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Sense Organs in the Antennae of *Anopheles Maculipennis Atroparvus* (v. THIEL), and their Possible Function in Relation to the Attraction of Female Mosquito to Man.

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Contents

I. Introduction.

Mosquitoes are responsible for the transmission of several human diseases. Intensive investigations have been undertaken in many countries on mosquito repellents capable of protecting mankind against these vectors. The repellent substance must not only possess intrinsic repellency; it must be able to offset the attractive stimuli of man. This explains the revival of interest in the nature of the stimuli that attract mosquitoes to their hosts. Research workers in this field have shown that body odour, moisture, temperature and carbon dioxide emanating from the host are the main responsible factors.

For several years the Swiss Tropical Institute has been working on this problem. RAHM (1956-1958) conducted experiments which determined the effect of these factors on the attraction of the female mosquito *Aedes aegypti*.

Once it had been established that these factors did actually have the power of attracting the mosquito, other types of experiments were made with the aim of discovering the sense organs in the insect which receive these stimuli from a considerable distance and guide the mosquito to its host. ROTH (1951), ROTH and

WILLIS (1952) and RAHM (1958) proved that the antennae are the sites of these sense organs.

In order to continue this work and in view of the importance of female anopheline mosquitoes for the transmission of malaria, a study of the morpho-histology, distribution and quantitative record of the sense organs in the antennae of *Anopheles maculipennis atroparvus* (v. THIEL), has been carried out by the author and will be described in the present paper. The study was followed by experiments designed to identify the possible chemo-, hygro- and thermo-receptors by cutting the antennae at different levels and exposing the operated mosquitoes to an air stream loaded with the different factors. The behaviour of the amputated mosquitoes was recorded quantitatively and compared with the distribution and number of the different types of sense organs in the antennal segments.

The author was also anxious to study the sense organs, as well as their distribution and number, in the antenna of the male mosquito in order to obtain a clear picture of the differences in both sexes.

II. Previous Investigations of the Role Played by the Host and the Female Mosquito in the Attraction.

In discussing the attraction of the female mosquito to the host we must remember that the process is twofold. On the one hand, the host emits from his body the necessary stimuli, and on the other, the mosquito receives these stimuli through its sense organs and is directed by the latter towards their source.

A. The host.

It is a known fact that the female mosquito does not approach and attack the host as an act of volition—in a search for food, for example—but because it responds to a number of factors introduced by the host into the environment, each of which might be a stimulus that the mosquito makes use of. These factors can be divided into: 1. Optical factors. 2. Physical factors (heat, moisture, etc.). 3. Chemical factors (carbon dioxide and other volatile substances which we may call "odours").

1. Optical factors.

As regards guiding the mosquito to the host, optical factors are not of primary importance either in Anopheles, which is a nocturnal insect, or even in Aedes, which is active in the daytime. It has been proved that mosquitoes are capable of finding man in total darkness. ROTH (1951), by covering the eyes of female *Aedes aegypti* with a layer of shellac rendered opaque with carbon dioxide, found that the eyes are not necessary for locating the host. The experiments of WILLIS (1947) showed that female *Aedes aegypti* and *Anopheles quadrimaculatus* will orient themselves towards an air stream loaded with human body odour in the dark chamber of an olfactometer.

2. Physical factors.

Heat: Attempts have long been made to find the causes which excite the insects to attack. HOWLETT (1910) was one of the first workers in this field. He found that if a test tube filled with hot water is put close to a cage containing