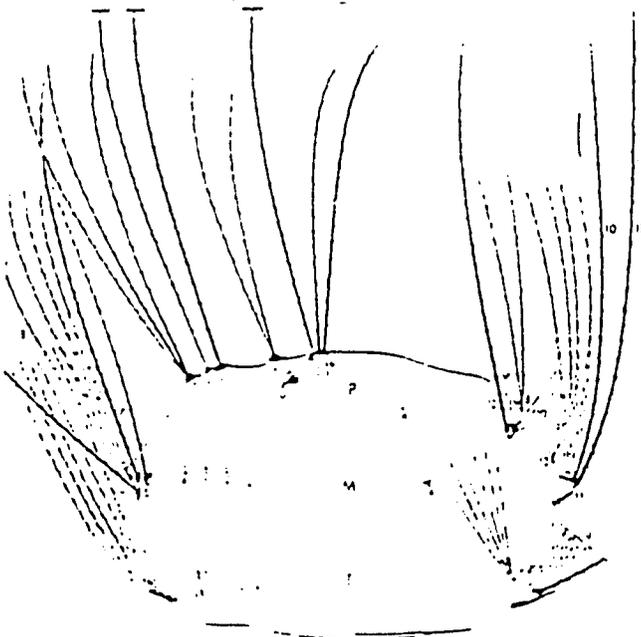


Fig. 51

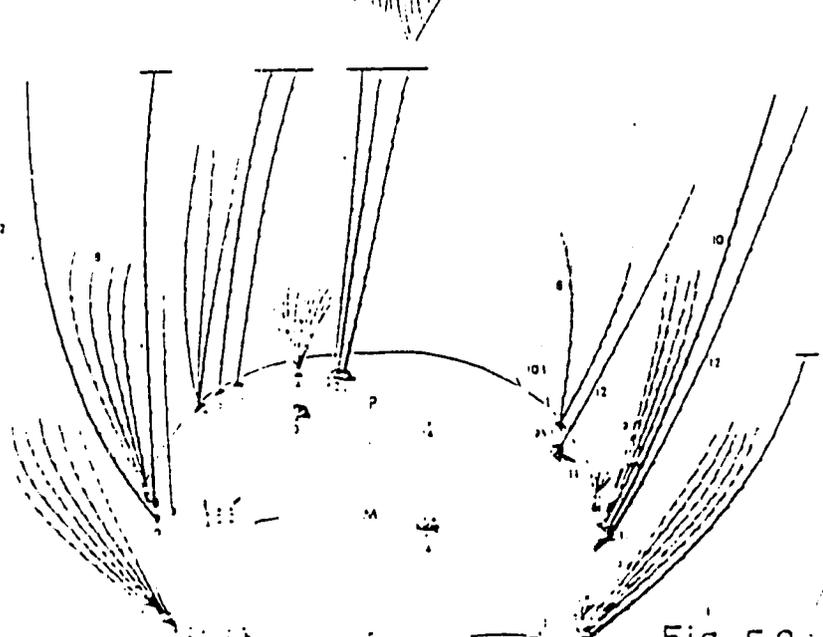
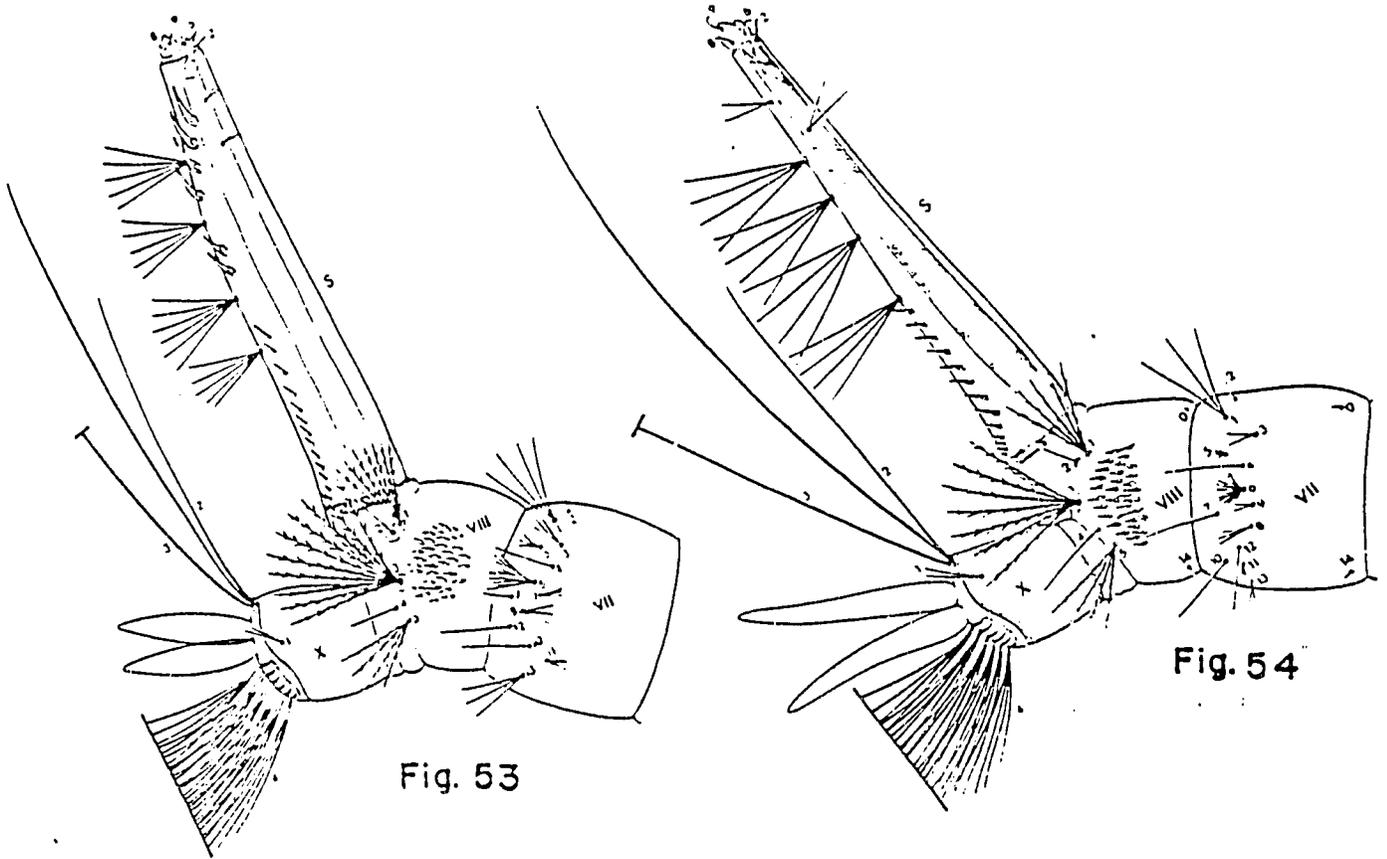


Fig. 52

- 14(11). Siphon with prominent spines on subventral surface
in apical 0.5 (Fig. 53).....jacksoni
Siphon without such spines (Fig. 54).....15



- 15(14). Comb scales with strong median spine (Fig. 55);
proximal 4 pairs of siphonal setae very strong,
closely spaced, 2-3X width of siphon at point
of attachment (Fig. 57).....mimeticus
Comb scales fringed apically with subequal
spinules or with weak apical spine (Fig. 56);
siphonal setae weak, widely separated, no
longer than width of siphon at point of
attachment (Fig. 58).....mimulus



Fig. 55



Fig. 56

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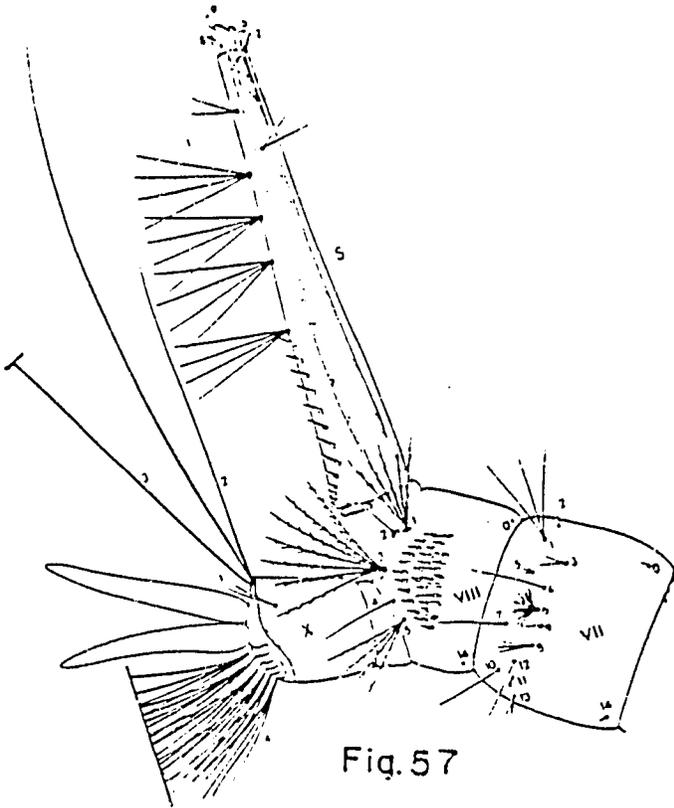


Fig. 57

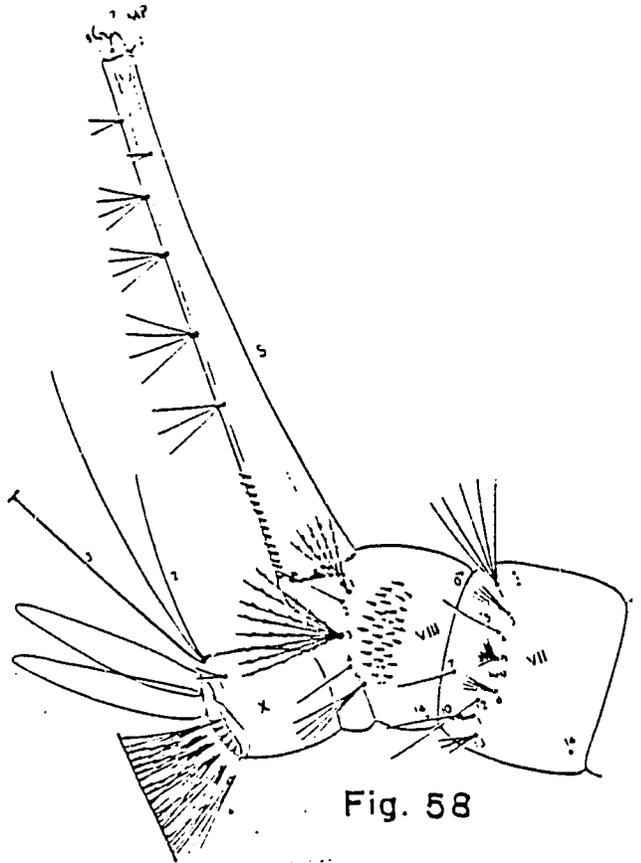


Fig. 58

16(1). Seta 2,3-A located 0.5 distance from attachment of seta 1-A to apex of antenna (Fig. 59); seta 4-P short, weak (Fig. 61).....sinensis
 Seta 2,3-A located near to apex of antenna (Fig. 60); seta 4-P long, strong (Fig. 62).....bitaeniorhynchus

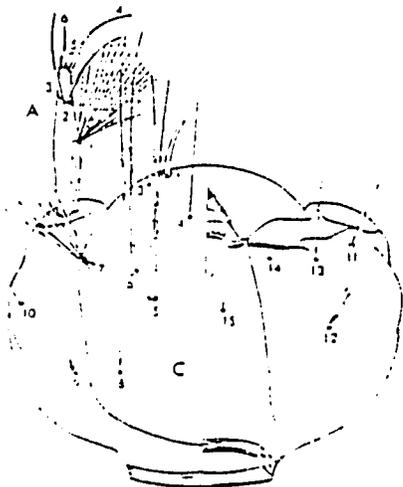


Fig. 59

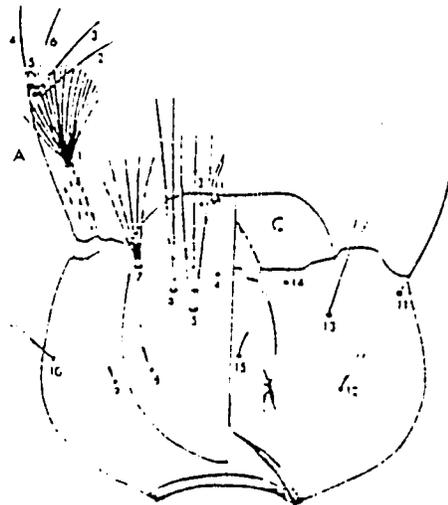


Fig. 60

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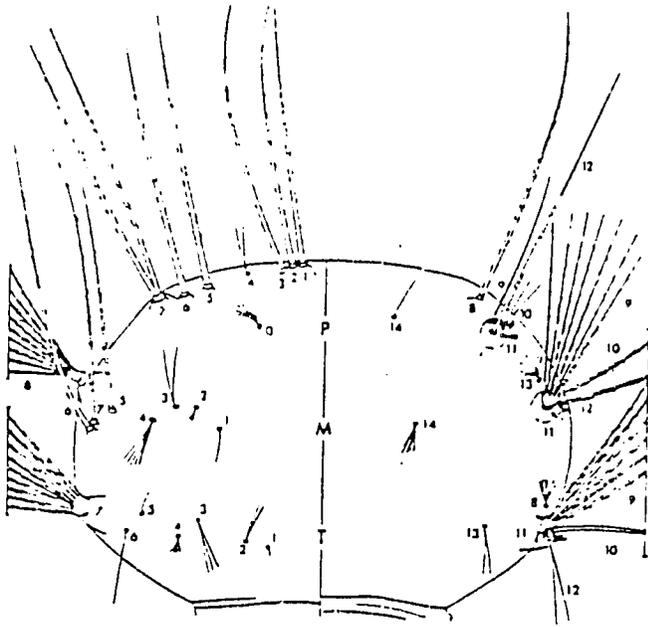


Fig. 61

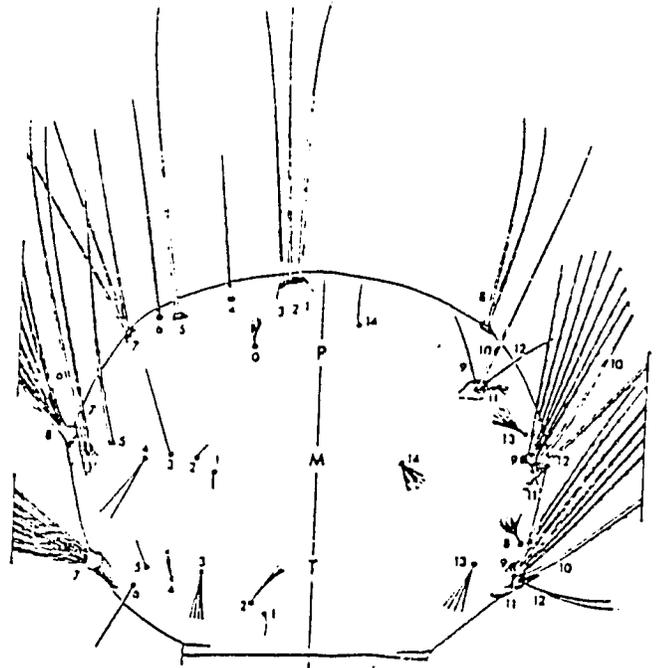


Fig. 62