

Introduction.

The object of this survey, undertaken as part of the course for the D.T.A., Trinidad, was to investigate the species of ants attending Homoptera on cocoa, and to consider a limited number of ecological and biological aspects of their relationship.

"The association of ants with certain species of Aphids and Coccids is common knowledge and it is also well known that such an association exists in the case of certain virus diseases that cause disastrous losses. It is therefore of the utmost importance to establish, if possible, the role played by the ants where the insects they attend have been proved to be the vectors of a disease". (Hall. Foreword to Nixon, 1951)

Strickland (1951 a) states that some seventy species of ants were found associated with the fourteen known vector species of the West African swollen shoot virus complex of cocoa, and at the time of his investigations swollen shoot was the only virus known to be carried by members of the super-family Coccoidea. Kirkpatrick (1950) has shown that at least four species of mealybug occurring on cocoa are vectors of the Trinidad cocoa virus of which three have been observed attended by ants in the present investigation. Kirkpatrick states that although no cocoa tree in Trinidad has been shown with certainty to have died as the result of the virus, yet, Baker and Dale (1947) have adduced evidence that the virus can be responsible for general unhealthiness in infected cocoa. In the Gold Coast, however, the swollen shoot virus has during the last ten years completely devastated large cocoa areas, greatly reducing yield. Strickland (1951 b) states that of almost 200,000 individuals of Pseudococcus njalensis Laing, (the most important of the virus vectors in W. Africa), counted in a field survey, almost 99% were directly associated with ants.

There are many instances of mealybugs, attended by ants, which influence the yield of economic crops not by the transmission of plant diseases, but by the direct action of their sucking the plant sap. This condition is exemplified by Pseudococcus brevipes (Cockerell) which causes a wilt of pineapples, where according to Carter (1933) the ants are essential for the normal development

of the mealybug.

Although the common cacao Aphid, Toxoptera aurantii Boyer has not been demonstrated by Kirkpatrick as a vector of the cacao virus in Trinidad, or by Posnette and Strickland (1948) in W.Africa, there are examples of ant-attended Aphids transmitting virus diseases. For instance, pepper 'vein banding virus' is transmitted by Aphis gossypii Glov. in Trinidad (Dale in preparation) and sugar cane mosaic by Aphis maidis Fitch (Loftin & Christenson 1934). Other Aphids, such as the Woolly Apple Aphid (writer's observations in England), reduce the yield of economic crops by directly sucking plant sap. Many members of the Membracidae are attended by ants, but their damage to economic crops is of little importance. Of the Delphacidae, however, Peregrinus maidis (Ashm.), observed being attended by ants in Trinidad, has been demonstrated by Briton-Jones (1933) to be the vector of the virus producing stripe disease of Zea mays L., the infected young maize plants producing no crop.

The foregoing examples serve to demonstrate the importance of a greater understanding of the relationship between ants and certain groups of the Homoptera, especially where the latter affect the yield of economic crops, both directly by reducing plant vigour by the imbibition of sap, and indirectly by the transmission of plant diseases.

The literature concerning the association between ants and certain of the Homoptera is so extensive that it is impossible to summarise it completely. Nixon (1951), in an attempt to give a broad account of what is known of the association of ants with Aphids and Coccids in connection with the transmission of crop diseases, has surveyed the literature up to and including 1948. Of the families of the Homoptera attended by ants the Aphidae have received the most attention, their interrelation being the object of the researches of the most eminent naturalists for centuries. "Although much has been written on this subject, a great deal has been taken for granted, copied and handed down from time to time regardless of the fact that the statements have been erroneous" (Jones 1929). It is to be expected that in the early writings,

fanciful theories will have been expounded to explain the association between these two groups of insects. Jones remarks that it was formerly supposed, and is often accepted today, that Aphids secrete a sweet substance from the cornicles, when in reality it is the excrement of the anus that the ants seek. Because of this misunderstanding, both early and recent workers have drawn analogies between Aphids and cows, commenting on the ants 'farming out their cattle'.

The same author quotes Goedart, who in 1685 attributed conversation between the ants and Aphidae, suggesting that the two insects warned each other of their enemies. He also remarks that Asa Fitch in 1860, on noting that a species of Formica attending Aphids imparted to the colony a peculiar odour, considered this to proclaim the ownership of the colony and that other ants would refrain from attending these Aphids.

The traditional interpretation of the association between ants and the honeydew-excreting Homoptera is "that Aphids, Coccids" (and other Homoptera)"provide the ants with a rich and easily accessible food supply in return for which the ants render them certain services, the chief of which is to protect them from their natural enemies" (Nixon 1951). Wheeler (1910) considers that Aphids show certain modifications both in structure and behaviour which provide unmistakable evidence that they have been adapted to their life with ants. Nixon summarises these as follows:-