



A JOURNAL DEALING WITH DEVELOPMENTS IN THE FIELD OF  
PUBLIC HEALTH IN AUSTRALIA

ISSUED BY THE

COMMONWEALTH DEPARTMENT OF HEALTH.

Vol. VI.

JANUARY, 1928.

No. 1

## Notes on the Life-Histories and Habits of Some Australian Mosquitoes.

By FRANK H. TAYLOR, Australian Institute of Tropical Medicine, Townsville.

**M**OSQUITOES are generally recognized as undesirable, though in the popular mind this belief is seldom founded on a definite knowledge of concrete facts; it has, therefore, seemed advisable to clarify the position by drafting a few notes on what is definitely known of the habits, life-histories, distribution, and pathogenicity of some Australian mosquitoes.

It should be understood that mosquitoes adversely affect man in several ways.

*First.*—The venom contained in the salivary glands which is injected when biting causes irritating papules. In some people, who seem to have an idiosyncrasy to this venom, the reaction is severe; in others there is but little local disturbance.

*Second.*—Sleep may be interfered with either by the actual act of biting by irritation caused by the lesions produced by former bites, or by the annoying buzzing produced by these insects.

*Third.*—Scratching of the bites may lead, especially in children, to a form of impetigo.

*Fourth.*—Certain specific diseases are known to be carried by particular varieties of mosquitoes.

*Anopheles annulipes* lays from 50 to 116 eggs singly in captivity. The average time of incubation, during April to July, is 60 hours, but may extend to three days. The duration of the larval period varies from seven to ten days in North Queensland and the pupal period from two to four days, according to climatic conditions.

Hill found that adults kept under laboratory conditions lived for periods up to 34 days, the males rarely surviving longer than six days, during which time they fed regularly on banana, jam, or dates. The writer has on several occasions kept the female, with regular blood meals, alive for periods varying up to two and a half months; the males always succumbed within seven days.

*Anopheles annulipes* enjoys a wide distribution on the mainland of Australia, extending from Kalgoorlie through the south-west of Western

### Commonwealth Department of Health

- Director-General of Health:**  
J. H. L. CUMPTON, M.D., D.P.H., 61 Spring Street, Melbourne.
- Chief Medical Officer, High Commissioner's Office, London:**  
C. L. PARK, M.D., D.P.H., Australia House, Strand, London, W.C. 2.
- Chief Quarantine Officers (General) in Local Administrative Control:**  
*New South Wales*—(Acting) Canon's House, Sydney.  
*North Eastern Division*—J. S. C. ELKINGTON, M.D., D.P.H., Scammony Buildings, Eagle Street, Brisbane.  
*Victoria*—(Acting) M. J. HOLMES, D.S.O., M.B., D.P.H., 61 Spring Street, Melbourne.  
*South Australia*—F. S. HONE, B.A., M.B., B.S., Pel. Chambers, Pel. Street, Adelaide.  
*Western Australia*—F. E. COX, M.B., D.P.H., Fotherell's Buildings, Fremantle.  
*Tasmania*—(Acting)
- Division of Marine Hygiene.**  
**Acting Director:** M. J. HOLMES, D.S.O., M.B., B.S., D.P.H., 61 Spring Street, Melbourne.
- Division of Laboratories.**  
**Director:** F. C. MORGAN, M.B., B.S., Commonwealth Serum Laboratories, Royal Park, Melbourne.
- (a) Commonwealth Serum Laboratories, Royal Park, Melbourne.
  - (b) Public Health Laboratory, Bendigo, Victoria.—**Medical Officer in Charge:** R. D. McIntosh, B.A., M.B., B.S.
  - (c) Public Health Laboratory, Townsville, Queensland.—**Medical Officer in Charge:** A. B. Lilley, M.B., Ch.M.
  - (d) Public Health Laboratory, Townsville, Queensland.—**Medical Officer in Charge:** N. W. Gutteridge, M.B., B.S.
  - (e) Public Health Laboratory, Rockhampton, Queensland.—**Medical Officer in Charge:** R. E. Richards, M.B., B.S.
  - (f) Public Health Laboratory, Rabaul, Territory of New Guinea.—**Medical Officer in Charge:**—Acting.
  - (g) Public Health Laboratory, Lismore, New South Wales.—**Medical Officer in Charge:** E. A. Richards, M.B., B.S.
  - (h) Public Health Laboratory, Port Pirie, South Australia.—**Medical Officer in Charge:** K. V. Mathew, M.B., B.S.
  - (i) Public Health Laboratory, Kaffeeville, West Australia.—**Medical Officer in Charge:** W. S. Nelson, M.D., Ch.M., M.R.C.P.
- Division of Tropical Hygiene.**  
**Director:** J. S. C. ELKINGTON, M.D., D.P.H., Eagle Street, Brisbane.
- (a) Australian Institute of Tropical Medicine at Townsville.—**Director:** R. W. Glenn, M.D., B.S., D.P.H., & H.
  - (b) Hookworm Campaign, carried on in conjunction with the States and engaged in hookworm control and malaria and diarrhoea survey.
- Division of Industrial Hygiene.**  
**Director:** D. C. ROBERTSON, M.D., D.P.H., 61 Spring Street, Melbourne.
- Commonwealth Medical Officer, Sydney:** A. H. MOSELEY, D.S.O., M.B., Ch.M.  
**Commonwealth Medical Officer, Melbourne:** F. R. KERR, D.S.O., M.D., D.P.H.
- Division of Public Health Engineering.**  
**Director:** A. C. GUTTERIDGE, M.C.E., M.Sc., M.R.S.M.I., 61 Spring Street, Melbourne.
- Division of Tuberculosis and Venereal Disease.**  
**Director:** M. J. HOLMES, D.S.O., M.B., B.S., D.P.H., 61 Spring Street, Melbourne.
- Division of Epidemiology.**  
**Director:** F. McCALLUM, M.B., B.S., D.P.H., D.T.M. & H., 61 Spring Street, Melbourne.
- Division of Veterinary Hygiene.**  
**Director:** W. A. N. ROBERTSON, D.V.Sc., 61 Spring Street, Melbourne.
- Division of Plant Quarantine.**  
**Director:** E. MACKINNON, B.A., B.Sc., A.A.C.I., 61 Spring Street, Melbourne.

experienced little difficulty in rearing the larvae of this species when the breeding cage was kept entirely in the shade and supplied with an abundance of food. The duration of the larval and pupal stages appear to approximate those of *Anopheles annulipes*.

*Anopheles bancrofti* has apparently a more restricted distribution on the mainland of Australia than that of *A. annulipes*, since it has up to date only been recorded from localities in North Australia and Queensland, including Elebe, Melville, and Croker Islands, off the coast of North Australia, and Palm and Banks Islands, off the coast of Queensland. It has a wide range in these two States, being found throughout the coastal belt as far south as Brisbane. It is, however, not merely a "lowland" species, since it has been taken on the Northern Tableland, at Mount Molloy, which has an elevation of about 2,000 feet. It is not improbable that the species will eventually be discovered in north-west Australia and northern New South Wales. It is known from Madang and the Admiralty Islands, in the Territory of New Guinea, and probably extends through Papua into Dutch New Guinea. *Anopheles pseudobarbatoris*, from the Philippine Islands, has been stated by Christophers to be a synonym of *A. bancrofti* and also *A. pallidus*, from the Dutch East Indies.

*Anopheles bancrofti*, unlike *A. annulipes*, shuns breeding grounds subjected to direct sunlight, neither has it been found in small collections of water, such as hoof holes. The writer has in mind a swamp that existed some years ago in Cairns, which was of fairly considerable length and about 2 feet in depth at its deepest point, toward one end of which a large tree had been felled across it. Mosquito larvae were abundant along the sides of this tree, and here the larvae of both *A. bancrofti* and *A. annulipes* were found, but those of the former were always on the shady side of the tree, while those of *A. annulipes* were indiscriminate. As a general rule, the larvae of *A. bancrofti* seem to prefer moderately shallow water well overgrown with grass or reeds. It has on several occasions been taken in the backwash of creeks, especially those protected by fallen trees or growing reeds; swamps that are more or less overgrown by the latter are also good breeding grounds. Larvae of this species have also been found in slowly running water by the writer. Pot-holes in creeks, in deep gullies, would probably be potential breeding grounds.

*Anopheles bancrofti* appears to feed readily, certainly from 2 until after 11 p.m. The writer was, quite recently, bitten by this species in a partially shaded gully at Mount Molloy a few minutes after 2 p.m., the sky being cloudless at the time. During the dry seasons of 1912-17, following good wet seasons, it was a common occurrence to be attacked by this species in the late afternoon when in the scrub on the Townsville Town Common. This mosquito shows no preference for attacking any particular portion of the person. It is an adept at biting through clothing, being able to pierce thick khaki trousers with apparent ease. It has been observed to be a gross feeder, for when apparently replete it will continue to suck blood, passing at the same time tiny droplets of a clear fluid *per anum*, until its abdomen is so distended with blood that it is unable to fly more than a few feet at a time without resting.

Australia northward to Derby, and under favorable climatic conditions is very probably common throughout the Kimberley district. It has been recorded from numerous localities in North Australia, including Elebe Island, and is present throughout Queensland, including most probably the whole of the Atherton Tableland, specimens being known from Irvinebank, which has an altitude of over 2,000 feet. The records are not as complete for New South Wales as Queensland, but *A. annulipes* has been found in several widely distant localities, e.g., the north coast district of New South Wales, Narramine, on the Bogan River, and Hay, on the Murrumbidgee. Known intervening localities are on record, particularly Gosford, the metropolitan area of Sydney (where apparently primary infections of malaria have occurred, this mosquito being the presumed transmitter of these sporadic cases), the Hawkesbury River Valley, &c. It is widespread in Victoria, and at times a particularly abundant species. The writer found, under the flood conditions prevailing in the latter part of 1916, that this mosquito was exceedingly abundant in the Goulburn-Murray Valleys, so much so that horses which had been employed in the plough during the day received no rest at night-time owing to the attacks of this vicious and blood-thirsty mosquito. Somewhat similar conditions were also found in some parts of South Australia along the Murray River. There is no information to hand concerning the distribution of this species in the area west of the Murray in this State. It is known from Charlotte Waters and Alice Springs, in Central Australia. The species has been recorded from Northern Tasmania, the original type coming from this State.

The writer has recorded this species from the Lakekamu Goldfield and the Mekeo district, in Papua, and the Solomon Islands, but he is convinced that these records are erroneous, and should refer to *Anopheles punctulatus*.

The breeding places of *Anopheles annulipes* are, *par excellence*, hoof-holes on the edges of swamps and other similar collections of water. The contained water may be either clear or muddy, overgrown with vegetation, or entirely free of such growth. Other breeding places are shallow swamps, usually overgrown, irrigation channels, street gutters containing slowly running or stagnant water, sheltered backwaters of creeks, rock pools above tide level (in one on Palm Island, where the larvae of this mosquito were found, the water was covered with green slime), running creeks, where the force of the current is broken by fallen trees, rocks, &c., tins on garbage dumps, where they have been found in company with those of *Aedes (Stegomyia) argenteus*. The larvae have, on one occasion, been found in saltwater in a tidal creek, but this is unusual, though the larvae will thrive in brackish water, since they had probably been washed down from pools higher up the creek by spring tides than prevailing.

The species does not appear to show any preference for any particular part of the person when biting, as they will attack the head, arms, and above the ankles with equal avidity. Summer clothing is no barrier against their attacks.

Very little is known concerning the life-history of *Anopheles bancrofti*. Gorged wild females, when placed in a breeding cage, have on several occasions refused to deposit eggs. However, the writer has

## HEALTH.

This mosquito will enter houses to bite, although both horses and cattle, besides a numerous poultry yard, intervene between its breeding place and the dwelling so entered.

*Culex fatigans*, the vector of the nocturnal type of *Filaria bancrofti* in Australia, lays its eggs in boat-shaped masses in numbers from a few to over 300 per batch. This species has been observed to lay as many as five batches of eggs in the course of its life, in captivity, if regularly fed with blood. The eggs hatch in about 24 hours; the larval period averages about seven, and the pupal about two days under favorable conditions, but adverse climatic conditions will considerably prolong the various stages of development. The adults will live for several weeks in captivity.

This mosquito is perhaps one of the most widely spread species in Australia, being found from Perth, in the west, to Darwin, in the north, extending to Launceston, in the south, thence across to South Australia. In the north-east it ranges across to Papua and the Territory of New Guinea. It is essentially a domestic and most annoyingly persistent species in Australia. The larvae are found in any kind of water in and around dwellings, sewage and the like being their most favoured pabulum. In the main, this mosquito seems to select unclean to clean water on which to lay its eggs. There is no situation near houses in which this mosquito may not be found, from the flower vase to the underground privy. The larvae are also to be found in street gutters, especially where the water is polluted, and in their gully traps. The most prolific breeding grounds in the north appear to be earth drains, street gutters, and other situations containing foul water, house tanks which are not regularly cleaned also form suitable breeding places. The writer on one occasion bred the mosquito from larvae found in a tin of stale urine. Rubbish dumps are also potential breeding grounds after rain.

*Culex fatigans* has in the past been regarded as being a strictly nocturnal feeder, but it can be induced to bite in a darkened room, and, having commenced to feed, be exposed to strong light, when it will then in no wise be disturbed in its feeding. It appears to show a preference for one's head and hands, though it will readily feed upon any exposed parts of the body.

In *Aedes (Stegomyia) argenteus*, commonly known as the "Tiger mosquito," we have, perhaps, the most domesticated and notorious mosquito known. It is the proven vector of both yellow and dengue fevers. The eggs are laid singly, from a few to about 80 per batch, are cigar shaped, and appear as minute black specks on the surface of the water, or round its edges on the surface of the container to which they are securely cemented awaiting submersion. Normally, the incubation period lasts about 24 hours, but it may be hastened or retarded by climatic conditions. The duration of the larval and pupal stages varies from five to seven days for the former, and two to three days for the latter under optimum conditions. Cold will materially lengthen these periods. A shortage of food in the larval period will produce adults much smaller than those of normal size. It is a well-established fact that the eggs of this mosquito retain their vitality over long periods in a desiccated condition; their fertility is also unimpaired by freezing.

## LIFE-HISTORIES OF SOME AUSTRALIAN MOSQUITOES.

The larvae may also remain more or less dormant during the cooler months in Townsville. It stands to reason, therefore, that during the same period of the year, where conditions are more adverse, i.e., below 42 deg. F., the larvae would be better able to overwinter successfully without undue loss of life than in the adult stage. That this is probably the case is shown by the presence of the species in the New England district of New South Wales, where the winter is rigorous.

The adaptability of this mosquito to local conditions is somewhat remarkable. The larvae have been found in such diverse situations as house tanks, rot-holes in trees, and a discarded paint tin containing water, which when emptied was found to contain the dregs of green, blue, and brown paints. Another unusual situation was that of an old tin about a third full of water, rendered foetid by decaying vegetable matter. The larvae have also been found in a fire-sprinkler tank in Brisbane over 100 feet above street level, and in a sump in a gold mine at Charters Towers. The usual breeding place of this mosquito is, however, water contained in domestic utensils—flower vases, pots filled with water used as protectors against ants, in which the legs of tables, ice chests, &c., are stood, water tanks, butts, fire buckets, disused tins, &c., in fact, any receptacle about houses capable of holding water. In this connexion, sagging roof gutters must not be overlooked after rains. Larvae have also been found in the small water traps used as a seal beneath ice chests. The eggs have also been recovered from the dried contents of rot-holes in trees proved by subsequent breeding out.

*Aedes (Stegomyia) argenteus* has a wide distribution in Australia. It is very probably to be found throughout Queensland. It is known to occur all along the coast, and specimens have been seen that were taken, in 1881, at Cunnamulla, 604 miles by train from the coast and about 450 miles by road. These "migrants" were undoubtedly carried by reamsters in the larval stage in their water tanks. The most southern limit of distribution is north of a line connecting Newcastle with Bourke, in New South Wales, and including these towns. It is not known from southern New South Wales, Victoria (contrary to reported records, due probably to confusion with *Filinia notoscriptus*), Tasmania, or South Australia. In Western Australia it is known from Broome (but it almost certainly occurs further southward) and Derby, also from Yeda Station, about 25 miles distant, where the larvae were found in a soak hole below the tap of a water tank, their presence there being due to the fact that travellers emptied their water bags at this spot before refilling at the tank.

There are no records concerning its presence in Wyndham, but its absence seems extremely improbable. Darwin, in North Australia, is a stronghold. From the mainland it spreads through Torres Strait across to Papua and the Territory of New Guinea.

The method of attack employed by this mosquito is exceedingly irritating; its mode of attack being a quick darting flight at the selected spot, when, if disturbed, it departs as quickly, only to renew the attack again and again, until it has succeeded in its quest or been killed in the attempt, a contingency that seldom happens. The parts of the body of special appeal to this pestilential insect are round the ankles and the wrists. Other selected sites are the neck, face, and any other exposed portions of the body. It will feed at any time of the day or night with avidity.