THE TARSAL CHEMICAL SENSE OF THE SCREW WORM FLY, *COCHLIOMYIA MACELLARIA* FAB.

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In 1921 Minnich found that the tarsi of *Pyrameis atalanta* Linn. and of *Vanessa antiopa* Linn. are sensitive to certain soluble compounds. He (1922) further demonstrated that a variety of compounds, when applied to the tarsi, result in an extension of the proboscis. Under some conditions even distilled water gave this result. The threshold varies with the physiological state of the animal. In 1926 Minnich also published a paper demonstrating that *Phormia regina* Meigen, *P. terræ-novæ* R. D., and *Lucilia sericata* Meigen also have this tarsal sense. These flies distinguish between water, paraffin oil, and saccharose solution by means of the tarsi and the oral lobes of the probosces.

The chemical senses of the screw worm fly (*Cochliomyia macellaria* Fab.) have been much studied and discussed, but owing to the fact that this work has been concerned with purely practical results, it has not greatly clarified the problem. (See U. S. D. A. Bul. No. 1472). While working for the Bureau of Entomology during the summer of 1928, it occurred to me that in order to study properly the chemical senses of these insects, separation of contact and distance stimuli was necessary. The short time at my disposal was accordingly devoted to the demonstration and study of tarsal receptivity.

Newly emerged flies were constantly available, and these were generally used. As these young flies were very restless, it was often necessary to defer the tests to the day following emergence. In no case were flies over twenty-four hours of age used in the first series of tests. Each fly was put into a shell vial (2.5 x 10 cm.), the open end of which was then closed with a single layer of cheese cloth held in place by a rubber band. Each fly was tested by wetting the cloth with the test substance. Extension of the proboscis was recorded as a positive response; the converse was considered negative. Flies that extended the proboscis before stepping upon the cloth were marked positive to

water vapor, and those not so responding were considered negative. This served as a check on the contact responses of the insects. The contact water tests served as a check on the responses to sugar solution.

Flies received no water until the first test. For flies tested the day after emergence this time interval was twenty-four hours; otherwise it was about four hours after emergence. Experience soon developed the fact that flies kept for a few hours without water, almost without exception extended the proboscis as soon as their tarsi encountered moisture. Such flies were said to be *water sensitized.* The only difficulty encountered was the general restlessness of the insects; this made it necessary to extend the period of water inanition, in many cases, to the following day. The only effect this had was to quiet the flies. There was no essential difference in their responses, from those kept for shorter periods without water.

The same flies were then given an abundance of water and tested again, usually about half an hour later. Such flies did not usually respond by proboscis extension. They are hence described as *water non-sensitized.* None of these flies were given food until tested with sugar solution. They were tested immediately after becoming *water non-sensitized,* that is, immediately after the tests just described. This interval probably never exceeded thirty minutes. Flies that were *water non-sensitized* were therefore *sugar sensitized.* They responded to sugar solution but not to pure water. All flies were carried through the three tests.

All the water used in the tests was distilled. The sugar solution consisted of 10 gms. of sucrose in 100 c. c. of water. Tests were also made with a solution of urea (5 gms. in 100 c. c. of water). No preliminary tests were made for vapor reactions with urea, but the flies were all *water non-sensitized.* A nearly equal number of male and female flies were used. Hypersensitive specimens were discarded.

The following is a summary of the response data with water and with sugar solution:

	Vapor		Liquid	
Water sensitized	Positive	Negative	Positive	Negative
Number (of flies)	7	190	173	24
Percent	3.5	96.5	97.9	12.1
Water non-sensitized				
Number	10	198	32	176
Percent	4.8	95.2	10.5	98.5
Sugar sentized				
Number	7	209	198	18
Percent	3.2	96.8	91.7	8.3

All flies tested while *water sensitized* were used in the other tests. The experiments with urea gave the following results:

	Positive	Negative
Number	5	44
Percent	3.2	89.1

The fact that the sexes were almost equal in number, and that they responded equally, indicates that there can be no great difference between them as regards this sense. The data given indicates that water vapor was not an important factor in initiating responses. The feeding reactions of the flies depended upon physiological states; those kept from four to twenty-four hours without water gave more reponses than those which had taken in water within thirty minutes. A comparison of the contact responses demonstrates that the flies easily distinguish between pure water and the sucrose solution.

The results of the experiments with urea were unexpected. Not only did the specimens fail to give a feeding response; they apparently made violent efforts to escape continued contact with the solution. Urea is very bitter to human end organs, and it

may have a similar effect upon the tarsal organs of the flies. Flies are not attracted to a solution of pure urea.

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