AFTERNOON SESSION

Chairman.—Mr. R. G. Coombe, Acting Chairman of the Board.

THE TORTRIX PROBLEM

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Economic Entomology deals with plant pests that are not included under the term disease. It seeks to develop in a variety of ways means of prevention, and means of assault. I wish to run over the general lines of campaign employed against insect pests in order to show to what extent one is limited when we consider both Tea and Tortrix in particular.

Natural controlling agencies are the result of a highly complex interchange of factors, in which weather plays an important part. In temperate zones, the winter season always exerts a powerful effect on pest populations the following spring, and it is not always a simple matter to prophesy the future in this respect, for while a very severe winter may kill a large proportion of any given pest, it may have a more severe effect on its parasites and the last state be worse than the first.

Weather is outside the control of man, but close study of another powerful controlling agency, which includes insects which prey on their brethren, has enabled striking results to be obtained in achieving control, otherwise unobtainable, by rearing parasites in laboratories for liberation elsewhere. Another way in which man can take a lesson from Nature is by careful observation and development of special strains of plants immune to certain pests. This kind of work has mainly been done with annual crops — in the case of a perennial plant like tea it would take a relatively enormous time to produce such strains by selective methods. The value of immunity is shown by an example given me by Mr. Carpenter of Tocklai, when they were working on Helopeltis some years ago. Their nearest material was 40 miles away, and they not only had to bring the insects from there, but tea shoots as well, because the bug refused to feed on the Tocklai tea. They were never able to discover the reason for this immunity. It may be remarked that immunity in this connection is more or less confined to sap-sucking insects.

Most lines of attempted control are of an artificial kind, as opposed to natural agencies, and they vary from simple remedies like trapping snails under boards to the later developments of chemical warfare.

Trapping on any scale is usually a failure. Its success depends on the degree of attraction exercised by apparatus on certain insects: thus there are light traps, bait traps where insects feed on poisoned material, and the like, and trap crops which are grown at the same time as the money crops to attract the pest away from the latter.

There are also cultural methods of control, but these again apply to temperate zones and annual crops where heavy machinery can be used regularly on the land.

The method of hand collection is used in those places where labour is cheap enough, mainly tropical countries, but with few exceptions it may be doubted whether this is always a paying proposition. I put Tortrix in the list of exceptions, for reasons which I hope will be appreciated later.

Chemical control is mostly directed against a pest to kill it, and has been elaborated in many ways. The principle is to kill the pest by making it eat poison with its food, or else by suffocation or action on the nervous system. In the first of these alternatives, the insects concerned are those with chewing mouth parts, such as beetles, caterpillars and grass-hoppers. The basis of most such poisons is arsenic. It can be readily understood that such a method is completely debarred from tea in plucking, which is a pity, since it is one of the most valuable assistants a crop grower has. Thousands of tons of arsenic are used every year in fruit orchards against insect pests, and the impossibility of using it on tea deprives us of our strongest weapon against both Tortrix and Nettle Grub. Poison materials included in this manner of attack are known as "stomach" poisons, and are applied by means of sprays or dusts.

The other type of killing material is called a "contact" insecticide, and includes soaps, oils and alkaloids. Soap is an excellent contact killer for many pests, including Nettle Grub, and is by far the cheapest insecticide we have. It has to be applied by a spraying machine, a special form of which we have developed for Nettle Grub work, which would also be useful for other purposes. But as far as Tortrix is concerned, this form of attack is also ruled out since it is too well protected by its leafy cover; with a contact

insecticide it is necessary to saturate each individual insect with the solution used.

Thus, in the fight against Tortrix we cannot use inorganic poisons; we cannot make use of cultural methods of annual crop farming which allows not only ploughing and harrowing, but the sometimes very effective method of crop rotation; and trapping is no good. Two kinds of trap are possible against Tortrix, bunches of grevillea leaves, in which the moths like to rest, and light traps. Nearly 100 per cent of female moths must be caught before laying to achieve any good. Light will, as a matter of fact, attract the moth before oviposition, but in this hilly country with so much shade, hundreds of traps would be required per acre to secure the desired result. The grevillea leaf traps attract only a small percentage of available moths, many of which have already oviposited.

For no very clear reason Tortrix as a pest is far less in evidence than it was a few years ago. Then it was sufficiently bad for collective action to be taken, and it was declared a pest, as a result of which the collection of eggmasses was made compulsory. It was also decided to investigate the possibilities of an egg parasite, which, because of the ease by which it may be produced in large numbers in the laboratory, made it a favourite plaything for entomologists all over the world. Suffice it to say now that it proved a complete failure.* Since then, we have been able to import some parasite material from Java, with the kind assistance of the Experiment Station there. Tortrix was known to be a tea pest in Java, but only to a slight extent, and it was considered that as the climates were not very dissimilar, there might be insect parasites over there which kept it well in check, and which might not be found in Ceylon. As things turned out, several species of parasites new to Ceylon were obtained from the material sent. We know as yet too little about them to say with any certainty whether any of them will be of use to us.

We fall back, therefore, on eggmass collecting as a remedy, and it is this that I wish to discuss today. But before I go on to that, it is necessary that I should relate in brief the life-cycle of the tortrix, in order that the facts that I shall refer to afterwards may be made clearer.

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* *The Tea Quarterly*, Vol. 6, page 166.
" " Vol. 7, page 15.
" " Vol. 8, page 140.

Life-Cycle.—The eggs, as you know, are laid in a flat mass on the upper surface of the leaf. They take a few days to hatch. The young caterpillar is endowed with great energy, and at once races away. Presently it will find its way to a shoot, and the caterpillar spins silk from side to side over itself, attaching the ends to the leaf surface. At first the silk is fairly damp, but as it dries, so it shrinks, and in shrinking it twists, thus greatly shortening the fibre, so that the sides of the leaf are brought together. Tucked away in this cosy situation, it starts to feed, as a result of which it grows. Now all animals which are provided with an external skeleton, which is only slightly elastic, soon find the skin becomes too unyielding when they are growing, and the adjustment to this predicament is that the old skin is ruptured and thrown off and replaced by a new one. It then continues its meal until again it has grown to the limit of its new skin. This process takes place some five or six times, as a rule, before it becomes full grown. During this time, it may have changed its position on the plant more than once. Sometimes it finds a suitable spot where two leaves lie against one another and it enters and webs them together before feeding, as is usual. After the last moult it enters the pupal stage, which is quiescent, and in which its internal economy is entirely reorganised, a process which takes about two weeks. When this is completed, the pupal skin is ruptured and the moth emerges. Then after mating, the cycle begins again with the laying of eggmasses. This cycle occupies roughly two-and-a-half months.

By collecting eggmasses at regular intervals of six days for some years past, it has been possible to find out how variable were the periods of time occupied by a single cycle at different times of the year, and in different years. A certain variability was to be expected, since, as we know, the weather is never normal, and it was anticipated that it would react to the vagaries of the monsoons — or absence of them. The result of this work is consolidated into a single year, and is shown in diagramatic form in Fig. I. The peaks of egglaying are seen to be every year in mid-August, the end of October, early January, the end of March and early June. Thus, in spite of the irregularities of the weather, the insect keeps to the even tenour of its way and is as regular in its habits as can be.* This is certainly an unlooked

* It appears to be widely held that rain exercises a direct influence on Tortrix, expressed in some such form as this "As soon as the rain came, the Tortrix disappeared." In point of fact rain brings no such consequence whatever.

for result, and is remarkable enough. But not only is this true here, but also of Maskeliya, and I have no doubt all of Dimbula and Dickoya. There is also evidence that on the Uva side the appearances of the generations correspond, too.

Before going on to consider eggmass collecting as a control measure, I must draw your attention to another feature of the diagram, and that is the size of the hills, representing the quantity of eggmasses, and therefore the density of moths. You will notice that the smallest generation is in June, that it gradually increases until January, and then falls again. The troughs between, which indicate few eggs about, represent the period of growth, that is, of actual attack on the tea. The drop from the January maximum to March is due to a heavy mortality in the caterpillar stage; and if it were not so, and the Tortrix was able to go on building up its numbers unchecked, you would all have had different jobs long ago. Fortunately, however, nature steps in in the first half of the year and lays the pest fairly low; however, when August week appears, Dame

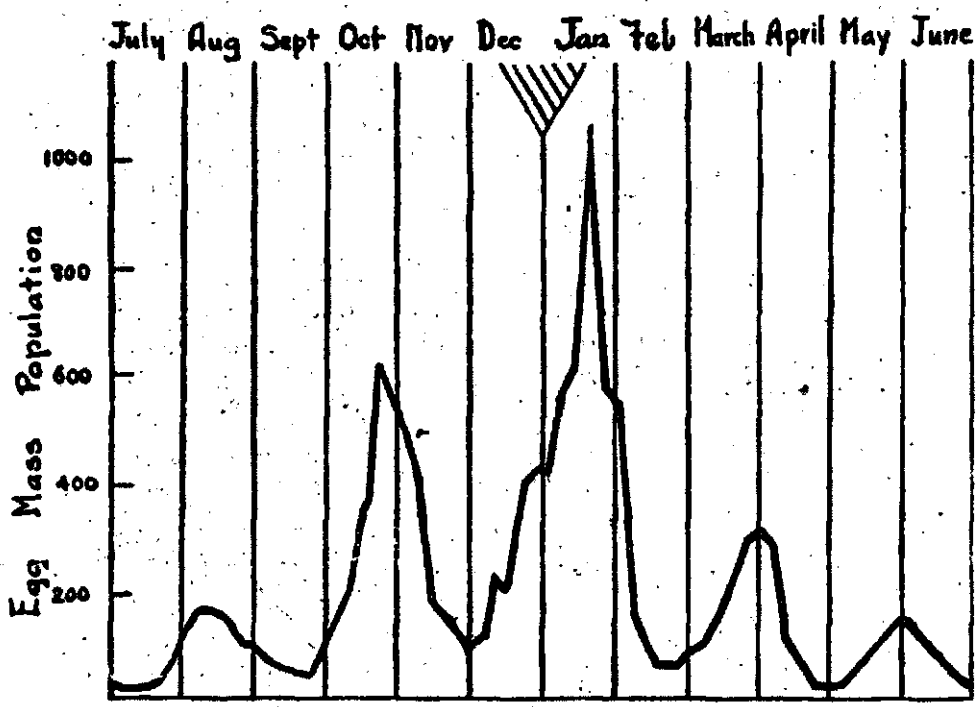

Figure I.—Graph showing the average variation in the numbers of Tortrix eggmasses collected from a four-and-a-half acre block, every six days, over a period of four years.

Nature takes a holiday and the Tortrix host, though small, like Samson's shorn locks, again begins to grow.

Systematic Eggmass Collection.—I have given a fairly true picture of the seasonal occurrence of Tortrix; the most important feature is the fact that it repeats itself at the same time every year, for it means that you can tell in advance, and a long time in advance, when the peak period of eggmasses is going to be. Now we have to consider in some detail how we can apply this knowledge. If expense were no object, it would be possible to keep a horde of podians for ever on the lookout for eggmasses. Unfortunately, tea is not the costly vegetable it used to be, so expenses must be cut down to the minimum. That means that collection must be worked somehow in the most efficient and economic manner possible. The first fact to take into account is the incubation period of the egg. This varies from 8-10 days. If collection is applied only at 12-day intervals over the same ground, a certain proportion of eggmasses will be left free to hatch and develop, quite a large enough proportion to develop a healthy attack, perhaps. Theoretically then, eggmasses should be collected over the same ground at least every seven days. That is the first point I wish to make. The second is this — that it will, I think, never be necessary to reckon the whole estate in planning the business, since some part will be just ready for pruning, another field perhaps is being pruned or has just finished being pruned. In calculating the area necessary to attend to on this basis, you can cut out all such fields, and all fields up to nine months from pruning. This should scale down the area quite a lot. Finally, by actual observation of the caterpillar population, *i.e.*, the degree of attack, it may be possible further to reduce the area, if such attack is only slight. We have now reached a stage where we have so reduced the area to be searched that it can be done pretty thoroughly. One further circumstance must now be taken in — the actual period of collection. I can tell you now that it is not worth while collecting at times corresponding with the valleys of this diagram. Further, I do not think it will usually be necessary to collect during the June generation, which means that no collecting would be done between mid-April and the beginning of August. There remain four peaks, for each of which it may be necessary to collect for four or five weeks; and this is my suggestion for doing it. Let us suppose we have to collect from August 1st. to August 31st. Let pluckers be told to collect what they can on their rounds, which we will assume to start on August 1st, 11th, 21st, 31st. Then

a podian gang should be arranged for August 6th, 16th, 26th, covering the same ground in the same order. The three periods, August, October-November, and December-January should always be treated like this, and observation may require also the March-April period.

The above scheme is applicable to the majority of planters who use their pluckers for collection, sometimes paid, sometimes not. Those who do not care to employ pluckers on a double job would have to use podian gangs once a week. The essential idea in the plan is to have collections made within the egg-incubation period, and this could probably be arranged to suit each individual estate. I will just state here that the plucker plus podian arrangement has worked satisfactorily on St. Coombs.

Working on the above basis, anti-Tortrix egg collection can be planned sufficiently in advance to include the cost in annual estimates.

I referred above to leaving out of account fields up to nine months from pruning. This is of course, in connection with planning the year's work and framing estimates. It may happen, as in those places which are known to suffer regularly from Tortrix, that egg-masses become sufficiently numerous to necessitate collection before the 9 months' period is up — although they are not likely to be so, much before. In such cases, observation of caterpillar attack before the time for egg collection is due should give the clue. In my opinion, however, such cases are likely to be uncommon, and to arise after an April-June prune.

Talking of pruning, if this happens to take place on the left hand side of a peak, the emerging moths will lay elsewhere. If, however, pruning is done during the downward trend of the curve, eggs will have already been laid on the tea and when the progeny hatch they will starve. Hence, here is an additional way of adding to the Tortrix mortality.

Summary of Plan for Systematic Egg Collection

1. Egg collection should be confined to tea at least nine months from pruning, except when observation shows that it may be necessary on younger tea. As far as advance calculation is concerned, however, the rule should hold good.

2. Before collection is due on the dates specified in No. 4, fields should be inspected and those showing no signs of Tortrix

podians in this case have no other work but to search for eggmasses.

4. Collection periods:—

I. August 1 to August 31.

II. October 15 to November 15.

III. December 15 to February 1.

In the event of exceptionally heavy attack, it may also be necessary to collect from March 15 to April 15.

The first period set down is of vital importance, being the beginning of the cycle of increase, and should not be left out, however few eggmasses there appear to be.

In addition to the foregoing, pruning in February, April, June, September, and November materially assists in reducing the numbers of Tortrix.

The Chairman then requested Dr. Norris to introduce a discussion on Tea Manufacture.