

# THE NATURAL ENEMIES OF LOCUSTS

By A. McMARTIN, Ph.D., B.Sc.

In the United States Department of Agriculture Yearbook for 1932<sup>5</sup>, we read:—"The most notable insect damage of the year resulted from an unprecedented increase of certain grasshoppers which are always present throughout the Mississippi Valley States....The situation this year was an outcome of two to three years favourable weather to local grasshopper multiplication and unfavourable to the fungus diseases and other natural control agencies that normally check increase."

The relationship between fungus diseases and other natural control agencies and a locust outbreak is expressed here as a somewhat bald statement of fact for which it is doubtful if there is sufficient supporting data; the assumption being that the increase of the one is due entirely to the decrease of the other, a phenomenon which still lacks proof. It nevertheless points to the fact that between the insect pest and its parasite there is a certain balance, which can be altered one way or another by climatic conditions, e.g., in the same Yearbook for 1934<sup>6</sup>, it is recorded that in 1932 a cool, wet spring with unusually heavy driving rains was followed by a general reduction in the number of grasshoppers in Nebraska, Iowa, and South Dakota, where in North Dakota and Minnesota an unusually dry spring was experienced, and the centre of most destructive infestation shifted to those states.

The whole history of locust invasions testifies to the important part natural enemies play in bringing an invasion to an end, but what is lacking is evidence that the same factor prevents an outbreak from taking place. This is natural, because the outstanding feature of a locust invasion is the suddenness with which it appears, a fact which in the past has militated against the investigation of conditions at the time when, or previous to, the invasion began.

Nevertheless, the study of the natural enemies of the locust is an important branch of the study of the locust problem, and if no practical benefit has so far accrued from such work in the way of the distribution of parasites, etc., it is due, neither to the lack of parasites nor of research into their habits and value, but to the complexity of the factors which have to be taken into consideration when dealing with a living organism and its relation to its environments.

The following is not meant to be a list of locust parasites, whose numbers are legion, but is rather a selection of different types, which have been brought to notice during the present invasion of the Redwing Locust.

## FUNGUS DISEASES.

The most important fungus disease is probably *Empusa grylli*, which is dealt with in a separate paper. This disease has attracted most attention possibly largely because of the characteristic manner in which the infected insects die, the

spectacle of hundreds of corpses remaining on the vegetation impressing itself on one's memory.

The other diseases about to be described are not nearly so well known, to the layman at any rate, due probably to the fact that they do not all show such pronounced symptoms as *Empusa*, and that the corpses are not found on the vegetation, the stricken insects preferring to die in some shady locality such as round the bottom of the stools of cane, in the trash, or in other hidden spots. Owing to these facts, it is difficult to gauge the extent of mortality due to disease of this nature, as many more locusts will die unobserved than in the case of *Empusa*.

## *Beauveria Globulifera*.

Judging by the number of specimens found, this appears to be the disease next in importance to *Empusa*. It is called the White Fungus Disease, owing to the fact that the dead locust becomes covered with a white cottony growth. It appears



Fig. 1.

Redwing Locust, dead from *Beauveria globulifera*.  
(Natural size).

that death occurs about six to eight days after infection. The infected insect ceases feeding, wanders aimlessly about, and just before death hides in a shady spot on or near the ground. The bottom of the cane stools are favourite places. After death, the whole of the inside of the insect is full of a white growth of fungus, which shortly pushes its way through the thin membranes between the segments of the abdomen, and appears on the outside as white rings along the body. The dead locust becomes mummified, and the growth of the fungus may continue on the outside till the whole body is covered. On this white growth the spores are produced, which are the source of infection for other locusts. Known originally as *Sporotrichum globuliferum*, it has a wide range of insect hosts, and an equally wide geographical distribution. It was present among locusts in Natal in 1896 (Cooper), and indeed was artificially grown and distributed in tubes along with *Mucor* as the "South African Locust Fungus;" and according to a statement of Howard<sup>1</sup>, was found in the United States to be the most effective of any culture which had been tried.

The attempt has been made on several occasions to use it as a control against insect pests, but always with results which did not justify its adoption. It was recorded in 1932 on the Philippine Migratory

Locust by Reyes<sup>3</sup>, who cultivated it and was able to infect locusts from the culture in the laboratory.

During the present invasion of Redwing Locust, it has broken out once or twice as an epidemic, when hundreds of specimens could be collected. It occurred naturally in one of the cages at the Experiment Station among adult locusts, and accounted for 60 per cent of the insects. It appeared again in a number of cages in which an experiment was being conducted with *Empusa*.

In doing the experiments, each time fresh locusts were caged the cage was cleaned out, washed, and disinfected with formalin, and each day while the experiment lasted the bottom of the cage was cleaned and excreta removed. In this particular experiment the effect of keeping the insects under unhygienic conditions was being tried: a number of cages were never cleaned for several weeks, with the idea of introducing *Empusa* into the cage from dead locusts, after these cages had become foul. Before this stage was reached, however, *Beauveria* appeared in each cage, and accounted for from 4 to 7 out of 10 insects.

This fungus can easily be cultivated artificially, but from the culture the results of infection experiments have been very unsatisfactory.

#### *Sporotrichum* Sp.

Very early last season occasional hoppers were found on the ground dead, turning a very bright pink shortly after death. The bodies became very hard, leathery, and finally whiteish, and when broken open the inside was seen to be lined with a white powdery material, which later turned green. This on examination was found to be due to a growth of a fungus, *Sporotrichum*. Infection experiments were carried out by powdering the dead diseased locusts, mixing the powder with diluted molasses, and dipping some healthy locusts in the mixture; 50 to 60 per cent mortality has been recorded in some cases, at other times, the mortality was nil. The treated insects died in from 6 to 10 days after infection, and from the corpses the same fungus was recovered. This fungus is easily grown artificially, and from the culture up to 100 per cent mortality has been obtained in cages by dipping locusts in some of the culture mixed up in water; the usual mortality is 50 to 60 per cent. It has been found possible to grow it easily on sterilised molasses, and on sterilised bagasse, finely chopped.

A fungus disease of locusts with the same symptoms has recently been described in the Argentine<sup>2</sup> on the locust *Schistocerca paranensis*, and has been named *Sporotrichum paranense*. In field experiments mortality of up to 65 per cent has been claimed by spraying the insects with the spores of the fungus suspended in water.

One interesting feature of this fungus disease is that it appears to be less influenced by climatic conditions than do *Empusa* and *Beauveria*, specimens having been found with a constant regularity

throughout the season, during both dry and wet weather. The mortality caused by this parasite, however, has never been high under natural conditions. Of the three fungi under consideration, it possibly plays the smallest part in natural control; this may be due, in part at least, to the manner in which the spores of the fungus are produced.

In *Empusa* and *Beauveria* the spores are found on the outside of the dead insect, whereas in the *Sporotrichum* under consideration, the spores are found inside the corpse, and the latter has to decompose before the former are liberated, a process which, owing to the leathery nature of a locust which has died of this disease, is under some circumstances a matter of many weeks.

#### INSECT AND OTHER ENEMIES.

The most important insect enemy of the Redwing Locust in Natal has been the fly *Stomorrhina lunata*. This fly (Fig. 2) was noticed during the



Fig. 2.

*Stomorrhina lunata*; larvæ, pupæ, and adults.  
(One and a half times natural size).

first year of the invasion (1933-34), but only to a limited extent. During the present season, however, its numbers had increased considerably, and attracted considerable attention when egg laying among the locusts began. The female fly hovers round the locust when laying, and as soon as the latter operation is completed, the parasite lays on the surface of the locust egg in the egg package. The egg of the fly hatches almost immediately, and the newly hatched larva, or maggot, begins feeding on the locust egg. When fully fed, the larva pupate, and from the pupa the fly emerges. The amount of damage done to the locust eggs varied considerably; in some cases only a few maggots were found, whereas in others the egg packages when dug up were so heavily infested

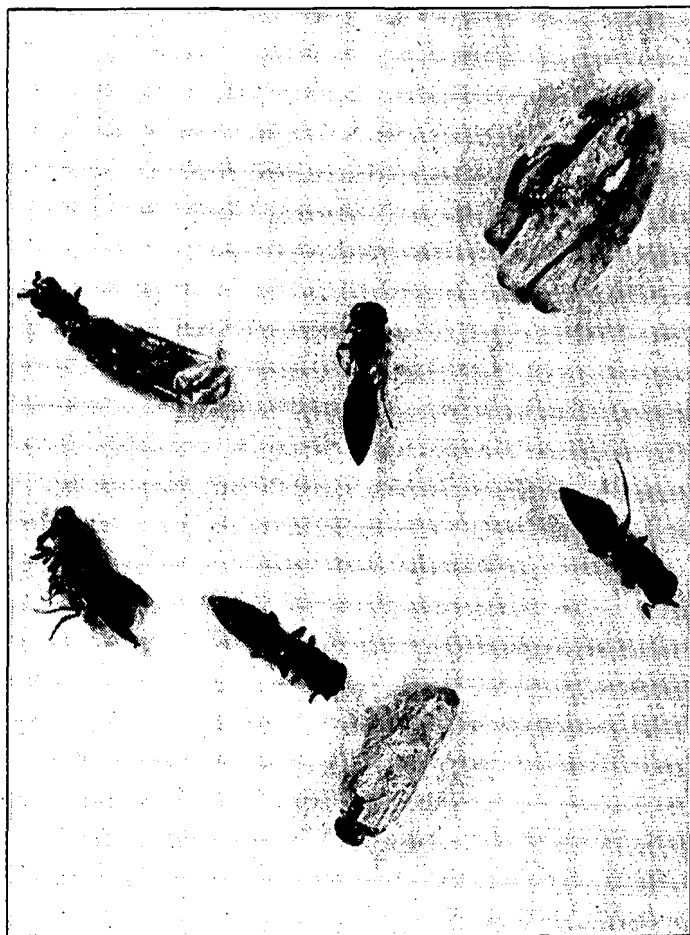


Fig. 3.

*Scelio* sp., and parasitised eggs of the Redwing Locust. (Four times natural size).

that all the eggs in the one package were parasitised, and destroyed. One noticeable feature of the activity of this fly was the manner in which it was confined to certain areas; in adjoining areas where egg laying among the locusts had occurred, one might be heavily parasitised by the fly, and the other remain free.

Noticeable also was the manner in which birds, particularly swallows, were found in some fields in large numbers feeding on the fly. These birds

when present among swarms of hoppers, probably accounted for considerable numbers of the latter: when, however, they appeared first of all when the adult locust were laying, and fed on the flies, their status as a natural control falls under suspicion, even though they feed eventually on the hoppers, as numbers of these hoppers would never have hatched had the flies not been destroyed. This phenomenon serves to show the complexity of the problem and points to the multiplicity of factors that have to be taken into consideration in dealing with the natural control of a pest.

Another parasite of locust eggs which has been found this season is a small black shining flying insect of the genus *Scelio* (Fig. 3). According to Uvarov<sup>4</sup>, this insect runs over the ground till it encounters a locust depositing eggs. As soon as the latter has finished, the parasite digs into the ground, and reaching the egg pod, turns upside down and infests the eggs one by one. The infested eggs look perfectly normal, and only with difficulty can be told from healthy eggs; indeed it is not usually till the *Scelio* emerges that the egg is seen to be parasitised. It is difficult to estimate the damage done by such a parasite as this, as it does not attract attention in the same manner as the fly *Stomorrhina*, but probably as control it is not of much importance.

Considerable attention has been drawn to the large flocks of birds which have been present among swarms of both flyers and adults, and which have on many occasions been credited with the destruction of large numbers of the pest. Many species of birds have been known from time to time to feed on locusts; such as kestrels, the yellow-billed kite, guinea fowl, pheasant, sprews, finches, starlings, swallows, and storks. The sight of these flocks is spectacular, and is probably more impressive than significant, as in habit and movement they are too erratic. Flocks have been known to be in a vicinity in which a large swarm of hoppers were present only a short distance away, and remained entirely unmolested by the birds, the latter evidently being able to find sufficient food elsewhere.

The value of bird life as a control, nevertheless, probably has some meaning towards the end of an invasion of locusts, in that they assist in its quicker termination. This is true, not of birds only, but of all the natural enemies. As the locust increases in numbers, so the parasites breed in greater numbers, and each year exercise a greater controlling influence, but it has been the experience of former invasions that the greatest effect of these parasites is not exercised till after the peak of the invasion has been reached and the numbers of locusts have begun to decline from other reasons.

#### REFERENCES.

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- <sup>3</sup> Reyes, S. M. An Unreported Fungus Disease of the Philippine Migratory Locust. Phil. Journ. Sci., Vol. 49, 3, 1932, p. 407.
- <sup>4</sup> Uvarov. Locusts and Grasshoppers. London, 1928, p. 113.
- <sup>5</sup> Yearbook of Agriculture, U.S. Dept. Agric., 1932, p. 67.
- <sup>6</sup> Ibid, 1934, p. 237.