The Cattle Tick

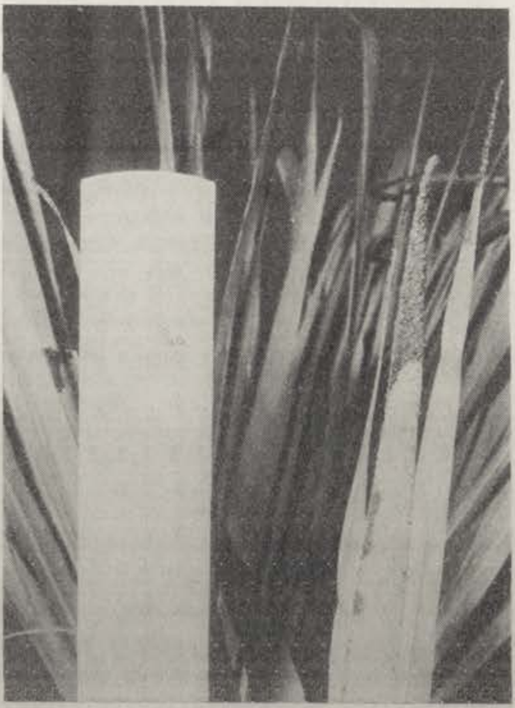
I. L. OWEN, Parasitologist, Veterinary Laboratory, Kila Kila

The cattle tick, Boophilus microplus, *is one of several species of ticks found on animals in Papua New Guinea. It is primarily a parasite of cattle, although it is also frequently found on rusa deer* (Cervus timorensis) *and has been found on goats, horses, pigs and dogs. It is widespread in the tropics, extending from South Africa, through East Africa to India and eastwards into Indonesia, the island of New Guinea, Australia and on the other side of the Pacific Ocean in Mexico, Central and South America and the West Indies.*

The genus *Boophilus* is considered to have four species, of which only one, *B. microplus*, is present in Papua New Guinea and Australia. It is an introduced pest in both countries, having been brought into Australia from Java in 1872 and into Papua New Guinea from the same area some time before the First World War. After the initial entry, the population in this country was replenished by the importation of ticky cattle from Queensland between the two World Wars. By the close of the Second World War the cattle population in Papua New Guinea had been drastically reduced but the tick remained wherever there were cattle. During the post-war period an eradication programme was begun and a stricter quarantine enforced. Under the provision of the Animal Disease and Control Ordinance (1952) it was made compulsory for cattle owners with ticky cattle to follow a set programme of spraying. Enforcement of this plan during the 1950's and 1960's resulted in all districts excepting Western, Gulf, Central, Milne Bay and New Ireland becoming free of cattle tick. At present most of the areas still tick-infested involve small isolated herds.

The presence of deer in two out of the five districts adds greatly to the problem of tick eradication. These deer, which carry tick and which roam uncontrolled in the vicinity of Port Moresby and the south-western part of the Western District, form a reservoir of the parasites.

The cattle tick is a one-host tick, i.e. it requires only one animal to live on (host) to complete its life cycle. This is in contrast with the dog tick, *Rhipicephalus sanguineus*, which requires three hosts before the adult stage of the tick is attained.



(Photo: D.I.E.S.)

Plate I.—The tick larvae climb to the top of a blade of grass and wait for a host animal to come past.

Boophilus microplus, like all ticks, feeds on the blood and tissue fluids, its mouthparts being highly adapted for piercing the skin of a host and for maintaining its position while feeding. Small blades at the tip of one pair of mouthparts (chelicerae) are used to penetrate through the host skin and this is followed by the insertion into the puncture of a toothed mouthpart (hypostome) which acts as an anchor. A secretion of the salivary glands of the tick affords an additional means of anchoring. This secretion is a cement-like substance which hardens to bind the mouthparts to the surrounding host tissue. Once firmly attached, a small cavity filled with blood, white cells and tissue fluids develops in the host tissue at the tip of the mouthparts and the contents are sucked up into the body of the tick. This meal of blood gives the mature female tick its characteristic slate blue/brown colour.

When fully fed, the adult female tick withdraws its mouthparts from the host skin and drops to the ground. It crawls away from light and seeks out a crevice or dense undergrowth in which to hide. Within two or three days eggs begin to be laid and this process may continue for several weeks. During this egg-laying period the female gradually changes from slate blue to a bright orange/yellow colour, becomes shrivelled in appearance and eventually dies. The surface of the eggs is sticky so that they remain together as a dark brown mass.

The time which elapses between the dropping of the female from the host and the establishment of an emergent larva on another host is a non-parasitic phase in the life cycle and is affected by the temperature and the humidity of the environment. (The parasitic phase, which extends from the arrival of a larva on a host to the dropping of the engorged female tick from that host, is affected very little by climatic changes of the environment since it is in close contact with the warm, moist body of the host.) The optimum temperature for egg-laying is between 75°F and 80°F and similar warm conditions coupled with high humidity are needed for incubation of the eggs. At 97°F incubation is completed in 14 days but at 62°F the process takes 114 days. At these temperatures the constant relative humidity must not fall below 70 per cent. In Port Moresby eggs take 3 to 4 weeks to hatch but take about a week longer on the Sogeri plateau at a height of 1,800 ft. above sea level.

Once out of their egg shells the larvae or seed tick remain quiescent for a couple of days and then become extremely active, swarming over surrounding vegetation and climbing up vertical objects—be they grass blades, shrubs or gate posts. Although attracted by light, the larvae normally seek that side of a grass blade or leaf which faces away from direct sunlight and will congregate in such positions in considerable numbers. They are most active during early morning when they show questing activity by waving their front legs. This becomes particularly vigorous if a warm-blooded animal approaches. The larvae are extremely sensitive to local changes in temperature which occur when the body of a mammal stands near. They are also stirred to activity by warm carbon dioxide-laden air being breathed on them. Both these reactions condition the larva to be at the peak of responsiveness when an animal such as a cow is grazing in the vicinity. If contact is made with a host the larva immediately clings to the hair or skin and often within a few minutes the mouthparts are inserted into the skin.

The length of time larvae can survive on pasture without finding a host is, to a large extent, controlled by the climate. During this period the larvae do not feed but they can absorb moisture from dew and possibly from plant juices. Atmospheric humidity, more than any other factor, seems to control the survival time of larvae.

In Queensland larvae are able to survive for 3 or 4 months in summer and for 5 or 6 months in winter. Work is in progress to find out the survival time of larvae in locations around Port Moresby which have differing rainfall and temperature ranges. It is expected that the results will approximate more to those of the Queensland summer rather than to the winter data. Because of the equitable climate of a tropical country like Papua New Guinea and the absence of a winter season, there is no seasonable break in the cycling of the tick.

Most movement shown by larvae during their non-parasitic existence is in the vertical plane but their ability to move horizontally either actively or passively is of greater significance when considering control or eradication.

Larvae probably migrate only for short distances under their own steam. For a long time a buffer zone of 12ft. was considered adequate to separate infested and clean areas. More recently, it has been shown that larvae can travel much further with wind assistance—up to 80 ft. This distance can be achieved either almost entirely by wind action or possibly more commonly as a result of groups of larvae being blown from the tips of vegetation on to neighbouring vegetation or the ground, the larvae climbing up and the process being repeated.

Attachment to an unsuitable host followed by a release of the attachment at a later time can mean that larvae are transported a considerable distance from their source. Various mammals and birds, as well as the clothing of humans, fit into this category of transportation.

(Photo: D.I.E.S.)

Plate II.—A close-up photo of a blade of grass. When a warm-blooded animal comes close, the larvae wave their legs in excitement. At first opportunity they will cling to the skin of the animal, and immediately start feeding on it.

Once attached to a suitable host the tick larva begins its parasitic existence. The six-legged larva feeds mainly on tissue fluids and will become fully fed or engorged in 5 to 13 days. The engorged larva measures about 1.5 mm in length and will shed its skin before becoming an eight-legged nymph. This stage usually attaches itself near to the earlier point of attachment of the larva and proceeds to feed on tissue fluids and some whole blood for 10 to 20 days, by which time it measures up to 3 mm in length. The small size of the larva and also of the nymph means that these stages are usually overlooked when an animal is being examined for ticks. The presence of a nymph, at least, is often indicated by a slight raising of the host skin at the point of attachment and this can be felt when running a hand over the body of an animal.

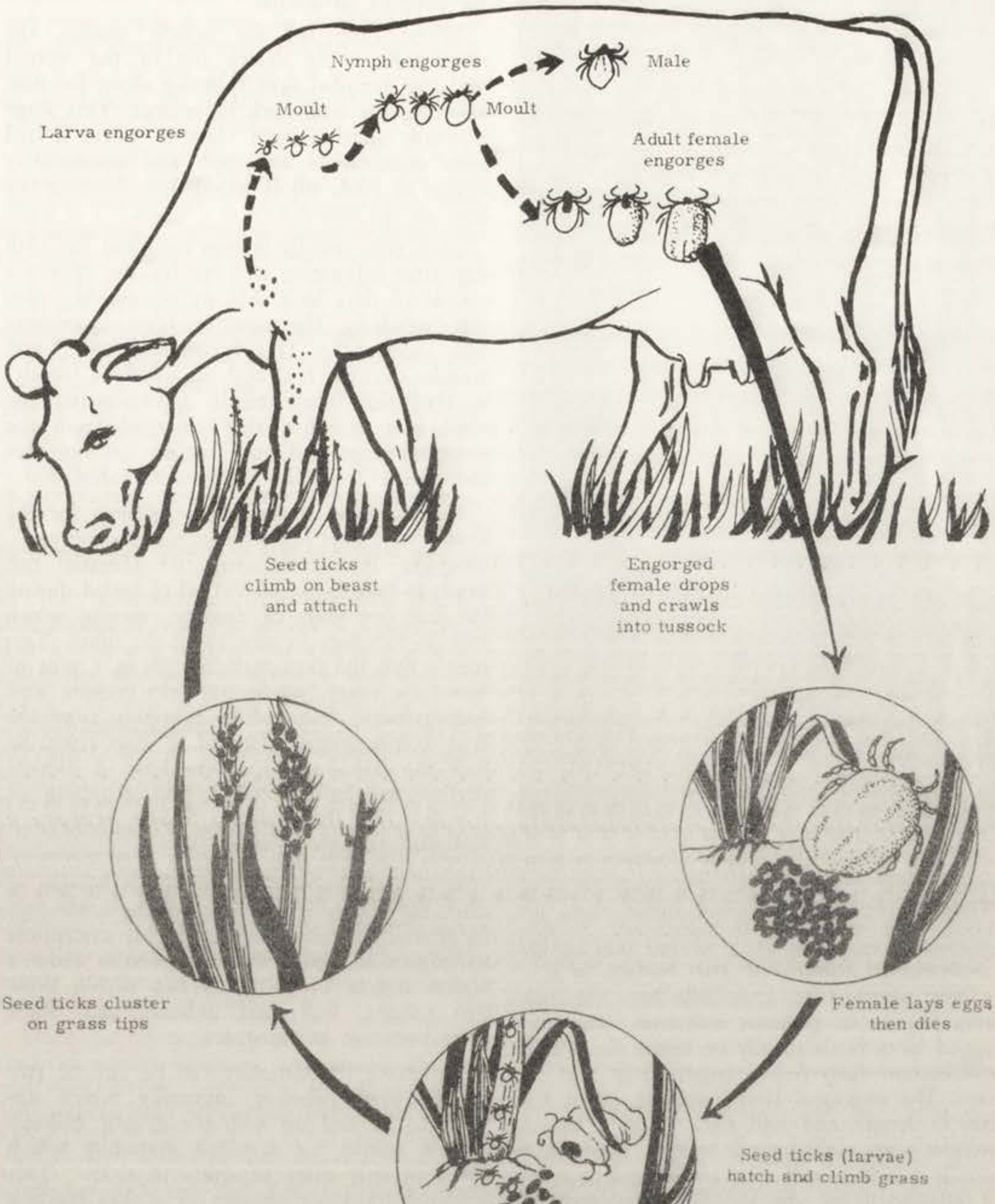
When fully fed the nymph moults, the mouthparts being drawn out of the wound and the nymphal skin splitting along its side, allowing the adult tick to emerge. This stage normally attaches itself close to where it had been attached as a nymph and immediately begins to feed, whole blood now forming the bulk of the meal.

Male ticks usually emerge on about the 13th day after infestation and the females appear a couple of days later. Mating occurs very soon after moulting. The males are fewer in number than the females. They feed intermittently and wander over the host body in search of females to fertilize. They remain approximately the same size as when they emerged from the nymphal stage and may live on the host for more than 2 months after initial infestation.

Engorgement of the female is slow for the first 3 or 4 days but then increases rapidly. To complete its development the female tick needs to take in 0.5 to 1.0 ml of blood during the last few days of feeding, during which time it increases in size about 40 times. This means that the host may lose about 1 pint of blood for every 500 female ticks present. Full engorgement, followed by dropping from the host, occurs between 19 and 37 days from the time the larvae arrive on the host. A diurnal rhythm has been noted in the dropping of female ticks, the majority falling between 6 a.m. and 10 a.m.

It is well known that different breeds of cattle show varying resistance to the cattle tick. In general, British breeds are highly susceptible to infestation, while Brahman breeds show a higher degree of resistance but within these two groups, individual animals may show great variation in resistance.

Resistance or immunity can be one of two kinds—either inherent immunity which appears to be tied up with the genetic makeup of the animal, or acquired immunity which develops only after exposure to ticks. This acquired resistance consists of a skin reaction to the salivary secretion of the tick, particularly to that of the larva and nymph, resulting in intense irritation which the animal tries to relieve by rubbing or licking. As a result, many ticks are removed, many others may wither and die or be drowned by a 'weeping' of the puncture.



(Redrawn from CSIRO)

Figure 1.—Life cycle of the cattle tick.

It is said that it is in inherent resistance that the British and Brahman breeds of cattle show the greatest difference, the two types showing little difference in acquired resistance. Experiments have shown that on Brahman cattle not only are smaller numbers of female ticks produced but these ticks are actually smaller in size and lay fewer eggs than do those from British type cattle. Crossbred Brahman cattle are also resistant to a degree, but this resistance is relative and depends on the proportion of Brahman blood in the offspring.

Rusa deer, the other common host for ticks in Papua New Guinea, also seem to show more resistance than do British breeds of cattle. Experimental work with tick on this species of deer shows that a return of 3-4 per cent engorged female ticks can be expected from 20,000 larvae. This compares with a return of 7-8 per cent from British breed calves used as control animals. The average size of tick recovered from deer is slightly smaller than those from control calves and these ticks lay fewer eggs than do the control ticks. It has been calculated that under experimental conditions a typical engorged female tick from a deer will produce approximately 1,500 eggs while a similar tick from a calf lays 2,200 eggs. The progeny of tick collected from deer readily infest cattle and vice versa.

These facts mean that the rusa deer is an efficient host for cattle tick but is not as good as are mixed British breed calves. It means that once deer have become infested with tick it will be virtually impossible to eradicate tick from any cattle in that area, as long as the two animals have access to the same grazing grounds.

The importance of the cattle tick to cattle owners is two-fold. First, the tick is a parasite and therefore dependent on its host for food. This means a considerable and constant loss of blood in a heavy infestation leading to anaemia, loss of condition, reduction in growth rate and interference with weight gain. If the cattle are in poor condition for other reasons, the added burden of a heavy tick infestation may cause death. Futhermore, because of the swelling and reaction around the point where they attach themselves to the skin of the animal, the hides of ticky cattle are very uneven and of poor quality.

Second, cattle tick can transmit certain organisms that cause disease in cattle. The most important of these organisms in Papua New Guinea is a minute blood parasite, *Babesia argentina*, which has a similar effect in cattle to that of the malaria parasite in man. The disease it produces, babesiosis (red water fever or tick fever), when not fatal, has a long-term effect on the well-being and productiveness of cattle. Another organism which causes disease and which has been found in Papua New Guinea is *Anaplasma marginale*. This, like *Babesia*, is a parasite of the red blood cells and can be transmitted by the cattle tick from one host to another. The cost of combating these diseases by vaccination or with the use of drugs can be high.

The cattle tick is therefore of considerable economic importance, since it can (i) lower returns through reduced growth rates, mortality and decreased hide values; and (ii) increase costs of production through expenditure on drugs and vaccines for babesiosis and on spraying programmes for the control of the tick itself.

This is why the Department believes that the eradication of the cattle tick, wherever possible is important for the continued success of the cattle industry. All farmers can contribute to the success of this programme by ensuring that they get the approval of a Stock Inspector before moving their cattle and by mustering their cattle regularly for spraying in the last few remaining areas where eradication is being carried out.