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CONTENTS

A LABORATORY REARING METHOD FOR THE CACAO MIRID *HELOPELTIS CLAVIFER* WALKER (HEMIPTERA:MIRIDAE)

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ABSTRACT

A method is described for continuous rearing and handling of large numbers of adults and nymphs of Helopeltis clavifer *Walk. Adults are caged with small cacao pods held in vials of water. Feeding and oviposition occur in the pods. Newly emerged nymphs are transferred to similar freshly prepared pods, which are changed daily thereafter. Under these conditions, the egg and nymphal stages last seven to eight days and 11 to 12 days respectively, which are very similar to their durations as recorded in the field.*

INTRODUCTION

THE cacao mirid *Helopeltis clavifer* Walker was first recorded on cacao (*Theobroma cacao* L.) in the Central District of Papua New Guinea during 1954 (Dun 1954) and it is now one of the most important pests of the crop, especially in the Northern, Morobe and Central Districts of Papua New Guinea. It has also been recorded on cacao in Sabah, Malaysia (Conway 1964).

In the field, eggs are inserted beneath the epicarp of cacao pods, beneath the epidermis of pod peduncles, and very occasionally beneath the epidermis of recently hardened vegetative shoots. Only a pair of fine terminal egg filaments protrudes from the surface of the plant tissue. Following an incubation period of seven to eight days, the nymphs hatch and begin feeding almost immediately on cacao pods. The insect passes through five nymphal instars, each requiring two days, except for the final instar which requires three days. Two to three days after moulting to the adult form, mating occurs and after a further two days, oviposition commences. Adults may live for up to four weeks and lay over 100 eggs, but normally lay between 60 and 80. The majority of eggs are laid within a week of mating.

Research into the bionomics, ecology and control of *H. clavifer* was initiated at Popondetta during 1959. To obtain a continuous supply of adults and nymphs for experimental work, it became necessary to rear the insect under laboratory conditions. Although most other cacao mirids are difficult to breed and maintain in the laboratory (Entwistle 1972), this species, being a pod feeder can be reared successfully using the method desribed in this paper.

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METHOD

Field collected (and later, laboratory reared) adults were caged in hurricane lamp glasses (Colman 'Pyrex', 12.5 cm diam., 13.0 cm long) covered at one end with insect screening (Sarlon shade, No. 60081) to allow for air circulation. Approximately ten males and ten females were placed in each cage, and these readily fed on and laid eggs into a small cacao pod (up to 10 cm in length). The pods were kept as fresh as possible by placing the stems in 2 x 1 inch vials of water. Each day, a fresh pod was offered, and the old pod, still in its vial was removed from the cage. The vial, labelled with oviposition date and the number of eggs laid in the associated pod, was then placed adjacent to the cage to await egg hatching.

Temperature and humidity conditions in the breeding room closely followed those outside, with an average diurnal temperature range of from 25 to 32° C and a relative humidity range of from 55 to 90 per cent.

Six days after oviposition, a fresh pod was placed touching the dried pod containing the eggs. This enabled newly hatched nymphs to move onto the fresh pod to feed. Unless the recently hatched nymphs fed soon after hatching, they rapidly died from desiccation. Since over 80 per cent of the eggs hatched between 0500 and 0800 hours, pods were inspected once daily at 0800 hours, and those newly emerged nymphs remaining on the old pod, were transferred to the fresh one by means of a fine camel hair brush. Eight days after oviposition, all viable eggs had hatched and the old pods were discarded. As egg incubation period was relatively short (seven to eight days), all eggs hatched before the pod became covered with fungal growth.

Unless prevented, early instar nymphs tend to wander from the pods and die from desiccation. To overcome this, the vials containing pods were placed for the first three days in a 9 cm petri dish, the lip of which had been coated with vaseline to prevent the nymphs moving from the dish. An additional access to the pod was provided by a green cacao shoot which was angled from the side of the petri dish to the top of the pod. One pod, if changed daily, was sufficient to support the feeding of 40 to 50 first or second instar nymphs or about 15 to 20 fifth instar nymphs or adults.

Both field collected and laboratory reared adults readily mated and oviposited while in the cages, but fecundity at 10 to 15 eggs per female was low. Much higher fecundity was obtained when a second method, incorporating field oviposition, was adopted. This entailed the use of cylindrical cages, 25 cm long and 10 cm in diameter, constructed of insect screening (Saron cloth), to confine field collected adults to cacao pods still attached to a tree. After six days of oviposition in the field, the pods were removed from the trees and placed in the breeding room where the newly hatched nymphs were collected and transferred to fresh pods as previously described. In these field cages, each female deposited 30 to 50 eggs into a pod.

Approximately 80 per cent of the eggs laid were viable, and 70 per cent of all nymphs attained the adult stage in the breeding room. No difference in either viability or incubation time was observed between laboratory-laid eggs and the field-laid eggs. Up to four successive generations of *H. clavifer* have been raised using laboratory ovipositing females, but for large scale nymphal or adult rearing, the field oviposition method is more efficient.

ACKNOWLEDGEMENTS

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SURVEY OF THE COPPER AND PHOSPHATE STATUS OF CATTLE IN PAPUA NEW GUINEA

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ABSTRACT

A survey of the copper and phosphate levels of cattle grazing in various locations near Lae has been carried out. At several stations, analysis of biological specimens has indicated an immediate need for supplementation of the animals' diet, followed by further laboratory investigation.

INTRODUCTION

MINERAL nutrition studies have an important place in any developing cattle industry if diseases caused by deficiencies of minerals and trace elements are to be completely eliminated. Over the past five years, field observations together with biochemical analyses have indicated that such deficiencies do exist in this country, and that in particular copper and phosphate are lacking in a number of areas.

In severe cases of mineral disorders obvious symptoms exist which characterise the various diseases. A depraved appetite, resulting in a tendency to gnaw at bark or stones, and bone disorders may be evident if a phosphate deficiency exists. Copper, on the other hand, has a vital role in animal metabolism in the processes of pigmentation of hair, formation of blood and bone, reproduction and myelination of the spinal cord, and a deficiency of this element may impair one or more of these processes.

More often the imbalance is mild and as such is difficult to diagnose by observation alone, as most forms of malnutrition cause symptoms such as poor development, loss of weight, impaired reproductive performance and general unthriftiness.

During 1970-71, a survey was carried out to investigate existing levels of copper and phosphate in an important cattle breeding region of the Morobe district, as earlier observations and estimations had indicated a deficiency in several areas. Both suspect and non-suspect properties were included in the survey in order to map exactly the deficient areas, and to obtain a range of mineral levels to be expected from cattle in non-deficient areas.

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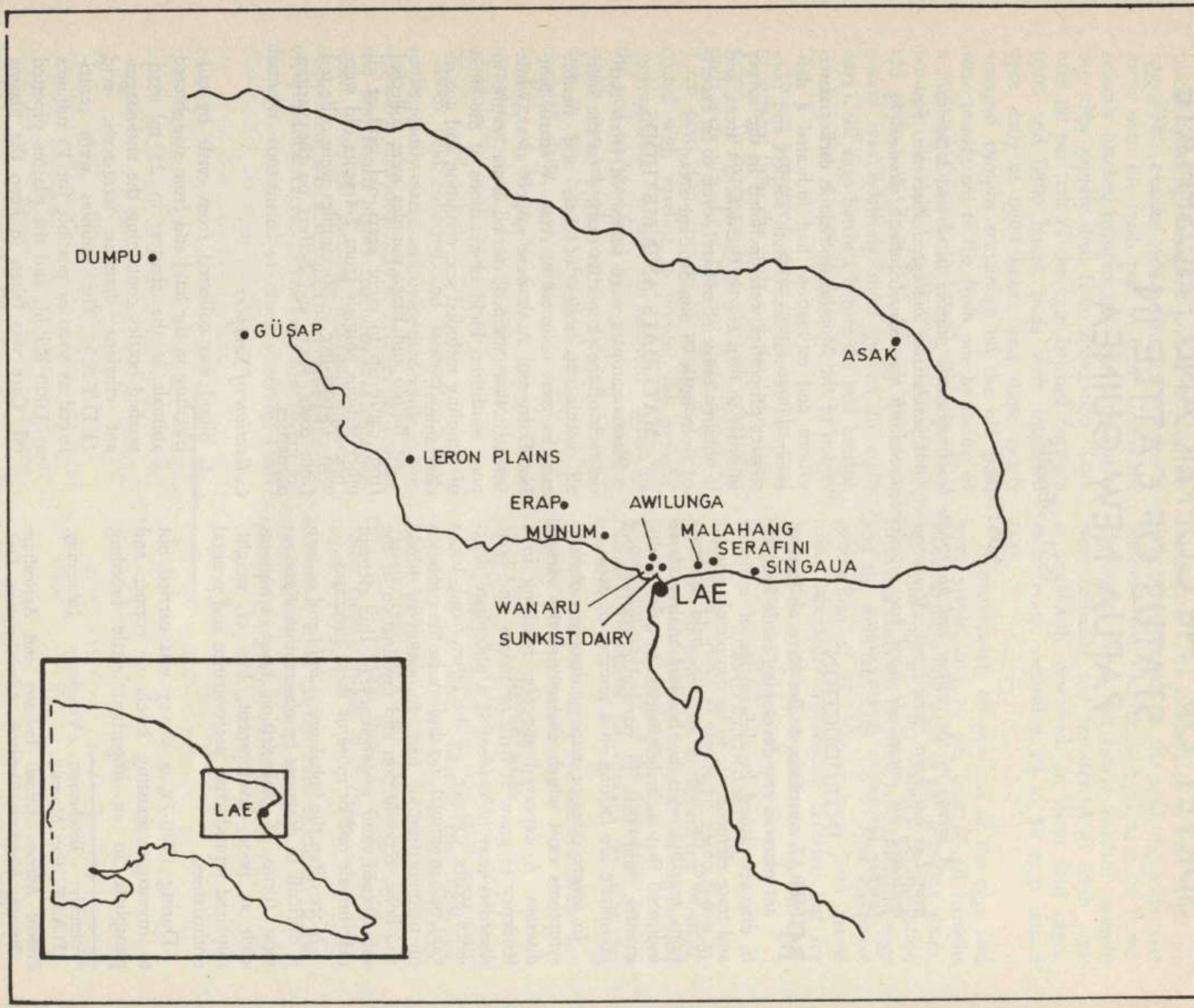
MATERIALS AND METHODS

Plasma samples were submitted from cattle on each of the properties marked on the map, all within 80 miles of Lae, and pasture samples were collected at Asak. Wanaru, Sunkist Dairy and Asak were suspect areas, while several other stations carried some cattle in poor condition. Field observations at the time of sampling included sex, condition and age of each animal.

At Bulolo and Erap, samples were collected from cattle up to eight years old, and at all other stations animals from 2-4 years old were used. Twenty-five to 50 samples were collected from cows, steers and heifers on the various properties.

Collection of Samples

1. Blood was collected from cattle by tail-bleeding in the field and from slaughtered animals at the abattoir in 25 ml acid-washed bottles containing the anti-coagulant ethylene diamine tetra-acetic acid (E.D.T.A.). The samples were centrifuged as soon as possible for 15 minutes at 3,000 R.P.M. and the plasma pipetted off. Care was taken to keep the plasma as cool as possible during transport from


DUMPU
GÜSAP
ASAK
LERON PLAINS
ERAP
AWILUNGA
MUNUM
MALAHANG
SERAFINI
SINGAUA
LAE
WANARU
SUNKIST DAIRY
LAE

Lae to the laboratory in Port Moresby for analysis. It has been found that bovine plasma with the use of a suitable anti-coagulant is a more reliable faction for phosphate determinations than serum, and the phosphate level remains stable for up to eight days (Newman, 1968).

2. Eight different pasture samples were received from Asak cattle station, and each of these had been selected from a mixture of many samples of the same type. Each sample was dried and ground, then 0.5 g was digested with 6 ml of the acid mixture: nitric acid/sulphuric acid/perchloric acid (4:2:1). The acid digest was filtered and made up to 50 ml with glass-distilled water.

Copper Determinations

An atomic absorption spectrophotometer (AA-100) was used for copper estimations. Trichloro-acetic acid (T.C.A.) 8 per cent was shaken with 1 ml of each plasma sample, allowed to stand for five minutes, centrifuged for five minutes and the supernatant aspirated into the burner. The absorbance was read at 3,247 A°, and standard solutions contained 0.1, 0.25, 0.5, 1, 2 p.p.m. copper in 4 per cent T.C.A.

An extraction procedure was employed to estimate copper in pasture samples. One ml 1 per cent ammonium pyrrolidine dithiocarbamate (A.P.D.) was shaken with the pasture digest; the copper complex was extracted with 5 ml iso-butyl methyl ketone, pipetted off and aspirated. Standards were prepared in the same way.

Phosphate Determinations

Inorganic phosphate was estimated in plasma and pasture samples by the method of Gomorri (1942).

RESULTS

For each cattle station, the average and range of bovine plasma phosphate levels obtained are shown in *Table* 1, and the plasma copper levels are shown in *Table* 2. The number of cattle bled at each station and the time at which biochemical estimations were carried out are indicated in *Tables* 1 and 2 respectively.

Table 1.—Average phospate levels in bovine plasma from various cattle stations in the Morobe District, and range of values obtained

Cattle Station	No. of cattle in each sample	Av. phosphate level (mg%)	Range of values (mg%)
Asak	100	6.5	4.9-7.7
Wanaru	25	6.3	4.2-9.9
Munum Plantation	50	6.9	3.8-10.5
Singaua Plantation	56	8.0	5.0-8.7
Bulolo	25	6.5	3.8-10.1
Erap	25	7.6	5.6-9.6
Sunkist Dairy	25	7.3	5.2-10.6
Malahang	50	6.9	4.6-9.2
Serefini	50	7.1	5.4-9.2
Gusap Downs	35	6.3	4.4-8.5
Dumpu	30	6.5	4.6-9.2
Dolarene	6	6.8	4.0-8.9

Table 2.—Average copper levels in bovine plasma from various cattle stations in the Morobe District, with range of values obtained. For each station the month in which both copper and phospate estimations were carried out is indicated

Cattle Stations	Time of Year	Av. Copper Level (p.p.m.)	Range of Values (p.p.m.)
Asak	Sept. 1970 Sept. 1971	0.7	0.65-1.0
Wanaru	Nov. 1970	0.06	0.04-0.12
Munum Plantation	Feb. 1971	0.8	0.50-1.1
Singaua Plantation	March 1971	0.8	0.30-1.3
Bulolo	April 1971	0.6	0.40-0.9
Erap	April 1971	1.0	0.60-1.4
Sunkist Dairy	Nov. 1970	0.3	0.17-0.55
Malahang	Aug. 1971	0.9	0.50-1.4
Serefini	Aug. 1971	1.0	0.50-1.2
Gusap Downs	Oct. 1971	1.2	0.40-1.7
Dumpu	Oct. 1971	1.1	0.80-1.5
Dolarene	Oct. 1971	1.1	0.80-1.5

In *Table* 3, the results of analysis of each of the average grass types are shown.

The average plasma phosphate level of cattle grazed on both suspect and non-suspect areas lay between 6.0 mg per cent and 8.0 mg per cent.

The average plasma copper level of animals in non-suspect areas fell between 0.6

Table 3.—Copper and phospate levels in eight types of pasture from Asak cattle station

Type of Grass	Copper (p.p.m.)	Phosphate (p.p.m.)
Desmodium	42	82
Kunai	22	86
Elephant	28	94
Stylo	25	170
Para	40	650
Kangaroo	30	270
Centro	20	190
Siratro	20	190

p.p.m. and 1.2 p.p.m. The level at Asak fell within this range (0.7 p.p.m.), but values obtained from Wanaru and Sunkist Dairy samples were very much lower.

DISCUSSION

Cattle slaughtered at the Lae abbatoirs included cows and steers from Gusap Downs, Dumpu, Erap and Dolarene, and these animals were reported to be in excellent condition. The range of plasma phosphate levels obtained from these stations was 4.4 to 9.6 mg per cent, which may be taken as the "normal" range.

Since the figures in *Table* 1 for cattle from all other stations fell within this range, phosphorus is not a deficient element within this region of Papua New Guinea.

The range of plasma copper levels obtained from healthy animals was 0.5 to 1.7 p.p.m. It is evident from the figures in *Table* 2 that a copper deficiency exists in two suspect areas: at Wanaru, the range of values 0.04 to 0.12 p.p.m. was well below the lower limit of the "normal" range (0.5 to 1.7 p.p.m.). At Sunkist Dairy the deficiency was less severe, the range of plasma copper levels being 0.17 to 0.55 p.p.m, and the average value at this station of 0.3 p.p.m. was well below that of non-suspect areas. Remedies to this deficiency include pasture improvement or copper therapy.

A detailed project was undertaken in 1970 to investigate the poor condition of cattle at the Lutheran Mission cattle station as Asak. The symptoms indicated a copper deficiency, but the copper levels of samples of plasma, hair and liver from each of five herds, together with pasture samples were all within the normal range. In these tissues, if the level falls below 0.6, 8 and 20 p.p.m. respectively or if 5 p.p.m. or less is detected in pasture a mineral imbalance is indicated. A cobalt treatment trial was then undertaken, as a cobalt deficiency often produces unthriftiness in young stock and loss of weight. However, cobalt did not improve the condition of the animals.

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INSECTICIDE CONTROL OF *SALINA CELEBENSIS* SCHAFFER (COLLEMBOLLA: ENTOMOBRYIDAE), A MINOR PEST OF CACAO IN PAPUA NEW GUINEA

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ABSTRACT

Lindane, dieldrin, chlordane, carbaryl, dicrotophos, fenthion, formothion, parathion, trichlorphon and superior white oil were tested against Salina celebensis *Schaffer a minor Pest of young cocoa in Papua New Guinea. Lindane and parathion at* 0.1 *per cent a.i. were the best treatments. The addition of superior white oil* 0.1 *per cent to insecticide mixtures enhanced the effectiveness of treatment. Carbaryl* 0.1 *per cent a.i. plus superior white oil* 1.0 *per cent and carbaryl* 0.7 *per cent a.i. plus superior white oil* 1.0 *per cent maintained plants substantially free of* S. celebensis *for ten and* 22 *days respectively. There was no evidence of phytotoxicity in any of the treatments.*

INTRODUCTION

THE springtail *Salina celebensis* Schaffer is listed as a pest of cacao in Papua New Guinea (Dumbleton 1954). The species has caused considerable leaf fall in young cacao seedlings on New Britain (Dun 1953). DDT and BHC were reported to be effective in controlling *S. celebensis* (Dun 1954).

During the course of investigations into entomological aspects of vascular streak dieback (as defined by Keane, *et al* 1972) of cacao, it was found that twice weekly applications of either 0.05 per cent dicrotophos or formothion in water were relatively ineffective in reducing *S. celebensis* numbers.

A series of insecticide control trials was therefore carried out from July to September 1967 to evaluate candidate materials to effectively control the species.

METHOD

The first two trials were conducted on ten weeks old cacao seedlings growing in a heavily shaded *Leucaena leucocephala* block. The third was also conducted in a heavily shaded *L. leucocephala* block (the same block), but the cacao seedlings were 12 weeks old. In all three experiments the seedlings were at the recommended planting distance of 12 feet on the triangle. There were five seedlings per treatment. Treatments were applied by hand atomizer and plants were sprayed to the point of runoff.

An average of 1.4 fl oz of the insecticide mixture was applied to each seedling in trial 1 and 1.8 fl oz to seedlings in trials 2 and 3. This represented an application rate of 4.9 oz per acre active ingredient insecticide for trial 1 and 6.1 oz per acre for trial 2.

A pretreatment count was conducted immediately prior to the application of treatments and a second count was made one hour after treatment. Further counts were made on successive days.

For all three trials, a randomized block design with five replicates per treatment was used.

In trial 1, lindane (e.c.), dieldrin (e.c.), chlordane (e.c.), carbaryl (w.p.), dicrotophos (w.s.c.), fenthion (e.c.), formothion (e.c.), parathion (e.c.) and trichlorphon (w.p.) as 0.1 per cent sprays were compared with a 1 per cent superior white oil/water spray. In the second trial, all the above materials were again applied at 0.1 per cent, but 1 per cent superior white oil was added to each insecticide mixture.

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In trial 3, lindane, carbaryl and parathion plus 1 per cent superior white oil were compared at 0.1 per cent, 0.3 per cent and 0.7 per cent plus 1 per cent superior white oil. Equivalent dosages of active ingredient insecticide were 6.1 oz/acre, 18.3 oz/acre and 42.7 oz/acre.

RESULTS AND DISCUSSION

Results of the *S. celebensis* counts for trials 1 and 2 are shown in *Tables* 1 and 2 respectively. During trial 1, 239 points of rain fell between the day 1 and day 2 counts. During trial 2, a total of 298 points of rain fell over the recording period of 33 days. The most significant falls were 41 points on the first day, 33 points on the sixth day and 192 points on the tenth day.

From *Table* 1 it can be seen that dicrotophos, lindane and carbaryl treatments substantially reduced populations and that this reduction persisted five days after treatment.

From *Table* 2, it can be seen that the cabaryl plus superor white oil, parathion plus superior white oil and lindane plus superior white oil, were the most effective in reducing collembola populations. The carbaryl/white oil treatment maintained plants substantially free of *S. celebensis* (one per seedling) for ten days.

The third trial was carried out to test the three most promising insecticides plus superior white oil at higher rates of application to see whether the period of protection could be lengthened. During the trial a total of 945 points of rain fell, the most significant falls occurring on day 6 (329 points), day 14 (45 points), day 15 (28 points), day 21 (37 points), day 23 (47 points) and day 24 (171 points). Other heavy falls were experienced during the last week of recordings. The results of this trial are shown in *Table* 3.

Table 1.—Effectiveness of nine insecticides against *S. celebensis*

Treatment	Rate (% a.i.)	0 (Pre-treatment)	Mean number of S. celebensis per seedling on day						
			Post treatment counts						
			1/24th	1	2	3	4	5	7
Dicrotophos	0.1	23	0	0.8	4	4	3	8	17
Carbaryl	0.1	37	0	0.6	8	4	7	5	14
Lindane	0.1	17	0	3	5	6	3	6	13
Dieldrin	0.1	30	0.6	0.8	5	3	5	8	15
Fenthion	0.1	14	0.6	3	6	4	8	17	23
Chlordane	0.1	21	2	3	7	9	8	18	16
Trichlorphon	0.1	41	0.2	4	10	11	12	10	29
Formothion	0.1	49	5	2	19	12	15	17	34
Superior White Oil	1.0	23	13	7	15	12	9	13	21
Control		36	36	30	37	32	38	65	45

All treatments greatly reduced the numbers of *S. celebensis* on treated seedlings. Carbaryl plus superior white oil gave the best results with ten days of substantially *S. celebensis* free plants at 0.7 per cent a.i. plus superior white oil.

From this series of trials it was concluded that carbaryl 0.1 per cent would provide good control of *S. celebensis* and that the addition of superior white oil 1.0 per cent enhanced the activity of carbaryl. Lindane and parathion also provided good initial kills but seedlings were rapidly recolonised by *S. celebensis.*

There was no evidence of phytoxicity in any of the treatments applied in the three trials.

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Table 2—Effectiveness of nine insecticides plus 1 per cent superior white oil against *S. celebensis*

Treatment	Rate (% a.i)	0 (Pre-treatment count)	Mean number of **S. celebensis** per seedling on day																
			Post treatment counts																
			1/24th	1	2	3	4	5	6	7	8	9	10	13	15	19	22	26	33
Carbaryl	0.1	28	0	0.4	0.2	0	0.2	0.8	0	0.2	0.8	0.2	0.2	3	3	6	15	23	33
Parathion	0.1	22	0.2	1	0.6	1	3	3	1	3	6	3	11	14	9	12	17	41	22
Lindane	0.1	20	0	0.2	0.4	2	4	5	4	1	11	7	6	29	21	38	16	27	27
Dicrotophos	0.1	27	0.4	1	0.6	0.6	5	11	9	11	17	7	6	20	24	36	24	46	35
Dieldrin	0.1	34	0	0.8	5	3	6	4	5	5	14	18	12	19	14	20	16	33	19
Chlordane	0.1	25	0.2	3	2	4	9	13	13	15	11	19	18	40	30	34	25	42	36
Formothion	0.1	44	2	8	8	13	14	12	19	14	17	24	27	40	20	41	54	34	22
Fenthion	0.1	30	0.8	9	12	7	10	24	18	27	36	32	29	62	33	39	38	45	44
Trichlorphon	0.1	36	0	7	6	7	11	15	21	36	33	39	30	60	26	49	58	35	31
Control		23	30	29	37	38	23	41	40	56	74	77	67	81	55	73	71	73	57

Table 3—Effectiveness of carbaryl, lindane and parathion at three concentrations plus superior white oil on *S. celebensis*

Treatment	Rate	0 (Pre-treatment count)	Mean number of S. celebensis per seedling on day									
			Post treatment counts									
			1/24th	1	3	7	10	14	17	24	28	31
Carbaryl	0.1%	36	0.6	0	0	0	0	0	0.2	15	22	30
	0.3%	26	0	0	0	0	0	0.4	0.8	12	28	21
	0.7%	28	0.2	0	0	0	0	0.2	0	0.6	4	4
Parathion	0.1%	33	2	0	0	0.2	0.4	0.6	2	26	49	69
	0.3%	12	0	0	0	0	0.2	1	1	12	15	29
	0.7%	54	6	0	0	0.8	0.6	1	0.6	19	34	36
Lindane	0.1%	29	0.2	0	0	0.6	2	9	14	49	53	35
	0.3%	41	0.2	0	0	2	6	10	22	32	62	69
	0.7%	36	0	0	0	0.2	0	0.4	4	6	12	21
Control		33	33	13	9	34	49	65	73	187	176	160

ASPECTS OF THE COCOA WEEVIL BORER *PANTORHYTES BIPLAGIATUS* GUER IN THE BRITISH SOLOMON ISLANDS PROTECTORATE

D. Friend*

ABSTRACT

Pantorhytes biplagiatus (*Guer*) *is a serious pest of cocoa in the British Solomon Islands. In some farms it has caused the death of up to* 50 *per cent of trees three years old and older, and in a trial plot yields were reduced by* 30 *per cent over a four year period.*

Insecticidal control is difficult and expensive. Control by hand removal of larvae and adults can be effective in small farms away from large infestations. This method is likely to prove tedious and expensive on larger plantations

Two other possible methods of control are discussed. The first is the introduction of the ant Oecophylla smaragdina (*F*) *to cocoa farms.* Oecophylla *is antagonistic to* Pantorhytes. *Lower numbers of larvae are to be found in trees on which* Oecophylla *is foraging. However, there are difficulties in introducing the ant into uncolonised young cocoa farms. These include competition from the ant* Technomyrmex detorquens (*Walk*), *enviromental factors, and possibly the availability of food. Further investigation of these factors is needed to determine the optimum timing for nest introductions.*

The second method is the use of less susceptible cocoa varieties. Amelonado and the progeny of clone Na32 were found to be less susceptible to Pantorhytes *damage than Trinitario. These types have a thinner smoother bark than Trinitario and the number of egg laying sites for* Pantorhytes *is probably therefore reduced.*

INTRODUCTION

Members of the genus *Pantorhytes* (Curculionidae, sub-family Pachyrinchinae are serious pests of cocoa in Papua New Guinea (Szent-Ivany 1961) and in the British Solomon Islands (Keevil 1966). Five species are known to attack cocoa in Papua New Guinea and of those *P. plutus* (Oberth); *P. batesi batesi* (Faust), and *P. szentivanyi* (Marsh) are considered the most serious. Only one species *P. biplagiatus* (Guer) has so far been identified on cocoa in the Solomons. This species does little damage in Papua New Guinea but it can cause tree mortalities of up to 50 per cent on small farms in the Solomons.

Department of Agriculture, Honiara, British Solomon Islands Protectorate.

LIFE HISTORY AND DAMAGE

Descriptions and illustrations of the important species in Papua New Guinea have been given by Szent-Ivany (1961) and Smee (1963). Adults and larvae of *P. biplagiatus* are shown in *Plate* I.

The life history of *P. biplagiatus* has not been studied in the British Solomons but G. S. Dun in a personal communication to the Department of Agriculture in 1961 gave the following information on the species. The eggs are laid in cracks in the bark of host plants. Some 10 to 17 days later the larvae emerge and immediately bore through the bark and tunnel into the sapwood parallel to the surface, but some 1.0 to 1.5 centimetres below it. They remain in these tunnels for up to six months and pupate within them. The adult female has

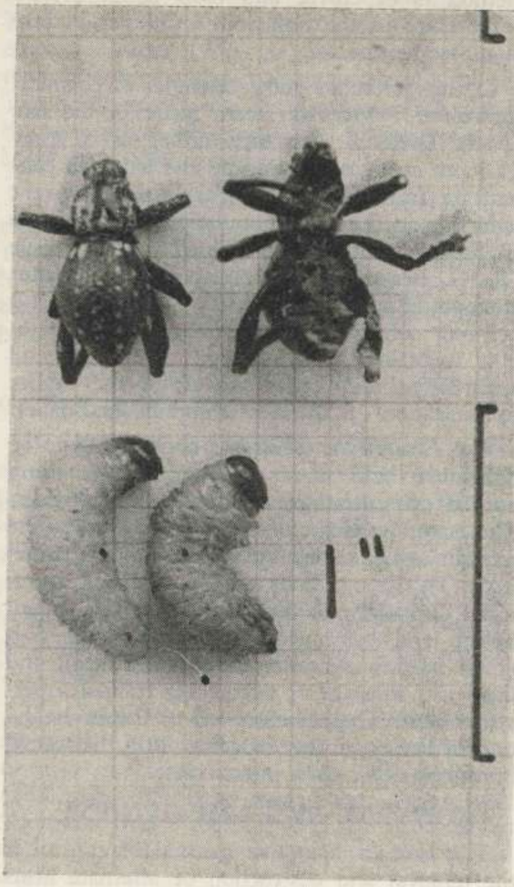

Plate I.—Adults and larvae of *Pantorhytes biplagiatus* Guer

a pre-oviposition period of from 14 to 21 days. The oviposition period lasts 160 days during which about 300 eggs are laid.

Dun did not state the conditions under which these observations were made. Both the pre-oviposition period and oviposition period quoted above are, however, shorter than for other species, e.g. 80 and 250 to 450 days respectively for *P. szentivanyi* (T. Bourke pers. comm. 1972).

The adults feed on the bark of young shoots, and this can cause twig dieback but generally the damage is of little consequence at the time of the attack. It may, however, give rise to a rough bark as the tree ages and provides more potential egg laying sites. The most serious damage is caused by the larvae. Larval damage is seldom seen in cocoa younger than 36 months. From 36 months to about the sixth year damage is usually restricted to the jorquette region. The tunnelling of the larvae often causes stem splitting and ring-barking of the branches which subsequently die. From the sixth year trees may be attached at the collar, on the trunk, at the jorquette, and on the main branches. Repeated attacks on the trunk and at the collar lead to a gradual dieback and eventually the death of the tree.

Phytophthora palmivora stem canker has been found associated with *Pantorhytes* damage. In a survey of 271 cankers, 12.2 per cent were associated with larval channels (Friend 1972).

ECONOMIC IMPORTANCE

P. biplagiatus occurs on all the main cocoa producing islands of the Protectorate. The highest level of infestation has, however, been found on Malaita Island where some two thirds of the Solomons' cocoa are planted. A survey of about 25 hectares of randomly selected farmers' plots throughout Malaita in 1967 showed that 13.4 per cent of the trees were infested by larvae. The per cent of trees infested in individual farms varied from nil to 56 per cent. The highest incidence of trees with larvae was, however, found in a subsequent survey in July 1968 on Dala Experimental Station, Malaita Island. Ninety-six per cent of the trees on a 1.6 hectares block of Trinitario cocoa were infested. The mean number of larvae per tree was 4.7, giving a population of 2,500 live larvae per hectare.

The effect of *P. biplagiatus* damage on yields in small farms is difficult to determine. From 1968 to 1971, however, eight plots of Trinitario cocoa were observed at Dala Station. Each of the plots consisted of 40 trees. The cocoa became infested in 1968. By December 1970, 50 per cent of the trees on four of these plots had been killed. The other four plots were less affected and only 17 per cent of the trees were killed in the same period. The mean yields of the heavily and lightly infested plots are compared in *Table* 1.

Over the four years recorded there was 30 per cent more cocoa produced on the lightly infested plot. In the last recorded year the

***Table* 1.—Effect of *Pantorhytes* infestation on the yield of Trinitario cocoa planted in 1964. Mean yields kg dry cocoa per hectare**

Year	Infestation Level		Percent Increase
	A—high	B—low	B—A
1968	243	187	−23
1969	228	270	18
1970	235	350	49
1971	268	458	71
Total:	974	1,265	30
% Trees killed to December 1970	50	17	

difference was over 70 per cent as the tree mortality increased markedly in the heavily infested plot. It is likely that yield decreases of this order were found on many small farms.

CONTROL OF *PANTORHYTES* BY INSECTICIDES

Three methods of control of *Pantorhytes* have been tried in Papua New Guinea. The first was based on the fact that *Pantorhytes* adults do not fly. Experiments were carried out in the 1940s using 10 per cent DDT, and later other insecticides, incorporated in a sticky compound, applied as bands around the trunk (Dun 1955). Banding experiments were later abandoned for economic reasons (Szent-Ivany 1961). The second method, again directed at the adults, was tree spraying with DDT at high and low volumes at six weekly and two monthly intervals respectively. It was said to be effective (Anon. 1961) although Smee (1963) stated that there was no reliable method of control by insecticides.

The third approach was directed at the larvae and consisted of painting the larval channels with a 0.25 per cent solution of fenthion (O'Connor 1969). The recommendation has now changed to a 1.25 per cent solution of fenthion or dichlorvos (T. Bourke pers. comm.). A sophisticated technique based on spraying with trichlorphon (Dipterex) was also recommended (Anon. 1971). In heavy infestations the farms are sprayed on a six weekly cycle in the first year, reducing to a three monthly cycle in subsequent years. This method is expensive and costs about \$A100 per hectare in the first and \$A50 per hectare in subsequent years.

In the Solomons some attempts at chemical control of *Pantorhytes* were made in the late 1950s. Dieldrin was used either as a spray (1.5 per cent) or painted on the trunk in concentrate form. The spray gave a 50 per cent reduction in the adult population after a single application, but was considered too expensive (P. G. Fennemore unpublished data). Later attempts at spraying with 0.5 per cent and 1.0 per cent solutions of dieldrin gave no significant reduction in the weevil population and apparently killed cocoa flowers at the higher concentration (R. A. Keevil unpublished data).

The *Pantorhytes* adult has been found to be difficult to kill under field conditions using normal concentrations of common insecticides. The larvae by virtue of their feeding habits are difficult to kill except on an individual channel basis. This is a tedious procedure. Most insecticidal campaigns require a great deal of organization and constant suveillance. In the Solomon Islands communications are difficult and there is a shortage of adequately trained supervisory staff. These factors led to the investigation of the possibility of controlling the weevil by means other than insecticides.

CONTROL BY FARM HYGIENE

The first stage in this method of control is the removal and destruction of alternate hosts of the weevil. In the Solomon Islands five alternate host species are known (Maquillan 1964). They are *Pipturus argenteus* (Forst, F.) Wedd., *Mellochia umbellata* (Houtt), Stapf., *Trichosperma psillocladum*. Merr of Perry., *Cananga odorata* (Lamk) Hook F. et Thomas, and *Trema cannabina* (Lour).

From about the second year of planting the farm is carefully observed on an individual tree basis for the presence of adults and larvae. The larvae are either removed from the channels with a sharp pocket knife, or killed with a sharpened wire. Adults are picked from the trees and killed. Inspections are made at monthly intervals.

Until 1969 no serious infestation of *Pantorhytes* had been found on Dala Experimental Station. By July of that year a high population of larvae was found on a plot of eight year old Trinitario. This plot was observed in detail until December 1970. At the same time two plots of five year old cocoa were also observed. The first was adjacent to the infested plot and the second was separated from it by an area of bush about 100 m wide.

The incidence of larvae in the trees on the eight year old plot was 96 per cent in July 1969. The incidence of larvae had been reduced by hand picking to 50 per cent in July 1970 but 50 per cent of the trees had been killed by *Pantorhytes* by December 1970.

No larvae were found in the two five year old plots in July 1969.

By July 1970 the incidence of larvae on the adjacent plot of five year old cocoa was 10.1 per cent and larvae were found up to 100 m inside the plot. By December 1970, 27 per cent of the trees had been killed by the weevil.

Larvae were found in 3.2 per cent of the trees on the isolated plot by July 1970, but no trees had been killed by *Pantorhytes* up to December 1970.

This method of controlling the pest is apparently only effective as a preventative measure in young cocoa away from serious infestations. No costs were kept during the 29 month observation period, but it is likely that this method would prove expensive on larger plantations.

BIOLOGICAL CONTROL

The question of biological control of *Pantorhytes* was briefly discussed by Szent-Ivany (1961). He mentioned a braconid parasite and the apparent antagonism of the ant *Oecophylla smaragdina* (F), but his general conclusions were that the chances of such control in Papua New Guinea were remote. Recently, however, there has been considerable work on biocontrol agents in Papua New Guinea and some 50 parasites and predators are known (T. Bourke pers. comm. 1969).

In the Solomon Islands the apparent antagonism between *Oecophylla* ants and *Pantorhytes* was noted in the late 1950s. Keevil (1966) stated that a useful method of controlling the weevil was to introduce and encourage the spread of *Oecophylla* within cocoa farms. No quantitative data was available to establish the relationship between presence of *Oecophylla* and absence of *Pantorhytes*. In the 1967 surveys, it was found that both insects were irregularly distributed through the cocoa growing areas. There was, therefore, the possibility of a chance occurrence of one without the other.

In 1970 studies on the relationship between *Oecophylla* and *Pantorhytes* and the possibilities of introducing the ants to uncolonised cocoa plots were started.

Three farms were studied in which both the ant and the weevil were found together. Individual trees were inspected and the presence or absence of foraging *Oecophylla* and *Pantorhyts* larvae were noted. The results of this survey are shown in *Table* 2.

Table 2.—Per cent cocoa trees with larvae, old larval tunnels and freely foraging *Oecophylla* ants in three farms in Malaita Island, March 1971

Farm	Trees with Larvae	Trees with Old Tunnels	Trees with Ants
1	3.6	16.8	94.0
2	45.6	4.6	64.0
3	67.5	18.9	25.0

As can be seen, there is a definite decrease in the percentage of trees with larvae as the percentage of trees occupied by foraging ants increases. Many trees with ants had old larval channels but no sign of recent damage. This suggests that as the ants were spreading within the farm the *Pantorhytes* adults were driven away. The mathematical relationship between the presence and absence of both pests is shown in *Table* 3.

Table 3.—The relationship between the presence of *Pantorhytes* larvae and *Oecophylla* ants on three cocoa farms

	Farm 1	Farm 2	Farm 3
Trees with ants	68	404	472
Trees without ants	210	151	361
Totals	278	555	833

$Chi^2 = 174.23$.

Observations did not show that the ants were predators of either adults or larvae. When adult weevils were placed on colonised trees they were quickly surrounded by the ants and thrown from the tree. Control is probably effected through the prevention of egg laying as the *Oecophylla* keeps the *Pantorhytes* adult away from the tree.

In 1970 a series of observations on introducing and establishing *Oecophylla* into uncolonised young cocoa was started at Dala Experimental Station.

Various fruit trees on the station, including varieties of citrus, soursop and custard apple, support large colonies of *Oecophylla*. The ants form two kinds of nest, main nests which can be up to 60 cm long (*Plate* II) and small outlying nests which often consist of only two or three leaves pulled together (*Plate* III).

Only the former were used. In the early morning when the ants were not actively foraging the large nests were clipped intact from the fruit trees with secateurs and taken immediately to the cocoa plots. They were then placed in the jorquettes of the cocoa trees at a rate of 15 per hectare.

Nests were first introduced into six small plots of cocoa planted in 1964 under thinned forest, which is the usual shade for cocoa in the Solomons. The trees had been bearing since 1968. By March 1972, ants were still found foraging in four of the six plots and large new colonies had been formed in both cocoa and shade trees within these plots.

In 1970 it was recommended that all new plantings of cocoa should be on clear-felled land using the tree *Leucaena leucocephala* as shade (Friend 1970). All the subsequent work on the introduction of *Oecophylla* has been carried out on non-bearing cocoa under this type of shade. Whereas the *ad hoc* introduction of nests into bearing cocoa under forest shade was successful, this was not so in young cocoa under *leucaena*.

In one plot the *Oecophylla* nests were vacated within 24 hours and no sign of the ants could be found on either the cocoa or the shade. A second introduction was then made and the nests were observed at two hourly intervals from 7 a.m. to 5 p.m. It soon became apparent that the *Oecophylla* were being attacked and killed by a small black tent building ant *Technomyrmex detorquens* (Walk). Every tree in the plot was occupied by *Technomyrmex*.

Plate II

Plate III

To reduce the number of trees occupied by, and also the total number of *Technomyrmex* foraging within the study area, the cocoa tree trunks and foliage were sprayed with a 1.3 per cent solution of dieldrin. When inspected one week later, 50 per cent of the trees were free of *T. detorquens* and the numbers foraging over the rest of the trees were very reduced.

When *Oecophylla* were again introduced two weeks after spraying colonisation was apparently successful. New nests were formed in the cocoa and the *Oecophylla* foraged freely in the surrounding trees. Some seven months after their introduction, however, the *Oecophylla* again disappeared from the plot. The dieldrin may have had some long term effect on the *Oecophylla,* but it was thought likely that factors other than competition with *Technomyrmex* were preventing their successful introduction.

One important factor which is probably influencing the introduction of *Oecophylla* intc young cocoa under *Leucaena* is the availability of food for the ants.

In the Solomons *Oecophylla* tends five species of pseudococcidae, and their honeydew forms an important part of their diet (Greenslade 1964). Other insects, especially larvae, make up the bulk of their diet.

Whilst no quantitative work on insect populations on young cocoa was carried out, it was observed that the pseudococcid population was generally very low in non-bearing cocoa, more being present when the flushes were young than when they had aged. With the onset of fruiting, the number of pseudococcids further increased. It was also noticeable that on farms where *Oecophylla* was present pesudococcid numbers were highest. Studies of such variations in natural insect populations and in particular the pseudococcids may lead to better timing of nest introduction.

Similarly studies of the environmental factors within the cocoa farm may also lead to more successful introductions. For example, Greenslade (1965) found in laboratory studies that the activity of *O. smaragdina* was directly related to the light intensity. Leston (1969) working with a related species *O. longnoda* in

Ghana found that they preferred sites with a well developed canopy and a light overhead shade. In the Solomons the densest populations of *Oecophylla* have been observed in areas of cocoa where the overhead shade was lighter than normal, such as in old coconut plantations and under poorly develped planted shade.

A simple trial to support this observation of the effect of shade density on the establishment of Oecophylla was commenced in October 1971. Ten nests were introduced into each of two plots of young cocoa under *Leucaena* planted at 8 x 8 feet (2.4 m) spacing. On one plot the *Leucaena* was thinned to 8 x 16 feet one month before the introductions were made. *Technomyrmex* were absent from both plots. By December 1971 no *Oecophylla* were to be found in the densely shaded plot although they appeared to have begun to establish new nests in November. They were still actively foraging on the lighter shaded plot. By March 1972, 14 new nests had been formed on the latter plot.

SUSCEPTIBILITY OF COCOA TYPES

From July 1969 to December 1970 *Pantorhytes* damage to a cocoa selection trial at Dala Experimental Station was observed at monthly intervals. The trial was originally planted in 1964 under thinned forest shade to compare the growth and yield of three cocoa selections with Trinitario cocoa from Keravat, New Britain. The four selections which were planted out in a Latin square with 40 trees per plot were Keravat Trinitario, a local Trinitario Selection, Amelonado and the progeny of the clone Na32.

Pantorhytes moved into the plot during mid 1968 from an adjacent heavily infested plot. The first two rows of plots were the most seriously damaged and by December 1970, 56 per cent of the trees of the two Trinitario types in these rows had been killed by the weevil compared with only 10 per cent of the Amelonado and 12.5 per cent of the progeny of Na32 (*Table* 4a).

The overall increases in mortality on the experiment from December 1968 to December 1970 are shown in *Table* 4b.

The December 1970 figures were analysed and showed that the plot to plot variation was high (CV = 66 per cent), but losses on the local Trinitario selection were significantly higher (P = 0.05) than on the Amelonado and the progeny of Na32. The difference between the Keravat Trinitario and the Amelonado just

***Table* 4A.—Number of trees killed by *Pantorhytes* on individual plots of four cocoa selections at Dala Malaita up to December, 1970**

					Total Row
Row 4	Na 4	A 1	KT 2	LT 13	20
Row 3	LT 8	Na 3	A 1	KT 4	16
Row 2	KT 26	LT 19	Na 4	A 3	52
Row 1	A 5	KT 19	LT 26	Na 6	56

Road 6M Wide

HEAVILY INFESTED PLOT

A = Amelonado KT = Keravat Trinitario
Na = Progeny of Na32 LT = Local Trinitario

***Table* 4B.—Trees killed by *Pantorhytes* from 1969 to 1970**

	Totals		Plot Means
	December 1969	December 1970	1970
Trinitario (ex Keravat)	18	51	12.8 a b
Trinitario (Local Selection)	32	66	16.5 a
Amelonado	8	10	2.5 b
Progeny of Na32	12	17	4.3 b

a b Duncan's test Means followed by the same letter are not significantly different at the 5 per cent level of probability. (SE ± 3.0)

failed to be significant at the 5 per cent level in this experiment (Rp = 10.9, actual difference 10.25).

It can be seen that there are obvious significant differences between the four selections in their susceptibility to the weevil. Almost the whole area of cocoa planted in the Solomons is Trinitario obtained originally from Keravat in New Britain, and even in badly infested farms some trees showed little or no damage by *Pantorhytes*. This evidence suggested the possibility of selection of cocoa types for low susceptibility, and possible mechanisms for resistance were therefore sought.

There is very little published evidence on resistance of cocoa trees to insect damage. Soria and Saunders (1966) suggested that resistance to the scolytin *Xyleborus ferrungineus* (F) was due to a naturally occurring endogenous substance. Schreurs (1965) reported apparent differences in susceptibility of some cocoa clones to attack by a cerambycid stem borer Glenea *lefebueri* (Guer) in West New Guinea. However, he did not suggest reasons as to why the difference occurred.

The susceptibility of timbers to some species of borer is probably influenced by the wood hardness and moisture content (M. B. Self and G. R. Watt pers. comm.). These factors were therefore investigated for the four selections listed in *Table* 4b. Blocks were cut from each of ten trees of Amelonado and the Na32 progeny, and from five trees of each of the Trinitario selections. The blocks measured approximately 8 x 2.5 x 2.5 inches. A small sample was cut (1 x 2.5 x 2.5 inches) for moisture determination and the remainder was used for a wood hardness test. This test was done by the Forestry Department and consisted essentially of dropping a steel ball from a fixed height on to the radial, tangential and end faces of the freshly cut block of wood.

The depth of penetration of the ball was then measured (Armstrong 1960).

Wood moisture content was estimated by oven drying the samples at 100° C for 24 hours.

The results (*Table* 5) did not show any significant difference between the selections.

It was then thought that the condition of the bark might influence susceptibility. As *Pantorhytes* lays its eggs in cracks in the bark, the thicker and rougher the bark the more potential egg laying sites there would be. This would lead to higher larval populations within and greater damage to the tree. Young trees with smooth bark would have fewer oviposition sites and would, therefore, be less susceptible to damage. Any tree which had naturally thin smooth bark would also be less susceptible in later years.

Ten bark samples were taken from the Trinitario, Amelonado and Na32 progeny. The roughness was scored on a scale 1 to 3, in order of increasing roughness and degree of natural cracking. Thickness was measured by using a micrometer and taking a mean of four sides of a 25 square centimetre sample. The results are shown in *Table* 6.

Table 5.—Wood hardness and moisture content of three cocoa types

	Progeny of Na32	Trinitario	Amelonado
Penetration (1/1000") (Means of three faces)	226	232	222
Per cent Moisture	54.2	54.3	53.9

Table 6.—Bark thickness and roughness of three cacao types

	F2 Na32	Trinitario	Amelonado
1. Mean thickness (mm)	4.4b	5.0a	4.3c
2. Roughness Score (Means)	1.7b	2.5a	1.5c

a, b, c, Duncan's Test. As for *Table* 5. S.E.1 ± 0.020 SE 2 ± 0.025

As can be seen there are definite differences between the three selections. The most susceptible, Trinitario has thicker and rougher bark at eight years old than the other selections. By retaining a smooth thin bark longer, a cocoa selection will support a lower population of *Pantorhytes* larvae. This in turn will lessen the burden of hand removal of larvae and adults. It will also facilitate the establishment of *Oecophylla,* as introductions can be delayed until the canopy is fully formed and the shade is thinned. The extra time could allow the build up of insect population within the cocoa and hence provide a better food supply for the ants.

CONCLUSION

At the present stage of development of the cocoa industry in the British Solomon Islands, there seems little hope for the control of *Pantorhytes* using insecticides. The techniques involved are too expensive and too sophisticated.

Control by plantation hygiene, which includes the hand removal of larvae and adults, is not successful in farms with or near heavy infestations. The results presented here suggest that the introduction of *Oecophylla smaragdina* into uncolonised farms may be a cheap and effective way of reducing weevil damage. However, further work on the environmental and biotic factors influencing the timing of the introduction, and the establishment of ant colonies is required.

Pantorhytes populations may be kept low in the early years by planting specially selected cocoa types with thin smooth bark and thereby allowing extra time for introducing *Oecophylla* and reducing the burden of hand removal of larvae and adults. Thin smooth bark should certainly be a criterion for selection among newly introduced cocoa varieties.

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SCOLYTIDAE AND PLATYPODIDAE OF THE ARCHBOLD EXPEDITIONS TO NEW GUINEA. 280. CONTRIBUTION TO THE MORPHOLOGY AND TAXONOMY OF THE SCOLYTOIDEA

Karl E. Schedl*

ABSTRACT

In this paper a new genus Protopityopthorus *in the Scolytidae is described. Descriptions are given of eleven new species of Scolytidae*: Poecilips suaui, Ozodendron curtus, *Eidophelus papuanus, Eidophelus subgranosus, Eidophelus tuberculatus, Protopityophthorus durus, Xyleborus chimbui, Xyleborus fuyugei, Xyleborus rosseli, Xyleborus suaui, Xyleborus timidus*, and of three new species of Platypodidae: *Crossotarsus motui, Platypus acuticornis* and *Platypus obliquesectus*. A new subspecies of Scolytidae: *Eidophelus subgranosus* Schedl *subaffinis* nov. subsp., is described.

INTRODUCTION

Mr Lee H. Herman of the American Museum of Natural History forwarded to me for identification the *Scolytidae* and *Platypodidae* collected in Papua New Guinea by the third to sixth Archbold Expeditions. The collections comprised 8,726 specimens partly mounted, the greater part unmounted in envelopes, nearly the entire material being collected at light traps.

In my experience light trap collections in tropical countries usually show a very high percentage of species being attracted to light. In Papua New Guinea the number of *Xyleborus perforans* Woll. collected at light amounted to about 5,000 specimens. For this species only a small number of specimens have been mounted from each locality. The records of known species are kept on file and will be published in connection with a monograph on the Melanesian fauna in preparation.

In the paper the following abbreviations are used: Archb. (Archbold); Dist. (District); Exp. (Expedition); M. Bay (Milne Bay) and nr (number).

DESCRIPTION OF NEW SPECIES

A. SCOLYTIDAE

Poecilips suaui nov. sp.

Dark reddish brown, 1.84 to 2.08 mm long, 2.16 times as long as wide. More closely allied to *Poecilips cyperi* Bees. but distinctly stouter, the pronotum wider than long, the subapical constriction more strongly developed, the pronotal disc less densely asperate-punctate and the apical margin of the elytra more broadly rounded.

Front subshining, convex minutely punctulate, rather coarsely and remotely punctured, somewhat aciculate, pubescence restricted to the usual fringe along the anterior margin.

Pronotum wider than long (23:21), postero-lateral angles of more than 90 degrees, slightly rounded, sides somewhat divergent on

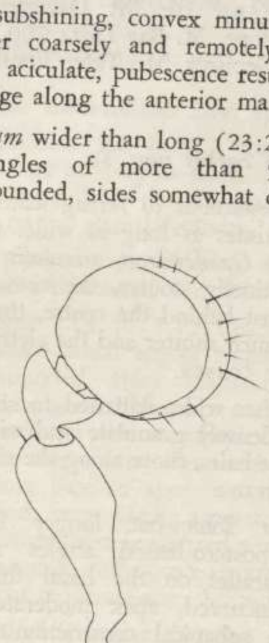

Figure 1.—Antennae of *Protopityophthorus durus* nov. s.p.

*Lienz, Osttirol, Austria.

basal fourth, thence broadly arcuate, apex rather narrowly rounded, subapical constriction distinct; disc shining, uniformly convex, rather regularly and finely granulate-punctate, with rather short and erect pubescence. Scutellum small, triangular, impunctate.

Elytra slightly wider (24:23) and 1.4 times as long as the pronotum, sides subparallel on basal third, thence gradually incurved, apex rather broadly rounded, declivity commencing after basal third, uniformly and obliquely convex; disc with rows of medium sized punctures in slightly impressed lines, interstices shining, with some very fine transverse wrinkles and each with a series of rather irregularly placed finer punctures bearing—as far as not abraded —short semi-erect hairs, the punctures of both series somewhat more conspicuous on the declivity.

Holotype and two paratypes in the American Museum of Natural History, two paratypes in Collection Schedl.

Type-Localities: Dawa Dawa, M. Bay Dist., 0-10 m, 2-6.XII.1956, L. J. Brass, Fifth Archb. Exp. nr. 16; Mt Dayman, Maneau Range, N. Slope, M. Bay Dist., 700 m, 13-20. VII.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 6.

***Ozodendron curtus* nov. sp.**

Female, testaceous to ferrugineous, 1.6 mm long, 2.45 times as long as wide. Of similar sculpture to *Ozodendron orientalis* Egg., but smaller, distinctly stouter, the summit of the pronotum just behind the centre, therefore the basal area much shorter and the elytral declivity more evenly convex.

Front rather wide, flattened to slightly concave, very densely granulate and with a brush of short pale hairs, those along the side margins a little longer.

Pronotum somewhat longer than wide (36:32), postero-lateral angles rectangular, sides subparallel on the basal third, thence gradually incurved, apex moderately broadly rounded, a subapical constriction difficult to recognize; disc convex, summit just behind the centre, anterior area very densely covered by small asperities gradually changing to a more granulate sculpture towards the base, pubescence rather conspicuous and erect. Scutellum small, shining.

Elytra slightly wider (33:32) and 1.25 times as long as the pronotum, sides parallel on the basal half, apex very broadly rounded, declivity very short, steeply convex; disc shining, striate-punctate, the strial punctures of moderate size, the striae only slightly impressed, interstices rather narrow, each one with a median row of much smaller puntures bearing moderately long erect setae; on the declivity the striae much more impressed, the strial punctures of similar size to those on the disc, the interstices somewhat elevated, each one with a regular row of setose granules, the apical margin finely carinate.

Male of similar size, colour and sculpture but the front more shining, broadly convex, densely and rather finely punctured, the pubescence less conspicuous, the pronotum more trapezoid in outline and the apex more narrowly rounded.

Holotype, allotype and two paratypes in the collection of the American Museum of Natural History, three paratypes in Collection Schedl.

Type-Locality: Waikaiuna, Normanby Isl., M. Bay Dist., 0-50 m, 10-25.IV.1956, L. J. Brass, Fifth Archb. Exp. nr 1.

***Eidophelus papuanus* nov. sp.**

Testaceous, 1.76 to 2.00 mm long, 2.5 times as long as wide. In general appearance somewhat similar to *Protopityophthorus durus* nov. sp., but larger, stouter, the pronotum more trapezoid in outline, the elytral declivity with the suture not raised and without setose granules.

Front plano-convex, minutely punctulate, finely granulate punctate, pubescence very sparse but long.

Pronotum slightly longer than wide (37:36), strongly trapezoid in outline, postero-lateral angles rectangular and rather strongly rounded, sides subparallel on basal fifth, thence rather strongly narrowed, apex moderately broadly rounded, a subapical constriction indicated; disc shining, nearly uniformly convex from apex to base, very finely asperate on the anterior half, regularly covered with rather large punctures behind, beaded line along the base weakly developed, pubescence sparse, erect and rather long. Scutellum moderate in size, shining and impunctate.

Elytra slightly wider (39:37) and 1.7 times as long as the pronotum, sides parallel on basal half, apex broadly rounded, declivity restricted to the posterior half, uniformly convex; disc shining, striate-punctate, the strial punctures from fine to moderately large, the striae very slightly impressed, the interstices of medium width, each one with a row of punctures being only a little smaller than those of the main striae; declivity with the same type of punctation as on the disc but slightly finer, the suture, the third interstices and the sides with few long erect hairs.

The specimens at hand do not show sexual differences.

Holotype and four paratypes in the American Museum of Natural History, three paratypes in Collection Schedl.

Type-Locality: Mt Dayman, Maneau Range, N. Slope, M. Bay Dist., 700 m, 13-20.VII. 1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 6.

Eidophelus subgranosus **nov. sp.**

Female testaceous, 2.0 to 2.1 mm long, 2.5 times as long as wide. Compared with *Eidophelus papuanus* nov. sp. the new species is distinctly stouter, the elytral declivity is much more steeply convex and the alternating interstices each with a row of setose granules.

Front plano-convex, silky shining, minutely punctulate, very finely and very closely punctured, the punctures bearing rather long and fine hairs.

Pronotum longer than wide (43:38), postero-lateral angles somewhat more than rectangular and broadly rounded, sides slightly divergent on basal fourth, thence gradually but not strongly incurved, apex broadly rounded; disc rather uniformly convex from base to apex, summit slightly behind centre, anterior area very densely and very finely asperate, basal area rather shallowly and finely punctured, the asperities extending beyond the centre on the sides, pubescence sparse, erect and moderately long. Scutellum comparatively small, shining, impunctate.

Elytra only slightly wider (39:38) and 1.3 times as long as the pronotum, sides parallel on little more than basal half, apex very broadly rounded, declivity short and steeply convex; disc shining, shallowly striate-punctate, the strial punctures rather small and closely placed, the interstices with similar punctures but their arrangement less regular, the striae slightly impressed except the first ones which gradually increase in depth towards the declivity; declivity with the second interstices distinctly impressed and the punctures nearly obsolete, the suture elevated, as high as the third interstices, both with a series of five to six small setose granules, with similar granules on the sides.

Male of similar size, proportions and sculpture as the female, but the front less densely punctured, intermixed with some minute granules and with sparse pubescence.

Holotype and allotype in the American Museum of Natural History, a pair of paratypes in Collection Schedl.

Type-Locality: Waikaiuna, Normanby Isl., M. Bay Dist., 0-50 m, 10-25.IV.1956, L. J. Brass, Fifth Archb. Exp. nr 1.

Eidophelus tuberculatus **nov. sp.**

Ferrugineous, 2.0 to 2.2 mm long, 2.86 to 2.90 times as long as wide. A new species easily recognized by the size and large setose tubercles on the elytral declivity.

Front plano-convex, shining, finely but not very densely punctured and with erect hairs.

Pronotum 1.14 to 1.15 times as long as wide, postero-lateral angles rectangular, rather broadly rounded, sides subparallel on basal third, thence gradually incurved, apex broadly rounded, without distinct subapical constriction; summit in the centre, disc rather uniformly convex from base to apex, anterior area very densely and very finely asperate, basal area shining, rather densely covered with moderately large punctures, pubescence sparse and long. Scutellum of moderate size, shining, impunctate.

Elytra slightly wider (37:36) and 1.41 to 1.50 times as long as the pronotum, sides parallel on basal half, apex very broadly rounded, declivity commencing somewhat behind basal half, rather strongly convex; disc shining, striate-punctate, strial punctures of moderate size and very closely placed, interstices rather narrow, each one with a somewhat irregular row of punctures being rather numerous and slightly smaller than those of the main striate; declivity brightly shining, the strial punctures reduced in size, the suture distinctly elevated, about as high as the third interstices, the second interstice impressed and nearly impunctate, interstices one, three and five each with a series of four to five large pointed tubercles bearing long erect setae.

Holotype in the American Museum of Natural History, one paratype in Collection Schedl.

Type-Locality: Mt Dayman, Maneau Range, N. Slope, M. Bay Dist., 700 m, 13-20.VII. 1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 6.

Eidophelus subgranosus subaffinis nov. subp.

Some smaller specimens, 1.56 to 1.90 mm long, being slightly stouter (2.4 to 2.5 times as long as wide) and having the striae nearly obsolete, the strial punctures strongly reduced in size on the elytral declivity, might be regarded as a subspecies of *Eidophelus subgranosus* nov. sp.

Holotype and two paratypes in the American Museum of Natural History, three paratypes in Collection Schedl.

Type-Locality: Waikaiuna, Normanby Isl., M. Bay Dist., 0-50 m, 10-25.IV.1956, L. J. Brass, Fifth Archb. Exp. nr 1.

PROTOPITYOPHTHORUS nov. gen.

Body elongate, cylindrical, head globose, eyes of moderate size, inner outline emarginate, antennal scape club-shaped, funicle consisting of two joints, a rather large pediculus and a much smaller distally widened segment as shown in *Figure* 1, club nearly circular in outline, flat, with a strongly curved suture following the distal border, the space between this suture and the anterior margin with a few moderately long setae. Pronotum trapezoid in outline, anterior margin unarmed, the fine, beaded marginal line near the posterior border rather weakly developed, disc with distinct summit, anterior area asperate, basal area punctured. Scutellum small, shining, impunctate. Elytra cylindrical, sides parallel anteriorly, apex rounded, declivity convex, disc striate-punctate. Fore coxae contiguous, tibiae slender, with two teeth on distal margin, one tooth and a few serration on outer edge, tarsi cylindrical.

The new genus has to be placed in the tribe Pityophthorini and is easily recognized by the characters of the antennae (nine specimens examined by microscopic mounts) (*Figure* 1.).

Genotype: *Protopityophthorus durus* nov. sp.

Protopityophthorus durus nov. sp.

Female testaceous, 1.0 to 1.5 mm long, 2.7 times as long as wide, with a considerable variation in size.

Front plano-convex, densely and rather finely punctured, with a downwardly directed brush of yellow hairs, those on the sides somewhat longer.

Pronotum longer than wide (29:25), postero-lateral angles rectangular, slightly rounded, sides parallel on the basal third, thence gradually incurved, apex moderately broadly rounded; summit in the centre, anterior area obliquely convex, very densely covered by small asperities, basal area subshining, minutely punctulate, shallowly and rather densely punctured, pubescence sparse, erect, moderate in length. Scutellum of medium size, shining, impunctate.

Elytra as wide and 1.4 times as long as the pronotum, sides parallel on basal half, apex broadly rounded, declivity restricted to distal half, evenly convex; disc shining, striate-punctate, the strial punctures moderately large and closely placed, the striae very slightly impressed, interstices with more irregularly and remotely placed punctures slightly smaller than those of the striae; declivity with the first striae more strongly impressed, the suture somewhat elevated, the third interstices forming a low lateral convexity and with the punctures larger and more irregularly placed, interstices one, three and five each with a few of the punctures bearing moderately long semi-erect setae.

Male usually somewhat smaller and distinctly stouter than the female, 2.6 times as long as wide, front more convex, pubescence sparse, the punctation coarser towards the sides.

Holotype, allotype and 89 paratypes in the American Museum of Natural History, 21 paratypes in collection Schedl.

Type-Localities: Biniguni, Gwariu River, M. Bay Dist., 150 m, 27.VII.-14.VIII.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 3.

Mt Dayman, Maneau Range, N. Slope, M. Bay Dist., 700 m, 13-20.VII.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 6.

Peria Creek, Kwagira River, M. Bay Dist., 50 m, 14.VIII.-6.IX.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 7.

Waikaiuna, Normanby Isl., M. Bay Dist., 10-25.IV.1956-14.V.1956, L. J. Brass, Fifth Archb. Exp. nr 1.

Iamelele, Fergusson Isl., M. Bay Dist., about 15 m, 25.V.1956, L. J. Brass, Fifth Archb. Exp. nr 3.

Agamoia, Fergusson Isl., M. Bay Dist., 200 m, 18-24.VI.1956, L. J. Brass, Fifth Archb. Exp. nr 5.

Jinju, Rossel Isl., M. Bay Dist., 0-100 m, 20-29.X.1956, L. J. Brass, Fifth Archb. Exp. nr 14.

Kulumadau, Woodlark Isl., M. Bay Dist., 0-100 m, 7.XI.1956, L. J. Brass, Fifth Archb. Exp. nr 15.

Modewa, Modewa Bay, M. Bay Dist., 0-50 m, 10-23.XII.1956, L. J. Brass, Fifth Archb. Exp. nr 17.

Umi Rover, Markham Valley, Morobe Dist., 480 m, 20.XI.1959, L. J. Brass, Sixth Archb. Exp. nr 14.

Xyleborus Chimbui nov. sp.

Female testaceous, elytra ferrugineous, 2.0 mm long, 2.7 times as long as wide. Allied to *Xyleborus leprosulus* Schedl, but somewhat larger, the elytral declivity more obliquely convex, the apical margin finely carinate, slightly angulate near the suture, the elytral disc with the interstitial punctures partly replaced by blunt tubercles towards the declivity.

Front broadly convex, shining, sparsely and very finely punctured.

Pronotum longer than wide (42:37), widest in the middle, postero-lateral angles rectangular, sides slightly divergent on basal half, apex broadly rounded, a subapical constriction not visible; summit in the centre, anterior area obliquely convex and densely asperate, basal area shining, minutely chagrined pubescence very sparse, a few hairs on the anterior area. Scutellum submerged.

Elytra as wide and 1.4 times as long as the pronotum, base finely carinate, sides parallel on basal half, apex broadly rounded, declivity restricted to the distal third of the elytra, somewhat abruptly obliquely convex; disc shining and confusedly very finely punctured on basal fourth, followed by a shallow transverse impression with rather coarse sculpture, striate-punctate, the striate fine and only slightly impressed, the strial punctures small and partly indistinct, the interstices moderately wide, each one with a row of granules increasing in size but decreasing in numbers towards the declivity and abruptly disappearing on the oblique declivital face: declivital face between the tubercles, as far as not abraded, with short semi-erect hairs; declivity very densely irregularly punctured and with short pubescence, suture slightly raised; the transverse depression of the elytra and the tubercles on them very distinct when viewed from the sides.

Holotype in the American Museum of Natural History, one paratype in collection Schedl.

Type-Localities: Peria Creek, Kwagira River, M. Bay Dist., 50 m, 14.VIII-6.IX.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 7.

Arau, Kratke Mts., Valley of upper Wanton R., 1,400 m, Eastern Highlands Dist., 7-19.X. 1959, L. J. Brass, Sixth Archb. Exp. nr 11.

Xyleborus fuyugei nov. sp.

Female ferrugineous, 2.5 to 2.8 mm long, 2.7 times as long as wide. Allied to *Xyleborus subagnatus* Schedl but somewhat larger, the elytral declivity a little more oblique and the granules on the declivital face hardly noticeable.

Front convex, shining, rather finely punctured and with sparse pubescence.

Pronotum longer than wide (26:22), postero-lateral angles rectangular, distinctly rounded, sides parallel on basal third, apex rather broadly arcuate, a subapical constriction noticeable; summit in the centre, anterior area obliquely convex and finely asperate, basal area shining, densely and finely punctured, pubescence short and dense. Scutellum small, triangular and shining.

Elytra slightly wider (23:22) and 1.4 times as long as the pronotum, sides parallel on basal two fifths, thence very slightly narrowed, apex broadly rounded when seen from above, declivity restricted to the distal third of the elytra, obliquely rather abruptly convex; disc shining, with rather regular rows of small and shallow punctures, interstices moderately wide, partly with some transverse wrinkles and each with a more irregular row of punctures similar to those in the main striae but bearing short semi-erect hairs; declivital face flat, the strial punctures less regular, the interstices more confusedly punctured, one or two of the punctures on interstices one, three and five replaced by minute granules, some larger and more pointed ones along the apical margin increasing in size from the sides to the suture, the pubescence longer and more erect.

Holotype and four paratypes in the American Museum of Natural History and three paratypes in Collection Schedl.

Type-Localities: Abaleti, Rossel Isl., M. Bay Dist., 0-50 m, 1-9.X.1956, L. J. Brass, Fifth Archb. Exp. nr 12.

Mt Riu, Sudest Isl., M. Bay Dist., 250-350 m, 1.IX.1956, L. J. Brass, Fifth Archb. Exp. nr 10.

Xyleborus chimbui nov. sp.

Female testaceous, 1.64 to 1.72 mm long, 2.7 times as long as wide. More closely allied to *Xyleborus recidens* Samps. but distinctly smaller, the pronotum more slender and more narrowly rounded at the apex, the wide interstices on the elytral declivity smooth and brightly shining and the granules on the alternating interstices comparatively larger.

Front broadly convex, subshining, minutely punctulate, densely punctured, with a few moderately long hairs.

Pronotum longer than wide (35:29), postero-lateral angles rectangular, slightly rounded, sides subparallel on the basal fourth, thence gradually incurved, apex moderately broadly rounded, a subapical constriction hardly noticeable; summit in the centre, anterior area very obliquely convex, densely and finely asperate, basal area subshining, minutely punctulate, rather densely covered with shallow punctures, pubescence sparse and erect, more conspicuous along the sides and on the anterior area. Scutellum moderate in size, shining, polished.

Elytra only slightly wider (30:29) and 1.3 times as long as the pronotum, sides parallel on basal half, apex broadly rounded, declivity short, restricted to the distal third of the elytra, rather strongly convex as in *Xyleborus recidens* Samps.; disc shining, striate-punctate, the strial punctures relatively small and closely placed, the striae fine and rather shallow, interstices wide, each one with a median row of more irregularly placed punctures; declivity very shining, smooth, the strial punctures and striae largely reduced, interstices 1, 3 and 5 each with a row of well developed rather remotely placed setose granules.

Holotype in the American Museum of Natural History, one paratype in Collection Schedl.

Type-Locality: Abaleti, Rossel Isl., M. Bay Dist., 0-50 m, 1-9.X.1956, L. J. Brass, Fifth Archb. Exp. nr 12.

Xyleborus suaui nov. sp.

Female ferrugineous, 2.0 mm long, 2.9 times as long as wide. More closely allied to *Xyleborus judenkoi* Schedl, but a little larger, more slender, the declivity shorter, more oblique and without larger granules.

Front convex, shining, shallowly punctured, sparsely pubescent.

Pronotum distinctly longer than wide (44:35), postero-lateral angles rectangular and rounded, sides very slightly divergent on basal half, apex broadly rounded, subapical constriction hardly noticeable; summit a little before the centre, anterior area obliquely convex and densely asperate, basal area shining, very finely and rather remotely punctured, pubescence moderately long and erect, more conspicuous along the sides and on anterior area. Scutellum rather small, shining.

Elytra as wide and 1.3 times as long as the pronotum, sides parallel on basal half, thence very slightly narrowed, apex broadly rounded, declivity restricted to distal third of the elytra, obliquely convex; disc shining, with rows of very fine punctures, the interstices with similar punctures of less regular arrangement and bearing moderately long semi-erect hairs; declivity flattened near the suture, the punctation more confused, some of the punctures on interstices one, three and five replaced by minute granuls, somewhat larger granules rather closely placed along the apical margin of the elytra, the pubescence more conspicuous on the declivity than on the disc.

Holotype and one paratype in the American Museum of Natural History, two paratypes in Collection Schedl.

Type-Localities: Biniguni, Gwariu River, M. Bay Dist., 150 m, 27.VII.-14.VIII.1953; Peria Creek, Kwagira River, M. Bay Dist., 14.VIII.-6.IX.1953, both Geoffrey M. Tate, Third Archb. Exp. nr 3 and 7.

Xyleborus timidus nov. sp.

Female testaceous, 2.12 and 2.18 mm long, 2.4 times as long as wide. A new species of the *Xylebori sordicaudi* group easily recognized by the subquadrate pronotum and the long very oblique elytral declivity.

Front plano-convex, brightly shining, with rather small and remotely placed punctures bearing long fine setae.

Pronotum about as long as wide, postero-lateral angles of little more than ninety degrees, broadly rounded, sides somewhat divergent on basal third of the pronotum, apex very broadly arcuate, the antero-lateral angles rather distinct; disc shining, moderately convex from base to apex, very densely covered with medium sized asperites on anterior half, thence very finely asperate, indistinctly punctured on a narrow strip along the base, pubescence sparse, moderately long and erect, more conspicuous on anterior area and along the sides. Scutellum triangular, impunctate.

Elytra slightly wider (45:43) and 1.6 times as long as the pronotum, sides parallel on basal half, apex rather broadly somewhat angulately rounded, apical margin acute and finely serrate, declivity rather long and very obliquely convex, commencing after basal third of the elytra; disc minutely punctulate, with rows of medium sized flat partly submerged punctures interstices wide, each with a row of very fine more irregularly placed setose punctures (as far as not abraded); declivity subopaque, minutely punctulate, the main striae distinctly impressed and rather wide, the interstices slightly elevated in the middle, each one bearing a very regular row of very small closely placed granules giving rise to semi-erect fuscous hairs, apical margin with a small triangular tubercle in continuation of the third interstices.

Holotype in the American Museum of Natural History, one paratype in Collection Schedl.

Type-Localities: Peria Creek, Kwagira River, M. Bay Dist., 50 m, 14.VIII.-6.IX.1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 7.

Mt Riu, Sudest sl., M. Bay Dist., 250-350 m, 11.IX.1956, L. J. Brass, Fifth Archb. Exp. nr 10.

B. PLATYPODIDAE

Crossotarsus motui nov. sp.

Male ferrugineous, 6.9 mm long, 3.6 times as long as wide. Somewhat allied to *Crossotarsus cheesmani* Schedl but the elytral declivity more strongly convex, the postero-lateral proceses, shorter, stouter and more triangular in outline.

Front flat, subshining, minutely punctulate, remotely punctured, the punctures bearing rather long and fine setae, with a short impressed striga in the centre.

Pronotum slightly wider than long (22:20), femoral emarginations rather deep, angulate at the anterior extremity, disc silky shining, indistinctly punctulate, with a row of larger and setose punctures along the anterior margin, a very delicate short pubescence along the sides and on the postero-lateral angles, median sulcus very short.

Elytra slightly wider (24:22) and 2.7 times as long as the pronotum, sides parallel on basal half, somewhat narrowed in straight lines behind, apex rather wide and transverse, postero-lateral process triangular, inner side with a small secondary tooth; disc shining, with regular rows of fine punctures in very slightly impressed lines, interstices very wide, without distinct punctation; declivity short, measuring not more than the distal fourth of the elytra, gradually convex, the striae more distinctly impressed than on the disc, the interstices irregularly and finely punctured, each one with a median row of largely more regularly placed setose punctures.

Female of the same size and colour as the male, but the elytral declivity shorter, less convex, the postero-lateral processes reduced to short blunt projections.

Holotype and allotype in the American Museum of Natural History, a pair of paratypes in Collection Schedl.

Type-Locality: Pengagl, Camp east slopes Mt Wilhelm, Chimbu Dist., 2770 m, 9.VII.-4.IX.1959, L. J. Brass, Sixth Archb. Exp. nr 6.

Platypus acuticornis **nov. sp.**

Male piceous, very shining, 5.2 mm long, 3.8 times as long as wide. This remarkable new species provisionally might be placed in the *Platypi proceri* group together with *Platypus philippinensis* Bltndf. and *P. diversipennis* Schedl and is easily recognized by the very slender and pointed postero-lateral processes of the elytra.

Front flat, shallowly areolate-punctate, with sparse inclined pubescence, convex towards the vertex.

Pronotum as long as wide, femoral emarginations moderately deep, angulate at the posterior extremity, disc shining, remotely and very finely punctured, a series of larger setose punctures along the anterior margin, a cordiform patch of medium sized and closely placed punctures around the median sulcus.

Elytra distinctly wider (34:31) and 2.6 times as long as the pronotum, sides subparallel on the basal half, gradually incurved behind, apex with very long and slender postero-lateral processes, between which is a deep u-shaped emargination, the side margin before the base of the processes finely dentate; disc shining, with regular rows of fine punctures in somewhat impressed lines, interstices wide and nearly impunctate, declivity very short, restricted to the distal fourth of the elytra, slightly convex, the strial punctures slightly larger, the striae more distinctly impressed, the interstices each with a row of moderately long inclined hairs.

Holotype in the American Museum of Natural History.

Type-Locality: Mt Dayman, Maneau Range, M. Bay Dist., 1,550 m, N. Slope, 30.VI.-13. VII. 1953, Geoffrey M. Tate, Fourth Archb. Exp. nr 5.

Platypus obliquesectus **nov. sp.**

Male: Ferrugineous, elytra towards the declivity darker, 6.0 mm long, 3.1 times as long as wide. This is a new species of the *Platypi truncatipenni* group, easily recognized by the shape of the elytral declivity.

Front flat, subshining, minutely punctulate, indistinctly punctured, convex towards the vertex.

Pronotum as long as wide, femoral emarginations deep, with an acute angle at the posterior extremity, disc shining, indistinctly very finely punctured, a series of larger setose punctures along the anterior margin, median sulcus rather long and fine.

Elytra distinctly wider (24:21) and 2.1 times as long as the pronotum, widest at the commencement of the declivity, sides straight and somewhat divergent from base to apex, apical margin very short, broadly rounded, transverse near the suture, disc shining, horizontal, nearly impunctate near the base, with gradually impressed rather wide but impunctate opaque striae towards the abruptly truncate declivity, the interstices wide, transversely terminating behind, each bearing a broad horizontal brush of fuscous hairs; declivital face opaque, circular in outline, slightly convex from base to apex, sides with margins acutely elevated all around, very densely finely granulate-punctate.

Holotype in the American Museum of Natural History.

Type-Locality: Pengagl, Camp east Mt Wilhelm, Chimbu Dist., 2,770 m, 2.IX.1959, L. J. Brass, Sixth Archb. Exp. nr 6.

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