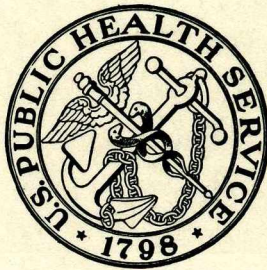


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IDENTIFICATION GUIDE TO THE

MOSQUITOES OF THE PACIFIC COAST STATES



FEDERAL SECURITY AGENCY
U. S. PUBLIC HEALTH SERVICE
MALARIA CONTROL IN WAR AREAS

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ATLANTA, GEORGIA

MAY 1943

IDENTIFICATION GUIDE TO THE MOSQUITOES OF THE PACIFIC COAST STATES*

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and

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After one has worked with any group of insects for a time there is a tendency to group the species with which one is dealing into certain definite associations of species. For instance, one group may have banded beaks, another may have the tarsi banded at both ends, etc. This association established, the field of possibility is thus limited to a few species. The worker then proceeds to apply recognition characteristics that are specific to the particular species and, by a process of elimination, arrives at a diagnosis.

We have attempted to arrange lists of Pacific Coast mosquitoes in this manner. The lists of species under any specific heading will lead to a proper identification if the reader begins with the uppermost and eliminates the major headings until one is found that fits. The same procedure should then be followed with the sub-divisions listed under the appropriate major heading. Short notes on the breeding habits, range and general appearance of the various species that are appended will aid in confirming a diagnosis.

In the section on Aedes larvae we have "stooped" to the use of habitat as a character but only as an alternative to using difficult and somewhat questionable characters so high up in the guide as to imperil its usefulness. This course is considered justifiable because the guide is intended for field men most of whom have an intimate knowledge of habitat preferences of the species which they collect. In order to avoid obvious difficulties, species which may occur in more than one habitat are repeated. This is frankly an experiment so corrections or suggestions for improvements will be appreciated.

* The authors are indebted to Eugene J. Gerberg, Asst. Sanitarian (R), USPHS for redrawing and preparing for publication the drawings used to illustrate the keys.

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Palpi of females more than one-half length of proboscis (Fig. 1.)

Anopheles

Abdomen of females blunt (Fig. 10); palpi short (Fig. 2.)

- Culiseta-----cross-veins nearly in a line (Fig. 5.);
spiracular bristles (Fig. 3.)
- Orthopodomyia-----4th tarsal segment of fore leg as wide as long;
mesonotum with delicate silvery pattern; no spiracular
bristles; rare. O. signifera (Coq).
- Culex-----cross-veins separated by own length; no spiracular
bristles; normal, narrow wing scales (Fig. 6.)
- Mansonia-----broad, bicolored wing scales (Fig. 7.); very fuzzy;
no spiracular bristles; M. perturbans (Walker).

Abdomen pointed (Fig. 14.); palpi short (Fig. 2.).

- Aedes-----no spiracular bristles; common.
- Psorophora-----spiracular bristles (Fig. 3.); rare; s.e. California. P. confinnis (L-A.).

LARVAE (GENERA)

Without a tubular air tube. (Fig. 15.)

Anopheles

With a tubular air tube (Fig. 16.)

Air tube without pecten (Figs. 21, 22).

- Orthopodomyia-----tree hole breeder (Fig. 21).
- Mansonia-----root breeder with saw-like projection of air tube
(Fig. 22.)

Single pair of multiple hair tufts on the air tube.

- Culiseta-----hair tuft situated within basal third of regular
portion of pecten (Fig. 20); all except morsitans
with distal pecten teeth produced into long setae.
- Aedes-----hair tuft beyond regular portion of pecten, some-
times within pecten; 8th segment comb scales in-
serted individually.
- Psorophora-----air tube swollen; 8th segment comb scales arising
from plate (Fig. 17).

Usually more than one pair of hair tufts on air tube; if a single pair only, it is distal and with other tufts represented by hairs; if none, the tufts are represented by single hairs (thriambus, restuans).

Culex

* Uranotaenia, on account of its rareness, is not included. A single species, U. anydor, has been taken only three times since 1906 and all from San Diego Co., California.

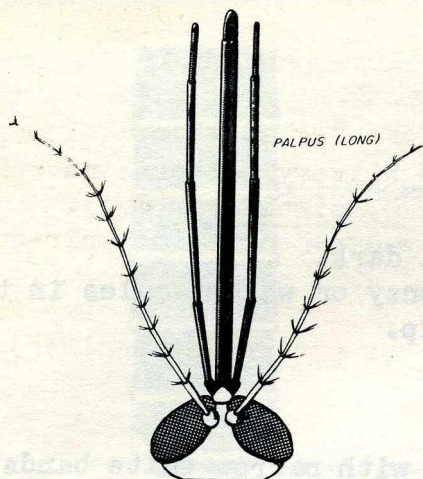


FIG. 1 HEAD OF ANOPHELINE FEMALE

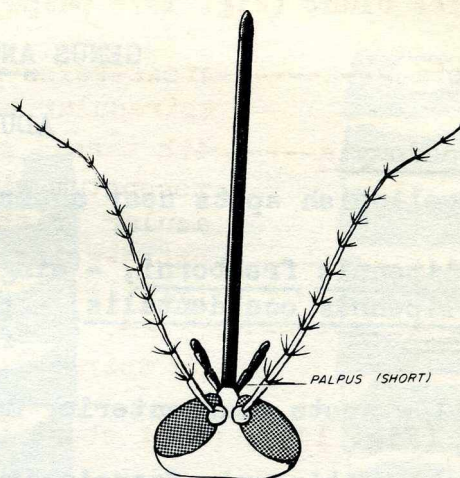


FIG. 2 HEAD OF NON-ANOPHELINE FEMALE

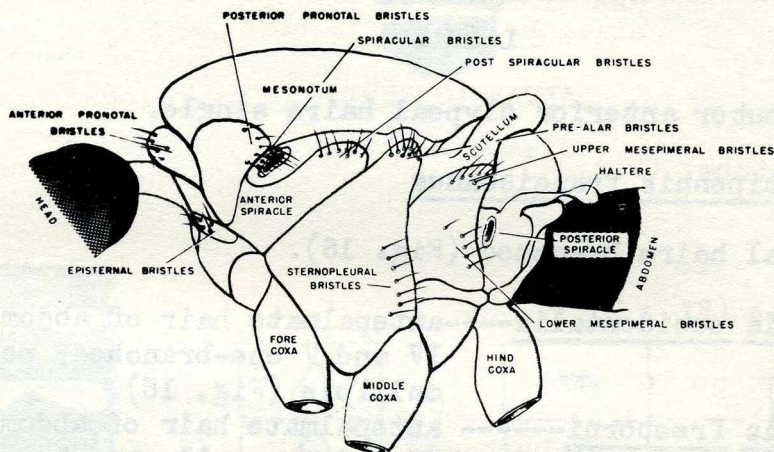


FIG. 3 SIDE VIEW OF THORAX (WING REMOVED)

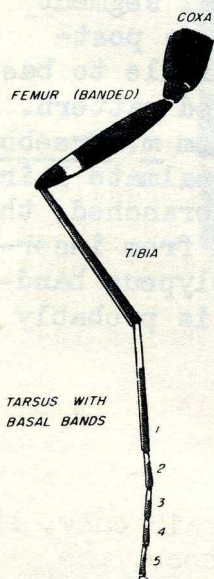


FIG. 4 HIND LEG

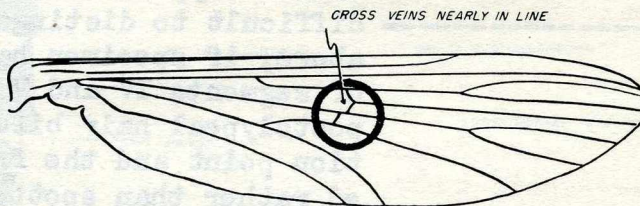


FIG. 5 WING OF CULISETA



FIG. 6 NORMAL WING SCALE

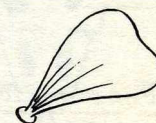


FIG. 7 BROAD WING SCALE



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3/8/91 James Stewart Grattis Jr

GENUS ANOPHELES

ADULTS

Wings without yellowish spots near anterior margin.

maculipennis freeborni, - wing scales all dark.

maculipennis occidentalis, - patch of bronzy or white scales in the fringe at tip.

Wings with yellow spots near anterior margin.

pseudopunctipennis franciscanus, - palpi with narrow white bands.
punctipennis, - palpi unbanded.

LARVAE

With both inner and outer anterior clypeal hairs single.

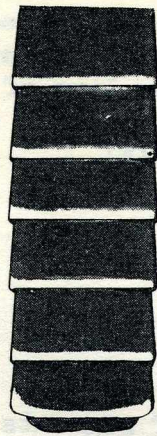
pseudopunctipennis franciscanus

Outer anterior clypeal hairs branched (Fig. 15).

maculipennis occidentalis-----antepalmar hair of abdominal segment IV and V one-branched; postclypeal hair multiple (Fig. 15).

maculipennis freeborni-----antepalmar hair of abdominal segment IV and V usually two-branched; postclypeal hair bifurcate at middle to base; fronto-clypeus with a spotted pattern.

punctipennis-----difficult to distinguish from m. freeborni above; if specimen has antepalmar hairs of segments IV and V three-branched, the postclypeal hair bifurcated from insertion point and the fronto-clypeus banded rather than spotted, it is probably this species.



APICAL BANDS

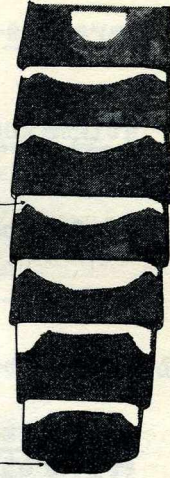
BASAL BANDS SEPARATED
FROM LATERAL SPOTS

FIG. 8 C. APICALIS



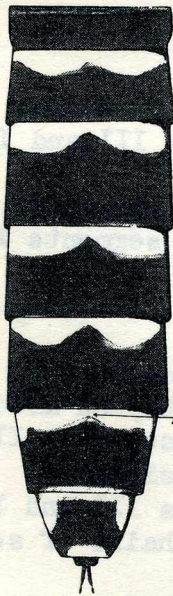
FIG. 9 C. QUINQUEFASCIATUS

BASAL BANDS JOINING
LATERAL SPOTS



BLUNT ABDOMEN

FIG. 10 C. PIPENS



INDENTED
BASAL BANDS

FIG. 11 A. VEXANS

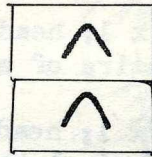


FIG. 12 C. TARSALIS

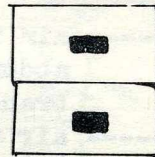
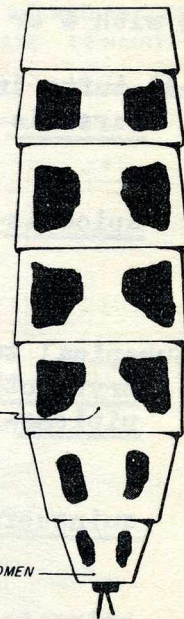


FIG. 13 C. STIGMATOSOMA

VENTRAL MARKINGS



LONGITUDINAL STRIPE

POINTED ABDOMEN

FIG. 14 A. DORSALIS



ADULTS

Tarsi with white bands (Fig. 4).

<u>thriambus</u> and <u>restuans</u> -----	proboscis unbanded although with some white scales below; adult females of these two species cannot be distinguished readily.
<u>tarsalis</u> -----	proboscis white banded; black inverted V on venter of abdominal segments (Fig. 12); outer surfaces of femora and tibiae with narrow line of white scales.
<u>stigmatosoma</u> -----	proboscis white banded; median black spot on venter of abdominal segments (Fig. 13).

Tarsi unbanded, abdomen unbanded.

anips----- rare species.

Tarsi unbanded, abdomen banded.

<u>apicalis</u> -----	abdominal bands at apices of segments (Fig. 8).
<u>erythrothorax</u> -----	foxy red mesonotum; mesonotal scales hair-like; abdominal bands very narrow and basal.
<u>pipiens</u> -----	brownish, abdominal bands broad and connected with lateral spots (Fig. 10).
<u>quinquefasciatus</u> ---	grayish; abdominal bands broad but not connected with lateral spots (Fig. 9).

LARVAE

Air tube with 4 or more pairs of tufts.

All tufts in line.

<u>tarsalis</u> -----	air tube 4 x 1; head hairs multiple; lateral abdominal hairs of segments III and IV three branched.
<u>apicalis</u> -----	air tube 7 x 1; head hairs single or double; lateral abdominal hairs of segments III and IV double.

Subapical tuft out of line.

<u>erythrothorax</u> -----	air tube evenly tapered from base, 7 x 1.
<u>pipiens</u> -----	air tube shorter, tapered beyond middle; subdorsal hairs of abdominal segments III and IV usually double, sometimes single.
<u>quinquefasciatus</u> ---	subdorsal hairs of segments III and IV usually single; lateral abdominal hairs of segments III and IV 2-branched.
<u>stigmatosoma</u> -----	subdorsal hairs of abdominal segments III and IV 3-branched; lateral abdominal hairs of same segments 3-branched.

Air tube with single hairs beyond pecten and sometimes a subapical tuft.

<u>thriambus</u> -----	antenna with tuft on outer third; part beyond tuft slender, differentiated from basal part.
<u>restuans</u> -----	antenna with tuft at or near middle; part beyond tuft evenly tapered.

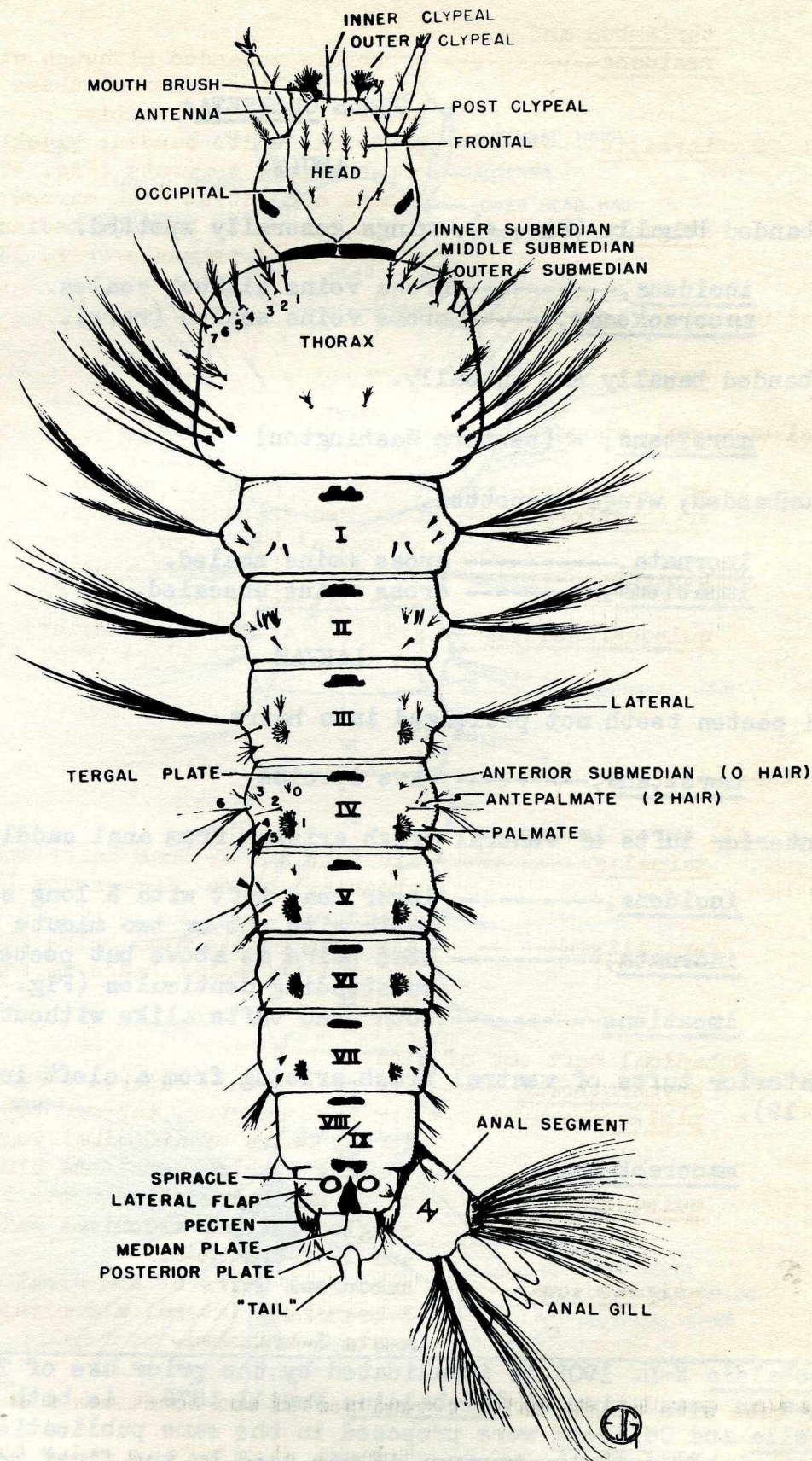


FIG 15 DIAGRAM OF AN ANOPHELINE LARVA

GENUS CULISETA*

ADULTS

Tarsi banded basally (Fig. 4); wings generally spotted.

incidens,----- cross veins without scales.
macrackenae,----- cross veins scaled (rare).

Tarsi banded basally and apically.

morsitans, - (eastern Washington)

Tarsi unbanded; wings unspotted.

inornata,----- cross veins scaled.
impatiens,----- cross veins unscaled.

LARVAE

Distal pecten teeth not prolonged into hairs.

morsitans,----- rare species.

Two anterior tufts of ventral brush arising from anal saddle.

incidens,----- lower head tuft with 3 long setae; basal pecten
teeth with one or two minute denticules (Fig. 24).
inornata,----- head hairs as above but pecten teeth with 3-4
outstanding denticules (Fig. 25).
impatiens,----- both head tufts alike without prominent hairs.

Two anterior tufts of ventral brush arising from a cleft in the anal saddle
(Fig. 19).

macrackenae, -

* Theobaldia N-L. 1902 is invalidated by the prior use of Theobaldia Fischer 1887 as an emendation of Theobaldius Nevill 1878. As both available synonyms, Culicella and Culiseta were proposed in the same publication by Felt in 1904, Culiseta takes priority because it was used by the first reviewer (Dyar, 1921) to designate the groups now included in the genus.

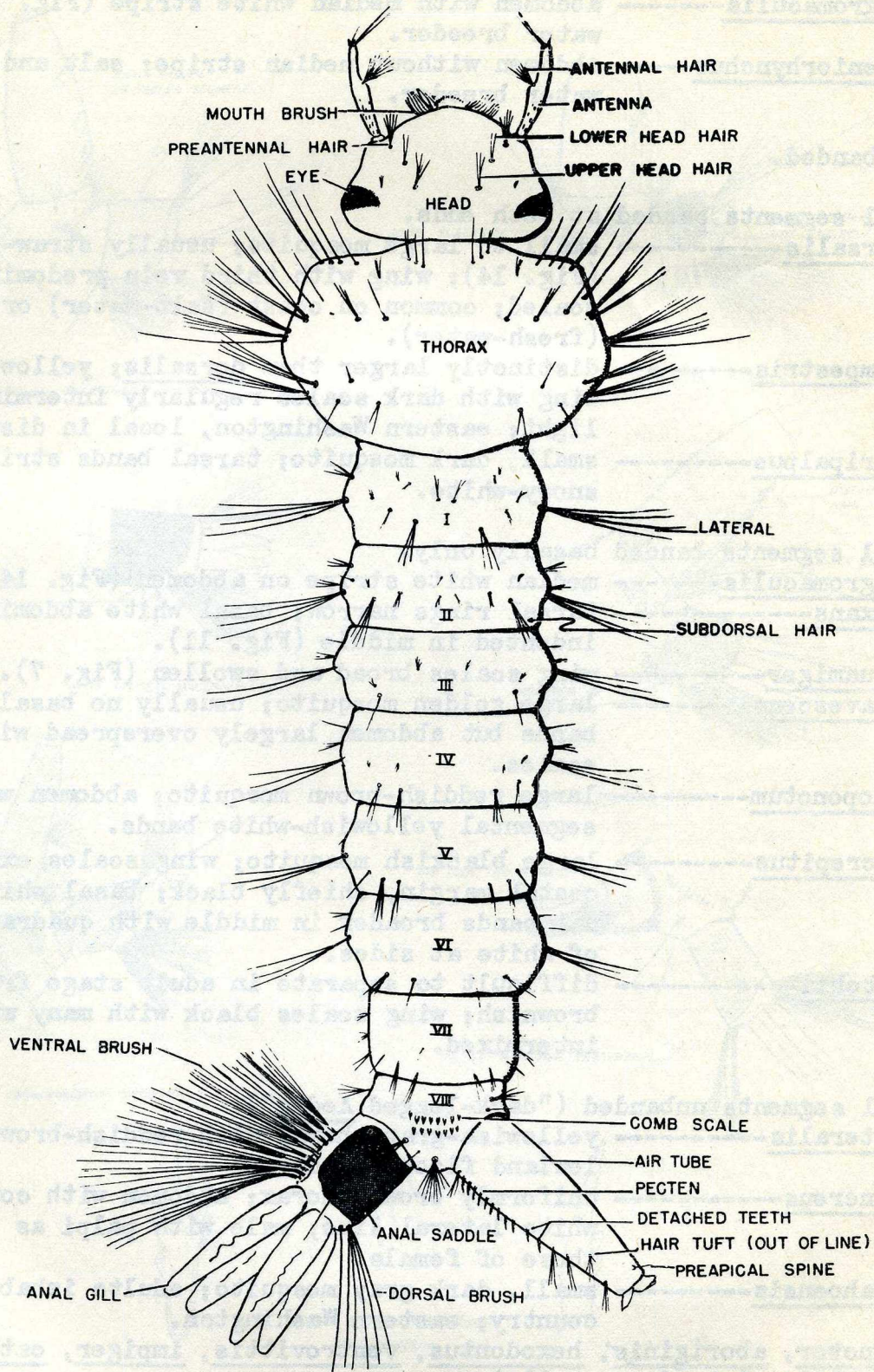


FIG. 16 DIAGRAM OF A CULICINE LARVA

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GENUS Aedes

ADULTS

Proboscis banded.

- nigromaculis----- abdomen with median white stripe (Fig. 14); fresh-water breeder.
taeniorhynchus----- abdomen without median stripe; salt and brackish water breeder.

Proboscis unbanded.

Tarsal segments banded at both ends.

- dorsalis----- small to large mosquito; usually straw-colored (Fig. 14); wing with third vein predominantly dark-scaled; common on coast (salt-water) or inland (fresh-water).
campestris----- distinctly larger than dorsalis; yellowish-gray; wing with dark scales regularly intermixed with light; eastern Washington, local in distribution.
varipalpus----- small, dark mosquito; tarsal bands strikingly snowy-white.

Tarsal segments banded basally only.

- nigromaculis----- median white stripe on abdomen (Fig. 14).
vexans----- tarsal rings narrow; basal white abdominal band indented in middle (Fig. 11).
squamiger----- wing scales broad and swollen (Fig. 7).
flavescens----- large golden mosquito; usually no basal abdominal bands but abdomen largely overspread with yellow scales.
aloponotum----- large reddish-brown mosquito; abdomen with basal segmental yellowish-white bands.
increpitus----- large blackish mosquito; wing scales, except at costal margin, chiefly black; basal white abdominal bands broader in middle with quadrate patch of white at sides.
fitchii----- difficult to separate in adult stage from increpitus; brownish; wing scales black with many white ones intermixed.

Tarsal segments unbanded ("dark-legged Aedes").

- lateralis----- yellowish-gray thorax with reddish-brown markings; lowland flood breeder.
cinereus----- uniformly brown thorax; abdomen with continuous white lateral line; male with palpi as short as those of female.
idahoensis----- small, dark gray mosquito; adults inhabit open dry country; eastern Washington.
punctator, aboriginis, hexodontus, ventrovittis, impiger, cataphylla, communis, intrudens, pullatus --- extremely difficult to distinguish as adults; these are all more or less restricted to high mountains and are commonly known as "snow-mosquitoes."

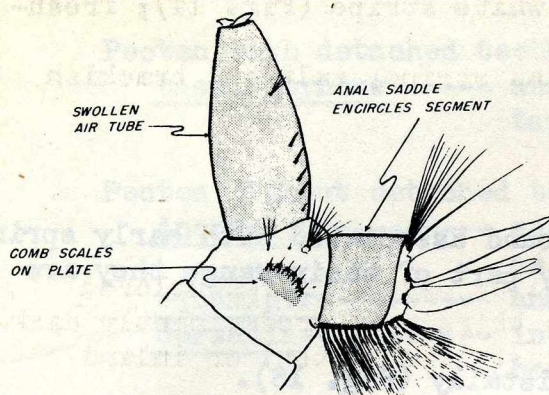


FIG. 17 PSOROPHORA CONFINNIS

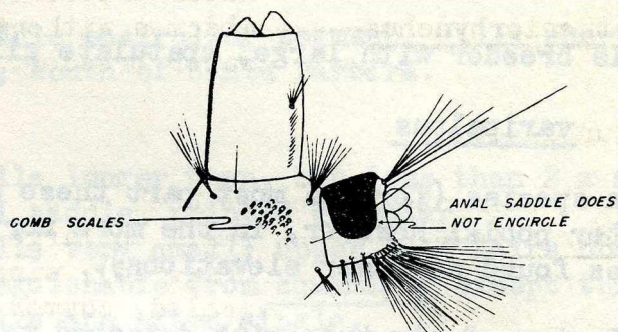


FIG. 18 AEDES DORSALIS

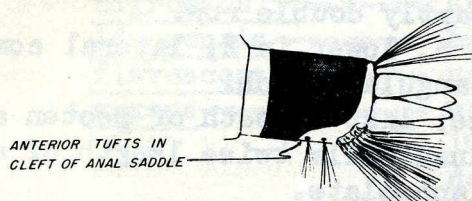


FIG. 19 CULISETA MACCRACKENAE

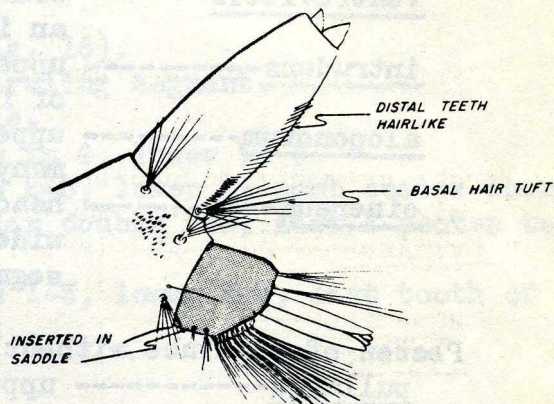


FIG. 20 CULISETA INCIDENS

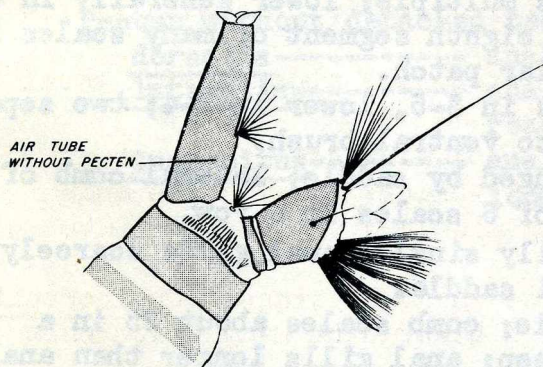


FIG. 21 ORTHOPODOMYIA SIGNIFERA

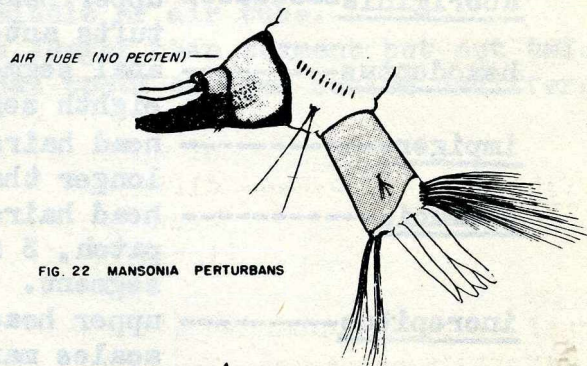


FIG. 22 MANSONIA PERTURBANS

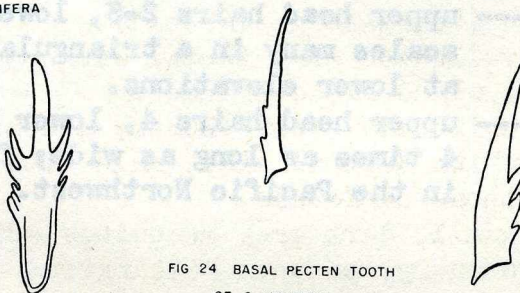


FIG. 23 COMB SCALE WITH
DIFFERENTIATED APICAL TOOTH

FIG. 24 BASAL PECTEN TOOTH
OF C. INCIDENS

FIG. 25 BASAL PECTEN TOOTH
OF C. INORNATA



LARVAE

Tree-hole breeder with large, spatulate gills.

varipalpus

Mountain species (for the most part these are found associated with early spring snow-water pools; however, in the more northerly part of their range they are sometimes found at lower elevations).

Pecten of air tube with detached teeth distally (Fig. 16).

- cataphylla----- hair tuft within the pecten.
- ventrovittis----- comb of eight segment of less than ten scales in an irregular row.
- intrudens----- upper head hairs in 4, lower in 3; lateral comb of few scales in partly double row.
- aloponotum----- upper head hair in 3, lower in 2; lateral comb of many scales in triangular patch.
- oinereus----- head hairs multiple; last 3 teeth of pecten stout, widely detached; anal gills twice length of anal segment, narrow, lanceolate.

Pecten of air tube without detached teeth.

- pullatus----- upper head hairs multiple; lower generally in 4; lateral comb of eighth segment of many scales in a large triangular patch.
- aboriginis----- upper head hairs in 3-5, lower in 2-4; two separate tufts anterior to ventral brush.
- hexodontus----- anal segment ringed by saddle; lateral comb of eighth segment of 6 scales in a row.
- impiger----- head hairs usually single; anal gills scarcely longer than anal saddle.
- communis----- head hairs single; comb scales about 25 in a patch, 3 rows deep; anal gills longer than anal segment.
- increpitus----- upper head hairs 2-3, lower 1-2; lateral comb scales many in a triangular patch; may be found at lower elevations.
- fitchii----- upper head hairs 4, lower 3; air tube more than 4 times as long as wide; found at lower elevations in the Pacific Northwest.

Salt and brackish water breeders.

Pecten with detached teeth.

taeniorhyncus----- anal saddle encircling segment, gills short but tapered; south of Santa Barbara.

Pecten without detached teeth.

increpitus----- anal gills longer than, but less than 2 x as long as, anal saddle, pointed globular.

squamiger----- anal gills very small; upper head hairs double.

dorsalis----- indistinguishable from squamiger except that upper head hairs are often single.

Inland flood water breeders.

Pecten with detached teeth distally (Fig. 16).

nigromaculis----- anal saddle encircling segment.

idahoensis----- head hairs single.

flavescens----- upper head hairs in 4, lower in 3.

vexans----- upper head hairs 2-3, lower 2; comb scales about 10 in an irregular double row; last 2 pecten teeth detached.

campestris----- upper head hairs 1-3, lower 2-3, last tooth of pecten detached.

Pecten without detached teeth.

dorsalis----- anal gills very short, sometimes globular.

lateralis----- anal gills twice as long as anal segment; pecten reaching middle of air tube.

increpitus----- anal gills longer than segment but not twice as long; apical tooth of comb scales undifferentiated.

Anopheles maculipennis occidentalis Dyar and Knab. For many years the spotted winged anopheline of the Pacific Coast was called A. quadrimaculatus, the important malaria vector of eastern and southern United States. Dyar and Knab then differentiated the west coast form, based on specimens from Palo Alto, California, as occidentalis and numerous references on malaria control in the West refer to the predominant carrier under this name. Occidentalis is characterized by a patch of pale scales in the wing fringe at the tip of the wing.

It was then confirmed that the west coast form was so closely related to the European maculipennis that this name came into vogue. Aitken, who reviewed the whole complex thoroughly, discovered that there were two variants in the complex, - A. maculipennis occidentalis, the pale-tipped form which occurs along a narrow strip of the Pacific Coast into Canada and then sweeps across the continent dipping into the northern tier of states where it occurs with quadrimaculatus, and a form closely allied to the European maculipennis which occurs everywhere in the Pacific Coast states except in a narrow strip along the coast and extends into the inter-mountain country and south to New Mexico. The latter species he named A. maculipennis freeborni. A. m. occidentalis seldom occurs in large numbers except at very localized points. It breeds in fresh water among the algae mats and withstands considerable sunlight. It has a tendency to be larger, more robust, than freeborni and is more heavily pigmented. It shows little tendency to enter dwellings and malaria has never become endemic in areas where this variant is the sole anopheline.

Anopheles maculipennis freeborni Aitken. (See the preceding account for taxonomy). This is the predominant malaria carrier. It breeds primarily in small, insignificant pools where the water is comparatively fresh; that are at least partially exposed to sunlight; and where there is vegetative protection such as algae. These conditions are met in such places as hoofprints in seepage areas, streamside bays in moving streams, out-off pools near receding streams, roadside pools of semi-permanent nature resulting from careless irrigation and countless other areas of similar nature. It is rarely found in foul water, artificial containers or large bodies of water such as ponds, clean-banked borrow pits or extensive swamps and almost never in deep water or heavily wooded areas.

It enters houses freely and is a vicious indoor biter, a characteristic that is doubtless responsible for its importance as a malaria vector. Its larvae are indistinguishable with any degree of certainty from those of A. punctipennis. The four-spotted wings and the absence of the wing tip spot of occidentalis separate the adults from other Pacific Coast anophelines but it is distinguished from the eastern quadrimaculatus only by characters of the larvae and male genitalia.

Anopheles punctipennis Say is typically a woodland anopheline on the Coast. In contrast to maculipennis it breeds in deep water, often even in the edges of moving streams if there is protection from the current and some vegetative or debris protection from fish. It is tolerant of considerable shade.

It is rated as a porch biter. It bites human beings readily but does not enter houses with anywhere nearly the frequency that freeborni does. It is an

adequate carrier of malaria under laboratory conditions but, possibly on account of its failure to become domesticated, has never been shown to be responsible for the production of endemic malaria.

Yellow spots on the wings and unbanded palpi are diagnostic for this species on the Coast.

Anopheles pseudopunctipennis Theobald. This interesting anopheline sometimes occurs in overwhelming numbers. It is a receding stream breeder utilizing the shallow, sunlit pools that are cut off from the running water as the stream shrinks. There are two and possibly three strains of this species present in California. Fortunately our forms do not invade houses and are probably of little significance as malaria vectors. The larvae can be identified by the characters in the guide and the banded palpi are diagnostic. Workers are urged to examine larvae of this species in their area for the presence of "tails" on the posterior spiracular plates (See Fig. 15). These are typical of the Central American forms and have been taken in Texas.

GENUS CULEX L.

Culex anips Dyar was described from a single capture in Southern California.

Culex apicalis Adams differs from all other Pacific Coast species of Culex by the presence of apical pale bands on the abdominal segments. Its larvae are found most frequently in shaded woodland pools and may be determined with some degree of success by their sharply rectangular heads, which are about twice as wide as long, their extremely long breathing tubes and the translucent appearance of their bodies. The adults feed on frogs and possibly other cold-blooded animals and, although they explore the skin of mammals, they have not been observed to bite. The species has been called testaceus and territans (the latter name belongs to another species that is now known as Culex restuans Theobald).

Culex erythrothorax Dyar has its range restricted to California. The adults might be confused with reddish-brown specimens of C. pipiens, but the scales on the back of the thorax are markedly hair-like and the abdominal basal bands which widen at the sides as in pipiens are quite yellow and indefinite. The larvae have a long breathing tube as in apicalis, but it is regularly tapered and not expanded at the tip as in apicalis. The favorite breeding place appears to be relatively large, shallow ponds among tules. They apparently prefer to feed on birds but attack human beings voraciously at times. Culex federalis Dyar, described from Mexico City and later synonymized with Culex badgeri Dyar from Bakersfield, California, is now considered a synonym of erythrothorax by Edwards.

Culex pipiens Linnaeus is probably the most widely distributed mosquito in the world and one of the most familiar to the layman because of its domestic habits, breeding in all sorts of water containers around human habitations. It breeds in heavily polluted water in which the available content of oxygen is too low for other species, as well as in clear water. Systematically it is hard to separate from C. quinquefasciatus, which, although primarily a tropical and subtropical species, at the northern limits of its range, overlaps that of pipiens, and with which it may interbreed. In well-differentiated specimens pipiens is

browner than gray and has its basal white abdominal bands continuous with the lateral spots. C. quinquefasciatus on the other hand is definitely grayer and the lateral spots are separated from the basal bands. Where the two species are found together in the central to southern part of California, specimens that cannot be distinguished are common. A number of subspecies of pipiens have been described on biological and morphological grounds, and on the basis of biting and egg laying habits. The northern California race more nearly corresponds to the subspecies pipiens molestus. The larvae of pipiens are difficult to separate from those of quinquefasciatus. The character of the singleness or doubleness of the subdorsal hairs of the third and fourth abdominal segments is not always sound, for although quinquefasciatus generally has these hairs single, some pipiens show singleness also.

Mr. Pedro Galindo of the University of California has done some interesting interbreeding experiments with California pipiens and quinquefasciatus which may throw more light on this problem.

Culex quinquefasciatus Say, 1823. This is the Culex fatigans Wiedemann, 1828, of British authors who claim Say's description of quinquefasciatus in which he notes that the "thorax (is) clothed with cinereous hair" is reference to an anopheline character. However his descriptive name "quinquefasciatus" (five-banded) refers to no anopheline and is most descriptive of the five abdominal bands of white scales that are so prominent in this species. References to this species as a carrier of dengue are in error.

For further discussion, see pipiens.

Culex restuans Theobald. This species, formerly known as territans Walker (not territans Howard, Dyar and Knab which is apicalis) was listed as occurring in California on the basis of a collection by Dyar in the Lake Tahoe Region. Whether this record represents C. thriambus (see below) or restuans cannot be shown at this time. However, true restuans larvae have been taken in ground pools in Orange County, California, by Galindo of the Division of Entomology and Parasitology of the University of California. These may be separated from the larvae of thriambus, the only other species showing single hairs in place of tufts on the breathing tube in this region, by antennal characters as pointed out above in the guide. Although certain characters of the male terminalia place these two species in rather widely separated systematic groups, the adult females cannot be separated readily.

Culex stigmatosoma Dyar. The white-banded proboscis differentiates this species from all other Pacific Coast species of Culex except tarsalis. It is differentiated from the latter by having a median black spot on the venter of each abdominal segment in a field of white scales instead of the inverted V as in tarsalis. These differences are well-marked in some specimens but in others, the V of tarsalis becomes indistinguishable from the spot of stigmatosoma. The larvae are distinguishable by the characters given in the key. They are found in the more permanent ponds and as a general rule build up to their greatest numbers in the latter part of the summer.

Culex tarsalis Coquillett breeds primarily in very stagnant, foul pools.

Its white-banded proboscis and dark V-shaped markings on the venter of the abdominal segments distinguish it at once. The outer edge of the femur and the tibia have a fine white line which may be continuous or sketchy like a series of dashes. This line is absent in stigmatosoma with which tarsalis is most apt to be confused. Its larvae have all air tube hair tufts in a line, - a characteristic that only C. apicalis shares on the Pacific Coast. The latter is easily distinguished by its abnormally long air tube and broad rectangular head with square corners. C. tarsalis has been shown to carry the virus of both St. Louis and western equine encephalitis and experimental findings seem to indicate that in some areas at least it plays a major role in the dissemination of the disease.

Culex thriambus Dyar was originally established as a species by Dyar but later reduced by him to synonymy with Culex stigmatosoma as a Texas race. The recent discovery by Galindo and Kelley that material in the University of California collection represents thriambus rather than restuans as it was originally determined, and the collection in the field of typical thriambus larvae show that this species is rather widespread in California. It has now been taken as far north as Marysville, Yuba County and as far south as southern Riverside County. It is the opinion of the above mentioned workers in the light of their studies that thriambus should be raised again to specific rank, and in this the present authors concur.

GENUS CULISETA FELT

Culiseta impatiens (Walker). A rare species in this area. It has been taken only infrequently in northern California. Its larvae are found in clear woodland pools. The species is said to bite readily in Alaska.

Culiseta incidens (Thomson) occurs from one end of the Pacific Coast to the other and east to the Rockies. It breeds with C. tarsalis in nature and in addition frequents artificial containers such as rain barrels and horse troughs. The guide characters separate the members of the genus very easily. There are apparently one or more strains of this species that feed avidly on human beings while others cannot be induced to do so, a fact that has given rise to many contradictory statements. It breeds throughout the year in California at the lower elevations but occurs as high as 8000 feet during the summer.

Culiseta inornata (Williston) is a large, clear-winged mosquito that breeds in woodland pools by choice but is apt to be found in any stagnant water including artificial receptacles. It extends over the whole Pacific area including southern Canada but occurs in greatest numbers in southern California.

Culiseta maccrackenae (Dyar & Knab) apparently breeds in deep, shaded woodland pools. It is rather rare. The adults have stained spots on the wing membrane and their flight is exceedingly rapid in a series of soaring swoops.

Culiseta morsitans (Theobald). Our only record from the Pacific Coast states is from eastern Washington. Accounts of this species appear in the literature as Culex dyari Coquillett but it is now known to be synonymous with the European morsitans in the genus Culiseta. The larvae differ from other members of the genus from this area by failing to have the distal teeth of the pecten prolonged in hair-like form.

Aedes aloponotum Dyar is a large, reddish-brown mosquito related to A. flavescens. It is a woodland species found chiefly in the coastal regions of Oregon and Washington. Matheson considers this to be synonymous with A. excrucians, but we follow Dyar in retaining its specific status.

Aedes campestris Dyar and Knab has been reported from Eastern Washington. It is typically a plains inhabiting mosquito, often breeding with the fresh-water form of A. dorsalis. Mail (1934) reports that in Montana its preferred breeding places appear to be the alkaline pools in the more arid plains sections. Although the female campestris may be confused with dorsalis, it is generally larger and more drab in coloration, and the wings have dark and light colored scales more or less evenly intermixed.

Aedes dorsalis (Meigen) is the brown salt marsh mosquito of the north Pacific Coast, that also has a fresh water form which extends far inland over the prairie sections of southern Canada and northern United States. The latter form occurs in sunlit, fresh water pools of temporary nature such as overflow water in roadside pools or in the lower checks of poorly irrigated fields. It is dependent on a pool that alternately dries and floods at least at its margins as the eggs apparently require a period of drying before they will hatch when wet. The rip tides along the coast fill high level pools that are not reached again until the next monthly high tide and thus furnish excellent sites for breeding.

The adults may be quickly determined by the paired quadrate black patches on the abdominal segments. They might be confused with nigromaculis by this character but the latter generally has a white banded proboscis and its tarsi are banded basally instead of at both ends as in dorsalis. The general color aspect ranges from a dusty straw color to brown that is almost black.

The larvae are often found in company with nigromaculis from which they are separated by having a pecten without detached teeth and an anal saddle which does not encircle the segment. The salt marsh larvae breed with squamiger from which they are indistinguishable.

It is an extremely wide spread species occurring across the United States, in Europe and Asia. Further work may well show that it is indistinguishable from Aedes caspius Pallas in which the latter name would apply. Caspius has a yellow rectangle on the thorax bordered by longitudinal white stripes while dorsalis has this area dark brown. Intergrades are common.

Aedes fitchii (Felt and Young) is rarely taken except in the mountains, in California, although Gjullin (personal communication) reports it as relatively common at Portland in the Willamette Valley and at Florence on the coast of Oregon and also on the Washington coast. The Pacific Coast form has been known as palustris but as the Rocky Mountain race mimesis apparently bridges all the differences in male genitalia that led to the establishment of palustris, the racial designation should probably be dropped.

Aedes flavescens (Muller) is a large mosquito with a golden abdomen, its preferred breeding places being grassy pools. It is probably single-brooded over

its northern range of Canada, Alaska and northern Europe, but in Modoc and Lassen counties in northeastern California where it breeds in waste irrigation water there is some evidence that it may produce a brood at each successive wetting of its breeding places. This is the Aedes fletcheri of earlier American accounts.

Aedes idahoensis (Theobald) is closely related to A. lateralis and has been reported from eastern Washington. It has many veins entirely white scaled and the tarsal segments are whitish beneath. Its larvae resemble those of ventrovittis.

Aedes increpitus Dyar. This was the mosquito that made Yosemite Valley almost uninhabitable until control measures completely eradicated it there. It now occurs throughout the Sierra at moderate altitudes (4-5000 feet), in the Coast Range and Cascades and within the last few years has been recorded with increasing regularity from the Central Valleys of California where it breeds in wooded overflow pools in company with vexans or lateralis. It is also taken at low elevations near Portland, Oregon (Gjullin).

The basal abdominal white bands are broader in the middle and the quadrate patch of white scales at the sides are so much whiter than those in the band that they make a striking field identification character. The adults may be confused with fitchii, but the latter have a very heavy sprinkling of white scales all over the wings while increpitus has but a few confined to the anterior margin. The larvae may be separated from their co-breeders by having no detached teeth in the pecten and lacking the differentiated apical tooth on the comb scales of the eighth segment.

Aedes lateralis (Meigen). This is the only black-legged Aedes that is commonly found at low elevations on the Pacific Coast. The American form which has its range on both sides of the northern Rockies was formerly called Aedes aldrichi. It is now known to be the same as the European lateralis and takes that name. It has been known to occur on the Pacific Coast in Washington and Oregon for many years but recently it has become a serious pest in the Central Valleys of California where it breeds in overflow pools in wooded river bottoms with A. vexans.

Aedes nigromaculis (Ludlow) is a recent addition to the mosquito population of the Pacific Coast. At the present time however, it is rapidly becoming one of our most important pest mosquitoes. It breeds in sunlit overflow, temporary pools in company with dorsalis. The adults that have a white band on the proboscis are easily separated from dorsalis, but when this is not present or obscure as is sometimes the case, it can be separated from dorsalis by its basal white tarsal bands of the hind legs, those of dorsalis being yellowish and involving both base and apex of the segments.

Aedes squamiger (Coquillett) is confined to salt and brackish water from San Francisco Bay area south. In the northern part of its range it is associated with dorsalis and in the southern part with taeniorhynchus. Its swollen, evenly mixed pale and dark wing scales are diagnostic of the species. Its larvae are indistinguishable from those of dorsalis.

Aedes taeniorhynchus (Wiedemann) is the southern salt marsh breeder. Its white-banded proboscis separates it from all West Coast Aedes except nigromaculis which breeds in fresh water and has a well marked longitudinal white stripe down the top of the abdomen which is lacking in taeniorhynchus. It breeds profusely along the coast of California from Santa Barbara south. Although it will breed in fresh water adjacent to the salt marshes as well as in the strongly saline marsh water it has never been found to breed in our area except in the immediate vicinity of salt marshes. This latter statement does not hold, however, for some areas in the Southwest where it breeds in fresh water far from salt marshes.

Aedes varipalpus (Coquillett) is known as the Western Tree-Hole Mosquito. Its small size and snowy white tarsal bands which overlap the joints to appear on both the bases and apices of the tarsal segments, distinguish it from all others. Its very white, snaky larvae with enormous anal gills inhabit water-filled tree holes in which they rest for long periods with their brown heads buried in the bottom silt. The eggs are laid above the surface of the water within the tree holes and hatch when wet provided the oxygen content of the water is sufficiently low. The adults have little difficulty in passing through ordinary screening and sometimes constitute serious local problems in wooded residential areas.

Aedes vexans (Meigen) is a flood water breeder preferring wooded river and creek bottoms, but also occurs in grassy pools if sufficient shade is present. The eggs laid the previous spring or summer hatch in overflow pools as soon as the water becomes quiet, despite the fact that the site of the pool may have been a rushing torrent capable of moving boulders and trees a day or two before. Several broods may originate from the same pool if the stream rises to flood during the summer. The subsequent broods probably originate from eggs that did not hatch in the initial wetting. The adults migrate long distances (several miles) and are vicious biters.

The adults are classified in the guide as having basal tarsal bands. These bands are creamy to bronze and not particularly noticeable. The basal abdominal band with its central indentation which often separates the two sides of the band is very diagnostic. The detached pecten teeth are distinctive for its habitat in wooded stream channels, as lateralis and inorepitus have no detached teeth.

The Mountain or Black-legged Aedes

Aedes aboriginis Dyar represents the punctor group along the Washington coastal forests. It is indistinguishable from punctor except that the anal saddle of the larva does not encircle the segment. Across southern and central Canada punctor represents the group while punctodes and alpinus extend progressively farther north.

Aedes cataphylla Dyar. This mosquito, described from an isolated area around Lake Tahoe, California, is now known to extend from Alaska through Canada to the Rockies (prodotes) and into northern Europe (rostochiensis). It has no

pronounced brown patch or lines on the thorax and has a brown appearance with a gray overcolor as if dusty. The larvae may be distinguished from all other mountain Aedes because it has detached pecten teeth beyond the hair tuft. It is very facultative in its breeding habits frequenting all sorts of pools caused by the melting snow.

Aedes cinereus (Meigen) is an Holarctic species occurring in northern Europe and northern North America. Its basal white abdominal bands unite at the sides to make a continuous longitudinal white stripe on either side. The first abdominal segment is white scaled with a median black spot. The California race has been called hemiteus while the race that extends through Oregon and Washington and across Canada has been called fuscus.

Aedes communis (DeGeer) was originally described from northern Europe. However, it has been described by Dyar from Lake Tahoe, California, as tahoensis; from Crater Lake, Oregon, as masamae; from Mt. Rainier, Washington, as altiusculus; by Ludlow from Alaska as borealis; and by Felt and Young from Canada and northern United States as lazarensis. These variants represent minor color phases or size differences and should be combined. To add to the confusion the adult females cannot be differentiated with certainty from impiger Walker and hexodontus Dyar but these forms do have larval and genitalic differences to justify the separation.

The larvae separate from all other snow Aedes in the area by having no detached pecten teeth and anal gills about twice as long as the anal saddle. Its characteristic breeding pools are the deep, straight-sided holes that occur in high mountain meadows. The first eggs often hatch in the pools beneath a snow arch. There is probably some delayed hatching also as the deeper pools show larvae late in the summer.

Aedes hexodontus Dyar adults have a yellow cast along the front and sides of the mesonotum (top) of the thorax whereas these areas are gray in communis. The species is one of the punctor-like series and is separated from the type species punctor by having two longitudinal brown stripes on the mesonotum where typical punctor has a solid brown quadrate area. The larvae of these two closely allied species, i.e. punctor and hexodontus, are indistinguishable and the genitalic difference in the male are matters of judgment.

The larvae separate easily from communis, impiger, and ventrovittis because the anal saddle encircles the segment in hexodontus.

It breeds in insignificant seepage pools such as hoofprints and other small depressions. Its southern limit seems to be at about the latitude of Lake Tahoe on the Sierra crest.

Aedes impiger (Walker) is a little known mosquito in this area. It is said to breed in small numbers with cataphylla whenever that species is present.

Aedes intrudens Dyar is a widespread mosquito in the Nearctic Region, although apparently rare on the Pacific Coast. There are records from the Crater

Lake region of Oregon.

Aedes pullatus (Coquillett) is apparently rare on the Pacific Coast. We have a record of this species from Crater Lake, Oregon, and C. M. Gjullin of the U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine has another from Emigrant Springs on the North Fork of the Umpqua River in Oregon.

Aedes ventrovittis Dyar breeds at extremely high altitudes, generally over 6000 feet. It appears on the wing long before the snow entirely disappears and has a wide dispersal range particularly to still higher altitudes. The adult is small, dark and can be recognized by the plum-colored sheen of the black scales on the dorsum of the abdominal segments. Ventrally the abdominal segments are white with an inverted "T" in black scales, the median longitudinal part of which may be absent or represented by a median spot thus leaving an apical band of black scales. It is the commonest high altitude mosquito at the latitude of Yosemite and occurs locally at high altitudes north into Washington.

GENUS ORTHOPODOMYIA THEOBALD

Orthopodomyia signifera (Coquillett), the one species in this genus known from the Pacific Coast, was recorded with certainty for the first time by Reeves in 1941. The larvae were taken in Southern California in tree holes of the cottonwood.

Adults of this species are readily recognized by the presence of six or eight delicate, longitudinal lines of white scales on the mesonotum. They may be found resting on the trunk of the tree or on the sides of the tree-holes in which the larvae occur.

Fourth instar larvae are characterized by the absence of a pecten on the air tube and the presence of a sclerotized plate on the eighth abdominal segment which is excavated to receive the lateral comb scales. It should be pointed out that fourth instar larvae alone should be used for determination of the species, as certain diagnostic characters are not acquired until this stage is reached.

GENUS PSOROPHORA ROBINEAU-DESVOIDY

On the West Coast the only representative of this genus is Psorophora confinnis (Lynch-Arribalzaga) which has been found in Riverside and Imperial Counties of California. (This species is also known as P. columbiae Dyar and Knab.)

The genus as a whole is closely related to Aedes, but is distinguished in the adult stage from Aedes by the presence of spiracular bristles. The larva is characterized by the single pair of hair tufts on a swollen air tube and by the comb scales of the eighth segment arising from a plate.

Psorophora confinnis breeds in temporary pools of rain or irrigation water. The eggs, as in Aedes, are laid above the existing water level on damp ground,

and are able to withstand long period of desiccation. The larval period is unusually short, and great swarms of adults originate from pools which last only a few days under the hot desert sun. The females are vicious biters and are a source of great annoyance wherever they occur. This species has not been incriminated as a vector of disease.

GENUS MANSONIA BLANCHARD

This genus was first reported from the Pacific Coast by Reeves in 1941 although the specimens had been collected in California in 1917. Later in the same year (1941) it was encountered in large numbers near Scappoose, Oregon, and at Yakima, Washington. The larvae of Mansonia are unusual in that they are found attached to the roots of aquatic vegetation by the heavily sclerotized and serrate breathing tube. Neither larvae nor pupae come to the surface of the water to breathe, obtaining their oxygen, it is thought, from the plants to which they are attached.

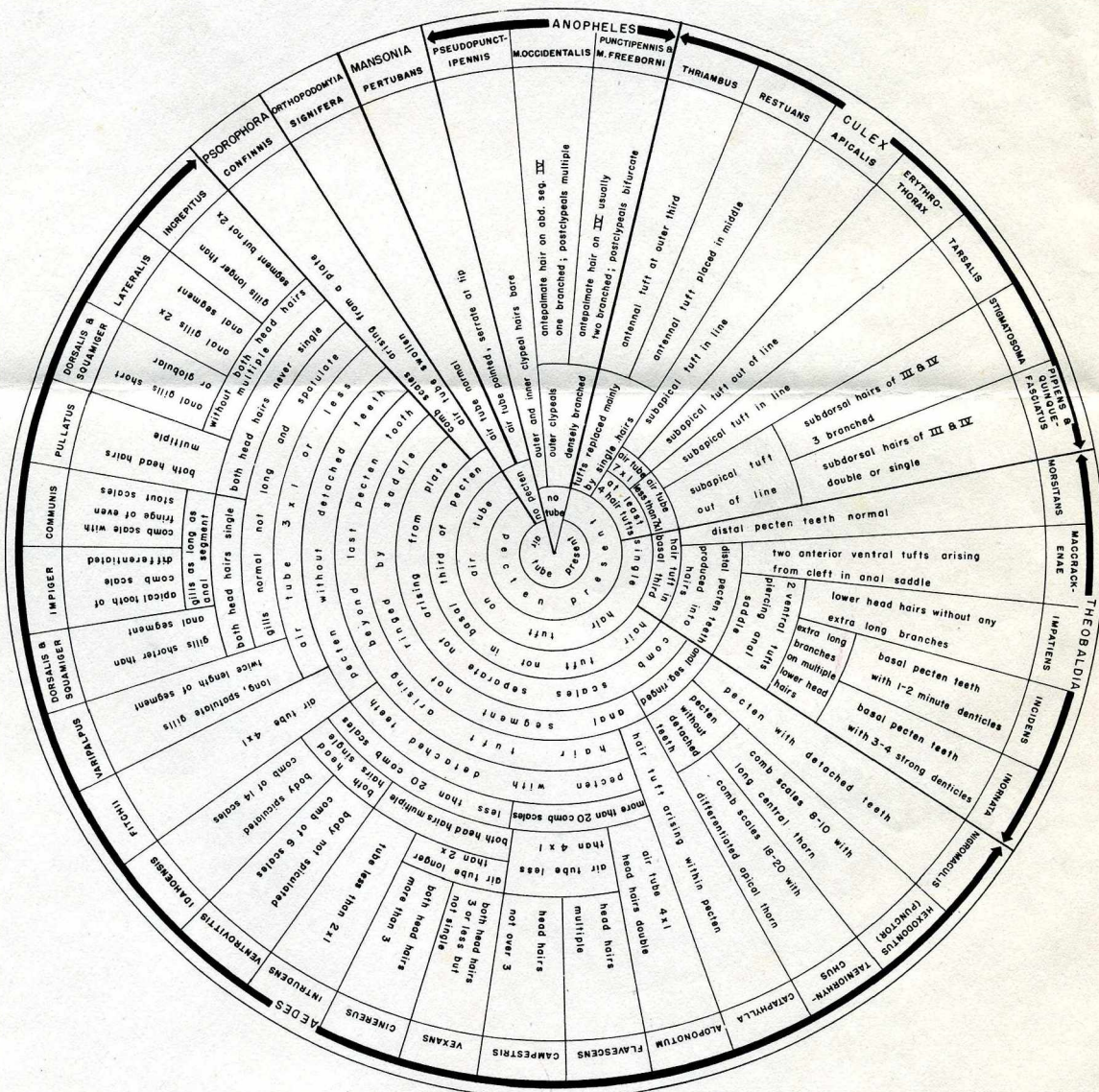
Adults, which are characterized by their rough or fuzzy appearance, are vicious biters and are readily attracted to light traps.

Mansonia perturbans (Walker) is the only species of this genus on the Pacific Coast.

A KEY TO THE MOSQUITO LARVAE

OF THE

PACIFIC COAST



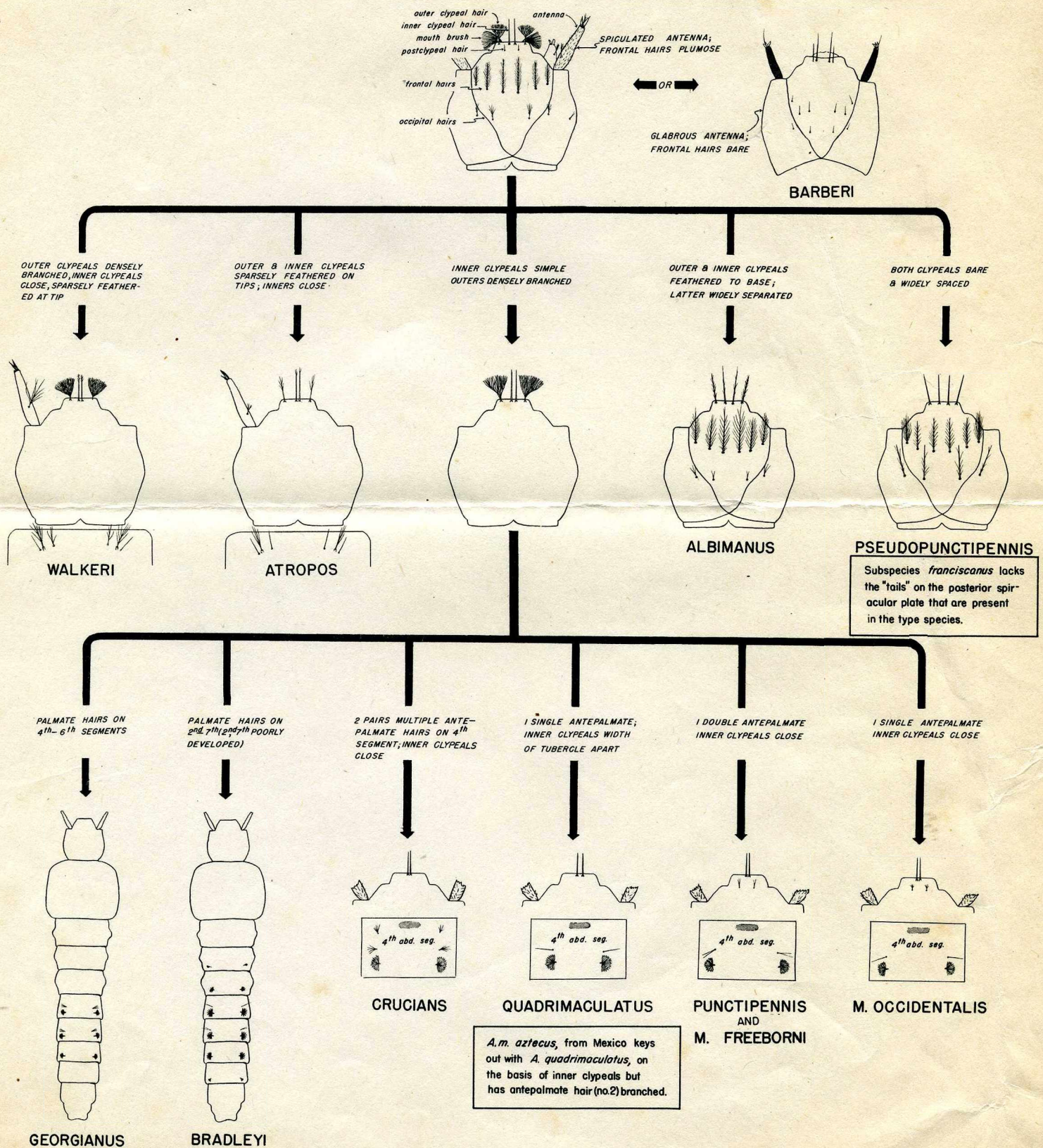
PROCEED OUTWARD FROM THE CENTER, FOLLOWING THE ALTERNATIVE CHOICES ARRANGED IN THE CONCENTRIC CIRCLES. BY PROCEEDING INWARD FROM THE CIRCUMFERENCE THE DISTINCTIVE CHARACTERS OF ANY SPECIES MAY BE DETERMINED

Prepared by
Stanley B. Freeborn &
Eugene J. Gerberg

MALARIA CONTROL IN WAR AREAS
U.S. PUBLIC HEALTH SERVICE



A PICTORIAL KEY TO THE NEARCTIC ANOPHELINE LARVAE



80° 120° 90° 60°

