CACAO FLUSH DEFOLIATING CATERPILLARS IN PAPUA AND NEW GUINEA *

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ABSTRACT

The distribution and importance of caterpillar species feeding on cacao flush in Papua-New Guinea is discussed and an outline is given of the type of damage they cause. The history of cacao growing and associated caterpillar damage in the Territory is discussed, and factors contributing to the nature and severity of the problem in various areas are considered.

INTRODUCTION.

Cacao is only of recent origin in the Territory of Papua and New Guinea. The first introductions of planting material were made about the turn of the century, but up to the commencement of the War both the area planted and the production were negligible. At that time the crop was only known to be attacked by a limited range of insect pests and of these only the weevil and the longicorn borers were thought to have any serious potential.

As from the end of the War, cacao planting was undertaken on a large scale and by the end of 1962-63 the area planted had risen to approximately 120,000 acres. As would be expected, this increase greatly influenced the insect fauna associated with the crop and to date some 300 separate species have been recorded as feeding on it and causing damage to varying degrees. All the species so far recorded are indigenous but many of them have ranges extending well beyond the limits of the Territory.

The main cacao growing areas are located on New Britain, New Ireland, Bougainville and the Northern District of Papua with lesser plantings in the Central district of Papua and in the Morobe and Madang Districts.

It is intended here only to summarise the position relating to the caterpillars which defoliate cacao flush. The main species are listed below:

Noctuidae:	*Achaea janata* L.
	Tiracola plagiata (Walk.)
	Ectropis bhurmitra (Walk.)
Geometridae:	*E. sabulosa* Warr.
Tortricidae:	*Adoxophyes sp.*
Thyrididae:	*Stringlina rufocastanea* Roth.
Limacodidae:	*Scopelodes sp.*
	Pinzulenza kukisch Hering
Lycaenidae:	*Jamides celeno* (Cr.)

In addition, various species of lymantriids and psychids appear always to be present in all the cacao-growing areas but no instance has occurred where they have reached a level of economic importance. The species causing most concern are *L. Achaea, Tiracola* and *Ectropis* (*Plate* I). *Jamides* occurs commonly in all the mainland areas but does not have the extensive damaging effect of the main species. *Scopelodes* and *Pinzulenza* differ from the other species in that they will feed on mature foliage as well as on flush growth. *Pinzulenza* was responsible for the complete defoliation of thousands of trees on Karkar Island and in parts of the Madang District over a period of about a year in the late 1950s but has since declined to a position of relative unimportance.

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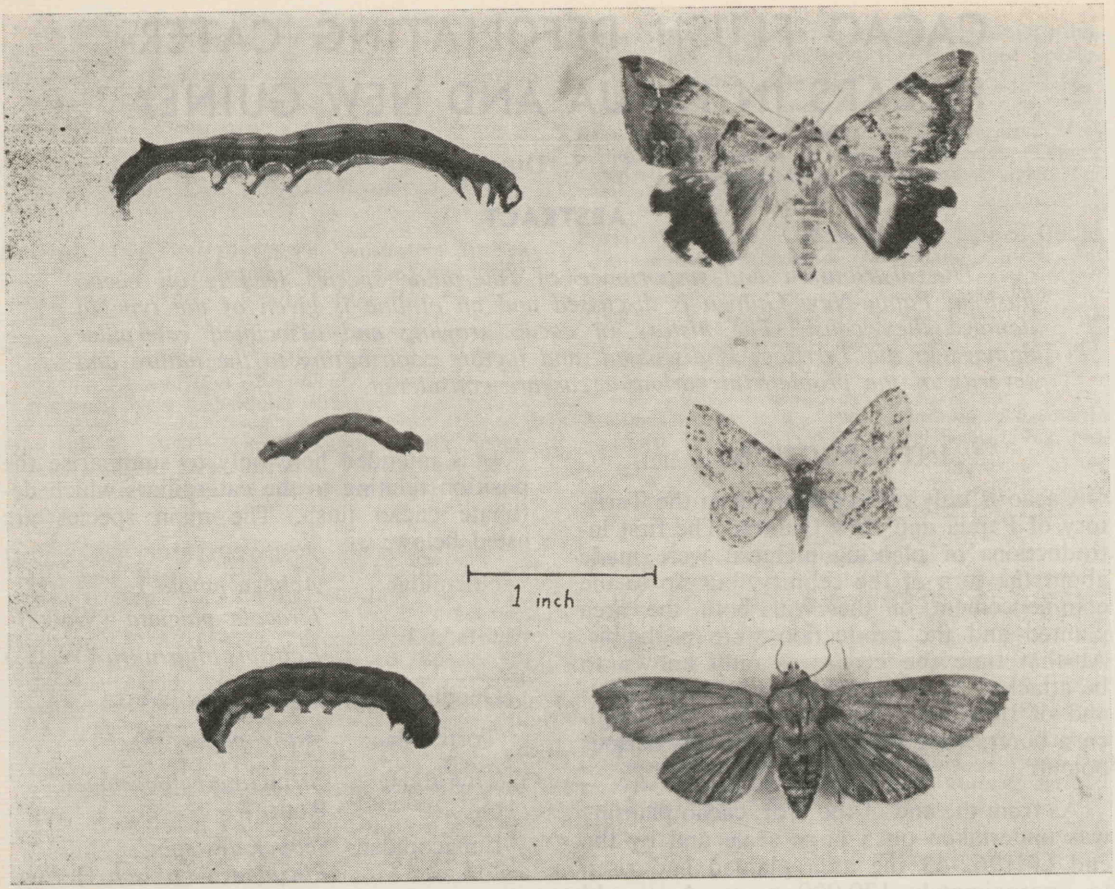

Plate I.—Top: *Achaea janata* L. Centre: *Ectropis* sp. Bottom: *Tiracola plagiata* (Walk.). Larvae on left, adult insects on right.

The distribution and relative importance of the various species is indicated in the following table:

	Papua		New Guinea		New Guinea Islands		
	Cent.	North	Morobe	Madang	N. Britain	N. Ireland	B'vle.
Achaea	x	xx	xx	xx	xx	x	—
Tiracola	x	xx	xx	xx	x	x	x
Jamides	—	xx	xx	xx	—	—	—
Ectropis	—	x	x	x	xx	—	—
Stringlina	—	x	—	—	x	—	x
Scopelodes	—	—	—	x	x	—	x
Pinzulenza	—	—	—	xx	—	—	—
Lymantriidae	x	x	x	x	x	x	x
Psychidae	x	x	x	x	x	x	x

DAMAGE.

In common with many tropical trees, cacao makes its growth in a series of flushes. Depending on various factors, these occur

approximately every six to eight weeks and usually most of the trees in a given area will flush at the same time. The flush leaves develop very quickly and harden off within two or three weeks. However, before the leaves harden they are very susceptible to attack by insects, of which the defoliating caterpillar are the most serious. Once the leaves have commenced to harden they are no longer attractive to the caterpillars, although if the defoliation is sufficiently extensive the tree will continue to put out flush growth thus putting a further strain on its resources. An interesting feature is that the period between flushes approximates to the time required for a generation of the pest species and, since most of the latter do not coincide precisely, the chances of a tree maturing an appreciable proportion of its growth during a caterpillar epidemic are slight.

Feeding results primarily in the destruction of new leaf tissue. If the new tissue hardens before the attacking species is ready to pupate, the caterpillars will then feed on the newly induced flush, the bark of the new shoots, the growing points and, in the case of Tiracola, on flowers and pods. However, in view of the fact that a normal tree produces many more flowers and fruit than it is physically capable of maturing, it is doubtful whether their loss is economically significant. Apart from the natural setback to the tree resulting from the defoliation, there is gross proliferation of branches resulting in a badly formed tree, a delay in the time required for the tree to come to normal bearing and a lowering of the yield, particularly in the prematurity years.

HISTORY OF INFESTATION.

Gazelle Peninsula.

The principal areas of caterpillar damage are on the Gazelle Peninsula of New Britain and in the Northern District of Papua (Popondetta). Of the main species, *Achaea* and *Ectropis* have predominated in the former area and *Achaea* and *Tiracola* in the latter. It will be noticed that *Ectropis* is present at Popondetta but it has never assumed the importance it reached in New Britain. There is some evidence that outbreaks of caterpillars occur in cycles. In the late 1940s *Ectropis* and *Achaea* (mainly the former) caused considerable damage in parts of the Gazelle Peninsula. On the Experiment Station at Keravat it was estimated that *Ectropis* was responsible for somewhat more than half the flush growth destruction for the year during which the outbreak lasted. During this outbreak a build-up of tachinids was noted which finally supressed it and, presumably, held the species in check until the current outbreak commenced early in 1960. This occurred at approximately the same time throughout the Territory and was not confined solely to species affecting cacao; among others, heavy and protracted infestations occurred of noctuids and psychids on *Poinciana,* torticids on *Peltophorum,* pierids on *Cassias,* etc. As distinct from the previous outbreak, the area under cacao on the Gazelle Peninsula now comprised many thousands of acres and both *Ectropis* and *Achaea* quickly increased to epidemic proportions. Up to the time of the outbreak, the amount of cacao planted at Popondetta was negligible. However, at this juncture an extensive settlers' project was started and the area under cacao has expanded rapidly until it is now of the order of 7,500 acres. The normal process of planting cacao comprises felling the primary bush, burning the detritus and *Achaea,* and planting the shade followed by the planting of the cacao. Up to this time both *Achaea* and *Tiracola* had been recorded as incidental pests of various crops in different parts of the mainland of New Guinea from sea level up to about 6,000 ft. Following the extensive clearing and burning at Popondetta the main regrowth weeds were very suitable hosts for *Tiracola,* which was able to reach dense populations there before cacao was even planted. *Achaea* did not appear in numbers until cacao was available as a host.

The course of the outbreak has been markedly different in the two main areas of infestation. On the Gazelle Peninsula, successive generations of both species remained at a very high level until the end of 1962 and during this period extensive spraying was necessary over most of the area. On the Experiment Station at Keravat a decline in numbers of both species was observed in

October, 1962. At the same time, a distinct rise in the rate of parasitism was observed. This increased rapidly in the several subsequent generations and both *Ectropis* and *Achaea* had fallen away to insignificant numbers by March 1963, a position that has been maintained until the present time. Recovery elsewhere in the Peninsula was somewhat slower, and it was not until early in 1964 that general spraying was no longer necessary. Thus, the position on the Gazelle Peninsula at the moment is that neither species is causing material setback to the development of the trees.

It is reasonable to ascribe this decline almost entirely to the action of parasites. From *Ectropis,* two species of tachinids have been reared; *Calozenillia sp.* and *Winthemia? diversa,* the latter greatly predominating. Two species have also been reared from *Achaea; Winthemia? diversa* and *Exorista sp.* nr. *sorbillans.* The latter species is not very common and, although the former oviposits readily enough on its host, the yield of parasites is very low. In the case of *Achaea,* it is thought that egg parasites were responsible for its decline. Two species of wasps have been reared from its eggs in abundance; a scelionid, *Telenomus sp.,* and a trichogrammatid, *Trichogramma japonicum.* In hatching over several generations the former generally predominated. No egg parasites have been reared from the eggs of *Ectropis,* possibly because they are very difficult to locate being usually secreted in crevices of the shade tree, *Leucaena.* At the peak of the outbreak at Keravat, a very appreciable portion of the larvae, particularly of *Ectropis,* were taken by *Bufo marinus* as they descended to pupate.

Northern District.

The position at Popondetta is quite different. As has been mentioned, *Tiracola* had a massive start with the availability of several hosts before the cacao was even planted. *Achaea* did not assume importance until cacao was available for it and at first was not considered to be of particular importance. However, despite its late start it has been responsible for an appreciable proportion of the damage at Popondetta.

At the start of the outbreak, populations of both *Tiracola* and *Achaea* remained at high to very high levels during successive generations and, since the two species do not overlap, the trees suffered accordingly. Although precise figures are not available on this point it would appear that the succession of generations at high levels of population lasted about two years. After this, the populations levelled out considerably with peak populations occurring at irregularly spaced intervals. At the present stage of growth of the cacao at Popondetta it is variously estimated that its growth has been set back by anything from six to eighteen months at its present average age of five years. Currently the position there is that both species are still present in troublesome numbers and are capable of appearing in epidemic proportions at unspecified intervals.

The parasite position at Popondetta is not nearly as favourable as it is on the Gazelle Peninsula. In mid 1963 it appeared that the *Achaea* problem would be coped with by the action of egg parasites. At this stage what appeared to be the same species that were operating in the Gazelle Peninsula were present in appreciable numbers at Popondetta; in some areas parasitism figures of over 90 per cent. were found in the western sector; for reasons that are not apparent these figures were not maintained. The tachinid *Exorista fallax,* and the ichneumonid *Echthromorpha insidiator* have been reared from both *Tiracola* and *Achaea,* but in very limited numbers and there is no indication that they are ever likely to prove effective. No egg parasites have been reared from *Tiracola* eggs although *Trichogramma* has frequently been observed walking over them and ovipositing. Recently, an as yet unindentified tachinid has begun to operate in the Popondetta area in appreciable numbers and is achieving a hopeful degree of parasitism. It does not appear to be effective against *Achaea,* however. Predators are present in appreciable numbers in cacao in all districts where the crop is grown, but they do not appear to exert any noticeable effect.

Other Areas.

It is not proposed to go into details of outbreaks of caterpillars in other districts. In general they have been much less widespread or damaging. However, there are several interesting features of the distribution of the principal species and their importance in areas other than those where they are major pests. It has been noted that *Ectropis* was the principal species in the Gazelle Peninsula; at Popondetta it has never been of more than incidental importance. It has also been recorded in the Morobe and Madang Districts —again in low numbers. *Tiracola,* since it has been a problem at Popondetta, has been recorded on four occasions outside the mainland of New Guinea. It has been recorded on two occasions in Bougainville, once on the leguminous cover crop, *Pueraria,* adjacent to cacao interplanted with coconuts at Baniu Plantation on the northern end of the island and again in the Kieta area in a young cacao planting. In neither case was there any recurrence of the caterpillar. On two occasions also it has been recorded in two widely separated areas in New Britain—again with no recurrence. The reasons why it has not been able to persist on Bougainville and New Britain are not clear.

IMPORTANCE OF SHADE TREES.

Under natural conditions, cacao grows under primary forest. Accordingly, it is standard practice to grow it on plantations under some type of shade cover. In New Guinea this is typically *Leucaena* and it is under this shade that the caterpillar problem has been most felt. Both *Tiracola* and *Ectropis* will feed and oviposit on this shade tree. Another widely used shade is coconuts. Their use originally was probably fortuitous but has proved highly satisfactory. As soon as the caterpillar outbreaks on the Gazelle Peninsula became apparent it was noted that the conditions provided by this combination were entirely unsuitable for the development of the more important species. It is more than likely that the freedom of New Ireland and Bougainville from caterpillar attack is a direct result of this, as the majority of their cacao is planted under coconuts. Unfortunately most Territory planters of recent years have not been able to avail themselves of this method of control.

More recently, as the severity of the caterpillar problem continues to be felt, there has been an increasing tendency to plant cacao under 'bush'. Here the primary forest is selectively felled leaving a high cover of larger trees. The result is the same as with planting under 'bush'. Here the primary forest is between the top of the cacao and the lower limits of the top cover instead of, as with *Leucaena,* the tops of the cacao being continuous with the lower limbs of the shade tree. Again there is a complete absence of caterpillar damage. The same position occurs when cacao is planted under rubber. The fall-off in caterpillar population from cacao/*Leucaena* to cacao/'bush' planting is very sharp; only an occasional straggler will be found in the high cover block. As a result of the association of caterpillars with *Leucaena* shade there is an increasing tendency to remove the latter to varying degrees up to complete removal; certainly this has a depressing effect on the *Tiracola.* The effect on *Achaea* is not so clear at the moment.

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