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AEDES (*VERRALLINA*) OF THE PAPUAN SUBREGION

(DIPTERA: CULICIDAE)[1,2]

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Abstract. Mosquitoes of the Papuan subregion heretofor placed in the genus *Aedes*, subgenus *Aedes* should be recognized as distinct and placed in the subgenus *Verrallina*. This conclusion was reached after study of the types of the species already described and after consideration of all known stages.

Twenty-eight species of the subgenus *Verrallina*, of which 5 are described as new, are recognized in the Papuan subregion. The species previously described are redescribed and discussed; the biology and the immature stages of most species are recorded and described for the first time. One species incorrectly reported from the area is discussed.

The morphological characters, bionomics, distribution, and general importance of all species of *Verrallina* known in the Papuan subregion are described and discussed. A summary regarding technique for rearing progeny from a single female of this group of mosquitoes is given.

The female genitalia seem to be very uniform and offer little assistance in identification, while the male genitalia, in general, present good distinctions. Characters of the tarsus and claws are very useful in the identification of the species; the immature stages of the group in the Papuan subregion also offer good characters for distinguishing between the members.

In the field, larvae and pupae of *Verrallina* were found in temporary ground pools in partially or deeply shaded areas; in sago, pandanus, grassy, and forest swamps; and in virgin forest pools with fresh, clear or slightly colored water, and with mud and decaying vegetation on the bottom. Larvae and pupae of three species were found to be infected by a fungus belonging to the genus *Coelomomyces* which appears to prevent ecdysis, and might possibly prove valuable for biological control.

In the laboratory, eggs of four species (*carmenti*, *funereus*, *lineatus*, and *parasimilis*) were obtained. The eggs were laid on a strip of filter paper in individual rearing vials. Progeny were successfully reared from individual females of two species.

Adults were collected from light traps and Malaise traps near the breeding sites in forested area. An adult male of *quadrifolium* was found resting on vegetation, 3–5 cm above the water surface of the breeding site in a forest, near Port Moresby, Papua. Several species are very common and readily attack man during the day as well as at night in the vicinity of forests, in sago swamps and in mangrove swamps.

Verrallina is confined to the Oriental and Australian regions. It occurs as far east as the New Hebrides. In the Papuan Subregion, it is found in the Solomon Is., the Bismarck Archipelago (New Ireland and New Britain), New Guinea, and the Moluccas (Ceram and Amboina).

INTRODUCTION

The New Guinea and South Pacific species of mosquitoes placed in the genus *Aedes*, subgenus *Aedes*, are now being placed in the subgenus *Verrallina*. Belkin (1962) pointed out that they have little in common with the type species of *Aedes* (*cinereus* Meigen, 1818, described from Europe), but they appear to be quite similar to *butleri* Theobald, the type species of *Verrallina*. The taxonomic study of the group has been distinctly handicapped previously by inadequate material, especially the lack of reared series in which both sexes and the larvae were definitely associated, and by lack of opportunity to compare reared series of materials with the types.

The identification of the females was based mainly on external characters since the female genitalia of the group in the Papuan subregion offer little assistance. Some of the important ex-

ternal characters, as many workers have noticed, are easily lost due to rubbing off of scales and hairs. When this occurs it becomes impossible to identify a number of closely related species. In addition, sexual dimorphism occurs in the adults. The ornamentation of the adults and the male genitalia appear to be extremely variable, and it is most difficult to differentiate between individual, ecological or geographical variation and specific differences without associated characters in the immature stages. The rearing of progeny from a single female is of the utmost importance, and each individual must be reared individually in order to establish the identity of the species.

Several species within the group are extremely abundant biting pests and might well be involved in virus transmission. The group is very poorly known, especially the natural habitats of the species; there are very few species which have been reared individually; no successful rearing of progeny from a single female had been done previously. For these reasons, it was considered important to study them from the taxonomic standpoint of view as well as from point of view of their possible medical importance.

To obtain the information required field work was conducted in New Guinea, existing collections were studied and the information regarding the group was assembled. During the course of this study special effort has been paid to collecting the immature stages in the field, the rearing of each individual separately, studying of the natural habitats, the rearing of progeny from single females, and detailed study and comparison of all stages with the type materials in museums.

The taxonomic study involved all stages of the insects whenever they were available. The species are arranged in alphabetical order except for species wrongly recorded from the Papuan subregion which are treated at the end. A chart of information available on stages, bionomics and distribution of all species of the subgenus *Verrallina* of the Papuan subregion is included.

Twenty-eight species of the subgenus *Verrallina*, of which 5 are described as new, are recognized here for the Papuan Subregion. The biology and the immature stages of most of the species are first recorded and described herein. The morphological characters, bionomics, distribution, and general importance of all species of *Verrallina* known to occur in the Papuan subregion are described and discussed whenever the material or the information is available. A summary regarding procedures for rearing of progeny from a single female is given. Keys to adults, male genitalia, eggs, larvae, and pupae are provided.

MATERIAL AND METHODS

This study has been based mainly on my field work in New Guinea; specimens in the collections of Bishop Museum; in the U. S. National Museum, Washington D. C.; and in the British Museum (Natural History), London. Additional material studied included specimens in the collections of the Department of Zoology, University of California, Los Angeles; the Department of Entomology, School of Hygiene and Public Health, Johns Hopkins University, Baltimore, Maryland; the Department of Entomology, University of Queensland, Brisbane; the School of Public Health and Tropical Medicine, University of Sydney, Sydney; the London School of Hygiene and Tropical Medicine, London; the Instituut voor Tropische Hygiene, Amsterdam; the Archbold collection; Dr J. Bonne-Wepster's personal collection and Dr W. Peters' personal collection.

All the type specimens of *Aedes* (*Verrallina*) and specimens from all the localities cited in the distribution have been examined. For comparative purposes, accessible material from the Oriental and Australian region was examined. Slides of genitalia, claws, larval and pupal skins, and egg shells were made for morphological studies. The procedures followed in making these slides are as follows: *Slides of genitalia:* (1) Relax specimen for half an hour, and cut off the apical portion of the abdomen. (2) Put the end of the abdomen in 10% KOH to clear. (3) Wash in distilled water

30 minutes. (4) Place in 95% alcohol 15 minutes. (5) Put in clove oil. (6) Mount in balsam on glass slide. *Slides of egg shell:* (1) Place shell in 95% alcohol 15 minutes. (2) Transfer to potassium chlorate and add hydrochloric to bleach the shell. (3) Wash in absolute alcohol several times to remove all acid. (4) Mount in euparal on glass slide. (5) A single layer of egg shell can be obtained by sliding the cover-slip back and forth while putting slight pressure on the cover-slip. *Slides of larval and pupal skins:* (1) Place larval or pupal skin in 95% alcohol for 20 minutes. (2) Transfer to clove oil. (3) Place in euparal on a slide and cover.

A study of methods for rearing of progeny from known females of *Verrallina* was made in Brisbane, Australia and in New Guinea during the field work from 17 March to 30 May 1965. The progeny of two species (*carmenti* and *lineatus*) were reared successfully from individual females. The most successful procedure was to capture females biting on man in the field. After having taken a full blood meal in the field, the female was gently picked up by a glass tube aspirator and put in a mass rearing pot covered with nylon net. A few raisins were put on the top of the pot which was then covered with wet tissue paper to retain a high humidity. Three days later, the females were separated individually into vials in which a strip of moistened filter paper had been placed. The rearing vial was covered with nylon net placed in a large container and the whole covered with wet tissue paper. In general, a female laid its eggs 4 or 5 days after having its blood meal; the eggs were laid singly on the strip of moist filter paper and were kept moist; the incubation period was 4 to 5 days. Larvae hatched within 15–20 minutes after the eggs were flooded with Brewer's yeast suspended in tap water; the non-hatched eggs were removed and kept in moist condition for a second or third treatment. Larvae were reared in the mass rearing pot; tap water and some finely ground native biscuits and cenovis vitamin yeast tablets were used as food; the stadium lasted 1–2 days. The pupa was transferred into clean water in an individual rearing vial, the vial being placed in a nylon net cage for the adult to emerge. In the laboratory, it took 10 to 11 days from hatching to the adult stage. For morphological studies, eggs and egg shells were preserved in 2% formalin; larval and pupal skins were preserved in 75% alcohol.

TERMINOLOGY AND ABBREVIATIONS

Various systems of nomenclature have been used for describing the parts of mosquitoes. The nomenclature chosen for the chaetotaxy of the larva and pupa and the terminology of structural parts of the adult used in this paper largely follows that of Belkin (1962, Vols. I & II).

Terminology of head (Fig. 1)

Dark scales: Scales black or nearly black in color.

Decumbent scales: Scales which lie flat against the integument or bend down toward the surface.

Erect scales: Scales standing upright from the surface; they are narrow at base and gradually widened distally, and the apex is usually forked.

Frons: The median space between the eyes above the antennal bases.

Occiput: The posterior dorsal portion of the head capsule; its boundary with the vertex is not definite; usually with erect scales.

Frontal bristles: Median orbital bristles located on the dorsal part of the frons.

Orbital bristles: A row of bristles near the posterior margin of each eye.

Orbital line or orbit: A narrow area along the anterior border of the vertex between the edge of the compound eye and the row of orbital bristles.

Pale scales: Scales white or nearly white in color.

Vertex: The dorsal surface of the head behind the eyes and frons.

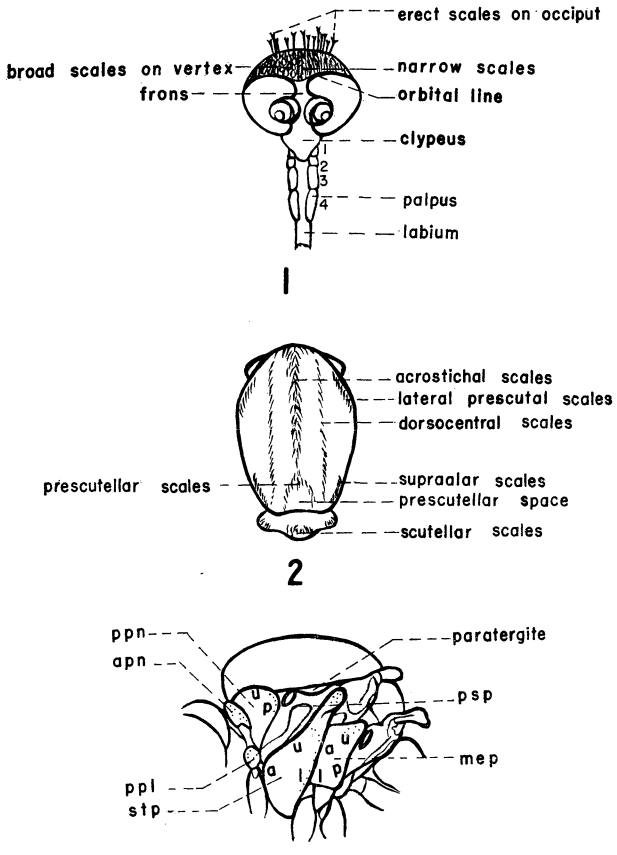


Fig. 1–3. *Aedes* (*Verrallina*) adult: 1, head-anterior view; 2, thorax-dorsal; 3, thorax-lateral. (Abbreviations: apn=anterior pronotum; mep=mesepimeron; ppl=propleuron; ppn=posterior pronotum; psp=postspiracular area; stp=sternopleuron; a=anterior; l=lower; p=posterior; u=upper.)

Terminology of thoracic-dorsum (Fig. 2)

Acrostichal area: Median longitudinal area of mesonotum from the anterior promontory to the prescutellar space.

Dorsocentral area: A pair of longitudinal areas of mesonotum, one on each side of the acrostichal area and extending from the anterior border to the outer part of the prescutellar area.

Lateral prescutal area: The lateral border of the mesonotum.

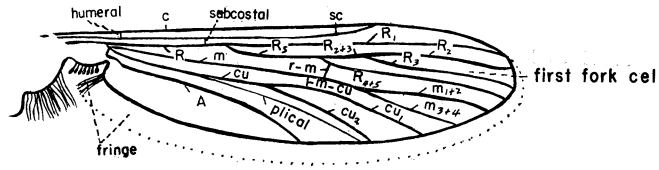
Prescutellar area: A broad median posterior area of the mesonotum immediately in front of the scutellum, frequently without setae or scales on the central and posterior part (bare space).

Scutellar area: Median lobe of the scutellum.

Supraalar area: A rather indefinite lateral area of the mesonotum mesad of the paratergite and wing.

Terminology of wing (Fig. 4)

First fork cell: Membranous part of the wing bounded by veins R_2 and R_3. This cell is measured along



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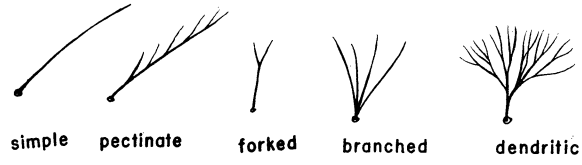

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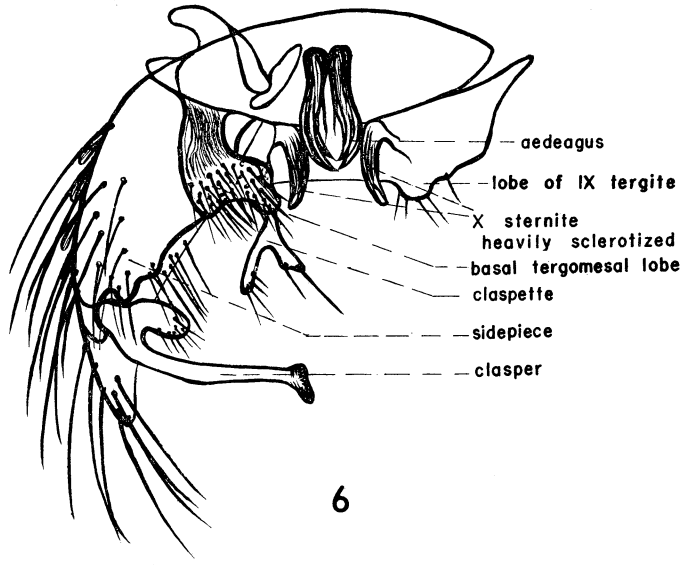

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Fig. 4–6. 4, *Aedes* (*Verrallina*): wing showing terminology used for venation; 5, *Aedes* (*Verrallina*): hair types of the larvae and pupae; 6, *Aedes* (*Aedes*) *cinereus* Meigen, ♂: genitalia with parts named, as seen from below. This species does not belong to the subgenus *Verrallina*, but is used here to indicate the different areas and help in description of the characters. (Abbreviations: C=costa; SC=subcosta; R=radius; M=media; CU=cubitus; A=anal; r-m=radio-medial; m-cu=medio-cubital.)

projection of longitudinal axis of vein R_{2+3} from the point of their separation to the apex of vein R_2; the length is compared to the stem of the cell (vein R_{2+3}), measured on the same axis, from the point of separation of veins R_{2+3} and R_{4+5} to the point of separation of veins R_2 and R_3.

Terminology of male genitalia (Fig. 6, 9)

Aedeagus: Median structure of phallosome, presumably the intromittent organ; often in the form of a trough-like structure or open tube; penis; mesosome.

Basal lobe: Basal lobe on mesal surface of sidepiece.
Basal tergomesal lobe or area: Basal lobe on mesal angle of tergal surface of sidepiece.
Clasper: Movable appendage borne at or near apex of sidepiece; dististyle.
Claspette: A mesal or sternomesal lobe at base of sidepiece.
Mesal lobe: Mesal lobe on mesal surface of sidepiece.
Proctiger: The anal lobe including all the structures distad of segment IX and bearing the anus.
Sidepiece: The most conspicuous component of the genitalia; one of a pair of large lateral articulated appendages arising from segment IX and bearing the clasper distally; basistyle.

Terminology of hair types (Fig. 5)

Branched: With branches arising at the base or within the basal third.
Dendritic: With irregular or dichotomous tree-like branching.
Forked: With a few conspicuous branches arising from main stem beyond basal third.
Pectinate: With numerous long branches arising entirely or largely on one side of the main stem.
Simple: Unbranched.
Spiniform: More or less thickened, spinelike.

Taxonomic Abbreviations

Larva
A = Antenna
C = Head
CS = Comb Scale
MP = Mental Plate
PT = Pecten Tooth
S = Siphon

Pupa
C = Cephalothorax
P = Paddle
T = Trumpet

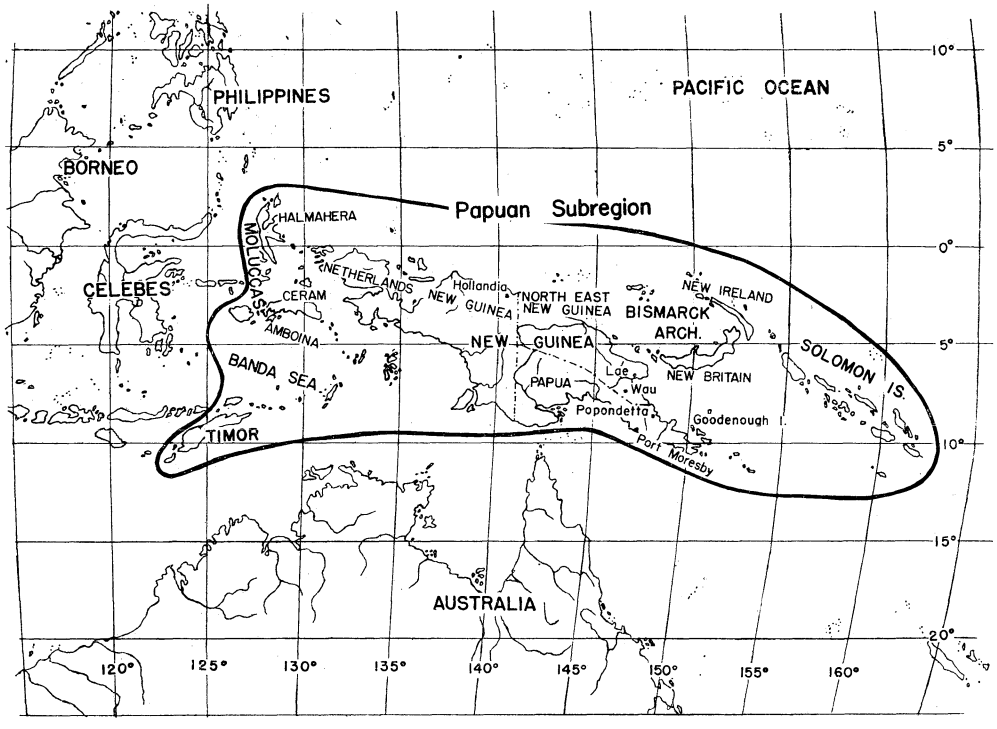
Thorax
apn = Anterior Pronotum
mep = Mesepimeron
ppl = Propleuron
ppn = Posterior Pronotum
psp = Postspiracular area
stp = Sternopleuron
a = anterior
l = lower
p = posterior
u = upper

Abbreviations of museums

BBM = Bernice P. Bishop Museum, Honolulu, Hawaii, U.S.A.
BMNH = British Museum (Natural History), London, England
LM = State Museum of Natural History, Leiden, Netherlands
UQ = University of Queensland.
SPHTM = School of Public Health and Tropical Medicine, University of Sydney, Sydney, Australia
USNM = United States National Museum, Washington, D.C., U.S.A.

Geographical Abbreviations

I. = Island
Is. = Islands
R. = River
NE NG = Northeast New Guinea
NW NG = Northwest New Guinea
SE NG = Southeast New Guinea (=Papua)
SW NG = Southwest New Guinea
Indomalay. = Indomalayan Subregion
Bismarck Arch. = Bismarck Archipelago



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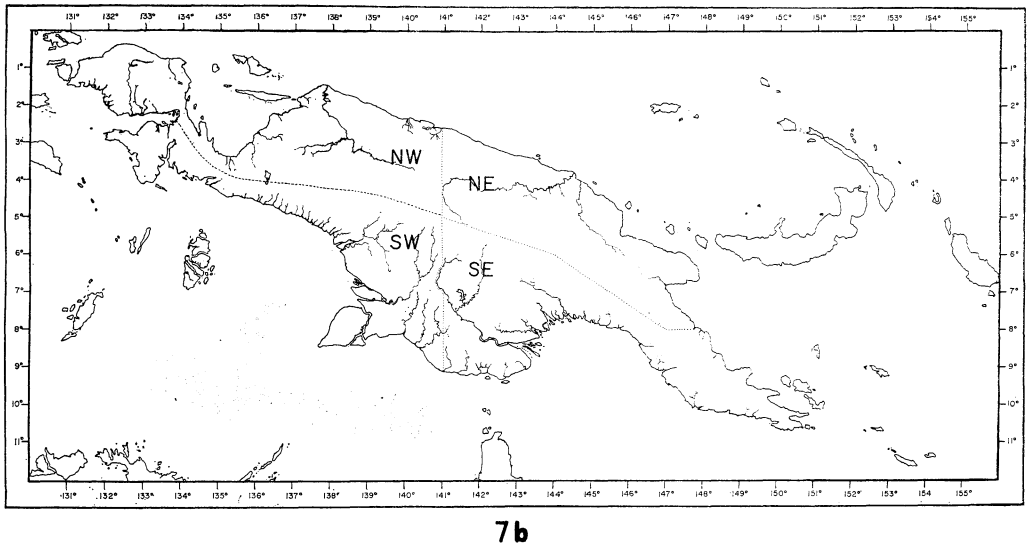

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Fig. 7a–b a, Map of the Papuan Subregion. b, Map of New Guinea showing the boundaries followed in the subdivision of localities. (NE=Northeast New Guinea; SE=Southeast New Guinea=Papua; NW + SW=Western New Guinea="Netherlands New Guinea"=West Irian.)

The Papuan Subregion (see Fig. 7) includes New Guinea and adjacent islands, the Moluccas, the islands of the Banda Sea, the Bismark Archipelago, and the Solomon Islands. The western boundary is essentially that of Lee and Woodhill 1944 as shown in Lee's Atlas of Mosquito Larvae.

Subgenus **VERRALLINA** Theobald

Aedes (*Verrallina*) Theobald, 1903, Mon. Cul. **3:** 295. Type-species: (*Aedes*) *butleri* Theobald, 1901, Malaya (BMNH)

Aedes (*Neomacleaya*) Theobald, 1907, Mon. Cul. **4:** 238. Type-species: (*N*). *indica* Theobald, 1907, India (BMNH)—synonymy with (*Verrallina*) uncertain.

Aedes (*Aioretomyia*) Leicester, 1908, Kuala Lumpur Inst. Med. Res., Fed. Malay States, Studies **3**(3): 185. Type-species: (*A.*) *varietas* Leicester, 1908, Malaya (BMNH)—synonymy with (*Verrallina*) uncertain.

Important references: Laffoon, 1946; King & Hoogstraal, 1947; Belkin, 1962.

The subgenus *Verrallina* is characterized by the following combination of characters. In some instances additional features are given to indicate variations which may be seen.

Adults. Proboscis with dark scales, longer than fore femur; palpus with dark scales, very short, less than 0.15 of proboscis; antenna 0.8 to 1.2 of proboscis; ♂ antenna plumose; clypeus bare; decumbent scales of vertex dark and broad excepting lateral strips of pale broad scales on each side; all scales on vertex flat; erect forked scales restricted to occiput; dark bristles present on front and orbit. All scales on scutum and scutellum narrow; paratergite bare; patches of broad scales on propleuron, on upper and lower portions of sternopleuron and on anterior upper part of mesepimeron; mesepimeron with hairs posterior to scale patch, sometimes hairs reaching beyond lower half of mesepimeron. Wing with dark scales; first fork cell of wing 1–2x as long as its stem. All scales on tibia and tarsus dark; claws of fore leg and mid-leg varied; claws of hind leg equal, simple. Abdominal segment I with pale scales on laterotergite. Female with abdominal segment VIII partially retracted; VIII tergite rounded apically; VIII sternite truncate, emarginate medially; postgenital plate with a median emargination; cerci conical; 3 spermathecae, all different in size.

Features which vary are as follows: Pale broad or narrow decumbent scales may be present or absent on the midline of the vertex or occur on the nape only; sometimes pale narrow scales are found between the eyes on the frons and on the orbital lines. The postspiracular area may be with or without scales; the anterior and posterior portions of the pronotum may have scales or not. Abdominal segments II-VIII may or may not possess pale scales on the sides or dorsum.

♂ genitalia (See Fig. 6, 9 for terminology and Fig. 8 for general characters): Sidepiece short and broad, 1–2x as long as wide; its scales restricted to basal lateral and ventral areas; with or without leaf-like subapical spine; mesal surface membranous; mesal lobe with or without bristles or hairs; basal lobe with or without hairs; without differentiated basal tergomesal area; without claspette. Clasper irregular in shape, with hairs; the place of insertion varied. Aedeagus triangular in dorsal aspect, simple, without lateral teeth; H-shaped structure of 10th sternite around the aedeagus present. (The homology of this H-shaped structure has not been determined; it appears to be a bridging of the dorsal arms of the 10th sternite). The 10th sternite is without heavy sclerotization. The proctiger varies in development. Within the genitalia the H-shaped structure of 10th sternite is sometimes well developed, sometimes indistinct, with or without the posterior projection on each side. The 9th tergite may be with or without a median extension, and the 8th tergite with or without rod-like bristles on each side.

Eggs (Figs. 25–28). Dark; elongate, about 3–6x as long as wide; the surface features as in the figures.

Larvae (See Fig. 11 for terminology). Antenna spiculate; 1-A inserted at or before middle of shaft; inner mouth brush pectinate at tip, rarely smooth. Comb scales usually in single row, oc-

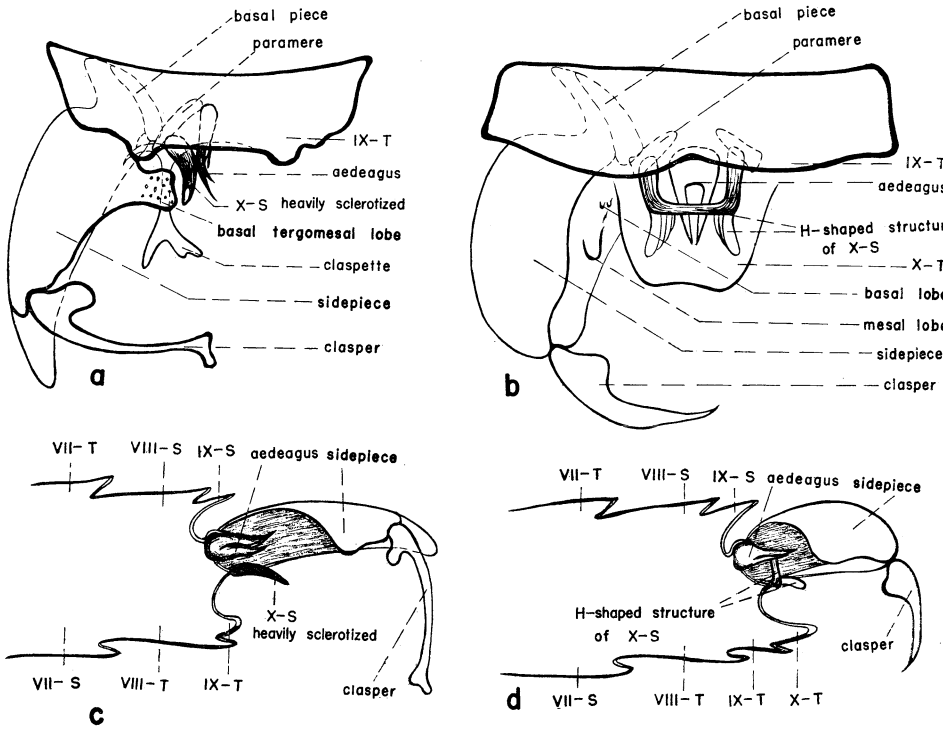

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Fig. 8. Male genitalia of the subgenera *Aedes* and *Verrallina*. a, *Aedes* (*Aedes*) ♂: genitalia, ventral view; b, *Aedes* (*Verrallina*) ♂: genitalia, ventral view; c, *Aedes* (*Aedes*) ♂: genitalia-right half as seen from inside; d, *Aedes* (*Verrallina*) ♂: genitalia-right half as seen from inside. (Abbreviations: S=sternite; T=tergite.)

casionally in 2 rows; each comb scale usually rounded and fringed apically but sometimes with terminal spine and fine lateral fringe. Siphon short, 1.8–4x as long as wide; acus present; pecten teeth evenly spaced or with 1–3 posterior teeth more widely spaced than those preceding; 1-S inserted beyond or before the last tooth and either in line with or ventrad of the teeth. Saddle incomplete; 2-x simple or 2- to 8- branched; 3-x simple; ventral brush with 5–7 pairs of hairs on grid, with 2 precratal tufts. Gills lanceolate or sausage-like.

Pupae (See Fig. 12 for terminology). Trumpet: 2–5x as long as wide; sculptured; tracheoid indicated at base. Metanotum: hair 10-C 3- to 9- branched, mesad and caudad of 11-C; 11-C simple or 2-branched. Abdomen: hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 2- to 8-branched; 2-I and 3-I widely separated, being from 2- to 7x as far apart as the distance between 4-I and 5-I; 1-II usually more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII or 2-IV-VII mesad of hair 1; 3-II and 3-III simple or branched; 5-IV, 5-V, and 5-VI simple or branched; 9-VIII simple or 2- to 6-branched.

Keys to species of Aedes (Verrallina) of the Papuan Subregion

Key to Adults

1. Abdominal tergites with complete transverse white bands on some segments..... 2

Abdominal tergites with no complete transverse white band....13

2 (1). Tergite II with complete transverse band.... 3
Tergite II without complete transverse band.... 4

3 (2). *Mep* with more than 10 hairs posterior to the scale patch, the hairs reaching to the lower border of *mep*....**trispinatus** ♂ & ♀ King & Hoogstraal
Mep with no more than 10 hairs posterior to the scale patch, the hairs not reaching to the lower border of *mep*....**foliformis** ♂ & ♀ King & Hoogstraal

4 (2). Tergite II with median white spot.... 5
Tergite II without median white spot....10

5 (4). Tergite VI with complete transverse band.... 7
Tergite VI without complete transverse band.... 6

6 (5). The larger claw of fore leg with a tooth (Fig. 14)....**embiensis** ♂ n. sp.
The larger claw of fore leg not toothed....**quadrispinatus** ♂ King & Hoogstraal

7 (5). *Mep* with more than 10 hairs posterior to the scale patch, the hairs reaching to the lower border of *mep*.... 8
Mep with no more than 10 hairs posterior to the scale patch, the hairs not reaching to the lower border of *mep*.... 9

8 (7). *Ppn* with broad pale scales ....**variabilis** ♂ n. sp.
Ppn without broad pale scales....**multifolium** ♂ King & Hoogstraal

9 (7). Vertex with pale scales; *apn* with scales....**lineatus** ♂ & ♀ (Taylor)
Vertex without pale scales; *apn* without scales....**funereus** ♂ & ♀ (Theobald)

10 (4). *Mep* with more than 10 hairs posterior to the scale patch, the hairs reaching below the middle of the lower half of *mep*....**leilae** ♂ King & Hoogstraal
Mep with no more than 10 hairs posterior to the scale patch, the hairs not reaching below the middle of the lower half of *mep*....11

11 (10). Tergite VI with complete transverse band....**reesi** ♂ King & Hoogstraal
Tergite VI without complete transverse band....12

12 (11). Claws of fore leg equal....**mccormicki** ♂ & ♀ Belkin
Claws of fore leg unequal....**bifoliatus** ♂ King & Hoogstraal

13 (1). Abdomen with lateral white spots....14
Abdomen without lateral white spots....34

14 (13). *Mep* with more than 10 hairs posterior to the scale patch, the hairs reaching below the lower half of *mep*....15
Mep with no more than 10 hairs posterior to the scale patch, the hairs not reaching below the lower half of *mep*....27

15 (14). Vertex with pale scales....16
Vertex without pale scales....26

16 (15). *Apn* with pale scales....17
Apn without pale scales....18

17 (16). Anterior corner of *stp* with pale scales....**panayensis** ♂ & ♀ Ludlow
Anterior corner of *stp* without pale scales ....**variabilis** ♀ n. sp.

18 (16). Claws of fore leg equal....19
Claws of fore leg unequal 23

19 (18). Claws of fore leg both toothed....20
Claws of fore leg both simple....22

20 (19). Scutum with golden yellowish scales on anterior and lateral prescutal areas and on acrostichal, posterior dorsocentral, supraalar, scutellar areas and prescutellar space....**killertonis** ♀ n. sp.
Scutum without such golden yellowish scales....21

21 (20). Anterior corner of *stp* with a hair patch; vertex with a median strip of pale narrow scales

on posterior half.....**neomacrodixoa** ♀ King & Hoogstraal

Anterior corner of *stp* without hars; vertex with a median strip of pale broad scales on posterior half.....**butleri** ♀ Theobald

22 (19). Upper *stp* with a patch of dark scales; *mep* with dark hairs in a strip, reaching to the lower border of *mep;* claws simple.....**multifolium** ♀ King & Hoogstraal

Upper *stp* with a patch of translucent scales; *mep* with hairs not arranged in a strip, the hairs reaching below the middle of lower half of *mep;* claws minutely toothed (mounted) .....**quadrispinatus** ♀ King & Hoogstraal

23 (18). Claw of fore leg toothed.....24

Claws of fore leg simple (Fig. 44).....**killertonis** ♂ n. sp.

24 (23). Claws of mid-leg toothed.....25

Claws of mid-leg simple.....**butleri** ♂ Theobald

25 (24). The larger claw of the fore leg with single tooth, the smaller claw simple (Fig. 45).....
.....**neomacrodixoa** ♂ King & Hoogstraal

The larger claw of the fore leg with two teeth, the smaller claw with one tooth (Fig. 42)
.....**vanapus** ♂ n. sp.

26 (15). *Stp* with translucent appressed scales; claw of fore leg single and toothed in the male (Fig. 47).....**quadrifolium** ♂ & ♀ Brug

Stp with a patch of dark scales.....**vanapus** ♀ n. sp.

27 (14). Vertex with pale scales.....28

Vertex without pale scales.....30

28 (27). *Ppn* with scales.....29

Ppn without scales.....**similis** ♀ (Theobald)
type B ♂

29 (28). *Ppn* with 6 or 7 broad translucent brownish scales on the posterior portion; claws of fore leg both toothed.....**cuccioi** ♀ Belkin

Ppn with dark narrow scales; claws of fore leg both simple...**milnensis** ♂ & ♀ King & Hoogstraal

30 (27). *Ppn* with scales.....31

Ppn without scales.....**parasimilis** ♀ King & Hoogstraal
simplus ♂ King & Hoogstraal
type A ♂

31 (30). With 2 rows of linear scales on the each vein (R_2, R_3) of the first fork cell; upper *stp* with translucent indistinct scale patch.....**reesi** ♀ King & Hoogstraal

Without such linear scales on the veins (R_2, R_3).....32

32 (31). Anterior corner of *stp* with hairs.....33

Anterior corner of *stp* without hairs.....**sentanius** ♂ & ♀ King & Hoogstraal

33 (32). Upper *stp* with a patch of dark scales; claws of fore leg both toothed (Fig. 9).....
.....**carmenti** ♂ & ♀ Edwards

Upper *stp* with pale scale patch; claws of fore leg both minutely toothed (must be mounted to be seen).....**azureosquamatus** ♀ Bonne-Wepster

34 (13). Claws of mid-leg equal (Fig. 41) .....**obsoletus** ♂ & ♀ n. sp.

Claws of mid-leg unequal.....**cuccioi** ♂ Belkin

Key to Males Based on the Genitalia

1. Ninth tergite with a Y-shaped median extension; with 2 branches on each arm, each branch tapered at tip and covered with hairs on basal and ventral surface (Fig. 33)
.....**neomacrodixoa** King & Hoogstraal

Ninth tergite without such an extension..... 2

2 (1). Sidepiece with a flat apical extension directed mesad; with a row of 3 stout bristles on the inner margin of dorsum; mesal lobe with a group of 10 bristles; an elongate

pointed arm from inner side of base.....**panayensis** Ludlow
Sidepiece without such an apical extension..... 3
3 (2). Sidepiece with leaf—like or bristle-like spine 4
Sidepiece without such a spine.....24
4 (3). Sidepiece with subapical spine..... 5
Sidepiece without subapical spine; with 2 leaf-like apical spines—one larger and one shorter- on the inner margin of dorsal surface.....**butleri** Theobald
5 (4). Sidepiece with 1 subapical spine..... 6
Sidepiece with more than 1 subapical spine.....16
6 (5). Sidepiece with stout bristles or spine-like bristles on the dorsal surface..... 7
Sidepiece without such bristles on the dorsal surface..... 8
7 (6). Sidepiece with 10 stout spine-like bristles on the dorsal surface; mesal lobe with 6 bristles; basal lobe with hairs.....**funereus** (Theobald)
Sidepiece with a row of 3 stout bristles on the dorsal surface; with 1 bristle on median portion and smaller bristles basal to it.....**mccormicki** Belkin
8 (6). Sidepiece with bristles on the mesal lobe..... 9
Sidepiece without bristles on the mesal lobe; 8th sternite with rod-like bristle on each side (Fig. 17).....**milnensis** King & Hoogstraal
9 (8). Sidepiece with more than 3 bristles on the mesal lobe.....10
Sidepiece with no more than 3 bristles on the mesal lobe.....13
10 (9). Sidepiece with 9 or more bristles on the mesal lobe.....11
Sidepiece with less than 9 bristles on the mesal lobe.....12
11 (10). Sidepiece with 1 bristle-like subapical spine; mesal lobe with 15 bristles ....**reesi** King & Hoogstraal
Sidepiece with 1 stout subapical spine; mesal lobe with a group of 9 bristles (Fig. 13) .....**embiensis** n. sp.
12 (10). Sidepiece with 7 bristles on the mesal lobe; basal lobe with hairs (Fig. 9).....**carmenti** Edwards
Sidepiece with a group of 6 bristles on the mesal lobe; basal lobe without hairs (Fig. 38) .....**vanapus** n. sp.
13 (9). Sidepiece with 2 bristles, 1 larger bristle distal to the leaf-like subapical spine and 1 smaller bristle basal to the leaf-like subapical spine (Fig. 16).....**lineatus** (Taylor)
Sidepiece with only 1 bristle which is basad of the leaf-like subapical spine.....14
14 (13). Clasper with distal portion curved at a right angle; not pointed at tip (Fig. 40)...**killertonis** n. sp.
Clasper with distal portion curved and tapered distally; pointed at tip.....15
15 (14). Clasper with 5 hairs on basal portion; with 2 hairs located one-third of the distance from the base to the apex, and 1 hair on the median portion (Fig. 34).....**type B**
Clasper with 8 hairs on the inner side of basal portion; without hair on the median portion (Fig. 52).....**sentanius** King & Hoogstraal
16 (5). Sidepiece with 2 subapical spines.....17
Sidepiece with more than 2 subapical spines.....19
17 (16). Sidepiece with a row of 5 curved bristles on the inner margin of dorsum..... .....**bifoliatus** King & Hoogstraal
Sidepiece without such bristles.....18
18 (17). Sidepiece with 2 leaf-like subapical spines; 8th sternite with a rod-like bristle on each side.....**cuccioi** Belkin
Sidepiece with 2 stout subapical spines, the distal one smaller than the basal one; 8th sternite without a rod-like bristle on each side (Fig. 37) .....**obsoletus** n. sp.
19 (16). Clasper ovoid in shape from dorsal aspect.....20
Clasper not ovoid in shape from dorsal aspect.....21
20 (20). Sidepiece with 4 pointed, leaf-like subapical spines; mesal lobe with 2 bristles; basal lobe with 1 bristle and hairs (Fig. 51).....**quadrispinatus** King & Hoogstraal

Sidepiece with 3 leaf-like subapical spines; basal lobe with a group of hairs only (Fig. 39) ..... **variabilis** n. sp.

21 (19). Sidepiece with 3 leaf-like subapical spines.....22
Sidepiece with more than 3 leaf-like subapical spines.....23

22 (21). Sidepiece with 2 larger bristles on apex and 1 or 2 larger bristles on dorsal surface (Fig. 53) .....**trispinatus** King & Hoogstraal
Sidepiece without such bristles on the dorsal surface and apex (Fig. 15)..... .....**foliformis** King & Hoogstraal

23 (21). Sidepiece with 4 leaf-like subapical spines; with 2 bristles on the mesal lobe; clasper not enlarged basally (Fig. 50).....**quadrifolium** Brug
Sidepiece with 5 leaf-like subapical spines; with a group of 4 or 5 bristles on the mesal lobe; clasper enlarged basally (Fig. 18).....**multifolium** King & Hoogstraal

24 (3). Clasper tapered at apex with 4 minute papillated hairs on inner side subapically..... .....**leilae** King & Hoogstraal
Clasper tapered distally and without hairs.....**simplus** King & Hoogstraal

Key to Eggs

1. More than 4 × as long as wide..... 2
Less than 4 × as long as wide..... 3

2. Length 5.9–6 × as great as the width; with 2 different kinds of sculpture pattern on the surface of shell (Fig. 25).....**carmenti** Edwards
Length 5.1–5.3 × as great as the width; with uniform sculpture pattern on the surface of shell (Fig. 28).....**parasimilis** King & Hoogstraal

3. Length 3.6–3.7 × as great as the width; the sculpture pattern on the surface of shell larger and elongate in shape (Fig. 27).....**lineatus** (Taylor)
Length 3–3.1 × as great as the width; the sculpture pattern on the surface of shell smaller and square in shape (Fig. 26).....**funereus** (Theobald)

Key to Larvae (4th instar)

1. 1-S inserted before the last pecten tooth..... 2
1-S inserted beyond the last pecten tooth..... 4

2 (1). Hair 6-C 2-branched..... 3
Hair 6-C 3-branched; 2-X 3-branched (Fig. 54).....**parasimilis** King & Hoogstraal **similis** (Theobald)

3 (2). Hair 2-X simple.....**cuccioi** Belkin
Hair 2-X 2-branched (Fig. 56).....**trispinatus** King & Hoogstraal

4 (1). Hair 5-C 2-branched..... 5
Hair 5-C more than 2-branched..... 8

5 (4). Hair 2-X 3-branched..... 6
Hair 2-X more than 3-branched..... 7

6 (5). 1-S inserted in line with the pecten teeth; pecten tooth with 1 denticule (Fig. 31)..... .....**multifolium** King & Hoogstraal
1-S inserted ventrad of the pecten teeth; pecten tooth with more than 1 denticule (Fig. 23) .....**foliformis** King & Hoogstraal

7 (5). Hair 2-X 6-branched.....**quadrispinatus** King & Hoogstraal
Hair 2-X more than 6-branched (Fig. 59) .....**variabilis** n. sp.

8 (4). Hair 5-C 3-branched..... 9
Hair 5-C more than 3-branched.....11

9 (8). Hair 6-C single; 2-X 8-branched (Fig. 35).....**neomacrodixoa** King & Hoogstraal
Hair 6-C 3-branched.....10

10 (9). Hair 2-X 7-branched; 1-S inserted in line with the pecten teeth (Fig. 29).....**lineatus** (Taylor)

Hair 2-X 8-branched; 1-S inserted ventrad of the pecten teeth.....**butleri** Theobald
11 (8). Hair 6-C 3-branched.....12
Hair 6-C more than 3-branched; 2-X 4-branched.....**sentanius** King & Hoogstraal
12 (11). Hair 2-X 3-branched.....13
Hair 2-X 4-branched; 1-S inserted in line with the pecten teeth.....**funereus** (Theobald)
13 (12). Hair 5-C 4-branched; 1-S inserted ventrad of the pecten teeth.....**mccormicki** Belkin
Hair 5-C 5-branched; 1-S inserted in line with the pecten teeth (Fig. 11).....**carmenti** Edwards

Key to Pupae

1. Hair 1-II more than 10-branched..... 2
Hair 1-II not more than 10-branched..... 9
2 (1). Hairs 5-IV, 5-V, and 5-VI simple, long, reaching beyond the following segment; hair 9-VIII 2-branched.....**cuccioi** Belkin
Hairs 5-IV, 5-V, and 5-VI branched..... 3
3 (2). Hair 9-VIII simple.....**butleri** Theobald
Hair 9-VIII branched..... 4
4 (3). Hair 9-VIII 2-branched (Fig. 60).....**variabilis** n. sp.
quadrispinatus King & Hoogstraal
Hair 9-VIII more than 2-branched..... 5
5 (4). Hair 9-VIII less than 6-branched..... 6
Hair 9-VIII 6-branched..... 8
6 (5). Hairs 3-II and 3-III simple..... 7
Hairs 3-II and 3-III 2-branched. (Fig. 30).....**lineatus** (Taylor)
7 (6). Hair 10-C 3-branched (Fig. 58).....**vanapus** n. sp.
Hairs 10-C more than 3-branched (Fig. 12).....**carmenti** Edwards
8 (5). Hairs 3-II and 3-III simple, short, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching beyond posterior margin of the following segment (Fig. 49) .....**quadrifolium** Brug
Hairs 3-II and 3-III simple, long, as long as segment III; 5-IV, 5-V, and 5-VI 2-branched, reaching beyond posterior margin of the following segment...**sentanius** King & Hoogstraal
9 (1). Hairs 5-IV, 5-V, and 5-VI simple.....10
Hairs 5-IV, 5-V, and 5-VI branched.....13
10 (9). Hair 9-VIII simple (Fig. 32).....**multifolium** King & Hoogstraal
Hair 9-VIII branched.....11
11 (10). Hair 9-VIII more than 3-branched (Fig. 24).....**foliformis** King & Hoogstraal
Hair 9-VIII not more than 3-branched.....12
12 (11). Hair 9-VIII 2-branched (Fig. 57).....**trispinatus** King & Hoogstraal
Hair 9-VIII 3-branched (Fig. 55).....**parasimilis** King & Hoogstraal
similis (Theobald)
13 (9). Hair 9-VIII simple (Fig. 36).....**neomacrodixoa** King & Hoogstraal
Hair 9-VIII 3-branched.....14
14 (13). Hairs 3-II and 3-III simple, shorter than segment III.....**mccormicki** Belkin
Hairs 3-II and 3-III simple, not shorter than segment III.....**funereus** (Theobald)

SPECIES OF *AEDES* (*VERRALLINA*) OCCURRING IN THE PAPUAN SUBREGION

1. **Aedes** (**Verrallina**) **azureosquamatus** Bonne-Wepster

Aedes (*Aedes*) *azureosquamatus* Bonne-Wepster, 1948, Treubia **19:** 320 (holotype ♀, Bernhard Camp B, NW NG; LM).

♀. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales on upper and 6 to 8 pale broad scales on posterior portion; upper *stp* with pale scale patch, with hairs on anterior

corner; *mep* with not more than 15 hairs posterior to scale patch, hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; first fork cell 2 times as long as its stem; fore and mid-legs with tarsal claws equal, each with minute tooth; abdomen with pale lateral spots on segments II-VII. (This description is based on the holotype, Neth. Ind-American New Guinea Expedit., Bernhard Camp B., 100 m., 9. IV. 1939, L. J. Toxopeus).

♂, *egg, larva, pupa.* Unknown.

DISTRIBUTION. NW NG: Bernhard Camp B.

Remarks. The type was described as having blue scales on the wings (Bonne-Wepster 1948). However, no visible blue scales on the wings of either holotype or paratypes were found, the indicating that color may have faded. The female resembles the female of *carmenti* Edwards but can be distinguished from *carmenti* by the pale scale patch on the upper *stp* and by the minute tooth on the claws of fore and mid-legs.

2. **Aedes** (**Verrallina**) **bifoliatus** King & Hoogstraal

Aedes (*Aedes*) *bifoliatus* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 120 (holotype ♂, Hollandia, NW NG; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale translucent scale patch, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5x as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with subbasal transverse pale bands on segments III-V; lateral pale spots on segments VI-VII; segment II with all scales dark from dorsal view. *Genitalia:* Sidepiece short, 1.4× as long as wide; its scales restricted to basal lateral and ventral areas; with 2 spoon-like subapical spines; with a row of 4 to 5 spine-like bristles on dorsal surface; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with hairs. Clasper enlarged basally, with 2 hairs on median portion and curved just beyond hairs; pointed and hooked at tip. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. 8th tergite with a rod-like bristle on each side. (Description based on holotype, light trap No. 1, 19 MGL, Hollandia, 8.V.1945, King & Hoogstraal).

♀, *egg, larva, pupa.* Unknown.

Biology. The breeding habitat is unknown. Adults have been collected from light traps at Hollandia, I-V. 1945 (King & Hoogstraal 1947).

DISTRIBUTION. NW NG: Hollandia (Kotabaru). SE NG: Milne Bay.

Remarks. All the paratypes (Hollandia, New Guinea, 24.I.1945, King & Hoogstraal) agree well with the holotype except one male paratype (Milne Bay, SE NG, 11.IV.1944, H. R. Roberts) whose abdomen has a basal median pale spot on segment III, and complete basal pale bands on segments IV-VII. The male genitalia are similar to the holotype. Until more information is available, it appears best to include this specimen in the concept of this species. The male of this species is similar to *mccormicki* Belkin, but can easily be distinguished by its unequal tarsal claws on the front and middle legs.

3. **Aedes** (**Verrallina**) **butleri** Theobald

Aedes (*Aedes*) *butleri* Theobald, 1901, Mon. Cul. **2:** 230 (Type ♀, Selangor, Malaya; BMNH).

Aedes (*Aedes*) *umbrosus* Brug, 1924, Bull. Ent. Res. **14:** 437 (Type: Undesignated, Tanah Grogot, SE Borneo (3 ♂♂, 2 ♀♀), or Weltevereden, Java (1 ♂; BMNH).—Laffoon, 1946, J. Wash. Acad. Sci. **36**(7): 243.

Aedes (*Verrallina*) *butleri*: Belkin, 1962, Mosquitoes S. Pacific **1:** 412.

♂. Vertex with pale scales on midline; *apn* without scales; *ppn* with dark narrow scales on

upper portion; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with hairs posterior to scale patch, the hairs reaching to middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; claws of fore leg unequal, both toothed; claws of mid-leg unequal, both simple; claws of hind leg equal, simple; abdomen with lateral pale spots on segments II-VII. *Genitalia:* Sidepiece very short, as long as wide, its scales restricted to basal lateral and ventral areas; 2 leaf-like apical spines, 1 longer and 1 shorter spine on inner margin of dorsal surface; mesal surface membranous; mesal ventral surface with hairs. Clasper enlarged basally, with 9 hairs on basal portion; distal portion forked, with 3 hairs near fork; 2 minute hairs and 2 minute spines on apex. Aedeagus triangular in dorsal aspect; pointed apically; bluntly rounded structure on each side around the aedeagus. (Description based on specimen in USNM, Tacloban, Leyte, 26.VII.1945, H. R. Roberts).

♀. Vertex with a row of pale broad scales on each side of midline; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with hairs posterior to scale patch, the hairs reaching to middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, toothed; abdomen with lateral pale spots on segments II-VII. (Description based on type in BMNH, Selangor, Malaya, 28.X.1899, A. L. Butler).

Larva (4th Instar). *Head.* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 3-branched, 7-C 6-branched. Mentum with 12 teeth on each side. *Segment VIII:* Comb scales 12 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 3-branched, 2-VIII 4-branched, 3-VIII 8-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon.* 2.5 × as long as wide; acus present; pecten teeth 10, the last reaching beyond middle of siphon; last 2 teeth more widely spaced than preceding 2; each tooth with 1 larger denticule and 1 to 2 smaller denticules; 1-S 5-branched, inserted beyond last tooth and ventrad of teeth; trachea broad, more than 0.5 width of siphon. *Anal segment.* Saddle incomplete; 1-X simple, as long as saddle; 2-X 8-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills as long as saddle, lanceolate.

Pupa. Trumpet. 4 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum.* Hair 10-C branched, mesad and caudad of 11-C; 11-C simple. *Abdomen.* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 5-branched; 2-I and 3-I widely separated, the distance between them being 5× distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching beyond posterior margin of following segment; 9-VIII simple. *Paddle.* Marginal spicules present; 1-P spiniform. (Descriptions of both larva and pupa are based on specimens in USNM, Tacloban, Leyte, 25.IX.1945, H. R. Roberts).

Biology. Females have been captured while biting in sago swamps in virgin forest during the day in Ceram (Brug & DeRook). Outside the Papuan subregion, larvae have been found in a slightly brackish, shaded, leaf-filled puddle in a nipa palm swamp at the extreme upper limit of the tidal zone and in temporary, shaded, fresh-water, leaf-filled ground pools. Females have been captured while biting during the day in a mangrove swamp (Laffoon 1946). In Malaya, larvae have been found in pools in coastal swamps (Macdonald 1957).

DISTRIBUTION. MOLUCCAS: *Ceram:* Wahaai; Hoelong; Wailoeloe. INDOMALAY.: *Celebes:* Makasser. *Borneo:* Tanah Grogot. *Malaya:* Selangor. PHILIPPINES: *Leyte:* Tacloban.

Importance. Outside the Papuan subregion, *butleri* has been recorded as virus vector in Malaya (Traub 1957).

Remarks. There are 3 ♀♀ (1 ♀, Hoelong, Ceram, 3.I.1932, Brug & DeRook; 1 ♀, Wahaai,

Ceram, 24.XII.1931, Brug & DeRook; 1 ♀, Wailoeloe, Ceram, 29.XII.1931, Brug & DeRook) in the British Museum which agree well with the type female in both external and genitalic characters. There is no doubt that *butleri* Theobald does occur in the Papuan subregion.

4. **Aedes** (**Verrallina**) **carmenti** Edwards Fig. 9–12, 25

Aedes (*Aedes*) *carmenti* Edwards, 1924, Bull. Ent. Res. **14:** 388–389 (Cotypes: Maravova, Guadalcanal, Solomon Is.; BMNH).—King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 115 (♀ lectotype designated; BMNH).

Aedes (*Verrallina*) *carmenti:* Belkin, 1962, Mosquitoes S. Pacific **1:** 416.

♂. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales; upper *stp* with darkish scale patch, with hairs on anterior corner; *mep* with not more than 15 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with scales dark but with lighter scales on supraalar and prescutellar areas; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, both toothed; abdomen with subbasal lateral pale spots on segments II-VII; segment VIII with all scales dark. Genitalia (Fig. 9): Sidepiece short, 1.4× as long as wide; its scales restricted to basal lateral and ventral areas;

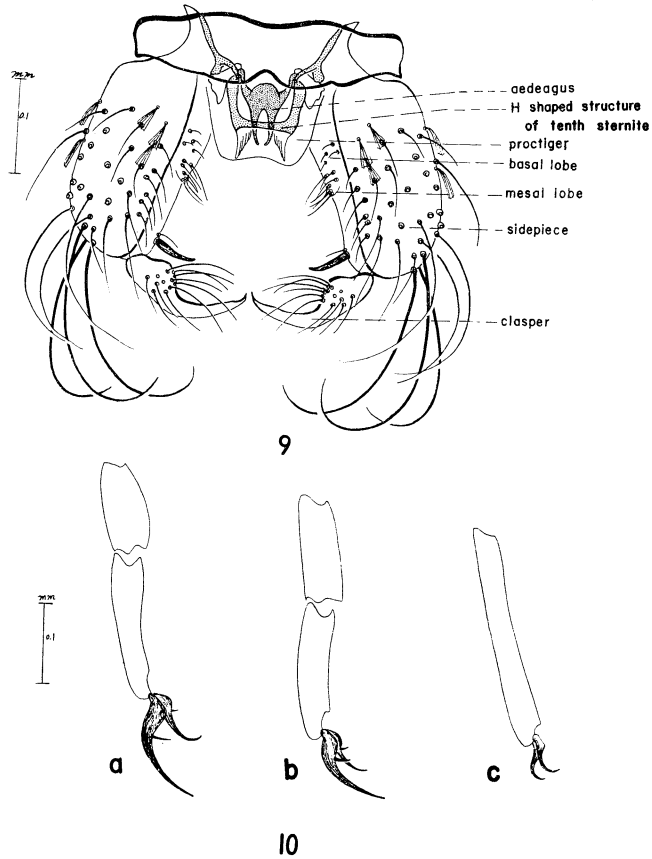

Fig. 9–10. *Aedes* (*Verrallina*) *carmenti* Edwards, ♂: 9, genitalia; 10, claws a, fore leg; b, mid. leg; c, hind leg.

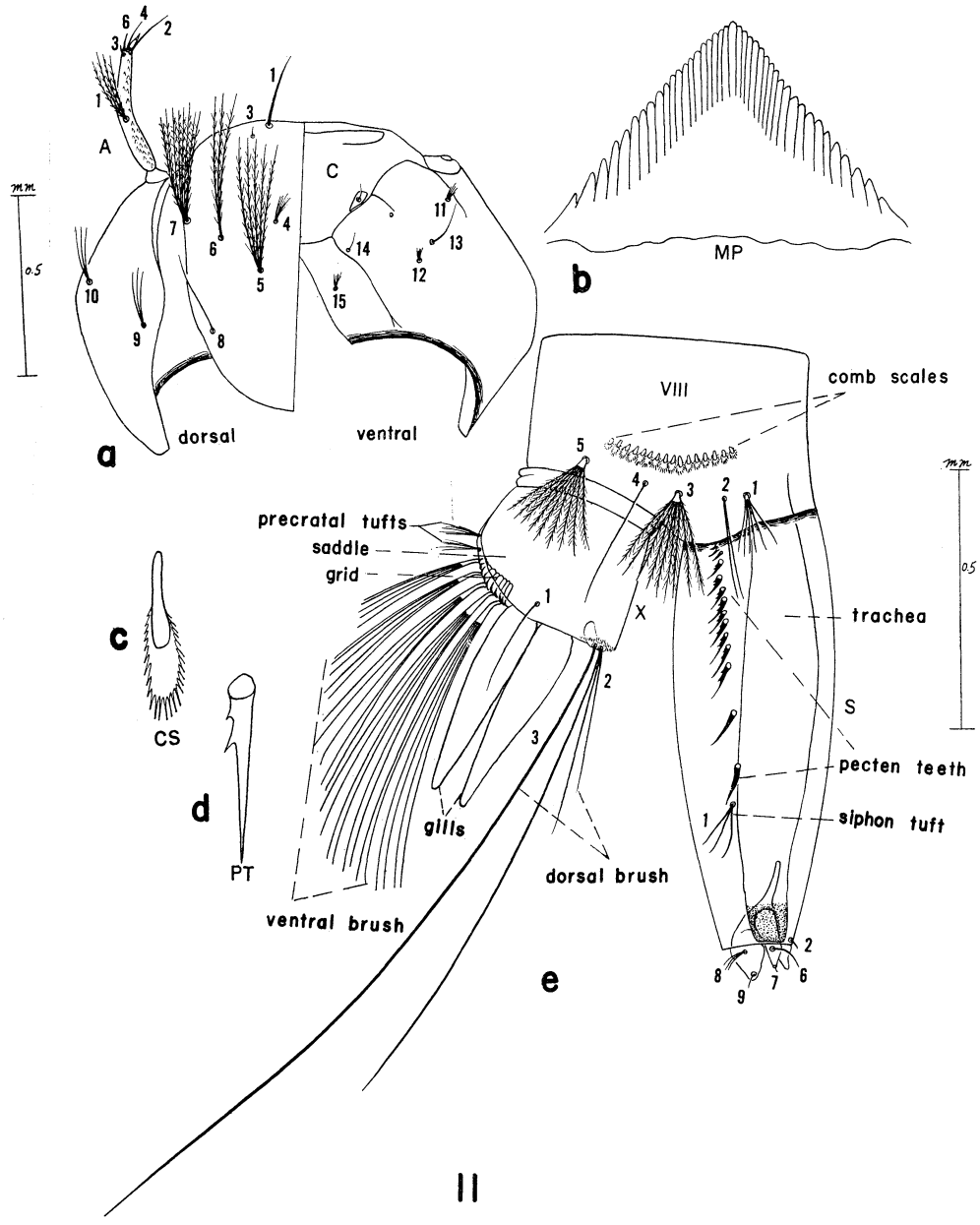

Fig. 11. *Aedes* (*Verrallina*) *carmenti* Edwards, larva, with system of chaetotaxy illustrated. a, head; b, mentum; c, comb; d, pecten tooth; e, terminal segments. (Abbreviations: A=antenna; C=head; CS=comb scale; MP=mental plate; PT=pecten tooth; S=siphon.)

1 leaf-like subapical spine; 1 bristle basad of the spine; mesal surface membranous; mesal lobe with a group of 7 bristles; basal lobe with hairs. Clasper enlarged basally, with 10 hairs; distal portion curved and without hair; pointed at tip. Aedeagus triangular in dorsal aspect; pointed apically;

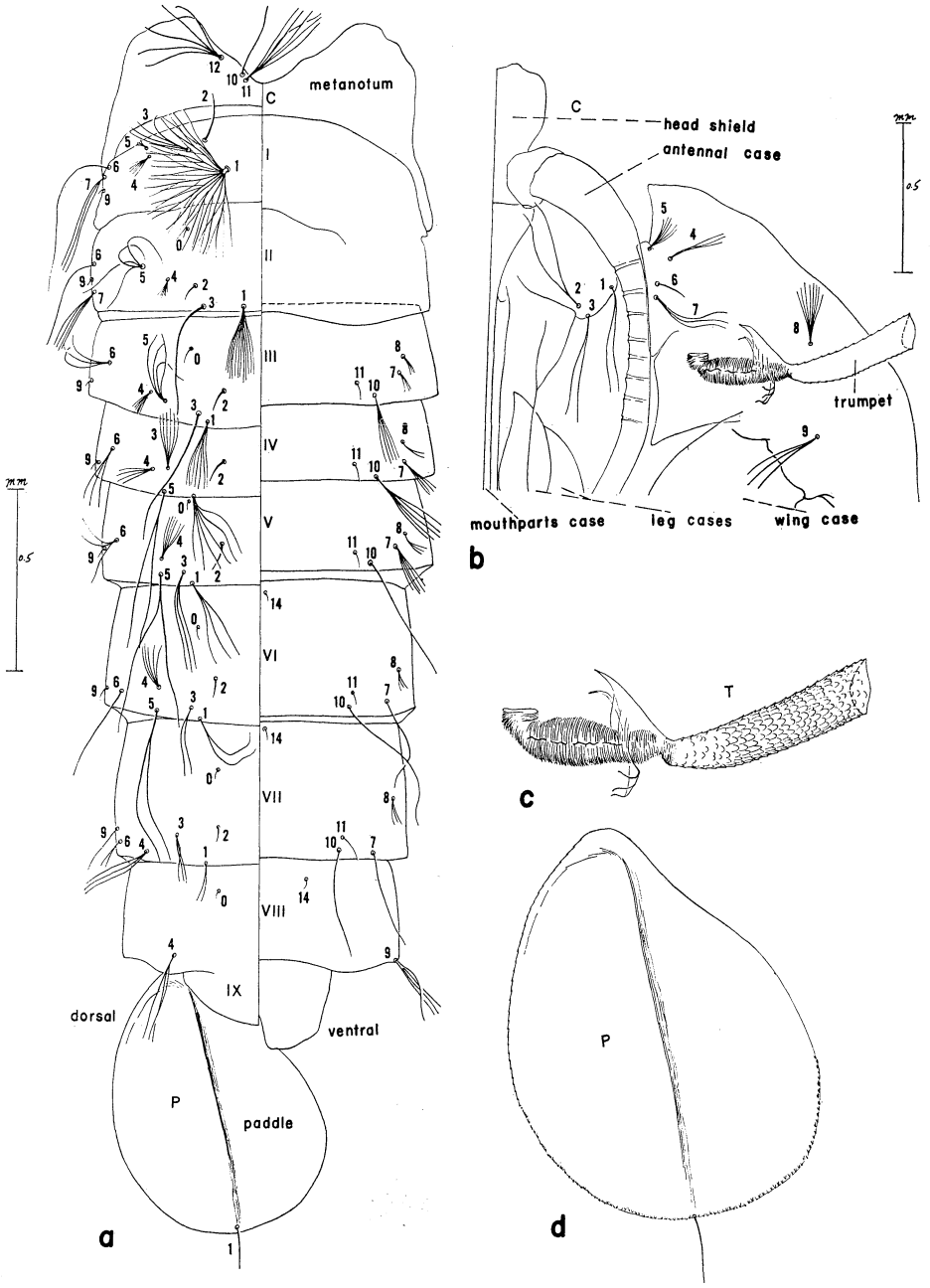

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Fig. 12. *Aedes* (*Verrallina*) *carmenti* Edwards, pupa, with system of chaetotaxy illustrated. a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations: C=cephalothorax; P=paddle; T=trumpet.)

H-shaped structure of 10th sternite present.

♀. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales on upper portion and hairs on posterior portion; upper *stp* with darkish scale patch, with hairs along anterior border and on anterior corner; *mep* with not more than 15 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark except lighter scales on supraalar and prescutellar areas; 1st fork cell of wing 1.5 × as long as its stem; fore and mid-legs with tarsal claws equal, both toothed; abdomen with lateral oblique pale spots on segments II-VII; segment VIII with all scales dark.

Egg (Fig. 25). Dark; elongate, 5.9–6 × as long as wide; 0.845 mm × 0.141 mm.

Larva (4th Instar) (Fig. 11). *Head.* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 5-branched, 6-C 3-branched, 7-C 8-branched. Mentum with 20 teeth on each side. *Segment VIII.* Comb scales 16 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 6-branched, 2-VIII 2-branched, 3-VIII 9-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon:* 2.6 × as long as wide; acus present; pecten teeth 14, last reaching to 0.55 of siphon; last 2 teeth more widely spaced than preceding 2; each tooth with 2 denticules, 1 larger than the other; 1-S 3-branched, inserted beyond last tooth and in line with teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.7 × as long as saddle, lanceolate.

Pupa (Fig. 12). *Trumpet.* 3.7 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 6-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, distance between them 3 × distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI 2-branched, just reaching to posterior margin of following segment; 9-VIII 4-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Larvae of 4th instar pupated within 24 hours after being brought from the field; the adult emerged in 3 days. They were collected in a small ground pool (about 60–90 cm diameter) in a grassy swamp at Cape Killerton, elevation 5 m, 6.V.1965. The temporary ground pool contained fresh clear water with mud and decaying vegetation on the bottom, and was situated in partially shaded area surrounded by abundant vegetation. Water mites were found in the water: adult females of *carmenti* Edwards usually carry 1 to 2 water mites on their bodies, sometimes up to 5 or 6. Fungi were also found, usually attached to the gills of larvae. Females were captured while biting man during the day, in a partially forested area, at Cape Killerton 6-11.V.1965; in a sago swamp, at Embi Lakes 1–11.V.1965; and in a cacao plantation at Epa Creek at night 1. V. 1965. Males and females were collected by Malaise and light traps, in a sago swamp in a partially forested area at Lae, 16–30.IV.1965; and while sweeping in partially forested area at Lae. In the laboratory, eggs were laid on a ribbon-like row on the sides of the test tubes (Belkin 1962).

The results of rearing of progenies from captured females are as follows: BBM-NG 2148: 300 ♀♀ captured as they were biting man during the day on 6.V.1965, in a forest swamp at Cape Killerton. After 5 days, 6 ♀♀ had laid eggs (26, 21, 5, 63, 14, and 36 eggs). On 12.V.1965, 2 more oviposited (30 and 73 eggs), and on 13.V.1965, 3 additional ♀♀ laid (33, 9, and 1 egg).—BBM-NG 2306: 200 ♀♀ were captured while biting man during the evening of 9.V.1965, in a forest swamp at Cape Killerton. After 4 days, 2 ♀♀ laid eggs (20 and 64 eggs).—BBM-NG 2307: 30 ♀♀ were captured while biting man during the day of 11.V.1965, in a sago swamp in a forest swamp at Oro Bay, Popondetta. After 4 days, 2 ♀♀ laid eggs (4 and 24 eggs):—BBM-NG 2150. 200 ♀♀

were captured while biting man during the day of 8.V.1965, in a sago swamp in a forest swamp at Embi Lakes, Popondetta. After 4 days 1 ♀ laid 64 eggs.

Most of the females oviposited at night, but one female laid in the afternoon. The eggs were deposited singly on the strip of filter paper in the individual rearing vials. Each ♀ laid its eggs all at one time, then became very weak and died, except 1 ♀ which laid 5 eggs on 11.V.1965 and 36 eggs on the following day. The eggs were first white, but about an hour later they began to gradually darken until the final color was attained. The incubation period was 4 to 5 days. After this period had passed, larvae hatched within 20 minutes after being flooded with the Brewer's yeast-tap water mixture. The newly hatched larvae were white, with the head and siphon the first parts to become pigmented. Larvae from one female were reared in the mass rearing pot in tap water. Finely ground native biscuits and Cenovis vitamin yeast tablets were provided as food. Each stadium lasted 1–2 days. It took 5 to 6 days from hatching to the 4th instar larval stage. Unfortunately, due to the necessity for discontinuing work in the field the rearing was not carried to the adult stage.

DISTRIBUTION. SE NG: Popondetta: Cape Killerton, Oro Bay, Embi Lakes, Epa Creek, Samboga Plt'n; Cape Rodney; Port Glasgow; Kerema; Brown R., Port Moresby; Milne Bay. NE NG: Lae; Alexishafen; Maprik; Karimui. SW NG: Merauke. NW NG: Archbold Lake; Hollandia; Cyclops Mts. BISMARCK ARCH.: *Manus:* Lorengau. *New Ireland:* Kavieng. *New Hanover:* Lavongai. SOLOMON IS.: *Guadalcanal.* MOLUCCAS: *Ceram:* Hoelong; Hatoenoerae; Karloetoe Kara; Oewin; Warasiwa; Lisicla; Paa; Wahaai. *Ambon:* Waai.

Importance. This is one of the most serious pest mosquitoes in the New Guinea area. It attacks man voraciously in forested areas both during the day and after dark. The disease relations are unknown. Random dissections of *carmenti* on Guadalcanal island failed to show natural infection with larval filariae (Belkin 1962).

Remarks. This is one of the most common species on New Guinea as well as on other islands within the Papuan subregion. All the specimens agree well with the material from Guadalcanal. The adults are, in general, quite similar to *azureosquamatus* Bonne-Wepster and *sentanius* King & Hoogstraal but can be distinguished from both by the characters used in the key. The male genitalia of this species, with a group of 7 bristles on the mesal lobe of the sidepiece, can easily be distinguished from the male genitalia of *sentanius*. The male of *azureosquamatus* is unknown.

5. **Aedes (Verrallina) ceramensis** Brug

Aedes (Aedes) ceramensis Brug, 1934, Bull. Ent. Res. **25:** 512. (Types: 2 ♂, Oewin and Warasiwa, Ceram, Moluccas; BMNH).

♂. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales; upper *stp* with brownish scale patch, with 2 or 3 hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell of wing equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, the claws unequal, both toothed; abdomen with lateral pale spots on segments II-VII. (Description based on cotype in BMNH, Oewin, Ceram, 3.I.1932, S. L. Brug). *Genitalia:* Closely resembling those of *carmenti* Edwards. Unfortunately, the specimen was not in good condition and could not be described.

♀, *egg, larva, pupa.* Unknown.

Biology. Larvae have been found in their natural habitats in swamps in virgin forest, Oewin, Ceram, 3.I.1932, and in ground pools in forest, Warasiwa, Ceram, 2.I.1932.

DISTRIBUTION. MOLUCCAS: *Ceram:* Oewin; Warasiwa.

Remarks. This species is only known by the male: Although the external characters differ

from those of *carmenti* Edwards in the smaller size of the lateral pale spots on abdominal segments II-VII, the genitalia closely resemble the genitalia of *carmenti*. King & Hoogstraal (1947) synonymized *ceramensis* Brug (1934) with *carmenti;* Belkin (1962), however, regarded it as a distinct species. Unfortunately, no further material has been collected, and the taxonomic position of this species remains questionable until more information is obtained.

6. **Aedes** (**Verrallina**) **cuccioi** Belkin

Aedes (*Verrallina*) *cuccioi* Belkin, 1962, Mosquitoes S. Pacific **1:** 414 (holotype ♂, Matanikau Valley, Guadalcanal, Solomon Is.; USNM).

♂. Vertex with pale scales on nape only; *apn* without scales; *ppn* without scales; upper *stp* with translucent darkish scale patch, with hairs on anterior border; *mep* with not more than 8 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep*; scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with all scales dark. *Genitalia:* Sidepiece short, 1.4 × as long as wide; its scales restricted to basal lateral and ventral areas; with 2 leaf-like subapical spines; with 2 bristles basad of spines; mesal surface membranous. Clasper enlarged basally, with 7 hairs on basal area; distally curved and without hair; pointed at tip. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. 8th tergite with a rod-like bristle on each side.

(Description based on holotype, Guadalcanal 1944, J. N. Belkin).

♀. Vertex with pale scales on nape and on posterior 1/3 of midline, forming triangular pale scale patch; *apn* without scales; *ppn* with 6 or 7 broad translucent brownish scales on posterior portion; upper *stp* with translucent darkish scale patch, with 1 or 2 hairs on anterior corner; *mep* with not more than 8 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. (Description based on allotype, Guadalcanal 1944, J. N. Belkin).

Larva (4th Instar). *Head:* Antenna: less than 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 3-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 2-branched, 7-C 6-branched. Mentum with 18 teeth on each side. *Segment VIII.* Comb scales 13 in 2 rows, each rounded and fringed apically; pentad hairs: 1-VIII 2-branched, 2-VIII 2-branched, 3-VIII 6-branched, 4-VIII simple, 5-VIII 7-branched. *Siphon:* 4 × as long as wide; acus present; pecten teeth 9, the last reaching beyond middle of siphon at 0.75 of siphon; pecten teeth evenly spaced and all simple; 1-S 5-branched, inserted before last tooth and ventrad of teeth; trachea narrow, less than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, shorter than saddle; 2-X simple; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills extremely long, 4 × as long as saddle, sausage-like.

Pupa. Trumpet: 3.5 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 8-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 4-branched; 2-I and 3-I widely separated, the distance between them being 5 × distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI simple, reaching beyond the following segment and at 2/3 of next segment; 9-VIII 2-branched. *Paddle:* Marginal spicules present; 1-P spiniform. (Description of larva and pupa based on slides associated with holotype in USNM, Guadalcanal, Solomon Is. 9.XII.1944, J. N. Belkin).

Biology. According to Belkin (1962), larvae were collected in a rot hole at base of a tree growing in a stream bed, in rock pools and potholes in a stream bed, and in a flooded stream on Guadalcanal; they were also found in a small clear swampland stream in Bougainville, and have been taken from a flooded area along a creek in New Georgia. Single male was collected resting near a sunny pool in a stream bed in Guadalcanal.

DISTRIBUTION. SE NG: Milne Bay (only larval and pupal skins, the adults missing from the pin mount). SOLOMON IS.: *Guadalcanal; Munda; New Georgia.*

Remarks. There are two slides of larval and pupal skins, Malaria Unit 75, New Guinea, 1944, 7–27–2, also 7–27–1 (larva and pupa); 7–27–3 and 7–27–4 (larva only) in USNM. Both larvae and pupae agree well with the type specimens and show that this species does occur in the New Guinea area.

The male genitalia are quite similar to those of *milnensis* King & Hoogstraal, but they can easily be distinguished from *milnensis* by the presence of two leaf-like subapical spines on the sidepiece. The larva of this species have the gills very long and sausage-like, the pecten teeth evenly spaced, the comb scales in two rows. This combination of characters will differentiate them from the other species.

7. **Aedes (Verrallina) embiensis** Huang, new species Fig. 13, 14.

Holotype: ♂ (BISHOP 7553; BBM-NG 2229–1) with associated genitalia slide (YMH-'65–10) and legs slide (♂ 2229–1), Embi Lakes, Popondetta, SE New Guinea, collected as a pupa in a small ground pool in partial forest, 2.V.1965, P. Shanahan.

♂. Vertex with all scales dark except few (2 or 3) broad pale scales on nape; *apn* without scales; *ppn* with dark scales and hairs on posterior portion; upper *stp* with darkish scales; *mep* with dark

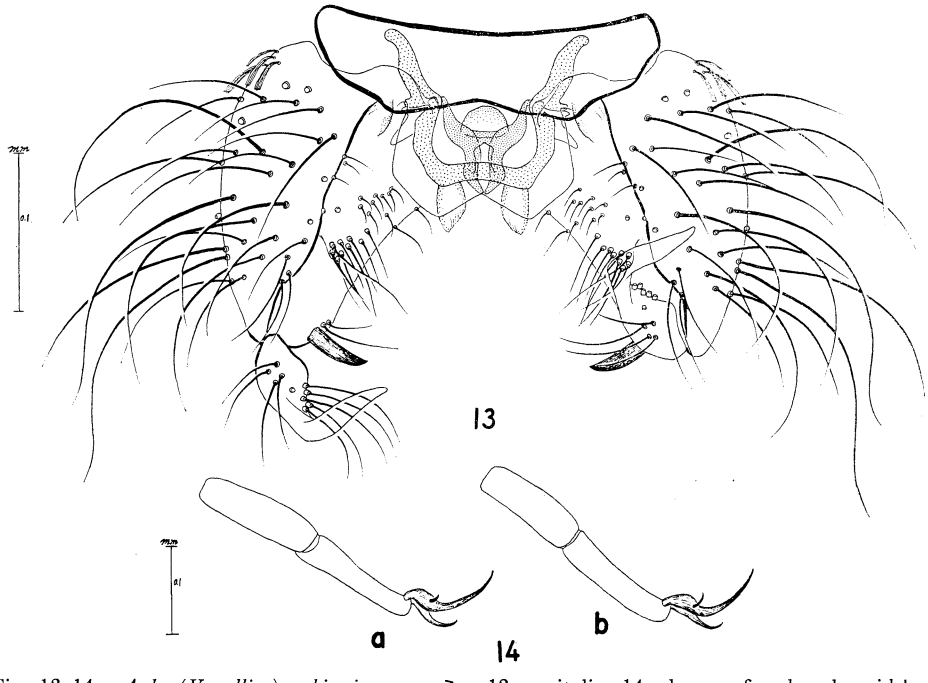

Fig. 13–14. *Aedes (Verrallina) embiensis* n. sp. ♂: 13, genitalia; 14, claws a, fore leg; b, mid leg.

hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.8 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, the larger one toothed; abdomen with median pale spot on segment II, transverse pale band on segments III-V (the bands wider on lateral portion), lateral pale spots on segment VI and VII, and segment VIII with all scales dark. *Genitalia* (Fig. 13): Sidepiece long, 2 × as long as wide, its scales restricted to basal lateral and ventral areas; 1 stout subapical spine; 2 bristles basad of spine; mesal surface membranous; mesal lobe with a group of 9 bristles; basal lobe with hairs. Clasper enlarged basally, with 5 hairs on mesal area and 5 hairs on lateral area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; H-shaped structure of 10th sternite present.

♀, *Egg, larva, pupa.* Unknown.

Biology. Pupae were found in a small ground pool in partially forested area at Embi Lakes, at an elevation of 15 m. The temporary ground pool contained fresh, clear water, with mud and decaying vegetation at the bottom, and was situated in deeply shaded area surrounded by scant vegetation.

DISTRIBUTION. SE NG: Embi Lakes, Popondetta.

Remarks. The male genitalia of this species are very similar to those of *reesi* King & Hoogstraal,

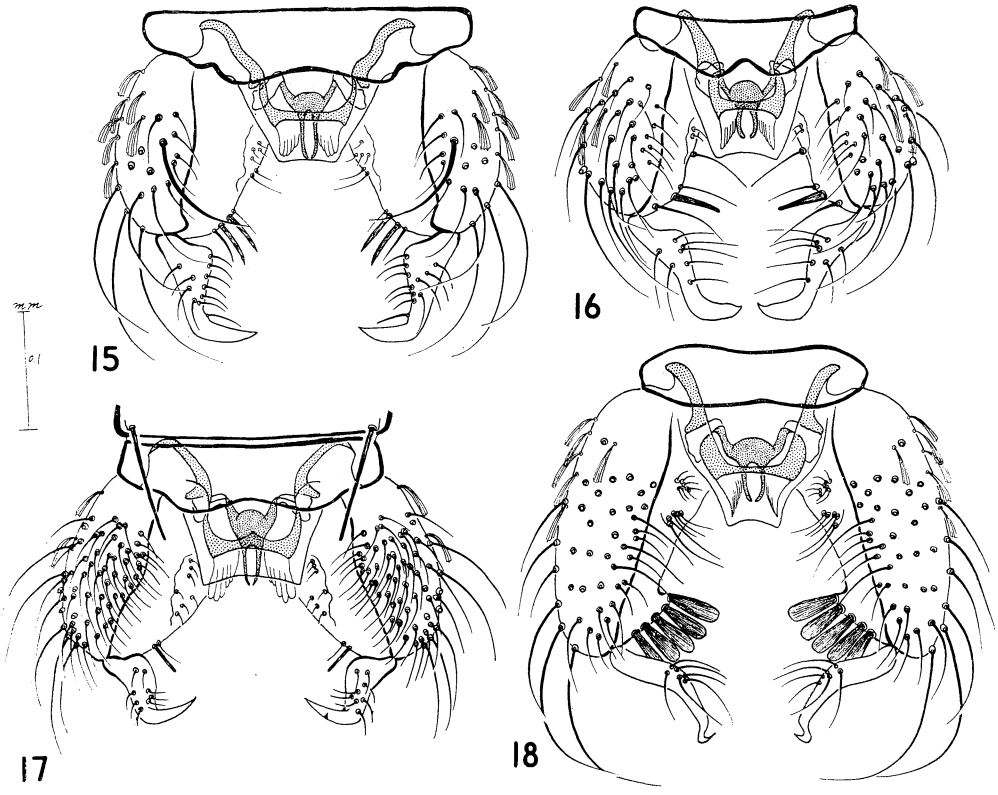

Fig. 15–18. Genitalia, ♂: 15, *Aedes (Verrallina) foliformis* King & Hoogstraal; 16, *Aedes (Verrallina) lineatus* (Taylor); 17, *Aedes (Verrallina) milnensis* King & Hoogstraal; 18, *Aedes (Verrallina) multifolium* King & Hoogstraal.

but they can easily be distinguished from *reesi* in having the sidepiece with one stout subapical spine and a group of 9 bristles on the mesal lobe of the sidepiece. Only one male was obtained; the external characters as well as the genitalic characters are different from all other species that have been described in this subgenus.

8. **Aedes (Verrallina) foliformis** King & Hoogstraal Fig. 15, 19, 23, 24.

Aedes (Aedes) foliformis King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 121 (holotype ♂, Gusika, Finschhafen area, NE NG; USNM).

♂. Vertex with a median strip of pale broad scales on posterior portion; *apn* without scales; *ppn* with broad brownish scales on posterior portion; upper *stp* with pale scales; *mep* with no more than 10 hairs posterior to the scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; first fork cell of wing equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with basal transverse pale band on segment II and III, with subbasal transverse pale band on segment IV and V, with median transverse pale band on segment VI and VII; segment VIII with all scales dark. *Genitalia* (Fig. 15): Sidepiece very short, as long as wide; scales restricted to basal lateral

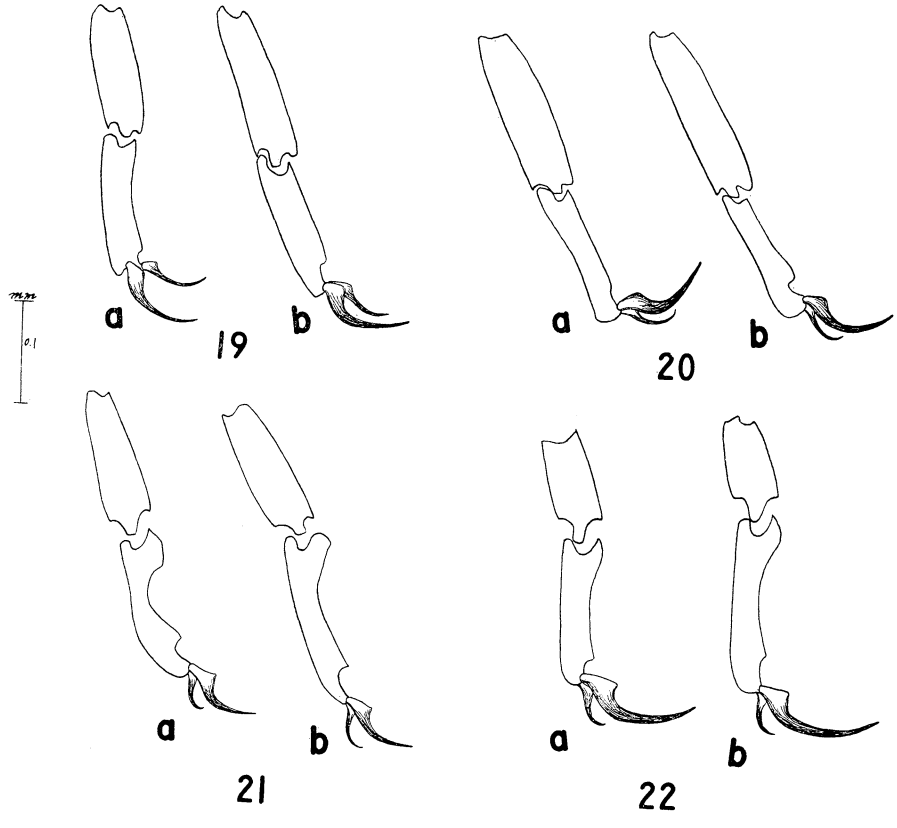

Fig. 19–22. Claws, ♂: 19, *Aedes (Verrallina) foliformis* King & Hoogstraal; 20, *Aedes (Verrallina) lineatus* (Taylor); 21, *Aedes (Verrallina) milnensis* King & Hoogstraal; 22, *Aedes (Verrallina) multifolium* King & Hoogstraal; a, fore leg; b, mid leg.

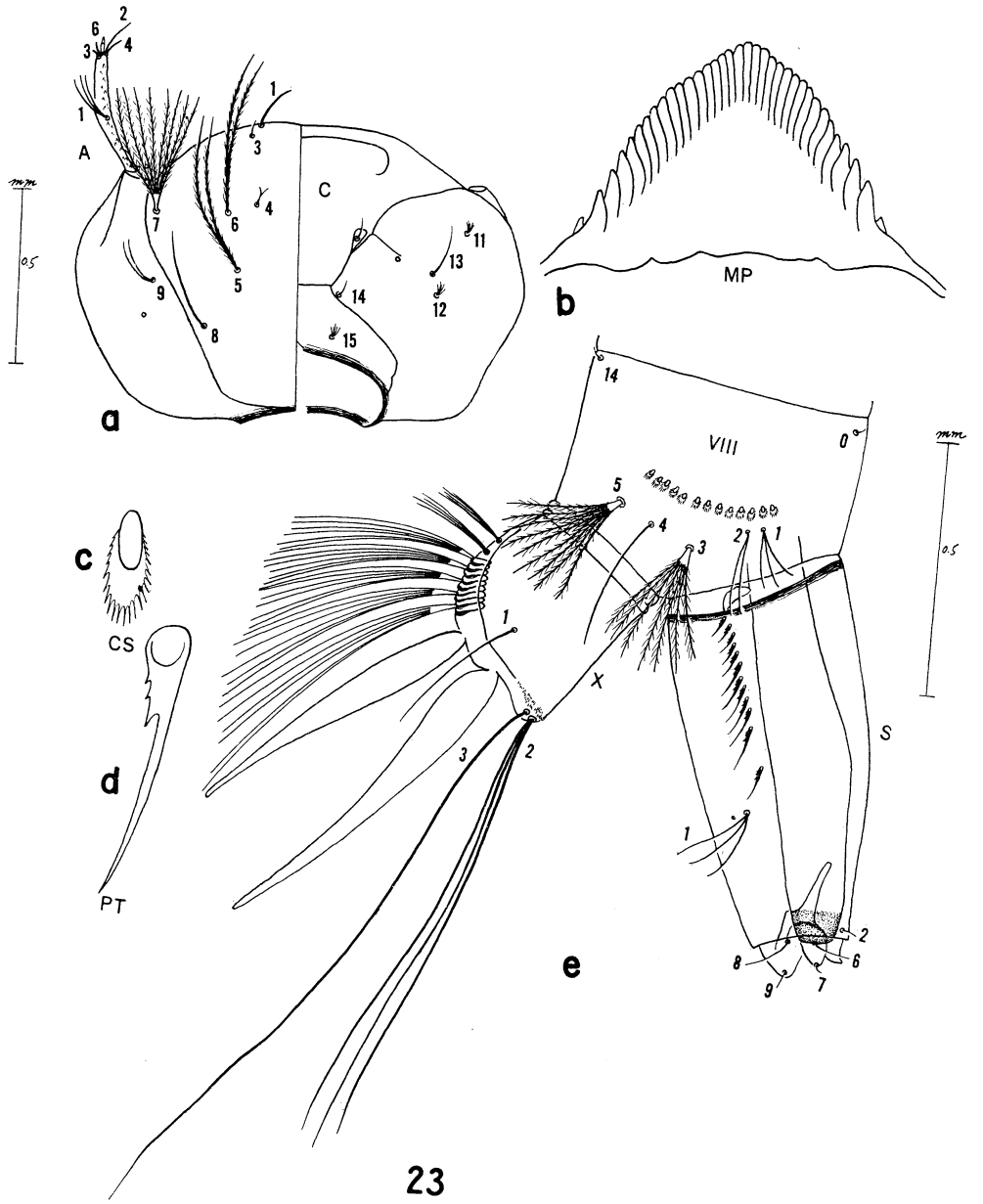

Fig. 23. *Aedes* (*Verrallina*) *foliformis* King & Hoogstraal; 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

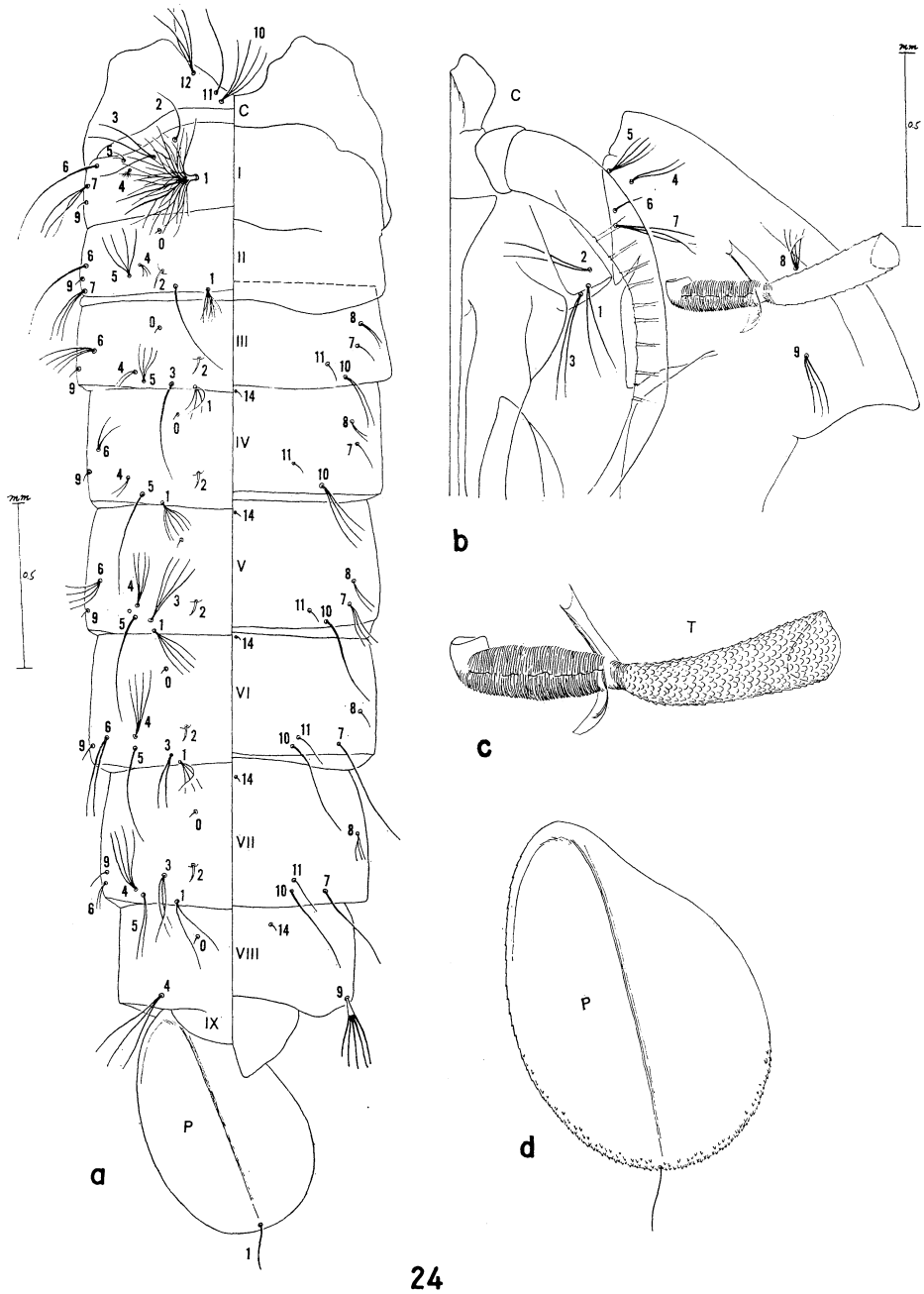

Fig. 24. *Aedes* (*Verrallina*) *foliformis* King & Hoogstraal; pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

and ventral areas; 3 leaf-like subapical spines, the distal one narrower and more pointed; 1 bristle basad of spines; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with hairs. Clasper enlarged basally, with 7 hairs on mesal area and 4 hairs on lateral area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of tenth sternite present.

♀. Vertex with median strip of pale broad scales on posterior 2/3 of midline; *apn* without scales; *ppn* with dark narrow scales on upper portion and 2 or 3 broad brownish scales on posterior portion; upper *stp* scale patch with pale scales on upper 1/3 and dark scales on lower 2/3; *mep* with no more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; first fork cell 1.4× as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with subbasal transverse pale band on segments II-IV, the band curving forward in middle and touching at base on segment II and III; with median transverse pale band on segments V-VII; segment VIII with all scales dark.

Larva (4th Instar) (Fig. 23). *Head:* Antenna: less than 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 3-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 2-branched, 6-C 2-branched, 7-C 8-branched. Mentum with 17 teeth on each side. *Segment VIII:* Comb scales 13 in a single row, each rounded and fringed apically; pentad hairs: 1-VIII 3-branched, 2-VIII 2-branched, 3-VIII 7-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon:* 2 × as long as wide; acus present; pecten teeth 12, the last reaching beyond middle of siphon, and more widely spaced than preceding 2; each tooth with 3 denticules, one larger than the other 2; 1-S 3-branched, inserted beyond last tooth; trachea broad, more than 0.5 width of siphon. *Anal segment.* Saddle incomplete; 1-X simple, shorter than the saddle; 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 2.2 × as long as saddle, lanceolate.

Pupa (Fig. 24). *Trumpet:* 3 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 4-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, 7 × as far apart as distance between 4-I and 5-I; 1-II less than 10-branched; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI simple, not reaching beyond posterior margin of the following segment; 9-VIII 4-branched. *Paddle.* Marginal spicules present; 1-P spiniform.

Biology. Larvae of 2nd instar were reared in water obtained from the original breeding site to which finely ground native biscuit had been added. The larvae pupated 11 to 12 days after being brought from the field. The pupal period lasted 2 days. The larvae were collected in a small isolated ground pool (about 75–90 cm diameter) in a pandanus swamp of a partially forested area at Mt Missim, Wau, elevation 860 m, 2.IV.1965. The deeply shaded temporary ground pool was surrounded by abundant vegetation, and contained fresh, clear water, with mud and decaying vegetation at the bottom. Adults have been collected in light traps (King & Hoogstraal, 1947).

DISTRIBUTION. NE NG: Mt Missim, Wau; Gusika, Finschhafen. NW NG: Hollandia (Kotabaru).

Remarks. Adults with correlated larval and pupal skins were obtained from larvae collected. The specimens agree well with the type. The adults are very similar to *trispinatus* King & Hoogstraal, and their differences are discussed under *trispinatus*. The male genitalia are quite characteristic, with three leaf-like subapical spines on the sidepiece, the distal one narrower and more pointed and in some specimens is reduced to a heavy pointed spine.

9. **Aedes (Verrallina) funereus** (Theobald) Fig. 26.

Skusea funerea Theobald, 1903, Monograph of the Culicidae 3:292 (Type ♀, Queensland, Australia; BMNH).

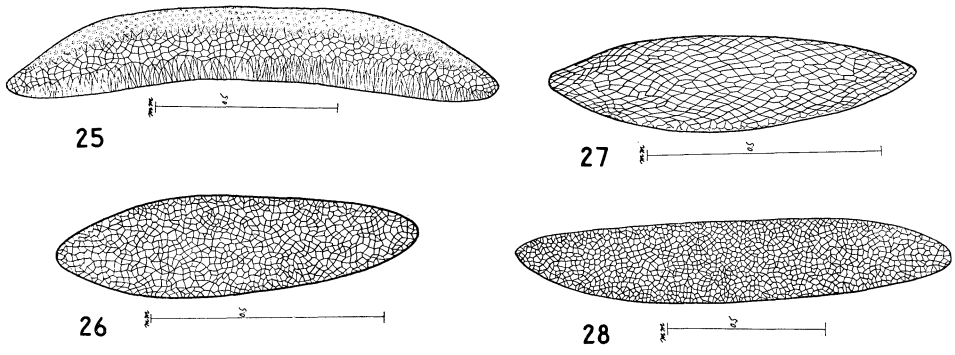

Fig. 25–28. Egg. 25, *Aedes (Verrallina) carmenti* Edwards; 26, *Aedes (Verrallina) funereus* (Theobald); 27, *Aedes (Verrallina) lineatus* (Taylor); 28, *Aedes (Verrallina) parasimilis* King & Hoogstraal.

Pseudoskusea basalis Taylor, 1912, Ann. Rept. Con. Publ. Health, Queensland, App. **6** : 21. (quoted from Edwards, 1924. Bull. Ent. Res. 14 : 388.)

Aedes (Aedes) funereus (Theobald), Lee, 1944, Atlas Mosq. Larv. Aust. Region: 76.—King & Hoogstraal, 1947, J. Wash. Acad. Sci. 37 : 117.

♂. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales; *stp* with pale translucent scales on upper portion and brownish scales on lower portion of scale patch, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with median pale spot on segment II; with transverse pale band on segments III-VI, the bands touching the base at middle and sides, and curved backward in between forming a scalloped shape; with lateral spots on segment VII; segment VIII with all scales dark. *Genitalia:* Side-piece short, 1.2 × as long as wide; its scales restricted to basal lateral and ventral areas; with 1 subapical spine; 10 stouter spine-like bristles on inner margin of dorsal surface; mesal surface membranous; mesal lobe with 6 bristles; basal lobe with 5 hairs. Clasper enlarged basally, with 6 hairs on basal portion; tapered distally and without hairs. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with all scales dark; *apn* without scales; *ppn* with narrow dark scales; upper *stp* scale patch with pale translucent appressed scales on upper portion and darkish scales on lower portion, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, the claws minutely toothed; abdomen with median pale spot on segment II, transverse pale band on segments III-VI, the bands touching base at middle and sides and curved backward in between forming a scalloped shape, and with lateral spots on segment VII; segment VIII with all scale dark.

Egg. (Fig. 26). Dark; elongate, 3 to 3.1 × as long as wide, size 0.806 mm × 0.268 mm.

Larva (4th Instar). *Head:* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 3-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 8-branched, 6-C 3-branched, 7-C 10-branched. Mentum with 19 teeth on each side. *Segment VIII.* Comb scales 12 in a single row, each rounded and fringed apically; pentad hairs: 1-VIII 4-branched, 2-VIII 2-branched, 3-VIII 6-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon.* 2.5 × as long as wide; acus present;

pecten teeth 11, the last reaching beyond middle of siphon; last 3 teeth more widely spaced than preceding 2; each tooth with 3 denticules, 1 larger than the other 2; 1-S 3-branched, inserted beyond last tooth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, longer than saddle; 2-X 4-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa. Trumpet: 3 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; distance between 2-I and 3-I 2 × distance between 4-I and 5-I; 1-II less than 10-branched; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI 2- to 3-branched, reaching to posterior margin of the following segments; 9-VIII 3-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Females were captured while biting man at noon and in the evening, in mangrove and sago swamps in a forest area at Cape Killerton, elevation 5 m.

The results of rearing of progenies from captured females are as follows: BBM-NG 2306: 200 ♀♀ were captured as they were biting man during the evening of 9.V.1965, in a sago swamp in a forest swamp area at Cape Killerton. After 4 days, 1 ♀ laid 2 eggs. In Brisbane, Australia, 1 ♀ was captured in the evening 17.III.1965, in a mountain creek, at Camp Mt Queensland. After 4 days, this ♀ laid 57 eggs. The eggs were laid singly on a strip of filter paper and kept moist. On 24.III.1965, the eggs were flooded with the Brewers' yeast-tap water mixture; after 15 minutes 8 larvae hatched and were placed in individual vials, but all died at 2nd instar. The eggs and egg shells were preserved in 2% formalin.

DISTRIBUTION. SE NG: Cape Killerton, Popondetta; Watutu Point, Goodenough I.; Milne Bay; Beteina Roro; Mekeo Dist. SW NG: Merauke. MOLUCCAS: *Ceram:* Noekoehai; Wahaai; Hatoenoeroe.

Remarks. The New Guinea specimens agree well with the type female (Burpengary, Queensland, Australia, T. L. Bancroft) in British Museum. The color of the scales on the abdominal segments of the adults of this species is similar to that of *lineatus* (Taylor); however they can easily be distinguished from *lineatus* by the absence of pale scales on the vertex and on the *apn*. The male genitalia, with 10 stouter spine-like bristles on the inner margin of dorsal surface of sidepiece, can easily be distinguished from those of all other males in this subgenus.

10. **Aedes (Verrallina) killertonis** Huang, new species Fig. 40, 44.

Holotype ♂ (BISHOP 7554; BBM-NG 2227) with associated genitalia slide (YMH-'65–110) and legs slide (♂ 2227), Cape Killerton, SE New Guinea, from Malaise trap in partial forest mixed with sago and pandanus vegetation, 6–13.V.1965, Y. M. Huang & W. A. Steffan. Paratypes: 6♂, 34♀ as follows: 2♂ (BBM-NG 2227) with associated genitalia slides (YMH-'65–26), (YMH-'65–27), 2♂ (BBM-NG 2237) with associated genitalia slides (YMH-'65–24), (YMH-'65–25), 2♂ (BBM-NG 2238) with associated genitalia slides (YMH-'65–11), (YMH-'65–111), 34♀ (BBM-NG 2226, 2227, 2238, 2230), all with same data as holotype. Deposited in BBM, BMNH, USNM, and UQ.

♂. Vertex with broad pale scales on posterior 1/2 of midline; *apn* without scales; *ppn* with dark narrow scales; upper *stp* with translucent scales on upper half and with brownish scales on lower half of scale patch; *mep* with dark hairs below scale patch, the hairs reaching to lower border of *mep;* scutum with golden yellowish scales on anterior and lateral prescutal areas, on acrostichal, posterior dorsocentral, supraalar, prescutellar space and scutellar areas; 1st fork cell 1.7 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple;

abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. *Genitalia* (Fig. 40): Sidepiece short, 1.4 × as long as wide, its scales restricted to the basal lateral and ventral areas; 1 leaf-like subapical spine; 1 bristle basad of spine; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with hairs. Clasper enlarged basally, with 10 hairs; distal portion curved at a right angle and without hair; not pointed at tip. Aedeagus triangular in dorsal aspect, pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with broad pale scales on posterior 3/4 of the midline; *apn* without scales; *ppn* with dark scales; upper *stp* with translucent appressed scales on upper half and brownish appressed scales on lower half of scale patch; *mep* with dark hairs below scale patch, the hairs reaching to lower border of *mep;* scutum with golden yellowish scales on anterior and lateral prescutal areas, on acrostichal, posterior dorsocentral, supraalar, prescutellar space and scutellar areas; 1st fork cell 1.8 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws equal, both toothed; abdomen with lateral oblique pale spots on segments II-VII; segment VIII with all scales dark.

Egg, larva, pupa. Unknown.

Biology. Males and females were collected by Malaise traps 6–13.V.1965, in a partial forest mixed with sago and pandanus vegetation, at Cape Killerton, elevation 5 m. Females were captured biting man in day time 4.V.1965, in a sago swamp in partially shaded area at Lae.

Distribution. SE NG: Popondetta: Cape Killerton; Mowkass Village, Dobodura. NE NG: Lae.

Remarks. Both males and females of this species possess the following characters: vertex with broad pale scales on midline along the posterior half or three-fourths; *mep* with dark hairs below the scale patch, the hairs scattered and reaching to the lower border of *mep;* scutum with golden yellowish scales on anterior and lateral prescutal areas, on acrostichal, posterior dorsocentral, supraalar, prescutellar space and scutellar areas. This combination of characters differs from that of all other species described in the subgenus.

11. **Aedes (Verrallina) leilae** King & Hoogstraal

Aedes (Aedes) leilae King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 121 (holotype ♂, Hollandia, NW New Guinea; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale translucent scale patch, with hairs on anterior corner; *mep* with many hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with transverse band close to the base on segment III-VI, but with narrow bare area between the band and the base; segment II with all scales dark from dorsal view; segment VII with lateral pale spots. *Genitalia:* Sidepiece short, 1.2 × as long as wide; no leaf-like subapical spine; mesal surface membranous; mesal lobe with 4 bristles; basal lobe with hairs. Clasper with 14 hairs on basal 2/3; curved on distal third; tapered at apex with minute papillated hairs on inner side subapically; pointed at tip. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. (Description based on holotype, 19 MGL, light trap No. 3, 500 ft, Hollandia, NW NG 2.IV.1945, King & Hoogstraal).

♀, *egg, larva, pupa.* Unknown.

Biology. The breeding habitat is unknown. Adults were collected from light traps at Hollandia, elevation 150 m, on III-IV.1945, by King & Hoogstraal.

Distribution. NW NG: Hollandia (Kotabaru).

Remarks. This species was not collected by me. The six male paratypes examined agree well

with the holotype. The male genitalia with 4 minute papillated hairs on the inner side of the distal portion of clasper, are characteristic of this species.

12. **Aedes (Verrallina) lineatus** (Taylor) Fig. 16, 20, 27, 29, 30.

Skusea funerea var. *ornatus* Theobald, 1905 (non Meigen, 1818), Ann. Mus. Nat. Hung. **3:** 79. (holotype ♀, Sattelberg, Huon Gulf, and Friedrich-Wilhelmshafen, NE NG).

Lepidotomyia lineatus Taylor, 1914, Trans Ent. Soc. Lond. **62:** 191. (syntypes ♀, Lake Kamu Gold field and Mekeo District, Papua; US).

Aedes (Aedes) funereus ornatus: Lee, 1944, Atlas Mosq. Larv. Aust. Region.: 77 (Description of larva from Milne Bay, Papua).

Aedes (Aedes) lineatus: King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 118.

Aedes (Verrallina) lineatus: Belkin, 1962, Mosquitoes S. Pacific **1:** 418.

♂. Vertex with median strip of pale broad scales on midline; *apn* with pale broad scales; *ppn* with dark narrow scales on upper portion and 2 or 3 pale scales on posterior portion; upper *stp* with pale scale patch; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with golden yellowish scales on anterior and lateral prescutal areas, on acrostichal, supraalar, prescutellar and on scutellar areas; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with median pale spot on segment II; with subbasal transverse pale band, curving forward toward base in middle on segment III; with median pale band on segments IV-VI; with incomplete median pale band on segment VII; segment VIII with all scales dark. *Genitalia* (Fig. 16): Sidepiece very short, as long as wide, its scales restricted to basal lateral and ventral areas; 1 leaf-like subapical spine; 1 larger bristle distad of spine and 1 smaller bristle basad of spine; mesal surface membranous; mesal lobe with 1 bristle; basal lobe with hairs. Clasper enlarged basally, with 5 hairs on mesal area and 2 hairs on lateral area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with a median strip of pale broad scales on midline; *apn* with pale narrow scales; *ppn* with dark narrow scales on the upper portion and 2 or 3 pale scales on the posterior portion; upper *stp* with pale scale patch; *mep* with not more than 10 hairs posterior to the scale patch, the hairs not reaching below the middle of the lower half of *mep;* scutum with golden yellowish scales on anterior and lateral prescutal areas, on acrostichal, supraalar, prescutellar and scutellar areas; 1st fork cell 2 × as long as its stem; fore and midlegs with tarsal claws equal, toothed; abdomen with median pale spot on segment II, with subbasal transverse pale band, curving forward toward base at the middle on segment III, median transverse pale band on segments IV-VI (some specimens with incomplete band on segment VI), and lateral spots on segment VII; segment VIII with all scales dark.

Egg (Fig. 27). Dark; elongate, 3.6 to 3.7 × as long as wide; 0.756 mm × 0.206 mm.

Larva (4th Instar) (Fig. 29). *Head:* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 5-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 3-branched, 7-C 8-branched. Mentum with 17 teeth on each side. *Segment VIII:* Comb scales 12 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 5-branched, 2-VIII 2-branched, 3-VIII 6-branched, 4-VIII simple, 5-VIII 10-branched. *Siphon:* 2.1 × as long as wide; acus present; pecten teeth 13–15, the last reaching to 0.6 of siphon; last 2 teeth more widely spaced than preceding 2; each tooth with 1 larger denticule and 1 smaller. 1-S 3-branched, inserted beyond last tooth and in line with the teeth; trachea broad, more than 0.5 width of siphon. *Anal seg-*

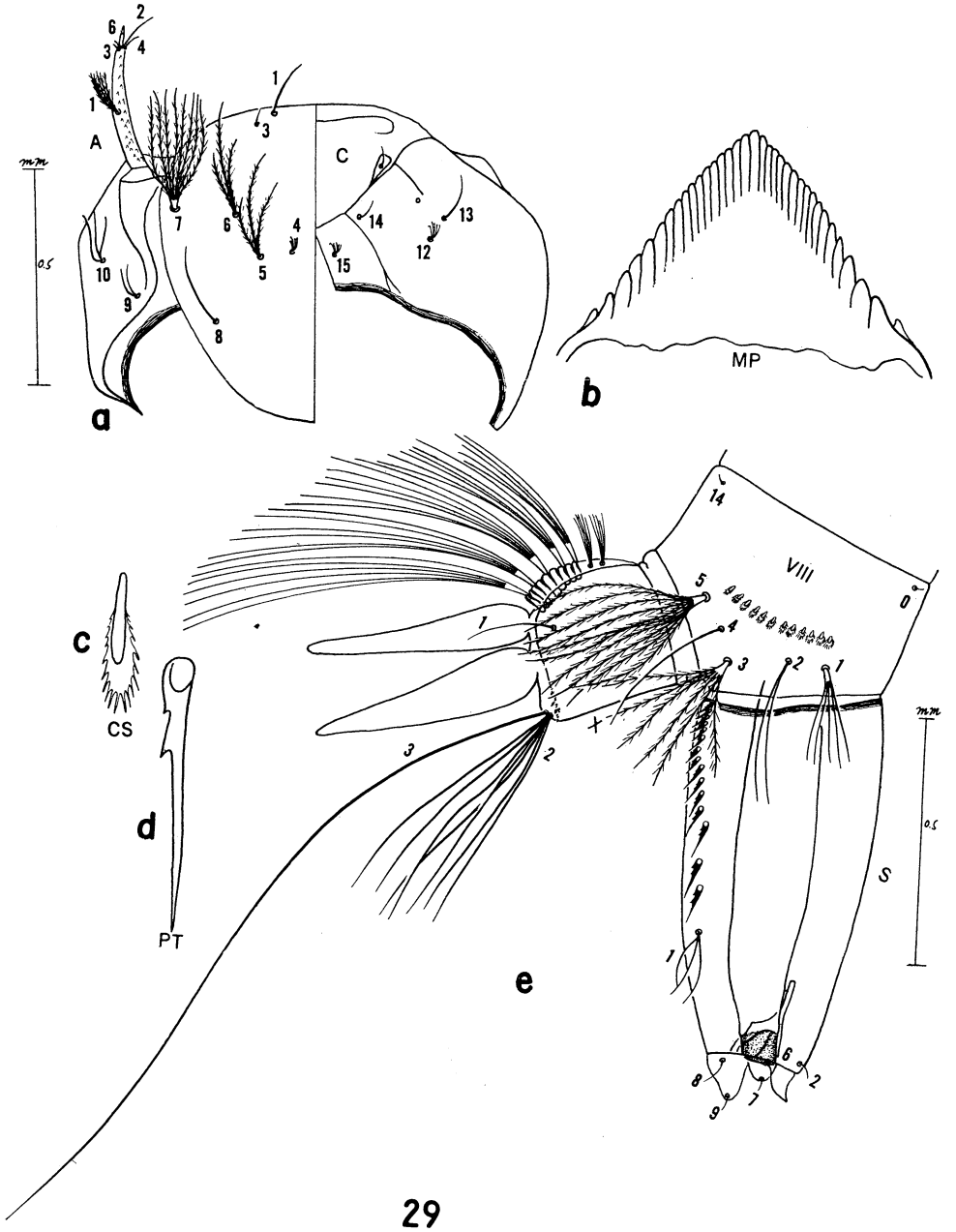

Fig. 29. *Aedes* (*Verrallina*) *lineatus* (Taylor), 4th instar larva: a, head; b, mentum; c, comb scales; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

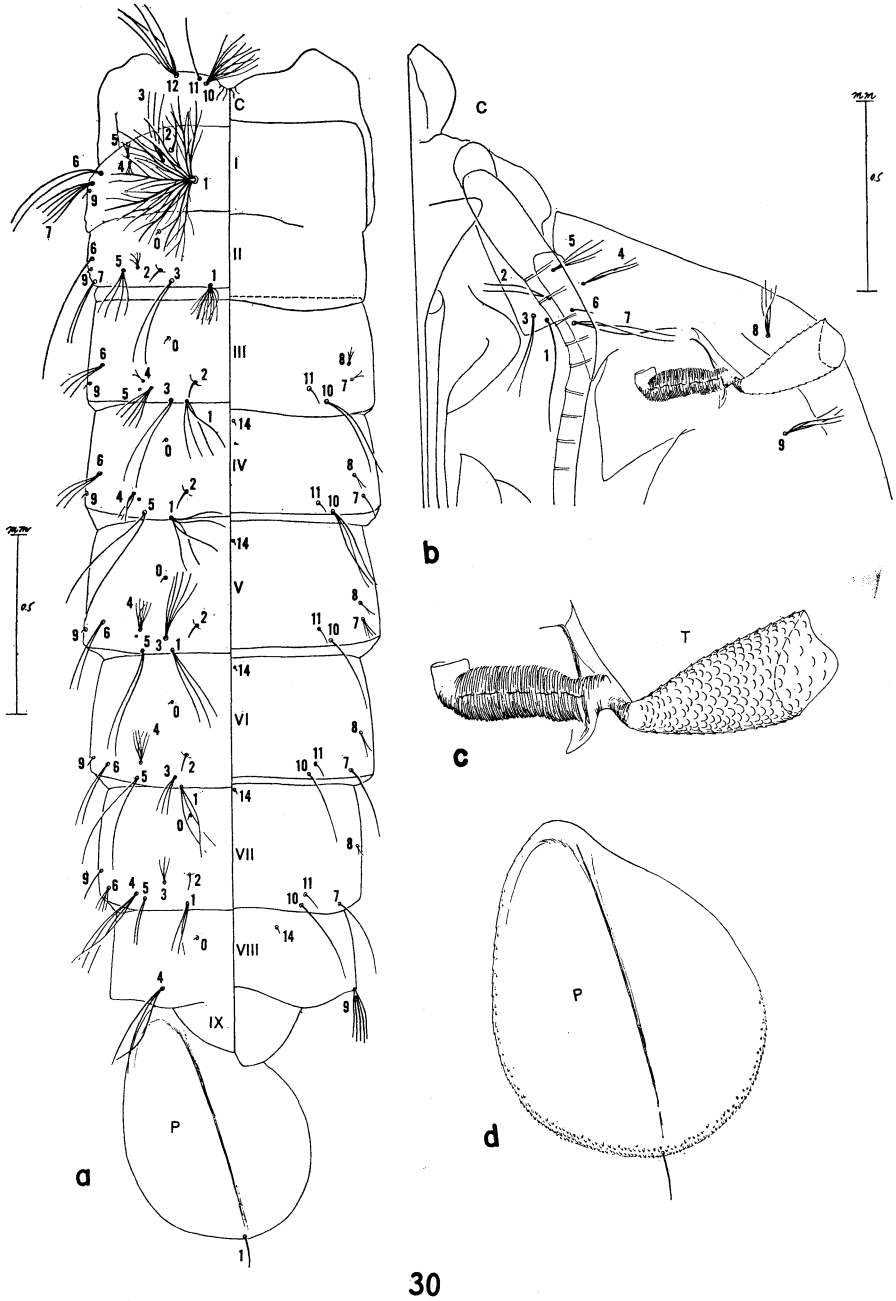

Fig. 30. *Aedes* (*Verrallina*) *lineatus* (Taylor), pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

ment. Saddle incomplete; 1-X simple, shorter than saddle; 2-X 7-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa. (Fig. 30). *Trumpet:* 2.6 × as long as wide; sculptured tracheoid indicated at base. *Metanotum:* Hair 10-C more than 10-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 4 × the distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III 2-branched, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching beyond posterior margin of the following segment; 9-VIII 5-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Larvae and pupae were collected 31.III.1965, in a ground pool on the road side in a grassy area, at Boroko, Port Moresby, at an elevation of 40 m. The temporary ground pool contained fresh turbid water, with mud and decaying vegetation at the bottom, and was situated in a partially shaded area surrounded by abundant vegetation. Females were captured while biting man in a forest swamp in a partially forested area at Brown River; in a sago swamp in virgin forest at Lae at elevation 5–10 m; in a forest swamp in a partially forested area at Busu River, elevation 150 m; in a rubber plantation at Sogeri, Popondetta; in a cocoa plantation in partially forested area at Epa Creek, Popondetta; in a flooded forest at Vanapa River, Port Moresby, elevation 200 m, both during the day and at night, III-V. 1965. Males and females were also collected from Malaise and light traps in the same area.

The results of rearing of progenies from captured females are as follows: BBM-NG 453: 20 ♀♀ were captured as they were biting man at noon on 13.VI.1965, in a partially forested area at Busu River, Lae. After 4 days, 1 ♀ laid 17 eggs.—BBM-NG 345: 32 ♀♀ were captured biting on man at noon 30.III.1965, in a swamp in a partially forested area at Brown River, Port Moresby. After 4 days, 1 ♀ laid 47 eggs on the strip of filter paper. The eggs were kept moist. Larvae hatched within 10 to 20 minutes after being immersed in the Brewers' yeast-tap water mixture on 13.IV.1965. The eggs which did not hatch were removed and kept moist for a second treatment. The larvae hatching from these eggs immersed a second time were successfully reared. The larvae were reared in the mass rearing pot; tap water and some finely ground native biscuits were used for food. Each stadium lasted 2 days; it required 8 to 9 days from hatching for the pupal stage to be reached; and 11 days to reach the adult stage.

DISTRIBUTION. SE NG: Port Moresby: Boroko, Brown R., Musgrave R., Vanapa R. Popondetta: Epa Creek, Dobodura. Tari; Cape Rodney; Port Glasgow; Kerema; Milne Bay; Sogeri. NE NG: Lae; Busu R.; Mt. Missim, Wau; Maprik; Alexishafen. NW NG: Hollandia. BISMARCK ARCH.: *New Britain:* Baining Dist.; Rabaul; Yalom. *New Ireland:* Kavieng; Kaili Bay Dann. *Hermit Is.:* Luf. *Mussau:* Bolin. SOLOMON IS.: *Bougainville.* MOLUCCAS: Wahaai; Lisabata; Hoelong; Wailoeloe; Lisiela; Piroe; Warasiwa; Hatoenome; Wakai. *Ambon:* Waai. NEW HEBRIDES: Pakea, Banks Is.; Santo; Malekula.

Importance. One of the most common mosquitoes. It attacks man in partially shaded areas, and in forest areas, wherever it occurs. The disease relation is unknown. Random dissections of *lineatus* (Taylor) on Guadalcanal failed to show natural infection with larval filariae (Belkin 1962).

Remarks. Taylor's name *lineatus* is available for this species, which has been known under the preoccupied name of *ornatus.* This species seems to be variable, particularly in size and in the ornamentation of the adults. It also appears to be semi-domestic. The immature stages are usually found in temporary ground pools in cleared and partially shaded areas in association with man, and less in undisturbed jungle area (Belkin 1962).

13. **Aedes (Verrallina) mccormicki** Belkin

Aedes (Verrallina) mccormicki Belkin, 1962, Mosquitoes S. Pacific **1:** 420 (holotype ♂, Lunga area, Guadalcanal, Solomon Is.; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with no more than 6 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segment 4, 2 × the length of segment 5, tarsal claws equal, simple; abdomen with basal transverse pale band on segments III-V; with lateral pale spots on segments II, VI, and VII. *Genitalia:* Sidepiece short, 1.5 × as long as wide; its scales restricted to basal lateral and ventral areas; 1 leaf-like subapical spine, with 1 bristle basal to it; a row of 3 stouter bristles on the dorsal surface; mesal surface membranous; 1 bristle on mesal lobe and smaller bristles basal to it. Clasper with 8 hairs on the basal area and 1 hair at distal third; distal portion pointed and without hairs. Aedeagus triangular in dorsal aspect; H-shaped structure of tenth sternite present. (Description based on holotype, Guadalcanal, X.1943-V.1945, J. N. Belkin et al.).

♀. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with no more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with subbasal transverse pale band on segments III-V, with lateral pale spots on segments II, VI, and VII; segment VIII with all scales dark. (Description based on allotype, Guadalcanal, 1944, J. N. Belkin).

Larva (4th Instar). *Head:* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 5-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 4-branched, 6-C 3-branched, 7-C 12-branched. Mentum with 17 teeth on each side. *Segment VIII:* Comb scales 16 in a single row, each rounded and fringed apically; pentad hairs: 1-VIII 6-branched, 2-VIII 2-branched, 3-VIII 8-branched, 4-VIII simple, 5-VIII 8-branched. *Siphon.* 3 × as long as wide; acus present; pecten teeth 15, the last reaching beyond middle of siphon; last 3 teeth more widely spaced than preceding 2; each tooth with 3 denticules, 1 larger than other 2; 1-S 6-branched, inserted beyond last tooth and ventrad of the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.7 × as long as saddle, lanceolate.

Pupa. Trumpet. 2 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 4-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 4× the distance between 4-I and 5-I; 1-II less than 10-branched, not dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, reaching to posterior margin of the following segment; 9-VIII 3-branched. *Paddle:* Marginal spicules present; 1-P spiniform. (Descriptions of both larva and pupa based on slides associated with allotype in USNM, Guadalcanal, 19.II.1945, J. N. Belkin).

Biology. Larvae were found in their natural habitats in temporary pools near swamp, and adults have been collected in the field in Guadalcanal, 1 ♀ resting on a tree trunk, 1 ♂ in flying, and a second ♀ in a night hand catch (Belkin 1962).

DISTRIBUTION. SOLOMON IS.: *Guadalcanal.*

Remarks. The adults can easily be distinguished from *similis* (Theobald) and from *parasimilis* King & Hoogstraal by the complete transverse band on abdominal segments III-V. There are

5 ♂ and 46 ♀ paratypes in USNM, Guadalcanal, 1944, J. N. Belkin, which agree well with the type materials. This species was not collected by me.

14. **Aedes (Verrallina) milnensis** King & Hoogstraal Fig. 17 21.

Aedes (Aedes) milnensis King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 122 (holotype ♂ represented by slide mount of terminal segments of abdomen, Milne Bay, Papua, New Guinea; USNM).

♂. Vertex with pale broad scales on nape; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with pale scale patch; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with basal lateral spots (2 or 3 translucent pale scales on basal lateral portion) on segments II-VII. *Genitalia* (Fig. 17): Sidepiece very short, as long as wide; scales restricted to basal lateral and ventral areas; 1 straight subapical spine, with a bristle basad of spine; mesal surface membranous; basal lobe with hairs. Clasper enlarged basally, with 8 hairs; distal portion curved and without hairs; pointed at tip. Aedeagus triangular in dorsal aspect, pointed apically; H-shaped structure of 10th sternite present. 8th tergite with a rod-like bristle on each side.

♀. Vertex with pale scales on the nape and on posterior 1/5 to 1/2 of midline; *apn* without scales; *ppn* with dark narrow scales on the upper portion and hairs on the posterior portion; upper *stp* with pale scale patch; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower 1/2 of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, minute toothed; abdomen with basal lateral pale spots on segments II-VII; segment VIII with all scales dark.

Egg, larva, pupa. Unknown.

Biology. Females were captured while biting man along a creek during the day, 16–17.IV. 1965, in a sago swamp in virgin forest in a partially forested area at Lae at an elevation of 5 to 10 m. Males and females were also taken in light and Malaise traps in the same area, 16–30.IV.1965.

Distribution. NE NG: Lae SE NG: Milne Bay.

Remarks. This species was represented only by 2 slide mounts of the male genitalia (Milne Bay, Papua) in USNM. The male genitalia of the specimens from Lae, NG, are the same as the type.

15. **Aedes (Verrallina) multifolium** King & Hoogstraal Fig. 18, 22, 31, 32.

Aedes (Aedes) multifolium King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 122 (holotype ♂, Hollandia, NW NG; USNM).

♂. Vertex with few (2 or 3) broad pale scales on nape; *apn* without scales; *ppn* with narrow dark scales mixed with hairs on upper and posterior portion; upper *stp* with translucent appressed scales; *mep* with dark hairs in a stripe posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.7 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with median pale spot on segment II and basal transverse pale band on segments III-VII; segment VIII with all scales dark. *Genitalia* (Fig. 18): Sidepiece long, 2 × as long as wide; scales restricted to basal lateral and ventral areas; 5 leaf-like subapical spine; mesal surface membranous; mesal lobe with a group of 7 hairs. Clasper enlarged basally, with 6 hairs on mesal area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with broad pale scales on nape and on posterior 1/5 of midline; *apn* without scales;

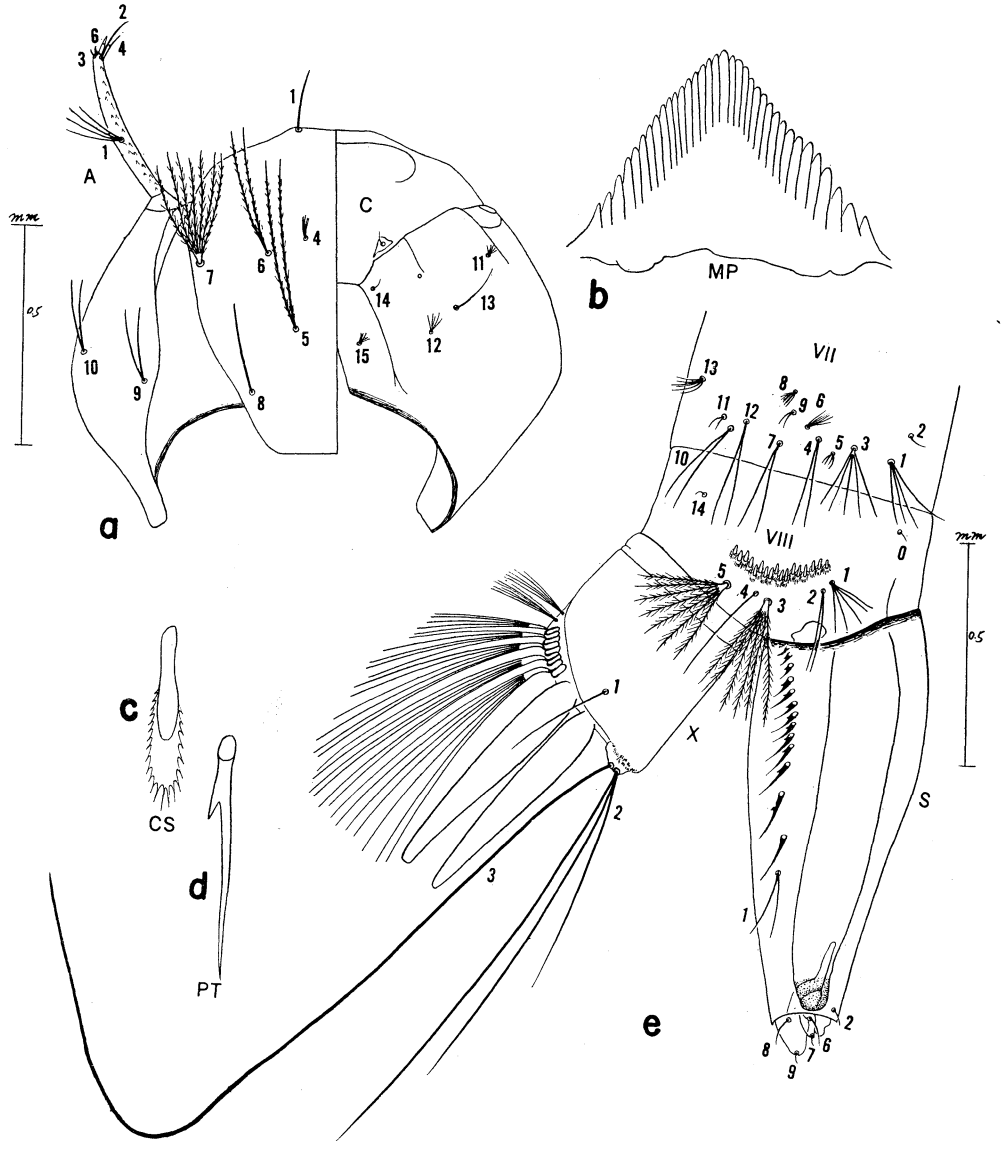

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Fig. 31. *Aedes* (*Verrallina*) *multifolium* King & Hoogstraal, 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

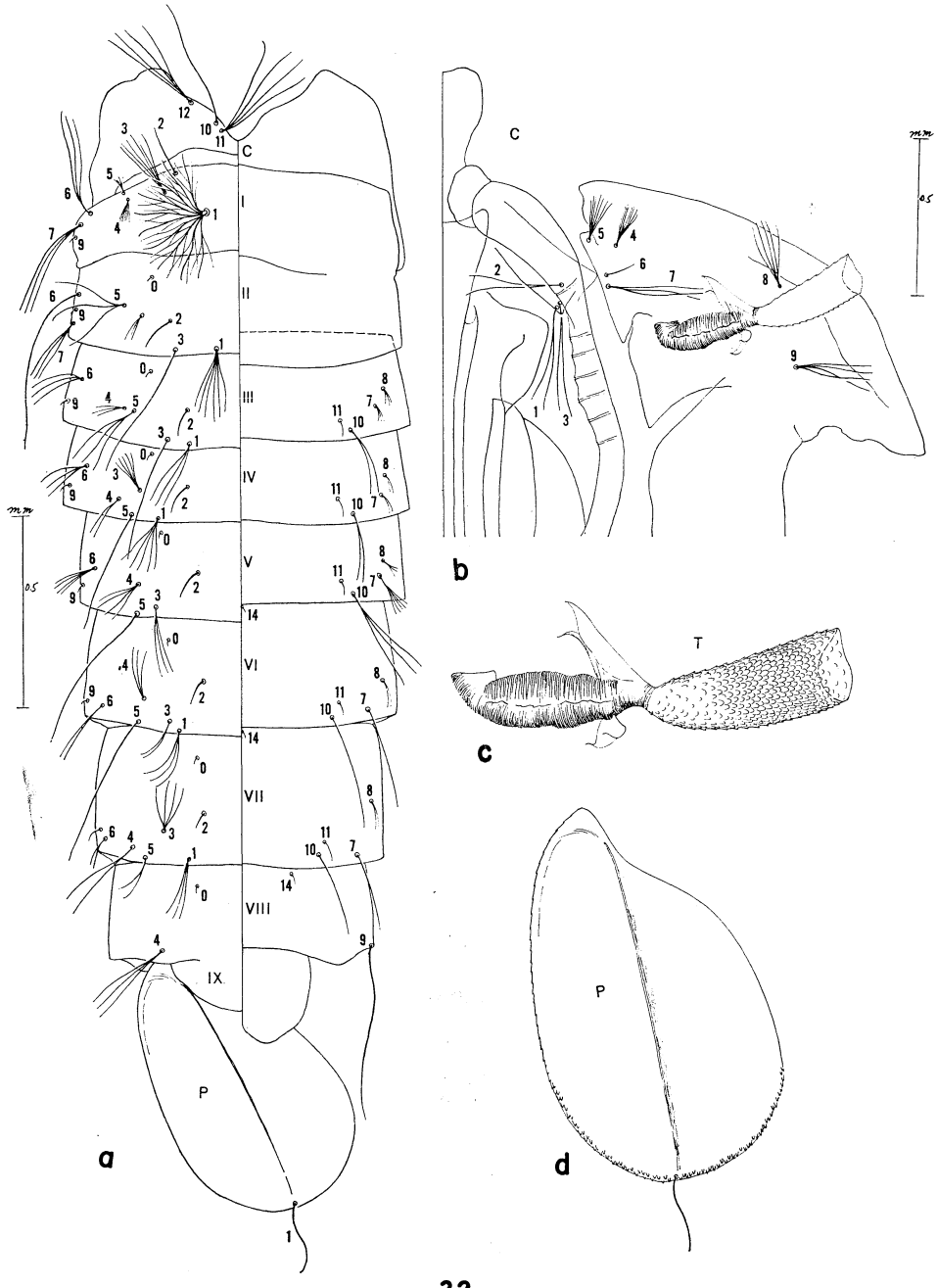

Fig. 32. *Aedes* (*Verrallina*) *multifolium* King & Hoogstraal, pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

ppn with narrow dark scales; upper *stp* with darkish scale patch; *mep* with dark hairs in a stripe posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.8 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with subbasal lateral pale spots on segments II-VII; segment VIII with all scales dark.

Larva (4th Instar) (Fig. 31). *Head.* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush not pectinate at tip. Hairs: 5-C 2-branched, 6-C 2-branched, 7-C 7-branched. Mentum with 17 teeth on each side. *Segment VIII*: Comb scales 17 in a single row, each rounded and fringed apically; pentad hairs: 1-VIII 5-branched, 2-VIII 2-branched, 3-VIII 6-branched, 4-VIII simple, 5-VIII 7-branched. *Siphon.* 2.5 × as long as wide; acus present; pecten teeth 13, the last extending to 0.65 of siphon; last 2 teeth more widely spaced than preceding 2; each tooth with 1 denticule; 1-S 2-branched, inserted beyond last tooth and in line with the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa. (Fig. 32). *Trumpet.* 2.9 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 4-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 6-branched; 2-I and 3-I widely separated, distance between them 3 × distance between 4-I and 5-I; 1-II less than 10-branched, not dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI simple, reaching beyond posterior margin of the following segment; 9-VIII simple. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Larvae were found infected by the *Coelomomyces* fungus, and were sometimes also found with stalked and ciliated protozoa. Water mites were found in the breeding sites.

Larvae of 4th instar pupated within 24 hours after being brought from the field; the pupal stage lasted one day. The larvae were collected from two temporary ground pools, one was about 1 m in diameter formed by buttresses of a tree in a flooded area of virgin forest 3 km S of Vanapa R., Brown River Road, 18–20.V.1965, elevation 200 m. It contained fresh, reddish water, with mud and decaying vegetation at the bottom., and was situated in partially shaded area surrounded by scant vegetation. The other pool (about 2.5 m diameter) contained fresh clear water, and was surrounded by abundant vegetation, with other habitat data as above, in a swamp of virgin forest at Mowkass Village, Dobodura, 4.V.1965, elevation 20 m. Adults were collected from Malaise traps near the first breeding site on 18–22.V.1965. Females were captured while biting man in sago swamp in a partially forested area in Lae. Adults have been taken by light traps (King & Hoogstraal 1948).

DISTRIBUTION. SE NG: Vanapa R., Port Moresby; Mowkass Village, Dobodura. NE NG: Lae. NW NG: Hollandia (Kotabaru).

Remarks. Adults with correlated larval and pupal skins were obtained from larvae collected. The specimens agree well with the type. This species is distinct from *quadrifolium* Brug and is discussed under *quadrifolium.*

16. **Aedes** (**Verrallina**) **neomacrodixoa** King & Hoogstraal Fig. 33, 35, 36, 45.

Aedes (*Aedes*) *neomacrodixoa* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 124 (holotype ♂, Hollandia, NW NG; USNM).

♂. Vertex with all scales dark and broad, except for patch of pale narrow scales on nape; *apn* without scales; *ppn* with dark narrow scales on upper and posterior portion; upper *stp* with brownish scale patch, and a hair patch on anterior corner; *mep* with pale hairs below scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell equal in length

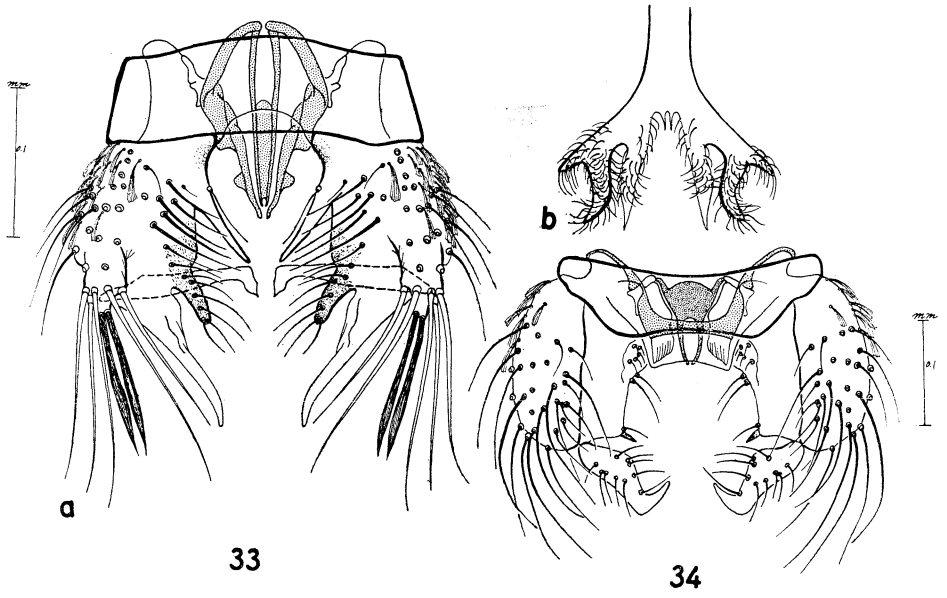

Fig. 33–34. 33, *Aedes* (*Verrallina*) *neomacrodixoa* King & Hoogstraal, ♂: a, male genitalia; b, Y-shaped median extension of ninth tergite. 34, *Type B* ♂: genitalia.

to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, the larger one toothed; abdomen with lateral oblique pale spots on segments II-VIII. *Genitalia* (Fig. 33): Sidepiece long, 2 × as long as wide; its scales restricted to basal lateral area; with an apical membranous arm, rounded at tip and bare; with a subapical ventral lobe outwardly bearing 2 bristles on the apical and 7 to 8 smaller scattered bristles; with a subapical ventral lobe bearing bristles inwardly; 6 bristles on basal inner margin of dorsal surface; an elongate tapered rod present on basal inner margin and a bristle basad of the rod. Clasper not enlarged basally, recurved at tip; without hair. Aedeagus longer and more slender than in other species; the structure around the aedeagus present though not so clearly H-shaped as in other species. 9th tergite with Y-shaped median extension; 3 branches on each arm, each branch tapered at tip and covered with hairs on basal and ventral surface.

♀. Vertex with a median strip of pale narrow scales on posterior half of midline; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with brownish scale patch, and a hair patch on anterior corner; *mep* with pale hairs below scale patch, the hairs reaching to lower border of *mep;* scutum with pale scales on anterior and lateral prescutal areas, on supraalar and scutellar areas; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal claws equal, toothed; abdomen with basal lateral pale spots on segment II, and oblique lateral pale stripes on segments III-VI extending toward dorsum on posterior segments.

Larva (4th Instar) (Fig. 35). *Head.* Antenna: more than 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush not pectinate at tip. Hairs: 5-C 3-branched, 6-C single, 7-C 9-branched. Mentum with 21 teeth on each side. *Segment VIII:* Comb scales 12 in single row, each with distinct terminal spine and fine lateral fringe; pentad hairs: 1-VIII 5-branched, 2-VIII 2-branched, 3-VIII 9-branched, 4-VIII 2-branched, 5-VIII 8-branched. *Siphon:* 2 × as long as wide; acus present; pecten teeth 15, the last reaching to

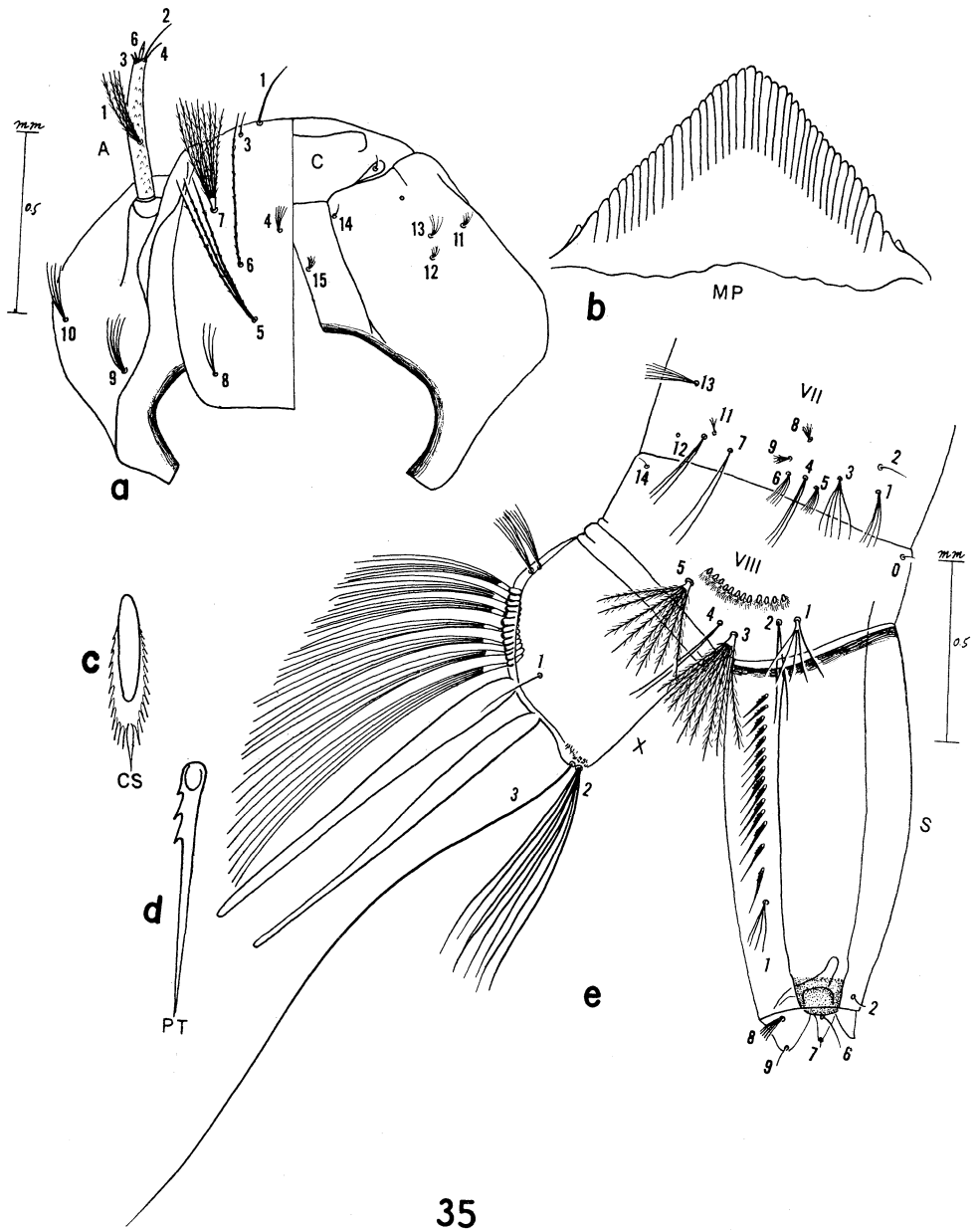

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Fig. 35. *Aedes* (*Verrallina*) *neomacrodixoa* King & Hoogstraal, 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

0.68 of siphon; last 2 teeth more widely spaced than preceding 2; each tooth with 3 denticules; 1-S 4-branched, inserted beyond last tooth and in line with the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment.* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 8-

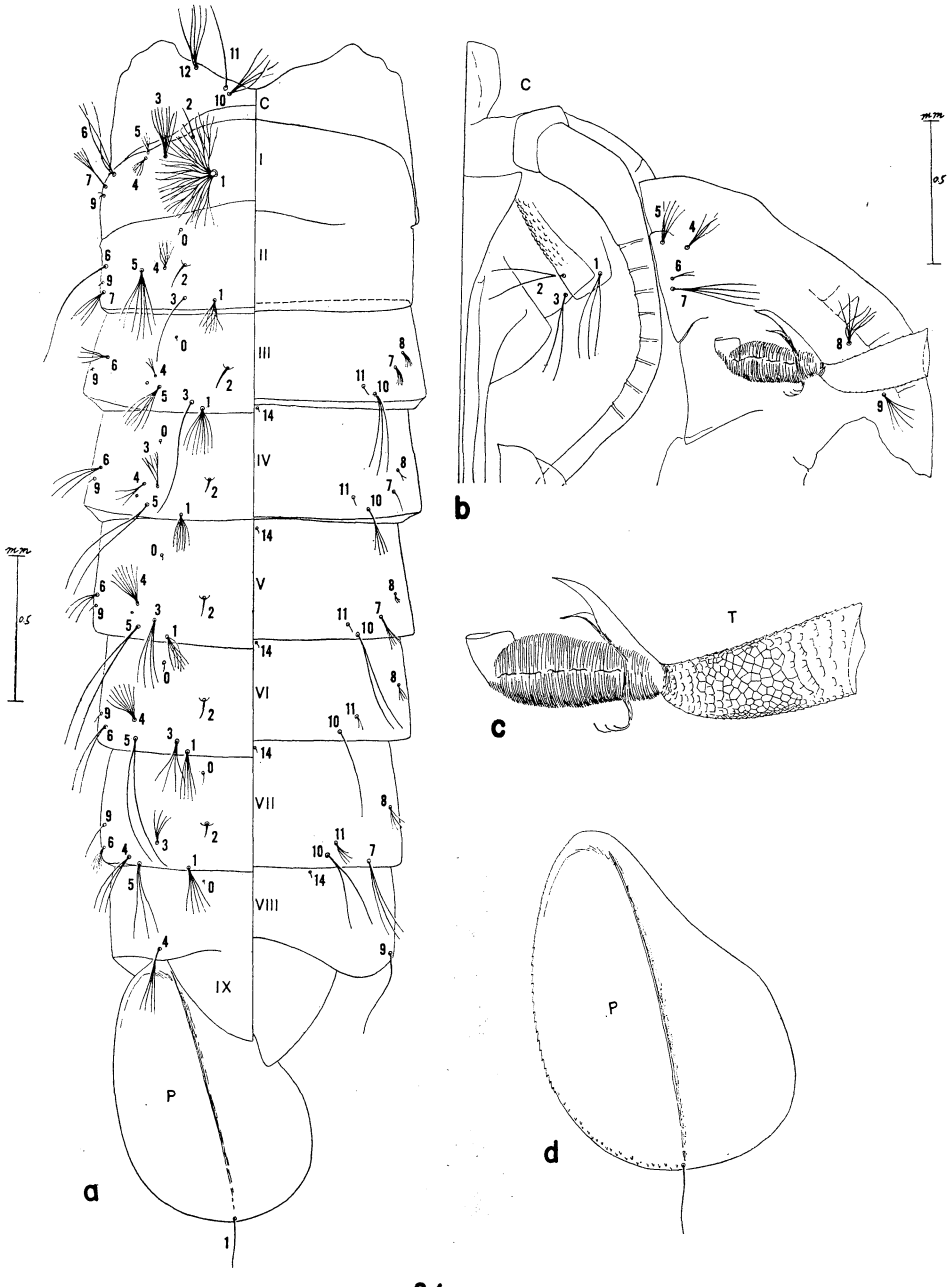

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Fig. 36. *Aedes* (*Verrallina*) *neomacrodixoa* King & Hoogstraal, pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

branched; 3-X simple; ventral brush with 7 pairs of hairs on grid, with 2 precratal tufts. Gills 2.3 × as long as saddle, lanceolate.

Pupa (Fig. 36). *Trumpet:* 2.7 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 6-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 4-branched; 2-I and 3-I widely separated, the distance between them being 6 × the distance between 4-I and 5-I; 1-II with less than 10 branches, not dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, reaching to posterior margin of the following segment; 9-VIII simple. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. A 4th instar pupated within 24 hours after being brought from the field. The pupal stage lasted 1 day. One larva and two pupae were collected in a small ground pool (about 1 m diameter) formed by buttresses of a tree in a flooded area of virgin forest 3 km S of Vanapa R., Brown River Road, Port Moresby, 18–20.V.1965, at an elevation of 200 m. The temporary ground pool contained fresh, reddish water, with mud and decaying vegetation at the bottom, and was situated in partially shaded area surrounded by scanty vegetation. Water mites were found in the water. Males and females were collected by Malaise traps near the breeding site on 18–26. V.1965. Adults have also been taken by light traps (King & Hoogstraal 1947).

DISTRIBUTION. SE NG: Vanapa R., Port Moresby. NE NG: Finschhafen; Maprik. NW NG: Hollandia (Kotabaru). MOLUCCAS: *Ceram:* Wahaai; Warasiwa; Noekoehai; Lisabata. *Ambon:* Waai. INDOMALAY.: *Celebes:* Kalawara.

Remarks. Adults with correlated larval and pupal skins were obtained from larva and pupae collected. The specimens agree well with the type.

This species is very similar to *macrodixoa* Dyar & Shannon from which it can easily be distinguished by the presence of the pale narrow scales on the vertex and by a Y-shaped median extension of the ninth tergite, each arm of the Y with two branches which taper to a point and are hairy at their bases and on the lower sides. The male genitalia appear to be quite similar to the Philippine species. The peculiar structure of tenth sternite around aedeagus is present, though not so well developed. Having each comb scale with a distinct terminal spine and a fine lateral fringe distinguishes the larva from the remaining species.

A male specimen from upper Digoel River, SW New Guinea was misidentified by Brug (1932) as *macrodixoa* Dyar & Shannon. It is *neomacrodixoa* King & Hoogstraal. The species *macrodixoa* does not occur in New Guinea, at least I have seen no material resembling this species from New Guinea.

17. **Aedes (Verrallina) obsoletus** Huang, new species Fig. 37, 41.

Holotype ♂ (BISHOP 7555; BBM-NG 2261) with associated genitalia slide (YMH-'65–39), and fore leg slide (♂ 2261), 3 km S. Vanapa River, Brown River Road, SE New Guinea, from Malaise trap, 17–26.V.1965, Y. M. Huang & W. A. Steffan. Paratypes: 3♂, 2♀ as follows: 1♂ (BBM-NG 2261) with associated genitalia slide (YMH-'65–7) and legs slide (♂ 2261), 2♂ (BBM-NG 2270) with associated genitalia slides (YMH-'65–43), (YMH-'65–44), 2♀ (BBM-NG 2279) with associated fore leg slide (♀ 2279), all with same data as holotype. Deposited in BBM, BMNH, and USNM.

♂. Vertex with all scales; *apn* without scale; *ppn* with narrow dark scales; upper *stp* with darkish scale patch; *mep* with hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.2 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length; claw of fore leg single, toothed; claws of mid-leg equal, simple; abdomen with all scales dark. *Genitalia* (Fig. 37): Sidepiece very short, as long as wide,

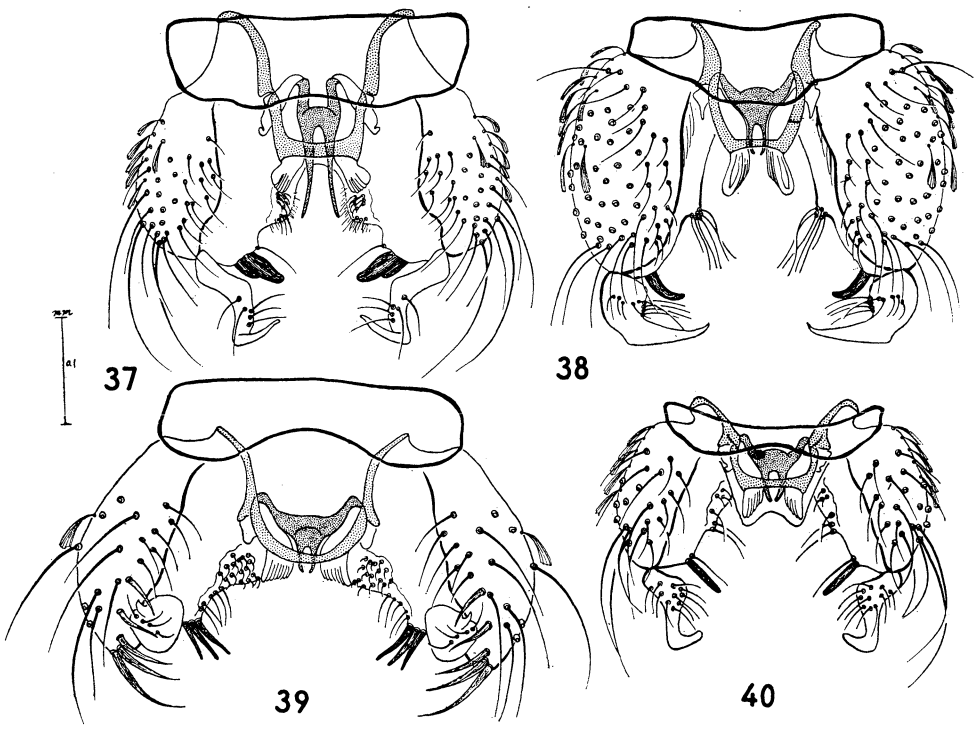

Fig. 37–40. Genitalia, ♂: 37, *Aedes* (*Verrallina*) *obsoletus* n. sp.; 38, *Aedes* (*Verrallina*) *vanapus* n. sp.; 39, *Aedes* (*Verrallina*) *variabilis* n. sp.; 40, *Aedes* (*Verrallina*) *killertonis* n. sp.

its scales restricted to basal lateral and ventral areas; 2 stout subapical spines, the distal one smaller than the basal one; 1 bristle basad of the spines; mesal surface membranous; mesal lobe with a group of 3 hairs; basal lobe with 7 hairs. Clasper not enlarged basally, with 3 hairs on mesal area and 2 hairs on lateral area; distal portion curved and without hair. Aedeagus longer than usual, reaching at 2/3 of sidepiece; lateral plates separated apically; H-shaped structure of 10th sternite present.

♀. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale translucent scales; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, claws equal, simple; abdomen with all scales dark.

Egg, larva, pupa. Unknown.

Biology. The natural habitat is unknown. Males and females were collected from Malaise traps, 20–26.V.1965, in a virgin forest 3 km S of Vanapa R., Brown River Road, at an elevation of 200 m.

Distribution. SE NG: Vanapa R., Port Moresby.

Remarks. The male genitalia of this species (having the sidepiece with two stout subapical spines, the distal one smaller than the basal one; with hairs on the mesal and basal lobe) are different from all other species that have been described in this subgenus.

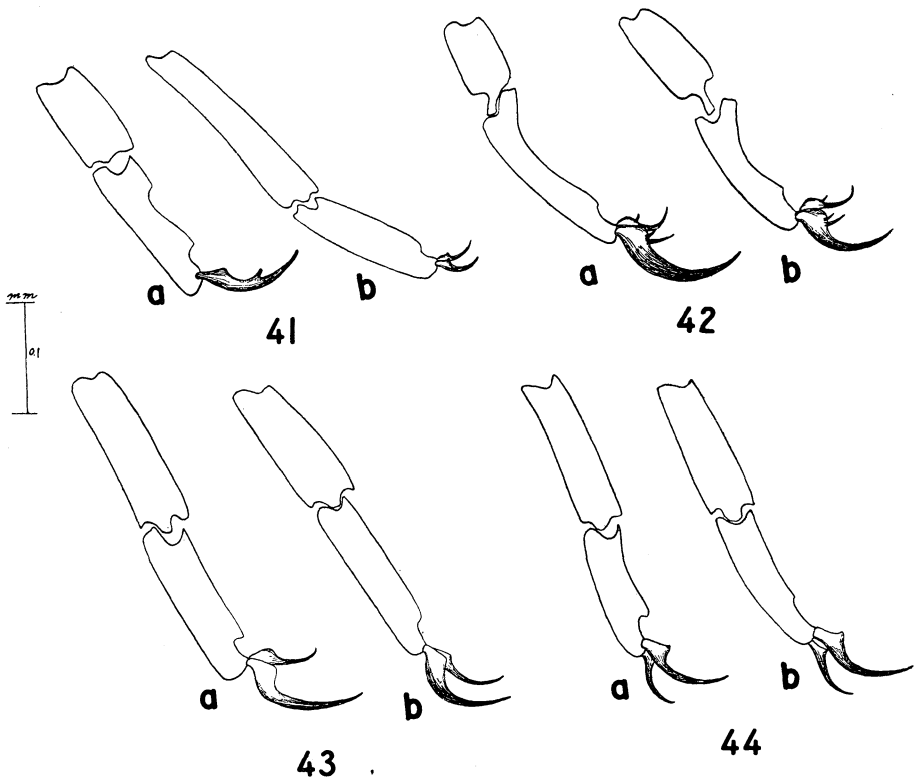

Fig. 41–44. Claws, ♂: 41, *Aedes* (*Verrallina*) *obsoletus* n. sp.; 42, *Aedes* (*Verrallina*) *vanapus* n. sp.; 43, *Aedes* (*Verrallina*) *variabilis* n. sp.; 44, *Aedes* (*Verrallina*) *killertonis* n. sp. a, fore leg; b, mid leg.

18. **Aedes** (**Verrallina**) **panayensis** Ludlow

Aedes panayensis Ludlow, 1914, Psyche **21:** 159 (48 cotypes from Iloilo, Panay, P. I.)

Aedes (*Aedes*) *panayensis:* Laffoon, 1946, J. Wash. Acad. Sci. **36:** 242. (♂ lectotype designated) (USNM).—King & Hoogstraal, 1947, *ibid.* **37:** 119.

♂. Vertex with pale broad scales on posterior half of midline; *apn* with pale broad scales; *ppn* with pale narrow scales on the upper 1/3; upper *stp* with pale scale patch, pale scales reaching to anterior corner; *mep* with many hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* with pale narrow scales on anterior and lateral prescutal, supraalar, prescutellar space and scutellum areas; 1st fork cell 1.2 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws equal, toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. *Genitalia:* Sidepiece 2 × as long as wide; its scales restricted to basal lateral and ventral areas; with row of 3 stout bristles on inner margin of dorsum; flat apical extension directed mesad, with minute teeth on outer apical margin; mesal surface membranous; mesal lobe with a group of 10 bristles; an elongate pointed arm from inner side of base. Clasper with basal portion elongate, bearing 1 stouter hair and 5 smaller hairs on the apical part of basal portion; distal portion curved and without hairs; pointed at tip. Aedeagus triangular in dorsal aspect; H-shaped structure of 10th sternite around aedeagus present, but not as distinct as in other species.

♀. Vertex with pale broad scales on posterior 1/2 to 2/3 of midline; *apn* with pale broad scales; *ppn* with pale narrow scales on upper 1/3; upper *stp* with pale scale patch, pale scales reaching to anterior corner; *mep* with many hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* with pale narrow scales on anterior and lateral prescutal, supraalar, prescutellar space and scutellum areas; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal claws equal, both toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark.

Egg, larva, pupa. Unknown.

Biology. Outside the Papuan subregion, larvae have been found in slightly brackish water in a beached canoe and in a shaded, leafy, slightly brackish puddle in a nipa palm swamp at the extreme upper limit of the tidal zone. Adults were taken while biting man in mangrove swamp during the day and while resting in a crab hole in a mangrove swamp (Laffoon 1946). Females have been captured while biting in virgin forest in Ceram (Brug & DeRook).

DISTRIBUTION. NW NG: Schouten Is. MOLUCCAS: *Morotai:* Point Gila. *Ceram:* Piroe; Wailoeloe. *Ambon.* INDOMALAY.: *Celebes:* Saleyer.

Remarks. This species was not collected by me. Males and females examined from the Papuan subregion agree well with the type. The species can easily be distinguished from the other species by the presence, in both sexes, of pale scales on the anterior corner of *stp.*

This is the only Philippine species which is definitely known from the Papuan subregion. The male genitalia of specimens from both areas show a somewhat similar bridge and a peculiar structure around the aedeagus. A specimen from the Philippine Is. shows a bridge of the dorsal arms of the tenth sternite (H-shaped structure) with a short rounded posterior projection on each side.

19. **Aedes** (**Verrallina**) **parasimilis** King & Hoogstraal Fig. 28.

Aedes (*Aedes*) *parasimilis* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 125 (holotype ♀, Hollandia, NW NG; USNM).

♀. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with not more than 8 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.3 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. (Description based on holotype in USNM).

Egg (Fig. 28). (From laboratory, eggs were laid by a ♀ apparently belonging to *parasimilis* which has all scales dark on the vertex). Dark; elongate, 5.1–5.3 × as long as wide; 1.04 mm × 0.20 mm.

Larva (4th Instar). *Head:* Antenna: less than 1/2 as long as head, spiculate; 1-A inserted at middle of shaft, 4-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 3-branched, 7-C 10-branched. Mentum with 18 teeth on each side. *Segment VIII:* Comb scale 13 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 7-branched, 2-VIII 2-branched, 3-VIII 9-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon:* 2 × as long as wide; acus present; pecten teeth 12, the last reaching to 0.75 of siphon; last 3 teeth more widely spaced than preceding 2; each tooth with 3 denticules, 1 larger than the other 2; 1-S 4-branched, inserted between last 1 and 2 teeth and ventrad of the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X (lost); 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa. Trumpet: 2.5 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well develop-

ed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 4 × distance between 4-I and 5-I; 1-II 10-branched; 2-II-VII spiniform; 2-IV-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI simple, reaching beyond posterior margin of following segment and reaching at 1/2 of next segment; 9-VIII 3-branched. *Paddle:* Marginal spicules present; 1-P spiniform. (Descriptions of both larva and pupa based on slides associated with holotype in USNM, Hollandia, NW NG, 27.I.1945, King & Hoogstraal).

♂. Unknown.

Biology. Fungi were found, usually attatched on the gills of the larvae. Larvae of 4th instar pupated within 24 hours after being brought from the field. The pupal stage lasted 1 to 2 days. The larvae were collected in a ground pool about 1.5 m in diameter and in a small ground pool (about 1 m diameter) formed by buttresses of a tree in a flooded area of virgin forest 3 km S of Vanapa R., Brown River Road, 18.V.1965, at an elevation of 200 m. The temporary ground pool contained fresh, reddish water, with mud and decaying vegetation at the bottom. Females were captured while biting man near the breeding site on 18–24.V.1965 and by a Malaise trap on 18–26. V.1965. One larva was collected in a temporary ground pool (about 1–1. 5 m diameter) in a partially forested area at Mowkass Village, Dobodura, 4.V.1965, at an elevation of 10 m. The pool contained fresh, clear water, with mud and decaying vegetation on the bottom, and was situated in partially shaded area surrounded by abundant vegetation. Water mites were found in the water. Larvae were collected from a crayfish hole in a rain forest, elevation 75 m (King & Hoogstraal 1947). Females were captured while biting man during the day, in a partially forested area at Dobodura, at Cape Killerton, Epa creek, 1–6.V.1965; in a sago swamp of a virgin forest at Lae, 16–30.III.1965; in a forest swamp at Brown R., 30.III.1965; and by Malaise and light traps at Lae, 17–28.IV.1965.

The results of rearing of progenies from captured females are as follows: BBM-NG 457: 200 ♀♀ were captured as they were biting man in the afternoon of 17.IV.1965, in a sago swamp, at Lae. After 4 days, 1 ♀ laid 2 eggs.—BBM-NG 2108: 200 ♀♀ were similarly captured in the evening of 21.IV.1965, in a sago swamp, at Lae. After 4 days, 1 ♀ laid 18 eggs.—BBM-NG 2321: 43 ♀♀ were captured as they came to man during the day of 22.V.1965, in a flooded area of virgin forest, Vanapa River, near Port Moresby. After 4 days 1 ♀ laid 1 egg.—BBM-NG 2148: 300 ♀♀ were captured biting on man in day time 6.V.1965, in a forest swamp at Cape Killerton. After 5 days, 1 ♀ laid 31 eggs singly on the strip of filter paper. The rearing of larvae of this species was not successful.

Distribution. SE NG: Port Glasgow; Kerema; Milne Bay; Port Moresby: Vanapa R., Brown R. Popondetta: Mowkass Village, Dobodura, Epa Creek, Cape Killerton, Embi Lakes. NE NG: Lae; Maprik. NE NG: Hollandia. MOLUCCAS: *Ceram:* Wahaai; Warasiwa; Oewin; Wailoeloe; Hoelong; Lisiela; Lisabata: Seleman; Neokoehai. *Ambon:* Waai.

Remarks. The type of this species is a female. There are two kinds of males (types A and B) in the collection of USNM. Both have indistinguishable genitalic characters or only a slight variation, but have distinct types of tarsal characters. Type A has the fore and mid-legs with tarsal segments 4 and 5 of equal length and the claws unequal, simple. Type B has the fore and mid-legs with tarsal segment 4 twice as long as segment 5 and the tarsal claws are equal and simple.

Adults with correlated larval and pupal skins were obtained from larvae and pupae collected. The specimens agree well with the type. Unfortunately, no type A male was collected, and no additional specimens were found in the materials examined. At present, it is impossible to determine whether the type A male is *parasimilis* King & Hoogstraal. King & Hoogstraal (1947) assigned type B male to *parasimilis;* however, the association is not positive. More discussion is presented under *similis* (Theobald).

20. **Aedes (Verrallina) quadrifolium** Brug Fig. 47, 49, 50.

Aedes (Aedes) quadrifolium Brug, 1934, Bull. Ent. Res. **25:** 512 (holotype ♂, Torpedoboot R., NW NG; BMNH).—King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 119.

♂. Vertex with all scales dark; *apn* without scales; *ppn* with narrow dark scales; upper *stp* with translucent appressed scales; *mep* with hairs posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.7 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length; claw of fore leg single and toothed; claws of mid-leg equal, simple; abdomen with basal lateral pale spots on segments II-VII; segment VIII with all scales dark. *Genitalia* (Fig. 50): Sidepiece short, 1.5 × as long as wide; its scales restricted to basal lateral and ventral areas; with 4 leaf-like subapical spines, the apex of spine wider than its base; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with hairs. Clasper not enlarged basally, with 5 hairs on mesal area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with all scales dark; *apn* without scales; *ppn* with narrow dark scales on upper and posterior portion; upper *stp* with translucent appressed scales; *mep* with hairs posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with lateral oblique pale spots on segments II-VII; segment VIII with all scales dark.

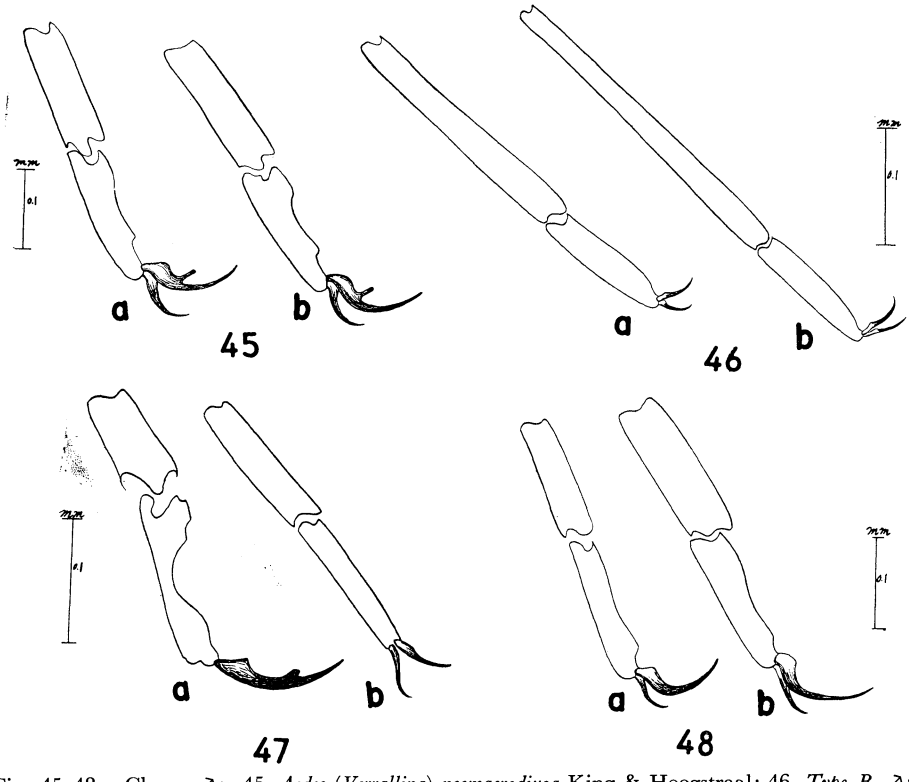

Fig. 45–48. Claws, ♂: 45, *Aedes (Verrallina) neomacrodixoa* King & Hoogstraal; 46, *Type B* ♂: 47, *Aedes (Verrallina) quadrifolium* Brug; 48, *Aedes (Verrallina) trispinatus* King & Hoogstraal. a, fore leg; b, mid leg.

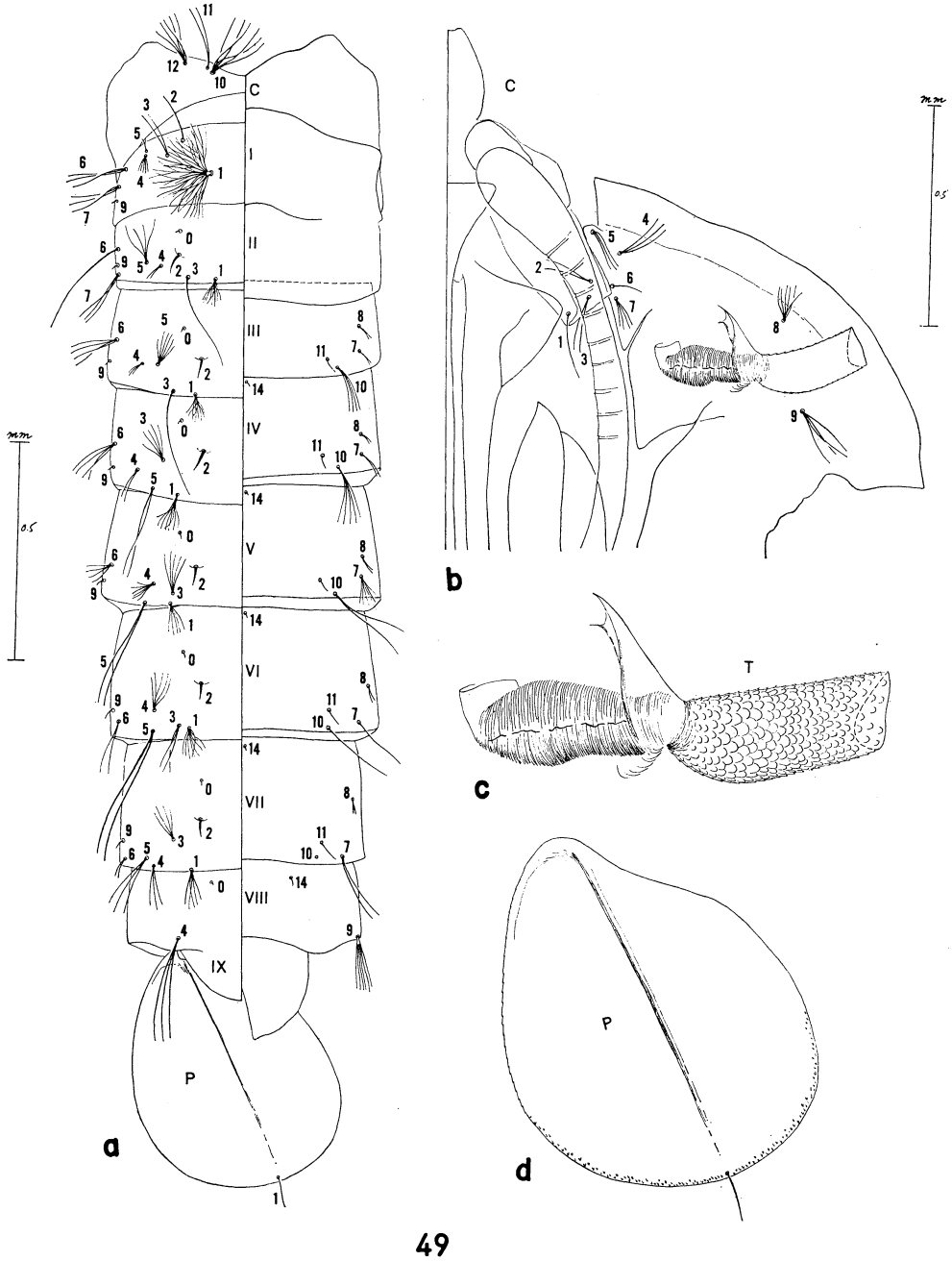

Fig. 49. *Aedes* (*Verrallina*) *quadrifolium* Brug, pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

Pupa (Fig. 49). *Trumpet.* 2.6 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 6-branched, mesad and caudad of 11-C; 11-C 2-branched. *Abdomen.* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 2-branched; 2-I and 3-I widely separated, the distance between them being 4 × distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching to posterior margin of following segment; 9-VIII 6-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Egg, larva. Unknown.

Biology. Adults emerged within 24 hours after pupae were brought from the field. The pupae were collected in the edge of a large flooded area, in an isolated ground pool (about 2 m diameter) in a flooded area of virgin forest 3 km S of Vanapa R., Brown River Road, Port Moresby, 20–24.V.1965, at an elevation of 200 m. The temporary ground pool was in partially shaded area surrounded by scant vegetation, and contained fresh clear water, with mud and decaying vegetation at the bottom. Water mites were found in the water. One male was collected resting on vegetation, 3–5 cm above the water surface of the breeding site, 22.V.1965. Adults were collected by a Malaise trap 22–26.V.1965.

DISTRIBUTION. SE NG: Vanapa R., Port Moresby. NW NG: Torpedoboot R.

Remarks. Pupae and adults of both sexes were collected; both male and female adults agree well with the type. The external characters of this species are very similar to *multifolium* King & Hoogstraal, but can easily be distinguished from *multifolium* in having all scales dark on the head (both sexes), and a single claw on the male fore leg.

21. **Aedes (Verrallina) quadrispinatus** King & Hoogstraal Fig. 51.

Aedes (Aedes) quadrispinatus King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 126 (holotype ♂, Toem, NG; USNM).

♂. Vertex with pale scales on nape; *apn* without scales; *ppn* with dark narrow scales on upper portion and with hairs on posterior portion; upper *stp* with translucent scale patch, with hairs on anterior corner; *mep* with many hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with median pale spot on segment II, basal transverse pale band on segments III-V, and lateral pale spots on segments VI and VII. *Genitalia* (Fig. 51): Sidepiece short, 1.5 × as long as wide; 4 pointed leaf-like subapical spines; 3 or 4 stout bristles in a row on dorsal surface; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with bristle and hairs. Clasper enlarged basally, ovoid in shape from dorsal aspect, with 7 or 8 hairs; slender distally and without hair, hooked at tip. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. (Description based on holotype, NG APO 565, 1.VIII.1944, E. S. Ross NO. 27).

♀. Vertex with pale broad scales on posterior 1/3 of midline, forming triangular pale scale patch; *apn* without scales; *ppn* with dark narrow scales on upper portion and with hairs on posterior portion; upper *stp* with translucent scale patch, with hairs on anterior corner; *mep* with many hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.8 × as long as its stem; fore and mid-legs with tarsal claws equal, minute toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. (Description based on paratype).

Larva (4th Instar). Same as *variabilis* n. sp., except anal segment with 2-X 6-branched.

Pupa. Same as *variabilis* n. sp.

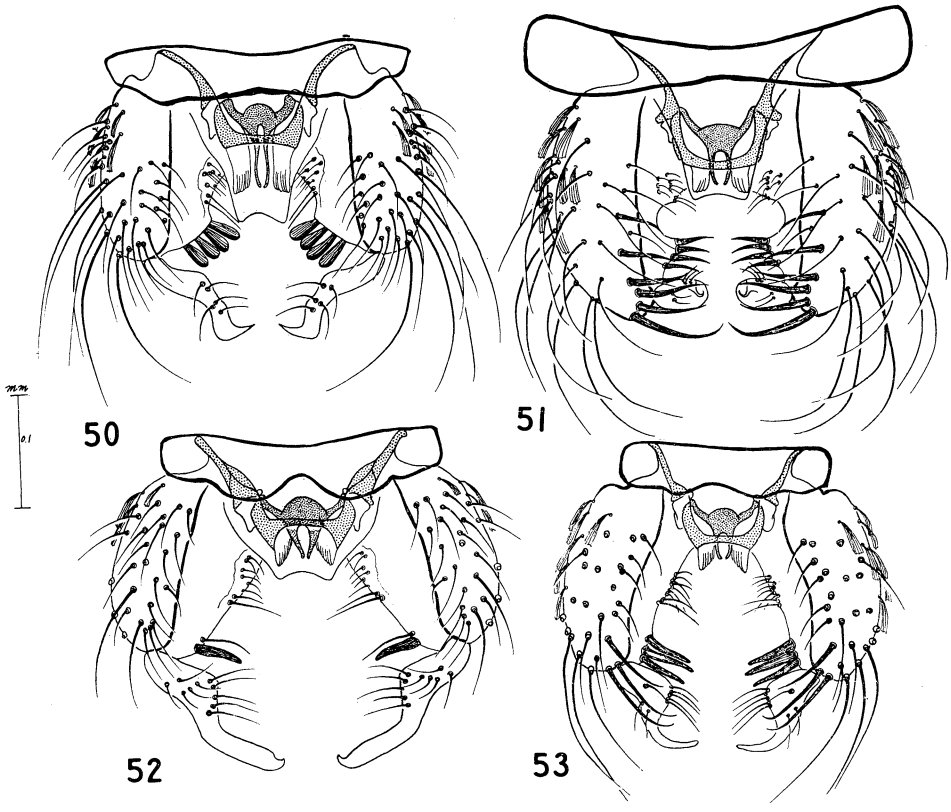

Fig. 50–53. Genitalia, ♂: 50, *Aedes* (*Verrallina*) *quadrifolium* Brug; 51, *Aedes* (*Verrallina*) *quadrispinatus* King & Hoogstraal; 52, *Aedes* (*Verrallina*) *sentanius* King & Hoogstraal; 53, *Aedes* (*Verrallina*) *trispinatus* King & Hoogstraal.

Egg. Unknown.

Biology. Larvae were found infected by the *Coelomomyces* fungus. The 4th instar larvae pupated within 24 hours after being brought from the field; the pupal period lasted one day. The larvae were collected in a ground pool (about 2.5 m diameter) in a swamp of a virgin forest at Mowkass Village, Dobodura, 4.V.1965, at an elevation of 20 m. The temporary ground pool contained fresh, clear water, with mud and decaying vegetation at the bottom, and was situated in partially shaded area surrounded by abundant vegetation. Water mites were found in the water. Both larvae and pupae were collected in pools with dead leaves in a primary forest, Dobodura, 4.V.1965; larvae were taken from a small, heavily shaded pool with dead leaves, at the edge of a forest at Shanahan's place, Popondetta, 5.V.1965 by P. F. Mattingly.

DISTRIBUTION. SE NG: Mowkass Village, Dobodura; Milne Bay; Watutu Point, Goodenough I.

Remarks. Adults with correlated larval and pupal skins were obtained from larvae and pupae collected in Dobodura, Popondetta area. The specimens agree well with the type. Two specimens from Goodenough I. in the collection of USNM named as *quadrispinatus* are different from the type in having vertex with pale broad scales on posterior 2/3 of the midline (both sexes); abdomen with

complete transverse pale band on segments III-VI (in ♂). The male genitalia differ from the type by having sidepiece with 3 leaf-like subapical spines instead of with 4 pointed leaf-like subapical spines. They are more similar to *variabilis* n. sp., than *quadrispinatus;* therefore, I include them in the concept of *variabilis* n. sp.

22. **Aedes** (**Verrallina**) **reesi** King & Hoogstraal

Aedes (*Aedes*) *reesi* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 127 (holotype ♂, Vivigani, Goodenough I. SE NG; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with translucent indistinct scale patch; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; with 2 rows of linear scales on each vein (R_2, R_3) of the 1st fork cell; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with basal transverse pale band on segments III-VII and all scales dark on segment II. *Genitalia:* Sidepiece very short, as long as wide, its scales restricted to basal lateral and ventral areas; 1 bristle-like subapical spine; mesal surface membranous; mesal lobe with 15 bristles; basal lobe with 10 hairs. Clasper enlarged basally, with 5 hairs on the base; pointed at tip. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. (Description based on holotype, Vivigani, Goodenough I., SE NG, 8.VII.1943, B. E. Rees).

♀. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with translucent indistinct scale patch; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem, with 2 rows of linear scales on each vein (R_2, R_3) of the 1st fork cell; fore and mid-legs with tarsal claws equal, minutely toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. (Description based on paratype, Vivigani, Goodenough I., SE NG, 8.VII.1943, B. E. Rees).

Egg, larva, pupa. Unknown.

Biology. The breeding habitat is unknown. Female adults were collected from light and Malaise traps in Lae area.

Distribution. SE NG: Vivigani, Goodenough SW NG: Merauke. NE NG: Lae.

Remarks. In the field, only female adults were collected from light and Malaise traps. The specimens agree well with the type.

A male specimen from Merauke, SW New Guinea, in British Museum, which agree well with the type, was previously misidentified as *incertus* Edwards. The male genitalia of this species, with only one bristle-like subapical spine on the sidepiece and mesal lobe with 15 bristles, can easily be distinguished from those of the other males in this subgenus.

23. **Aedes** (**Verrallina**) **sentanius** King & Hoogstraal Fig. 52.

Aedes (*Aedes*) *sentanius* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 128 (holotype ♂, Hollandia, NW NG; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with translucent darkish scale patch, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with lateral pale spots on segments II-VII. *Genitalia* (Fig. 52): Sidepiece short, 1.5 × as long as wide; its scales restricted to basal lateral and ventral areas; with 1 leaf-like subapical spine, with 1 bristle basad of

it; mesal surface membranous; mesal lobe with 2 or 3 bristles; basal lobe with 15 hairs. Clasper enlarged basally, with 8 hairs on inner side of basal portion; tapered distally and without hairs. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. (Description based on holotype, 19 MGL, Hollandia, NG, 5.IV.1945, King & Hoogstraal).

♀. Vertex with all scales dark; *apn* without scales; *ppn* with dark narrow scales on upper portion; upper *stp* with translucent darkish scale patch, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* yellowish scales on anterior prescutal, supraalar, prescutellar space and scutellum areas; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, minutely toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. (Description based on paratype, 19 MGL, Hollandia, NG, 5.IV.1945, King & Hoogstraal).

Larva (4th Instar). *Head.* Antenna: less than 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 9-branched, 6-C 8-branched, 7-C 12-branched. Mentum with 15 teeth on each side. *Segment VIII.* Comb scales 12 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 6-branched, 2-VIII 2-branched, 3-VIII 8-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon.* 3 × as long as wide; acus present; pecten teeth 13, the last reaching beyond middle of siphon, the last 3 teeth more widely spaced than preceding 2; each tooth with 1 larger denticule and 1 to 3 smaller denticules; 1-S 3-branched, inserted beyond last tooth and ventrad of teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, as long as saddle; 2-X 4-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa. Trumpet. 5 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I branched; the distance between 2-I and 3-I being 2 times the distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI 2-branched, reaching beyond posterior margin of the following segment; 9-VIII 6-branched. *Paddle:* Marginal spicules present; 1-P spiniform. (Descriptions of both larva and pupa based on slides of material associated with the type in USNM).

Biology. Males were collected by Malaise traps in a sago swamp in a partially forested area, at 14 km W of Lae, Lae-Wau Road, at an elevation of 5 to 10 m, 22–28.IV.1965; the trap was set along the creek One .male was reared from a larva collected in Mowkass Village, Dobodura, 4.V.1965. Females were captured while biting man in a sago swamp in partially shaded area in Lae. Larvae were taken in a hog wallow in a sago swamp at Poee Village on the S side of Lake Sentani, Hollandia area, 5.VI.1945 (King & Hoogstraal 1947). Both larvae and pupae have been collected in shallow footprints in dense forest, Dobodura, 5.XII. 1943 (King & Hoogstraal 1947).

Distribution. SE NG: Popondetta: Cape Killerton; Mowkass Village, Dobodura. Milne Bay. NE NG: Lae; Maprik. NW NG: Poee Village, Hollandia (Kotabaru); Bernhard Camp B, SW NG.

Remarks. This species is very similar to *carmenti* Edwards but differs as follows: no hair on the anterior corner of *stp* (both sexes); fore and mid-legs in ♂ with tarsal claws unequal and simple, in ♀ equal and with a minute tooth. Males and females collected by me agree well with the type specimen. There are a few female specimens which have 2 or 3 pale broad scales on the posterior portion of *ppn;* this may be indicative of specific distinctness. However, they agree with the type in all respects and I include them in the concept of this species.

24. **Aedes (Verrallina) similis** (Theobald) Fig. 54, 55.

Pseudoskusea similis Theobald, 1910, Monograph of the Culicidae **5:** 189 (holotype ♀, Kuranda, Queensland, Australia; BMNH).

Aedes (Aedes) similis: Edwards, 1924. Bull. Ent. Res. **14:** 388. (Reported from Burpengary, Queensland and Saparoea I., Ambon).

♂. Not definitely associated with ♀. Perhaps the form discussed as Type B below. See also *parasimilis*.

♀. Vertex with broad and narrow pale scales on posterior 1/2 of midline, forming triangular pale scale patch; *apn* without scales; *ppn* without scales, with 2 or 3 hairs on posterior portion; upper *stp* with pale scale patch, without hairs on anterior corner; *mep* with 5 or 6 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum scales quite rubbed off, with pale yellowish scales on anterior and lateral prescutal areas, and prescutellar space area; 1st fork cell 1.4 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with lateral pale spots on segments II-VII. (Description based on the type in BM NH).

Type B ♂. (Fig. 34, 46). Vertex with pale broad scales on the nape; *apn* without scales; *ppn* without scales; upper *stp* with pale scale patch, without hairs on the anterior corner; *mep* with not more than 8 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segment 4, 2× length of segment 5, tarsal claws equal, simple; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark. *Genitalia* (Fig. 34): Sidepiece short, 1.3 × as long as wide; scales restricted to basal lateral and ventral areas; with 1 leaf-like subapical spine; with 1 bristle basad of spine; mesal surface membranous; mesal lobe with 2 bristles; basal lobe with hairs. Clasper enlarged basally, with 10 hairs on basal portion; distal portion curved and without hairs. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

Larva (4th Instar). (Fig. 54). *Head:* Antenna: more than 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 3-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 3-branched, 7-C 9-branched. Mentum with 18 teeth on each side. *Segment VIII:* Comb scales 14 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 6-branched, 2-VIII 2-branched, 3-VIII 7-branched, 4-VIII simple, 5-VIII 8-branched. *Siphon.* 1.8 × as long as wide; acus present; pecten teeth 16, the last reaching to 0.72 of siphon; the last 2 teeth more widely spaced than preceding 2; each tooth with 1 larger denticule and 1–2 smaller denticules; 1-S 5-branched, inserted before last tooth and ventrad of the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment:* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 3-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills longer than saddle, lanceolate.

Pupa (Fig. 55). *Trumpet:* 3 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 6-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 2-branched; 2-I and 3-I widely separated, the distance between them being 4 × distance between 4-I and 5-I; 1-II no more than 10-branched, not dendritic; 2-II-VII spiniform; 2-IV-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI simple, reaching beyond posterior margin of the following segment; 9-VIII 3-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Fungi were found attached to larvae. Larvae of 4th instar pupated within 24 hours after being brought from the field; the pupal period was one day. Both larvae and pupae

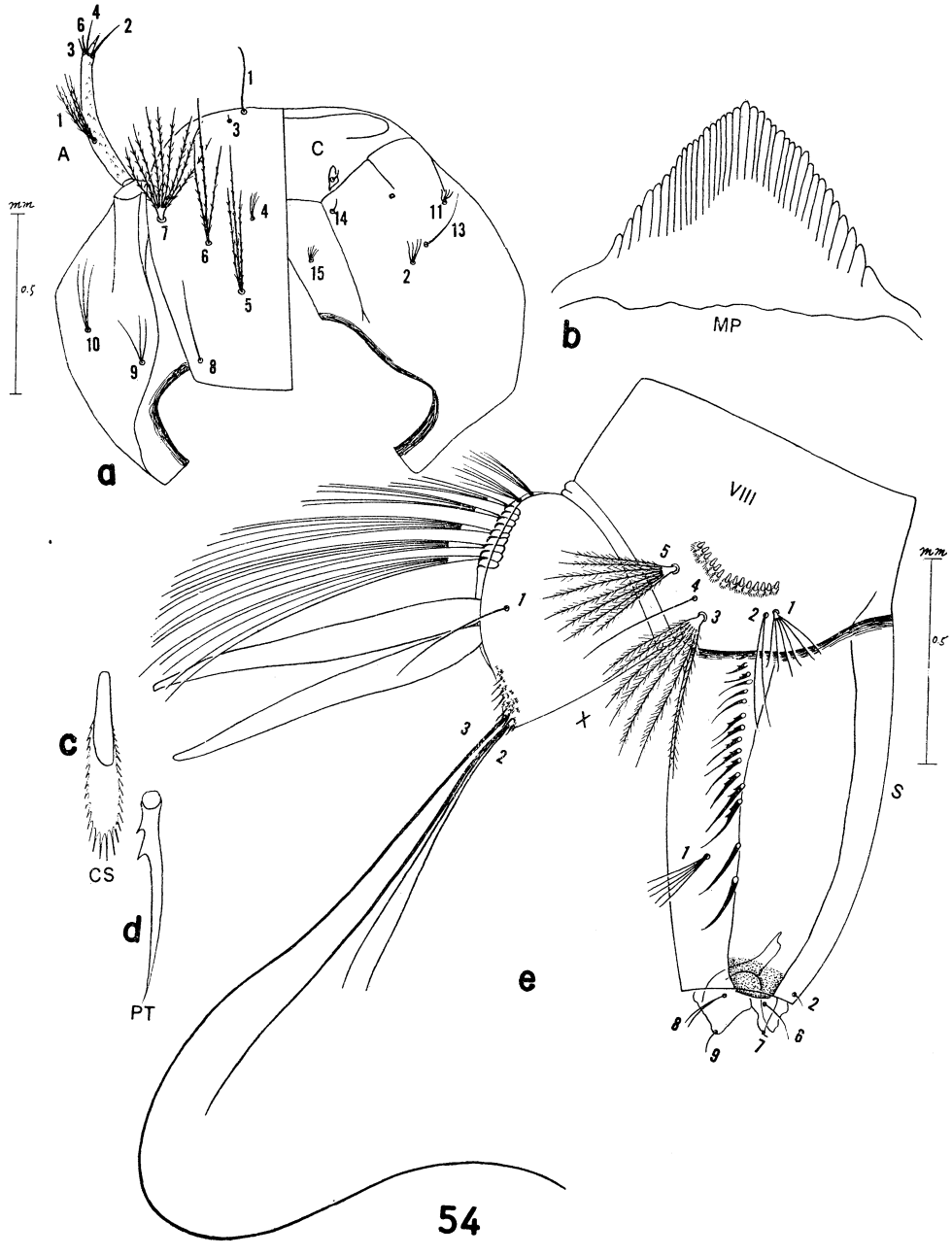

Fig. 54. *Aedes* (*Verrallina*) *similis* (Theobald), 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

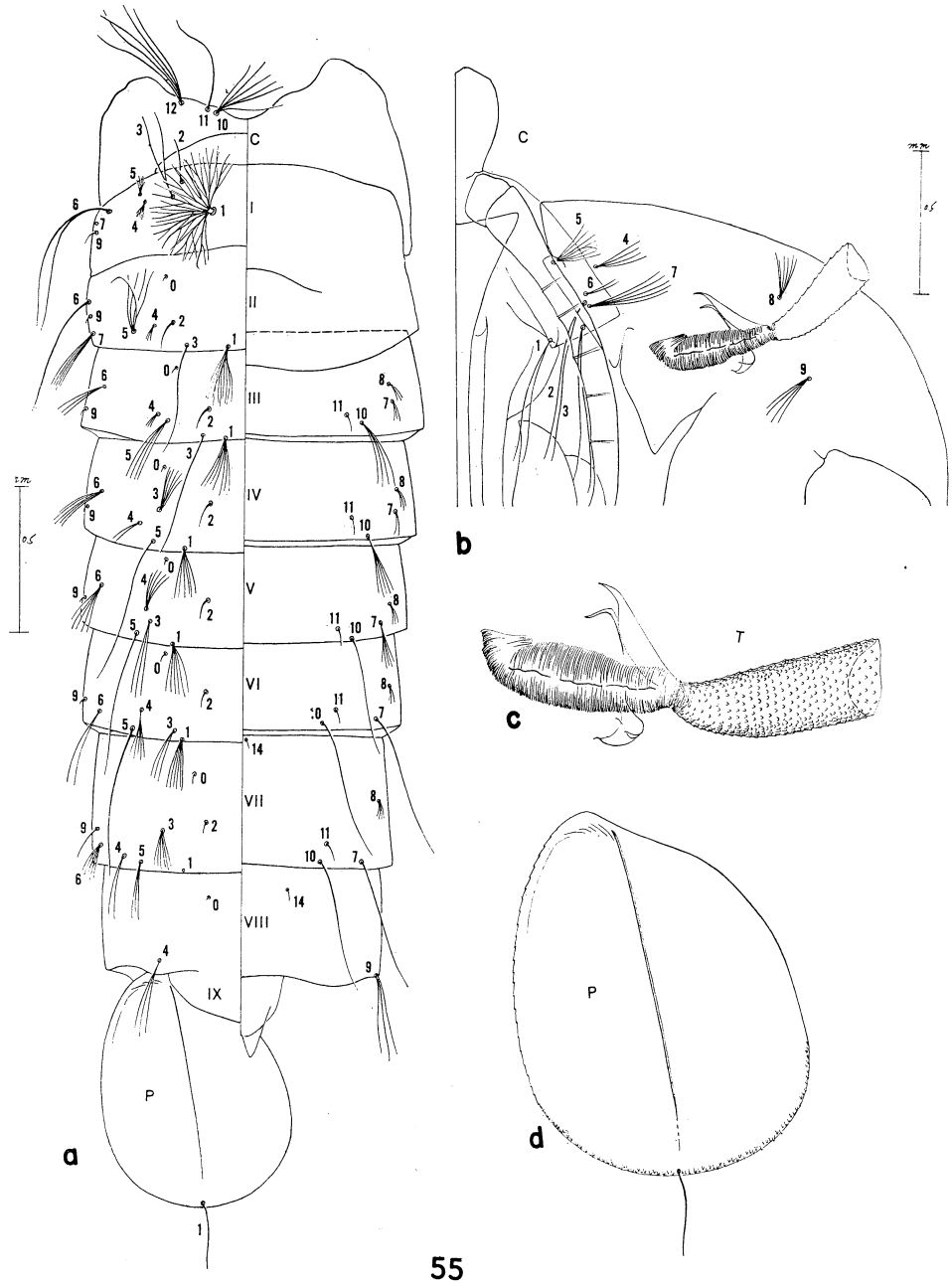

Fig. 55. *Aedes* (*Verrallina*) *similis* (Theobald), pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

were collected in a ground pool (about 1.5 m diameter) and in a small ground pool (about 1 m diameter) formed by buttresses of a tree in a flooded area of virgin forest 3 km S of Vanapa R., Brown River Road, Port Moresby, 19–20.V.1965, at an elevation of 200 m. The temporary ground pools contained fresh, reddish water, with mud and decaying vegetation on the bottom, and was situated in partially shaded area surrounded by scanty vegetation. Water mites were found in the water. Males were collected by Malaise trap, on 18–22.V.1965. Females were captured while biting man during the day, in a partially forested area at Mowkass Village and at Epa Creek 1–4.V.1965; in a sago swamp in a forest swamp at Embi Lakes 8.V.1965.

DISTRIBUTION. SE NG: Vanapa R., Port Moresby; Mowkass Village, Epa Creek, Embi Lakes, Port Glasgow; Kerema; Mow Roto. NW NG: Vogelkop, Kebar Vol. MOLUCCAS: *Ceram:* Karloetoe Kara; Oewin; Hoelong; Hatoenoeroe; Wailoeloe; Lisabata; Wahaai; Seleman; Lowki; Lisiela; Neokoehai; Warasiwa. *Ambon:* Waai.

Remarks. The ♀ type examined in BMNH differs from *parasimilis* King & Hoogstraal in having pale scales on the vertex, forming a triangular pale scale patch at midline of posterior portion.

Adults with correlated larval and pupal skins were obtained from larvae and pupae collected in New Guinea. The specimens agree well with the type. Larva and pupa of this species are apparently indistinguishable from *parasimilis* King & Hoogstraal. Male adults emerged from same type of larva and pupa having type B tarsal characters, and having indistinguishable genitalic characters or slight variation from *parasimilis* which King & Hoogstraal (1947) assigned to. It seems that type B male is a *similis* male.

In the field, both *parasimilis*-like and *similis*-like females were reared from same type of larvae and pupae which were collected from same lot or same locality. Only males with type B tarsal characters were obtained. Since the larvae and pupae of *parasimilis* and *similis* are indistinguishable the identity of the males of the two species is unknown. At present, I consider *similis* and *parasimilis* to be two different species according to the presence or absence of the pale scales on the vertex. To settle the identity of the males and the species, a study of the progeny from a single female is required.

25. **Aedes** (**Verrallina**) **simplus** King & Hoogstraal

Aedes (*Aedes*) *simplus* King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 130 (holotype ♂, Hollandia area, NW NG; USNM).

♂. Vertex with all scales dark; *apn* without scales; *ppn* without scales; upper *stp* with translucent pale scale patch, without hairs on anterior corner; *mep* with not more than 10 hairs posterior to scale patch, the hairs not reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell equal in length to its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, tarsal claws unequal, simple; abdomen with lateral pale spots on segments II-VII. *Genitalia:* Sidepiece very short, as long as wide, its scales restricted to basal lateral and ventral areas; lacking any leaf-like or bristle-like subapical spine; mesal surface membranous; basal lobe with hairs. Clasper with 2 hairs on the base and 5 hairs on basal 1/4 area; curved and tapered distally and without hairs. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present. (Description based on holotype, light trap No. 1, 19 MGL, Hollandia, NG, 21.II. 1945, King & Hoogstraal).

♀, *Egg, larva, pupa.* Unknown.

Biology. The breeding habitat is unknown. Males have been collected from light traps at the edge of rain forest, at Hollandia area, on 21.II.1945 (King & Hoogstraal 1947).

DISTRIBUTION. NW NG: Hollandia (Kotabaru).

Remarks. This species is only known from the male. The genitalia lack leaf-like or bristle-like subapical spine on the sidepiece and hairs on the distal three-fourth of the clasper. It can easily be distinguished from the genitalia of all other males in this subgenus.

26. **Aedes (Verrallina) trispinatus** King & Hoogstraal Fig. 48, 53, 56, 57.

Aedes (Aedes) trispinatus King & Hoogstraal, 1947, J. Wash. Acad. Sci. **37:** 130–131 (holotype ♂, Milne Bay, SE NG; USNM).

♂. Vertex with pale broad scales on the nape; *apn* without scales; *ppn* with dark narrow scales on upper portion and hairs on posterior portion; upper *stp* with translucent appressed brownish scale patch; *mep* with pale hairs below scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length; tarsal claws unequal, simple; abdomen with basal transverse pale band on segments II-VII; segment VIII with all scales dark. *Genitalia* (Fig. 53): Sidepiece short, 1.6 × as long as wide; its scales restricted to basal lateral and ventral areas; 3 leaf-like subapical spines; 2 larger bristles on apex and 1 or 2 larger bristles on dorsal surface; mesal surface membranous; basal lobe with a group of hairs. Clasper enlarged basally, with 8 hairs; distal portion curved and without hairs. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with pale broad scales on nape and on posterior 1/3 of midline, forming triangular pale scale patch; *apn* without scales; *ppn* with dark narrow scales on upper portion and hairs on posterior portion; upper *stp* with appressed brownish scale patch, with hairs on anterior corner; *mep* with pale hairs below scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with basal transverse pale band on segments II-V and lateral pale spots on segment VI and VII; segment VIII with all scales dark.

Larva (4th Instar) (Fig. 56). *Head:* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 5-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 3-branched, 6-C 2-branched, 7-C 8-branched. Mentum with 17 teeth on each side. *Segment VIII:* Comb scales 17 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 5-branched, 2-VIII 2-branched, 3-VIII 7-branched, 4-VIII simple, 5-VIII 8-branched. *Siphon:* 1.8 × as long as wide; acus present; pecten teeth 17, the last reaching to 0.75 of siphon; the last 3 teeth more widely spaced than preceding 2; each tooth with 1 denticule; 1-S 4-branched, inserted before last tooth and ventrad of teeth; trachea broad, more than 0.5 the width of siphon. *Anal segment:* Saddle incomplete; 1-X (lost); 2-X 2-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills (lost).

Pupa (Fig. 57). *Trumpet:* 3.5 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 5-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 5 times the distance between 4-I and 5-I; 1-II less than 10-branched, not dendritic; 2-II-VII spiniform; 2-IV-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI simple, reaching beyond posterior margin of the following segment; 9-VIII 2-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Larvae of 4th instar pupated within 2 days after being brought from the field. The pupal period was 2 days. Both larvae and pupae were collected from Mowkass Village, Dobodura, 4.V.1965, at an elevation of 10 m. The larvae were collected in temporary ground pool (about 1.5 m diameter) in a partially forested area; the pool was in partially shaded area surrounded by abundant vegetation, and contained fresh, clear water, with mud and decaying vegetation at the bottom. Water mites were found in the water. Pupae were collected in a ground pool (about 2 m diameter) in a forest swamp in a virgin forest, with same data as above. Adults have been collected by light trap (King & Hoogstraal 1947).

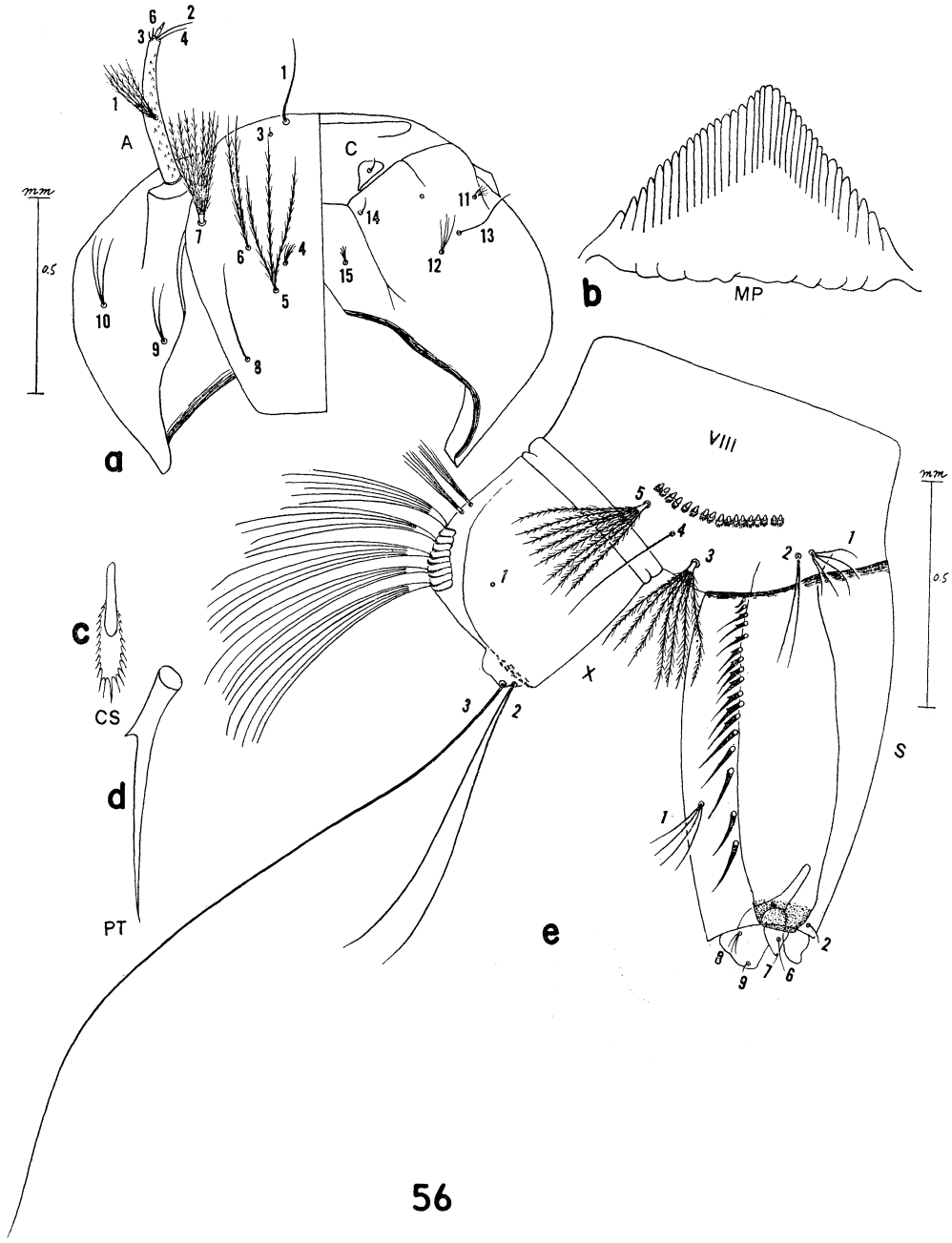

Fig. 56. *Aedes* (*Verrallina*) *trispinatus* King & Hoogstraal, 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

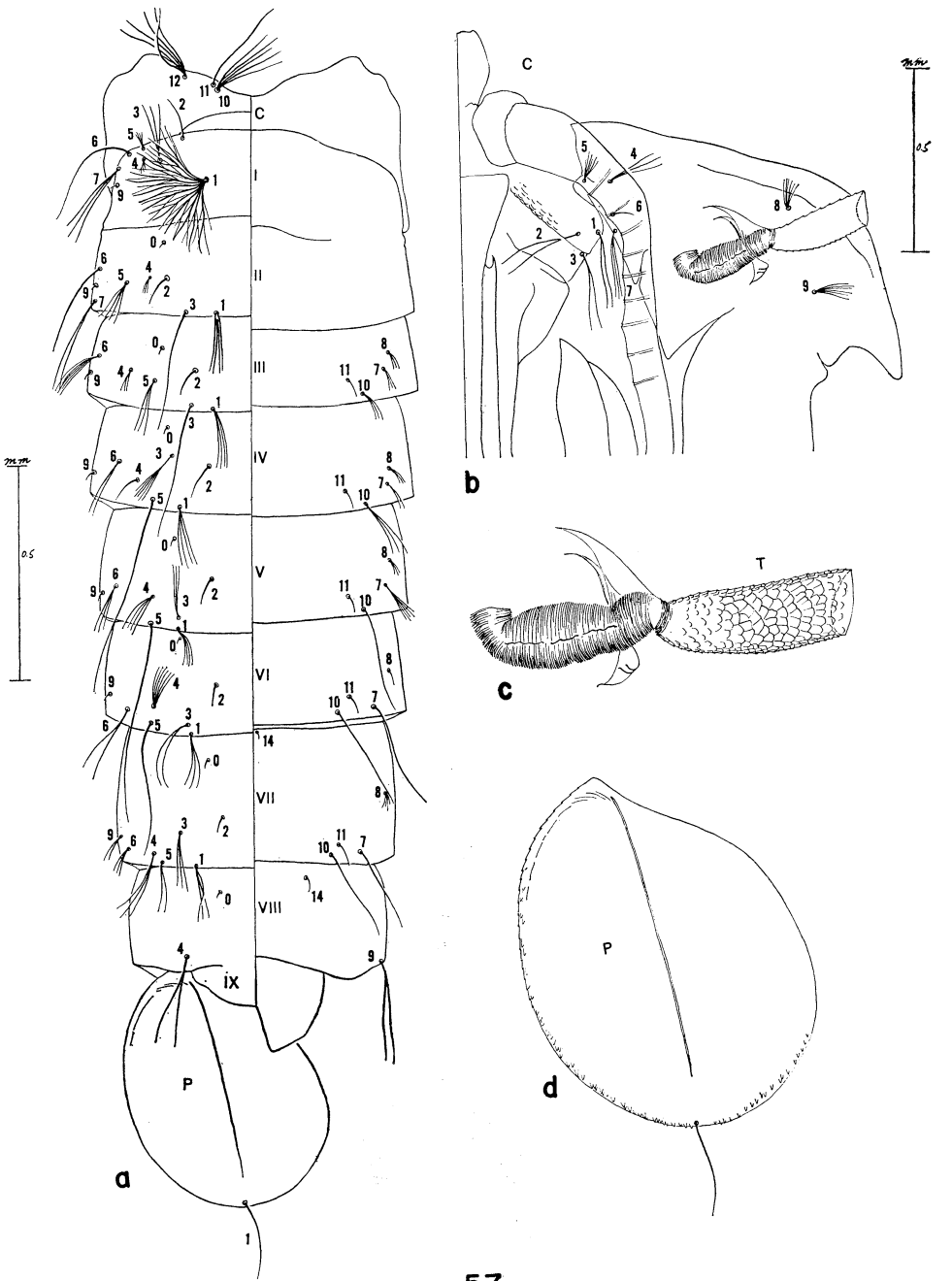

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Fig. 57. *Aedes* (*Verrallina*) *trispinatus* King & Hoogstraal, pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

DISTRIBUTION. SE NG: Mowkass Village, Dobodura; Milne Bay. NE NG: Maprik. NW NG: Hollandia (Kotabaru).

Remarks. Adults with correlated larval and pupal skins were obtained from larvae and pupae collected. The specimens agree well with the type. The adults of this species are quite similar to *foliformis* King & Hoogstraal but they can easily be distinguished by the presence of many hairs on the lower half of *mep*. The male genitalia of this species, having larger bristles on the apex and on the dorsal surface of the sidepiece, can easily be distinguished from the male genitalia of *foliformis*.

27. **Aedes** (**Verrallina**) **vanapus** Huang, new species Fig. 38, 42, 58.

Holotype ♂ (BISHOP 7556; BBM-NG 2318-3) with associated pupa skin slide and genitalia slide (YMH-'65–83), 3 km S of Vanapa River, Brown River Road, SE New Guinea, collected as a pupa in a small ground pool formed by buttresses of a tree, in flooded forest, virgin forest, 20.V. 1965, Y. M. Huang. Paratypes: 2♂, 8♀ as follows: 1♂ (BBM-NG 2318–9) with associated pupa skin slide, genitalia slide (YMH-'65–84), and legs slide (♂ 2318–9), 1♂ (BBM-NG 2318–4) with associated pupa skin slide, 4♀ (BBM-NG 2318–1b, 2318–1c, 2318–1d, 2318–17) with associated pupa skin slides, 1♀ (BBM-NG 2257–1) adult only, 2♀ (BBM-NG 2279) from Malaise trap, 1♀ (BBM-NG 2312) from biting on man, all with same data as holotype. Deposited in BBM, USNM, BMNH, and UQ.

♂. Vertex with pale broad scales on nape; *apn* without scales; *ppn* with narrow dark scales and hairs; upper *stp* with darkish scale patch; *mep* with dark hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 1.5 × as long as its stem; fore and mid-legs with tarsal segment 4 shorter than segment 5, claws unequal, the larger one has 2 teeth, the smaller one has 1 tooth; claws of hind leg equal, simple; abdomen with subbasal lateral pale spots on segments II-VII; segment VIII with all scales dark. *Genitalia* (Fig. 38): Sidepiece short, 1.3 × as long as wide, its scales restricted to basal lateral area; 1 subapical spine; mesal surface membranous; mesal lobe with a group of 6 bristles. Clasper enlarged basally, with 6 hairs on mesal area and 3 hairs on lateral area; distal portion curved and without hair. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with all scales dark; *apn* without scales; *ppn* with narrow dark scales; upper *stp* with darkish scale patch; *mep* with dark hairs posterior to scale patch, the hairs reaching below middle of lower half of *mep;* scutum with all scales dark; 1st fork cell 2 × as long as its stem; fore and mid-legs with tarsal claws equal, simple; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark.

Pupa. (Fig. 58). *Trumpet:* 4.8 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 3-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 5 × the distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-III-VII mesad of hair 1; 3-II and 3-III simple, as long as segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching beyond posterior margin of the following segment; 9-VIII 4-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Egg, larva. Unknown.

Biology. Adults emerged within 24 hours after pupae were brought from the field. The pupae were collected in a small ground pool (about 1 m diameter) formed by buttresses of a tree in a flooded area of virgin forest, 3 km S of Vanapa R., Brown River Road, at an elevation of 200 m. The temporary ground pool contained fresh reddish water, with mud and decaying vegetation at the bottom, and was situated in partially shaded area surrounded by scanty vegetation. Water mites were found in the water. Females were collected by Malaise traps, 24–26.V.1965; one female was captured while biting man in day time, 18.V.1965, near the breeding site.

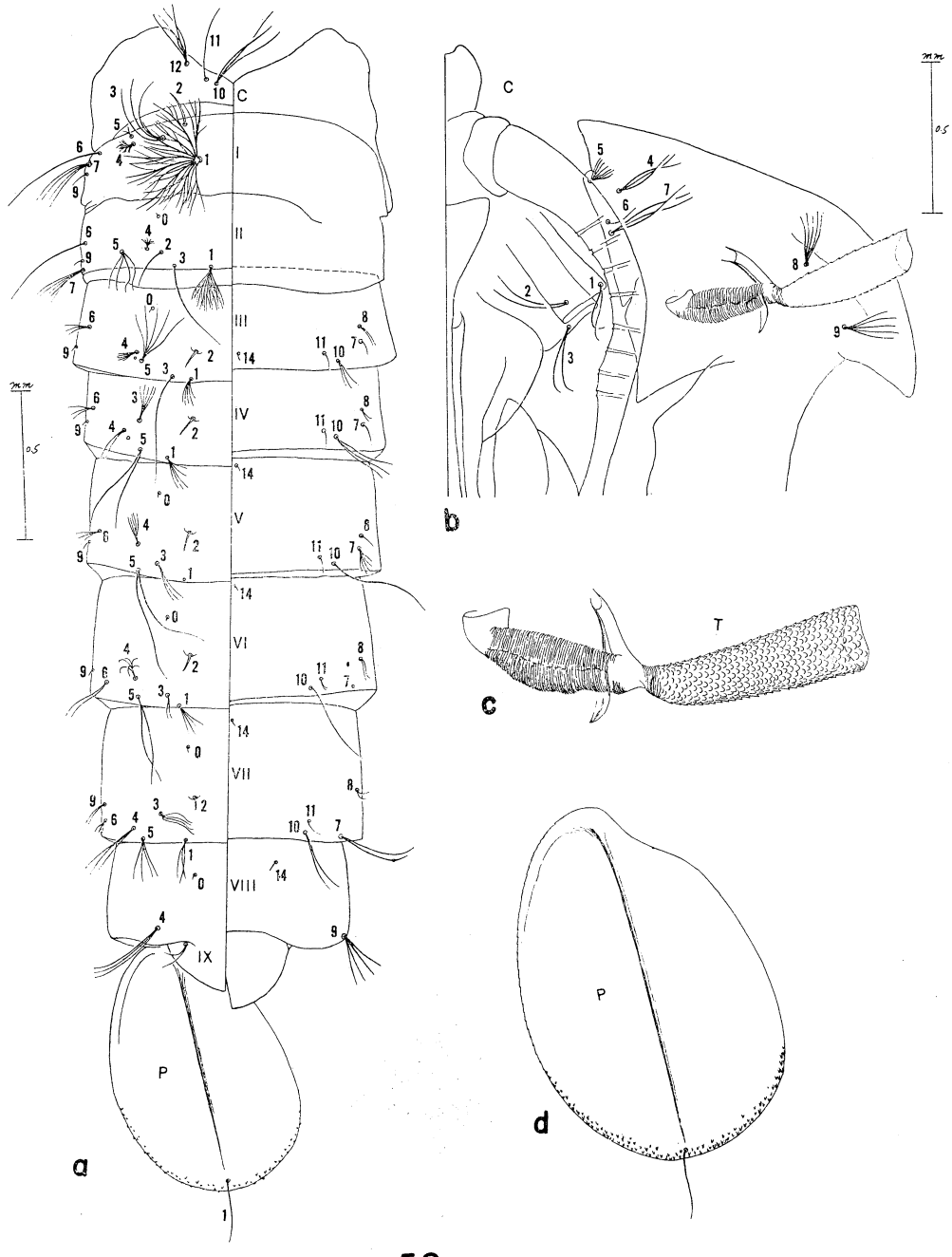

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Fig. 58. *Aedes* (*Verrallina*) *vanapus* n. sp., pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

DISTRIBUTION. SE NG: Vanapa R., Port Moresby.

Remarks. The ♂ genitalia of this species are very similar to the male genitalia of *carmenti* Edwards; but can easily be distinguished from those of *carmenti* by having sidepiece with only one subapical spine and without a bristle basad of the spine; by the conspicuous mesal lobe with 6 bristles and the absence of hairs on the basal lobe.

The males, having the claws of the fore and mid-legs unequal in size, the larger one with 2 teeth and the smaller one with 1 tooth, differ from all other species that have been described in this subgenus.

28. **Aedes** (**Verrallina**) **variabilis** Huang, new species Fig. 39, 43, 59, 60.

Holotype ♂ (BISHOP 7557; BBM-NG 2317–8) with associated pupa skin slide and genitalia slide (YMH-'65–128), 3 km S. Vanapa R., Brown. Road, SE New Guinea, collected as a pupa in the edge of the large flooded area in flooded forest, virgin forest, 20.V.1965, Y. M. Huang. Allotype ♀ (BBM-NG 2317–6) with associated pupa skin slide, with same data as holotype. Paratypes: 59♂, 73♀ as follows: 2♂, 4♀ (BBM-NG 2317), 7♂, 5♀ (BBM-NG 2319), 13♂, 6♀ (BBM-NG 2322), 2♂, 7♀ (BBM-NG 2259), 9♂, 4♀ (BBM-NG 2257) in the edge of the large flooded area in flooded forest; 1♂ (BBM-NG 2314–A1), 4♂, 7♀ (BBM-NG 2318) in a small ground pool formed by buttresses of a tree in flooded forest; 7♂ (BBM-NG 2258–1), 1♂, 5♀ (BBM-NG 2324) in a small isolated ground pool in flooded forest; all were collected either as a larva or as a pupa, with associated larva, pupa, genitalia or legs slides. 3♂, 14♀ (BBM-NG 2261), 7♂, 2♀ (BBM-NG 2263), 2♂, 16♀ (BBM-NG 2270), 1♂, 3♀ (BBM-NG 2272) from Malaise traps, with associated genitalia slide. All with same data as holotype, on 17–26.V.1965, Y. M. Huang & W. A. Steffan. Deposited in BBM, USNM, BMNH, and UQ.

♂. Vertex with broad pale scales on nape and on posterior 1/3 of midline; *apn* without scales; *ppn* with broad scales (broad dark scales on anterior and upper portion and broad pale scales on posterior portion) and hairs; upper *stp* with translucent pale scales on upper portion and dark scales on lower portion; *mep* with hairs posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.4 × as long as its stem; fore and mid-legs with tarsal segments 4 and 5 of equal length, claws unequal, simple; abdomen with median pale spot on segment II, basal transverse pale band on segments III-VI, with lateral pale spots on segment VII, and segment VIII with all scales dark. *Genitalia* (Fig. 39): Sidepiece short, 1.6 × as long as wide, its scales restricted to basal lateral and ventral areas; 3 leaf-like subapical spines; 3 larger bristles on the apex and 2 larger bristles on dorsal surface; mesal surface membranous; 5 bristles along mesal inner margin; basal lobe with group of hairs. Clasper enlarged basally, ovoid in dorsal aspect, with 4 hairs; distal portion slender and smaller. Aedeagus triangular in dorsal aspect; pointed apically; H-shaped structure of 10th sternite present.

♀. Vertex with pale scales on nape and on posterior 1/3 of midline; *apn* with broad translucent pale scales; *ppn* with broad scales (broad dark scales on anterior and upper portion and broad pale scales on posterior portion) and hairs; upper *stp* with translucent pale scales on upper portion and dark scales on lower portion; *mep* with hairs posterior to scale patch, the hairs reaching to lower border of *mep;* scutum with all scales dark; 1st fork cell 1.8 × as long as its stem; fore and mid-legs with tarsal claws equal, minutely toothed; abdomen with lateral pale spots on segments II-VII; segment VIII with all scales dark.

Larva (4th Instar) (Fig. 59). *Head:* Antenna: 1/2 as long as head, spiculate; 1-A inserted before middle of shaft, 4-branched. Inner mouth brush pectinate at tip. Hairs: 5-C 2-branched, 6-C 2-branched, 7-C 9-branched. Mentum with 17 teeth on each side. *Segment VIII:* Comb scales 14 in single row, each rounded and fringed apically; pentad hairs: 1-VIII 3-branched, 2-VIII 3-

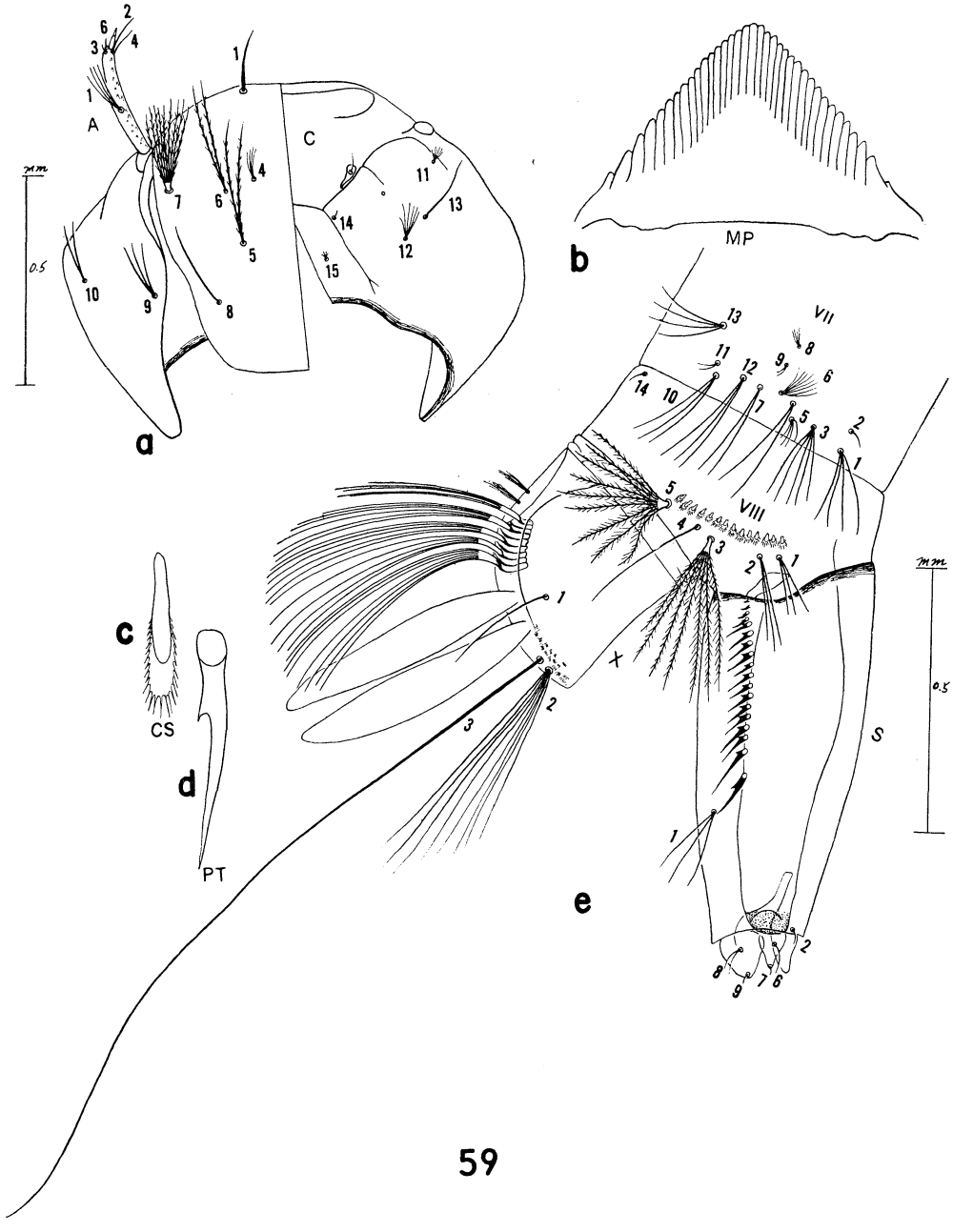

Fig. 59. *Aedes* (*Verrallina*) *variabilis* n. sp., 4th instar larva: a, head; b, mentum; c, comb scale; d, pecten tooth; e, terminal segments. (Abbreviations as in fig. 11.)

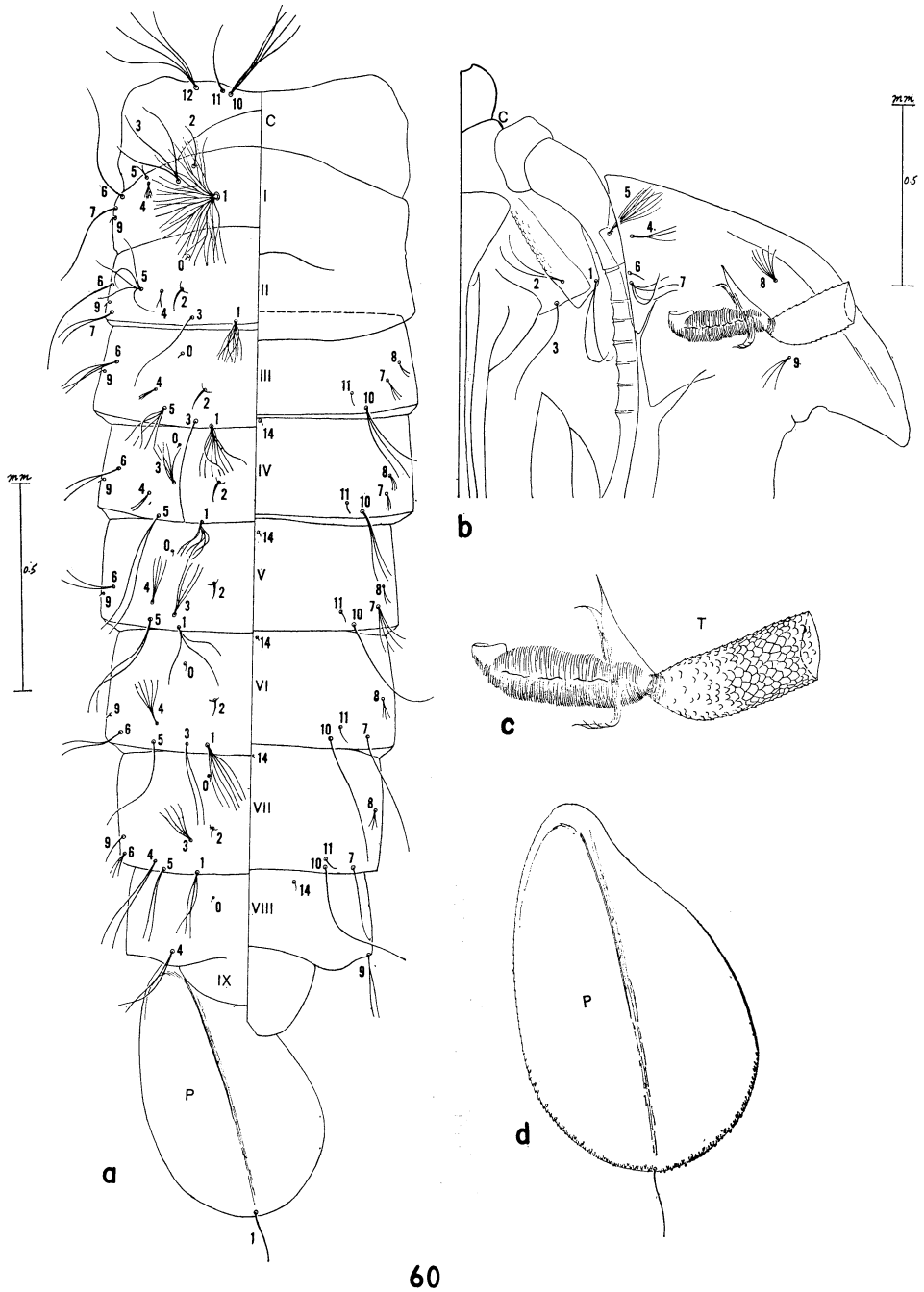

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Fig. 60. *Aedes* (*Verrallina*) *variabilis* n. sp., pupa: a, metanotum and abdomen; b, cephalothorax; c, trumpet; d, paddle. (Abbreviations as in fig. 12.)

branched, 3-VIII 7-branched, 4-VIII simple, 5-VIII 9-branched. *Siphon:* 2.2 × as long as wide; acus present; pecten teeth 17, the last reaching to 0.65 of siphon; the last 2 teeth more widely spaced than preceding 2; each tooth with 1 denticule; 1-S 3-branched, inserted beyond last tooth and ventrad of the teeth; trachea broad, more than 0.5 width of siphon. *Anal segment.* Saddle incomplete; 1-X simple, shorter than saddle; 2-X 8-branched; 3-X simple; ventral brush with 5 pairs of hairs on grid, with 2 precratal tufts. Gills 1.5 × as long as saddle, lanceolate.

Pupa (Fig. 60). *Trumpet:* 2.5 × as long as wide; sculptured; tracheoid indicated at base. *Metanotum:* Hair 10-C 4-branched, mesad and caudad of 11-C; 11-C simple. *Abdomen:* Hair 1-I well developed, with more than 20 branches, dendritic; 2-I simple; 3-I 3-branched; 2-I and 3-I widely separated, the distance between them being 5 × the distance between 4-I and 5-I; 1-II more than 10-branched, dendritic; 2-II-VII spiniform; 2-IV-VII mesad of hair 1; 3-II and 3-III simple, shorter than segment III; 5-IV, 5-V, and 5-VI 2-branched, not reaching beyond the posterior margin of the following segment; 9-VIII 2-branched. *Paddle:* Marginal spicules present; 1-P spiniform.

Biology. Larvae and pupae were found infected by the *Coelomomyces* fungus and died within 24 hours after being brought from the field; most of them died during ecdysis. Larvae of 4th instar pupated within 24 hours after being brought from the field. The pupal period lasted one day. Both the larvae and pupae were collected at the edge of a large flooded area in a small ground pool (about 1 m diameter) formed by buttresses of a tree, and in an isolated ground pool (about 2.3 m diameter) in a flooded area of virgin forest 3 km S of Vanapa R. Brown River Road, Port Moresby, 20–24.V.1965, at an elevation of 200 m. The temporary ground pools contained fresh, clear (reddish in ground pool formed by buttresses of a tree) water, with mud and decaying vegetation at the bottom, and was situated in partially shaded area surrounded by scanty vegetation. Water mites were found the water. Males and females were collected by Malaise traps 18–24.V.1965.

DISTRIBUTION. SE NG: Vanapa R., Port Moresby.

Remarks. Adults of this species have *ppn* with both dark and pale broad scales and hairs (both sexes) thus differing from all other species described in this subgenus. The male genitalia are very similar to the male genitalia of *quadrispinatus* King & Hoogstraal; they differ in having the sidepiece with 3 leaf-like subapical spines, the spines stouter than the spines of *quadrispinatus*, the basal lobe better developed, basal lobe with a group of hairs only, and H-shaped structure of 10th sternite higher arched. Larvae have the anal segment with 2-X 8-branched and can easily be distinguished from those of *quadrispinatus* King & Hoogstraal.

This species seems to be variable, particularly in the ornamentation of the adults, some having more pale broad scales on *ppn*, some having more hairs on *ppn* and fewer broad scales. This may be an indication that more than one species is involved.

SPECIES ERRONEOUSLY RECORDED AS OCCURRING IN THE PAPUAN SUBREGION

Aedes (Aedes) incertus Edwards

Aedes (Aedes) incertus Edwards, 1922, Indian J. Med. Res. 10 : 264, 468, 1924, Bull Ent. Res. **14** : 388. Syn. *A. taeniata* Leicester.

The type of this species is a ♀; the ♂ of *incertus* Edwards is unknown but the Merauke, New Guinea, record for this species was based on a ♂ specimen. Both cotype female (Kuala Lumpur, Malaya) and the male (Merauke, New Guinea) which was under *incertus* Edwards in British Museum, were examined. These 2 specimens are not the same species. The ♂ specimen is *reesi* King & Hoogstraal. Therefore, the record is incorrect by misidentification. The species *incertus* Edwards does not occur in New Guinea; at least, no material resembling this species has been found.

CONCLUSIONS

The characters of the adults as well as the larva and the pupa of *butleri*, the type species of *Verrallina*, provided the typical characters for the species of this group in the Papuan subregion. There is no doubt that all of them, formerly placed in the subgenus *Aedes*, should be recognized as constituting a distinct subgenus and placed in *Verrallina*.

Twenty-eight species of *Verrallina* are recognized from the Papuan subregion. Only 1 Malayan species, *butleri*, 1 Philippine species, *panayensis*, and 2 Australian species, *funereus* and *similis*, are definitely known from the Papuan subregion. Eight species of the Papuan subregion (the New Guinea and the South Pacific species), *carmenti*, *cuccioi*, *leilae*, *lineatus*, *multifolium*, *parasimilis*, *quadrispinatus*, and *reesi* are known to occur in northern Australia so far, and *lineatus* also occurs in the New Hebrides.

All the New Guinea species as well as the South Pacific species together with the Australian species are strikingly characterized by the development of a peculiar H-shaped structure around the aedeagus of the male genitalia. This is apparently a bridging of the dorsal arms of the tenth sternite, with a flattened posterior projection on each side made up of a number of elongate, closely appressed, rounded filaments, or of a striated leaf-shaped membrane. In *neomacrodixoa*, the H-shaped structure is present although not so well developed as the other species. *Panayensis* and some other Philippine species also show a somewhat similar bridge and peculiar structure around aedeagus, but the posterior arms are less developed or absent. It may be necessary to place all the other Indomalayan and Oriental species, formerly placed in the subgenus *Aedes*, in the subgenus *Verrallina*, and keep only the Palaearctic species in the subgenus *Aedes* although both Indomalayan and Oriental species appear to represent a group, yet they are more similar to *butleri*, the type species of *Verrallina*, than to *cinereus*, the type species of subgenus *Aedes*. To establish a definite taxonomic position for those species requires a detailed study and comparison of all stages of the group in those areas.

The identification of female mosquitoes of the group in the Papuan subregion is based mainly on the coloration of the scales and the hairs on the body. The female genitalia of the group seem to be very uniform and offer little assistance but may be used to separate some of the more distinctly marked forms which can usually be identified by their coloration. The species having similar coloration have been found to have nearly identical genitalia. Female genitalia in this group have, therefore, only limited value in the identification of the species of the Papuan subregion.

The male genitalia of the group, in general, present good distinctions and the characters of the tarsus and claws also are very useful in the identification of the species.

The characters of the immature stages play an important part in mosquito taxonomy which has long been recognized by many workers; many species can be more easily distinguished in the larval than in the adult stage. Most of the immature stages of *Verrallina* of the Papuan subregion present good characters for distinctions. The characters which have been most useful in species diagnosis of the group are:

1. EGGS: Shape and surface features of the shell.
2. LARVAE: Position of siphon tuft (1-S); branches of head hairs 5-C, 6-C; branches of dorsal brush 2-X; number of denticules of pecten tooth.
3. PUPAE: Branches of hairs 1-II, and 9-VIII; branches and length of hairs 3-II and 3-III; 5-IV, 5-V, and 5-VI.

Several species of *Verrallina* are very common and attack man very readily by day as well as at night, in the vicinity of forests, in sago swamps and in mangrove swamps.

Most of the male adults of the group were collected from light traps and Malaise traps. The resting places of the group are very poorly known; only a single male adult of *quadrifolium* was col-

lected by me while resting on vegetation, 3–5 cm above the water surface of the breeding site in a forest, in the Port Moresby area, SE New Guinea, and a single male of *cuccioi* was collected resting near a sandy pool, in a stream bed, in Guadalcanal by Belkin in 1962.

The larvae and pupae of the group were found:

1. In isolated small temporary ground pools or in the edge of large flooded areas; in ground pools formed by buttresses of a tree, in a flooded area of virgin forest, at an elevation of 200 m (species such as *similis*, *parasimilis*, *quadrifolium*, *multifolium*, *neomacrodixoa*, *vanapus* and *variabilis*). Larvae of *parasimilis* were collected from crayfish holes in a rain forest.
2. In temporary ground pools in a forest swamp, at an elevation of 20 m (*quadrispinatus* and *tris-*

Table 1. Species of *Aedes* (*Verrallina*) in the Papuan Subregion their distribution and the stages known.

Species	Stage						Distribution													
	Adults						Papuan Subregion								Other localities†					
	♂	♀	Egg	Larva	Pupa	Bionomics	Solomon Is.	Bismarck Is.	New Ireland	New Britain	New Guinea	Moluccas	Ceram	Amboina	New Hebrides	Celebes	Australia	Philippines	Malayan Subregion	Thailand
azureosquamatus		×									×									
bifoliatus	×										×									
butleri	×*	×		×*	×*	×*							×			×		×	×	×
carmenti	×	×	×	×	×	×	×	×	×		×		×	×			×			
ceramensis	×												×							
cuccioi	×	×		×	×	×	×				×						×			
foliformis	×	×		×	×	×					×									
funereus	×	×	×	×	×						×		×				×			
leilae	×										×						×			
lineatus	×	×	×	×	×	×	×	×	×	×	×		×	×	×		×			
mccormicki	×	×		×	×	×	×													
milnensis	×	×									×									
multifolium	×	×		×	×	×					×						×			
neomacrodixoa	×	×		×	×	×					×		×	×		×				
panayensis	×	×				×*					×	×	×	×		×		×		
parasimilis		×	×	×	×	×					×		×	×			×			
quadrifolium	×	×			×	×					×									
quadrispinatus	×	×		×	×	×					×						×			
reesi	×	×									×						×			
sentanius	×	×		×	×	×					×									
similis		×		×	×	×					×		×	×			×			
simplus	×										×									
trispinatus	×	×		×	×	×					×									
embiensis n. sp.	×					×					×									
killertonis n. sp.	×	×									×									
obsoletus n. sp.	×	×									×									
vanapus n. sp.	×	×			×	×					×									
variabilis n. sp.	×	×		×	×	×					×									

* material or information obtained from outside Papuan subregion.

† specimens which have been examined.

pinatus).

3. In temporary ground pools in a grassy swamp, at an elevation of 5 m or in ground pools in jungle (*carmenti* and *mccormicki*).
4. In temporary ground pools on the road side in a grassy area, at an elevation of 40 m (*lineatus*).
5. In stream bed pools and in ground level tree holes in stream beds (*cuccioi*).
6. In hog wallow in sago swamp or in shallow foot-prints in dense forest (*sentanius*).
7. In isolated temporary ground pools in a pandanus swamp in a partially forested area, at an elevation of 860 m (*foliformis*).

All were found in partially or deeply shaded areas except *lineatus* which occurs in more open pools, in pools with fresh, clear or slightly colored water and with mud and decaying vegetation on the bottom.

In nature, eggs of *carmenti* have been found in a ribbon-like gelatinous string which is attached to various objects above the water. In the laboratory, eggs were laid in a ribbon-like row on the sides of the test tube (Belkin 1962). In the laboratory, eggs of four species (*carmenti*, *funereus*, *lineatus*, and *parasimilis*.) were laid on a strip of filter paper in individual rearing vials.

Outside the Papuan subregion, larvae of *butleri* have been collected in a slightly brackish, shaded, leaf-filled puddle in a nipa palm swamp at the extreme upper limit of the tidal zone and in temporary, shaded, fresh-water, leaf-filled ground pools, and females have been captured while biting during the day in a mangrove swamp; larvae of *panayensis* have been collected in slightly brackish water in a beached canoe and in a shaded leafy, slightly brackish puddle in a nipa palm swamp at the extreme upper limit of the tidal zone, and the adults were taken while biting man in mangrove swamp during the day while resting in a crab hole in a mangrove swamp (Laffoon 1946).

Fungi, protozoa, and water mites were found in the water of the breeding sites. The larvae and pupae of *multifolium*, *quadrispinatus*, and *variabilis* infected by the *Coelomomyces* fungus were dead within 24 hours after being brought from the field; most of them died during ecdysis. It appears that the *Coelomomyces* fungus prevents the larvae and pupae from shedding their skins. This fungus may well be useful for biological control.

Verrallina is confined to the Indomalayan, Oriental, and Australasian regions, Celebes and the New Hebrides. In the Papuan subregion, it is found in the Solomon Is., the Bismarck Archipelago (New Ireland and New Britain), New Guinea, and the Moluccas (Ceram and Amboina). Several species are extremely severe biters, yet nothing is known of the disease relations of the species of *Verrallina* of the Papuan subregion. Random dissections of *carmenti* and *lineatus* on Guadalcanal failed to show natural infection with larval filariae (Belkin 1962). Outside the Papuan subregion, *butleri* has been recorded as a virus vector in Malaya (Traub 1957).

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technic of field collecting and rearing, and also for permitting me to examine specimens in the Department of Zoology, University of California, Los Angeles; to Dr A. Stone for making available the type materials in the mosquito collection of the U. S. National Museum, Washington D. C., and also for many helpful suggestions and valuable advice regarding this study.

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New names are indicated by **bold face** types, synonyms by *italics*.

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