QUEENSLAND.

BUREAU OF SUGAR EXPERIMENT STATIONS.

DIVISION OF ENTOMOLOGY.
BULLETIN No. 11.

An Account of a New Moth Borer of Sugar Cane (Family Tineidae);

Together with

Further Notes on the Pyralid Moth Borer of Cane (Polyocha sp.).

BY

EDMUND JARVIS,

Assistant Entomologist.

1921.

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Bureau of Sugar Experiment Stations,
Brisbane, 1st February, 1921.

The Under Secretary,
Department of Agriculture and Stock,
Brisbane.

SIR,—I have the honour to submit for publication as Bulletin No. 11 of the Division of Entomology of the Bureau of Sugar Experiment Stations "An Account of New Moth Borer of Sugar Cane (Family Tineidæ): Together with Further Notes on the Pyralid Moth-Borer of Cane (Polyocha sp.)," by Mr. Edmund Jarvis.

I have, &c.,

HARRY T. EASTERBY,

General Superintendent.

Approved:
E. G. E. SCRIVEN,
Under Secretary.

An Account of a New Moth Borer of Sugar Cane (Family Tineidae); together with Further Notes on the Pyralid Moth Borer of Cane (Polyocha sp.).

PREFATORY NOTE.

During 1919, while studying the economy of our *Noctuid* Moth-Borer of cane (*Phragmatiphila truncata Walk.*) quite a number of young ratoons were observed by the writer to be infested by larvæ of a lepidopteron not hitherto recorded as being injurious to sugar-cane.

Although the smallest of our three moth-borers, this new species happens to be of decided economic interest, so has been rather fully illustrated and described in the present Bulletin.

Unfortunately, the genus to which it belongs has not yet been determined, as the insect proved to be new to our finest named collections of Australian lepidoptera.

Many specimens of our second moth-borer (*Polyocha sp.*) were at the same time found associated with it, thus affording an opportunity for noting, as far as possible, the range of occurrence and precise economic position of this destructive Pyralid moth, and illustrating its life-history, the only previous record of which was published in Bulletin No. 3 of this Office.*

The writer has avoided exhaustive technical descriptions of life-cycle stages, wishing merely to record and describe these moth-borers in a manner that, together with the illustrations given, will enable readers to identify them without difficulty.

Quite possibly much of the damage to sugar-cane attributed as a matter of course to the action of root-eating beetle grubs may, in reality, be the work of insects thought to be of minor importance, the presence of which has in the past been altogether ignored.

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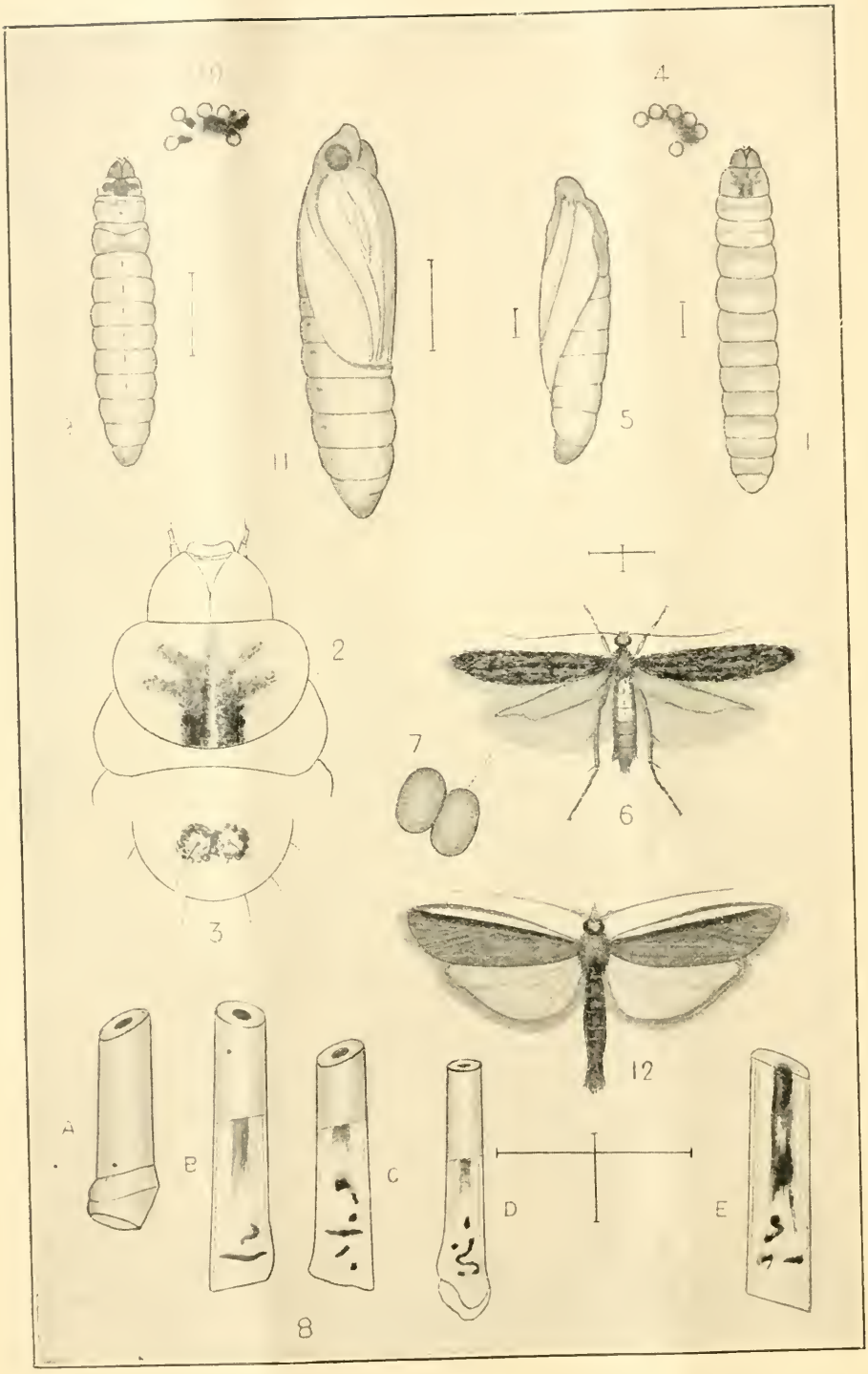
* Queensland Bureau Sugar Experiment Stations, Div. Ent. Bull. No. 3, p. 10, 1916.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EXPLANATION OF PLATE.

(All Drawings Original.)

Fig. 1.—Larva of *Tineid Moth-Borer* (magnified ten times).

Fig. 2.—Diagrammatic dorsal view of prothoracic segment of same (highly magnified).

Fig. 3.—Diagrammatic dorsal view of end of anal segment of same (highly magnified).

Fig. 4.—Arrangement of stemmata on head of same (much enlarged).

Fig. 5.—Pupa of same (magnified ten times).

Fig. 6.—*Tineid Moth-Borer* (magnified six times).

Fig. 7.—Eggs of same (greatly enlarged).

Fig. 8.—A to E—Basal portions of ratoons attacked by same (natural size) A, B—External view, showing "pinholes," etc. C, D, E—Basal sections, indicating nature of internal injuries.

Fig. 9.—Larva of *Polyocha sp.* (magnified).

Fig. 10.—Arrangement of stemmata on head of same (highly magnified).

Fig. 11.—Pupa of same (magnified).

Fig. 12.—Moth of *Polyocha sp.* (twice natural size).

TINEID MOTH-BORER. (Family TINEIDÆ).

Introduction.

With view to roughly estimating the percentage of shoots destroyed by this new cane-borer, one hundred "dead-hearts" were collected at random early in November on a plantation at Meringa from shoots of first ratoons covering an area of four chains, which, upon being sectioned and carefully examined, yielded the following interesting data :—

9	ratoons contained larvæ of *Tineid* moth.
32	ratoons killed by larvæ of *Tineid* moth.
6	ratoons contained larvæ of *Polyocha sp.*
11	ratoons probably killed by larvæ of *Polyocha sp.*
10	ratoons probably killed by larvæ of *P. truncata.*
24	ratoons killed by moth-borers other than the *Tineid.*
8	ratoons. Death due to mechanical injuries, and malformation of internal tissues.
100	

A month later (5th December, 1919) ratoons affected by larvæ of this little borer were observed on a plantation at Kamma ; and again at Gordonvale (20th December), so that in all probability the species will eventually prove to be widely distributed.

It evidently attacks the crop at a very early stage of plant-growth, nearly all the injured shoots collected having been destroyed before attaining a height of 9 inches (stem length).

A very decided infestation was noticed on 13th December at Meringa in a fourth locality. The cane on this block, which had been burnt and harvested during November, had ratooned freely in spite of drought conditions, and three weeks after cutting the young shoots averaged a foot in height. Owing to dry weather the burn had been an exceptionally clean one, and yet in less than a month fully 20 per cent. of the stools were affected by this Tineid, many having lost from two to five suckers. An examination of seventy-five shoots—about 10 per cent. of those destroyed—on a space of about 100 feet square, gave the following conclusive evidence :—

20	ratoons contained larvæ of *Tineid* moth.
35	ratoons killed by larvæ of *Tineid* moth.
2	ratoons contained larvæ of *Polyocha sp.*
3	ratoons killed by larvæ of *Polyocha sp.*
5	ratoons killed by borers other than this *Tineid.*
10	ratoons. Death due to various mechanical injuries.
Total 75	

On 30th December another plantation at Kamma was found to be rather badly attacked; and finally, on 5th January, a very decided infestation was observed at Pyramid on a selection near the Mulgrave River, the soil being a medium clay-loam of a yellowish-brown colour.

The cane on the latter selection was cut 13th December, and averaged about 20 tons to the acre. By 5th January, 1920, the ratoons ("Badila") were over a foot high, and in many cases from five to ten in a single stool had been destroyed by this borer, twenty to a stool being the highest loss recorded (see table on page 14). Four "dead-hearts" out of eight obtained from one stool contained larvæ, while from one hundred "dead-hearts," a portion only of those occurring on about a square chain, I secured no less than thirty-seven larvæ of the *Tineid*, and five of *Polyocha sp.*

In view of the foregoing evidence we cannot, I think, do otherwise than include the former species amongst our more serious insect pests of sugar-cane.

Apparently plant cane is very seldom attacked by it, whereas the entire area of a field under ratoons may be more or less affected by this moth-borer.

Upon revisiting the patch of three-weeks-old first ratoons, discovered at Meringa on 13th December to be badly infested, I found that during an interval of thirty-nine days the cane as a whole had made good growth, heavy rains having proved beneficial. It was noticeable, however, that over rather extensive patches, where this borer had previously been much in evidence, many stools were undersized and carried only from two to five canes, which, although in the first instance presumably weakly and of late growth, had apparently forged ahead after the destruction of earlier suckers.

Nature of Injury.

Outwardly, the damage to young ratoons corresponds in general appearance with that caused by our common *Noctuid* moth-borer, *Phragmatiphila truncata Walk.*, the destruction of the central or heart-leaves being a conspicuous and certain indication of internal trouble.

Upon removing the few short basal leaves surrounding the bottom of an affected ratoon one or more tiny pinholes in the side, near or under the ground, are usually discernable, and if the shoot be pared away with a sharp knife at this spot a narrow section of its internal basal portion is seen to have been devoured transversely across the stem at one or more places in such manner as to completely sever the central core. The vascular tissue immediately above the seat of this injury soon reddens and gradually decays upwards throughout the length of the ratoon, while the heart-leaves, deprived of their normal supply of moisture, quickly wither and turn light yellowish-brown. In some instances the

sides of stems were found to be spirally ringbarked, as it were, near the ground; no sign of such tunnelling, however, being noticed until the lower leaf-sheaths had been removed.

After destroying the heart leaves in this manner the larva proceeds either to tunnel in a downward direction or travel upwards, in the latter case consuming first the dying vascular tissue, and then often boring erratically around the side of the shoot among the softer portions.

Unlike *Polyocha*, the caterpillars of this pest never feed upon or inhabit the central rotting core, often, indeed, vacating a shoot after having devoured the juicy basal part, and entering another.

Shoots affording a good illustration of the invasion of injuries below ground by the common red rot disease (*Colletotrichum falcatum*) were occasionally met with; the presence of the fungus in such cases having apparently proved distasteful to the larvæ and induced them to decamp prematurely.

Description of Egg.

Elongate-oval (Fig. 7); pale greenish-yellow, beautifully shot with iridescent blue and gold-pink; surface, when highly magnified, slightly roughened.

The eggs of this species, which, although very minute (about 0·70 by 0·40 mm.) are just visible to the naked eye, were found attached to the cane stalk close to a node but not quite hidden by the leaf-sheath, two being placed side by side touching, and a third slightly separated from them. Having been deposited by a caged female, however, the above data respecting number and position cannot be taken as indicative of the habits of this insect in the field. Males were confined in the same cage, and copulation evidently took place, since larvæ were hatched from these eggs in due course.

Description of Larva.

Pale, creamy-yellow, broadly banded transversely on dorsal area of eleven body segments with a greyish-pink suffusion, the bands (where magnified) consisting of innumerable minute ring-like dots. Occasional specimens, just before pupation, are dark-reddish. First thoracic segment with two very irregular somewhat triangular or Y-shaped brown blotches, usually blackish posteriorly, but sometimes wholly black, and composed of granular markings. (Fig. 2.) Head light yellowish-brown, partly concealed in first body segment; mandibles and outlining of eyes reddish; ocelli six, grouped as in Fig. 4, four of them more or less obscured by an irregular black suffused blotch. Anal segment with two centro-dorsal white, slightly tuberculate spots surrounded by a dark brown ring of granular markings (Fig. 3). Body sub-cylindrical, obtusely pointed at each end. Length about 5 mm. (Fig. 1).

Habits of the Larva.

Upon cutting open an affected stem and exposing the tunnelling, the larva, instead of seeking to retire into darkened recesses, usually crawls out towards the light and commences to actively traverse the exterior surfaces. If placed with its head in the tunnel at this time it refuses to take cover, even when urged to do so. A specimen put into a glass tube containing the stem bored by it disregarded the latter, and crawling with ease up the vertical glass sides burrowed at once into the firm plug of cotton-wool. Upon substituting a cork for the wool stopper it managed to squeeze under its lower edge, and when looked at a few hours later had started to construct a cocoon of webbing covered by tiny grains of cork.

The Pupa.

Somewhat boat-shaped, pale ochraceous, darker on dorsal surface; body segments 3 to 6 with a more or less interrupted mid-dorsal brown stripe. Legs, antennæ, head, etc., outlined in reddish. Wings reaching beyond fifth abdominal segment, tips of same and end of anal-segment reddish-brown, the latter tipped with a few short white hook-shaped hairs. Length 4·30 mm.; width (side view) 1 mm. (Fig. 5).

The pupa is concealed in a frail cocoon of silk covered by excreta or fragments of fine debris.

A larva that pupated 11th November produced a moth of the female sex fifteen days later; while another remained only ten days in the pupal condition, the imago emerging on 25th December, 1919.

Again, several larvæ that pupated 10th January produced moths seven days later.

All pupæ obtained were from larvæ in captivity that had come out of shoots and transformed in crevices of breeding-cages, etc. Pupation does not take place in the tunnels of affected ratoons, as although more than 200 were carefully examined no pupæ were found. We may, I think, infer that when fully grown, the larvæ leave the cane and pupate either in crevices of dead twisted leaves or on the ground. Specimens confined in cages containing damp earth pupated under debris lying on the surface; constructing their cocoons partly in the ground and covering them with tiny particles of soil. Larvæ that transformed in such situations remained about a week in the pupal condition. When confined in cages with dead cane leaves resting on soil covered in part with debris they pupated among the twisted leaves.

Description of Moth.

Female.

General colour dark-grey sprinkled with white. Eyes deep-red-brown; palpi conspicuous, curved upwards over face to top of head; first joint large, broadly triangulate, its lower edge presenting a toothed appearance, remaining joints much smaller, banded with white, the

terminal one pointed. Antennæ dark-grey, reaching hind margin of fourth abdominal segment. Abdomen silvery-grey with faint pink and green iridescence; mid-dorsal areas of segments 1 to 3 with a large suffused yellow blotch; ventral surface of thorax metallic silver in certain lights. Fore-wings pale grey, dotted with dark-grey scales and striped longitudinally with several dull ochraceous more-or-less-interrupted narrow bands extending to ends of wings; central area with three blackish spots placed in form of triangle, two being about parallel with lower margin of wing. Hind wings light grey, fringe of hind margin more than twice width of wing. Legs rather long, grey dusted with whitish; outer surfaces of front femora and tibiæ, inner surfaces of intermediate tibiæ, outer surfaces of hind femora and inner of hind tibiæ, centre of first hind tarsal joint and distal ends of all tarsi covered with silvery-yellow scales; distal ends of intermediate tibiæ with two spurs, hind tibiæ with two central and two apical spurs. Length 4 mm.; wing expanse 10 mm. (Fig. 6.)

Male.

Resembles the female, but the fore-wings are either entirely grey dotted with black, or have a single dull ochraceous stripe; upper and hind edges of lower wings about parallel, the extremity of the former, as in the opposite sex, acutely pointed, projecting considerably beyond outer border of wing; first antennal joint largest, about as long as the three succeeding joints. Length of body 3 mm.; wing expanse 7·50 mm.

PYRALID MOTH-BORER (*Polyocha sp.* Family *Pyralidæ*).

Introduction.

Although probably a minor pest of sugar-cane it is interesting to find, as a result of observations made during November, 1919, that the insect in question must be considered as responsible at times for injuries of a rather serious nature to ratoons, extending in all probability over a considerable area, but fortunately, so far as observed, affecting only a small percentage of the young crop.

As already indicated on page 6, fully 17 per cent. out of one hundred "dead-hearts" obtained from a plantation at Meringa during November. 1919, were considered by the writer to be the work of this moth-borer, six canes out of those examined being found to contain larval specimens.

A year later (18th November, 1920), the writer collected from within an area of one square chain 44 "dead-hearts" from ratoons 18 inches high, in a cane field at Pyramid, which, when examined, yielded no less than 33 larvæ of Polyocha *sp.* The remaining 11 ratoons were deserted, but, with the exception of two destroyed by mechanical injuries, showed unmistakable evidence of moth-borer attack.

Nature of Injury.

The damage inflicted by this pyrale happens to be similar in external appearance with that caused by the *noctuid* moth-borer *P. truncata Walk.*; a circumstance that may account for the occurrence of the former and of the *Tineid* in our canefields having been overlooked in the past.

Its larvæ, unlike those of the other two moth-borers, seldom attack the woody basal portion of shoots, preferring to tunnel higher up in softer parts of the stem. They rarely eat holes in the sides above the point of invasion, although frequently gnawing the internal tissue lying immediately beneath the outer sheathing.

A single irregular hole at the bottom of affected ratoons, but of larger diameter than that made by the *Tineid* borer, generally denotes the presence of this *pyralid* moth.

Many of the larvæ collected were found tightly packed in the central decaying core, in such manner as would lead one to infer that this species requires very little air during its larval condition.

Up to the present, infestations of *Polyocha* have been noticed by the writer on a plantation at Pyramid, near Cairns, 1915; in two localities at Meringa; and another at Pyramid during 1919-20.

Description of Larva. (Fig. 9.)

Light bluish-green, usually but not invariably suffused with pink. Thoracic segments pale sea-green with a few small irregular pink markings; the first segment with a shining black plate bordered anteriorly by yellowish-green; second segment with a centro-dorsal square greenish-brown blotch, clouded centrally with darker, and sometimes adjoining prothoracic plate. Pulsating line interrupted, dark-brown, conspicuous, margined on each segment by a sub-dorsal irregular greenish-white patch. Dorsal surface of abdomen pink; a row of triangular blotches on sides between spiracles and claspers, and numerous sub-dorsal suffused blotches greenish-white. Ventral area green suffused with pink. Head reddish-yellow, mouth parts blackish, ocelli, six in number, partly suffused with black blotches (Fig. 10). Body tapering abruptly towards either extremity; each segment bearing about 10 scattered long white hairs. Legs pale-green or yellow. Length, about 11 mm. (nearly half-an-inch).

A few hours before pupation the colour fades, the larva becoming whitish instead of bluish-green, with abdominal blotches pale-blue, the prothoracic plate light yellowish-green, and the head very pale yellow. Some specimens become dark reddish in colour.

Behaviour of the Larva.

The caterpillar of this species, unlike that of the preceding, is negatively photo-tropic; that is, when exposed to view, it invariably tries to avoid the light by crawling, if possible, into the darkest portion of its tunnel.

Description of the Pupa. (Fig. 11.)

Yellowish-brown ; head-end, spiracles, and hind margins of abdominal segments 5 to 7, below ends of elytra, reddish ; upper half of abdominal segments punctulate, the punctures brown, somewhat scattered. Head, thorax, etc., more or less roughly striate, the former produced into a short obtuse point. Anal segment terminating in a shining reddish knob, without hooks or spines, from which runs a broken centro-ventral black line, grooved posteriorly. Length 15 mm. ; greatest width 3·50 mm.

Pupation takes place inside the cane shoot, the pupa occupying a vertical position with head pointing upwards.

When fully grown the caterpillar eats a hole through the side of the cane, and after lining part of its tunnel and the mouth of this hole with silk pupates about an inch below the opening, among rotting fibres, debris, etc. Upon removing the outer sheathing of a shoot containing a pupa this exit mouth of the tunnel, composed of webbing stiffened with pellets of excreta, often protrudes slightly, funnel-wise, from the surface.

The pupal stage occupies from twenty to twenty-six days, a larva that transformed at Gordonvale 22nd November producing the imago on 12th December, 1915 ; while other larvæ obtained at Meringa 8th November, 1919, pupated five or six days later, the moths emerging on 9th December (24 days). Finally, additional specimens that pupated 8th January, 1920, emerged on the 16th (8 days later).

Description of Moth.

Female. (Fig. 12.)

Fore-wings light pinkish-yellow with a broad brown-pink sub-costal band ; fringe composed of three rows of silvery spatulate scales. Outer area crossed longitudinally by sixteen sub-parallel pink lines, extending to outer edge of wing. Hind wings pale silvery-yellow suffused with grey on apical portion and border of outer margin ; fringe with a basal band of dark-grey just outside edge of wing. Beneath :—Fore-wings yellow, clouded with pink on outer and grey on central areas respectively. Patagia large, pale yellow. Head nearly width of thorax ; eyes black ; vertex concave, formed of two flat tufts of silvery-pink scales edged with yellowish. Antennæ pale ochraceous, first joint large oblong-ovoid, concave above, a shell-like tuft of white scales arising from second joint ; palpi brown, porrected in living specimens, but sometimes covering lower part of face after death. Abdomen brownish-black above, banded with silvery-yellow lines ; dorsum of segments 1 to 3, ochraceous ; anal segment tufted with long yellowish-pink scales. Ventral surface and legs brownish-pink ; centre and distal end of hind tibia armed with two spurs of unequal length, the outer edge densely fringed with long yellow hairs ; intermediate tibiæ with two distal spurs. Wing expanse 31 mm. (about 1¼ inches) ; length of body 15 mm.

Natural Enemies.

(1) *Hymenopterous Parasite.* (*Braconidae sp.*).

Cocoons of this wasp were found on several occasions (December, 1919; February and December, 1920) in the tunnels in suckers destroyed by larvæ of Polyocha. From one of these white elongate-oval silken cocoons about a quarter-of an-inch long a parasite emerged on 8th February and may be briefly described as follows :—

Male.—Reddish-yellow, sides and venter of abdomen cream colour; eyes, a patch on vertex enclosing ocelli, antennæ, a small spot at root of wing, and ends of intermediate and posterior tarsi, black; mandibles prominent, reddish-brown; wings pale yellow, a transverse central band and whole of upper half of fore and hind wings dusky grey, membrane tinted with iridescent green, pink, and gold; wing expanse 6 mm.; length of body 4·10 mm.; length, including antennæ, 8·25 mm.

(2) *Predaceous Larva of Elaterid Beetle.* (*Agrypnus sp.?*).

A larva of this "skip-jack" beetle was found 30th January, 1920, feeding upon a larva of Polyocha, having evidently entered its tunnel through the hole at the base of the sucker. The caterpillar was dead, and had probably been sucked, its body being much shrunken.

NOTES ON INFESTATION AND CONTROL.

The severest infestations of the *Tineid* borer apparently occur among third ratoons, many of which spring from buds situated above ground level, the trouble being less noticeable in the case of first ratoons that arise mostly from buried eyes; while the shoots from plant cane originating well under the soil are rarely attacked.

Now, it is a well known fact that a stool when ratooning produces more suckers than are able to mature, the final number of canes harvested depending on the width between the rows and plants, fertility of the soil, and other factors.

Assuming that fully 50 per cent. of shoots in a stool perish naturally during the struggle for existence, it may be reasoned that those killed by small moth-borers merely represent a proportion of such percentage, and would have died in any case.

This argument may, I think, be considered as applicable to a large number of the thin weakly ratoons attacked by the above moth, but, on the other hand, numerous shoots invaded by this pest, and more abundantly by *Polyocha*, being robust and of vigorous growth, might, if left alone, have produced mature canes.

The following table gives an idea of the degree of infestation mentioned as having been noticed at Pyramid. The cane examined was selected from three different spots on the plantation, two examples (1 to 8 and 9 to 16) consisting each of eight, and the third (17 to 20) of four stools, which in all instances were taken consecutively. The land was clay loam river-flat, and the crop planted 5 feet in the rows and 1 foot 10 inches between the sets.*

NUMBER, CONDITION OF GROWTH, AND DEGREE OF INFESTATION OF 20 STOOLS OF "BADILA" THIRD RATOONS (ABOUT TWENTY-FOUR DAYS OLD).

Number of Stools.	Total Number of Ratoons in Ten Stools.	Number of Robust Shoots about 18 in. high.	Number of Ratoons killed by Moth-borers.	Number of Stools.	Total Number of Ratoons in Ten Stools.	Number of Robust Shoots about 18 in. high.	Number of Ratoons killed by Moth-borers.
1	36	7	20	11	18	9	1
2	32	9	9	12	33	10	7
3	13	2	11	13	20	9	6
4	27	8	12	14	22	8	3
5	27	8	5	15	32	12	9
6	36	9	16	16	25	8	2
7	11	4	2	17	51	13	19
8	8	4	3	18	20	4	13
9	30	12	15	19	28	5	10
10	22	8	8	20	12	4	3
	242	71	101	..	261	82	73
	..	..	..	..	242	71	101
Totals for 20 stools			..	..	503	153	174

It will be seen by the above that about one-third of the shoots in each stool examined had been destroyed by moth-borers, during a period of less than four weeks' growth. In short, these figures point to the probability of more than half of our assumed natural loss of 50 per cent. of suckers in a ratoon crop being brought about for the most part by this Tineid moth-pest. Presuming the average damage to such infested ratoon crops (including first, second, and third year suckers) to be 50 per cent. *less* than that shown in the above table, viz., 4 suckers per stool instead of 8—the infestation would then work out at about 11,000 to the acre, out of which we may reasonably suppose at least 10 per cent. to consist of robust ratoons, representing what might have been 1,100 mature sticks.

In the absence of more extended investigation in various districts, embracing our first to third ratoon crops during at least six months' growth, the preceding remarks, although largely of a provisional character, may yet be of some interest to cane-growers.

* This plantation was ploughed out a few weeks later, and the land replanted.

Control.

By adopting remedial measures against these moth-borers would it be possible to secure heavier ratoon crops in certain localities ? The question presents rather a nice point for investigation, although at present the writer is not in a position to advance definite recommendations in this connection.

River flats liable to flooding seem to suffer more than high land, owing, perhaps, to a comparative scarcity in some such situations of small predaceous insect enemies. The severity of the infestation at Pyramid, tabulated above, may serve to illustrate this point, as during a rather prolonged examination of these affected ratoons I did not once meet with a single specimen of *Pheidole megacephala*, although this voracious ant usually occurs freely in lands of volcanic origin around Gordonvale, where it does useful work in subduing certain cane pests.*

The practice adopted some years ago in parts of America of "shaving" cane stools directly after harvesting a crop in order to remove damaged buds situated above ground and force out the lower eyes, might be found beneficial in the present instance, since it would materially reduce the percentage of suckers springing from buds exposed to direct sunlight.

* See Queensland Bureau Sugar Experiment Stations, Div. Ent. Bull. No.3, p. 7, 1916.

By Authority: Anthony James Cumming, Government Printer, Brisbane.