propagated since the inoculation of a solution of trypsinogen with trypsin gives rise to a very large quantity of trypsin and this process may be repeated indefinitely. In the crude extract this reaction is prevented by the presence of a substance which inhibits trypsin activity. A compound of this inhibitor and trypsin has been isolated and crystallized (Fig. 9). It may be separated into its constituents by treatment with trichloracetic acid. The trypsin precipitates and the inhibitor may be crystallized from the trichloracetic acid solution (Fig. 10). It has the general properties of a peptone and a molecular weight of about 6,000.[1]

[1] Summary of a paper presented before The Harvey Society, New York City, May 16, 1935.

Locust Research in Nigeria.

By F. D. Golding, M.A., F.R.E.S.
(*Agricultural Department, Ibadan, Nigeria.*)

INTRODUCTION.

BEFORE describing the locust research carried out by the entomological section of the Agricultural Department during the last five and a half years, it is necessary to give a brief account of the various species of locusts which occur in Nigeria.

Swarms of the Tropical Migratory Locust, *Locusta migratoria migratorioides*, R. and F., entered the south-western corner of Nigeria in December 1929, and had reached the Northern frontier by April 1930. Swarms have been present in this country ever since the original invasion and, each year, there have been two generations of hoppers.

In July 1930, hopper bands of the Red Locust, *Nomadacris septemfasciata*, Serv., were discovered near Lake Chad. Only one adult swarm has been found at a distance of more than about 12 miles from the lake.

Swarms of the Desert Locust, *Schistocerca gregaria*, Forsk., were present in that part of Nigeria lying to the north of the 12th parallel N. in April and May 1931; but, there is no evidence that *Schistocerca* either bred or caused damage to crops.

Occasional swarms of the Tree Locust, *Anacridium moestum melanorhodon*, Walk., have been reported from the north-western corner of Nigeria; but this species was not responsible for any damage to crops.

EXPLORATION OF SUSPECTED OUTBREAK CENTRES.

In June 1929, an elephant-hunter saw swarms of an unidentified species of locust migrating south-westwards to the central portion of the Nigerian shore of Lake Chad. These swarms settled and bred in this area. The presence of locusts in the Chad area some six months before the main invasion occurred led to Chad being regarded as a possible outbreak centre of *Locusta*. The discovery of numerous bands of *Nomadacris* hoppers in the southern half of Nigerian Chad in 1930 was the first record of the mass occurrence of the Red Locust in West Africa. As there was no evidence that swarms had migrated to Chad from the outbreak centre south of the equator it seemed probable that the bands were derived from solitary individuals locally.

In October and November, 1931, a preliminary survey was made of the shores of Nigerian Chad. It was found that *Nomadacris* was confined to the southern half of the shore and was associated with a tall grass, *Cymbopogon giganteus*, Chiov., which is absent from the northern part of the lake shore. *Locusta* adults of phases *solitaria* and *transiens* (*dissocians*) were found near the northern frontier and in the southern part of the shore. In June and July each year, *Locusta* swarms arrive from the south-west and breed in the Chad area, so it was impossible to say whether the solitary adults were derived from hoppers surviving the anti-hopper campaigns of 1930 and 1931 or, were the descendants of a permanent *solitaria* population. During the survey a site for a laboratory was selected at Kalkala near the south-western corner of the lake.

During the first six months of 1933 an ecological survey was made of the twelve square miles surrounding Kalkala. From January to April, the *Nomadacris* adults remained in *Cymbopogon* and other tall grasses. Shortly before the rains began in mid-May they commenced to spread from the tall grass areas into short grass and open farmland. Copulation was first

observed on June 20th. Phases *solitaria* and *transiens* (*dissocians*) of *Locusta* were present until mid-March though the number of individuals of both was small. From mid-March to the end of May only *solitaria* was present. Burning and grazing of the grass continually disturbed the locusts which were almost annihilated by Carmine Bee-eaters (*Merops nubicus nubicus*).

It was concluded that the Chad area is unlikely to be an outbreak centre of *Locusta* and that it was probable that conditions there are unsuitable for the production of the gregarious phase of *Nomadacris*.

The ecological survey at Kalkala was continued from September 1933, to January 1934, and from May to October 1934. In addition, a survey was made of a large section of the northern shore which had not been examined in 1931. As a result of this work it was concluded that the region from Kalkala eastwards to the French Cameroun frontier was probably merely the western fringe of a potential outbreak centre of *Nomadacris*. The Red Locust was found to absent from the northern half of British Chad and it was considered that conditions were unfavourable in that part of the southern shore lying to the north of Kalkala. Breeding began on June 1st, 1934. and oviposition was observed on the 16th of that month. As a result of a drought from mid-June to mid-July few hoppers emerged, and the Red Locust reverted to the solitary phase in the Chad area.

An interesting feature of this study was the discovery of *Nomadacris* adults in late October 1934, in areas some 30 miles to the south of the lake.

In May 1935, an entomologist was attached to a French locust mission and the southern shore of Chad was explored from the French Cameroun frontier eastwards to the south-east corner of the lake. Not a single specimen of *Nomadacris* was seen and the wooded character of this part of the shore makes it highly improbable that it is an outbreak centre of the Red Locust. At the conclusion of this work, a visit was paid to Kalkala and it was found that the solitary phase of *Nomadacris* has now become extremely rare in that district. It is possible that the energetic locust campaigns of 1930 and 1931, when about 20 Europeans were engaged in control work in the Chad area, prevented *Nomadacris* from attaining the swarming phase.

From April to September 1932, an entomologist explored the outbreak centre of *Locusta* in the Middle Niger region of French Soudan. The results of this work have not yet been published. The area was subsequently examined by a French locust mission.

FUTURE RESEARCH WORK.

In the near future it is proposed to examine certain marshes in the Bornu and Adamawa Provinces in order to determine the range of *Nomadacris* in Nigeria. It is possible that one or more of these marshes may prove to be a potential outbreak centre.

Every year it is proposed to visit the Chad area with the object of observing the *Nomadacris* population and of organising an anti-hopper campaign should there be any sign of transition from the solitary to the gregarious phase. After *Locusta* has reverted to the solitary phase, these annual visits will afford an opportunity of determining whether this species exists in the Chad area during the intervals between outbreaks.

THE EFFECT OF CLIMATE ON MIGRATION AND BREEDING.

Monthly maps showing the movements of *Locusta* swarms in Nigeria have been prepared since the beginning of the infestation in 1929. The swarm movements are studied in conjunction with climatic factors. As a result of such a study (for the first 17 months of the infestation) an entomologist concluded that with very few exceptions, swarms remain where the mean relative humidity (9 a.m., L.M.T.) is not more than 85% and not less than 40%. This worker also studied the effect of climate upon breeding and concluded that breeding does not commence after the dry season until the humidity rises to 65% and the degree of wetness (total monthly rainfall × number of days on which rain fell ÷ 10) reaches 2.

A similar study is now being made of the data available for the first five years of the infestation.

Other branches of research are the biometrical study of adult locusts and the testing of various poisoned baits for use against hopper bands.