

BIOLOGICAL CONTROL OF THE PUSTULE SCALE IN PUERTO RICO

George N. Wolcott¹

INTRODUCTION

Total disappearance of an insect pest from a region over a series of years, giving the appearance of extermination, may result from the perfection of biological control. Such temporary elimination may indeed prove permanent, presumably because of natural control by parasites and predators already present and endemic as in the case of the cotton leafworm, *Alabama argillacea* Hübner. From 1942 to 1949 it did not appear in Puerto Rico at all in any part of the Island (1)², and cotton growers and members of the cotton cooperative began to wonder what to do with their stocks of arsenate of lead accumulated in anticipation of outbreaks that did not occur.

But the cotton leafworm is really unique and hardly comparable to any other insect. Its moths fly in from adjacent islands to start an infestation which may quickly develop into widespread outbreaks extending from one side of the Island to the other and continuing indefinitely because of the local two-season system of cotton growing. For lack of fresh fields to attack, or because of excessive parasitism, or an impulse to migrate affecting all the moths of the final generation, the insect may have disappeared for good. We can be the more certain of its absence here because the caterpillars feed only on cotton leaves, and growers are vociferous in their complaints if any small field anywhere is attacked. Entomologists in Venezuela report that the leaves of a wild cotton, *Cienfugosia affinis* (H.B.K.) Hochr. (= *Hibiscus sulphureus*), a common weed in burned-over regions and abandoned fields, serve as alternate host for the caterpillars, but this plant does not occur in Puerto Rico.

The enormous numbers of the introduced giant Surinam toad, *Bufo marinus* Linnaeus, which developed in Puerto Rico within a few years from the few individuals sent from Barbados in 1920, and from those brought from Jamaica 2 years later had a more profound effect on some of the insects and other small invertebrates of the Island than any other addition to the local fauna in historic times (2). One must not suppose, however, that the numbers of all the endemic species of May beetles were reduced

¹ Entomologist and Head of Department, Agricultural Experiment Station, University of Puerto Rico, Río Piedras, P. R.

² Numbers in parentheses refer to Literature Cited, p. 233.

to the vanishing point, for those which occur only at the higher elevations where the minimum temperatures are too low for the permanent presence of the toad, were unaffected.

Walter Jepson, who attempted the first introduction of *Bufo marinus* into Mauritius, tells me that the toads there, although thriving during warm weather when they first arrived, found the winter temperatures too cold for their continued existence even along the coast. Along the coast of Puerto Rico where most of the sugarcane is grown, the temperatures proved to be optimum for the development of the toad, and control of white grubs in cane fields was total for 12 or 15 years. The very perfection of white grub elimination by the toad proved to be the reason it could not be permanent.

Despite the considerable number of other insects and small animals such as millipedes which could serve to supplement the maybeetles³ as major items in the food of the toad, millions of the toads perished from starvation when all of these ceased to exist in appreciable numbers. Indeed, so few toads survived as to present an opportunity for all of the insects and other small animals eaten by toads again to begin increasing in numbers, at least temporarily unchecked by *Bufo*. It was by far the most conspicuous local example of the principles of biological control: temporarily so successful as to make its subsequent failure all the more distressing, and the necessity for the eventual use of chemical insecticides imperative.

CONTROL AND REAPPEARANCE OF PUSTULE SCALE

The purpose of the present paper is to present still another instance of the merely temporary effectiveness of biological control. The pustule scale, *Asterolecanium pustulans*, originally described from Jamaica in 1892 by T. D. A. Cockerell (3), was collected in Puerto Rico in 1900 by Augustus Busck (4). It attacks no economic crop, but it has been under more or less continuous observation by entomologists, and we have numerous records of its occurrence and abundance (1). Indeed, to it may be ascribed the practical disappearance of the Australian silver oak, *Grevillea robusta* Cunn. after it had been introduced and extensively planted, some 20 years ago.

Especially noticeable in 1939-40 were outbreaks on maga, *Montezuma speciosissima* Sessé & Moc., an endemic tree with wood even more highly valued by the cabinetmaker than mahogany. A few years earlier the local Forest Service had introduced *Sciacassia siamea* (Lam.) Britton, a very rapidly growing tree, of which rapid growth was almost the only valuable characteristic. The pustule scale attacked it with such deadly effect that

³ Although Dr. Wolcott prefers the spelling "May beetle", the January 1953 Edition of the U. S. Government Printing Office Style Manual, which is followed in editing, prescribes "maybeetle."

trees 6 and 8 inches in diameter were killed down to the ground. The pustules on tender shoots of oleander, *Nerium oleander* L., were especially large and distorting, and were omnipresent on this host everywhere up to 1940.

When Louise M. Russell visited Puerto Rico in the spring of 1952, every effort was made to find specimens on oleander, for her major publication is "A Classification of the Scale Insect Genus *Asterolecanium*" (5). Despite persistent search, no specimen of the scale could be found. If pustule scale had formerly been a rare or inconspicuous insect, such a result might have been anticipated, but on the contrary, it previously had been common, and the injury it caused was very conspicuous. The leaves of maga on branches killed by the pustule scale turn brown and adhere en masse, at a distance resembling the symptoms of fire blight on apple or pear, and forming extensive brown areas on roadside trees that can be readily noted without even stopping the car.

Consulting our records, the last observation was at Guanica in 1941, by Luis F. Martorell on *Colubrina ferruginosa* Brongn. On mass infestations collected before that time, many scales were noted with parasite emergence holes, presumably of the endemic *Mercetiella reticulata* and *Euaphycus portoricensis* described by H. L. Dozier (6). These parasites were unquestionably present in Puerto Rico long before they were reared and described, but up to this time had never exerted more than partial control. Some other factor must have been operating to cause the disappearance of the pustule scale in the subsequent 12 years.

In the early days of citrus growing in Puerto Rico, before oil sprays for the control of scale insects had been discovered by W. W. Yothers in Florida, almost the only measure that the grower could take to try to prevent heavy scale-insect infestation was to favor entomogenous fungi by planting windbreaks. Those of common bamboo, *Bambusa vulgaris* L., were almost invariably heavily infested with scale insects, *Asterolecanium bambusae* Boisduval and *A. militaris* Boisduval, but as these scales did not spread to the citrus trees and appeared to have little effect on the growth of the bamboos, nobody gave them serious attention.

When Atherton Lee was appointed Director of the Federal Experiment Station at Mayagüez, he had just returned from a tour of duty in the Philippines and the Orient, where the bamboo is economically much more important than in Puerto Rico. Convinced that something should be done about its heavy scale infestations, he was instrumental in having predaceous ladybeetles imported to prey upon them. In the Mayagüez region several of these imported ladybeetles are reported to be "firmly established", but the only one almost invariably present on bamboo elsewhere on the Island, and definitely and consistently feeding on the scale insects of bamboo, is

a large, bright-yellow ladybeetle with iridescent green elytra: *Cladis nitidula* Fabricius.

Despite this new factor in their environment, the bamboo scales appear to be quite as abundant as formerly, the rapidity of reproduction of the beetle and its natural control by lizards being so well adjusted to the rapidity of reproduction of the scale insects that they are in perfect balance. Sometimes venturesome ladybeetles abandon bamboo and are noted eliminating infestations of quite different kinds of scale insects on other hosts. But one can always find them abundant on the clump of bamboos near the old Río Piedras reservoir, which appears to be a permanent sanctuary for them.

Much the most adventurous and venturesome of these introduced ladybeetles in *Chilocorus cacti* Linnaeus, all black in color except for a crimson spot on each elytron. It will feed on the scale insects of bamboo, but is preferably almost omnivorous on many other kinds of scale insects on numerous hosts. It was one of the "Introduced Ladybeetles on Mona Island" which apparently invaded Mona without the intervention of man, and was observed there in the spring of 1944, when it had cleaned up scale-insect infestations on several hosts so recently that the outlines of the scales could still be seen on the host plants (7). The single record of the twice-stabbed ladybeetle eating the scales of *Asterolecanium pustulans* was at Guanica in 1941, but the time when *Chilocorus cacti* was most abundant here synchronized closely with the practical disappearance of several other scales, especially those on papaya.

The growing of papayas is hardly on a large commercial scale as yet, but numerous plantings have been made in recent years. Most surprisingly, scale-insect infestations rarely develop in these plantations, in very marked contrast to the rapid inevitability of infestation on papaya plants before *Chilocorus cacti* was brought to Puerto Rico. Two scale insects attack papaya in the West Indies: the grey scale, *Pseudoparlatoria ostreata* Cockerell, and the white scale, *Pseudalacaspis pentagona* Targioni. The latter is historically known as the "West Indian peach scale", and in the Kenscoff region of the mountains of Haiti it was a major pest on peach trees, as well as on papayas at lower elevations. Lizards inhabiting every tree and post of the coastal areas are important limiting factors on the abundance of ladybeetles, especially when they rest on the naked trunks of papayas. But there are no arboreal lizards in the high mountains of Haiti and *Chilocorus cacti* practically eliminated West Indian peach scale on peaches there (8). A year later, every remaining infestation had disappeared, and at least local extermination of *Pseudalacaspis pentagona* was an accomplished fact.

Even to approach such control of the same insect on papayas in Puerto

Rico is a slower and much more uncertain process because of the omnipresence of lizards. Several personal experiences in attempting to bring ladybeetles from the papaya grove at Isabela Substation to the metropolitan area of San Juan, and having a lizard rapidly devour beetle after beetle before they could get adjusted to a similar environment in a new locality, all too clearly indicated the hazards attendant on the life of a black ladybeetle attempting to be inconspicuous on the naked white trunk of a papaya. Fortunately, the gregarious larvae are much less obvious; they move like a tidal wave engulfing a mass infestation of scale insects. Slowly but inevitably every scale is devoured. The final result is so close to extermination of both species of scale insects on papaya that one can rarely find them at all on new plantings being made. If growers are spraying at all, it is with DDT to control the leafhopper transmitting bunchy-top disease.

Chilocorus cacti feeds by preference on other scales than on those on bamboo, but it not only can, but does eat those species of *Asterolecanium* on bamboo when other sources of food fail. However, it greatly prefers *Asterolecanium pustulans*. The last record of this scale before its disappearance was of being eaten by the twice-stabbed ladybeetle, and so also the first record of its reappearance: in 1935 at Vega Baja on oleander, with numerous empty craters which the ladybeetles had just emptied of their insect contents.

In the absence of pustule scales to attack oleander, this ornamental recently has become almost universally infested with a whitish scale insect, identified by Harold Morrison as *Aonidiella orientalis* (Newstead) "for many years reported as *A. cocotiphagus* Harl.", and this scale insect is apparently not being eaten at all by the twice-stabbed ladybeetle. Such surprising specificity in its choice of food by *Chilocorus cacti* has thus allowed one formerly none too common scale insect to become omnipresent on oleander at the same time that for 12 years it kept this host entirely free of pustule scale.

SUMMARY

The perfection of biological control results in only apparent extermination for a period of years. The pustule scale, *Asterolecanium pustulans* Cockerell, so eagerly eaten by the introduced twice-stabbed ladybeetle, *Chilocorus cacti* Linnaeus, as to result in its complete disappearance, appeared again in Puerto Rico after 12 years.

RESUMEN

La excelencia del control biológico resulta sólo en una aparente exterminación del insecto dañino por un período de años. La cochinilla pustulosa, *Asterolecanium pustulans* Cockerell, tan ávidamente engullida por la coto-

rrita, *Chilocorus cacti* Linnaeus, importadó para ese fin, desapareció completamente para luego surgir después de 12 años.

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