A FRESH INFESTATION

At about the time this was written, a new infestation by the pink bollworm was discovered in Texas. This is in the extreme western part of the state along the Rio Grande, where the insect has been found in widely scattered fields along a front of 150 miles. Everything indicates at this time that the infestation is due to the smuggling of seed across the river from Mexico. The region is isolated from any other territory in the United States in which cotton is planted by hundreds of miles of mountains and deserts. To control the situation there as it now appears is a matter of the utmost simplicity compared to the gratifying and possibly absolute control which has been obtained in other parts of the state. The finding of the new infestation at present, therefore, does not seem in the slightest degree to detract from the present generally hopeful outlook.

INVESTIGATIONS IN MEXICO

This paper would not be complete without at least a reference to the work of the Department of Agriculture in Mexico. This is conducted under the direction of Mr. August Busck. It includes studies of the bionomics of the species to serve as a basis for control measures which may be put into operation in case, by any chance, the pest ever becomes established in the United States. It also includes an effort towards the total elimination of the pink bollworm in Mexico. This project is by no means as visionary as might be supposed, and definite progress has already been made. This subject, however, must be dealt with more fully in a paper prepared by Mr. Busck, which in the nature of the case cannot be written until there has been time for further developments in Mexico.

PARASITE INTRODUCTION AS A MEANS OF SAVING SUGAR

By T. E. HOLLOWAY, *Entomological Assistant, Bureau of Entomology, Department of Agriculture*

This paper is a report of progress on work in parasite introduction, but it may also serve to point out the benefits which may come from the active interest of the agricultural public in any bit of scientific endeavor which appeals to it.

The control of the sugar cane moth borer, *Diatraea saccharalis*, has been a subject of investigation in Louisiana for many years. As time passed and experimental results accumulated, it became more and more apparent that only by the introduction of foreign parasites could

control be effected. In Cuba the moth borer was known to be much less injurious than in Louisiana, and in 1914 Mr. George N. Wolcott reported a tachinid parasitic on the larva. In 1915 the Bureau of Entomology arranged to investigate this parasite, with the intention of introducing it into Louisiana. Mr. U. C. Loftin was sent to Cuba, where he traveled about over the island, collecting parasites and sending them to the writer at New Orleans. Though they attacked the moth borer in Louisiana, they subsequently died out.

Experience has been gained, however, in methods both of collecting and breeding, and it was intended to continue the work the following year. But lack of funds and the department regulation prohibiting foreign travel during the war prevented parasite introduction during the next two years. The same conditions prevailed during 1918, but some of the sugar planters in Louisiana had become interested, and at the meeting of their association in New Orleans in June one member proposed that those so inclined subscribe one hundred dollars each to defray the expenses of the work. Thirteen planters immediately agreed to contribute this amount, and checks were received from some others after the meeting. Sufficient funds having been raised, a telegram signed by several prominent planters was sent to the Secretary of Agriculture, who approved the plans by telegraph the same day.

The writer proceeded to Cuba as soon as a passport was issued, and through the kindness of Mr. S. G. Chiquelin, superintendent of the sugar factory at Mercedes, Cuba, was able to make his headquarters at the private experiment station of the Cuba Cane Sugar Corporation. The director of the station, Sr. M. A. Centurion, received him cordially and gladly coöperated in every way possible. On July 12, the first sending of parasites was forwarded to Mr. E. R. Barber, of the Bureau of Entomology, and Mr. W. G. Taggart, assistant director of the Louisiana Sugar Experiment Station, who had agreed to receive the parasites at New Orleans. (Mr. U. C. Loftin, who had been in Cuba before, was no longer connected with the investigation.)

Four species of parasites were found, which had also been collected by Mr. Loftin. The egg parasite, *Trichogramma minutum* Riley, already occurs in Louisiana. Of the others, the most efficient is the tachinid, *Euzenilliopsis diatraea* Townsend. The writer estimated that from 20 to 50 per cent of the moth borer larvæ were parasitized, though in one small field the percentage was much higher. The tachinid larvæ emerge usually from the larvæ of the moth borer, but occasionally from the pupæ. Soon after emerging they form puparia, which may be found in the tunnels of the host or nearby between the stalk and the leaf-sheaths of the plant.

As the attack of the moth borer results in the death of young cane

plants, the procedure was to walk through the fields until a dying plant was found, then dissect it carefully and examine it for either a borer or a parasite. The moth borer larvæ and pupæ were taken on the chance that parasites would emerge from a certain percentage of them. Parasite larvæ or puparia were very carefully collected and brought to the laboratory, where the puparia were placed in tin salve boxes with damp sphagnum moss and cotton. The salve boxes were in turn packed in pasteboard mailing cases and sent to New Orleans. At Mr. Barber's suggestion, holes were made in both the salve boxes and the tin bottoms of the mailing cases for ventilation, and it was found that fewer parasites died en route when shipped in this way. About 33 per cent arrived in New Orleans alive. All parasites were sent by ordinary mail, refrigeration not being used.

On reaching their destination, the puparia were placed on damp sand under glasses, and when the flies emerged they were transferred to cages containing growing cane infested with the moth borer. The most successful cage was a large one built over a corner of a sugar cane field. Ripe sweet fruits and honey-water were given the flies, such substances having been recommended by Mr. O. H. Swezey, of the Hawaiian Sugar Planters' Experiment Station, as being satisfactory for a tachinid of similar habits. The parasites passed through two and possibly three generations in New Orleans.

Of the other two parasites in Cuba, one is *Bassus stigmaterus* Cresson (*Microdus*) and the other *Apanteles* sp. They are comparatively rare, and it was thought best not to attempt to introduce them without further study. During the summer over 650 tachinid puparia, representing about 600 parasitized moth borers, were collected, while the moth borers attacked by the other two parasites amounted to not more than a half dozen by each one.

It was hoped by means of heated greenhouses to cause the tachinids to breed continuously through the winter, and two greenhouses containing growing cane were provided, but by December it became evident that the parasites were in a dormant state. On December 2 one puparium was found in a field cage, but the fly did not emerge and it seems that the insect is dead. It is believed that other parasites are present within the host larvæ and will emerge in the spring.

If the parasites become established in Louisiana and are as efficient there as they are in Cuba where they have to contend, by the way, with a secondary parasite, they will do much to control a pest which causes a serious loss annually. With a maximum infestation of the moth borer, it has been calculated both by entomologists and by sugar planters that the annual loss amounts to over 1,000 pounds of sugar per acre. Investigations to be published in Department Bulletin No.

746 show that the average infestation is about 50 per cent of the maximum, which roughly gives a loss of about 500 pounds of sugar per acre on the area infested, which amounts to some 300,000 acres in Louisiana alone. The total annual loss would thus be 150 million pounds, valued during pre-war times at about \$7,000,000. This means that if the insect were controlled the Louisiana sugar planters would make approximately that much more sugar every year, or about one-fourth more than the average crop. There is also considerable damage to corn in Louisiana and to corn and sugar cane in Texas and Florida which has not been estimated.

A system of control by the native egg parasite, *Trichogramma minutum*, has already been found satisfactory to some extent. It has been the custom on the plantations to burn the leaves of the sugar cane plant which are left on the field after the stalks are cut and carried to the mill. This burning probably results in killing vast numbers of the egg parasite without a corresponding reduction in the numbers of the moth borer. To prevent it, the plowing under of the leaves has been tried for the past six years, a method of cultivation having been perfected in coöperation with the Louisiana Sugar Experiment Station, and it has been found that the infestation by the moth borer is never increased by this operation but may be considerably reduced, while the benefit to the soil is very marked. The cost of the additional labor required has been estimated by plantation managers to be less than one dollar per acre, and considering the fertilizing value of the leaves it really amounts to nothing at all.

By avoiding the destruction of beneficial insects and by adding one or more larval and pupal parasites to the very efficient egg parasite already present, it is believed possible ultimately to obtain a fair degree of control.

METHODS IN ENTOMOLOGICAL FIELD EXPERIMENTATION¹

By W. P. FLINT, C. F. TURNER and J. J. DAVIS

The accuracy and value of results from field experiments, whether they be experiments in agronomy, in entomology or other agricultural subjects, depend largely, and in most cases wholly on the accuracy and reliability of the methods used in obtaining the data.

The past year the writers have been associated in the Hessian fly problem and have found it necessary to work out ways of obtaining data and to check and recheck the various methods to determine the most accurate and satisfactory from all standpoints. Although most

¹ Published by permission of the secretary of agriculture.