



Introduction

Mosquitoes are two winged insects belonging to the order Diptera, family Culicidae. They are small and fragile, ranging in body from 3 to 6 m.m. They are probably the best known group of insects because of their importance to man as pest and vectors of animals and human disease.

Mosquitoes are an almost constant annoyance and they are some that bite by night and other that bite by day. Great swarms may be produced even in small quantities of water. They breed in all sorts of water, fresh or salt, foul or potable; water in tin cans, and vast stretches of salt marsh. Real estate values suffer where the mosquito pest prevails, and losses resulting from lowered industrial efficiency are frequently considerable because of mosquito annoyance. Economic losses due to mosquitoes would alone, no doubt, amply justify the great sums now spent on mosquito abatement, yet these losses are minor compared with the prodigious damage done to the public health by mosquitoes as a vector of disease.

Mosquitoes are the most significant of all insects as the vectors of disease, although not all species carry disease. Malaria is carried by the various species of the genus Anopheles. The genus Aedes aegypti are vectors of dengue fever, yellow fever, haemorrhagic fever. Infectious encephalitis is carried by species of the genus culex and possibly others; and species of the Aedes, culex, and Anopheles genera have been incriminated in the transmission of filariasis.

Mosquitoes as Vectors of disease

Mosquitoes are the most significant of all insects as the vectors of disease, although not all species carry disease. The diseases which ~~are~~^{are} carried by the mosquitoes, are malaria, yellow fever, dengue fever, infectious encophalitis, and haemorrhagic fever. These disease are carried by mosquito-borne disease of certain speices.

Malaria

Malaria is carried by the various species of the genus Anopheles. It is the most important mosquito-borne disease at the present time. This disease is the endemic

in many parts of the world including parts of United States. Malaria is seldom a fatal disease, but it is difficult to cure, it recurring attack will incapacitate the victim for varying periods over a term of years. Even between attacks the sufferer may be so weak as to lack any ambition or desire to work. This result in low earning capacity and lack of resource to obtain adequate medical cure and protective housing. Generally such endemic areas cannot afford efficient public-health services. Thus a vicious circle is set up that perpetuates the ravages of the disease. Now many conditions of techniques for controlling this disease are improved in the endemic area, and these techniques have become available in the past few year. But unfortunately some of these techniques have been unable to use in Asia or Thailand.

Yellow fever

Yellow fever derives its name from the jaundiced color of the skin, mucous membrane, and sclera, which usually develop about the third or fourth day of the illness. The fatal cases death usually occurs between the fifth and eighth day of the illness. The mosquito of genus *Aedes aegypti* serves as the intermediate host for parasite of

yellow fever. This disease is transmitted to the person by mean of the bite of the mosquito that has previously fed on the blood of those sick with this disease. The disease is found in South America and particularly in West Africa. In Thailand, this disease is not found, although, we have found the mosquito of this species.

Dengue fever

Dengue fever also known as breakbone fever or dandy fever, is widespread disease of tropical and subtropical regions but it also occurs in temperate climate where suitable vectors are present. The disease is characterized by its sudden attack, severe rheumatic pains in the joints and limbs, intense headache, backache and high fever; a remission of two to three days follows the first attack of three days; the second attack lasts usually but a day and is accompanied by a rapidly spreading rash. The death by this disease is very low, but it also prolongs convalescence and debilitating effect. The mosquito of genus *Aedes aegypti* is the vector of disease and transmit this disease by the bite. In Thailand this disease occurs at occasional times and have low death rate.



Filariasis

This disease is also named "elephantiasis". It is widespread over the tropical areas of the world. It occurred by the nematode worm belonging to the family Filariidae. The larval worms are commonly known as microfilariae and occur in the circulatory and lymphatic systems, connective tissue layers, and serous cavities of vertebrate hosts. This is the communicable disease but it does not cause death such as malaria. It effects to the body of person by losing the shape or make the limb being cripple and makes them suffering for long times. The vector of this disease is the species of genus culex, Anopheles, Mansonia and Aedes. In Thailand this is found in the eastern coast of the southern part.

Infectious encephalitis

Infectious encephalitis is a disease that causal agent is virus. This virus is known as Japanese B. virus, and may have other viruses mixed with this virus. This disease is found in sections of United States and Japan. In Thailand, This is found in the beginning of the rainy season and found in some place. This disease is not well.

known as malaria or other disease. The vector is the species of genus culex and possibly other. This disease can occur in animals, such as horses and asses and cause their death about 25 - 30% which is shown on the report of Soawapa station or Thai Red Cross. This is the new disease and has no new method for curing the patient, thus death rate is higher than 50%

Haemorrhagic fever

This disease is found in Thailand and occurs in occasional time. It is the disease that causal agent is virus. This is the new kind of disease and occurs with the children in adult does not find. In children some case, the symptom is an acute, febrile infection characterized by a petechial rash, tendency to hemorrhage from mucous membrane, and evidence of damage to the kidneys. The causal agent is known as mosquito of species of genus *Aedes aegypti* and *Culex pipiens quinquefasciatus*. This disease is not severe as malaria or other disease. Now the research in this disease is progressing.

Life cycle of the mosquito

The life cycle of the mosquito is characterised by complete metamorphosis, having four successive stages in its development, namely egg, larva, pupa, and adult winged insect. The principal characteristics of these four stages are described below.

Egg.

The female mosquito lays egg in batching ranging in number from less than 50 to more than 200, one female may deposit several batches in her life time. The eggs of some species are glued together in mass which floats on the water; other are deposited on soil at the edge of water or in depression where the water will collect, and some species may lay singly on the still water. The eggs of the species *Anopheles* or the malaria mosquito are in the last group. The eggs of yellow fever mosquito, *Aedes aegypti*, prefers to lay its eggs on wet surface contiguous to water in artificial container. Some species such as, *Finlaya*, subgenus mosquito lay their eggs on the sides of tree cavities and depend on flooding by rainfall to submerge the eggs before

hatching. The female of culex, Mansonia, Culiseta, and Uranotaenia generally glued their eggs together in raft like masses which are deposited upon the surface of the water. The incubation period is usually two to three days in warm weather, and sometime the eggs of some species may remain dormant for month or year. They are the eggs of the salt-marsh mosquitoes. However the eggs of many species can withstand long periods of drying or cold.

Larva

After the eggs of a mosquito have been in contact with water for a sufficient time, the eggs hatch into the larva, which are popularly known as wigglers or wiggletail. The larvae of all mosquitoes are aquatics; they are air breather and must renew their air supply occasionally through a breathing tube situated at the tail. They remain in this stage for four to ten days. During growth the larvae shed its skin four times. All mosquito larvae must come to the surface at frequent intervals to obtain oxygen. The member of the genus mansonia, the larvae and pupae attach themselves to the submerged roots and stems of plants and obtain oxygen from plant tissue. The anopheles larva rests in a horizontal

position and the larva of the other species hang head downward.

Most mosquito larvae are free swimming. The food of the larvae consist of small plants and animals and particles of organic matter which are swept into the mouth by mouth brushes.

Pupa

This stage appears with the fourth molt. They are comma-shaped, and are still aquatic and air breathing, but do not feed. The pupae rest at the surface because it is lighter than water, and there is an air cavity between the wings of the future adult. The wing is formed in this stage and usually emerges in about two days.

Adult

Upon emerging, the adult swallows some of the air within the pupal skin and exert internal pressure by muscular action to split the dorsum of the cephalothorax. The adult rests on the surface of the water until its wings dry and harden. Then it is capable of flight.

In the life span of adult mosquito is only a few week during the summer month, but yellow fever mosquito, *Aedes aegypti* may live a month or more.

Habit of the Adult Mosquito

Mosquitoes are the best known because of their blood sucking habit. However, only the female mosquito is able to bite human or animal, the mouth of the male mosquito cannot pierces the human or animal skin. The male lives up on the plant juices. The female must obtain a blood meal to the development of viable eggs. Certain mosquitoes are night biters and spend the day-light hours in dark corners of structures and in high grass, weed, vines, and shrubbery, where they are sheltered from the sun, wind and rain. The discomfort that result from mosquito bites is caused by the small amount of liquid which is injected by the mosquito as soon as she has penetrated the skin.

Mosquitoes do not travel long distances. Anopheles are likely to travel a half mile, and occasionally more than a mile from their breeding places. The common mosquitoes are usually produced in the immediate neighborhood. There are a small percentage of them may ravel much farther than a mile.

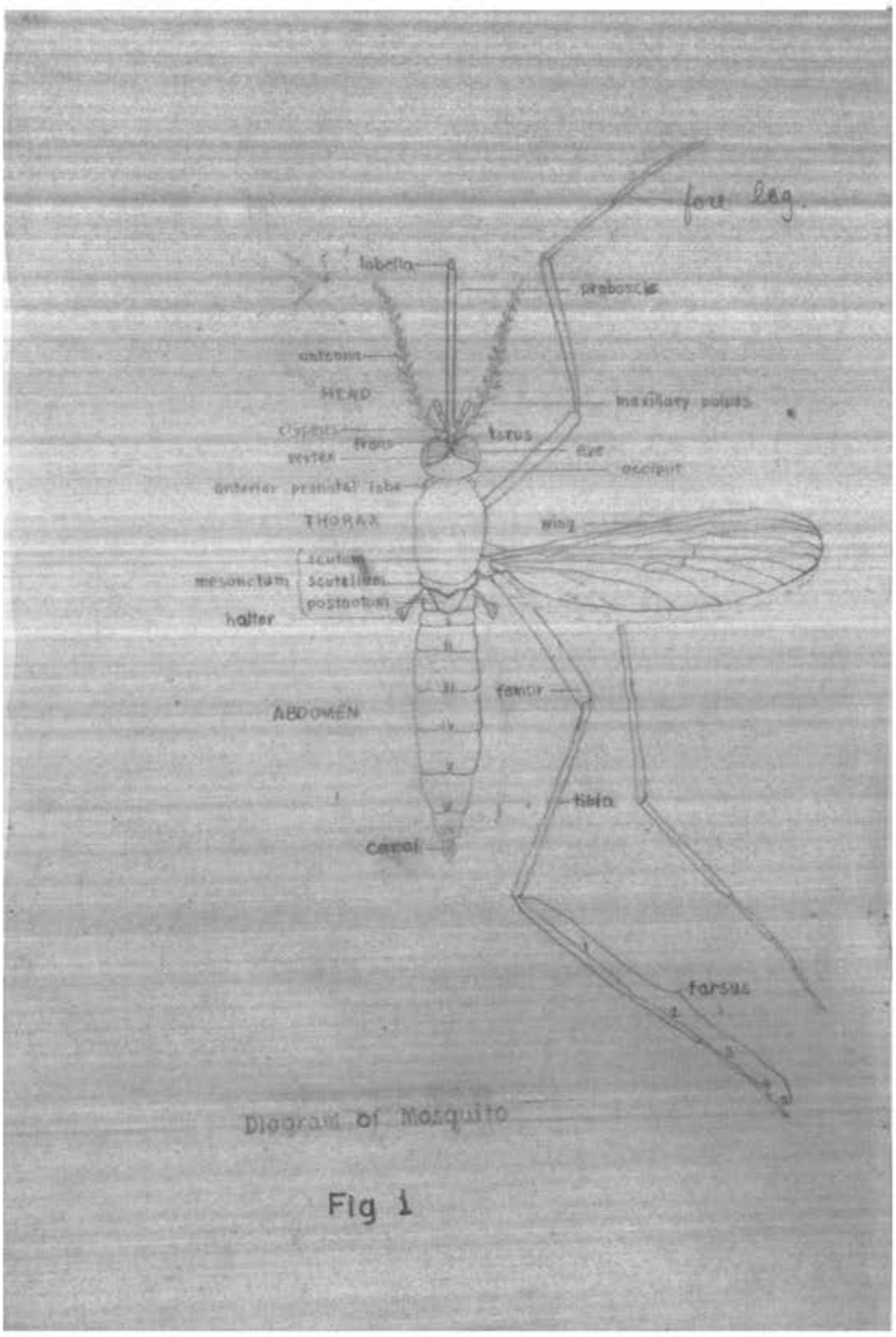
a mile. Salt-marsh mosquitoes will travel long distances with favourable winds, they can travel as far as 30 to 40 miles.

Characteristic of Adult Mosquito

The body of an adult mosquito comprises three distinct regions: the head, the thorax, and the abdomen. The figure of mosquito is shown on the next page. In the figure, it is the principal structure of an adult female mosquito. The principal part will be explained in the following paragraph.

Head

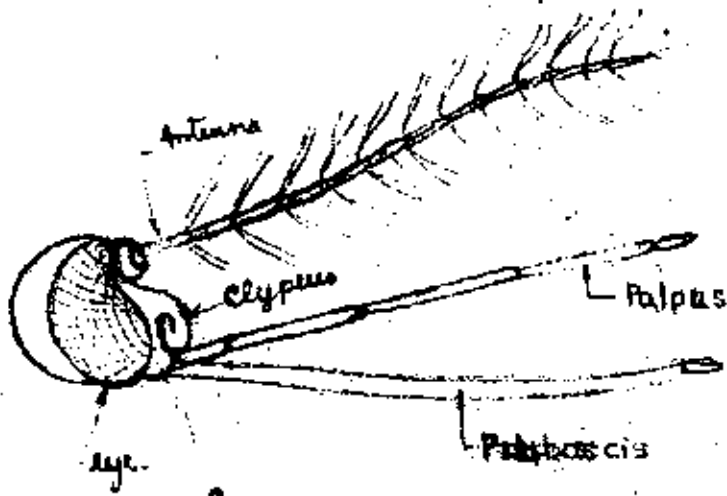
The large compound eyes-most of the lateral part of the head, ocelli are lacking. The part of the head posterior to the eyes is termed the occiput, and the part extending forward between the eye, the vertex. The frons lies between the base of the antennae and joins the anterior margin of the vertex. The occiput and vertex are clothed with erect and decumbent scales of various types and colours, often providing good characters for identification. The clypeus is a short projection situated just anterior to the frons.



It is longer than broad, and has its distal margin rounded in the tribe Anophelini and Culicini, but is wider than long and has its distal margin trilobed in the tribe Toxorhynchitini.

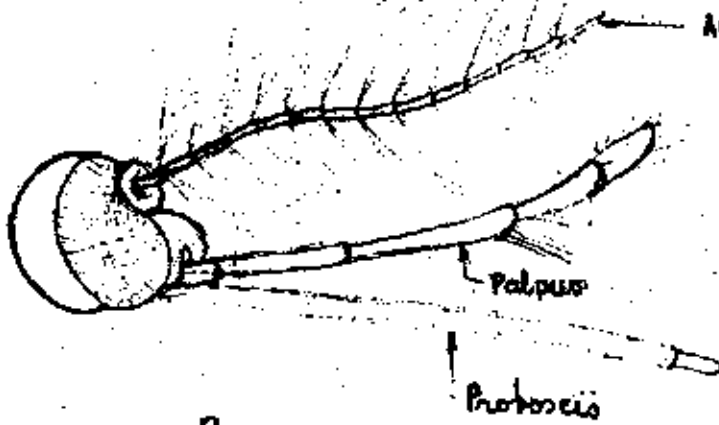
The antennae are long, slender, 15 segmented structures arising on either side of the frons between the eyes. The first segment is small and is hidden beneath the large globular second segment (torus). The remaining thirteen segments are filamentlike and make up the flagellum. Each flagellar segment bears a whorl of hairs, short and sparse in the females and usually longer and more abundant in the males. The palpi are 5 segmented, the first being very short. In Culicines the palpi of the female are usually smooth scaled, more or less straight, and much shorter than the proboscis. The male Culicines usually have densely haired palpi, longer than the proboscis and with the distal segments angled upward and tapered to a point. The male are easy to recognize by their long bushy palpi and bushy antennae.

The proboscis is composed of the greatly elongated lower lip known as the labium, with its enclosed piercing and sucking structures. The labium is sheathlike and terminates in a pair of small lobes (labellae). The labium never enters the wound during the feeding process. It serves as a protective sheath and guides and supports the piercing mouth parts, but is bent out of the way as the skin is pierced and penetrated.



Head of female Anopheles

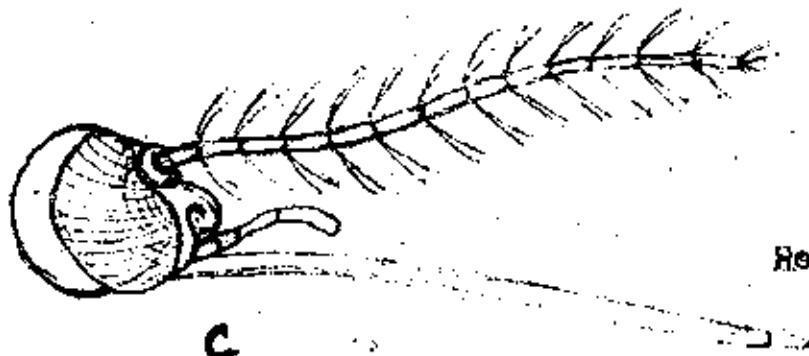
A



Antenna

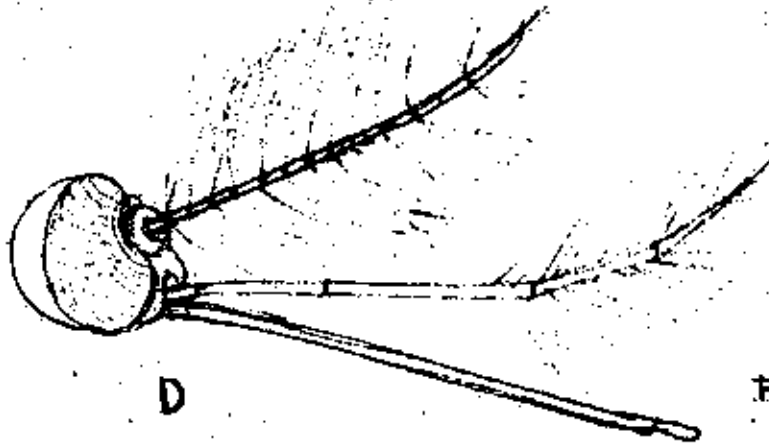
Head of male Anopheles

B.



Head of female Culicini

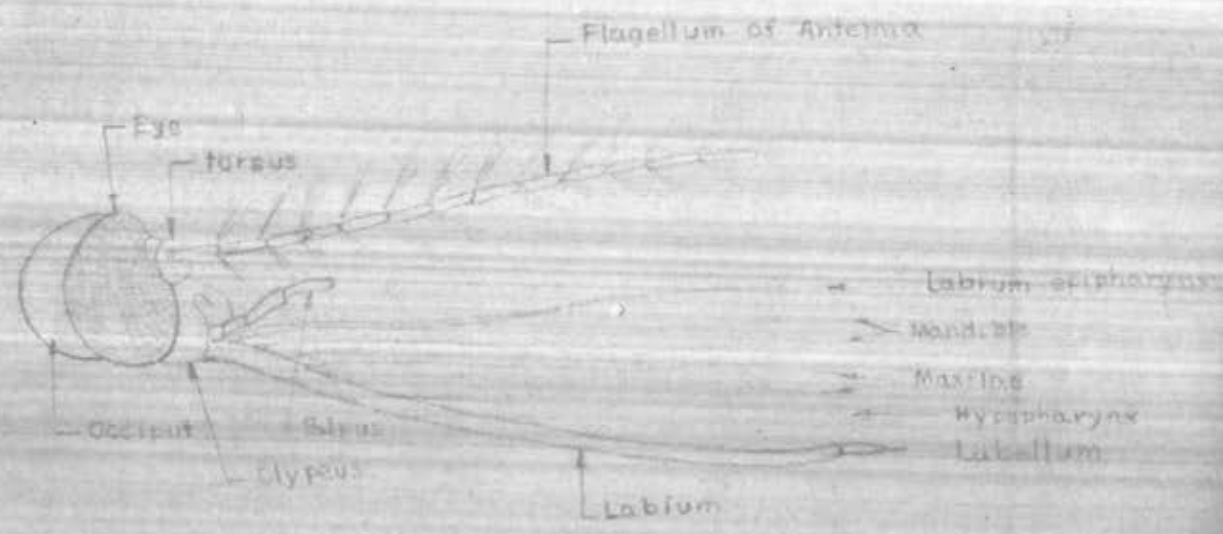
C



Head of male Culicini

D

Fig 2



Mouth part of female mosquito

Fig 3

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The mouth parts are described as follow: the labrum-epipharynx, an elongated organ, inverted U shape in cross-section; the hypopharynx, lying directly beneath the labrum-epipharynx and forming a canal through which liquid food is drawn during feeding; the paired mandibles delicate in form and lying lateral to the labrum-epipharynx; and the paired maxillae, lying beneath and lateral to the hypopharynx and dentate apically. The mouth parts of the male are modified, the hypopharynx usually fused with labium, the maxillae delicate and greatly reduced and the mandibles poorly developed.

Thorax

The thorax is composed of three fused segments. The prothorax bearing the front pair of legs, the mesothorax bearing the wings and the middle pair of legs, and the metathorax bearing the halteres and the hind pair of legs.

Legs

The mosquito has six legs. One each segment of the thorax bears a pair of legs; the front legs arising from the prothorax, the middle legs from the mesothorax, and hind legs from the metathorax. Each leg is composed of a coxa, trochanter, femur, tibia and five segmented tarsus (fig above). The fifth tarsal segment bears a pair of small tarsal claws or ungues. The legs are clothed with scales, hairs and bristles. The scale are used for description the species of mosquitoes.

Wing

The wing of mosquito with venation is shown in the figure.

Halter

It is used as balancing organs and is not used in flight. The halter comprises three parts: the scabellum or base, the stem like part or mid halter, and the capitellum or terminal knob. The color of integument and scales of halter is used in separating species.

Abdomen

The abdomen is composed of ten segments; the first eight of which are distinct and unmodified. The ninth and tenth segments are greatly modified for sexual function in both male and female.

Egg Characters

The shell of mosquito egg comprises three layers: the innermost thin vitelline membrane surrounding the yolk; the intermediate endochorion, the more or less sclerotized opaque outer shell, and the exochorion, a thin transparent layer covering the endochorion and marked with small protuberances and reticulations. The new laid egg the endochorion is also transparent but soon becomes opaque. Mosquito eggs are white when laid but gradually become dark brown or black.



Wing of mosquito with venation.

- | | |
|------------------------------|-----------------------------|
| C - Costa | 5 - Fifth longitudinal vein |
| Sc - Subcosta | 5.1 - Anterior branch |
| 1 - First longitudinal vein | 5.2 - Posterior branch |
| 2 - Second longitudinal vein | S - Sixth longitudinal vein |
| 2.1 - Anterior branch | H-V - Humeral cross vein |
| 2.2 - Posterior branch | 2-3, 3-4, 4-5 - Cross vein |
| 3 - Third longitudinal vein | Pt - Petiole of vein 2 |
| 4 - Fourth longitudinal vein | |
| 4.1 - Anterior branch | |
| 4.2 - Posterior branch | |

Fig 4

The eggs of Culicine mosquitoes are usually elongate-oval in shape (figure 5A...). The larger end, containing the head of the developing embryo, is usually rounded, though the posterior end is bluntly pointed. The eggs are laid in raftlike masses.

The eggs of Anopheline mosquitoes are boat shaped, flattened, or slightly concave dorsally and convex ventrally (figure 5B,C). They are deposited separately on the water.

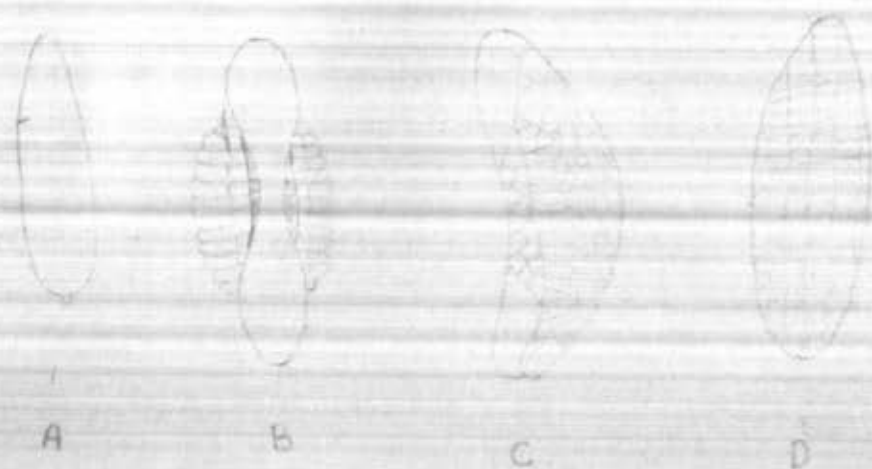
The eggs of Aedine mosquitoes are elongate-oval in shape, but the both ends are rounded (figure 5D..), one side has more curve than one side. They are laid singly on the surface of water.

Tribes of Mosquitoes

There are about 1,600 species of mosquitoes in the world. For practical purpose, some books may be divided into four tribes.

1. Megarhinini, basal half of proboscis rigid and distal portion flexible, the adult are flower-feeding and the larvae are predaceous.

2. Culicini, in which the palpi of the female are less than half as long as the proboscis, scutellum, trilobed, pulvilli, present, eggs laid in rafts.



A = Egg of Culex

B = Egg of Anopheles (dorsal view)

C = Egg of Anopheles (lateral view)

D = Egg of Aedes aegypti

Fig 5

3. Aedini generally include with Culicini in which the palpi and scutellum are as in the Culicini, but the abdomen of the female is pointed postspiracular bristles are present, pulvilli absent or hair-like, eggs are laid singly.

4. Anophelini, in which the palpi of both sexes are as long or nearly as long as the proboscis, scutellum rounded without lobed, eggs laid singly.

Tribe Megarhinini

Characteristic

This tribe occurs in tropical as well as temperate climate and are usually highly coloured; they are day flier; both sexes are flower-feeders and do not suck blood. The basal half of the proboscis is stout and rigid while the distal portion is flexible, which accounts for the curious hook like position of proboscis when at rest. The palpi vary in length from one-fourth the length of the proboscis to nearly the same length. The huge larvae are predaceous and cannibalistic. The mouth parts are particularly adapted for capturing prey. The eggs are deposited singly and most species breed in small confined collections of water, such as in bamboo stems, tree holes and the like.

Tribe Culicini

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Characteristics

All members of this tribe have the scutellum trilobed with each lobe bearing bristles, the abdomen is blunt and completely clothed with broad scales which nearly always lie flat, the pulvilli are broad and distinct; postspiracular bristles are absent; the larvae have a prominent siphon with well-developed pecten and usually numerous hair tufts on the siphon. The eggs are usually deposited in tight raft-like masses on the surface of water.

From the report of the world, this tribe have 700 species distributed among more than 20 genera, of which the genus *Culex* alone contains nearly 400 species. Some species of this tribe are found in Bangkok which will be shown on the other part.

Tribe Aedini

Characteristics

Ordinarily the *Aedes* Mosquitoes are included in the tribe of Culicini, but because of their remarkable breeding habits and other striking characteristics. Thus

it has taken the liberty to set apart the Aedes. There are about 600 species in the world.

The tribe Aedini have a trilobed scutellum. The most of the species, the claws are toothed in female, postspiracular bristles are present, the pulvilli are absent or hair-like, and the female abdomen tend to be more pointed and the cerci longer than in other group. The eggs are deposited singly on the surface of the water, on mud, or even in situation submergence may follow. The female of this tribe bite, many of them viciously. Most of them bite toward evening.

The tribe may be divided into salt-marsh mosquitoes, flood-water Aedes, and tree hole mosquitoes. The other genera are genus Psorophora, genus Mansonia, and genus orthopodomyia and may have other genus which we cannot shown in this subject. These tribes may be divided in to many species. The species which is the most important is Aedes aegypti, yellow fever mosquito.

Tribe Anophelini

Characteristics

The characters are generally employed to characterize the tribe Anophelini; palpi of both sexes are usually about

as long as the proboscis; the scutellum is evenly rounded, mandibles and maxillae of the female are well developed and toothed; legs are very long and slender, there are no distinct tibial bristles and no pulvilli, the abdomen is without scales or at least with sternites largely bare; the wings usually have distinct markings.

The tribe Anophelini has been divided in numerous genera. In Bangkok the tribe Anophilini is shown on the following table of page. **28.**

The eggs of Anophelini are deposited singly on the surface of the water.