

Serial Number.	Soil description.	Carbon. %	CaCO <sub>3</sub> %	Remarks.
<b>Dryland Soils.</b>				
1	Coimbatore, Central Farm. (New Permanent Manurials) Cattle manure plots.	0.74, 0.74	2.27	Pale red soil.
2	Do. No manure plots.	0.59, 0.59	2.75	"
3	Hagari (Bellary district) Soil Moisture Plots. 1st foot	0.53, 0.52	5.95	Heavy black soil.
	" 2nd "	0.52, 0.54	6.55	"
	" 3rd "	0.50, 0.50	6.84	"
	" 4th "	0.52, 0.52	7.34	"
	" 5th "	0.59, 0.58	8.27	"
	" 6th "	0.49, 0.46	8.59	"
4	Koilkuntla (Kurnool district).	0.53, 0.51	3.32	Black soil.
5	Palakkuppam.	0.35, 0.35	0.39	Red loamy soil.
<b>Wet Land Paddy Soils.</b>				
6	Coimbatore, Central Farm. Green manure plot.	0.74, 0.74	0.41	Puddled with green manure. Heavy soil.
7	Vedapatty, Paddy Breeding Station, Coimbatore.	0.73, 0.73	0.93	"
<b>Estate Soils.</b>				
8	Upper Parlai Estate, Valparai.	2.66, 2.69	0.32	Pale red soil.
9	Arnakal Estate.	2.00, 1.96	0.14	"

This work was done in the Chemistry Section of the Agricultural Research Institute, Coimbatore and the author expresses his thanks to the Govt. Agricultural Chemist for facilities offered.

### References.

- (1) Soil Science, 30. 97.
- (2) " 24. 65.
- " 31, 483.
- " 29, 239.
- (3) Journal of Agricultural Science. 19, 315.
- (4) Pregl. Quantitative Organic Micro-analysis. (translated by Fyfe).
- (5) Journal of the Chemical Society. 1927, 3161.

## SUGARCANE INSECTS AND PROBLEMS CONNECTED WITH THEM IN SOUTH INDIA\*.

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**Introduction.** In the Madras Presidency, sugarcane is cultivated in all the important agricultural tracts, and at present, the area under this crop occupies somewhere about 126,000 acres.

The latest available crop statistics show the following distribution of cane area in the Presidency.—N. Circars 48,750 acres; Central districts 44,500; Carnatic including Nellore, Chingleput and S. Arcot 12,850; the Ceded Districts 11,700; the Southern districts 3,800; West Coast and Hills 3,620. For the whole of India the area under cane during 1931—32 has been noted to be 2,886,000 acres; over 50% of the sugar products is from the U. P.

\* Note prepared as a member of the Committee for preparing a Sugarcane Pests Research Scheme, which met at Simla on 7th August 1933.

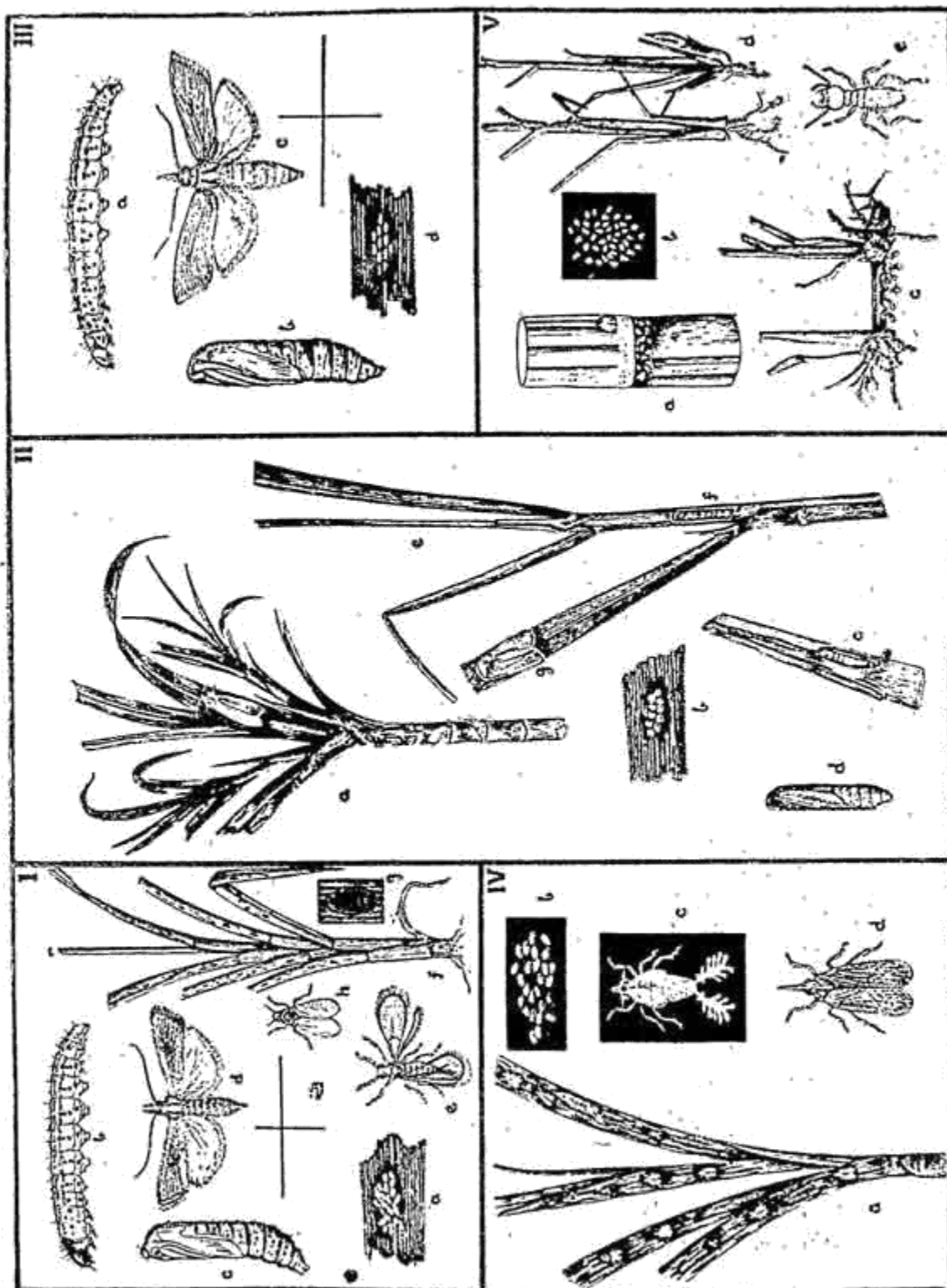
Of this total area, over two thirds of the acreage is confined to the Northern Circars including the Ganjam, Vizagapatam, Godavari and Kistna Districts and the central tract including the districts of Chittoor, North Arcot, Salem, Coimbatore and Trichinopoly. As a result of the recent inducements to develop the Sugar industry in the shape of tariff protection, and the opening up of several irrigation projects in the different provinces, there are indications to show that the existing area under sugarcane is sure to increase considerably during the coming years, and that the problems connected with this industry are sure to assume more and more prominence in the near future. And of the various such problems, those connected with the animal and vegetable parasites which levy their toll on this important crop, are no less important. According to Fletcher, the damage done by cane borers alone is roughly estimated at 30 million rupees a year. Though this estimate may not be quite accurate, it gives us some idea of the loss by pest infestation, and reminds us of the fact that this aspect of the sugar industry is well worth a thorough investigation at the hands of scientific men and sugarcane cultivators. This note is prepared with the idea of presenting in a brief manner the present position regarding sugarcane insects in S. India, their comparative economic importance, and the chief problems connected with them which the sugar planter has to deal with. As far as possible, scientific details and technicalities have been avoided.

**Sugarcane pests in S. India.** Though the area under cane in S. India is far less than in some of the Northern Provinces and the damage caused to the sugarcane crop by insect and other pests is not so pronounced as in the case of crops like paddy or cotton; sugarcane often suffers at the hands of such pests and diseases, and appreciable damage and loss are caused thereby. To the sugarcane farmer who is anxious to grow a good crop and reap a decent harvest of vigorous, vermin-free and healthy canes, a knowledge of the nature and habits of the more important pests, and some familiarity with the possible control measures against them, will always be of very great help. And now that the area under sugarcane is increasing rapidly, information in this direction might be of great use and very much appreciated. With regard to cane insects with which only this note deals, though a dozen or more insects have been found associated with the sugarcane plant in the different tracts of this province\*, not more than three or four could at present be put down as forms which might be considered as serious major pests; the others are ordinarily of minor importance and become serious only very rarely, causing sporadic local infestations.

**The Major Pests.** The most important pests of sugarcane in S. India which may be ranked as the foremost and which generally

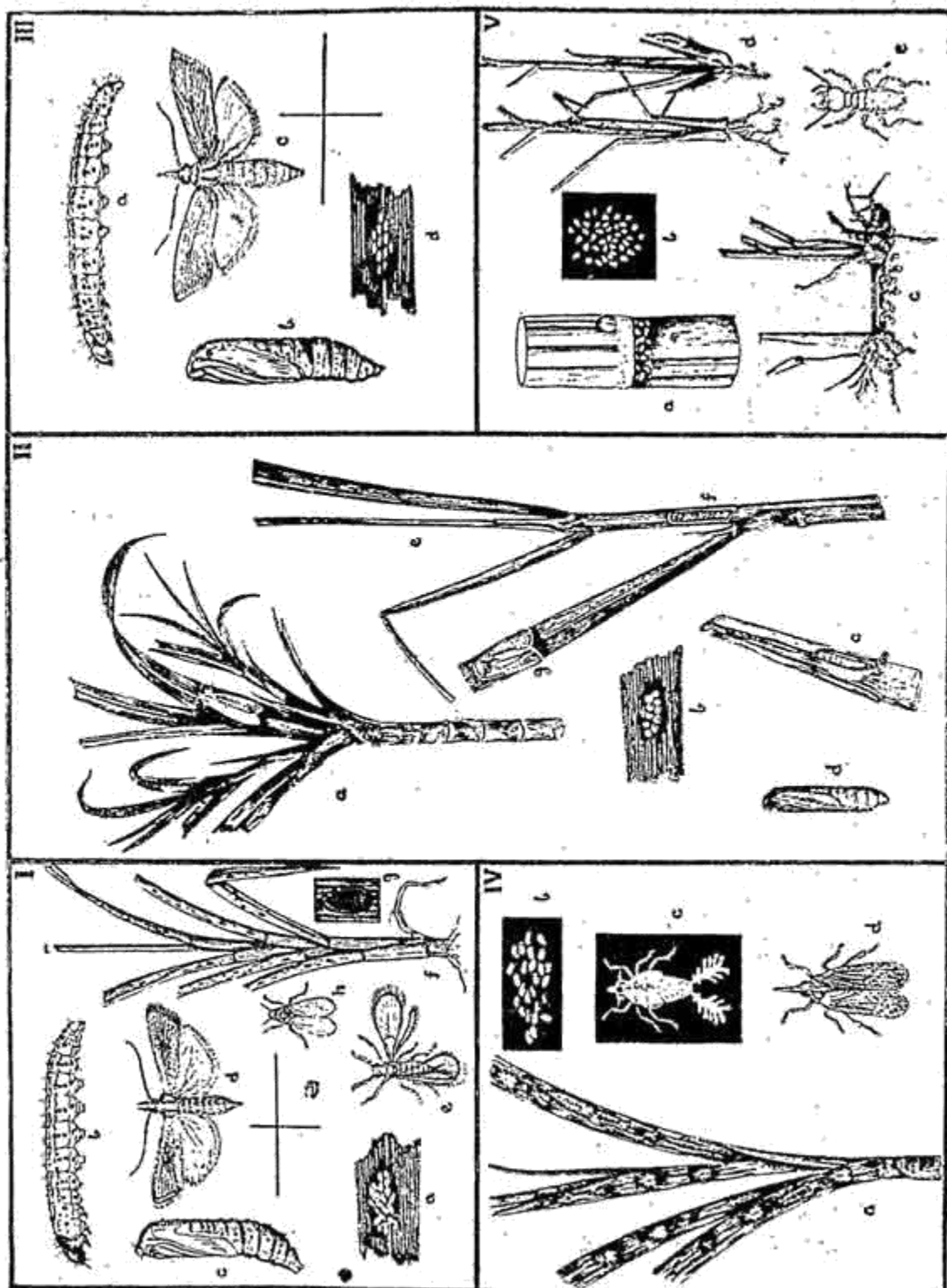
\* *Vide* author's bulletin on List of S. Indian crop pests—Madras Department Bulletin No. 27 (1932).

# SUGARCANE INSECTS OF S. INDIA



- I. (a) Eggmass of *Argyria sticticae*pis.  
 (b) Larva of Do.  
 (c) Pupa of Do.  
 (d) Moth of Do.  
 (e) *Trichogramma minutum*, R. (egg parasite).  
 (f) Cane showing central shoot drying and leaves infested with mealy wing.  
 (g) Puparium of mealy wing.  
 (h) Adult mealy wing.
- II. (a) Cane shoot showing attack by white top shoot borer with moth on it.  
 (b) Egg group of white borer (*Scirphophaga*).  
 (c) Pupa of Do in stem.  
 (d) Pupa enlarged.  
 (e) Plant showing attack by pink borer (*Sesamia inferens*) with larva in stem.  
 (f) Moth on plant.
- III. (a) Larva of *Diatroea venosata*.  
 (b) Pupa of Do.  
 (c) Moth of Do.  
 (d) Eggs of Do.
- IV. (a) Plants showing *Pyrilla* infestation.  
 (b) Eggs of Do.  
 (c) Nymphs of Do.  
 (d) Adult bug.
- V. (a) Cane showing mealy bugs on node.  
 (b) Young larvae of mealy bugs.  
 (c) & (d) Termite attack on setts and plants.  
 (e) Termite enlarged.

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cause appreciable damage are the Moth borers and Termites, and it is only in connection with these two sets of pests that the Entomologist very commonly receives complaints and reports. As next in importance to them, we may include the two or three sucking insects which occasionally appear as pests, viz., the cane mealy bug, the mealy wing and the leaf hopper.

**The Moth Borers**— Of the insects associated with sugarcane, the borers of one or other species are very ancient and well-known pests of this crop, being found in almost all the sugarcane areas of the world; and unlike other insects which have often a local or restricted distribution, the moth borers are very cosmopolitan and practically perennial pests of the crop: the only point to be noted is, that the species in different countries are not the same. The species chiefly concerned in the West Indies, Louisiana, Mexico and British Guiana is *Diatroea saccharalis*, F. Of the three or four species of sugarcane moth borers found in S. India, the only important one is the insect known by the name *Argyria sticticrasis*, H. Though this insect has been known for a very long time it was not until very recently that the correct identification of this borer was obtained. For many years past this insect was confused with one or two similar borers which very closely resembled this species and had practically the same life habits; and all these passed under the same name *Chilo simplex*, B., since all these allied insects were found breeding on sugarcane, sorghum, maize and allied plants. Recent work on this insect and other allied borers, especially done in Pusa†, has clarified this confusion to a certain extent, and as far as we know, our most important moth borer pest of sugarcane is now definitely identified as *Argyria sticticrasis*, H. Though found on allied plants it is particularly partial to sugarcane and attacks the latter usually during the very early stages, causing 'dead hearts' in young plants; it does not infest grown up canes so much as those in the younger stages. This insect may be considered as the most important of sugarcane pests in the province. Another borer which is said to attack the upper part of cane in Java\* (*Diatroea penosata*, W) and which has practically the same habits as *Argyria* is not so common as the latter and is generally found attacking grown up canes and causing comparatively much less damage. The white top shoot borer (*Scirpophaga nivella* F), is another very easily distinguishable, cream-white moth with quite different habits and found occasionally in Circars, S. Arcot and Coimbatore. The caterpillar, unlike as in other forms, burrows down into the top shoots of the grown up cane, kills the central shoot and often causes the peculiar bunchy side shoots which indicate the presence of the pest in the field. Though this

† Vide papers in the Reports of 3rd and 4th Entomological Meetings—Pusa—by Fletcher & Ghosh.

\* [Hart] Ren Apptry June 1933 p. 274.

insect is mainly confined to sugarcane as its food plant and does not breed on sorghum and other crops like the two previously mentioned forms, it has rarely assumed the status of a serious pest so far. Another borer worth noting in connection with cane, is what is known as the wheat stem borer in N. India and the ragi Pink borer (*Sesamia inferens*, D) in S. India. In S. India it is a specific pest of ragi and maize and is found breeding on sugarcane only occasionally; the caterpillar has a pinkish color and the moth is a member of a different family from the other borers noted above, and does not strictly come under the category of what are considered as typical moth borers.

**Termites.** Next to the moth borers we may place the termites as cane pests of some real importance. Two species have so far been found connected with injury to cane, viz., *Odontotermes obesus*, R., and *Eutermes heimi*, W. The great bulk of the damage caused to sugarcane by white ants is to planted underground setts; these are entirely eaten up hollow and the germinating buds completely destroyed in many cases. This happens especially in white-ant-infested and comparatively dry areas and this kind of damage is due chiefly to the work of *O. obesus*, R., a very widely distributed termite in S. India. Serious and whole-sale losses of seedlings are often reported from different parts, especially from newly planted and termite-infested tracts. The other species (*E. Heimi*, W) is a leaf eater and swarms of these appear late in the evening on young seedlings, cut out pieces of the leaf blades and strip the leaves outright, skeletonising the few leaves of seedling canes. This kind of damage is often particularly bad in the nurseries raised in the Sugarcane-breeding Station at Coimbatore where very young seedlings are raised from seeds.

**Minor Pests.** Among the insects of secondary importance as cane pests in S. India, we may include in the order of their importance, the mealy bugs, the mealy wings and the cane leaf hopper; all these are sucking insects and are not internal feeders like borers. The damage done by mealy bugs consists in colonies of the small insect in different stages attaching themselves to the nodes of the growing cane, sucking up the juice and allowing the plant to lose its vigour and in bad cases to fade away. Generally these are small pale reddish creatures covered with a white mealy bloom and found partially protected by the drying up leaf sheaths at the nodes, and this protection hides them from exposure. Often, these creatures are carried in setts used for planting and get distributed from place to place. Of the species known from S. India, the commonest appears to be *Ripersia sacchhari*, Gr. (Fig.) though the species *Aclerda japonica*, N., is occasionally noted. The mealy wings and the leaf hopper are found on the foliage, where they cause the same kind of harm as the mealy bug, by sucking up plant juice, thus draining away the nutrition from the growing plants and causing them to fade. The mealy wings found, include two species



*Aleurolobus barodensis*, M., and *Neomaskellia bergii*, S. though the former is the commonest (see Fig.) and has a very wide distribution all over India; the bluish-black puparia of this insect are often found in numbers on the foliage of grown up canes in certain tracts, and this often gives a blighted appearance to the leaves. The cane leaf hopper (*Pyrilla perpusilla*, W) is a very active straw colored bug, with the head prominently drawn forwards as a sort of rostrum (Fig.). In certain seasons and tracts, the insect increases in some numbers and colonies of the same in its various stages are found causing appreciable damage to the tender foliage of sugarcane plants. This insect may to some extent, be compared with the frog hopper pest of Trinidad and the cane leaf hopper of Hawaii, though our insect has not as yet assumed the role of either of these two serious exotic pests. Since preparing this note, the writer has received two reports of serious damage by this insect—one from Salem and one from the Nellikuppam Distilleries sugar farms. The pest in the latter case was found rather serious and organised control measures in the shape of eggmass collecting, bagging and light traps were suggested. Masses of eggs, and colonies of the hopping nymphs may be found in badly infested fields and generally, the eggs are found badly parasitised.

The other insects associated with sugarcane in S. India include one or two leaf caterpillars,<sup>1</sup> a leaf eating beetle,<sup>2</sup> a species of thrips,<sup>3</sup> and a species of root aphid.<sup>4</sup> The leaf caterpillars and the beetles have never been noted as serious so far; the thrips, which attack the tender foliage and cause the peculiar rolling and wriggling of the leaf tips, occasionally cause the leaf tips to dry, but is very rarely serious. The same can be said of the root lice also, which now and then damage the roots in some areas. The rice grasshopper<sup>5</sup> though known to be a pest of cane in parts of N. India, is not generally found to be serious in this province; it might, as in parts of Ganjam, do some occasional damage to cane growing in the midst of paddy on which the insect is a very serious pest.

Before closing the remarks on cane insects, mention has to be made of the notorious *Aphis maidis*, F., which is said to be responsible, as the vector, for the mosaic disease of cane which is not absent in S. India. This insect is commonly found on cholam and as far as the writer is aware, it has not been found in any notable numbers on cane in S. India.

**Problems Connected with Sugarcane Insects.** The entomological problems connected with sugarcane in S. India are mainly, if not solely, those relating to the investigation and control of the *moth borers*

1. *Helicota angias*, L. (a butterfly)
2. *Phidodonta modesta*, W. (a small spiny black beetle).
3. *Bregmatothrips ramakrishnae*, B.
4. *Tetraneura ulmi*, V. G.
5. *Hieroglyphus banian*, F.

and the *Termites*. Recent studies carried out by the Entomological staff of the Madras Agricultural Department especially in the N. Circars, have shown more than anything else that the only borer with which we in S. India have to seriously contend against is the species *Argyria sticticrasis*, H. This borer is present in all the important cane tracts like the Northern Circars, Coimbatore, Ceded Districts, S. Arcot, etc. The extent of damage done by this borer to the primary shoots often ranges from 10 to 30 per cent. or more in certain years. The intensity or otherwise of the infestation often varies with seasonal changes taking place in the area in addition to the different varieties of cane grown. The infestation generally takes place from the period of germination up to a period of 5 weeks, and it is during this period that dead-hearts appear in the infested fields. Though the results of work so far done show in many cases a final difference of 10 per cent. in favour of borer free canes, the writer is of opinion that the actual loss finally caused to the cultivator by this insect does not very much depend upon the percentage or degree of infestation of the primary shoots. For, in some cases, the final out-turn from badly infested fields have been found to be much more than that from fields which were comparatively free or very mildly infested in the early stages. There is one important factor which has to be taken into account in investigating the subject of borer attacks in the early stages of cane, and that is, the tillering properties of canes and the consequent power they often possess of picking up vigour during their growth for 8 or 10 months after initial borer infestation, and regaining the standard output. Though some substantial work has been done in estimating the loss caused by the borer and data have been collected, it is believed that a good deal of further work has to be carried out to ascertain definitely the actual loss caused by moth borer attack to different canes and in important cane growing tracts. In this connection it will not be out of place to quote the pertinent remarks\* of Dr. Myers on this question of determining the loss by borer attack.

"What we most clearly lack, however, is a standard method of estimating infestation and from that, determining damage so that figures from different fields and different countries can be legitimately and conveniently compared so that we may, in some manner keep our thumb on the pulse of moth borer destruction, and really observe whether our own or our neighbours' attempts at control, are having any effect and if so just how much."

We have therefore to devise some standardised methods of estimating borer injury to cane to get at the real loss caused. A good deal of ecological study has also to be done in connection with the moth borers in the relation to cane varieties, seasonal changes, alternate host plants, temperature, humidity changes in cultural practices and other factors including the nature and activities of natural enemies.

\* International Sugar Journal—October 1932, p. 377.

Regarding trials of control methods a good deal might be done in the way of prophylactic measures. Of these, the selection of healthy setts for seed is a very important one; for unless this is very carefully done we will be planting the borers also when we plant the seed cane! Trials with insecticidal methods of killing with arsenicals, fluosilicates etc., have not shown any encouraging results; nor has the time arrived to suggest such measures to Indian ryots. Neither the adoption of trash traps nor the method of egg picking has been found of any avail as effective or practical control propositions. There is a good field, open of course to cane breeders, to help the ryot by breeding and evolving out borer-resistant varieties and such work is being carried in all the important cane growing areas of the world. Coming to the method of biological control, it is known that the borer is subject to the attacks of some hymenopterous parasites, some of which are present in most areas\*. However, it is not yet definitely known whether their work of checking the borer has been sufficiently evident and satisfactory. Speaking especially of the biological method of control with the egg parasite *Trichogramma minutum*, Ry. (Fig.) now being adopted in various parts of the world, though it has been boomed by some in different countries as a remarkable success, there is a consensus of opinion among the more responsible men concerned in this work that this method of control has not as yet been found very convincing. This may be gathered from an important resolution† adopted on biological control by the meeting of several eminent entomologists at the Fourth Congress of the International Society of Sugarcane Technologists held in March 1932 at San Juan in Porto Rico. The resolution was to this effect: "In view of the great publicity which has been given to costly attempts in various parts of the world to control the cane moth borer by mass breeding and liberation of *Trichogramma* egg parasite, and in view of the fact that entomologists who have been engaged in this work on a comprehensive scale are in wide disagreement as to the practical results, if any, of this method, this Congress, after examination of all published evidence cannot endorse the plan, until answerable statistical evidence of its efficacy is forthcoming." This weighty statement does not, of course, mean that further investigations should not be continued in this line, but only goes to show that the work with parasites is not after all as easy and smooth sailing as some of us believe; in the words of Dr. Howard "one's outlook becomes more or less confused when one considers the complications" connected with such work. Coming to the direct methods of control, cutting out the dead hearts in time, to check the multiplication of the borer at the very early stages might deserve a

\* In S. India we have one or more braconids of the genera *Stenobracon* and *Apanteles* and of the ichneumonids *Xanthopimpla* and among Stelconids a *Phanurus* and of the chalcids we have the now well-known and famous wasp *T. minutum* R.

† Inter sugar, gl. October 1932 p. 379.

word or two. The borer which attacks the cane during the younger stages can be controlled to some extent by prompt destruction of the shoots with dead hearts; but in most cases the cultivator is either indifferent or the operation is done very unsatisfactorily by only pulling out the dead shoot and leaving the borer in tact! In the N. Circars where there is the method of wrapping and supporting the growing canes, some of the side shoots are removed as a cultural practice during the operation; if in this process the farmer takes some care to specially cut out the infested shoots with the borer *in situ* and destroy them, a certain amount of control could also be effected. One unfortunate fact in connection with the cane borers is that, in most of these cane areas, there is sugarcane growing at some stage or other throughout the year for the pest to pass over from season to season and help its perennial multiplication. As suggested above, we have to carry out first and foremost an intensive study of the bionomics of the different moth borers to gauge the actual loss caused by each and then experiment with different control measures before we are in a position to suggest any methods of an economic and practical nature to the ryot.

The Termite problem is not half so important or serious as that of the borers which are often described as "the hardy annuals if not perennials among the pests of sugarcane". Proper selection of termite free area for cultivation, sufficient culture of the land, proper irrigation and other prophylactic measures like selection of healthy seeds and treating the setts with deterrent substances would certainly keep away termites, and even if they occur there are methods which can check their damage in the shape of soil fumigation by mixing the irrigation water with tar water or Crude oil emulsion. A radical method for termite in any area is to locate the termite nests in the vicinity, dig out the nests and destroy the queens, and in the case of the leaf feeding termite in cane nurseries the plants may be sprayed with a dilute solution of some deterrent like Crude oil emulsion. In this work, of course, proper identification and habits of the termites concerned is an essential preliminary since errors are very often made in mistaking one species for the other and applying the wrong treatment.

Regarding the other insects—only the Mealy bugs, Mealy wings and the Leaf hopper occasionally call for attention though they have been noted rarely as serious pests in the province. As in the termites some preliminary work has to be done in identifying correctly the mealy bugs and mealy wings responsible for the damage on cane in the different tracts before adopting the appropriate measures suited to each form. For mealy bugs, the selection of clean setts is of very great importance. Some of the other measures suggested by Hall\*

\* The outbreak of *Pseudococcus sacchari*. C., on sugarcane in Egypt by W. J. Hall.—Technical and Scientific bulletin, Cairo, 1922. There are some records of the existence of this bug on cane in some parts of India but this has to be definitely ascertained.



for the Egyptian mealy bug may also be tried. The mealy wings and the leaf hopper which are leaf pests, occasionally appear to do some harm in certain seasons but prompt mechanical methods may be found to check these pests to a great extent. Both these kinds of insects are also subject to the attacks of some effective parasites.

**Suggestions For Future Work.** In the opinion of the writer, the following appear to be the more important items in research work connected with sugarcane insects in India.

(i) A complete survey of the insect fauna of the sugarcane plant in different parts of India and Burma; this should include the geographical distribution, original habitat, different food plants, natural enemies, life history notes and the economic importance of each insect. This would give us the correct identity and the distribution of each of the different borers etc.

(ii) A detailed study of the behaviour of the more important cane pests of each tract with special reference to such factors as the time of planting, manurial response, spacing, tillering with reference to varieties, etc.

(iii) The exact nature and the correct estimate of the damage caused by each pest both in relation to different localities and varieties of cane.

In Madras, such special studies are to be devoted to the *borers*, *termites*, *mealy bugs* and the *leaf hopper*.

(iv) The study of sugarcane mosaic in relation to insects as vectors.

(v) Trial of remedial measures including Prophylactic, Cultural, Mechanical, Insecticidal and Biological methods. Special attention may be devoted to the study of natural enemies and methods of biological control according to modern technique. These may be carried out in ways which will suit the different local and economic conditions in the different tracts of India.

(vi) Trials in evolving varieties of cane which may be pest resistant, in co-operation with breeders.

Thus, the investigations relating to cane pests have to be carried out with due regard to all the different aspects of the subject; it may not be a wise policy to depend on one set of activities alone to get quick and satisfactory results. It is all very easy and convenient to remark glibly to an audience that the easiest way of fighting disease is by a change of variety and dispense with Entomologists and Mycologists, or to opine that Biological control is the only successful remedy against pests. But responsible workers all over the world, realising, as they do, the short-comings of such one sided activities in relation to the time factor, economy etc., appear to be of opinion that we cannot depend upon one or two factors alone and wait for the results, but



should explore all avenues of attack until we have found out the most suitable measure for each pest and region. Our main aim is to help the sugar planter as quickly and economically as possible.

Before concluding this short note the attention of entomologists and others interested in the sugar industry in India may be invited to the fact that, while we are engaged in devising ways and means to fight our local pests, we should not forget to provide ourselves with the proper precautions which will prevent the entry of the some of the serious sugarcane pests of other countries such as the sugarcane weevil<sup>1</sup> of Australia, the dreaded leaf hopper<sup>2</sup> of Hawaii, the frog hopper<sup>3</sup> of Trinidad, the cockchafer<sup>4</sup> of Mauritius or the widely distributed moth borer<sup>5</sup> of the West Indies—insects which have been causing very serious losses to the sugar industry in their respective countries. It is needless to add that in these days of rapid and convenient transportation facilities, animals and plants have very good chances of getting widely dispersed from place to place. I believe some of us are already aware of the fact that on two occasions the Imperial Entomologist, Pusa, while examining parcels of sugarcane setts received from abroad, came across the live grubs of the West Indian sugarcane weevil (*Sphenophorus sacchari*) in a parcel from Antigua and that of the Javanese beetle pest (*Holanaria picesens*) in a parcel from Java. It is incumbent on us, therefore, to see that two objectives are kept in view, viz., the control of the existing pests on the one hand and the prevention of exotic pests from entry. For, while we are engaged in solving our own insect problems connected with sugarcane, we should also be careful to see that no exotic pests of any kind get entry into the country and add to our already existing troubles.

## NOTE ON THE CULTIVATION OF PINE APPLE ON THE LOWER PALNI HILLS

By A. M. MUTHAYYA NATTAR, L. Ag.,

Agricultural Demonstrator, Dindigul.

The cultivation of pine apple, was first introduced on the lower Palni hills about 18 years ago by Mr. Bell, who was working as a coffee expert under Messrs. Stanes & Co., who then managed large estates both on Sirumalai and lower Palni hills. He introduced an Australian variety and it was propagated later on carefully by the Roman Catholic Missionaries in their estates on the hills. However, the crop was abandoned by them later on, owing to considerable damage done by

1. *Rhizdocnemus obscurus*, B.      3. *Tomaspis saccharina*, D.

2. *Perkinsiella saccharida*, P.      4. *Phytalus smithii*, A.

5. *Diatraea saccharalis*, F.