CAWTHRON INSTITUTE,
NELSON, NEW ZEALAND.

IDENTIFICATION OF NEW ZEALAND MOSQUITOES

by

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and

W. J. PHILLIPPS, Dominion Museum.

(1952)

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The purpose of this brochure is to supply a means by which the known mosquitoes occuring in New Zealand can be readily identified by officers of the Department of Health, local bodies and by any others interested in the subject. A pocket lens, magnifying at least six times, will be the only necessary aid to follow most of the information given in the following pages.

Of the ten species dealt with, seven are peculiar to New Zealand in so far as is known at present, and three are also found elsewhere.

Though no malaria-transmitting mosquitoes have yet been found in New Zealand, the possibility of these reaching our shores is now very great under modern conditions of air transport. Special attention is being given to this aspect and it would be of considerable aid if observers would collect mosquitoes and larvae and send them direct to the Director, Entomological Research Station, Cawthron Institute, Nelson.

When collecting mosquitoes care should be taken not to damage the insects or handle them with the fingers since the vestiture of scales and hairs are readily rubbed off and characters based on colour pattern lost; the insects are best enticed into a glass phial at the bottom of which are some crushed young laurel leaves covered with pieces of crumpled tissue paper; this acts as a killing bottle. In the absence of laurel leaves or a killing bottle the mosquitoes can be killed by tobacco smoke in any container. To transmit by post and to avoid crushing, the insects should be laid between layers of cotton wool and packed in a tin container of some sort.

In the case of larvae. These can be collected by rapidly dipping them from the water where they are breeding by means of a wide-mouthed jar, though the best method is to suck them up by means of a glass tube and rubber bulb—an instrument similar to that used for filling motor car batteries. For posting, a simple method is to place a layer or two of wet blotting paper in a tin having the bottom punctured by numerous

holes; on to this the water with the larvae is poured and allowed to drain off, when the residue of larvae is covered by further layers of wet blotting paper, the tin closed and sent by air-post.

It is important to supply with each collection as much data as possible; for example, date, name of place, location (indoors, in bush, in open, etc.), time of day, and, in the case of larvae, whether collected in troughs, tanks, gutters, discarded receptacles, streams (slow-flowing or stagnant), pools, or tree holes, etc., and whether under shade or exposed to sun, whether from clear or polluted water, etc.

In the preparation of this work, our acknowledgements are owing to several of the field officers of the Department of Health for the collection of mosquitoes and larvae and for observations made during the survey carried out in the North Island.

HOW TO RECOGNISE A MOSQUITO.

At the outset MAKE SURE THAT THE FLY TO BE IDENTIFIED IS A MOSQUITO—otherwise the following pages will be meaningless! It would seem hardly necessary to stress this, but there are so many other frail-bodied, mosquito-like flies often mistaken for mosquitoes.

A mosquito is readily recognised in the following manner:

(a) Among our frail-bodied flies, the mosquito is the only one that possesses a needle-like piercing proboscis (fig. 1).

(b) There is only one pair of wings in mosquitoes and other flies (figs. 1 & 2). The second pair of wings, possessed by other insects, being reduced to a pair of pin-like structures called "balancers" (fig. 1).

(c) The delicate membrane of an insect wing is supported, like an opened fan, by a number of ribs or "veins". The arrangement of these veins is characteristic in the mosquitoes and differs from other similar flies (figs. 1 & 2). Further, the veins of the mosquito wing are more or less densely clothed with "scales" (fig. 3), while in other mosquito-like flies the veins are bare.

(d) The antennae of the female mosquito (fig. 1) are long, and consist of a series of joints from each of which arises a whorl of short, delicate hairs. In the case of the male, however, (fig. 4) the antennae are densely

clothed (with one exception in New Zealand, see fig. 17) with long hairs. A fly (fig. 2) likely to be mistaken for a male mosquito, owing to the haired antennae, is a very abundant species of fungus gnat (*Chironomus zealandicus*), especially since it creates a "piping" sound when in flight as does the mosquito. But distinguishing features are to be noted in the absence of a long proboscis, and in the arrangement of the wing veins as shown in the figures when compared (figs. 1 & 2).

Though there are, as yet, no malaria-carrying, or *anopheline*, mosquitoes in New Zealand, a careful watch must be kept for them; therefore, the following characters should be noted in order to distinguish them from the New Zealand, or *culicine*, mosquitoes which do not carry human malaria. The recognition of these two kinds is very simple from a study of the head.

Arising from the head at the base of the proboscis, and one on each side of the latter, is a jointed appendage—the palpus (figs. 5, 6 & 7). In all males, whether *anopheline* or *culicine*, these palpi are about as long as or longer than the proboscis (fig. 7). In the female *culicine*, however, the palpi are comparatively very short (fig. 6), but in the *anopheline* female they are about as long as the proboscis (fig. 5) as in male mosquitoes.

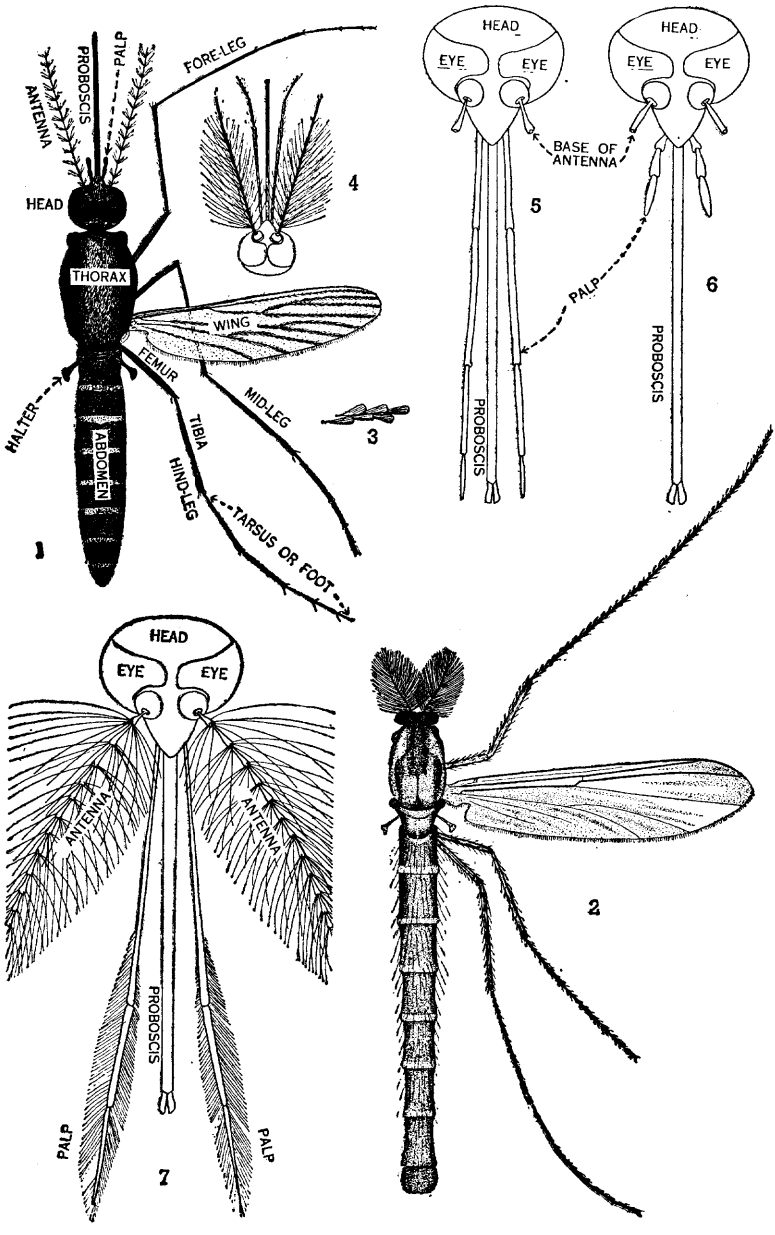


PLATE 1.

Fig. 1: A female mosquito (legs and wing of one side not shown).
Fig. 2: A male fungus gnat (legs and wing of one side not shown).
Fig. 3: Scales on vein of a mosquito wing.
Fig. 4: Head of a male mosquito.
Fig. 5: Head and mouth parts of a female **anopheline** mosquito (only base of antennae shown).
Fig. 6: Head and mouth parts of a female **culicine** mosquito (only bases of antennae shown).
Fig. 7: Head, mouth parts and part antannae of a male mosquito.

HOW TO RECOGNISE MOSQUITO EGGS, LARVAE AND PUPAE.

All mosquitoes breed in water so that it is there that eggs, larvae and pupae are to be found. As with the adult flies, there are characters by which the *culicine* and *anopheline* groups can be broadly distinguished in the egg and larval stages. Furthermore, since individual species can be identified by their larvae without having the winged mosquito at hand, special attention is given herein to this aspect.

Eggs. It is usual for the female mosquito to deposit her eggs on the surface of the water, though they are placed under water in a few cases. The *culicine* eggs may be laid separately, or deposited in masses of from 200 to 400, and so may assume the form of a miniature raft resembling a small paring from a lead-pencil floating on the surface of the water (fig. 8).

On the other hand, *anopheline* eggs are placed separately on the water surface though they may be grouped in clusters forming various patterns (fig. 9); each egg is spindle-shaped, is generally supported by a characteristic float on each side (fig. 9A), and lies horizontally on the water surface.

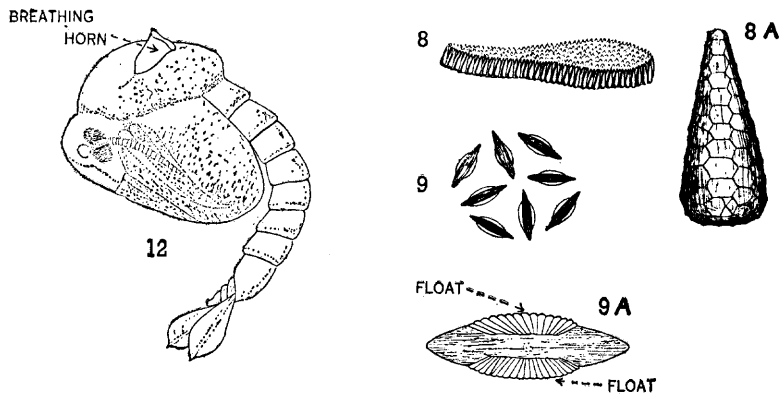
Larvae. The *culicine* larva (fig. 10) is somewhat club-shaped, the swollen end being the head and thorax; at the opposite end, posteriorly, projects the breathing siphon (figs. 10 & 13), at the tip of which are openings leading into the breathing system. The tip of this siphon is thrust above the water in most species, so that the larva, hanging head downwards, is yet in direct contact with the air. The shape of the siphon, and the arrangement of the hairs and spines on its surface, together with similar features on the last body and anal segments (fig. 13), vary in each species and are of value for the purpose of identification (e.g. compare figs. 18, 26, 36, 41, etc.). The features to be noted and to which reference will be made when dealing with the different species are named in the figure (fig. 13).

A few other aquatic larvae might be mistaken for those of *culicine* mosquitoes; but the latter are the only type that has the thorax wider than the abdomen and formed of a single mass and not of three distinct segments as in other mosquito-like larva; further, the *culicine* larva has the head broad and quite distinct from the thorax.

The *anopheline* larva (fig. 11) is elongate and narrow bodied. Unlike the *culicine* it has no siphon, the breathing

system opening directly on the body surface; thus the *anopheline* larva, when breathing, lies parallel to and immediately under the water surface, and does not hang head downward.

Pupae. When fully grown the larva transforms to the comma-shaped pupa (fig. 12). Though it does not feed, the pupa is very active and comes to the surface to breathe through a pair of horn-shaped funnels situated on the thorax. From the pupa the winged mosquito emerges on the water surface and takes to the wing (figs. 14 & 15).



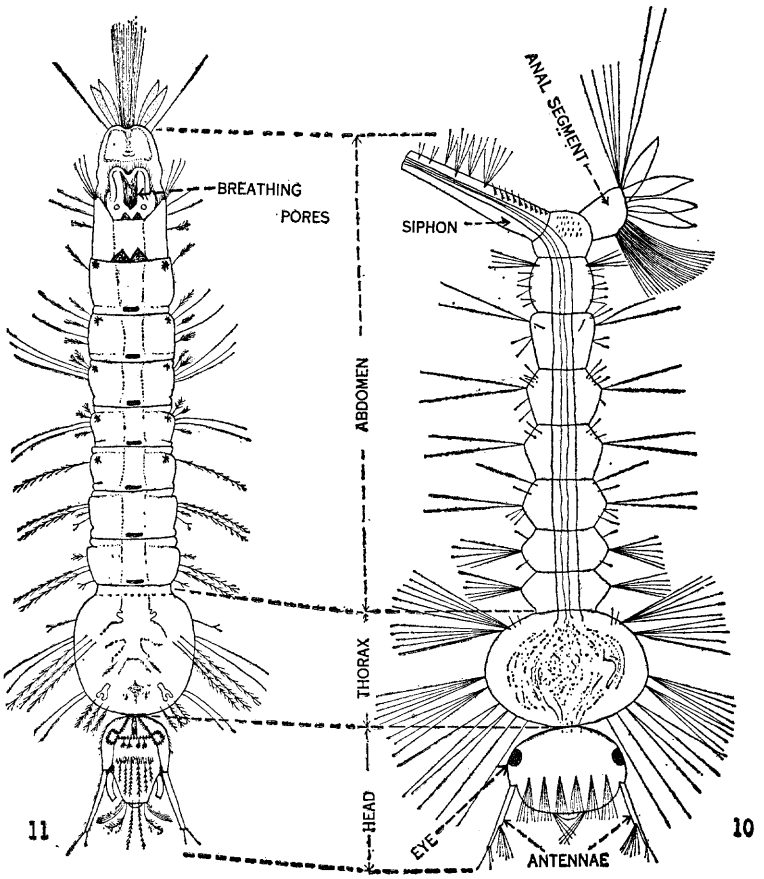
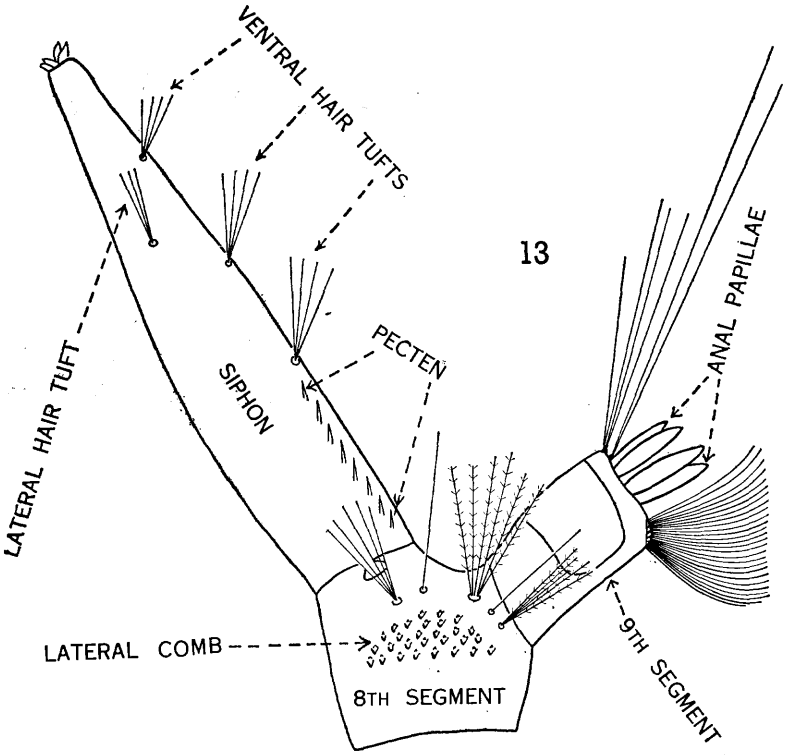


PLATE 2.

Fig. 8: Egg-raft of a **culicine** mosquito; **8A,** a single egg.
Fig. 9: Eggs of an **anopheline** mosquito; **9A,** a single egg.
Fig. 10: A **culicine** larva.
Fig. 11: An **anopheline** larva.
Fig. 12: A pupa (after Nuttall & Shipley).



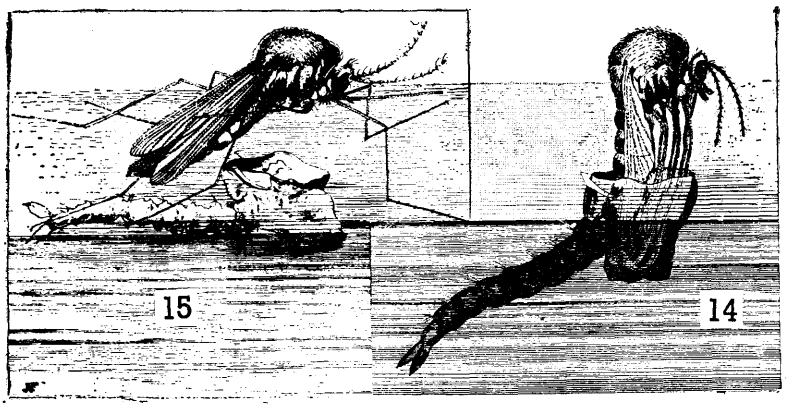
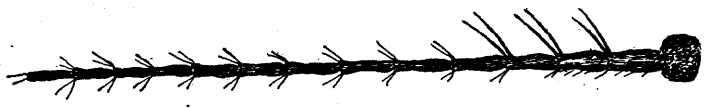


PLATE 3.

Fig. 13: Larval siphon and terminal segments of a **culicine** mosquito showing the position and names of hairs and spines used for purposes of identification (modified after Woodhill & Pasfield).

Figs. 14 & 15: A mosquito emerging from its pupa (after Grant Allen).



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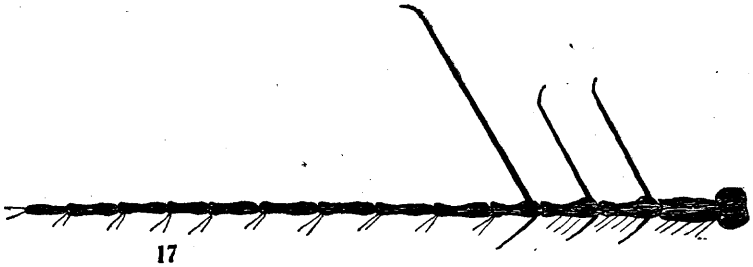

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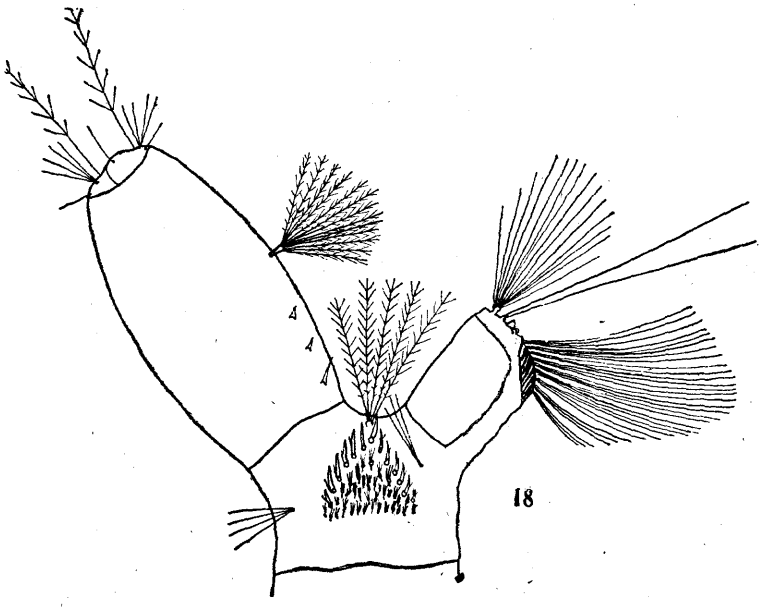

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PLATE 4.

Opifex fuscus Hutton.

Fig. 16: Female antenna.
Fig. 17: Male antenna.
Fig. 18: Terminal larval segments.

Opifex fuscus Hutton.

Opifex fuscus is the large blackish mosquito that frequents the rocky coast line of the North Island and the northern part of the South Island. Its bite is a most painful one. This mosquito is very easily identified and cannot be mistaken for any of the other species. It is a robust, blackish fly with no colour pattern on body or legs, and it is not found beyond the rocky coast. The outstanding features for its recognition are:—

(a) The male antennae (fig. 17 compared with fig. 7) are not densely haired as in other species, there being only three large spine-like hairs, one on each of the second, third and fourth basal segments. In the case of the female antennae (fig. 16 compared with fig. 1) there are no very conspicuous whorls of hair on each segment, but on each of the first three basal ones is a pair of conspicuous rigid hairs.

(b) The wings are slightly brownish and the veins are not densely clothed with scales.

(c) The fore-legs of the male are shorter than the others and much stouter, while the claws of the fore-feet are long and very conspicuous.

Larva. *Opifex fuscus* breeds in saline pools above high water and the black eggs are attached singly to the rock below water at the pool margins; they are thus difficult to see. The larvae thrive best in pools free of crabs, fish and other enemies and where there is a good growth of sea-grass; sand drifting into the pools seems to be inimical to the larvae.

The siphon is short and barrel-shaped (fig. 18); in this respect it resembles somewhat the larvae of *Aedes notoscriptus* (fig. 26) and *Aedes aegypti* (fig. 27), but is otherwise distinct in that the single pair of ventral plumose hair tufts are situated at the middle of the siphon, while the pecten consists of only three widely separated spines. Further the lateral comb of the eighth segment is virtually in the form of an equilateral triangle, the outer spines of which are large and strong; also the anal papillae are minute and inconspicuous (fig. 18).

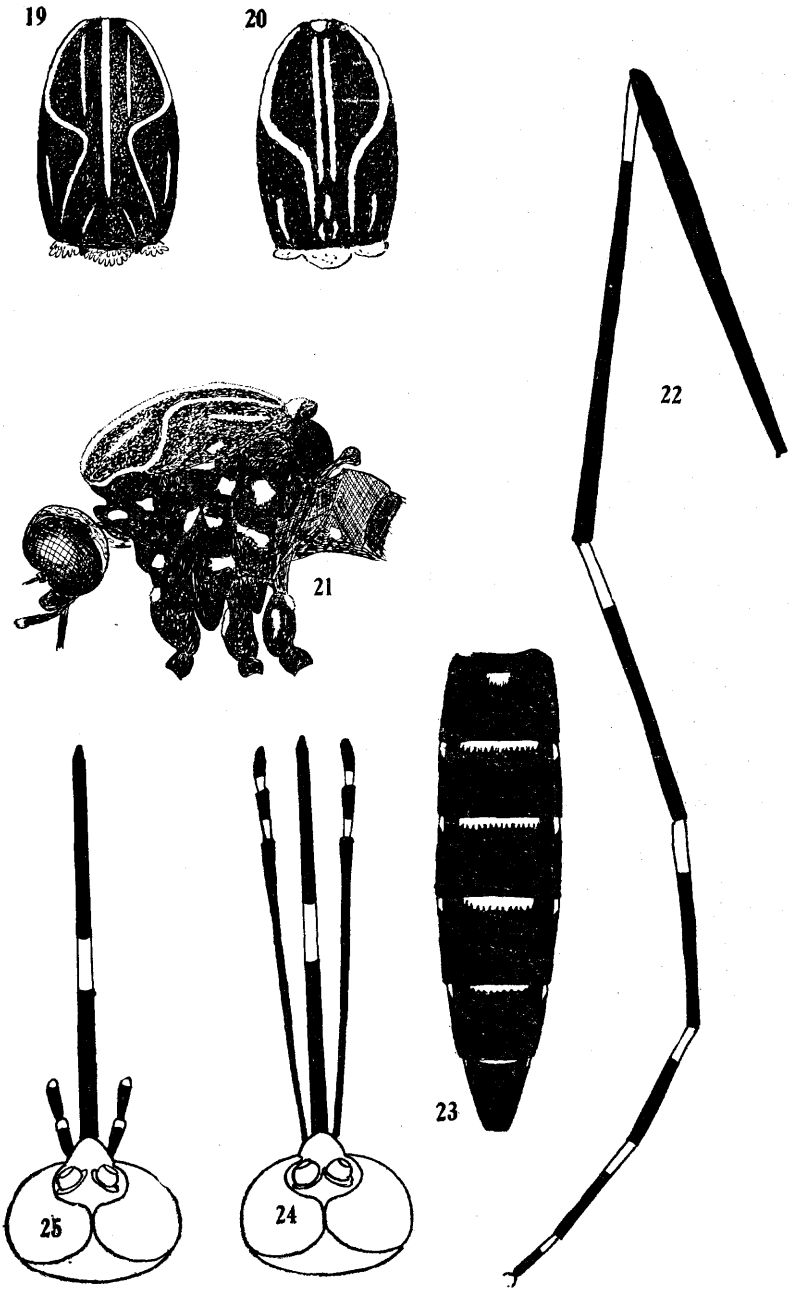


PLATE 5.

Aedes notoscriptus (Skuse).

Fig. 19: Pattern on back of **A. notoscriptus** compared with that of **A. aegypti** (fig. 20).
Fig. 21: Pattern on side of thorax.
Fig. 22: Pattern of leg.
Fig. 23: Pattern on abdomen.
Figs. 24 & 25: Pattern on mouth parts of male and female respectively.

Aedes notoscriptus (Skuse).

This species occurs in the northern parts of the North Island, as well as in Australia, Dutch East Indies, Papua and New Caledonia. It is a blackish fly rendered conspicuous by the thorax and legs being striped and spotted with white, which gives a speckled impression; thus it is quite distinct from the other species. It is active during the day for the most part, and is silent in flight. The following are the salient features by which it can be identified.

(a) On the back of the thorax (fig. 19) is a pair of lateral, white, lyre-shaped stripes, while down the middle line, but not extending the full length, is a single straight stripe; in addition, on each side of the middle line are shorter and narrower stripes as shown in the figure. On the sides of the thorax is a characteristic pattern of white spots (fig. 21).

(b) The legs have the bases of the tibiae and of the tarsal joints broadly banded with white (fig. 22).

(c) The abdomen has a white band across the centre of the anterior margin of each segment, and a white spot at the sides (fig. 23).

(d) The proboscis has a broad white band in the middle (figs. 24 & 25), about one eighth the length of the proboscis itself, while the two terminal joints of each palpus are white at the base in the male (fig. 24), but at the apex in the female (fig. 25).

(e) The posterior margins of the eyes are bordered with white.

Aedes notoscriptus bears a superficial resemblance to the somewhat smaller yellow-fever mosquito, *Aedes aegypti;* though the latter has not yet been found in New Zealand a comparison is of value. The two species can be separated at once by a comparison of the pattern on the back of the thorax; in this, *A. aegypti* (fig. 20) differs from *A. notoscriptus* (fig. 19), among other features, in the stripe along the median line being paired and unaccompanied by shorter lateral stripes.

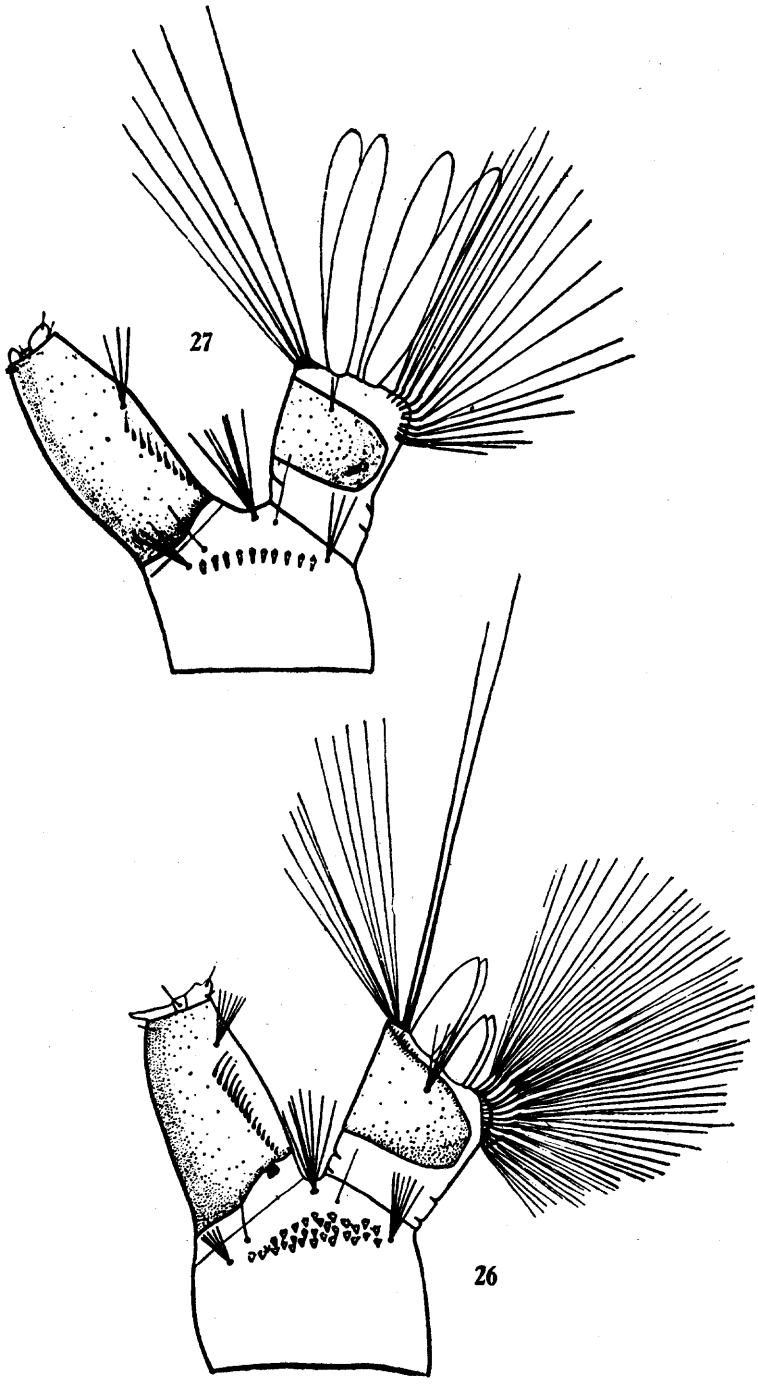


PLATE 6.

Fig. 26: Terminal **larval** segments of **Aedes notoscriptus** (after Woodhill & Pasfield).
Fig. 27: Terminal larval segments of **Aedes aegypti** (after Woodhill & Pasfield).

Larva. The eggs are laid in water under shaded conditions and preferably where there is a high content of organic matter; in such an environment the larvae thrive.

The siphon of the larva is short and broad (fig. 26); the single pair of ventral hair tufts is situated slightly beyond the middle, and the pecten extends to about the middle distance. The lateral comb is broadly triangular, with the bristles in several rows, while the anal papillae are distinctly shorter than the ninth segment.

In the case of *Aedes aegypti* (fig. 27), the single pair of ventral hair tufts on the short and broad siphon is toward the apex of the latter, and the pecten extends distinctly beyond the middle distance; the lateral comb consists of a single row of bristles, and the anal papillae are much longer than the ninth segment.

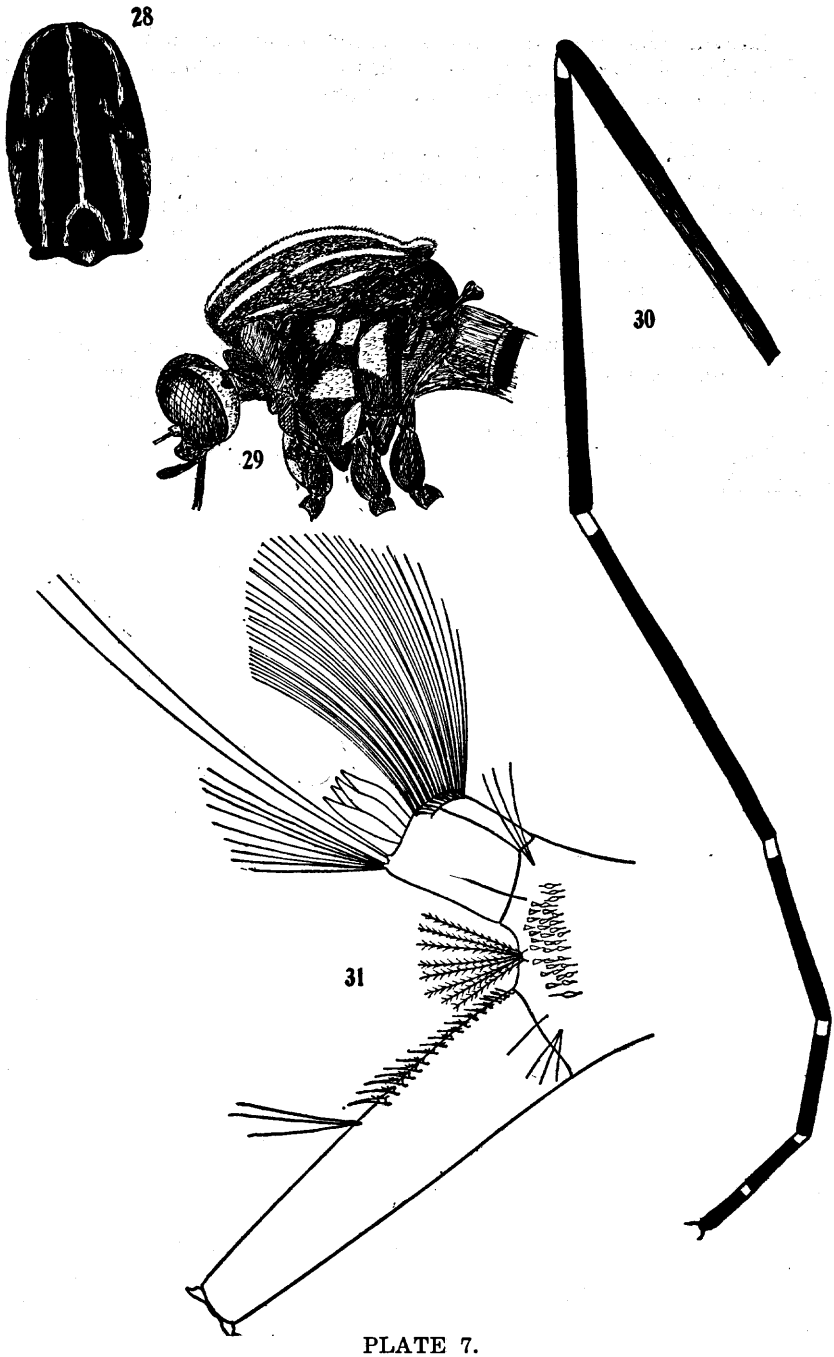


PLATE 7.

Aedes antipodeus (Edwards).

Fig. 28: Pattern on back of thorax.
Fig. 29: Pattern on side of thorax.
Fig. 30: Pattern on hind leg.
Fig. 31: Terminal larval segments.

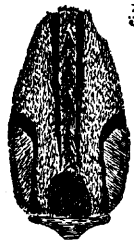
Aedes antipodeus (Edwards).

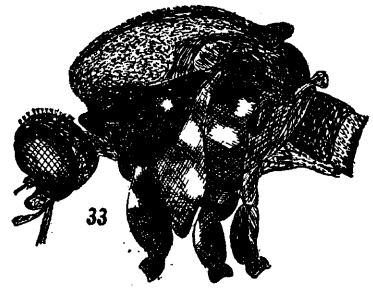
This mosquito has been found as far north as Kaitaia and as far south as New Brighton. It is abundant in dense bush and also in settled communities, and appears to be much more active in colder than in warmer seasons, so much so that it could well be called the "Winter Mosquito".

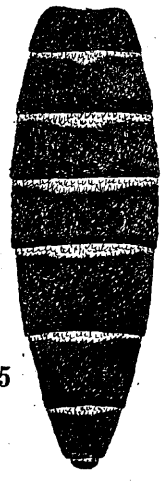
The fly is of a pale chocolate-brown colour with a yellowish, though not very conspicuous, pattern on the back and sides of the thorax (figs. 28 & 29). The legs (fig. 30) are banded like those of *A. notoscriptus* (fig. 22) at the base of the tibiae and of the tarsal joints, but in *antipodeus* these bands are yellowish and not white and are much narrower than in *notoscriptus*.

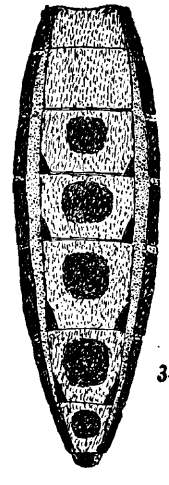
Larva. The eggs are laid in soft mud or slime in shaded locations in the forest and elsewhere in hollows under overhanging trees. The larvae avoid both direct and indirect sunlight and tend to prefer semi-darkness such as is found under road culverts or beneath vegetation at the margin of water. Mr. F. Ellett, Inspector of Health, Masterton, has ascertained that, when the water temperature rises, larval development is very much retarded; indeed, during August, when nocturnal temperatures fell to 13 deg. F., alternating with warm diurnal temperatures, larvae of *antipodeus* were quite active.

The larval siphon (fig. 31) is elongate (compare this with the short siphons of figs. 18, 26 & 27) and in this respect is of the same type as all the following species (figs. 36, 39, 41, 47 & 51). From the latter it is to be distinguished by the presence of only a single pair of ventral hair tufts arising at the middle length, and by the pecten that extends almost to the ventral hair tufts. The anal papillae are shorter than the ninth segment.









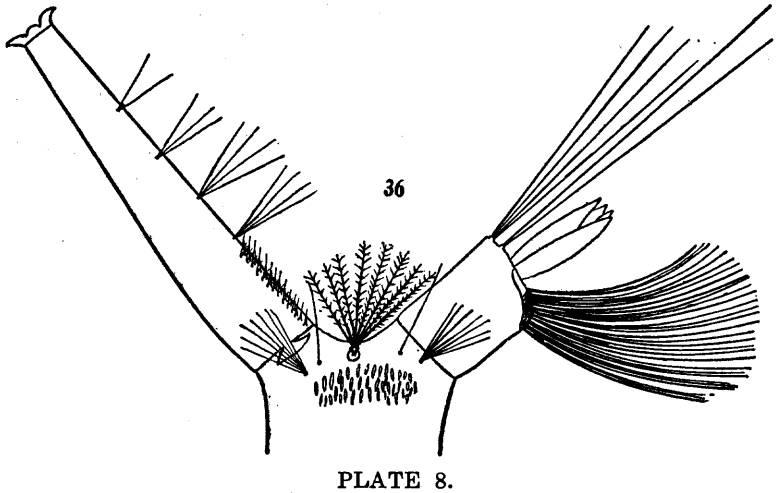


PLATE 8.

Culex pervigilans Bergroth.

Fig. 32: Pattern on back of thorax.
Fig. 33: Pattern on side of thorax.
Fig. 34: Arrangement of spots on underside of abdomen.
Fig. 35: Pattern on upper surface of abdomen.
Fig. 36: Terminal larval segments.

Culex pervigilans Bergroth.

This is the common domestic mosquito of New Zealand. The dense, rather golden, vestiture on the back of the thorax is evenly distributed and there is no distinct pattern; a close examination, however, reveals some darker lines, while down the middle line the vestiture tends to assume a "herring-bone" pattern (fig. 32). On the sides of the thorax are some yellowish spots arranged as in the figure (fig. 33). The legs have no particularly conspicuous markings, but a characteristic feature (though not well marked in some specimens) is the row of blackish spots on the under side of the abdomen (fig. 34). The whitish bands on the upper surface of the abdomen (fig. 35) should be compared with those of *Culex fatigans* (fig. 38) since *pervigilans* and *fatigans* are somewhat alike in general appearance.

Larva. *Culex pervigilans* is able to breed in a varied environment—in pure or polluted water, and even in semi-saline pools at the head of tidal flats or along the coast above the reach of high tides. It has been noted that ideal conditions are found in wooden receptacles where it seems that the wood retains a higher temperature during the night. The larvae do not develop during the winter, though some activity takes place under spells of warm weather; the greatest activity occurs from spring to late summer. The eggs are laid in raft-like batches (fig. 8) which float on the water surface.

The larval siphon is long (fig. 36) and from others having this character (figs. 31, 39, 41, 47 & 51) it differs in that there are four pairs of ventral hair tufts. Other features are that the pecten does not reach beyond the first quarter of the siphon, while the anal papillae are barely as long as the ninth segment. The larvae of this species present considerable variation in the arrangement of the hair tufts.

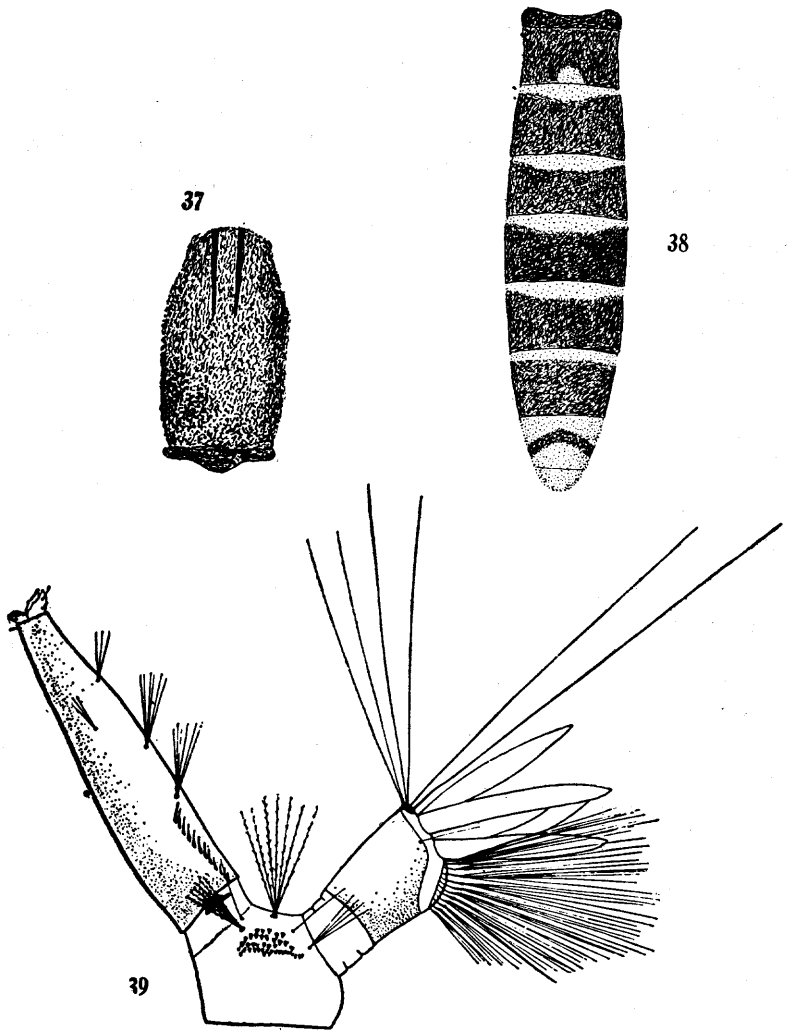


PLATE 9.

Culex fatigans Wiedemann.

Fig. 37: Pattern on back of thorax (adapted from Terzi).
Fig. 38: Pattern on upper surface of abdomen (adapted from Terzi).
Fig. 39: Terminal larval segments (after Woodhill & Pasfield).

Culex fatigans Wiedmann.

This is a cosmopolitan mosquito and resembles *Culex pervigilans* in general appearance and in its golden colour. However, the indistinct pattern on the back of the thorax (fig. 37) consists merely of a pair of short darker stripes on the anterior part (compare with fig. 32). Though the absence of spots on the under surface of the abdomen readily separates *fatigans* from *pervigilans* (fig. 34), the whitish bands present on the upper surface of the abdomen in both species should be compared (figs. 38 & 35).

Larva. The siphon (fig. 39) is elongate as in *pervigilans* (fig. 36), but there are three and not four pairs of ventral hair tufts, the central pair being on about the centre line of the siphon; in addition there is a lateral hair tuft in line between the central and more apical pair of ventral tufts; the pecten does not reach much beyond the first third of the siphon. The anal papillae are a little longer than the ninth segment.

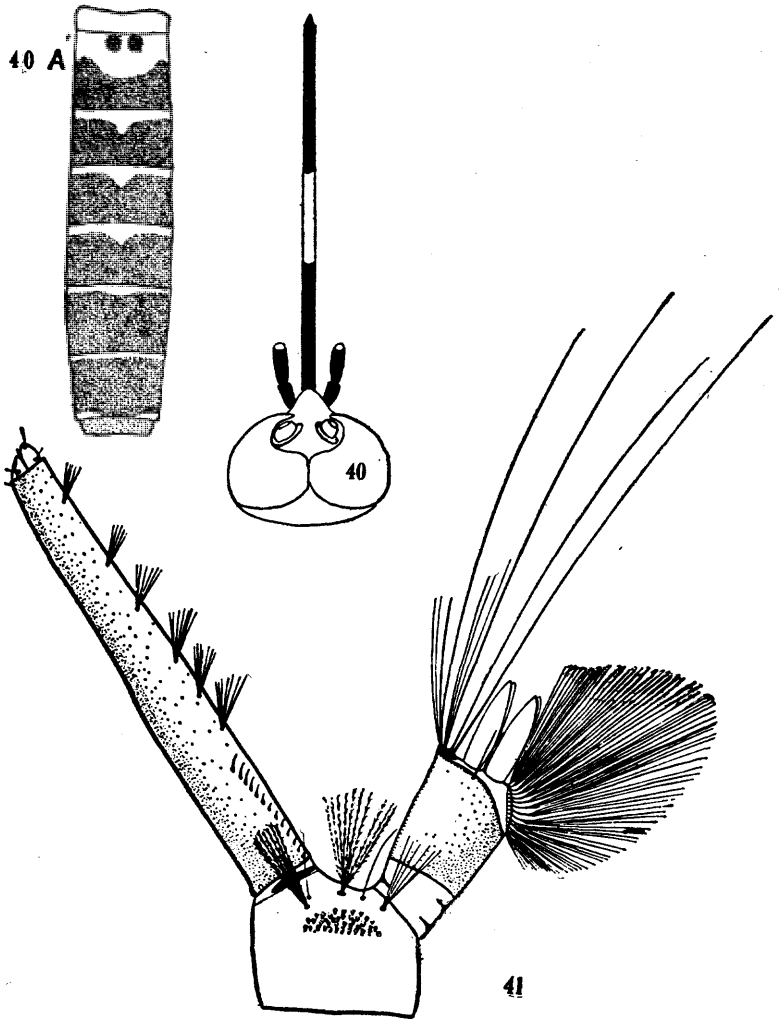


PLATE 10.

Culex annulirostris Skuse.

Fig. 40: Head, proboscis and palpi of female (modified after Taylor).

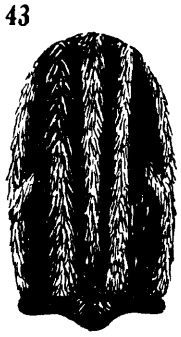
Fig. 40A: Pattern of abdomen.

Fig. 41: Terminal larval segments (after Woodhill & Pasfield).

Culex annulirostris Skuse.

This fly has a golden thorax and the legs and abdomen brownish. There are two whitish patches on the sides of the thorax. The basal half of the femora are mottled with white scales on the under side, the hind femora and their tibiae having a pale spot at their extremities, while the first three joints of the tarsi have cream-coloured banding. One quarter of the proboscis is occupied by a central cream-coloured band (fig. 40), and the white-tipped palpi of the female are about one fifth the length of the proboscis. The abdomen has a pattern of whitish bands (fig. 40A).

Larva. A distinctive feature is the very elongated and narrow siphon (fig. 41) with its six pairs of ventral hair tufts; the pecten does not reach beyond the first quarter of the siphon's length. The anal papillae are a little more than half the length of the ninth segment.



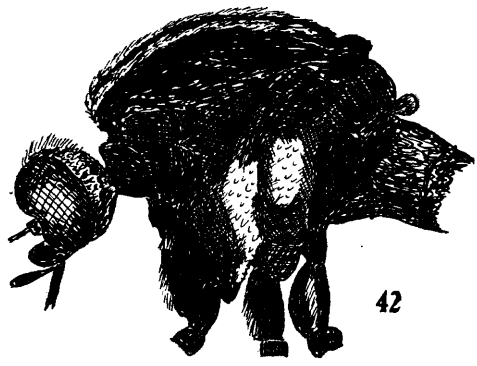


PLATE 11.

Mansonia iracundus (Walker).

Fig. 42: Pattern on side of thorax. **Fig. 43:** Pattern on back of thorax.

Mansonia iracundus (Walker).

A dark to blackish-brown fly with no conspicuous markings on body, wings or legs, though when examined by means of a lens indistinct whitish patches are seen on the sides of the thorax and arranged as in the figure (fig. 42); also the vestiture on the back of the thorax is arranged as illustrated (fig. 43).

This species is rather similar to the following one (*Mansonia tenuipalpis*), but the two can be distinguished by an examination of the palpi. In *iracundus* the male palpi, which are

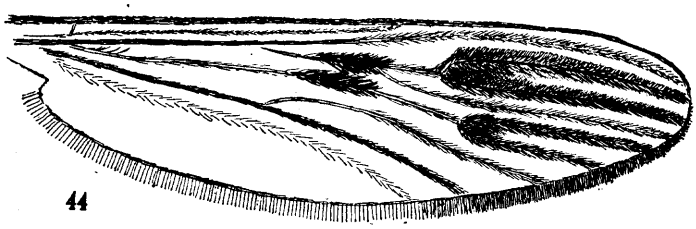
not much longer than the proboscis, have the last two segments only about half the length of the preceding one, the apex of which, together with the base of the next, is somewhat swollen. In the female the palpi are barely one fifth as long as the proboscis.

The larva is at present unknown.

Mansonia tenuipalpis (Edwards).

This mosquito is similar to *Mansonia iracundus* but the male palpi are much longer than the proboscis, the last two segments are about equal in length to the preceding one, and none of the segments is swollen. The palpi of the female are about one quarter as long as the proboscis.

The larva is as yet unknown.



44

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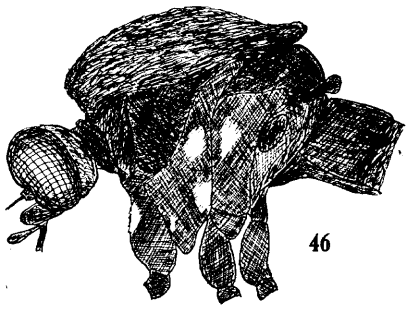
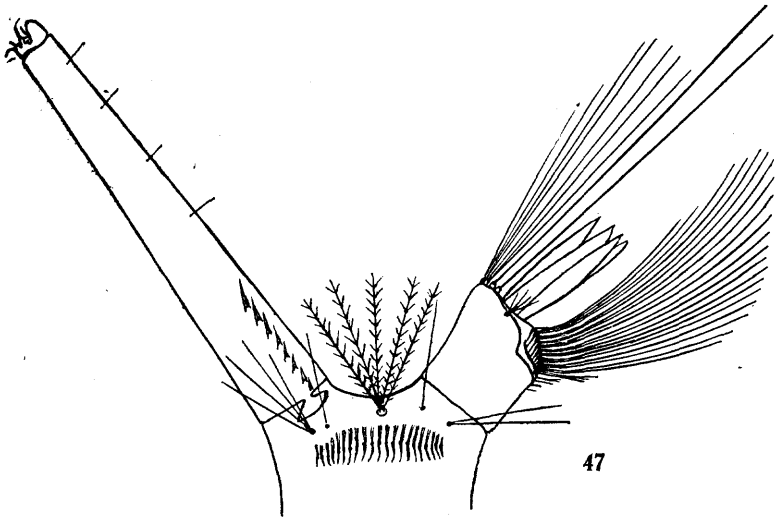


46



47

PLATE 12.

Theobaldinella tonnoiri Edwards.

Fig. 44: Wing showing darker pattern.
Fig. 45: Pattern on back of thorax.
Fig. 46: Pattern on side of thorax.
Fig. 47: Terminal larval segments.

Theobaldinella tonnoiri Edwards.

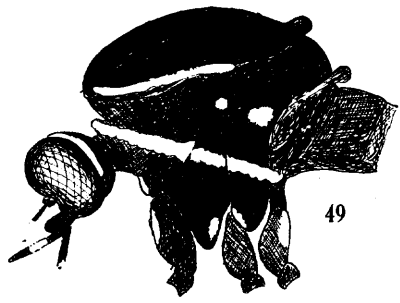
This mosquito is of a pale-brown colour with no conspicuous whitish markings, though on the legs the femora and tibiae are distinctly tipped with yellow, while the base of the femora is the same colour.

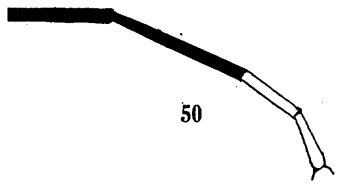
The feature by which this species can be distinguished among all the others described herein is found on the wings; these have transparent and darker areas forming distinct markings owing to the arrangement of the scales on the veins (fig. 44).

On the back of the thorax the golden vestiture is arranged as illustrated (fig. 45), and there is a pattern of whitish spots on the sides (fig. 46).

Larva. The larvae of *tonnoiri* were first discovered by Mr. H. R. Simpson, of Dargaville, in the Waipoua Kauri Forest. So far, they have been found only in the back waters of streams where there is very slow-flowing, or comparatively dead, water sheltered by a dense canopy of foliage and rich in decaying matter including leaves and other debris; amongst the latter, the larvae of *tonnoiri*, like those of *antipodeus*, hide when alarmed and are difficult to find, but unlike *antipodeus* they appear to develop chiefly during the summer.

The siphon of *tonnoiri* is long and narrow (fig. 47) and resembles that of *annulirostris* (fig. 41) in this respect; but beyond this there is no resemblance. In *tonnoiri* the ventral tufts are represented by four pairs of *single* very minute hairs; the pecten lies on the first quarter of the siphon; the anal papillae are somewhat longer than the ninth segment. In colour, the larva is reddish or purplish on the abdomen becoming darker at the anal end; the thorax is whitish and the head a golden brown.





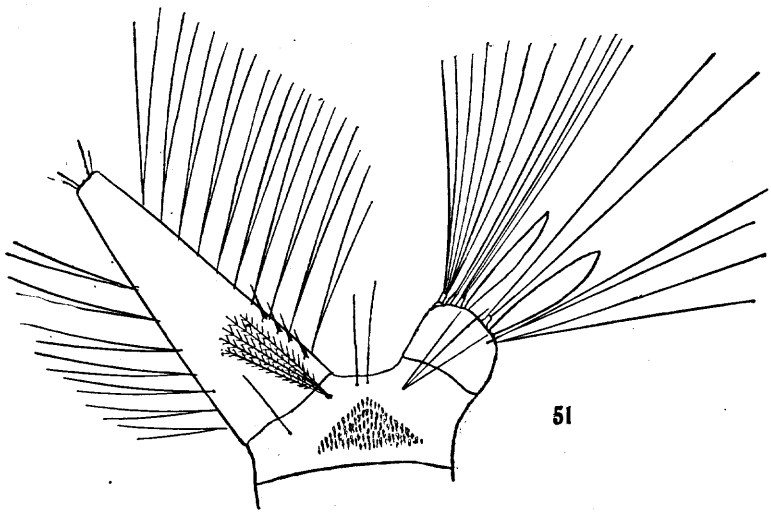


PLATE 13.

Trypteroides argyropus (Walker).
Fig. 48: Pattern on back of thorax.
Fig. 49: Pattern on side of thorax.
Fig. 50: White terminal joints of foot.
Fig. 51: Terminal larval segments.

Trypteroides argyropus (Walker).

This is a very distinctly and characteristically marked mosquito, and is very easily identified even by the unaided eye.

The back of the otherwise blackish-brown thorax is bordered by a distinct white strip on each side (fig. 48), while in profile (fig. 49), and in addition to one of the stripes bordering the back, another white stripe is seen running diagonally across the thorax; between these two stripes is a pair of white spots posteriorly. The legs are also characteristically marked; the last two segments forming the tips of the feet are white (fig. 50), while there is a white spot at the end of both the femora and tibiae. Further, the base of the antennae is orange, the palpi are bluish white in the middle, and the posterior margins of the eyes are bordered with bluish white.

Larva. The larvae are difficult to find owing to their habit of remaining submerged for long periods; they have been recorded so far only from Titirangi. D. G. Graham has noted that the eggs are laid during the day, in clusters of from 12 to 20, water in secluded places near, or in, native bush being selected for this purpose.

The larva is quite distinct from that of other species. The siphon (fig. 51) is in the form of an elongated cone, the ventral hair tufts, with corresponding but shorter dorsal ones, are represented by pairs of long rigid hairs along practically the full length of the siphon. The anal papillae are longer than the ninth segment. The larva, which is rather large, is of a bright golden-yellow colour posteriorly and white anteriorly.