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FOREST TREE AND TIMBER INSECT PESTS IN PAPUA NEW GUINEA. II.[1]

By B. Gray and F. R. Wylie[2,3]

Abstract: In this paper 98+ species are listed, with the following orders represented: Coleoptera (31), Diptera (4), Hemiptera (8), Hymenoptera (4), Isoptera (17+), Lepidoptera (32) and Orthoptera (2). Notes on the species distribution, biology and control are given, when possible, together with records of collection, excluding data given in Gray (1968). Not all of these may prove to be forestry pests. The most serious plantation pests are *Hylurdrectonus araucariae* Schedl and *Vanapa oberthuri* Pouillaude which attack Hoop Pine. The other most serious pests are ambrosia beetles which infest newly felled logs in large numbers if the lumber is left unprotected in the forest or in a situation accessible to the beetles.

INTRODUCTION

Many new forest tree and timber pests have been found in Papua New Guinea[4] since the establishment of a forest entomology section in June 1966. The section is actively engaged upon surveys of insects of major plantation tree species, timber borers (especially of Platypodidae and Scolytidae) and termites. As a result of these surveys, and reports by forestry personnel of outbreaks, several new pests have been identified.

In 1967 a paper was prepared which listed pest species largely known in Papua New Guinea prior to establishment of the forest entomology section (Gray 1968). In the paper 52+ insect species were listed together with notes on their distribution, biology and control, whenever possible, but in most cases very little was known about them other than the observation that they were causing damage at the time of collection.

In the present paper, several new pest species are listed and distributional data, notes on biology and control of these and previously listed species are given wherever the relevant information is to hand. However, much of the intensive research carried out on three major pests (see Gray 1971a): *Hylurdrectonus araucariae* Schedl (Scolytidae), *Vanapa oberthuri* Pouillaude (Curculionidae) and *Milionia isodoxa* Prout (Geometridae), has been published in greater detail in other papers, and there are several papers in press (refer text and bibliography) and in preparation. Therefore, only brief summaries of work carried out to date on these species are given in this paper.

The Entomology Section, Department of Agriculture, Stock and Fisheries, Papua New Guinea, in recent years has been publishing insect pest surveys (Anon. 1969, 1971), in which several of the pests listed in our paper have been mentioned. They have also mentioned a few pests of ornamental trees not recorded in our paper. With a few significant exceptions, these records and notes have been excluded to avoid unnecessary duplication.

As in the first paper (Gray 1968) species considered are arranged alphabetically by order, family, genus and species; host plant records, localities and districts in

1. Approved for publication by the Director, Department of Forests, Hohola, Port Moresby, Papua New Guinea.

2, 3. Department of Forests, Bulolo, Papua New Guinea.

4. Prior to 1971 Papua New Guinea was known as the Territory of Papua and New Guinea.

which the specimens were collected are included and arranged chronologically. Species listed in the first paper are denoted in this paper by an asterisk(*). The abbreviation L.A. is used to denote logging areas. The common names Hoop Pine and Klinkii Pine of *Araucaria cunninghamii* and *Araucaria hunsteinii* respectively are used throughout in the discussion and notes on biology. The following abbreviations are used for the names of the districts (Dist.) throughout the paper:

B.	Bougainville	M.B.	Milne Bay
C.	Central	M.I.	Manus Island
E.H.	Eastern Highlands	N.	Northern
E.N.B.	East New Britain	N.I.	New Ireland
E.S.	East Sepik	W.	Western
G.	Gulf	W.H.	Western Highlands
M.	Morobe	W.N.B.	West New Britain
Mad.	Madang	W.S.	West Sepik

LIST OF FOREST INSECT SPECIES

COLEOPTERA

Bostrychidae

1- **Dinoderus minutus** (Fabricius)*

COLLECTIONS: On *Coryota* sp., Webelo, Normanby Island, M.B. Dist., 17.VII.1970, R. Dobunaba. Boring in fence post, Banz, W.H. Dist., 14.X.1971, R. Oswell.

2. **Heterobostrychus aequalis** Waterhouse*

COLLECTIONS: Attracted to house light, Bulolo, M. Dist., 25.IV.1968, B. Gray.

3. **Sinoxylon anale** Lesne*

COLLECTIONS: Infesting softwood crates from Hong Kong, Madang, Mad. Dist., VIII.1968, D. Maclean. In freshly fallen log, *Pterocarpus indicus*, Beipa'a, C. Dist., 9.V.1969, H. Ivagai.

4. **Sinoxylon pugnax** Lesne

COLLECTIONS: Infesting softwood crates from Hong Kong, Madang, Mad. Dist., VIII.1968, D. Maclean.

DISTRIBUTION AND BIOLOGY: This species has been previously recorded from India.

5. **Xylothrips religiosus** Boisduval*

COLLECTIONS: Attracted to tent light, Forest Office, Bulolo, M. Dist., 25.I.1967, B. Gray. Boring into log, Karimui, Chimbu Dist., 12.VI.1968, B. Gray. In stem of *Garuga floribunda*, Brown River, C. Dist., 7.II.1969, H. Ivagai. In fallen log *Pterocarpus indicus*, Beipa'a, C. Dist., 3.V.1969, H. Ivagai. In freshly fallen log *Anthocephalus cadamba*, Compartment 3, Nauwata Banda L.A., Bulolo, M. Dist., 3.IX.1969, Lei. Boring into fallen *Amoora* sp., Yakawa L.A., Watut, M. Dist., 30.X.1969, B. Gray & Anton. In freshly fallen log *Canarium* sp., Liloi, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log *Anisoptera polyandra*, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, J. Dobunaba. In freshly fallen log *Elaeocarpus sphaericus*, cattle paddock adjacent Rd. 6, Bulolo, M. Dist., 17.IV.1970, H. Ivagai & Anton. In freshly fallen log *Aleurites moluccana* and *Dysoxylum* sp., cattle paddock adjacent Road 6, Bulolo, M. Dist., 21.V. 1970, J. Dobunaba. On fallen log *Planchonella papuana*, Wadalei, Fergusson Island, M.B. Dist., 23.VI.1970, B. Gray & J. Dobunaba. In freshly fallen *Pterocarpus indicus*,

Sewa Bay, Normanby Island, M.B. Dist., 20.VIII.1970, J. Dobunaba. Boring in fence post, Banz, W.H. Dist., 14.X.1971, R. Oswell.

DISTRIBUTION AND BIOLOGY: This bostrychid appears to be the commonest powder-post borer in Papua New Guinea. The species caused extensive boring in a fire-damaged plantation species, ***Eucalyptus torelliana***, at Bulolo in late 1972 (Wylie, in preparation). Also see Gray (1968).

Cerambycidae

6. **Dihammus australis** (Boisduval)

COLLECTIONS: On ***Araucaria cunninghamii***, Station L.A. (1945/50), Bulolo, M. Dist., 24.X.1966, B. Gray. On ***Araucaria*** sp. log, Watut Valley, M. Dist., VII. 1967, Kias. Attracted to house light, Bulolo, M. Dist., 9.X.1967, F.R. Wylie. Adult chewing bark of ***Kibara*** sp., Heads Hump L.A., Bulolo, M. Dist., 21.VI.1971, A. Kairo. On fallen log ***Terminalia*** sp., Bulolo, M. Dist., 4.I.1969, F.R. Wylie. On freshly fallen log, ***Anisoptera polyandra***, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, F.R. Wylie. On fallen log ***Araucaria cunninghamii***, Beenleigh L.A., Wau, M. Dist., 24.XI.1970, B. Gray & J. Dobunaba.

DISTRIBUTION AND BIOLOGY: ***Dihammus australis*** is also found in Irian Jaya in Indonesia and in Queensland in Australia. This species is fairly common in the older Hoop Pine plantations at Bulolo and Wau. The female adults lay their eggs on the freshly fallen trees or logs. The larvae cause extensive damage to the logs. Duffy (1963) records ***Terminalia kaernbachii*** as the host plant and mentions that it is also a minor pest of ***Theobroma***.

7. **Dihammus tincturatus** Pascoe* Fig. 1.

COLLECTIONS: Attracted to house light, Bulolo, M. Dist., 23.IX.1967, B. Gray. In stem of moribund ***Araucaria cunninghamii***, 4 m high, Compartment 2, Inakanda L.A. (1958/59), Bulolo, M. Dist., 12.II.1968, B. Gray. On leaf of shrub, Watut Valley, M.

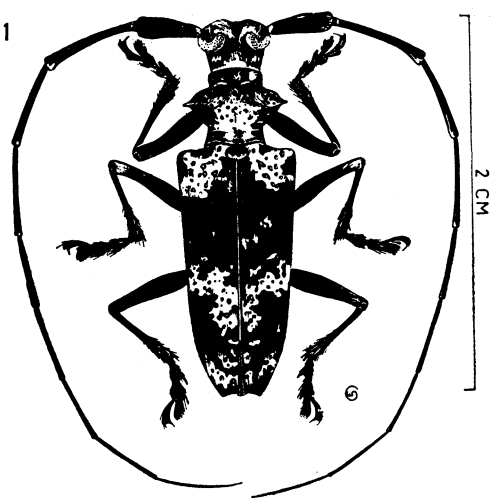

Fig. 1. Adult of ***Dihammus tincturatus***.

Dist., 9.X.1969, S. Davies. Reared from fallen ***Pinus patula***, Compartment 2B, Taun L.A. Bulolo, M. Dist., 4.XI.1969 — reared 29.XII.1969, B. Gray. On fallen ***Anisoptera polyandra***, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, F.R. Wylie & L. Radunz. On fallen log, Gowl, Kar Kar Island, Mad. Dist., 21.V.1970, B. Gray.

DISTRIBUTION AND BIOLOGY: Previously recorded from Irian Jaya in Indonesia. ***Dihammus tincturatus*** often infests the smaller moribund stems (less than 15 cm diameter at breast height) of Hoop Pine in plantation areas severely affected by ***H. araucariae*** and occasionally the freshly fallen stems of similar size. Many adults were reared from a fallen stem of ***Pinus patula***, which had been attacked in 1969 in a very small experimental plot.

8. **Diotimana undata** (Pascoe)*

COLLECTIONS: No additional collection records.

DISTRIBUTION AND BIOLOGY: This insect appears to be fairly rare in the ***Araucaria*** plantations and it is not a primary pest as previously thought. Duffy (1963) has described the immature stages. Also see Gray (1968).

9. **Hoplocerambyx severus** Pascoe* Fig. 2, 3.

COLLECTIONS: On freshly fallen ***Anisoptera polyandra***, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, F.R. Wylie and L. Radunz. Attracted to fallen ***A. polyandra***, Gabensis L.A., M. Dist., 23.V.1972, native collectors.

DISTRIBUTION AND BIOLOGY: ***Hoplocerambyx severus*** has also been found in the Cyclops Mountains in Irian Jaya. This species had extensively damaged fallen logs, especially ***Anisoptera*** species, used as ramps by the logging operators at Gabensis (Fig. 2 and 3). The adults are strongly attracted in large numbers to the freshly fallen logs in the early morning, but they disappear later in the morning into the forest. Several hundred adults were observed by the junior author on a large ***Anisoptera*** log at Kui on the Morobe coast.

10. **Potemnemus detzneri** Kries Fig. 4.

COLLECTIONS: Pupal chamber in stem of ***Tectona grandis***, Oomsis, M. Dist., 29. VIII.1967, B. Gray.

DISTRIBUTION AND BIOLOGY: ***Potemnemus detzneri*** has also been recorded from Queensland in Australia. In August 1967, several ***T. grandis*** trees, 3—4 years old, were found with large bore holes in the stem at Oomsis plantation. The infestation was evident on attacked trees from skin eruptions of the bark caused by larvae burrowing up the cambium. Of the 271 trees in the plantation some 36, or approximately 13%, had been attacked.

Initially the eggs were probably laid by the adult female in crevices or old scars and on eclosion the young larvae burrowed up the cambium for 10—20 cm and then up into the wood for a further 10—30 cm. These tunnels reached 2 cm in width, and since several tunnels were made in some trees damage could be serious. As a control measure all tunnels were opened and specimens of ***P. detzneri*** within destroyed. Subsequent inspections have revealed no further signs of activity. Very similar damage has been observed in ***T. grandis*** at Beon Prison Farm near Madang, Madang District, and reported from Kedia Plantation on Fergusson Island.

11. **Pterolophia duplicata** Pascoe

2

3

Fig. 2. Larvae of ***Hoplocerambyx severus*** in log of ***Anisoptera polyandra*** near Oomsis. (Size of larger larva — length 8 cm). Fig. 3. A log of ***Anisoptera polyandra*** used as a ramp near Oomsis which has been heavily infested by the cerambycid ***Hoplocerambyx severus***.

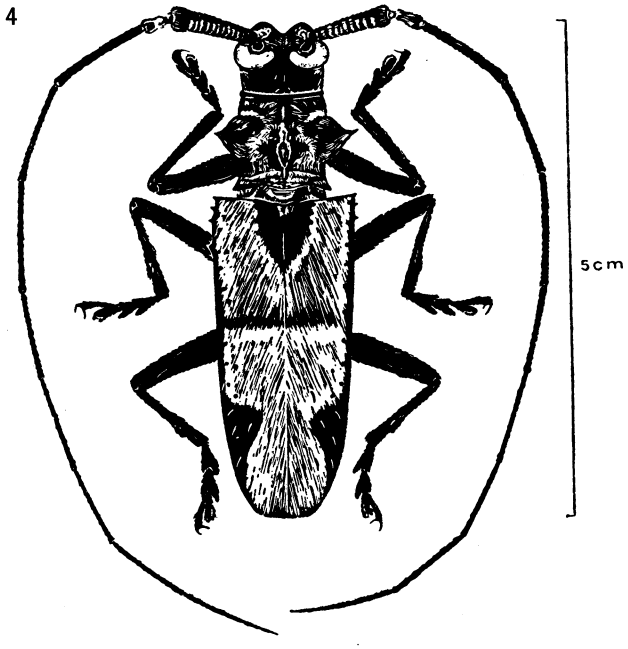

Fig. 4. Adult of *Potemnemus detzneri*.

COLLECTIONS: Rabaul, E.N.B. Dist., 16.X.1940, J.L. Froggatt. Keravat, E.N.B. Dist., 10.VI.1946, B.A. O'Connor. Larvae boring up branch of ***Araucaria cunninghamii***, Nauwata Banda L.A., (1961/62), Bulolo, M. Dist., 15.IX.1967, B. Wills. Attracted to house light, Bulolo, M. Dist., 12.XI.1967, B. Gray. On branch of moribund ***Populus*** sp., Forest Research Station garden, Bulolo, M. Dist., 28.IX.1970, B. Gray.

DISTRIBUTION AND BIOLOGY: Previously collected in the British Solomon Islands. Several scattered young Hoop Pine in the plantation have exhibited dieback of one or two branches, which is usually due to ***P. duplicata*** and other insects boring along the pith. Several adults were collected off a moribund ***Populus*** sp. tree affected by ***Fomes noxious*** in the garden of the Forest Research Station in early 1972.

Chrysomelidae

12. **Arsipoda** sp.*

COLLECTIONS: No additional collection records.

13. **Rhyparida coriacea** Jacoby*

COLLECTIONS: On branchlet of ***Araucaria cunninghamii***, 2 years old, Forestry Nursery, Bulolo, M. Dist., 6.XI.1966, B. Gray. On leaf ***Araucaria hunsteinii***, 0.2 m high, Forestry Nursery, Bulolo, M. Dist., 19.XI.1966, B. Gray. Attracted to house light, Forestry Station, Bulolo, M. Dist., 7.XII.1966, B. Gray. On leaf of seedling ***Terminalia complanata***, Beon Nursery, Mad. Dist., 19.I.1967, B. Gray. On leaf of ***Eucalyptus robusta*** and ***Sonchus*** sp., Korn Farm, W.H. Dist., 30.VIII.1967, F.R. Wylie. On leaf of shrub, Karimui, Chimbu Dist., 12.VI.1968, B. Gray. On leaf of ***Terminalia brassii***, 0.2 m

high, Mirap, Mad. Dist., 19.VI.1968, B. Gray. On leaf *Citrus* sp., Aiome, Mad. Dist., 19.VI.1968, B. Gray. On leaf of *Terminalia brassii*, Forestry Nursery, Vanimo, W.S. Dist., 25.VI.1968, B. Gray. On leaf planted *Terminalia brassii* and on branch *Casuarina oligodon*, Kunjingini, E.S. Dist., 20—21.VI.1968, B. Gray. On leaf marigold, Baiyer River, W.H. Dist., 26.VII.1968, F.R. Wylie. On leaf *Tectona grandis* seedlings, Brown River, C. Dist., 3.IX.1968, B. Gray. On leaf *Eucalyptus deglupta*, Goroka, E.H. Dist., 15.XII.1968, F.R. Wylie. On leaf planted *Eucalyptus deglupta* and *Eucalyptus grandis*, Kunjingini, E.S. Dist., 16.I.1969, N. Gough. On leaf of *Fraxinus* sp., Madang, Mad. Dist., 20.I.1969 F.R. Wylie. On fallen log, Rabenhen, N.I. Dist., 7.V.1969, B. Gray. On ground and shrubs, along the Hegiso-Kesebe track, S.H. Dist., 22.XI.1969, B. Gray. On leaf (Zingiberaceae), McAdam Park, Wau, M. Dist., 24.III.1969, B. Gray. Large numbers defoliating *Eucalyptus deglupta* 1 year old, Mosa Plantation, via Hoskins, W.N.B. Dist., 25. I.1971, B.C. Peters. On leaves of 2 year old *Eucalyptus deglupta*, Tabairikau, via Hoskins, W.N.B. Dist., 4.II.1971, B.C. Peters. On *Eucalyptus deglupta* seedlings, Wilelo, W.N.B. Dist., 26.III.1971, B.C. Peters. On *Eucalyptus deglupta*, Entomology Laboratory, Bulolo, M. Dist., 28.V.1971, B.C. Peters.

DISTRIBUTION AND BIOLOGY: The Department of Forests, Annual Report (Anon. 1960) mentions that a leaf-eating *Rhyparida* sp. attacked seedlings of *Ochroma* sp., *Octomeles sumatrana* and *Terminalia brassii* at Keravat in the East New Britain District. It was controlled by the application of the insecticide Benzene hexachloride (BHC). At Mirap, *R. coriacea* had severely defoliated young *T. brassii* trees in June 1968. This species is very common throughout much of Papua New Guinea. Usually the defoliation caused is slight, but when *R. coriacea* is present in plague numbers then extensive damage may result. Damage to *Eucalyptus deglupta* in the forestry nursery at West Goroka and to trees on the Goroka Golf Course was reported in late 1968.

Severe damage to *Eucalyptus deglupta* occurred in May and June 1971 in an experimental plot of 1200 trees at Dami in the West New Britain District. Approximately 5 to 10 % of the trees were completely defoliated by the adults of *R. coriacea* chewing the petioles at the base (J. Dalton, pers. comm.). This caused wilting and subsequent infection by fungi. Some mortality was later experienced. Also see Gray (1968).

Curculionidae

14. **Apirocalus cornutus** Pascoe

COLLECTIONS: On stem of *Tectona grandis*, 4 years old, Brown River, C. Dist., 27. IX.1966, B. Gray. On branch of *Araucaria hunsteinii*, 2 years old, and on branchlet *Araucaria cunninghamii*, Forestry Nursery, Bulolo, M. Dist., 6.XI.1966, B. Gray. In forest, along Gimi Road 62 km from Okapa, E.H. Dist., 1.VI.1967, B. Gray. On *Sida* sp., Bulolo, M. Dist., VI.1967, S. Auno. On *Imperata cylindrica*, Murrmurr Village, 2590 m, W.H. Dist., 18.VIII.1967, F.R. Wylie. On leaf *Canna* sp., Tambul, W.H. Dist., 18. VIII.1967, F.R. Wylie & S. Auno. On leaf *Eucalyptus torrelliana*, near Forestry Nursery, Bulolo, M. Dist., 16.X.1967, B. Gray. On leaf *Hibiscus* sp., Mt Kaindi, 1500 m, M. Dist., 12.XII.1967, F.R. Wylie. On *Hibiscus* sp., Mapos, M. Dist., 21.I.1968, F.R. Wylie. On leaf of *Cucurbita pepo*, Station L.A., Bulolo, M. Dist., 30.IV.1968, Simon. On leaf of tree, Karimui, Chimbu Dist., 12.VI.1968, B. Gray. On leaf *Fraxinus* sp., 1.1 m high, Mirap, Mad. Dist., 18.VI.1968, B. Gray. On leaf *Tectona grandis*, Beon Nur-

sery, Mad. Dist., 19.VI.1968, B. Gray. On leaf *Macaranga* sp., Jimi Valley, W.H. Dist., 19.IX.1968, F.R. Wylie. Attacking *Eucalyptus* sp., 0.6 m high, in nursery, Malawaka, E.H. Dist., 7.IV.1969, W.R. Bartlett. On leaf *Trema orientalis*, adjacent to Hegiso — Pimaga track, S.H. Dist., 22.XI.1969, B. Gray & H. Ivagai. On leaf *Toona australis*, Bamboo L.A., Wau, M. Dist., 3.VIII.1970, B. Gray. 17 km NE of Biawa, M. Dist., 27. XIII.1970, B.C. Peters.

DISTRIBUTION AND BIOLOGY: This species is endemic to New Guinea. Szent-Ivany & Ardley (1963) reported *A. cornutus* causing severe damage to young *Theobroma cacao* leaves by feeding on the growing point, while Smee (1964) recorded it as a pest of *Hevea brasiliensis* in Papua New Guinea. The insect is omnivorous. *Apirocalus cornutus* adults are quite common on small Hoop Pine trees and seedlings in several areas of Papua New Guinea. In 1967, very little was known about the extent of damage caused to the plants and a "force-feeding" experiment was undertaken. In the experiment, 2, 10 and 50 adults of *A. cornutus* were placed in 3 cages respectively with a seedling of Hoop Pine on 17 March 1967. Damage was first observed 4 days after, when a branchlet was chewed off. In the cage with 50 adults the seedling was severely damaged and it died 4 weeks later. Much of the cambial layer was eaten, leaving the woody heartwood, and almost all of the branchlets had fallen off. Similar, but less extensive damage occurred in the other cages. No sign of egg laying was observed and all adults had died by 18 April 1967.

15. Gen. et sp. indet.*

COLLECTIONS: No additional collection records.

DISTRIBUTION AND BIOLOGY: This species was wrongly referred to earlier as Barinae sp. (see Gray 1968). Examination of several specimens by Dr G. Kuschel (pers. comm.) showed that they belonged to a new genus and species.

16. **Oribius cruciatus** Faust*

COLLECTIONS: On branch *Araucaria cunninghamii*, 0.2 m high, Forestry Nursery, Bulolo, M. Dist., 16.XIII.1966, B. Gray. On *Eucalyptus* sp., Station L.A., Bulolo, M. Dist., 3.IV.1967, F.R. Wylie. On leaf *Tectona grandis*, Brown River, C. Dist., 1.VIII. 1967, B. Gray. On leaf *Eucalyptus* sp., Vanimo, W.S. Dist., 25.VI.1968, B. Gray. On leaf *Macaranga* sp., Watut Valley, M. Dist., 13.IX.1968, B. Gray.

DISTRIBUTION AND BIOLOGY: This species appears to be very widely distributed throughout Papua New Guinea, and it is also omnivorous. It has caused defoliation and subsequent dieback of branches of Hoop Pine seedlings in the nursery at Bulolo. Also see Gray (1968).

17. **Oribius destructor** Marshall*

COLLECTIONS: On branchlet *Araucaria cunninghamii* seedling, Okapa, E.H. Dist., 21.III.1967, B. Gray. Severe attack on *Crotalaria anagyroides*, Okapa Station, E.H. Dist., 17.V.1967, B. Gray. On stem of *Araucaria cunninghamii* 15 m high, Kainantu township, E.H. Dist., 6.VI.1967, B. Gray. On leaf *Canna* sp., Kamaga, W.H. Dist., 17. VIII.1967, F.R. Wylie. On *Imperata cylindrica*, near Kamaga, 2260 m, W.H. Dist., 17. VIII.1967, F.R. Wylie. On *Fraxinus* sp., 1 m high, Forest Nursery, Goroka, E.H. Dist., 22.VIII.1967, F.R. Wylie & S. Auno. On *Eucalyptus tereticornis*, *Eucalyptus torelliana*, *Passiflora* sp., *Populus* sp. and *Sonchus* sp., Korn Farm, W.H. Dist., 30.VIII. 1967, F.R. Wylie. On *Casuarina* sp., Togaba, W.H. Dist., 30.VIII.1967, F.R. Wylie. On

Pinus patula and on leaf *Cupressus* sp., Asaroka Lutheran Mission Station, E.H. Dist., 31.X.1967, F.R. Wylie. On leaf *Eucalyptus grandis*, Togaba, W.H. Dist., 3.XI.1967, F.R. Wylie. On leaf *Codiaeum variegatum*, Karimui, Chimbu Dist., 10.VI.1968, B. Gray. On leaf shrub, Karimui, Chimbu Dist., 11.VI.1968, B. Gray. On leaf shrub, Karimui, Chimbu Dist., 11.VI.1968, B. Gray. On leaf *Hibiscus* sp., Sunken Gardens, Mount Hagen, W.H. Dist., 29.VII.1968, F.R. Wylie. On branchlet *Araucaria cunninghamii*, Erave, S.H. Dist., 7.VIII.1968, F.R. Wylie. On branchlet *Casuarina* sp., Asaroka, E.H. Dist., 30.VIII.1968, F.R. Wylie. On leaf *Cucurbita pepo*, Goroka, E.H. Dist., 3.IX.1968, F.R. Wylie. On leaf of *Pipturus* sp., Hegiso—Pimaga Road, S.H. Dist., 25.XI.1969, B. Gray and H. Ivagai. On leaf of *Ficus* sp., Pimaga, S.H. Dist., 25.XI.1969, Aubeta Kairo. On leaf shrub, Goroka, E.H. Dist., 15.III.1970, B. Peters.

DISTRIBUTION AND BIOLOGY: The junior author found *O. destructor* decapitating the growing tip of *Eucalyptus deglupta* seedlings at Korn Farm in the Western Highlands District in 1968. Also see Gray (1968).

18. **Oribius inimicus** Marshall*

COLLECTIONS: On branchlet *Araucaria cunninghamii* seedling, Okapa, E.H. Dist., 21.III.1967, B. Gray. Severely attacking *Crotalaria anagyroides*, Okapa Station, E.H. Dist., 17.V.1967, B. Gray. On branchlet *Araucaria cunninghamii*, Tarabo, E.H. Dist., 23.V.1967, B. Gray. On *Canna* sp., Murrmurr Village, W.H. Dist., 2590 m, 17.VIII.1967, F.R. Wylie. On branchlet *Araucaria cunninghamii*, Minj, W.H. Dist., 17.VIII.1967, B. Gray. On *Eucalyptus grandis*, *Grevillea robusta*, and *Cucurbita pepo*, Korn Farm, W.H. Dist., 30.VIII.1967, F.R. Wylie. On leaf *Eucalyptus torrelliana*, Korn Farm, W.H. Dist., 3.XI.1967, F.R. Wylie. On leaves *Pinus patula*, Marafunga, E.H. Dist., 2600 m, 1.VI.1968, B. Gray. On leaf *Eucalyptus deglupta*, Korn Farm, W.H. Dist., 8.VI.1968, B. Gray. On branchlet *Araucaria cunninghamii*, *Coffea robusta*, on leaf *Eucalyptus grandis*, on leaf *Eucalyptus deglupta*, and on branch *Casuarina* sp., Utu, Mad. Dist., 15.VI.1968, B. Gray. On leaf *Hibiscus* sp., Sunken Gardens, Mt Hagen, W.H. Dist., 29.VII.1968, F.R. Wylie. On branchlet *Araucaria cunninghamii*, Kagua, S.H. Dist., 7.VIII.1968, F.R. Wylie. On leaf *Cucurbita pepo*, Goroka, E.H. Dist., 3.IX.1968, F.R. Wylie. On leaf shrub, Korn Farm, W.H. Dist., 12.IX1968, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: This species causes similar damage to that of *O. cruciatus* and *O. destructor*. Also see Gray (1968).

19. **Vanapa oberthuri** Pouillaude

COLLECTIONS: Adult on stem *Araucaria cunninghamii*, Asaroka Lutheran Mission High School grounds, E.H. Dist., 10.VII.1970, A. Lake & P. Bogia. On stem of *Calophyllum* sp. in natural *Araucaria hunsteinii* stand, Garaina, M. Dist., 20.VII.1970, A. Kairo. Attracted to black light 12.00—1.00 am, Forestry Compound, Bulolo, M. Dist., 26.VII.1970, M. Gamea. On stem *Araucaria cunninghamii*, Ameria, Mad. Dist., 5. XI.1972, B. Gray & J. Dobunaba.

DISTRIBUTION AND BIOLOGY: The collection of *V. oberthuri* off *Calophyllum* sp. in a natural stand of Klinkii Pine is most intriguing. In all previous collections and observations made by the authors the insect was invariably found on Hoop Pine. According to Mr A. Kairo, who is an experienced botanical observer, there were no nearby trees of the latter species for several km (10—15). *Vanapa oberthuri* was collected for the first time in a natural Hoop Pine forest at Ameria, but no damage was seen. Also see Bar-

rett (1967), Gray (1968) and Gray and Howcroft (1970).

Vanapa oberthuri was reported (Gray 1968) to be a relatively minor pest. However, with the implementation of high pruning and thinning operations in the plantations, its status could become of major importance. In older plantations several patches of dead trees formerly infested by the weevil have been observed. Its biology in several respects is similar to that of *Aesiotes notabilis* Pascoe, which was a serious pest in Hoop Pine plantations in Queensland (Gray 1972).

Dynastidae

20. **Papuana woodlarkiana semistriata** Arrow

COLLECTIONS: Attracted to house light, Bulolo, M. Dist., 7.XII.1966, B. Gray. On stem *Castanopsis* sp., Wau, M. Dist., 2330 m, 11.II.1967, D. McIntosh. Attracted to tent light, Jimi Valley, W.H. Dist., 18.IX.1968, F.R. Wylie. Kivnaga, W. Dist., 35 m, VIII. 1969, J. & M. Sedlacek. On *Saccharum* sp., along road between Hegiso and Pimaga, S.H. Dist., 25.XI.1969, B. Gray.

DISTRIBUTION AND BIOLOGY: The species has been recorded from Kei Island in the New Hebrides and from Mansela, Kajeli-Boeroe (Moluccas, Indonesia?). Some heavy losses of Klinkii Pine seedlings in nursery beds at Bulolo were reported by the Department of Forests in the Annual Report for 1960 (Anon. 1960). Control was achieved by application of Aldrin (R) dust.

21. **Xylotrupes gideon** (Linnaeus) Fig. 5, 6.

COLLECTIONS: On branch *Araucaria cunninghamii*, 3 m high, Forestry Nursery, Bulolo, M. Dist., 25.X.1966, B. Gray. Attracted to house light, Forestry Station, Bulolo, M. Dist., 6.XII.1966, B. Gray. On *Samanea* sp., Forestry Station, Bulolo, M. Dist., 27. VI.1967, F.R. Wylie & S. Auno. On branch of *Delonix regia*, Bulolo, M. Dist., 16.V. 1969, B. Gray. Chewing stem *Pinus patula*, Taun L.A., Bulolo, M. Dist., 5.XI.1969, N. Howcroft. Chewing bark of *Fraxinus* sp., West Goroka Forest Nursery, E.H. Dist., 13. I.1970, A. Ross. Chewing bark of *Fraxinus* sp., Lapegu, 18.III.1970, F.R. Wylie & B.C. Peters. Chewing bark of *Eucalyptus deglupta*, West Goroka Nursery, E.H. Dist., 18. III.1970, F.R. Wylie & B.C. Peters. Chewing bark of *Toona australis*, Compartment 2, Bamboo L.A., Wau, M. Dist., 19.III.1971, B. Gray. To electric grid trap, Pacific Island Timbers Mill, Cape Rodney, C. Dist., 28.VIII.1972, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: This species has a wide distribution from North India and China to Australia and the New Hebrides (Szent-Ivany 1969). Adults of *X. gideon* caused minor bark damage to a stand of 200 *Fraxinus* sp. trees at Lapegu in March 1970 and to another stand of similar size at the West Goroka Nursery. The trees were aged 2 years and averaged 8 m high. Strips of bark, approximately 6 cm in length, 1 cm wide and 0.5 cm deep were chewed from the stem near the lowest node about 5 m above the ground, but only slight penetration of the cambial layer was evident. At the time of observation in March, one to two sexual pairs were found on each tree.

When the trees were shaken, the adults fell readily to the ground where they were then destroyed by physical means. This procedure was carried out at weekly intervals and it proved a simple, but inexpensive, and effective means of reducing the pest to insignificant numbers.

Severe injury to most of the 496 *Toona australis* trees in a small experimental

5

6

Fig. 5. Scar damage to stem of *Toona australis* caused by the dynastid *Xylotrupes gideon*. Fig. 6. *Toona australis* tree deformed by the combined insect attack of *Xylotrupes gideon* and *Hypsipyla robusta*.

plot in Bamboo L.A., Wau, was observed in early 1971. Strips of bark were gouged off the stem and branches by the adults and in some trees there was considerable deformation and dieback (Fig. 5 and 6), in addition to that caused by ***Hypsipyla robusta***. Many adults were collected off the trees and destroyed in February 1971. As a result of further damage to the trees the plot was subsequently written off as a loss in 1972. A fire in September 1972 destroyed the plot.

A similar attack on ***Toona australis*** (=***Cedrela toona***) by the elephant beetle, ***Xvlotrupes gideon australicus*** Thomson, at the Kamarunga State Nursery near Cairns in northern Australia is reported by Froggatt (1923). Szent-Ivany (1969) reported damage to the bark on stems and branches of ***Delonix regia*** by ***X. gideon*** in Bulolo, Garaina, Goroka, Port Moresby and at several localities on New Britain Island, and to ***Elaeocarpus sphaericus*** at Wau.

Lyctidae

22. **Lyctus brunneus** (Stephens)

COLLECTIONS: Boring in ***Aglaia*** sp., ***Cryptocarya*** sp., and ***Planchonella*** sp., Marafunga, E.H. Dist., 5.VIII.1962, K.J. White. Boring in handle of tomahawk (***Eucalyptus maculata***) imported from Australia, intercepted at Port Moresby, C. Dist., VIII.1962, S.J. Colwell. In seasoned ***Myristica*** sp., Goroka, E.H. Dist., 7.XIII.1967, C. Levy. In wood artifact, Wewak, E.S. Dist., 2.XI.1970, J. Stibick. In fence post, Banz, W.H. Dist., 14.X.1971, R. Oswell.

DISTRIBUTION AND BIOLOGY: This species has a cosmopolitan distribution.

23. **Minthea rugicollis** (Walker)

COLLECTIONS: Attacking sapwood of assorted hardwoods in store in Forest Products Research Centre, Hohola, Port Moresby, C. Dist., 16.IX.1970, J. Beesley & C. Levy. In drum, Port Moresby, C. Dist., 2.XI.1970, J. Stibick.

DISTRIBUTION AND BIOLOGY: This species has a pantropical distribution.

Platypodidae

24. **Crossotarsus mniszechi** Chapuis*

COLLECTIONS: Semkamin, Lelet Plateau at 900 m, N.I. Dist., 15.IV.1962, Danish 'Noona Dan' Expedition. Yalom, Gazelle Peninsula at 1000 m, E.N.B. Dist., 22.V.1962, Danish 'Noona Dan' Expedition. In freshly fallen log, Gowl, Kar Kar Island, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen logs of ***Antidesma*** sp., ***Cananga odorata***, ***Dracontomelum*** sp., ***Maniltoa*** sp., ***Pangium*** sp., ***Polyalthea*** sp., and ***Vitex*** sp., Gogol Base, Mad. Dist., 23.I.1970, B. Gray.

DISTRIBUTION AND BIOLOGY: ***Crossotarsus mniszcechi*** was one of the most common ambrosia beetles attacking series of logs of several tree species at Gogol which were being evaluated for use in pulp-wood studies at Madang. Also see Gray (1968).

25. **Platypus jansoni** Chapuis*

COLLECTIONS: In logs of ***Anisoptera*** sp., Killerton Beach, N. Dist., 27.VI.1960, F. Coppock. Sumcina, Dyaul Island, N.I. Dist., 6—13.III. 1962, Danish 'Noona Dan' Expedition. Lemkamin, Lelet Plateau, at 900 m, N.I. Dist., 14—21.IV.1962, Danish 'Noona Dan' Expedition. Komgi, Gazelle Peninsula, 1000 m, E.N.B. Dist., 14.V.1962, Danish

'Noona Dan' Expedition. Lorengau, M.I. Dist., 15.VI.1962, Danish 'Noona Dan' Expedition. Valoka at Cape Hoskins, W.N.B. Dist., 7—12.VII.1962, Danish 'Noona Dan' Expedition. In stem of ***Hevea brasiliensis***, Aikinumu Plantation, Logen, C. Dist., 31. VII.1963, J.J.H. Szent-Ivany, L. Smee & E. Kanjiri. Suspected primary borer in the stem of ***Theobroma cacao***, according to collector killed 2 trees; Lalahon Village, Buka, B. Dist., 1.V.1965, H. Burton. Boring into green bark of ***Hevea brasiliensis***, especially in tapping area, Merani Estate, Cape Rodney Area, C. Dist., 9.X.1965, G.E. Elsworthy. Borer in ***Anthocephalus*** and ***Anisoptera*** logs treated with a mixture of borax, boracic acid, arsenic pentoxide, sodium fluoride, mixed with water to a concentration of 39.7% (W/W) expressed on a borax pentahydrate equivalent, Wewak Timbers Ltd., Wewak, E.S. Dist., 17.VI.1965, G.N. Vickers. Attracted to house light, Bulolo, M. Dist., 20.XI.1966, B. Gray. On pole ***Araucaria hunsteinii***, Bulolo, M. Dist., 28.I.1967, B. Gray. Boring into cut bole of live ***Araucaria hunsteinii***, Station L.A., (1949/50), Bulolo, M. Dist., 5.III.1967, B. Gray. In fallen log of ***Xanthophyllum*** sp., Watut Valley, 1200 m, M. Dist., 1.III.1968, B. Gray & F.R. Wylie. In fallen log of ***Garuga*** sp., Watut Valley, 1200 m, M. Dist., 1.III.1968, Bereima & S. Auno. In fallen log (Sterculiaceae), Watut Valley, 1200 m, M. Dist., 1.III.1968, B. Gray, F.R. Wylie & Walu. In log of ***Ficus*** sp., Watut Valley, M. Dist., 14.III.1968, B. Gray & Walu. Boring into fallen log, Karimui, Chimbu Dist., 11.VI.1968, B. Gray. Boring into freshly fallen log ***Intsia bijuga***, Utu, Mad. Dist., 15.VI.1968, B. Gray. Under bark fallen ***Alstonia scholaris***, Watut Valley, M. Dist., 13.IX.1968, Bereima. In freshly fallen logs, Peaga and Rosun, M.I. Dist., 21.IV.1969, B. Gray. In freshly fallen logs, Loniu and Lugos, M.I. Dist., 22.IV.1969, B. Gray. In freshly fallen logs, Fangawala, Lemusmus and Kabelman, N.I. Dist., 25.IV.1969, B. Gray. In freshly fallen log, Namarodu, N.I. Dist., 29.IV.1969, B. Gray. In freshly fallen log, 2 km N of Ruwong Sawmill, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen log, Rabenhen, Matakan and Raseerick, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen log, ***Terminalia brassii***, 2 km N of Ruwong Sawmill, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen log, ***Dysoxylum*** sp., Lakunai, E.N.B. Dist., 2.V.1969, B. Gray. In freshly fallen log ***Dysoxylum*** sp. and ***Myristica*** sp., Warangoi, E.N.B. Dist., 3.V.1969, B. Gray. In freshly fallen logs ***Endospermum medullosum***, ***Ficus*** sp. and ***Pometia pinnata***, Aropa, B. Dist., 5.V.1969, B. Gray. In freshly fallen log, Buin, B. Dist., 7.V.1969, B. Gray. In stem of ***Sloanea forbesii***, Long Island L.A., Bulolo, M. Dist., 13.IV.1969, B. Gray. Boring in fallen stem of ***Althoffia*** sp., ***Octomeles sumatrana*** and ***Trema orientalis***, Road 14, Nauwata Banda L.A., Bulolo, M. Dist., 5.IX.1969, J. Dobunaba. In freshly fallen logs of ***Laportea*** and ***Macaranga*** sp., Road 11, Long Island L.A., Bulolo, M. Dist., 9.IX.1969, J. Dobunaba and Anton. Boring in freshly fallen ***Araucaria cunninghamii***, Kulolo L.A., Wau, M. Dist., 29.X.1969, J. Dobunaba & Lei. Boring into fallen ***Sloanea forbesii***, Yakawa L.A., Watut, M. Dist., 30.X.1969, B. Gray & Anton. In fallen log of ***Litsea domarensis***, Bunu, Lake Kutubu, S.H. Dist., 23.XI.1969, B. Gray. In fallen log of ***Ficus*** sp., Pimaga Airstrip, S.H. Dist., 25.XI.1969, B. Gray. In fallen log ***Spondias*** sp., Pimaga, S.H. Dist., 26.XI.1969, B. Gray. In freshly fallen log, Kaviak, Kar Kar Island, Mad. Dist., 20.I.1970, B. Gray. In freshly fallen log ***Mangifera minor***, Liloi, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log, Gowl, Katom, Kubam, Liloi and Yuk Yuk, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log ***Artocarpus incisus***, Lang Lang, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen logs of ***Buchanania*** sp., ***Carallia*** sp., ***Evodia*** sp., ***Pterocymbium*** sp.,

Spondias sp., *Terminalia sepicana*, No. 1 Ramp, Gogol, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen log *Anisoptera polyandra*, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, J. Dobunaba. On fallen log (2), Kassam, M. Dist., 13.III.1970, B.C. Peters & F.R. Wylie. In freshly fallen log *Harpullia pedicellaris*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 17.IV.1970, H. Ivagai and Anton. In freshly fallen log *Dysoxylum* sp., cattle paddock adjacent Road 6, Bulolo, M. Dist., 17.IV.1970, H. Ivagai. In freshly fallen logs *Garuga floribunda* and *Xanthophyllum papuanum*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 21.V.1970, H. Ivagai. In freshly fallen log *Aleurites moluccana*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 21.V.1970, M. Gamea. In freshly fallen log *Pterocarpus indicus*, Mogova, Goodenough Island, M. B. Dist., 22.VI.1970, J. Dobunaba. In freshly fallen log *Elaeocarpus sphaericus*, Wadalei, Fergusson Island, M.B. Dist., 23.VI.1970, B. Gray & J. Dobunaba. In freshly fallen logs of *Hibiscus tiliaceus* and *Pterocarpus indicus*, Alotau, M. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In freshly fallen logs of *Endiandra* sp. and *Pterocarpus indicus*, Naura, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In freshly fallen *Hibiscus tiliaceus*, Kela Kela, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In timber *Alstonia scholaris* treated with methyl bromide, Pacific Island Timbers, Port Moresby, C. Dist., 4.VII.1970, C. Levy & K. Garbutt. In freshly fallen logs of *Cerbera floribunda* and *Inocarpus fagiferus*, Sewa Bay, Normanby Island, M.B. Dist., 20.VIII.1970, J. Dobunaba. In logs of *Homalium foetidum* and *Pometia* sp., Kwalakessi, W.N.B. Dist., 5.II.1971, B.C. Peters. In *Eucalyptus deglupta*, 13 days after felling, Dagi R., W.N.B. Dist., 10.II.1971, B.C. Peters. In logs of *Endospermum* sp. and *Pterocymbium* sp., Wilelo, W.N.B. Dist., 29.II.1971, B.C. Peters. Boring in log *Sterculia* sp., Kwalakessi Sawmill, W.N.B. Dist., 12.V.1971, F.R. Wylie & H. Ivagai. Boring in treated logs of *Canarium indicum*, *Celtis* sp., *Pterocymbium beccarii* and *Sterculia* sp., Buluma Beach, Cape Hoskins, W.N.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. Boring in freshly fallen log of *Anthocephalus cadamba*, Buluma Mill, Cape Hoskins, W.N.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. Boring in fallen logs of *Octomeles sumatrana*, *Planchonella* sp. and *Pterocymbium beccarii*, Potogalai L.A., Hoskins, W.N.B. Dist., 14.V.1971, F.R. Wylie & H. Ivagai. Boring in treated logs on beach *Octomeles sumatrana* and *Pterocymbium beccarii*, Kwalakessi Mill, W.N.B. Dist., 15.V.1971, F.R. Wylie & H. Ivagai. Boring in fallen logs of *Carallia brachiata*, *Endospermum* sp., *Homalium foetidum* and *Pimeleodendron amboinicum*, Kumbango L.A., Hoskins, W.N.B. Dist., 16.V.1971, F.R. Wylie & H. Ivagai. In freshly felled logs of *Dracontomelum mangiferum*, *Eugenia* sp., and *Palaquium galactoxylon*, Goldore, Vanimo, W.S. Dist., 2.VI.1971, F.R. Wylie. In *Celtis* sp. (creosoted) and *Endospermum medullosum*, Goldore, Vanimo, W.S. Dist., 2.VI.1971, F.R. Wylie. In *Celtis latifolia*, *Octomeles sumatrana* and *Planchonella* sp., Goldore, Vanimo, W.S. Dist., 3.VI.1971, F.R. Wylie. In treated flooring timber, Technical School, Arawa, B. Dist., 3.XI.1971, Zimmerman. In plank *Endospermum medullosum*, house bearer, Arawa, B. Dist., 9.XI.1971, F.R. Wylie. In fallen log *Nauclea* sp., Bulolo, M. Dist., 10.XII.1971, F.R. Wylie & J. Simpson. In logs of *Dracontomelum* sp. and *Pterocymbium beccarii*, Vanapa River, C. Dist., 15.III.1972, F.R. Wylie. Attracted to mercury vapour light, Latep L.A., Bulolo, M. Dist., 21.IV.1972, F.R. Wylie & M. Gamea. In billet *Araucaria hunsteinii* and log *Nauclea* sp., Golden Pines Sawmill, M. Dist., 21.VI.1972, F.R. Wylie & P. Shanahan. In logs of *Alstonia scholaris*, *Celtis* sp., *Pometia tometosa*, *Pterocarpus indicus* and *Sloanea forbesii*, Cape Rodney, C. Dist., 23.VII.1972, F.R. Wylie. On sawn timber

prior to dipping and after dip-diffusion treatment, Cape Rodney, C. Dist., 27.VII.1972, F.R. Wylie. In log *Agathis alba*, Panganda L.A., Watut Valley, 2320 m, M. Dist., 7.VIII.1972, P. Shanahan & H. Ivagai. In freshly fallen *Wrightia laevis*, Block 10, New Guinea Industries L.A., Gabensis, M. Dist., 10.VIII.1972, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: This is the most important and widespread pest of logs and sawn timber in Papua New Guinea. It is endemic to this country and has been recorded from 53 species belonging to 27 plant families. *Platypus jansoni* has been found attacking sawn timber in diffusion chambers at Vanimo and Cape Rodney. Also see Gray (1968)

26. **Platypus selysi** Chapuis* Fig. 7a, b.

COLLECTIONS: In stem of *Hevea brasiliensis*, Mamoo Plantation, N. Dist., 7.XII.1955, J.J.H. Szent-Ivany. Boring into green bark of *Hevea brasiliensis* especially in the tapping area, Merani Estate, Cape Rodney Area, C. Dist., 9.X.1965, G.E. Elsworthy. Attracted to house light, Bulolo, M. Dist., 23.IX.1968, H. Ivagai. In freshly fallen log *Myristica* sp., No. 1 Ramp, Gogol, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen logs *Evodia* sp. and *Polyalthia* sp., Gogol Base, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen log *Aleurites moluccana* and *Horsfieldia irya*, cattle paddock adjacent to road 6, Bulolo, M. Dist., 21.V.1970, H. Ivagai & J. Dobunaba.

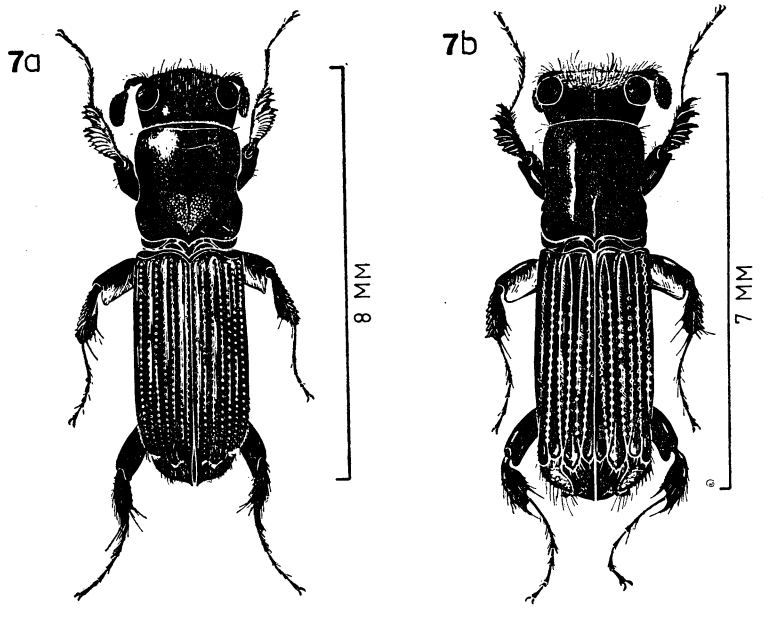

Fig. 7. Adults of *Platypus selysi:* a, female; b, male.

DISTRIBUTION AND BIOLOGY: This is also a very serious timber boring pest in Papua New Guinea. The female and male adults are illustrated in Fig. 7a and 7b. Also see Gray (1968).

27. **Platypus solidus** Walker*

COLLECTIONS: In logs of *Anisoptera* sp., Killerton Beach, N. Dist., 27.VI.1960, F. Coppock. Two specimens found in one hole in *Anthocephalus* sp. preservatively treated by dip diffusion process using a mixture of borax, boracic acid, arsenic pentoxide, sodium dichromate and sodium fluoride, a mixture with water to a concentration of 39.7% (W/W) expressed on a borax pentahydrate equivalent. Other specimens of the same species found boring in *Anthocephalus* and *Anisoptera* logs preservatively treated with the above described dip diffusion process, timber yard of Wewak Timbers Ltd., Wewak, E.S. Dist., 17.VI.1965, G.N. Vickers. In stem of live *Araucaria cunninghamii*, 12 m high, Goroka cemetery, E.H. Dist., 22.III.1967, B. Gray. In live *Eucalyptus grandis* stem, Togoba, W.H. Dist., 30.VIII.1967, F.R. Wylie. Boring into *Geijera salicifolia* stem, Divide L.A., (1967/68), Watut Valley, M. Dist., 27.II.1968, F.R. Wylie & J. Riley. Boring into fallen log, Karimui, Chimbu Dist., 11.VI.1968, B. Gray. In freshly fallen *Laportea* sp., Road 11, Long Island L.A., Bulolo, M. Dist., 9.IX.1968, J. Dobunaba & Anton. In freshly fallen log *Canarium indicum*, Warangoi, E.N.B. Dist., 3.V.1969, B. Gray. In freshly fallen log, Buin, B. Dist., 7.V.1969, B. Gray. Boring in fallen stem of *Octomeles sumatrana*, Road 14, Nauwata Banda L.A., Bulolo, M. Dist., 5.XI.1969, J. Dobunaba. In freshly fallen *Macaranga* sp. and *Rhus taitensis*, Road 11, Long Island L.A., Bulolo, M. Dist., 9.IX.1969, J. Dobunaba & Anton. In freshly fallen log, Pimaga, S.H. Dist., 25.XI.1969, B. Gray & H. Ivagai. In fallen log of *Campnosperma* sp., Pimaga Airstrip, S.H. Dist., 25.XI.1969, B. Gray. In freshly fallen log, Kaviak, Kar Kar Island, Mad. Dist., 20.I.1970, B. Gray. In freshly fallen log *Canarium* sp., Gowl, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log *Terminalia sepicana*, No. 1 Ramp, Gogol, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen log *Evodia* sp., Mogova, Goodenough Island, M.B. Dist., 22.VI.1970, B. Gray. In freshly fallen log *Ficus* sp., Alotau, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In freshly fallen log *Althoffia* sp., Ailuluwai, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. At hurricane lamp, Dagi River, W.N.B. Dist., 10.II.1971, B.C. Peters. Boring in logs, Era Sawmill, Era River, G. Dist., 12.I.1972, F.R. Wylie. In logs of *Dracontomelum* sp. and *Pterocymbium beccarii*, Vanapa River, C. Dist., 15.III.1972, F.R. Wylie. In log *Nauclea* sp., Manki L.A., Bulolo, M. Dist., 22.VI.1972, F.R. Wylie & P. Shanahan. In logs of *Celtis* sp. and *Sloanea forbesii*, Cape Rodney, C. Dist., 23.VII.1972, F.R. Wylie. Boring in fallen *Protium macgregorii*, Bulolo, M. Dist., 9.VIII.1972, J. Dobunaba.

DISTRIBUTION AND BIOLOGY: This species accounted for the majority of specimens caught in sticky traps during flight activity studies in the Hoop Pine plantations (Gray 1973c), and in fire-damaged areas at Bulolo (Wylie, in preparation). However, in the natural forest it is relatively rare. Also see Gray (1968).

A number of *Eucalyptus grandis* trees planted at Marafunga in the Eastern Highlands District and at Togaba in the Western Highlands District were attacked lightly by *P. solidus* in 1967 and 1968. The adults were found boring in the bark and outer sapwood and there was relatively high mortality due to drowning in the sap flow. The species is omnivorous (Table 1).

Scolytidae

28. **Hylurdrectonus araucariae** Schedl*

COLLECTIONS: Gray (in preparation).

DISTRIBUTION AND BIOLOGY: A summary account of research carried out on *H. araucariae* over the period 1966 to 1972 by the senior author is given below. More detailed accounts are available in published papers (Gray 1971b, 1971c, 1973f) and in papers in press (Gray 1973a, 1973b, 1973e). Also see Gray (1968).

Hylurdrectonus araucariae was described by Schedl in 1964 from specimens collected from infested Hoop Pine planted in Andersons L.A. at Wau in Papua New Guinea in 1963. Until the commencement of studies in late 1966, no research had been carried out on *H. araucariae* and its propensity as a pest was little appreciated. The pest is unique in the tropics as a branchlet-mining scolytid of considerable economic significance.

The egg, larval and pupal stages of *H. araucariae* have been described and illustrated in detail (Gray 1973f). Both larvae and adults eat the tissue inside the branchlets, which then die. The life cycle is brief and the insect breeds throughout the year, with up to 5 and more generations per annum. A small proportion of the newly founded colonies are aborted due to the adults dying or leaving the newly excavated nests. The number of individuals found in a nest varied considerably according to the age, the type of foliage and individual tree, but a maximum of 75 individuals was found. Natural mortality was low in the nests, being highest among the adults.

Hylurdrectonus araucariae was collected in several natural stands and on planted trees of *A. cunninghamii* in the Chimbu, Eastern Highlands, Morobe and Southern Highlands Districts of Papua New Guinea. In the natural stands the insect was present in very small numbers, whereas in plantations at Bulolo and Wau and in other areas where there are many young planted trees the insect is often present in epidemic numbers. Seedlings are seldom infested, young trees with juvenile foliage are severely infested, but the older (>15 years old) trees with adult foliage are rarely severely infested.

Dispersal is largely by flight from tree to tree by individual adults at irregular but frequent intervals, and also by the adults walking from branchlet to branchlet to new sites on a tree. Flight is directional and occurs largely during the day, but some occurs at night (Gray 1973b). In general the insect has dispersed down the slopes, since most initial infestations were by colonizing adults from remnant trees left adjacent to the upper plantations. As the infestation progressed through the plantations many previously uninfested compartments were attacked by adults from the infested plantations.

The infestation was most severe at Wau in the younger plantations aged from 4—10 years. Considerable growth loss was evident in the severely infested plantation areas on poor sites and high tree mortality has been recorded. This mortality was largely due to secondary insects which attack the weakened trees. The more vigorously growing trees appear better able to survive attack in terms of increment loss. There is usually a marked peak of population build-up in an area, then a decline to a low, but relatively static level.

Although several associated insects were recorded, a search for potential biological control agents has proved fruitless. The most active predators were spiders, which are very common on the plantation trees, and they accounted for a small, but unknown, percentage of adults.

In chemical control studies, 28 insecticides were evaluated in the field from April 1968 to December 1969, using 3 methods of application (Gray 1971b). Most of the test insecticides were excluded from further testing on the basis of poor results or high

Table 1. Host families of *Platypus solidus**

Family	Number of host species recorded in				
	Indian area	Malaya	Malay Archipelago	Japan	Papua New Guinea
ANACARDIACEAE	5	—	—	—	3
ARECACEAE	—	1	1	—	—
ARAUCARIACEAE	—	—	—	—	1
BETULACEAE	—	—	—	1	—
BIGNONIACEAE	2	—	—	—	—
BURSERACEAE	2	—	—	—	2
COMBRETACEAE	1	—	—	—	1
DATISCACEAE	1	—	—	—	1
DIPTEROCARPACEAE	2	3	1	—	1
ELAEOCARPACEAE	—	—	—	—	1
EUPHORBIACEAE	1	2	2	—	1
FAGACEAE	1	—	—	—	—
LAURACEAE	2	—	—	—	—
LEGUMINOSAE	6	2	1	—	—
LYTHRACEAE	1	—	—	—	—
MALVACEAE	1	—	—	—	—
MELIACEAE	1	—	—	—	—
MORACEAE	—	—	—	—	1
MYRISTICACEAE	—	1	—	—	—
MYRTACEAE	—	—	—	—	1
RHIZOPHORACEAE	—	1	—	—	—
RUBIACEAE	3	—	—	—	2
RUTACEAE	—	—	—	—	2
SAPINDACEAE	1	—	—	—	—
SAPOTACEAE	—	1	2	—	—
STERCULIACEAE	2	—	—	—	2
STYRACACEAE	—	1	—	—	—
THEACEAE	—	—	—	1	—
TILIACEAE	—	—	—	—	1
ULMACEAE	—	—	—	—	1
URTICACEAE	5	1	3	—	1
VERBENACEAE	1	1	—	—	—
	38	14	10	2	22

* Data on host species from regions other than Papua New Guinea were obtained from Browne (1961: 207—208, Table 27).

mammalian toxicity. However, 7 insecticides with low mammalian toxicity showed high mortality against *H. araucariae*. Further testing of propoxur was carried out at more economical dosage rates (Gray 1971c). As a result of these trials, Malathion and propoxur were selected for aerial application trials, and applied by means of a Helicopter Underslung Spray System(R). These trials were unsuccessful due to very arduous spraying conditions and to heavy rain falling shortly after each application. Because of the operational and climatic difficulties encountered in these trials, large-scale spraying operations against *H. araucariae* were discontinued.

At the onset, thinning, high pruning and fertilizing were tried in plots as a possible means of silvicultural control, but these methods were of little value. Where large areas of young plantations were threatened, the Department of Forests embarked upon a routine programme wherein the trees were pruned of all infested foliage. In this operation nearly 600 hectares of the plantation were covered, but the infestation was only temporarily halted. Pruning was most successful in one area where it forestalled the infestation of several hundred hectares of young plantations.

Following the surveys in the Bulolo-Wau area and highlands and examination of the biology and ecology of *H. araucariae*, a recommendation that further large scale plantings of Hoop Pine be abandoned until another method of control was discovered was put forward in late 1967. This recommendation was adhered to, and as from 1969 no large scale plantings have been undertaken. Instead, Klinkii Pine has been substituted, and this has proved much less susceptible to primary insect attack.

29. **Xyleborus barbatus** Hagdorn

COLLECTIONS: Under bark of *Cinnamomum* sp., Okasa pine forest, E.H. Dist., 2.VI.1967, B. Gray. In stem of moribund *Araucaria cunninghamii*, 12 m high, Goroka cemetery, E.H. Dist., 8.VI.1967, B. Gray. Boring into 4-week log of *Araucaria cunninghamii*, Inakanda L.A.,(1958/59), Bulolo, M. Dist., 3.XI.1967, B. Gray & J. Buchter. Boring into stem of standing *Casuarina oligodon*, Kundiawa, Chimbu Dist., 21.XI.1967, A.E.H. Ross. In freshly fallen log, Loniu and Nuwok, M.I. Dist., 21.IV.1969, B. Gray. In freshly fallen log, 2 km N of Ruwong Sawmill, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen log *Dysoxylum* sp., Lakunai, E.N.B. Dist., 2.V.1969, B. Gray. In freshly fallen log *Myristica* sp., Warangoi, E.N.B. Dist., 3.V.1969, B. Gray. In freshly fallen log *Endospermum medullosum*, Aropa, B. Dist., 5.V.1969, B. Gray. In freshly fallen logs, Buin, B. Dist., 7.V.1969, B. Gray. Boring into log *Sterculia* sp., Kwalakessi Sawmill, W.N.B. Dist., 12.V.1971, F.R. Wylie & H. Ivagai. Boring into freshly fallen log *Anthocephalus cadamba* and into treated log of *Canarium indicum*, Buluma Beach, Cape Hoskins, W.N.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. Boring into log of *Myristica* sp., Kumbango L.A., Hoskins, W.N.B. Dist., 16.V.1971, F.R. Wylie & H. Ivagai. Boring in fallen log *Nauclea* sp., Bulolo, M. Dist., 10.XII.1971, F.R. Wylie & J. Simpson.

DISTRIBUTION AND BIOLOGY: This insect was reported to be causing the death of a number of *Casuarina* sp. trees at Kundiawa, Chimbu District, in 1967. An inspection was carried out of all trees in the area and 7 *Casuarina oligodon* trees adjacent to the Forest Nursery were found to be heavily attacked by the borer. However, the attack appeared to be secondary and no further damage has been recorded.

30. **Xyleborus bidentatus** Motschulsky*

COLLECTIONS: In log of *Anisoptera* sp., Killerton, N. Dist., 4.VII.1960, F. Coppock.

Sumuna, Dyaul Island, N.I. Dist., 24.VI.1962, 4.III.1962, Danish 'Noona Dan' Expedition. Lorengau, M.I. Dist., 24.VI.1962, Danish 'Noona Dan' Expedition. Sydney, N.S.W., 9.I.1964, H. Jaffe, from New Guinea, live beetles cut from timber. In freshly fallen log *Calophyllum inophyllum*, Somanim, N.I. Dist., 28.IV.1969, B. Gray.

31. **Xyleborus perforans** Wollaston*

COLLECTIONS: In logs of *Anisoptera* sp., Killerton Beach, N. Dist., 27.VI.1960, F. Coppock. From soil litter consisting of old foliage near river in rain forest, Talumalaus, Mussau Island, N.I. Dist., 19—31.I.1962, Danish 'Noona Dan' Expedition. Bati-Tam, Lavongai, N.I. Dist., 20—21.II.1962, Danish 'Noona Dan' Expedition. Lemkamin, Lelet Plateau at 900 m, N.I. Dist., 5, 11, and 17.IV.1962, Danish 'Noona Dan' Expedition. Yalom, Gazelle Peninsula at 1000 m, E.N.B. Dist., 17.V.1962, Danish 'Noona Dan' Expedition. In stem of *Leucaena leucocephala*, Gazelle Plantation, E.N.B. Dist., 25.V.1965, Dorothy Shaw. In swarming flight 5.00—6.00 pm, Keravat Golf Course, E.N.B. Dist., 21.VI.1966, B. Gray. Swarming at 6.30 pm attracted to fluorescent light in house, Bulolo, M. Dist., 22.X.1966, B. Gray. In pole *Araucaria hunsteinii*, Bulolo, M. Dist., 27.I.1967, B. Gray. In stem *Araucaria cunninghamii*, 6 m high, Orabana Village, E.H. Dist., 24.VI.1967, B. Gray. In flight, 7.30 pm, Popondetta, N. Dist., 24.VII.1967, B. Gray. In log of *Castanopsis acuminatissima*, Erave Pine Forest, S.H. Dist., 14.VIII.1967, B. Gray. In fallen logs *Aglaia* sp., *Garuga* sp. and *Xanthophyllum* sp., Watut Valley, 1200 m, M. Dist., 1.III.1968, Bereima and S. Auno. In fallen log (Sterculiaceae), Watut Valley, 1200 m, M. Dist., 1.III.1968, B. Gray, F.R. Wylie & Walu. In log of *Ficus* sp., Watut Valley, M. Dist., 14.III.1968, B. Gray & Walu. Boring into fallen log (1 month) *Anisoptera* sp., Oomsis, M. Dist., 15.III.1968, B. Gray & Walu. Boring into freshly fallen log *Pometia* sp., Oomsis, M. Dist., 15.III.1968, B. Gray & Walu. In log *Araucaria* sp., Bulolo, M. Dist., 15.III.1968, Walu. In fallen log *Pometia pinnata*, Keravat, E.N.B. Dist., 8.V.1968, B. Gray. In freshly fallen hardwood log, Baiyer River Sanctuary, W.H. Dist., 7.VI.1968, B. Gray. In freshly fallen logs, Nuwok, Peaga and Rosun, M.I. Dist., 21.IV.1969, B. Gray. In freshly fallen logs, Loniu, Lugos and Sandpa, N.I. Dist., 22.IV. 1969, B. Gray. In freshly fallen logs, Fangalawa, Kabelman, Lemusmus and Penipol, N.I. Dist., 25.IV.1969, B. Gray. In freshly fallen log *Intsia bijuga*, Karbul, N.I. Dist., 28.IV.1969, B. Gray. In freshly fallen logs, Himau, Likas and Namarodu, N.I. Dist., 29.IV.1969, B. Gray. In freshly fallen log *Terminalia* sp., 2 km N of Ruwong Sawmill, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen logs, Matakan and Rabenhen, N.I. Dist., 30.IV.1969, B. Gray. In freshly fallen *Pometia pinnata*, 2 km N of Ruwong Sawmill, N.I. Dist., 30.IV.1969, B. Gray. In standing dead tree *Octomeles sumatrana*, Vudal, Compartment 1, Keravat, E.N.B. Dist., 2.V.1969, B. Gray. In freshly fallen logs of *Dysoxylum* sp. and *Melochia odorata*, Lakunai, E.N.B. Dist., 2.V.1969, B. Gray. In freshly fallen log *Ficus* sp., Asock Plantation, Keravat, E.N.B. Dist., 2.V.1969, B. Gray. In freshly fallen logs of *Areca catechu* and *Endospermum medullosum*, Aropa, B. Dist., 5.V.1969, B. Gray. In freshly fallen log *Canarium indicum*, Warangoi, E.N.B. Dist., 3.V.1969, B. Gray. In freshly fallen log, Buin, B. Dist., 7.V.1969, B. Gray. In freshly fallen log *Araucaria cunninghamii*, thinned area Compartment 1, Sawmill L.A., Bulolo, M. Dist., 29.VI.1969, J. Dobunaba. Under bark of dead *Pinus* sp., Road 11, Bulolo, M. Dist., 6.VIII.1969, B. Gray. Boring in fallen stem of *Octomeles sumatrana*, Road 14, Nauwata Banda L.A., Bulolo, M. Dist., 5.IX.1969, J. Dobunaba. Boring in fallen stem of

Anthocephalus cadamba, Nauwata Banda L.A., Bulolo, M. Dist., 5.IX.1969, J. Dobunaba. In freshly fallen *Ficus* sp., *Macaranga* sp., and *Rhus taitentsis*, Road 11, Long Island L.A., Bulolo, M. Dist., 9.IX.1969, J. Dobunaba & Anton. Boring into fallen *Endiandra* sp., Kulolo L.A., Wau, M. Dist., 29.X.1969, B. Gray & Anton. Boring into freshly fallen *Araucaria cunninghamii*, Kulolo L.A., Wau, M. Dist., 29.X.1969, J. Dobunaba. In freshly fallen *Pterygota* sp., Yakawa L.A., Watut, M. Dist., 30.X.1969, B. Gray & Anton. Boring into freshly fallen *Cryptocarya* sp., Yakawa L.A., Watut, M. Dist., 30.X.1969, J. Dobunaba & Lei. Boring into fallen *Myristica* sp., Yakawa L.A., Watut, M. Dist., 30.X.1969, H. Ivagai & Jack. In fallen log *Albizia falcata*, Hegiso, S.H. Dist., 25.XI.1969, B. Gray. In freshly fallen log, Pimaga, S.H. Dist., 25.XI.1969, B. Gray. In freshly fallen log *Canarium* sp., Kaviak, Kar Kar Island, Mad. Dist., 20.I.1970, B. Gray. In freshly fallen log, Gowl and Kubam, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log, *Mangifera minor*, Liloi, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In freshly fallen log *Evodia* sp., Gogol Base, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen log *Terminalia complanata*, No. 1 Ramp, Gogol Base, Mad. Dist., 23.I.1970, B. Gray. In freshly fallen log *Anisoptera polyandra* and *Terminalia brassii*, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, J. Dobunaba. In freshly fallen log of *Elaeocarpus sphaericus*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 17.IV.1970, H. Ivagai & M. Gamea. In freshly fallen log *Garuga floribunda*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 21.V.1970, M. Gamea. In freshly fallen log *Aleurites moluccana*, cattle paddock adjacent Road 6, Bulolo, M. Dist., 21.V.1970, J. Dobunaba. In freshly fallen log *Evodia* sp. and *Myristica* sp., Mogova, Goodenough Island, M.B. Dist., 22.IV.1970, B. Gray & J. Dobunaba. In freshly fallen logs of *Elaeocarpus sphaericus* and *Myristica* sp., Wadalei, Fergusson Island, M.B. Dist., 24.VI.1970, B. Gray & J. Dobunaba. In freshly fallen log *Kleinhovia hospita*, Alotau, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In freshly fallen logs of *Althoffia* sp. and *Pterocarpus indicus*, Ailuluwai, M.B. Dist., 29.VI.1970, B. Gray & J. Dobunaba. In freshly fallen log *Endiandra* sp., Naura, M.B. Dist., 27.VI. 1970, B. Gray & J. Dobunaba. In freshly fallen log *Anthocephalus* sp. and *Exocoecaria agallocha*, Bubuleta, M.B. Dist., 29.VI.1970, B. Gray & J. Dobunaba. In freshly fallen log *Kleinhovia hospita* and *Macaranga* sp., Dadua, M.B. Dist., 29.VI.1970, B. Gray & J. Dobunaba. In freshly fallen log *Ficus* sp. and *Glochidion* sp., Ahioma, M.B. Dist., 29.VI.1970, B. Gray & J. Dobunaba. In freshly fallen logs *Inocarpus fagiferus*, *Intsia bijuga*, *Koompassia* sp., and *Semecarpus* sp., Sewa Bay, Normanby Island, M.B. Dist., 20.VIII.1970, J. Dobunaba. In freshly fallen log *Calophyllum papuanum*, Sewa Bay, Normanby Island, M.B. Dist., 20.VIII.1970, J. & R. Dobunaba. In freshly fallen *Cerbera floribunda* and *Litsea* sp., Sewa Bay, Normanby Island, M.B. Dist., 20.VIII.1970, J. Dobunaba. At light, Dami station, W.N.B. Dist., 26.I.1971, B.C. Peters. In stem *Eucalyptus deglupta*, 8 days after felling, Dagi River, W.N.B. Dist., 5.II.1971, B.C. Peters. In log *Tectona grandis*, Tabairikau, W.N.B. Dist., 8.II.1971, B.C. Peters. At hurricane lamp, Dagi River, W.N.B. Dist., 10.II.1971, B.C. Peters. In *Eucalyptus deglupta*, log diameter 1 m, lying in yard 3—4 months, Buluma Sawmill, W.N.B. Dist., 22.III.1971, B.C. Peters. In log *Pometia* sp., Bubu, W.N.B. Dist., 24.III.1971, B.C. Peters. In log *Calophyllum* sp. and *Pometia* sp., Bialla, W.N.B. Dist., 24.III.1971, B.C. Peters. In log *Eucalyptus deglupta*, Wilelo, W.N.B. Dist., 25.III.1971, B.C. Peters. In log *Pometia* sp., and *Pterocymbium* sp., Wilelo, W.N.B. Dist., 29.III.1971, B.C. Peters. In felled tree *Eucalyptus deglupta*, Buvusi, W.N.B. Dist., 5.IV.1971, B.C. Peters. In injured *Eucalyptus*

deglupta tree, and in *Dracontomelum* sp., Wilelo, W.N.B. Dist., 14 and 18.IV.1971 respectively, B.C. Peters. Boring in log *Homalium foetidum* on beach, Kwalakessi Sawmill, W.N.B. Dist., 12.V.1971, F.R. Wylie & H. Ivagai. Boring in treated log of *Canarium indicum*, Buluma Beach, Cape Hoskins, W.N.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. Boring in freshly fallen logs of *Anthocephalus cadamba* and *Dracontomelum mangiferum*, Buluma Mill, Cape Hoskins, W.N.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. In treated logs of *Amoora cucullata*, *Celtis* sp. and *Pterocymbium beccarii*, Buluma Beach, Cape Hoskins, W.H.B. Dist., 13.V.1971, F.R. Wylie & H. Ivagai. Boring in fallen log of *Octomeles sumatrana*, Potogalai L.A., Hoskins, W.N.B. Dist., 14.V.1971, F.R. Wylie & H. Ivagai. Boring in treated log *Octomeles sumatrana* on beach, Kwalakessi Mill, W.H.B. Dist., 15.V.1971, F.R. Wylie & H. Ivagai. Boring in fallen log *Dracontomelum* sp., *Endospermum* sp. and *Octomeles sumatrana*, Kumbango L.A., Hoskins, W.N.B. Dist., 16.V.1971, F.R. Wylie & H. Ivagai. In log *Flagellaria* sp. and *Palaquium* sp., Keravat, E.N.B. Dist., 24.V.1971, B.C. Peters. In *Celtis latifolia*, *Eugenia* sp. and *Planchonella* sp., Goldore, Vanimo, W.S. Dist., 1.VI.1971, F.R. Wylie. In *Endospermum medullosum* and *Palaquium galactoxylon*, Goldore, Vanimo, W.S. Dist., 2.VI.1971, F.R. Wylie. In *Intsia bijuga* and *Octomeles sumatrana*, Goldore, Vanimo, W.S. Dist., 3.VI.1971, F.R. Wylie. In treated *Endospermum medullosum*, Technical School, Arawa, B. Dist., 9.XI.1971, F.R. Wylie. In fallen log *Nauclea* sp., Bulolo, M. Dist., 10.XII.1971, F.R. Wylie & J. Simpson. In logs of *Dracontomelum* sp. and *Pterocymbium beccarii*, Vanapa River, C. Dist., 15.III.1972, F.R. Wylie. In logs of *Alstonia scholaris*, *Celtis* sp. and *Pometia tometosa*, Cape Rodney, C. Dist., 23.VII.1972, F.R. Wylie. On sawn timber prior to dipping, Cape Rodney, C. Dist., 27.VII.1972, F.R. Wylie. In freshly fallen logs of *Dracontomelum* sp. and *Palaquium* sp., Block 10, N.G.I. L.A., Gabensis, M. Dist., 10.VIII.1972, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: *Xyleborus perforans* is the most omnivorous, widespread and common ambrosia beetle in Papua New Guinea (Table 2). It often causes extensive damage to softwood species if left unprotected in the forest or sawmills and it is a major quarantine problem. Also see Gray (1968).

DIPTERA

Chloropidae

32. **Hippelates pallida** Loew

COLLECTIONS: In *Araucaria hunsteinii* seed, Kulolo L. A., Wau, M. Dist., 27.VIII. 1968 — reared 26.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: *Hippelates pallida* has also been found in the West Indies and Zanzibar. This insect was reared in small numbers from the green cones of Klinkii Pine. However, the status of the insect as a pest, or possibly as a parasite, has not been determined.

33. **Elachiptera** (s. l.) sp.

COLLECTIONS: In *Araucaria hunsteinii* seed, Kulolo L. A., Wau, M. Dist., 27.VIII. 1968 — reared 29.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: See comments on *H. pallida* above.

34. **Pseudogaurax** sp.

Table 2. Host families of *Xyleborus perforans**

Family	Number of host species recorded in					
	India etc.	Malaya	Sunda Islands	Philippines and Pacific	Papua New Guinea	Australia
AMARYLLIDACEAE	—	1	—	—	—	—
ANACARDIACEAE	7	—	—	—	4	2
ANNONACEAE	—	1	—	—	—	1
APOCYNACEAE	—	—	—	—	1	—
AQUIFOLIACEAE	—	—	—	1	—	—
ARALIACEAE	—	1	—	—	—	—
ARAUCARIACEAE	—	—	—	—	2	2
ARECACEAE	2	2	—	1	1	—
BIGNONIACEAE	1	—	—	—	—	—
BORAGINACEAE	1	—	—	—	—	—
BURSERACEAE	2	2	—	—	4	—
CARICACEAE	—	—	—	—	—	1
CASUARINACEAE	—	—	—	—	—	1
CLUSIACEAE	—	—	—	—	1	—
COMBRETACEAE	9	—	—	—	2	—
CORNACEAE	1	—	—	—	—	—
DATISCACEAE	—	—	—	—	1	—
DILLENIACEAE	1	—	—	—	—	—
DIPTEROCARPACEAE	4	10	2	1	2	—
EBENACEAE	2	—	—	—	—	—
ELAEOCARPACEAE	—	—	—	—	1	1
EUPHORBIACEAE	1	2	2	1	6	2
FAGACEAE	1	—	1	—	1	—
FLACOURTIACEAE	—	—	—	—	1	—
FLAGELLARIACEAE	—	—	—	—	1	—
GRAMINEAE	—	—	1	2	—	—
HYPERICACEAE	—	—	1	—	—	—
LAURACEAE	1	1	—	1	3	5
LEGUMINOSAE	10	4	3	7	7	3
LILIACEAE	—	—	—	1	—	—
LOGANIACEAE	—	1	—	—	—	—
LYTHRACEAE	1	—	—	—	—	—
MALVACEAE	3	2	—	—	—	—
MELIACEAE	2	1	1	1	3	2
MORACEAE	—	—	—	—	1	—
MYRISTICACEAE	1	1	—	1	1	—
MYRTACEAE	2	1	—	1	2	10
OLACACEAE	—	1	—	—	—	—
PINACEAE	—	—	—	1	1	—
POLYGALACEAE	—	—	—	—	1	—
PROTEACEAE	—	—	—	—	—	1
RHIZOPHORACEAE	2	3	—	—	—	—
RUBIACEAE	2	—	—	1	2	—
RUTACEAE	—	—	—	1	1	4
SAPINDACEAE	1	1	—	1	2	—
SAPOTACEAE	2	1	—	—	2	1
STERCULIACEAE	5	—	—	—	5	1
STYRACACEAE	—	1	—	—	—	—
SYMPLOCACEAE	—	—	1	—	—	—
TILIACEAE	2	1	—	1	1	—
ULMACEAE	—	—	—	—	1	—
URTICACEAE	5	2	3	5	—	—
VERBENACEAE	3	—	—	—	1	—
	74	40	15	28	62	37

* Data on host species from regions other than Papua New Guinea were obtained from Browne (1961: 141, Table 17) and for Australia from Brimblecombe (1953: 30—32).

COLLECTIONS: In *Araucaria hunsteinii* seed, Kulolo L. A., Wau, M. Dist., 27.VIII. 1968 — reared 29.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: See comments on *H. pallida* above.

Lonchaeidae

35. **Lonchaea** (s. l.) sp.

COLLECTIONS: Larvae in *Araucaria cunninghamii* seed, Manki Saddle, Watut Valley, M. Dist., 30.VII.1968 — reared 12.IX.1968, J. Thompson. In *Araucaria hunsteinii* seed, Manki Saddle, Watut Valley, M. Dist., 30.VII. 1968 — reared 17.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: The larvae are frequently found in maturing seed of both *Araucaria* species in the Bulolo-Wau region. Many adults have been reared out with other fauna found in the seed.

HEMIPTERA

Coccidae

36. **Chrysomphalus aonidum** Linnaeus*

COLLECTIONS: No additional collection records.

37. **Maconellicoccus hirsutus** (Green)*

COLLECTIONS: No additional collection records.

38. **Saissetia coffeae** (Walker)*

COLLECTIONS: No additional collection records.

Coreidae

39. **Leptoglossus australis** (Fabricius)*

COLLECTIONS: On branchlet *Araucaria cunninghamii*, 1.6 m high, Forestry Nursery, Bulolo, M. Dist., 26.XII.1966, B. Gray. On *Pometia pinnata*, Vudal, E.N.B. Dist., 8.V. 1968, F. R. Wylie. On leaf *Hibiscus* sp., Bulolo, 30.IX.1968, F. R. Wylie. On leaf of shrub, Tonolei, B. Dist., 8.V.1969, B. Gray. On fallen log *Ficus* sp., Watut Valley, M. Dist., 6.XII.1971, F. R. Wylie.

40. **Pternistria levipes** Horvath*

COLLECTIONS: No additional collection records.

41. **Pternistria macromera** Guerin*

COLLECTIONS: No additional collection records.

Flatidae

42. **Paratella errudita** Melichar*

COLLECTIONS: No additional collection records.

DISTRIBUTION AND BIOLOGY: It now appears doubtful that this species is of any economic consequence. Also see Gray (1968).

Pentatomidae

43. **Austromalaya** sp.*

COLLECTIONS: No additional collection records.

HYMENOPTERA

Megachilidae

44. **Lithurge scabrosus** Smith*

COLLECTIONS: No additional collection records.

45. **Megachile frontalis** (Fabricius)*

COLLECTIONS: No additional collection records.

Anthophoridae

46. **Xylocopa aruana** Ritsema* Fig. 8.

COLLECTIONS: In dead wood of branch of ***Delonix regia***, Konedobu, Port Moresby, C. Dist., 25.IX.1966, B. Gray. On lawn, Popondetta, N. Dist., 24.VII.1967, B. Gray. Tunneling in softwood facia board, Gulf Hotel, Baimuru, G. Dist., 11.I.1972, F. R. Wylie. Tunneling in softwood planks, Era Sawmill, G. Dist., 12.I.1972, F. R. Wylie.

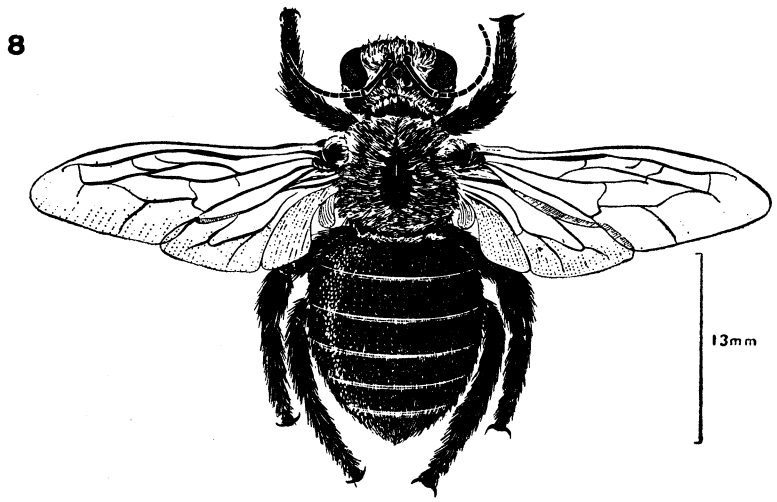

Fig. 8. Female adult of ***Xylocopa aruana***.

DISTRIBUTION AND BIOLOGY: ***Xylocopa aruana*** is a common pest of untreated softwoods in towns along the Papuan coast. Bore holes are more common in skirting and facia boards of buildings.

Formicidae

47. **Tetramorium guineense** Linnaeus

COLLECTIONS: Seriously damaging stacks of sawn timber *Pterocymbium beccarii*, Keravat Sawmill, E.N.B. Dist., II. 1960, S. J. Colwell (Szent-Ivany & Catley 1960).

DISTRIBUTION AND BIOLOGY: The reference to damaging timber is probably incorrect; we suggest that the ant invaded the timber after or during a termite attack and then established its nest(s).

ISOPTERA

Calotermitidae

48. **Cryptotermes domesticus** (Haviland)*

COLLECTIONS: In power line pole, Vanimo, W.S. Dist., 1.VI.1971, F. R. Wylie.

DISTRIBUTION AND BIOLOGY: Hill (1942) recorded *C. domesticus* from shelving of a bookcase at Rabaul in the East New Britain District. This species has become widely dispersed throughout the Pacific area with its probable centre of dispersal in South East Asia (Gay 1967). The finding at Vanimo represents the first record for the New Guinea mainland. *Cryptotermes* sp., possibly *C. domesticus*, was found in a library bookcase at Port Moresby by the junior author in November 1971.

49. **Cryptotermes** sp.

COLLECTIONS: Ex house bearer, Bulolo Gold Dredging premises, Lae, M. Dist., 7.XI.1966, T. Fenner & K. Skyring.

DISTRIBUTION AND BIOLOGY: Several buildings, mainly staff houses in the Milford Haven area in Lae, were damaged by *Cryptotermes* sp. in association with *Schedorhinotermes* sp. In many cases the infestations were well established. Damaged timber was removed and replaced with treated timber.

50. **Glyptotermes taveunienis** Hill*

COLLECTIONS: No additional collection records.

51. **Neotermes schultzei** Holmgren*

COLLECTIONS: No additional collection records.

52. **Neotermes** spp. (Several species)*

COLLECTIONS: Ex *Theobroma cacao* branch, Lakuramau Plantation, N. I. Dist., 15.II. 1966, D. F. O'Sullivan & D. August. Ex *Theobroma cacao* trunk, Lorabau Plantation, W. N. B. Dist., 10.V.1966, D. F. O'Sullivan. In stem *Castanopsis* sp., Wau, M. Dist., 2300 m, 18.II.1967, D. McIntosh. In rotten tree stump, Okasa Pine Forest, E. H. Dist., 23.VIII.1967, F. R. Wylie & S. Auno. In stem *Toona* sp., Divide L. A., Bulolo, M. Dist., 24.III.1969, B. Winning. In standing tree, Naringil, M. I. Dist., 22.IV.1969, B. Gray. In standing tree, Pukpuk Creek, M. I. Dist., 22.IV.1969, B. Gray. In branch *Eucalyptus deglupta*, Wilelo, W. N. B. Dist., 19.IV.1971, B. C. Peters.

Mastotermitidae

53. **Mastotermes darwiniensis** Froggatt*

COLLECTIONS: No additional collection records.

DISTRIBUTION AND BIOLOGY: Unfortunately this pest still has not been eradicated from the Lae township where it was introduced. However, its presence has been confined

until recently to a small area.

Rhinotermitidae

54. **Coptotermes elisae** (Desneux)* Fig. 9.

COLLECTIONS: In live ***Araucaria cunninghamii*** and ***Araucaria hunsteinii***, Madang, Mad. Dist., 16.VI.1968, B. Gray. In live ***Araucaria hunsteinii***, 5 m high, Catholic Mission, Maprik, E. S. Dist., 21.VI.1968, B. Gray. In stem ***Pinus*** sp., Oomsis, M. Dist., 24.IX.1968, F. R. Wylie, & Bereima. In stem and roots ***Cupressus arizonica***, Forest Station, Bulolo, M. Dist., 16.XII.1968, F. R. Wylie & Bereima. On leaf ***Eucalyptus deglupta***, Kunjingini, E. S. Dist., 16.I.1969, N. Gough. In Stem ***Grevillea robusta***, New Administration Area, Madang, Mad. Dist., 20.I.1969, F. R. Wylie. Nest up pipe of log of ***Anisoptera pussi***, Oomsis, M. Dist., 15.III.1969, B. Gray. On stem of large ***Araucaria cunninghamii***, Sugedamer, S. H. Dist., 25.XI.1969, B. Gray. In log of ***Anisoptera pussi***, Kui, M. Dist., 10.II.1970, F. R. Wylie & J. Dobunaba. In stump of ***Cinnamomum*** sp., Kui, M. Dist., 10.II.1970, F. R. Wylie & L. Radunz. In roots and stem of ***Pinus kesiya***, Golf Course, Bulolo, M. Dist., 7.IV.1972, F. R. Wylie & J. Simpson.

DISTRIBUTION AND BIOLOGY: Gray & Buchter (1969) gave details on control methods used against ***C. elisae*** in the Bulolo/Wau plantations. Recently commercial thinning operations were commenced in Sawmill L. A. (planted 1952/53), Bulolo. A number of termite-infested trees were observed, but there was no evidence of mortality. Data on the proportion of attacked trees and the length of galleries up the stem are given in Table 3. The survival of the older plantation trees is interesting in view of the mortality observed among trees 14 years and younger. However, the infested portions of the bole had to be discarded. Large ***Araucaria*** trees in the forest with established nests of ***C. elisae*** are more prone to windthrow in high winds which blow infrequently in the Bulolo Valley.

In late May 1970 the entomologists were asked to assist in eradicating termites causing considerable damage to the Bulolo Rifle Club. Several supporting floor joists and pillars had been completely hollowed out and external galleries were evident over

Table 3. Incidence and dimensions of termite infested trees in a 21—22 year old Hoop Pine plantation at Bulolo in Papua New Guinea.

Date of sample survey	Number of trees examined	Number of trees infested	Percentage infested	Length (range) of pipe in meters	Size of infested trees	
					Mean height ± S. D. in meters	Range in meters
5.III.1973	56	0	0			
7.III.1973	80	0	0			
8.III.1973	182	16	9	0.55—5.20	27.55±6.42	19.60—43.30
12.III.1973	27	1	4	0.76	19.20	
13.III.1973	63	0	0			
30.IV.1973	49	6	12	0.80—2.80	25.39±3.22	20.69—29.12

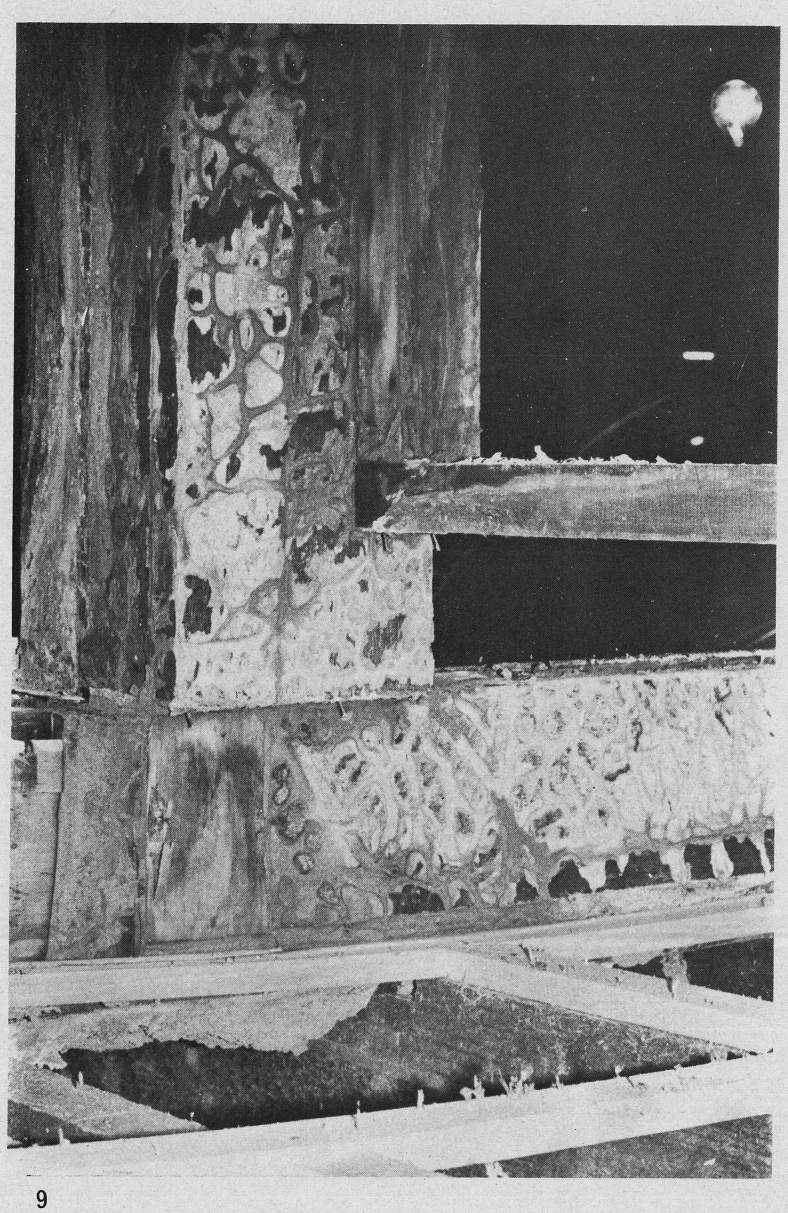

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Fig. 9. Severe damage done to timber in basement of Pine Lodge Hotel at Bulolo by *Coptotermes elisae.*

most timber beneath the building. A stack of timber located 10 m from the building was heavily infested with termites, and a nest was found but with no physogastric queen, beneath a stump immediately adjacent to the pile of timber.

A thorough search was carried out of all remnant stumps and trees for galleries and nests to within 50—100 m of the building. Two nests were located. The first, 35 m distant, was situated beneath an old remnant stump to a depth of 2.5 m in which many adult reproductives were collected. The second nest contained a small satellite colony about 90 m away in a relatively young stump.

The badly damaged pillars were replaced and gallery systems destroyed as well as the nests. A creosote solution was then applied to all supporting pillars, joists and to the soil beneath the building. However, in early July 1970 more termite activity was observed. Galleries were evident on a small citrus tree and some pillars. A runway, some 4—6 cm in width, was dug up and followed for nearly 20 m from the tree to beneath the building. This runway varied in depth from 10 to 35 cm; black soil was quite moist surrounding the runway, which was greyish in colour and well padded. Adult reproductives were also found in a nest situated inside a pillar.

Fairly extensive damage was caused by ***C. elisae*** to the Bowling Club at Bulolo in 1971. The damage was to linings in rooms and joists beneath the building. Similar damage occurred at the Pine Lodge Hotel, Bulolo, in 1972 and the cost of repairs was estimated at approximately A$2,000.00 (Fig. 9).

55. **Coptotermes grandiceps** Snyder*

COLLECTIONS: Nest in ground, Nuwok, M. I. Dist., 21.IV.1969, B. Gray.

56. **Coptotermes obiratus** Hill*

COLLECTIONS: In stem of ***Araucaria hunsteinii***, Compartment 1, Station L. A., Bulolo, M. Dist., 22.VII.1969, J. Dobunaba.

57. **Coptotermes pamuae** Snyder*

COLLECTIONS: In fallen log, Karimui, Chimbu Dist., 12.VI.1968, B. Gray. In stem of ***Araucaria hunsteinii*** and ***Grevillea robusta***, New Administration Area, Madang, Mad. Dist., 20.I.1969, F. R. Wylie. In stem ***Nauclea*** sp., Forestry Experimental Plot, Mad. Dist., 20.I.1969, F. R. Wylie. In stem ***Caryota*** sp., Tonolei, B. Dist., 8.V.1969, B. Gray. Under bark of ***Pinus*** sp., Road 11, Bulolo, M. Dist., 6.VIII.1969, B. Gray. In cupboard ***Araucaria*** sp., Bulolo, M. Dist., 1.XII.1971, F. R. Wylie. Nest under base ***Araucaria hunsteinii***, Wau, M. Dist., 2.XII.1971, M. Gamea.

58. **Coptotermes** sp.*

COLLECTIONS: In stem ***Araucaria hunsteinii***, New Administration Area, Madang, Mad. Dist., 20.I.1969, F.R. Wylie. In stem of ***Delonix regia*** and ***Grevillea robusta***, Technical School, Madang, Mad. Dist., 20.I.1969, F.R. Wylie. In rotten log, Brown River, C. Dist., 5.II.1969, H. Ivagai.

DISTRIBUTION AND BIOLOGY: This species is common in the Madang District where it has attacked many planted Klinkii Pine, ***D. regia*** and ***G. robusta*** trees in the new Administration area. Many of these trees were left as shade trees when the new Administration buildings were built in 1969.

59. **Microcerotermes biroi** (Desneux)*

COLLECTIONS: On dead bamboo stem, Plant Introduction Station, Laloki, C. Dist., 1.IX.1966, B. Gray. Carton nest and galleries on stump *Artocarpus* sp., Oomsis, M. Dist., 15.III.1968, B. Gray. In fallen log, Yasonim, E.S. Dist., 22.VI.1968, B. Gray. In live *Araucaria cunninghamii* and *Grevillea robusta*, Madang, Mad. Dist., 16.VI.1968, B. Gray. In rotten log, Jimi Valley, W.H. Dist., 18.IX.1968, F.R. Wylie & S. Kaoko. On stem *Cocos nucifera*, Rosun, M.I. Dist., 21.IV.1969, B. Gray. Gallery on tree, Nuwok, M.I. Dist., 21.IV.1969, B. Gray. Stem of tree *Bambusa* sp., Lugos, M.I. Dist., 22.IV.1969, B. Gray. In standing tree, Lolok, M.I. Dist., 22.IV.1969, B. Gray. On stem of tree, Penipol Plantation, N.I. Dist., 25.IV.1969, B. Gray. In freshly fallen log, Lemusmus, N.I. Dist., 25.IV.1969, B. Gray. On fallen log *Pometia pinnata*, Namarodu, N.I. Dist., 29.IV.1969, B. Gray. On stem *Terminalia brassii*, 3 years old, Fryer L.A., Keravat, E.N.B. Dist., 1.V.1969, B. Gray. On stem *Cocos nucifera*, Marup, Kar Kar Island, Mad. Dist., 20.I.1970, B. Gray. Nest on stump, Wara Sweet L.A., Kui, M. Dist., 10.II.1970, J. Dobunaba. In pillar and joists *Araucaria* sp., Rifle Club, Bulolo, M. Dist., 20.III.1970, F.R. Wylie. Nest on stem *Mangifera minor*, Ailuluwai, M.B. Dist., 18.VI.1970, B. Gray & J. Dobunaba. Nest on stem *Pterocarpus indicus*, Mogova, Goodenough I., M.B. Dist., 22.VI.1970, B. Gray. Nest in *Althoffia* sp., Ahioma, M.B. Dist., 29.VI.1970, B. Gray. Galleries on stem *Leucaena* sp., Arawa, B. Dist., 9.XI.1971, F.R. Wylie. Nest in tree fern, Latep L.A., Bulolo, M. Dist., 28.XII.1971, F.R. Wylie. Nest on *Eucalyptus* sp., Sogeri, C. Dist., 22.XI.1971, F.R. Wylie, C. Levy & E. Conron.

DISTRIBUTION AND BIOLOGY: *Microcerotermes biroi* was commonly found in *Artocarpus* logs during logging operations in the Oomsis area, Morobe District, and several infested logs had been discarded for milling purposes. Also see Gray (1968).

60. **Schedorhinotermes dimorphus robustior** (Silvestri)

COLLECTIONS: In dead hardwood stump, Crooked L.A., Bulolo, M. Dist., 22.VII.1963, L. Clifford. In rotten dressed timber, Bulolo, M. Dist., 1.IV.1969, J. Dobunaba. Attacking pine board on ground, Bulolo, M. Dist., 30.XI.1971, B. Gray & F.R. Wylie.

DISTRIBUTION AND BIOLOGY: This species appears rare in Papua New Guinea and damage caused has been very limited.

61. **Schedorhinotermes sanctaecrucis** (Snyder)

COLLECTIONS: On dead stump, Karimui, Chimbu Dist., 11.VII.1968, B. Gray. Under bark dead *Araucaria cunninghamii*, 600 m S of Pimaga, S.H. Dist., 25.XI.1969, B. Gray & H. Ivagai.

DISTRIBUTION AND BIOLOGY: This species has not previously been recorded from the Papua New Guinea mainland, although it occurs in the Santa Cruz Archipelago. At Pimaga the termite had made many galleries in the bole of the large Hoop Pine trees which had been killed by debarking.

62. **Schedorhinotermes** spp.*

COLLECTIONS: Nest in decaying log, Okasa Pine Forest, E.H. Dist., 18.V.1967, B. Gray. In decaying log, Killerton Beach, N. Dist., 24.VII.1967, B. Gray. In rotten log, Catholic Mission Station, Erave, S.H. Dist., 7.VIII.1968, F.R. Wylie. In rotten log, Jimi Valley, W.H. Dist., 18.IX.1968, F.R. Wylie & S. Kaoko. On stem of tree, Fangalawa, N.I. Dist., 25.IV.1969, B. Gray. In freshly fallen log, Rabenhen, N.I. Dist., 30.IV.1969, B. Gray. On standing dead tree *Octomeles sumatrana*, Compartment 1, Vudal L.A.,

Keravat, E.N.B. Dist., 2.V.1969, B. Gray. On freshly fallen log, Buin, B. Dist., 7.V.1969, B. Gray.

Termitidae

63. **Nasutitermes novarumhebridarum** (N. & K. Holmgren)*

COLLECTIONS: In dead wood of 1-year old *Tectona grandis*, Keravat, E.N.B. Dist., 27.VI.1966, B. Gray & Alikana. Nest on *Cocos nucifera*, Tavilo Plantation, Gazelle Peninsula, E.N.B. Dist., 29.VI.1966, B. Gray & Iamai. Galleries running up chemically treated electricity pole 11 km W near Highlands Highway, Lae, M. Dist., 7.II.1967, B. Gray & F.R. Wylie. In decaying log, Killerton Beach, N. Dist., 24.VII.1967, B. Gray. Nest and galleries on stem *Buchanania* sp., Jimi Valley, W.H. Dist., 18.IX.1969, F.R. Wylie & S. Kaoko. On fallen log, Lugos, M.I. Dist., 22.IV.1969, B. Gray. In freshly fallen log, Fangalawa, N.I. Dist., 25.IV.1969, B. Gray. Nest on tree, Buin, B. Dist., 7.V.1969, B. Gray. In freshly fallen log, Kaviak, Kar Kar Island, Mad. Dist., 20.I.1970, B. Gray. Nest on stump of *Canarium* sp., Katom, Kar Kar Island, Mad. Dist., 21.I.1970, B. Gray. In fallen log, Kui, M. Dist., 10.II.1970, F.R. Wylie & L. Radunz. On stem of *Bruguiera mapoya*, Fergusson Island, M.B. Dist., 23.VI.1970, B. Gray & J. Dobunaba. Nest on stem *Pandanus* sp., Boada, Fergusson Is., M.B. Dist., 24.VI.1970, B. Gray. In *Althoffia* sp., Alotau, M.B. Dist., 27.VI.1970, B. Gray & J. Dobunaba. In branch *Eucalyptus deglupta*, Wilelo, W.N.B. Dist., 19.IV.1971, B.C. Peters. Galleries on dead *Eucalyptus deglupta*, Keravat, E.N.B. Dist., 12.V.1971, B.C. Peters. In *Eucalyptus deglupta*, Madang, Mad. Dist., 26.XI.1971, B.C. Peters.

64. **Nasutitermes princips** (Desneux)*

COLLECTIONS: Nest in live *Eucalyptus deglupta*, Madang, Mad. Dist., 16.VI.1968, B. Gray. In stems of live *Araucaria cunninghamii*, *A. hunsteinii* and *Grevillea robusta*, New Administration Area, Madang, Mad. Dist., 20.I.1969, F.R. Wylie. In stem *Nauclea* sp., Forestry Experimental Plot, Madang, Mad. Dist., 20.I.1969, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: Of interest is the finding of galleries of *N. princeps* and *Coptotermes* sp. in the stem of the same Klinkii Pine tree at Madang. See also Gray (1968)

LEPIDOPTERA

Cosmopterygidae

65. **Sathrobrota** sp.

COLLECTIONS: In *Araucaria hunsteinii* seed, Manki Saddle, Watut, M. Dist., 30.VII.1968 — reared 12.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: This species was reared in small numbers, together with several other species, from infested cones.

Cossidae

66. **Zeuzera coffeae** Nietner

COLLECTIONS: Pupa on *Delonix regia*, but failed to emerge, Bubia near Lae, M. Dist., 20.X.1958, J.H. Ardley. Tea borer reared ex pupa, Garaina, M. Dist., 16.VII.1964,

P.J. Southern.

DISTRIBUTION AND BIOLOGY: It has been recorded from many south-east Asian countries and Pacific Islands: Formosa, Malaysia, Indonesia, Singapore, Bangladesh, Tonkin, Cochinchina, Timor and Guadalcanal. Although the insect attacks many different tree species it most commonly occurs as a pest of coffee (Browne 1968). The Department of Forests (Anon. 1963) recorded that *Z. coffeae* damaged young *Terminalia brassii* in the plantation at Keravat. An attack was reported in *Eucalyptus deglupta* plantations at Keravat in 1969. Approximately 2 to 4 trees per hectare were affected. The larvae bored into the stem and across the sapwood of trees up to 10 cm in diameter at breast height (A.V. Williams, Departmental Report, 1969). These infested trees were very prone to wind damage. Of note is a report that *Z. coffeae* had ruined plantations of *Eucalyptus deglupta* in Malaysia (Streets 1962).

Geometridae

67. **Milionia isodoxa** Prout*

COLLECTIONS: To be reported (Wylie, 1974b in press).

DISTRIBUTION AND BIOLOGY: *Milionia isodoxa* was first recorded as a pest of Hoop Pine in the Eastern Highlands District (Szent-Ivany & Catley 1960). Following severe defoliation by larvae of *M. isodoxa* to ornamental Hoop Pine at Rintebe, Eastern Highlands District in 1966, and Korn Farm and Minj, Western Highlands District in late 1967, research was commenced on the biology and control of the insect. A summary account of research carried out on *M. isodoxa* over the period 1967—1970 by the junior author is given below. More detailed accounts are available in papers in press (Wylie, 1974a, 1974b in press).

The egg, larval and pupal stages of *M. isodoxa* have been described for the first time and the adult redescribed in detail (Wylie, 1974a in press). The insect has been found in 7 mainland districts and larvae have been collected from naturally occurring Hoop Pine in the Madang and Southern Highlands Districts. *Milionia isodoxa* is multivoltine and the life cycle takes approximately 8 weeks to complete with 5 larval instars. The duration of each instar I—V is 4, 4, 4, 5 and 10 days respectively. Pupation usually takes place in the soil beneath attacked trees and the pupation period is approximately 2 weeks. An examination of pupae collected from beneath attacked trees at Goroka and Baiyer River showed that the sex ratio is approximately 1:1. However, in the Hoop Pine plantations at Bulolo, the sex ratio of adults varies with the time of day and the type of area in which collections are made. Adult males feed on the fluids contained in decaying organic matter, e.g. animal dung, while the females are mainly blossom feeders.

The ichneumonid wasps *Echthromorpha insidiator* Smith and *Lissopimpla scutata* Krieger and the chalcid *Brachymeria* sp. are the main pupal parasites of *M. isodoxa*. The ant species *Anoplolepis longipes* (Jerdon) and *Oecophylla smaragdina* Fabricius are particularly effective larval predators in the Bulolo plantations. Mantids and spiders are predators of the adults. *Beauveria bassiana* (Balsamo) Vuillemin, an entomophagous fungus is responsible for high pupal mortality in the Highlands.

Frass-drop frequency studies of *M. isodoxa* larvae in the laboratory showed that feeding activity is greatest in the early instars. Larvae reared at below normal tempera-

tures exhibit a much longer larval period than those reared under normal conditions.

Larval population studies carried out in the Bulolo/Wau plantations during the period 1968—1970 showed that larvae were more abundant on trees in areas adjacent to streams or soaks than in drier areas of the plantations. Considerably more larvae were found on trees aged between 6—7 years than for any other age class.

The number of adults found along roads and streams adjacent to the plantations varies with time of day and weather conditions. Adults generally leave the plantations in the early morning to feed and return to the forests later in the morning as the ambient temperature increases. Males usually return earlier than the females. Adult activity is greater on warm, sunny days and the return to the forest occurs earlier than on cool, overcast days.

Rainfall appears to be the main climatic factor affecting numbers of the insect in the Highlands. A very low rainfall period of 4 to 6 weeks preceded all outbreaks. Increased rainfall following outbreaks caused (i) higher mortality in the first instar as the newly hatched larvae drowned in water droplets on the trees, (ii) water logging of the pupation site with subsequent death of the pupae and (iii) promotion of fungal growth which was responsible for high pupal mortality (Wylie, 1974b in press).

Malathion E.C. has been used with success against larvae of *M. isodoxa* on attacked trees at Baiyer River, Western Highlands District, and Pangia, Southern Highlands District.

Limacodidae

68. **Scopelodes dinawa** Bethune-Baker

COLLECTIONS: Pupa on *Coffea* sp., Keravat, E.N.B. Dist., 24.VI.1956, K. Newton. Cocoon, Didiman's Creek, Lae, M. Dist., II. 1956, J.J.H. Szent-Ivany. On *Cassia* sp., Keravat, E.N.B. Dist., III.1958, G.S. Dun. Cocoons on *Cocos nucifera* leaves, L.M.S. Mission Garden, Petoi Village, G. Dist., 9.V.1959, J.J.H. Szent-Ivany. Larva on *Musa paradisiaca*, Kukual Village, near Maprik, E.S. Dist., 2.III.1960, J.J.H. Szent-Ivany. Larvae on Manila Hemp, Bubia, near Lae, M. Dist., June 1970, A. Catley. Larvae defoliating *Terminalia brassii*, Oomsis, M. Dist., 28.VIII.1969 — reared 29.IX.1969, J. Dobunaba.

DISTRIBUTION AND BIOLOGY: Previously collected from Irian Jaya. This species was found on 2 occasions causing almost complete defoliation of *Mangifera indica* in 1965 and 1966 at Wau (Szent-Ivany 1955; Szent-Ivany & Stevens 1966). In 1969 a small number of *Terminalia brassii* trees located in the Department of Forests nursery at Oomsis were heavily infested by large numbers of *S. dinawa* and *Scopelodes venosa*. These trees were almost completely defoliated.

69. **Scopelodes venosa** Walker

COLLECTIONS: Szent-Ivany (1963b), records other known collections. Larva on *Theobroma cacao*, Aropa Plantation, B. Dist., VI.1956, H. Smith. Larvae defoliating *Terminalia brassii*, Oomsis, M. Dist., 28.VIII.1969 — reared 25.IX—6.X.1969, J. Dobunaba.

DISTRIBUTION AND BIOLOGY: Previously collected from Burma, India, Sri Lanka, China, Japan, Indonesia and Vietnam. Refer remarks on *S. dinawa* above.

Lymantriidae

70. **Dasychira wandammena** Bethune-Baker.

COLLECTIONS: Larvae defoliating *Pinus patula*, Forestry Station, Wau, M. Dist., 21.VIII.1970 — reared 21—22.IX.1970, F.R. Wylie & R. Holdsgrove.

DISTRIBUTION AND BIOLOGY: Previously collected from Irian Jaya. Late instar larvae of *D. wandammena* were found attacking the foliage of several 5-year old *Pinus patula* trees in a small plot (0.5 ha.) adjacent to the Wau Forest Office. Only 1 or 2 larvae were found on each tree and damage was slight. The larvae were wasteful feeders chewing through the needles close to their base. Similar feeding behaviour has been recorded for larvae of *Lymantria ninayi* (see below). An inspection was made of all trees in the plot and the larvae removed by hand. No recurrence of attack has been reported.

71. **Lymantria flavoneura** Joicey Fig. 10, 11.

COLLECTIONS: Larvae eating foliage *Pinus patula*, Lapegu Plantation, E. H. Dist., 1.IX.1967, pupated 5.XI.1967 and emerged 3.XII.1967, F.R. Wylie. Pupae on *Pinus patula*, Asaroka, E.H. Dist., reared 1.VI.1969, N. Howcroft.

DISTRIBUTION AND BIOLOGY: The species has been previously collected from Irian Jaya. The insect was first reported in October 1967 as a pest by Mr A. Ross, who observed severe defoliation of a small group of trees in the *Pinus patula* plantations at Lapegu. Larvae and pupae of *L. flavoneura*, together with pupae of *L. ninayi*, were collected off the trees. Many of the insects were destroyed by hand, while those out of reach were sprayed with Malathion 5% EC, which was very effective in killing the larvae.

A relatively large number of adult females of *L. flavoneura* were observed laying eggs on *Pinus patula* at Agarabi, 4 km NE of Kainantu in the Eastern Highlands District, by Mr N. Howcroft on 6.IV.1970 (Fig. 10). On 21.IV. we inspected the site at Agarabi where 400 to 500 trees, up to 15 m in height, were growing (planted December 1963). On several trees 1 or at most 3 egg clusters were laid on the stem, while of all the trees only 1 cluster was observed attached to the needles. Some empty egg clusters were present. The egg clusters comprised from 500 to 2000 eggs and were covered by a light orange-white coloured material. Many eggs were collected and reared in the insectary at Bulolo, wherein the egg chorion changed from white to grey then to black just prior to eclosion. At Agarabi, several first instar larvae were seen on the needles, but few later instar larvae were found and only 1 pupa. Thus the first instar larvae emerged approximately 19 days after the eggs were laid, as previously observed by Mr Howcroft. The duration of the larval and pupal stages is approximately 74 days and 17—28 days respectively. The pupae of *L. flavoneura* were more commonly found on the needles than those of *L. ninayi*.

No appreciable defoliation was evident in the Agarabi plot in April 1970. An inspection of another small *P. patula* plot at Ontabura, some 5 km away, revealed no sign of *L. flavoneura*. While *L. flavoneura* often occurs in association with outbreaks of *L. ninayi*, more damage is caused by the latter.

72. **Lymantria ninayi** Bethune-Baker

COLLECTIONS: Larvae on *Pinus patula*, Wapenamanda, W.H. Dist., 9.X.1967 — reared 20.X.1967, J. Lowien. Pupae on foliage of *Pinus patula*, Lapegu Plantation, E.H. Dist.,

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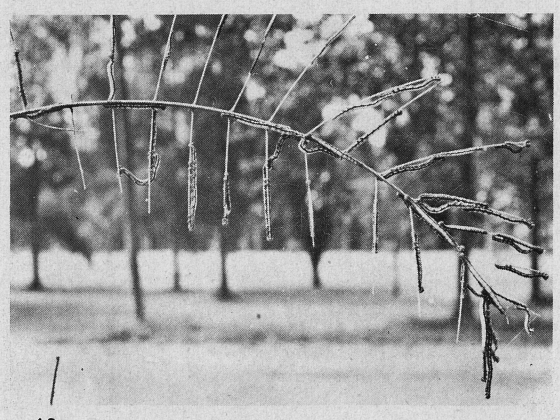

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Fig. 10. Adult of ***Lymantria flavoneura*** resting on stem ***Pinus patula*** at Agarabi (N. Howcroft). Fig. 11. Mist spraying of ***L. flavoneura*** and ***L. ninayi*** at Agarabi. Note severely defoliated tree in foreground and partially defoliated tree in background. Fig. 12. ***Delonix regia*** tree completely defoliated by ***Pericymea cruegeri*** at Bulolo in April 1969. Fig. 13. Many larvae of ***P. cruegeri*** on defoliated branch of ***Delonix regia***. Fig. 14. Growing tips of young ***Toona australis*** tree infested by ***Hypsipyla robusta***.

1.XI.1967 — emerged 22.XI.1967, F.R. Wylie. Larvae on ***Pinus patula***, Kainantu, E.H. Dist., 7.X.1969 — reared 21.X.1969, N. Howcroft. Puparia on ***Pinus radiata***, Ufeto School grounds, E.H. Dist., 22.IV.1970, B. Gray & F.R. Wylie. Pupae on ***Pinus patula***, Agarabi, E.H. Dist., 14.VII.1970, reared 26.VII.1970, F.R. Wylie. Pupae on ***Pinus patula***, Ontabura, E.H. Dist., 8.X.1969, F.R. Wylie & E. Williams.

DISTRIBUTION AND BIOLOGY: This insect has also been recorded from Irian Jaya. It was first reported as a pest in Papua New Guinea by Mr J. Lowien who observed an outbreak in a small plot of ***Pinus patula*** in August 1967 at Koglamp "T" School near Mt Hagen. Three of the 12 trees had been completely denuded of foliage by the larvae. Some nearby ***Casuarina oligodon*** trees had incurred minor defoliation. In October 1967 larvae and pupae of ***L. ninayi*** were found on ***P. patula*** at Wapenamanda in the Western Highlands District. In May 1968 a tree was completely defoliated at Kundiawa in the Chimbu District, while in October outbreaks were recorded at Lapegu and at Wabag in the Western Highlands District. At Lapegu the attacked trees were sprayed with Malathion 50% E.C. and all pupae collected off the trees and destroyed by physical means.

In November 1969 a severe outbreak of ***L. ninayi*** occurred in 4 plots of ***P. patula*** planted near Asaroka Lutheran Mission High School, approximately 15 km NW of Goroka. The trees had been planted in the 1961—62 planting season and at the time of the outbreak they ranged from 7 to 20 m in height. In one plot approximately 90% of the trees had been almost completely defoliated, while in 2 other plots they had been severely defoliated, and in the 4th plot only mild defoliation had occurred. Generally the largest trees exhibited the greater degree of defoliation.

In early December 1969 an entomologist, Mr G.G. Furness, visited the outbreak area to undertake biological observations and test 2 insecticides. He observed only late instar larvae and pupae, including many pupal cases, on the trees. During the day, an estimated 50% of the larvae congregated near the base of the trees in the bark crevices, where they remained fairly inactive; other larvae were seen higher up the stem, on the branches and foliage. At night, the larvae were observed crawling up the trees. Pupae were largely found near the base of the trees, a few were on the needles. Mr A. Ross, who reported the outbreak, had noted that much of the larval activity had ceased prior to the entomologist's arrival.

Of interest was the finding of ***L. ninayi*** larvae at the base of a ***Casuarina oligodon*** tree growing on the edge of one of the plots. This finding, together with the observation of defoliation at Koglamp "T" School, suggests that ***C. oligodon*** may be the natural host tree, since the pine had only been recently introduced into Papua New Guinea, whereas ***C. oligodon*** has been widely grown in the outbreak areas for a much longer period.

Of 2 insecticides, dicrotophos 85 wt/wt and fenthion 50 E.C., tried against the remaining larval population on 4.XII.1969, the latter proved more effective with mortality ranging from 30 to 100% in the 5 trial spray plots, whereas zero mortality was counted in the 5 plots sprayed with dicrotophos 85 wt/wt. Heavy rainfall in the afternoon and night following spraying was experienced and this most probably diminished the effectiveness of the insecticides.

In May 1970 we visited the Asaroka plots and found no sign of active ***L. ninayi*** on the trees. Empty puparia were found on the same field trip to Ontabura, and at Ufeto

Primary "T" School near Lapegu, puparia were collected from ***Pinus radiata***. At Agarabi several puparia were found on the needles, 4 of which had been parasitized.

In July 1970 a severe outbreak was reported at Agarabi, most of the trees in the plot being attacked and some completely defoliated (Fig. 11). A few early instar larvae and pupae were observed, but no adult moths or eggs were found. Defoliation of the trees was more severe than the larval numbers present would suggest. This is because the larvae are wasteful feeders, chewing through the base of the needles which then fall to the ground. The whole plot area was covered in a thick mat of these uneaten needles. No predators or parasites were found, but there was a low incidence of suspected viral disease among the larvae.

All trees in the plot were sprayed with chlordane 80% E.C. and up to 100% larval mortality was recorded (Fig. 11). A subsequent report by Mr J. van Hecke in September indicated that attacked trees were rapidly refoliating. Further outbreaks were reported at Asaroka in February 1972 and at Mt Hagen Junior High School in April 1972.

73. **Euproctis** sp. near **fulvistriata** Swina*

COLLECTIONS: No additional collection records.

Lyonetiidae

74. **Erechthias** sp. near **caustophora** Turner

COLLECTIONS: In pith of branch of ***Araucaria cunninghamii***, Inakanda L.A., (1958/59), Bulolo, M. Dist., 13.II.1968 — reared 10.III.1968, B. Gray & Bereima.

DISTRIBUTION AND BIOLOGY: This insect was reared from a moribund branch found on a tree in the plantations. The occurrence of isolated moribund branches on healthy trees in the Hoop Pine plantations is rare.

Noctuidae

75. **Agrotis ipsilon** Hufnagel

COLLECTIONS: No collection records.

DISTRIBUTION AND BIOLOGY: This species has a very wide distribution occurring in the Holarctic, Ethiopean, Indo-Australian and Neotropical regions. Szent-Ivany (1958) mentions that larvae of ***A. ipsilon*** often attack ***Casuarina*** sp. trees planted as shade trees or wind breaks in coffee plantations, besides damaging lawns, pastures and coffee seedlings in the Eastern and Western Highlands Districts.

76. **Hyblaea puera** Cramer*

COLLECTIONS: Defoliating ***Colocasia*** sp., Bulolo, M. Dist., 23.IX.1971, B.C. Peters. Larvae defoliating ***Kigelia pinnata***, Forestry Station, Bulolo, M. Dist., 11.X.1972 — reared 17.X.1972, I. Barber.

DISTRIBUTION AND BIOLOGY: Very severe defoliation of the trees in the ***Tectona grandis*** plantations at Brown River was experienced during the dry season in 1972. Infestations of the pest were also seen in a small plot of ***T. grandis*** near Dumpu in the Madang District by the senior author in November 1972.

77. **Othreis fullonia** (Clerck)

COLLECTIONS: Reared from larvae, Keravat, E.N.B. Dist., 18.VII.1954, J.J.H. Szent-Ivany. Larvae defoliating ***Erythrina merrilliana***, Bulolo, M. Dist., 15.V.1969 — reared 18.VI.1969, H. Ivagai.

DISTRIBUTION AND BIOLOGY: Comstock (1966) mentions that the insect has a wide distribution in the tropical areas of Africa, Asia, Melanesia, Australia and the South Pacific islands; he also gives notes on its biology and illustrations of the life forms.

In middle May 1969 a severe outbreak was observed on an ornamental ***Erythrina merrilliana*** tree at Bulolo and little foliage was left. Most other ***E. merrilliana*** in the township were lightly defoliated. A light outbreak occurred in November 1969 and another lighter outbreak was recorded in April 1970.

78. **Pericymea cruegeri** Butler Fig. 12, 13.

COLLECTIONS: Szent-Ivany (1959, 1960, 1963a) and Szent-Ivany & Catley (1960) list many localities. Pupae on ground beneath ***Delonix regia***, private residence, Bulolo, M. Dist., 16.V.1969 — reared 1.VI.1969, B. Gray & F.R. Wylie.

DISTRIBUTION AND BIOLOGY: It is also found in Australia in Queensland & the Northern Territory, Borneo, Indonesia, Philippines and Thailand. Szent-Ivany (1960, 1963a) gives notes on the species biology. Our observations supplement those of Szent-Ivany.

A mild outbreak of ***P. cruegeri*** was observed in August 1968; however, in April 1969 nearly all ornamental ***Delonix regia*** trees were defoliated at Bulolo, and some were completely denuded of foliage except for flowers (Fig. 12). This outbreak was preceded by a period of particularly hot and dry weather, which may have influenced the severity of attack. In one instance most of the foliage on a tree was eaten in 2 days (Fig. 13). The larvae then emigrated into and beneath the adjacent house in large numbers and on to a shrub, ***Gardenia augusta***, close to the tree. They were a nuisance in the house and caused concern by secreting a reddish liquid on to clothes, bed sheets, etc. when an attempt was made to remove them. No larvae were seen on the many bushes and shrubs in the surrounding garden; these included — ***Allamanda cathartica, Calliandra surinamensis, Cassia spectabilis, Eugenia michelci, Hibiscus rosa-sinensis, Leucaena leucocephala, Plumeria acutifolia*** and ***Spathodea campulata***. In the garden of an adjacent residence, ***Peltophorum ferrugineum*** had been defoliated by an unknown insect, probably ***P. cruegeri***, since Szent-Ivany (1960) has recorded ***P. ferrugineum*** as a secondary host plant.

Several predators were observed in the outbreak area and parasites were reared from larvae in the laboratory. Five nests of the green tree ant ***Oecophylla smaragdina*** Fabricius on nearby ***Eucalyptus deglupta*** trees were examined for larvae of ***P. cruegeri***, but only 2 were found indicating it was not a significant predator in view of large numbers of both larvae and adults present. A few workers of ***O. smaragdina*** were seen attacking larvae beneath the tree. Nests of the vespid ***Eumenes latreillei petiolaris*** Schultz were found to contain several larvae. Many ichneumonids, ***Echthromorpha insidiator*** Smith and ***Hyposoter*** sp., chalcids, ***Brachymeria euploeae*** Westwood, and vespids, ***E. petiolaris*** and ***Ropalidia domestica*** Cheesman, hovered about and parasitized the larvae of ***P. cruegeri***. Adults of ***B. euploeae*** and ***E. insidiator*** were later reared from attacked larvae. Szent-Ivany (1963a) recorded ***B. euploeae, E. insidiator***, the tachinids ***Drino discreta*** Wulp, ***Exorista fallax*** Meigen, ***Exorista sorbillans*** Wiedemann and the penta-

tomid ***Platynopus melacanthus*** Boisduval, as either predators, or parasites or possible hyperparasites.

Endosulfan(R) 35% E.E. mixed at a rate of 120 ml per 10 l was found very effective in killing larvae of ***P. cruegeri*** and adults of the rhinocerus beetle, ***Xylotrupes gideon*** present on ***D. regia*** in large numbers. The latter recolonized the tree 3 days after applying endosulfan. It took 7 months for the completely stripped trees to show much growth flush.

In late March 1970 another severe outbreak occurred at Bulolo. At the pre-school two trees were severely attacked in the grounds — one a ***D. regia*** and the other ***P. ferrugineum***. Many thousands of larvae were present and 2,000—4,000 of these had congregated in a rough circle beneath a round native-material hut on the ground. This behaviour may have been caused by a response to shading from the sun.

Notodontidae

79. **Ichthyura** sp. near **rubida** Druce

COLLECTIONS: Larvae defoliating ***Populus*** sp., clone 163, Korn Farm, W.H. Dist., 4.X.1969, F.R. Wylie.

DISTRIBUTION AND BIOLOGY: A stand of 35 ornamental ***Populus*** sp. trees at Korn Farm Forest Nursery, Western Highlands District, were completely defoliated by the insect in December 1968. At the time of the attack the trees were aged 1 year and averaged 5 m in height. A second attack was noticed in late March 1969 and 75% of the foliage was destroyed. Complete renewal of foliage occurred after each attack (J. Lowien, pers. comm.). A third attack was observed in early October 1969 and roughly 60% defoliation of the trees had occurred. The estimated larval population per tree was between 200—300 larvae, with all stages present. Large numbers of larvae were found on nearby ornamental bushes and plants such as ***Agave*** sp., ***Canna*** sp., ***Coleus*** sp., and a plant of the family Bignoniaceae. No feeding or pupation occurred on these plants. Prior to ecdysis and pupation, the larvae join together the poplar leaves with silk to form cocoons with 1 and sometimes 2 exit holes. The terminal leaves of each branch are favoured pupation sites. The pupa, within its silk and leaf cocoon, is fastened to the leaf by means of a terminal stipe. The larval bristles are not incorporated into the body of the cocoon.

The bird ***Rhipidura leucophrys melaleuca*** (Latham), commonly known as the willy wagtail, was the only active predator observed. A number of adults of the vespid ***Polistes multipictus*** Smith and pompilid ***Cryptochilus bicolor*** Fabricius, which are known predators of several other Lepidoptera, were in the immediate vicinity. Some pupae were found to be parasitized by the ichneumonid ***E. insidiator***. The chalcid ***Brachymeria*** sp., which is a known pupal parasite of many Lepidoptera, was noticed hovering near pupating larvae.

A large number of larvae around the tree base appeared to have been killed by drowning. Heavy rain had fallen almost daily at Korn Farm during the previous two weeks. A low incidence of a viral disease was noticed among larvae (mostly late instar) on the trees. Approximately 5% of pupae examined were affected by a fungal disease, which was probably promoted by the high rainfall. Many adults of the curculionid ***Oribius*** sp. also contributed to the defoliation and they sheltered in webs spun by the

larvae and in empty pupal cases. Malathion 50% E.C. proved effective in killing the larvae.

80. **Ichthyura** sp.

COLLECTIONS: Larvae defoliating ***Populus*** sp., West Goroka Forest Nursery, E.H. Dist., 18.III.1970, F.R. Wylie & B.C. Peters. Pupae on leaves of ***Populus*** sp., West Goroka Forest Nursery, E.H. Dist., 18.III.1970 — reared 23.III.1970, F.R. Wylie & B.C. Peters.

DISTRIBUTION AND BIOLOGY: The insect caused light to moderate defoliation on a stand of 22 ***Populus*** sp. trees at the West Goroka Forest Nursery in March, 1970. At the time of the attack the trees were aged 18 months and averaged approximately 6 m in height. The estimated larval population per tree was between 20—30 larvae, with all stages present. Larvae and pupae were found on nearby ornamental bushes and tree seedlings such as ***Eucalyptus saligna***, ***Pinus patula***, ***Sashania*** sp., and ***Toona australis***. No feeding occurred on these plants. As with the other mentioned species of ***Ichthyura***, the larvae join together poplar leaves with silk to form cocoons, and the terminal leaves of each branch are favoured pupation sites. Adults reared in the laboratory mated 24—36 hours after emergence. The mating pair assume a position in which their heads are in opposite directions once they have become securely attached together. The eggs, which are semi-spherical, 1 mm in diameter and reddish-mauve in colour were laid 1 or 2 days after copulation. At West Goroka, egg clusters were found on the under-surface of ***Populus*** sp. leaves. The number of eggs per cluster varied greatly, the smallest and largest clusters counted contained 26 and 120 eggs respectively.

No predators of the insect were observed. An ichneumonid parasite was recovered from a pupa collected at West Goroka, but identification of the parasite was not possible since it had died before reaching full maturity.

The trees were sprayed with fenthion 50% E.C. and again after 2 days with malathion 50% E.C. which was effective against the larvae. No further attacks have been reported.

Pieridae

81. **Catopsilia pomona** (Fabricius)

COLLECTIONS: Larvae on ***Cassia grandis***, Koitaki Estate, C. Dist., 9.XI.1965, R. Carver. Larvae defoliating ***Cassia grandis***, adjacent to Entomology Research Building, Bulolo, M. Dist., 18.VIII.1969 — reared 5.IX.1969, J. Dobunaba. On ***Cassia*** sp., Lae, M. Dist., 14.IX.1969, R. Lyons.

DISTRIBUTION AND BIOLOGY: The species is widely distributed from the Indian subcontinent to the Pacific (Browne 1968). A severe attack occurred on the young ***Cassia grandis*** tree, 3 m high, growing near the Entomology Building at Bulolo in 1969 and 1970. However, as the tree has grown larger no further heavy infestations have been observed though the insect still feeds on the tree.

Psychidae

82. **Pteroma plagiophleps** Hampson

COLLECTIONS: Larvae defoliating ***Pinus patula***, Road 4, Wau, M. Dist., 26.VI.1970 —

reared 20.VII.1970, F.R. Wylie & H. Ivagai.

DISTRIBUTION AND BIOLOGY: Larvae of *P. plagiophleps* were found attacking 25 4-year old ornamental *P. patula* trees bordering a coffee plantation at Wau. The number of infested branches per tree varied from 8 to 56 with a mean of 35 ± 12 branches. Five of the 25 trees affected were almost completey defoliated and the total number of larvae on all trees was estimated at over 13,000. The trees were sprayed with Vapona(R) insecticide in water using a Solo(R) mistblower. Two days after spraying, larval cases were collected from the trees and dissected. All larvae examined were dead. *Pteroma* sp., probably the same species, has previously been recorded at Wau on *Coffea arabica*, *Leucaena leucocephala* (shade trees) and *Vanilla planifolia* (Szent-Ivany & Stevens 1966).

Pyralidae

83. **Hypsipyla robusta** (Moore) Fig. 14.

COLLECTIONS: Larvae boring into terminals of *Toona australis*, Compartment 2, Bamboo L.A., Wau, M. Dist., 19.III.1970 — reared 10.IV.1970, B. Gray.

DISTRIBUTION AND BIOLOGY: The species is widespread occurring in Africa, Pakistan, Ceylon, India, Burma, Java, Sarawak, Australia and the British Solomon Islands (Gray 1972). Beeson (1919), Entwistle (1967) and Roberts (1968) give notes on its biology, while Bradley (1968) reviewed the taxonomy of the genus *Hypsipyla*.

The Department of Forests (Anon., 1960) stated that *H. robusta* is a barrier to the establishment of Red Cedar and exotic members of the family Meliaceae in the Territory. In February 1969 a small planting of approximately 650 *Toona australis* seedlings was made in Compartment 2, Bamboo L.A., Wau. These trees were inspected at 6 monthly intervals over a period of 3 years and censuses were undertaken recording the number of infestations per tree. The results of the inspections over the period 1969 to 1972 are given in Table 4. The growing tips were heavily infested by *H. robusta* (Fig. 14) and consequently the young trees were deformed. This combined with an attack by the dynastid *Xylotrupes gideon* destroyed the commercial potential of the trees. In September 1972 the plot was wiped out in a fire.

84. **Tirathaba mundella** Walker

COLLECTIONS: Larvae in male cone of *Pinus kesiya*, Forestry Station, Wau, M. Dist., 1.VI.1972 — reared 24.VII.1972, B. Gray.

DISTRIBUTION AND BIOLOGY: The species has been found in British Solomon Islands Protectorate, Fiji, India, Malaysia, Philippines and Seleyer. Many of the male cones of *Pinus kesiya* at Wau are destroyed annually. The larvae eat through the cones leaving a dry shell which then disintegrates.

85. **Tirathaba rufivena** (Walker)

COLLECTIONS: Bred from cone of *Araucaria hunsteinii*, Maus Bokis, Bulolo-Wau Gorge, M. Dist., 12.IX.1969 — reared 22.X.1969, B. Gray.

DISTRIBUTION AND BIOLOGY: *Tirathaba rufivena* has also been found in the British Solomon Islands Protectorate, Fiji, Indonesia, Malaysia, Philippines, India and Seleyer. Refer Anon. (1971) and Szent-Ivany (in preparation) for notes on biology.

Saturniidae

86. **Synthereta janetta** White*

Table 4. Number of attacks per *Toona australis* tree and percentage of trees attacked by *Hypsipyla robusta* at six-monthly intervals in a trial planting established in Compartment 3, Bamboo L. A., Wau. Trees planted in February 1969*

No. of infestations per tree	Number of trees attacked							
	Aug 1969	Feb 1970	Aug 1970	Feb 1971	Aug 1971	Feb 1972	Aug 1972	Total
1	46	95	101	94	62	58	74	530
2	11	68	63	40	64	16	31	292
3	7	37	53	28	45	6	16	192
4	2	19	33	17	32		6	109
5		10	18	4	38	1	3	74
6	1	7	9	4	16	1	2	40
7		2	8	3	12	1		26
8		2	2	1	9	1	1	16
9		2	5		4		3	14
10					3			3
11		1			3			4
12					4			4
13					3			3
14			1			1		2
15				1	2			3
16					1			1
17					1			1
18								
19								
20								
Total No. of trees attacked	67	243	293	192	298	85	136	1314
Percentage of trees attacked	11.5	49.1	59.9	39.1	60.6	17.9	28.2	

*These trees were destroyed by a forest fire in September 1972.

COLLECTIONS: Attracted to house light, Forestry Station, Bulolo, M. Dist., 20.IV.1970, F.R. Wylie.

Stathmopodidae

87. **Hieromantis** sp. near **ephodophora** Meyr.

COLLECTIONS: In *Araucaria hunsteinii* seed, Manki Saddle, Watut, M. Dist., 30.VII. 1968 — reared 9.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: See remarks on *Stathmopoda* sp.

88. **Stathmopoda** sp.

COLLECTIONS: In *Araucaria hunsteinii* seed, Kulolo, near Bulolo, M. Dist., 27.VIII.-

1968 — reared 22.IX.1968, J. Thompson.

DISTRIBUTION AND BIOLOGY: The status of this insect as a pest or predator has not been determined. In Australia, the larvae of *Stathmopoda* have been recorded tunneling in fruit and galls and as predators of scale insects and spider's eggs (Common 1970).

Tortricidae

89. **Adoxophyes** sp.

COLLECTIONS: In tip of branch of *Araucaria cunninghamii*, Compartment 2, Crooked L.A. (1962/63), Bulolo, M. Dist., 22.XII.1967 — reared 21.I.1968, B. Gray & S. Auno.

DISTRIBUTION AND BIOLOGY: Several growing tips of 5-year old Hoop Pine trees in Crooked L.A. were found infested by the larvae. These tips had died or were moribund in appearance.

90. **Adoxophyes** sp.

COLLECTIONS: Larvae in male cone of *Pinus kesiya*, Forestry Station, Wau, M. Dist., 1.VI.1972 — reared 24.VII.1972, B. Gray.

DISTRIBUTION AND BIOLOGY: Refer remarks on *T. mundella* above.

91. **Epiphyas** sp.

COLLECTIONS: Off leaves *Eucalyptus torelliana*, Henganofi, E.H. Dist., 14.II.1968 — reared at Bulolo 28.II.1968, A. Ross.

DISTRIBUTION AND BIOLOGY: Larvae and cocoons of *Epiphyas* sp. were collected off the trees.

92. **Homona coffearia** (Nietner)

COLLECTIONS: Larva on *Coffea arabica*, Ovihaka Plantation, Asaro Valley, E.H. Dist., 10.X.1965 — emerged 20.X.1965, J.J.H. Szent-Ivany. Larvae on *Theobroma cacao*, Gela Gela Plantation, E.N.B. Dist., 11.VII.1966, pupated 14.VII.1966, emerged 20.VII.1966, D.F. O'Sullivan. In branch tip of *Araucaria cunninghamii*, Compartment 2, Crooked L.A., (1962/63), Bulolo, M. Dist., 22.XII.1967 — reared 21.I.1968, B. Gray & S. Auno.

DISTRIBUTION AND BIOLOGY: Szent-Ivany (1958) records that larvae, pupae and parasites of *H. coffearia* were bred by Mr R.S. Paine at Lae in the Morobe District.

93. **Tracholena** sp.

COLLECTIONS: Reared from seed of *Araucaria hunsteinii*, Road 31, Heads Hump L.A., Bulolo, M. Dist., 29.VIII.1967, J. Thompson.

DISTRIBUTION AND BIOLOGY: From July to October each year, when the seed of Hoop Pine and Klinkii Pine ripens, it is infested mainly by a curculionid and less so by other insects including *Tracholena* sp. On some trees nearly all the seed is destroyed due to the mining activity of these species. *Tracholena* sp. predominated in rearings of Microlepidoptera from infested Hoop Pine cones collected by Mr J. Thompson in the Wau/Bulolo gorge in August 1970. Peak adult emergence occurred approximately 8—9 weeks after the cones were collected (Table 5).

Table 5. Emergence of Microlepidoptera, predominantly specimens of *Tracholena* sp., from infested cones of *Araucaria cunninghamii*. The cones were collected by Mr J. Thompson on 4 August, 1970, near Cliffside in the Wau-Bulolo gorge. Twenty cones were placed in each of the 7 cages.

Date Period of Emergence*	Emergence of adults							Total number of adults
	Cage 1	Cage 2	Cage 3	Cage 4	Cage 5	Cage 6	Cage 7	
28.IX.1970						2		2
30.IX.1970	3		1		1	2	3	10
1.X.1970	2		2			1		5
2.X.1970	1	1	1	2	2	2	2	11
3—5.X.1970	7	3	2	10	5	7		33
6.X.1970	4	9		1		4	5	23
7.X.1970	12	3	4	5	9	3		36
8.X.1970	5	3		3	4	2		17
9.X.1970	5	4	2		5	3	2	21
10—12.X.1970	11	6			6	1		24
13—14.X.1970	2	7	3	1	4	2		19
15.X.1970	1					1		2
16.X.1970				1			1	2
17.X—5.XI.1970								0
	53	36	14	23	36	30	13	205

*None had emerged prior to 28 September 1970.

Tineidae

94. **Setomorpha rutella** Zeller*

COLLECTIONS: No additional collection records.

Xyloryctidae

95. **Cryptophasa setiotricha** (Meyrick)

COLLECTIONS: Boring in *Casuarina* sp., Pacific Islands Regiment Headquarters, Taurama, C. Dist., emerged 4.IX.1956, E. Kanjiri. Reared from pupa in *Cassia fistula* and *Samanea saman*, Konedobu, C. Dist., 15.VIII.1957, E. Kanjiri. Reared from larvae ex *Samanea saman*, Port Moresby, C. Dist., pupated 10.VIII.1968, emerged 9.X.1968, T.L. Fenner & Miss C. Dederka.

DISTRIBUTION AND BIOLOGY: The species has been previously collected in Queensland, Australia. This is a pest of *Samanea saman*, commonly known as raintree in the Port Moresby area (Anon. 1971). The larvae bore into the cambium of the stems of the trees. Larvae of *Cryptophasa* sp., probably *C. setiotricha*, caused severe damage to several raintrees at the Forest Products Research Centre, Port Moresby, in November 1971. Extensive larval tunneling was noted by the junior author on all trees and several main branches were almost completely girdled. The tunnels were covered with a web of silk and macerated bark tissues. Most of the attacks appeared to have been initiated in the main forks of the trees. Borings, frass and webbing similar to that of *C. setiotricha* have been found on *Albizia procera* in the Port Moresby savanna area (T.L. Fenner, pers. comm.).

Yponomeutidae

96. ? Gen. ? sp.

COLLECTIONS: In seed of *Araucaria cunninghamii*, Power Line area, Wau Gorge, M. Dist., 3.X.1967 — reared 25.X.1967, J. Thompson.

DISTRIBUTION AND BIOLOGY: This was one of the most common lepidopteran insects reared from infested cones of Hoop Pine and Klinkii Pine.

ORTHOPTERA

Gryllidae

97. **Gymnogryllus** sp.

COLLECTIONS: Attacking foliage of *Araucaria cunninghamii* and hybrid *Eucalyptus grandis* × *Eucalyptus robusta*, Baiyer River, W.H. Dist., 6.III.1968, J. Lowien.

DISTRIBUTION AND BIOLOGY: Approximately 12 trees of the hybrid *Eucalyptus grandis* × *Eucalyptus robusta* were completely defoliated by the gryllid, but little damage was done to the Hoop Pine trees.

Gryllotalpidae

98. **Gryllotalpa** ?**africana** Beauvois*

COLLECTIONS: No additional collection records.

DISCUSSION

Much of the research carried out by the Entomology Section since its establishment in 1966 has been concentrated on four pests of Hoop Pine in the Bulolo/Wau plantations. *Hylurdrectonus araucariae* is the most important though there are indications that its status will decline as the plantations mature. The pest status of *Vanapa oberthuri* has increased following the advent of large scale thinning operations at Bulolo. *Milionia isodoxa* appears to pose no major threat to the plantations since its population is kept in check by a number of natural control agents. However, it remains an important pest of ornamental Hoop Pine in the Highlands. Control measures recommended by Gray & Buchter (1969) against *Coptotermes elisae* have been successful in reducing the incidence of attack and the extent of damage caused to Hoop Pine and Klinkii Pine in the Bulolo/Wau plantations.

Observations over the past 6 years suggest strongly that there is an age effect associated with insect attack on Hoop Pine. *Hylurdrectonus araucariae* infests severely those trees aged between 2.5 and 12 years, but not those in other age classes; *Vanapa oberthuri* may kill trees aged from 5 to 22 years, but older trees appear more resistant to fatal injury; *M. isodoxa* rarely, if ever, defoliates trees more than 20 years old, preferring age classes 6 to 8 years; lastly, the termite *C. elisae* seldom destroys trees more than 20 years old even though the infestation may remain for many years.

Few serious pests have been recorded of Klinkii Pine and only *C. elisae* has been of any consequence. Several pests of the green mature cones of Hoop Pine and Klinkii Pine have been recorded. Many cones are destroyed by these pests which include primarily a weevil and several species of Microlepidoptera and Diptera; the role of the

latter remains to be determined. The Diptera probably occur as either predators or parasites.

A preliminary survey of insects associated with *Eucalyptus deglupta* has been made throughout Papua New Guinea. Psychids show indications of being serious pests. Reports have recently been received of severe damage caused to *E. deglupta* at Vanimo by a stem-boring xyloryctid. In view of the proposed establishment of large-scale plantings of *E. deglupta* near Madang and Open Bay, close surveillance of the trees for insect pests such as these will be necessary.

Species of *Lymantria* pose a danger to *Pinus* plantations in the Highlands, although attacks to date have been sporadic, and the prompt use of insecticides has kept the insects in check. Outbreaks of *Hyblaea puera* in the *Tectona grandis* plantations at Brown River have been more severe than those at Keravat where there is a less marked dry season. No new plantings of *Toona australis* have been made in Papua New Guinea because of the damage caused by *Hypsipyla robusta*. Research has recently commenced on the control of this pest by the use of sustained release systemic insecticides.

A number of insect pests have been recorded on ornamental tree species. Generally damage caused is of an aesthetic rather than of economic importance.

Ambrosia beetles remain the most important pests of logs and sawn timber in Papua New Guinea. Although no estimate has been made of the annual monetary loss involved, several thousands of cubic meters of timber are rendered unsaleable or downgraded by ambrosia beetle attack. For example, at the Commonwealth New Guinea Timbers Sawmill at Bulolo in 1972, 1,611 m^3 of Hoop Pine and Klinkii Pine logs valued at approximately A$19,000.00 were rejected (B. Harding, pers. comm.). Ambrosia beetle attack was responsible for the rejection of 1,180 m^3 of export logs destined for Japan at Vanimo in June, 1971 (Gray 1973a). Fumigation costs for sawn timber exported to Australia must also be added to the total loss caused by these insects. During the past 6 years we have carried out extensive surveys of Platypodidae and Scolytidae throughout Papua New Guinea and over 240 species have been recorded including 104 new species.

Papua New Guinea has one of the richest faunas of Platypodidae and Scolytidae in the world with over 400 known species in 45 genera and it is estimated that there are 700—800 species altogether. Of these, 30—40% are considered common throughout the Indo-malayan region, the rest being endemic or typical for the western part of the Pacific islands (K.E. Schedl, pers. comm.). In comparison, Browne (1961) recorded 435 species of Scolytidae and Platypodidae in the Malaysian region which has been subjected to more intensive collecting than Papua New Guinea.

Although Papua New Guinea has a rich fauna of Cerambycidae (particularly Lamiinae), there is surprisingly little damage caused as compared with the depredations of longicorn beetles in most other tropical countries. Only a few species have been observed in large numbers at logging sites in Papua New Guinea. Probably the most notable of these is *Hoplocerambyx severus* a very large beetle 4.5 to 7.5 cm in length. However, even in this instance the economic damage involved is slight because the logs are promptly extracted from the lowland rain forest. The attractively coloured lamiid *Sphingnotus albertisi* Gestro is common at logging sites in the Morobe District but it causes little noticeable damage. At Bulolo in the Hoop Pine plantations large numbers of the

lamiid *Dihammus australis* are found in slash left over after thinning operations.

The widespread use of treated timbers, compulsory since 1964, has resulted in fewer reports being received of termite damage to newer structures. *Cryptotermes* spp. in older buildings in Lae are still of some concern. However, reports have been received very recently of occurrences in the Lae area of the introduced species *Mastotermes darwiniensis* outside its former confined location. This spread of the pest is disturbing in view of damage caused in Australia. Termite damage in the Highlands is rare and most termite activity has been reported from lowland areas.

With the exception of *Dinoderus minutus*, few Bostrychidae have been collected in natural forest. The population of *Xylothrips religiosus* at Bulolo has increased markedly following a fire in the plantations in September 1972 (Wylie, in preparation), and attack has recently been noted on damaged standing trees in the natural forest. Bostrychids are a serious pest of *Tectona grandis* roundwood at Port Moresby (C. Levy, pers. comm.). Lyctidae are known to occur at a number of towns in Papua New Guinea, but they are not serious pests.

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