The Copra Bug.

Necrobia Rufipes De Geer.

C. H. CORBETT, B.Sc., *Entomologist*

and

CEDRIC DOVER,

Department of Agriculture, F.M.S. & S.S.

ABOUT five years ago a Company in Singapore wrote to the Agricultural Department for assistance in eradicating certain beetles which infested their copra godowns, from whence they spread to private houses in the vicinity, thus causing considerable annoyance. Indeed, so troublesome was this insect that the Municipal Commissioners passed the following resolution :—

"That the state of things at the Company's godown where copra bugs are produced in enormous quantities and hence infest the neighbouring houses constitutes a nuisance of a public nature and that notice be given to the occupiers that unless the same be abated within one month from this date the Commissioners will consider the advisablity of proceeding at law for the abatement thereof under Section 237 of Ordinance No. 135 (Municipal)."

As the immediate control of these beetles was therefore necessary, the Company's godowns were visited and various boats, which carried a cargo of copra, were also inspected in Singapore Harbour. Beetles were found in large numbers in these localities, and proved on examination to be *Necrobia rufipes* De Geer (Order Coleoptera, Family Cleridæ), a cosmopolitan pest of copra and other stored products and foodstuffs. As little is known about *Necrobia rufipes* in Malaya, the following notes are offered in the hope that they will prove of interest to those engaged in the copra industry.

Systematic Position.

Necrobia rufipes is the most injurious species of the family Cleridæ, the larvæ of which are usually predaceous, such as *Callimerus arcufer* Chpn. on the Zygænid pest, *Artona catoxantha* Hamps. on coconuts. It was originally described by De Geer (1775) as *Clerus rufipes* and was transferred in 1796 to the genus *Necrobia* by Latreille. A list of references and synonymy is given by Schenkling (1910).

Distribution and Popular Names.

This species is very widely distributed, and is known as a common pest of copra in the tropics, though little has been done to control it. It is often a nuisance on ships carrying a cargo of copra, J. B. Corporaal (1922) recording an outbreak on a voyage from the Dutch East Indies to Europe, when the beetles devoured considerable quantities of foodstuffs, even attacking candles. In the Seychelles, it attacks salt fish as well as copra, both of which are stored in close proximity to each other. According to Froggatt

(1911), the beetle is known in the Pacific Islands as the "copra bug," the name usually applied to it in Malaya. In America, it is a serious pest of smoked meats, such as ham and bacon and is, therefore, known as the "red-legged ham beetle" or the "ham beetle," these names being apparently commoner in entomological literature than "copra bug."

The Beetle.

The beetles are of a deep blue colour with a violaceous or greenish lustre, with the legs and first five segments of the antennae brownish; eyes black. They measure about 6 mm. in length and 2·5 mm. in breadth. The females may be distinguished from the males by the fact that each of the elytral punctures gives rise to a stiff black hair, anteriorly inclined, while in the male the hairs are almost recumbent and directed posteriorly. The habits of the adults have not been studied in detail in this country. Like the larvae they are markedly predaceous and are even said to be cannibalistic. They seldom fly, the usual method of progression, being by rapid running. In America, it has been noticed by Simmons and Ellington (1925) that they feign death when roughly handled, and similar observations were made here in 1922.

The Egg.

The eggs of *Necrobia rufipes* are more or less sausage-shaped and of a shining translucent appearance; they measure about 1 mm.x ·25 mm. They are laid in groups, records between 20-7-22 and 4-10-22 showing that 23 eggs may be laid in one group, while in a few exceptional cases they were even laid singly. Towards the end of the incubation period, which was four days in all cases, the eggs become more transparent at the extremities, the shape of the embryo being clearly discerned in the middle.

Hatching.

On the point of hatching, the larvae stretches itself out, its movements causing the egg at the anal end to be burst open on account of the tubercles on the caudal plate, and the posterior half of the larvae is then extended. The anterior half of the larva may remain within the shell for a considerable period, but the larva, by means of its mandibles, eventually tears the shell open about the middle and works its way out. It is probable that the larva whilst inside is feeding upon the egg-shell. In America Simmons and Allington (1925) observed that the larva generally tears open both ends of the shell with its mandibles and caudal tubercles respectively, often remaining in the shell, as in a short tunnel, for several hours before leaving it.

The Larva.

The newly hatched larvae are delicate, wrinkled, hairy grubs measuring about 1 ·25 mm.x ·25 mm. and of a more or less uniformly whitish colour. They are quite inactive at the beginning, feeding on unhatched eggs or shells in the vicinity. They are repelled by light and spend most of their time hidden underneath the copra. The full grown larva measures about 10 mm :x 1 ·50 mm. The head, upper surface of the first segment and anal segment are more or less ochraceous brown, the rest of the upper surface of the body being white with fine brownish spots and numerous hairs. These larvae are able to crawl actively and to seize and kill such living organisms as they can utilize for food.

The Cocoon.

When fully fed, the larvae attached itself to a dark, dry spot and begins to build a cocoon or a pupal cell. The cocoon is built with a white frothy substance, exuded at will from the mouth of the larva, and is usually completed in about 24 hours. During this period the larva lies curled up within the cell.

The Pupa.

Before pupating the larva shrinks considerably in size (*i.e.* to about 6 mm.), so that the body consequently appears to be more robust. The head is fixed at right angles to the axis of the body, and the grub changes to a prepupa, the prepupal period lasting about six days. The pupa measures about 4 ·25 mm.x 1 ·50 mm., and is of a more or less greyish-white colour with brown eyes. It is covered with short hairs. Pupal movement is restricted to slight riggling of the abdomen. The adult emerges by gnawing an irregular hole in the pupal case, and usually two days or so elapse before it becomes fully pigmented and capable of flight.

Life Cycle.

In the accompanying table, details of the life-history of eleven specimens at a temperature between 72 ·1 and 89 ·8 (F) are given. It will be seen that the incubation period occupies 4 days, the larval period between 69 and 97 days (or an average of 81 ·54 days), the pre-pupal period between 5 and 10 days (or an average of 6 ·03 days), and the pupal period between 6 and 8 days (or an average of 6 ·45 days), while the newly emerged imago remains in a depigmented state for one or two days. In captivity imagines lived for approximately two months, though in America they have lived as long as fourteen months, a single female sometimes depositing more than 2,000 eggs in that period. In America, the larvae were also found to feed on caterpillars of the cheese-skipper (*Piophila Casei* Linn.), sometimes completing their life-cycle in 30 days. The average period of the life-cycle in Malaya, according to the figures below, is 100 days.

Development of *Necrobia rufipes* de Geer in days

Larvae bred in entomological laboratory on copra.

No.	Egg Period	Larval Period	Prepupal Period	Pupal Period	Drying Period	Total Period of life-cycle
1	4	77	6	6	1	94
2	4	76	7	6	2	95
3	4	78	7	7	2	98
4	4	75	6	6	2	93
5	4	77	7	6	2	96
6	4	81	5	8	1	99
7	4	93	7	7	1	112
8	4	92	10	7	1	114
9	4	82	6	6	1	99
10	4	97	5	6	1	113
11	4	69	7	6	1	87
Average	4	81·54	6·63	6·45	1·36	100

Control Measures.

This species is controlled in the Philippines (Froggatt, 1911) by fumigation with carbon bisulphide under a tarpaulin, while in the Dutch East Indies (Rutgers, 1918) it is thought sufficient to constantly turn the copra over, which disturbs the beetles and drives them away (a method which would only aggravate conditions in Singapore, as the beetles would probably take refuge in the neighbouring houses), and to separate the copra from young nuts, which is generally less thoroughly cured and, therefore more liable to attack than copra from old nuts. The best control measure would undoubtedly be to build special fumigation chambers near the customs wharf in each town in which an active trade is carried on in copra (as in Singapore) and to fumigate all incoming copra with hydrocyanic gas. There are numerous difficulties in the way of constructing such a fumigatorium, and thoroughly competent supervision would be essential if copra companies decided to use hydrocyanic gas. The formula for fumigation per hundred cubic feet is as follows :—

Potassium cyanide, 98 per cent.	...	1 oz.
Commercial sulphuric acid 1·84 sp. gr.	...	1 ,,
Water	...	3 ,,

The purity of the Potassium cynaide and sulphuric acid to the degree indicated is essential to the success of the fumigation. It was thought that fumigating with hydrocyanic gas may affect the edible and commercial value of the copra. A quantity of copra was, therefore, fumigated for twenty-four hours and then handed over to the Agricultural Chemist (Major B. J. Eaton), who concluded that no ill-effects would result from careful treatment with hydrocyanic gas, provided that the copra was thoroughly aired before use. His report is added as an Appendix to this paper.

For many companies it would perhaps be best to cover the copra with a tarpaulin and fumigate with carbon bisulphide, as is done in the Seychelles and Philippines. Commercial grades of carbon bisulphide may be used with success, about 15 lb. of carbon bisulphide to each 1,000 cubic feet of space being sufficient, though the exact quantity for effective destruction of the pest will depend on the amount of egress permitted by the tarpaulin, and will, therefore, have to be determined by experiment. The tarpaulin must be left on the copra, and the godowns closed, for about two days, during which period they must be carefully guarded, as carbon bisulphide is highly inflammable. It is not, however, injurious to the copra, and evaporates quite cleanly without leaving any residue.

It is obvious that great care must be exercised in using these two gases and copra companies who decide to employ fumigation to control *Necrobia rufipes* are recommended to communicate with the Agricultural Department for detailed advice.

Summary.

Necrobia rufipes De Geer, a blue beetle, with brownish legs, measuring about 6 mm. long, is widely distributed in the warmer parts of the world as a pest of copra and other stored products, often doing considerable damage.

The larvae is whitish with brown spots, and the corneous parts brown; it measures about 10 mm. in length when full grown.

The average period of the life-cycle appears to be 100 days in Malaya, though it may be considerably less or more. Both larvae and adults are actively predaceous.

Various measures have been suggested for the control of this beetle the most successful being thorough fumigation in an air-tight chamber with hydrocyanic gas. The following measures are also useful :—

(1) As far as possible thoroughly dried copra should be obtained, as damp and mouldy copra is particularly conducive to the breeding of this insect. It should be remembered that copra from old nuts is less liable to attack than that from young and insufficiently dried nuts.

(2) Where the nature of the locality permits the copra should be constantly turned over to disturb the beetles and drive them away.

(3) Periodic fumigation of the godowns with carbon bisulphide under a tarpaulin would be useful. Normal care must be exercised in its use, and it must be remembered that the gas is very inflammable.

References to Literature.

1775.—Greer, C. De.—Memoires pour servir a l' historie des insects, V. page 165.

1796. Latrielle, P. A.—Precis des caracteres generiques des insects, disposes dans unnatural, p.35.

1910. Schnkling, S.—Coleopterorum Catalogus, part 23, Cleridae, pp. 142—143.

1911. Froggatt, W. W.—Pests and Diseases of the Coconut Palm. In Dept. of Agri. N. S. Wales, Sci. Bull., 2.

1918 Rutgers, A. A. L.—Verslag van den Directeur van Het Algemeen Proefstation der A. V. R. O. S., 1st July. 1917—30th June, 1918. Medan, 1918.

1922. Corporaal, J. B.—Ent. Ber. Ned. Ent. Vereen, Amsterdam, VI No. 126, pp. 93-94.

1925. Simmons, P. and Ellington, G. W.—The Ham beetle, *Necrobia rufipes* De Geer. In Journal Agricultural Res. Washington, XXX. No. 9, pp. 845-863.

This paper is the most important single contribution to the biology of *Necrobia rufipes*, containing a review and a list of previous literature, etc.

Appendix.

Report on the Presence of Prussic (Hydrocyanic) Acid in Copra after Fumigation with the Gas.

B. J. EATON,

Agricultural Chemist.

The object of this investigation was to ascertain whether hydrocyanic acid was present in copra after treatment with the gas to destroy *Necrobia rufipes*.

This method of fumigation is one of the most efficient, and is practised in the case of other edible products.

Method of investigation.—It was found that the only test of sufficient delicacy was the Copper Sulphate-Guaiacum test, which detects 1 in 3,000,000.

A standard solution of sodium cyanide was prepared containing 0·035 grammes, equivalent to 0·0160 grammes of prussic acid in 2,000 ccs. of acidified water containing 5·9 ccs. of N/10 sulphuric acid, which was sufficient to liberate the prussic acid.

A series of small filter papers in glass funnels were impregnated with gum guaiacum, dried and then treated with a 0·05 per cent. solution of copper sulphate. 50 ccs. of the above standard solution of prussic acid was raised to boiling point and a funnel with filter paper impregnated as