THE DEFENCE OF APHIDS AGAINST PREDATORS AND PARASITES

G. D. HEATHCOTE

THE success of aphids (greenfly and blackfly) is shown by their wide distribution and the vast populations they often achieve. Their success depends in fact on their ability to reproduce rapidly when conditions favour them; this they do asexually, unmated females producing living young, which within about ten days are themselves producing three or four young every day. One aphid may produce sixty or more young during the three or four weeks of her adult life. In these circumstances many may fall prey to natural enemies, but those that survive multiply so much that populations increase very rapidly. It is when circumstances do not favour their multiplication that individuals need protection from predators to ensure that some survive until conditions again allow them to reproduce rapidly.

Aphids seem fragile and poorly protected against their many enemies. Indeed, the survival of individuals depends largely on their inconspicuousness. Most aphids are small, and the non-gregarious forms are usually green, matching the colour of the leaves on which they feed. The peach-potato aphid (*Myzus persicae*), which feeds on many plant species, is also unusually variable in colour. The dark green line marking the centre of the body of some otherwise pale green aphids (such as the rose-grain aphid, *Metopolophium dirhodum*) may be 'disruptive coloration', which changes the apparent outline of the insect. Aphids are still for much of their lives, and once settled remain without moving for several hours, thus helping them to escape the attention of predators unable to distinguish readily between colours.

The dorsal abdominal processes (FIG. 1) of some Callipterine aphids (such as the oak aphid, *Myzocallis querceus*) may also be protective. They often contrast in colour with the rest of the aphid's body, and may act like the false 'eyes' on the wings of some butterflies and moths, drawing attention away from vital parts of the body.

Aphids usually feed on the lower surfaces of leaves where they are less easily seen by large predators, such as birds, are protected from rain, and can also feed on the conducting tissues (phloem) in the leaf veins more easily than from the upper surface. Some aphids cause the leaves on which they feed to roll, which increases protection from predators, and others cause pocket-like 'pseudo-galls', e.g., the currant blister aphid (*Cryptomyzus galeopsidis*). True galls may be formed round other species, such as the flask galls of poplar, which enclose the lettuce root aphid and other *Pemphigus* species. Other aphids, usually white, feed on roots and are hidden in the soil.

Once found by predators, not all aphids are palatable. Dixon (1958) found that the elder aphid (*Aphis sambuci*), the mealy plum aphid (*Hyalopterus pruni*), and the vetch aphid (*Megoura viciae*) are not favoured by ladybird (Coccinellid) larvae, or may be poisonous to them. El-Hariri (1966) recorded that two-spot ladybirds (*Adalia bipunctata*) laid twice as many eggs when fed on the pea aphid (*Acyrthosiphum pisum*) as when fed on blackfly. The 'fluffy' waxy coating of some aphids, such as the cabbage aphid (*Brevicoryne brassicae*) and the woolly aphid (*Eriosoma lanigerum*) of orchard trees, makes them unattractive food to predators, and the 'hairy' bodies of the wingless forms of some others such as the strawberry aphid (*Pentatrichopus fragaefolii*) (FIG. 1), probably protect them from parasites and small predators.

Some aphids and ants live together, a symbiotic arrangement in which the ants protect the aphids and the aphids provide the ants with 'honeydew' for food. Ants may do more than protect aphids from predators, for Banks (1958) found that those attended by ants reproduced faster than unattended ones. Orlob (1963) suggested that ants probably defend territory against predators rather than actually defend the aphids. Ant-attended aphids are seldom green but resemble the ants (e.g., blackfly and the common black ant, *Lasius niger*), and form dense, easily-seen colonies. Bradley and Hinks (1968) found that removing the ants attending *Cinara* spp. in Canada made the aphids restless. When ant nests near aphid-infested plants are destroyed, flies and wasps soon increase around the aphids, and the aphids disappear. The ants can survive without the aphids.

Some aphids will actively escape from parasites or predators by dropping from the plant when disturbed (as with pea aphids) or jumping (as do *Thripsaphis*). When alarmed, pea aphids lower their antennae over their backs, withdraw their stylets from leaves, hunch their legs up to their bodies and drop, apparently instantaneously. Others (such as cabbage aphids and many Lachnids) do an extraordinary 'dance'. They lift their hind legs off the leaf several times a minute, while keeping their head still, and then lower their legs with a twisting movement of the body. A whole colony may act in this way with a co-ordinated rhythmic movement. When the rhythm slows, it can be restarted by vibration, even by clapping the hands. Taylor (1950) found that these movements can be restarted in blackfly by moving a pencil or a finger within 3 to 4 cm. of the insects.

Williams (1922) reported such 'dancing' by a tropical aphid (*Toxoptera aurantii*) in the presence of hover-fly larvae, and found that it was accompanied by a scraping sound. Aphids do not usually make sounds, but a large colony of the citrus aphid was audible up to 18 inches from the plant. This again may be a protective device. The stridulating mechanism, which is similar

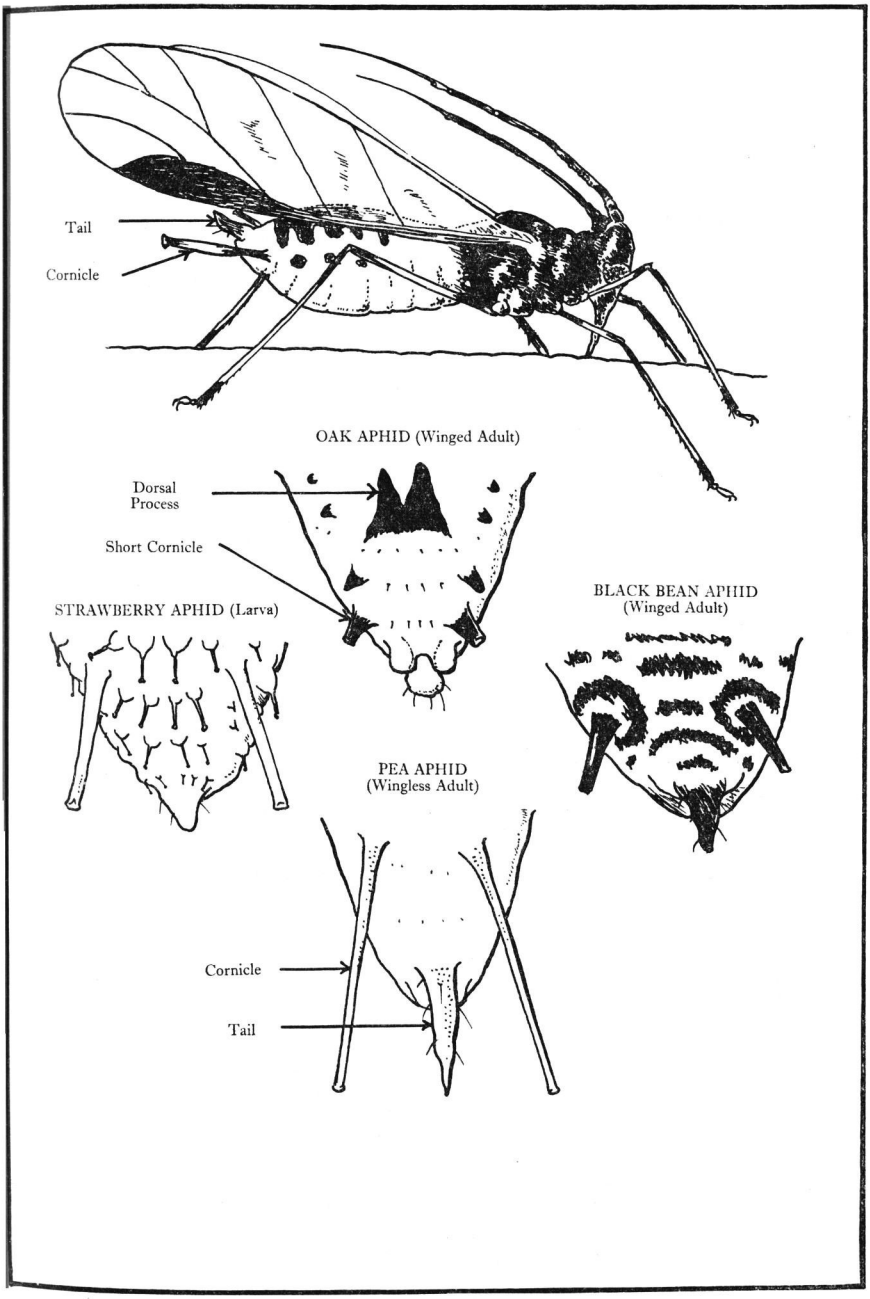

FIG. 1. WAX GUNS (CORNICLES) OF APHIDS.

(*above*) Side view of Winged Aphid feeding on a leaf.
(*below*) Abdomens of some aphids from above.

to that of grasshoppers, consists of a row of short hairs on the hind legs (tibia) and a pattern on the abdomen of raised and serrated cuticle.

The escape responses of the nettle aphid (*Microlophium evansi*) when threatened by the ten-spot ladybird (*A. 10-punctata*) were described by Dixon (1958). The aphids tend to face downwards on a stem or petiole, and so face approaching predators. Aphids approached from the front by a predator will walk away or drop from the leaf, but may kick small predators away. Aphids approached from the rear turn their cornicles (tubular structures on the abdomen once thought to give out 'honeydew') towards these predators and 'shoot' out wax. Edwards (1966) showed that the cornicles secrete a substance (primary triglycerides, myristic acid, etc.) that rapidly hardens into a waxy plate when in contact with a solid surface. A drop 150μ in diameter hardens in 20 seconds (Strong, 1967). This waxing can kill hymenopterous parasites (*Aphidius* spp.). The aphids that live in galls or on roots have short cornicles, whereas those that live exposed (especially species not protected by ants) have long cornicles.

Although aphids are preyed upon by other insects, they occasionally prey on one another when starving (Banks, Macaulay, and Holman, 1968), and they can destroy eggs of ladybirds (Girault, 1908) and lacewings (Kurisaki, 1920) by sucking out their contents, but this probably happens rarely.

Although predators and parasites kill many aphids and doubtless play an important part in limiting their populations, aphids are by no means defenceless, but are adequately equipped to survive periods unfavourable to their multiplication. All but the two foreign species mentioned can be found in Suffolk.

References

Banks, C. J. (1958). *Bull Ent. Res.* 49, 701-14.
Banks, C. J., Macaulay, E. D. M., and Holman, J. (1968). *Nature, Lond.* 218, 491.
Bradley, G. A. and Hinks, J. D. (1968). *Can. Ent.* 100, 40-50.
Dixon, A. F. G. (1958). *Trans. R. Ent. Soc. Lond.* 110, 319-34.
Edwards, J. S. (1966). *Nature, Lond.* 211, 73-4.
El-Hariri, G. (1966). *Ent. exp. appl.* 9, 349-58.
Girault, A. A. (1908). *Ent. News* 19, 132.
Kurisaki, M. (1920). *Insect World, Giru* 24, 115.
Orlob, G. B. (1963). *Ent. exp. appl.* 6, 95-106.
Strong, F. E. (1967). *Ann. Ent. Soc. Am.* 60, 668-73.
Taylor, L. R. (1950). *Ent. mon. Mag.* 86, 52.
Williams, C. B. (1922). *Ent., Lond.* 55, 173-6

Dr. G. D. Heathcote, F.R.E.S., Broom's Barn Experimental Station, Higham, Bury St. Edmunds, Suffolk.