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Response of Insects to Ultraviolet Light as Compared to White Light and Observation of Other Factors Involved in their Response, Part 2

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RESPONSE OF INSECTS TO ULTRAVIOLET LIGHT AS COMPARED TO WHITE LIGHT AND OBSERVATION OF OTHER FACTORS INVOLVED IN THEIR RESPONSE

PART II

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INTRODUCTION

This paper is not intended to be a conventional "lab" report. What I intend to do is to present what I did, how I did it and to make some conclusions as to the "why". I do not mean to be antagonistic or to be bucking the system.

The experiment was a simple one. My results were also relatively simple and they need not be stuffed into a voluminous technical report. I am not an entomologist nor do I pretend to be an authority on the subject.

The experiment was born of a simple interest in the reaction of insects to different wavelengths of light. Since I have had no formal training in the subject of entomology my conclusions are also simple and may appear (to those who have studied in the area) to be rather naive. Even though my results are simple, they are positive. They are a definite improvement over the runs made during the Fall of 1973 and the Spring of 1974

The report will be presented in this order.

I. Purpose

II. Methods and Apparatus

III. Observations and Conclusions

IV. Data

V. Graphs

I. Purpose

The goal of this experiment was to confirm the response of insects to ultraviolet light as compared to white light. This is the data collecting portion of the experiment.

Another equally important objective was simply to observe and record the insects' response to the light and their relation to factors other than the light itself. The possibility of a connection between the number of insects attracted to the light and the intensity of the moonlight was not thought of until later in the experiment.

To develop my powers of observation was an important goal. Any type of research is more than simply data collection; although data collection is an important part.

II. Methods and Apparatus

The method of determining the degree of response to the different wavelengths of light was to set up a light source and then record the number of insects that came to the light.

Two types of apparatus were used, as shown on page 5. The apparatus used for the ultraviolet light was located in an outdoor nightclub. While I was eating at the club one night I noticed that the apparatus could be used to count the insects attracted. Each time an insect came to the light it would come into contact with the electrified wires which surrounded it.(refer to page 5 for diagram). As it touched the wires it would pop and crackle and give off a flash of light. I had intended to make my own apparatus but this light seemed to be so suitable that I decided to use it to count the insects attracted to the ultraviolet light. It was already equipped with two twenty watt ultraviolet light bulbs.

Since I couldn't use it for the white light I put together the rather simple apparatus shown on page 5 to use for the white light.

The equipment was changed because the equipment used in the Fall of 1973 and Spring of 1974 could not be taken to the Philippines. This experiment, made during the Summer of 1974, was made on the Island of Mindanao in the Republic of the Philippines.

The fact that more insects were attracted does not necessarily mean that the newer apparatus was more efficient. In this case there were simply more insects present in the Asian location than in Arkadelphia, Arkansas, where the earlier runs had been made. Refer to accompanying Lab Report for Data collected in Arkadelphia.

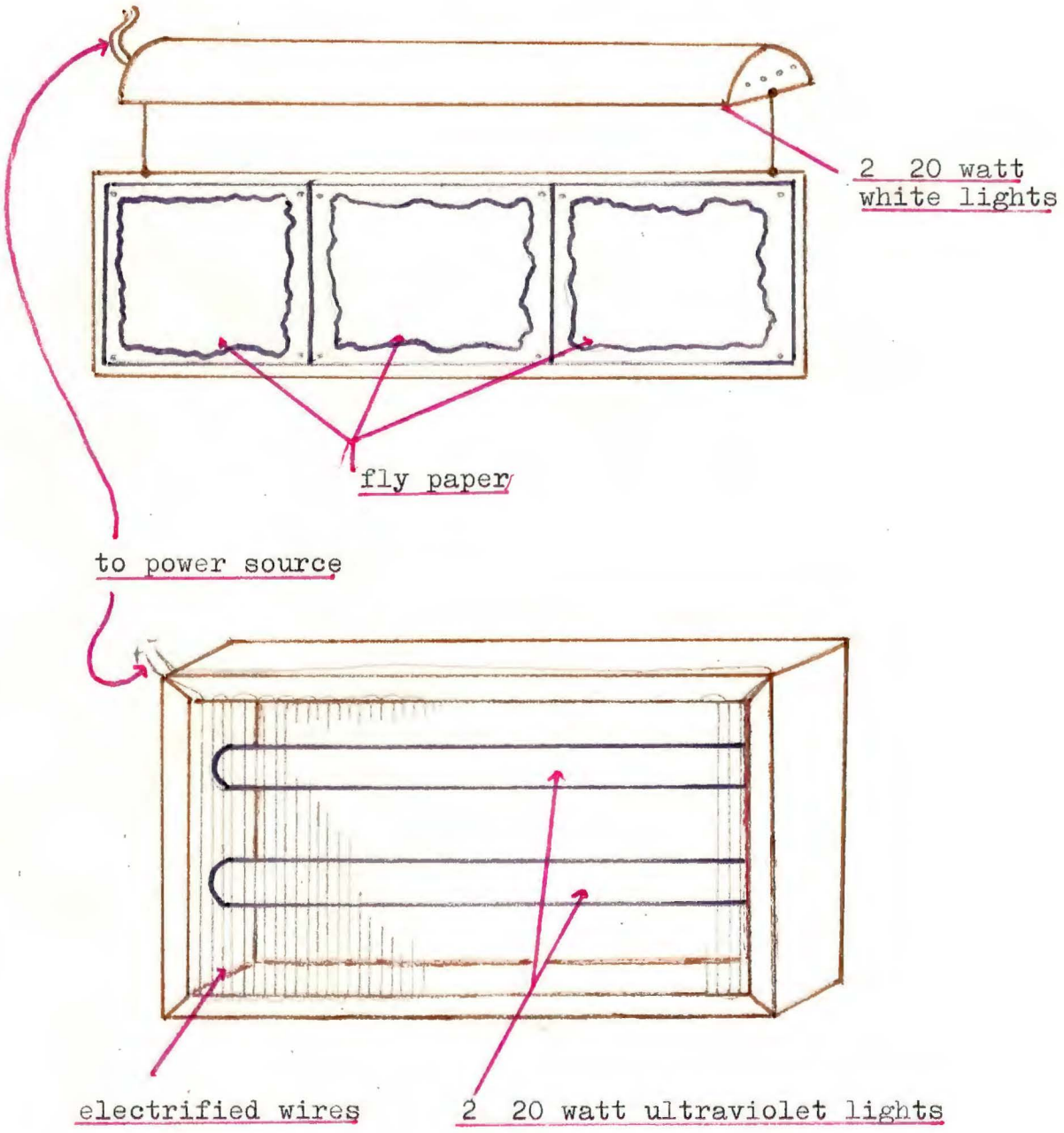
With the newer apparatus it was impractical to classify the insects collected. Once the insect made contact with the electrified wires there remained little left of the insect.

As for classifying the insects attracted to the white light,it was impractical to remove the insects from the sticky substance after they had been captured. When I attempted to take an insect off, a portion of it would always remain stuck. The wings were especially hard to remove. Refer to page 5 for a diagram of the apparatus used to collect the insects attracted to the white light.

The insects captured by the fly paper were counted after each time period and the increase recorded as the catch for that period. New fly paper was used every night.

APPARATUS: 2 20 watt ultraviolet light bulbs
2 20 watt white light bulbs
fly paper (manufactured by Haneta Inc., Tokoyo)
thermometer
relative humidity gauge
(the air control tower was consulted for wind speed)

DIAGRAMS OF APPARATUS



III. Observations and Conclusions

A. Location

The insects were attracted from a swampy field of about two acres. The majority of the field was covered with Cogan grass; a species of wild grass which grows to an average height of about eleven feet. As mentioned previously, the experiment was made near the city of Davao, on the Island of Mindanao, in the Republic of the Philippines. It is an excellent habitat for insects.

It also happens to be an excellent habitat for large frogs, which help to keep down the insect population (especially the mosquitoes).

The lights were placed at about 12' off the ground. The height was necessary to keep the lights from being obscured by the Cogan grass.

B. Other Factors

There were few other lights present in the catch area that would attract any considerable amount of insects away from the light source. The only lights in the area were small 3" kerosene lamps which were placed on each table in the night-club. These only gave light to an area of about three feet in area.

The possibility of food aromas attracting insects was also minimal. The food was prepared in a small kitchen located 75' from the ultraviolet light. There were also some nipa(dried coconut leaves)partitions between the kitchen and the light source.

The temperature range was between 79 and 86 degrees Fahrenheit. The relative humidity ranged between 80% and 85%. The winds were never more than 5 or 6 miles per hour.

On three occasions it rained during the experiment. Refer to pages 13 & 14 for graphs. The data shows a decrease in catch during the rain and an increase shortly after. In my opinion the rain made it difficult for the insects to reach the light source. The rain also hastened the insects life cycle, resulting in more adult flying insects. This would explain the increase in catch number after the rain.

Since the temperature, relative humidity and the wind speed were relatively constant they would have a negligible effect on the catch number.

Another factor which I think is very important is the intensity of the moonlight. If the nights are cloudy, if the moon is not visible, or if it is in a first or last quarter, there will be more insects attracted to the light source. When the moon is bright there seems to be more insects in the air, but less actually attracted to the light source. Refer to data on pages 10 & 11 and graph on page 12.

It is my opinion that this variance is due to the relative intensities of the light sources. When the moon is bright the insects are attracted by it and will tend to fly around more, but less insects will actually be attracted to my light sources.

When it is cloudy or when the moonlight is not very bright more insects will be attracted to my light sources.

It was also observed that some insects will actually fly into the light whereas others will come within in a certain distance and remain there. The catches recorded in the data are only those insects that would have come into contact with the bulbs.

Obviously some insects have a preference regarding the intensity - some preferring the greater intensity and some the lesser. A good question would be-why? Unfortunately I have no answer for this question. A detailed experiment would have to be designed to measure the response of the light-sensitive epithelial cells and the cells in the insects rhabdomere.

C. General Conclusions

A general conclusion can be made regarding the response of insects to ultraviolet and white light. There are more insects that are attracted to the ultraviolet region than to white light. Refer to graphs on pages 12 & 13. This is a positive confirmation of the theory.

In general, insects are more responsive to ultraviolet light than to white light. There is also a connection between the intensity of the moonlight and the catch number. This is most likely a relative relationship depending upon the intensities of the light sources.

It seems a bit ironical that in this experiment, which was designed mainly to answer one question, I have come up with more questions than answers. One can observe many facts but still not know why they happen. Why is the insect more responsive to ultraviolet light than to white light? Why are more insects in the air after a rain? Why are more insects attracted to a light source on a cloudy night? The insects actions have been recorded, but the fact of "why" remains to be answered through future experiments.

V. Data

Each column contains the number of insects caught, in a series of five-minute periods, for one evening. Below each column is the total for that evening and the average number attracted in one period.

A. White Light
Columns I, V, VI - clear night, bright moon
III, IV, VII - cloudy night
II - partly cloudy

I		II		III	IV	
17	16	22	19	8	7	31
14	13	38	15	5	17	17
12	12	0	17	4	8	19
9	21	6	22	7	5	32
21	15	10	21	17	15	20
14	6	13	8	17	21	16
15	5	11	16	10	12	13
12	12	11	20	15	9	23
8	8	10	0	15	12	425
21	7	9	14	19	16	13.7
5	5	7	9	22	15	
17	452	4	12	17	21	
14	13.3	6	505	28	6	
21		9	14.4	12	4	
16		9		22	3	
18		22		8	9	
12		21		7	5	
9		24		19	5	
11		25		14	9	
8		23		21	12	
15		17		31	6	
22		21		318	14	
21		14		15.14	23	

V		VI		VII	
14	12	22	8	15	29
21	17	16	13	12	12
6	19	9	9	16	16
4	6	12	8	23	9
9	14	12	7	17	11
12	12	17	12	32	14
7	11	6	10	12	27
12	8	13	10	17	16
6	16	11	15	19	128
5	231	22	6	14	388
13	11.0	16	9	26	17.6
7		5	269	31	
			11.7		

B. Ultraviolet light
Columns II,VI - clear, bright moon, full moon
I, III, V - cloudy, no moon
IV - partly cloudy

I	II	III
61	60	39
35	49	62
82	34	46
76	27	44
53	48	66
59	33	61
48	84	59
83	46	82
82	25	61
74	78	47
69	62	61
76	43	65
54	32	33
35	41	31
72	30	33
102	56	52
57	41	27
46	44	46
61	64	37
63	62	42
49	53	51
38	64	95
1375	49	89
62.5	84	89
	1209	72
	50.4	94
		106
		53
		47
		1657
		57.13

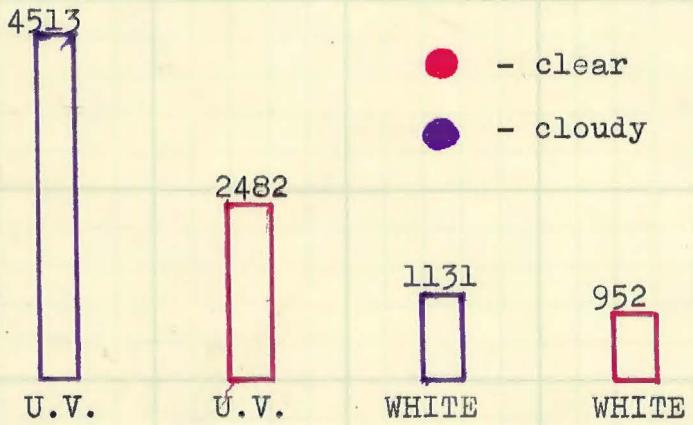
IV		V		VI	
56	39	49	46	49	52
36	46	63	84	84	87
92	1142	74	76	76	52
52	60.1	36	45	33	49
59		84	52	28	56
56		72	61	48	58
104		95	1581	33	48
56		63	67.32	64	62
89		47		43	1273
36		86		45	53.04
78		72		53	
65		63		49	
61		107		65	
84		49		42	
59		69		31	
32		88		66	

C. Analysis

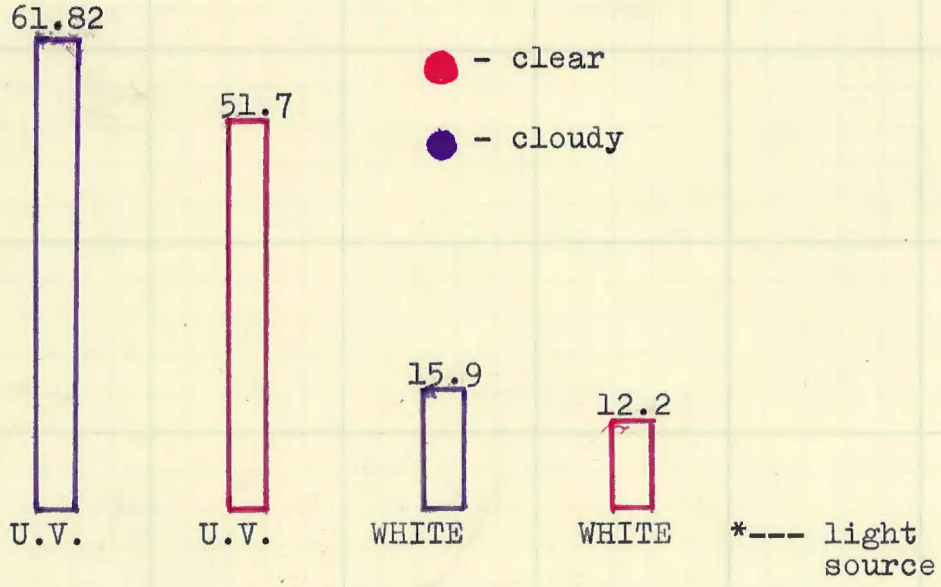
light source	No. of insects attracted
U.V.	8,137
WHITE	2,588

Average no. attracted in 5 minutes

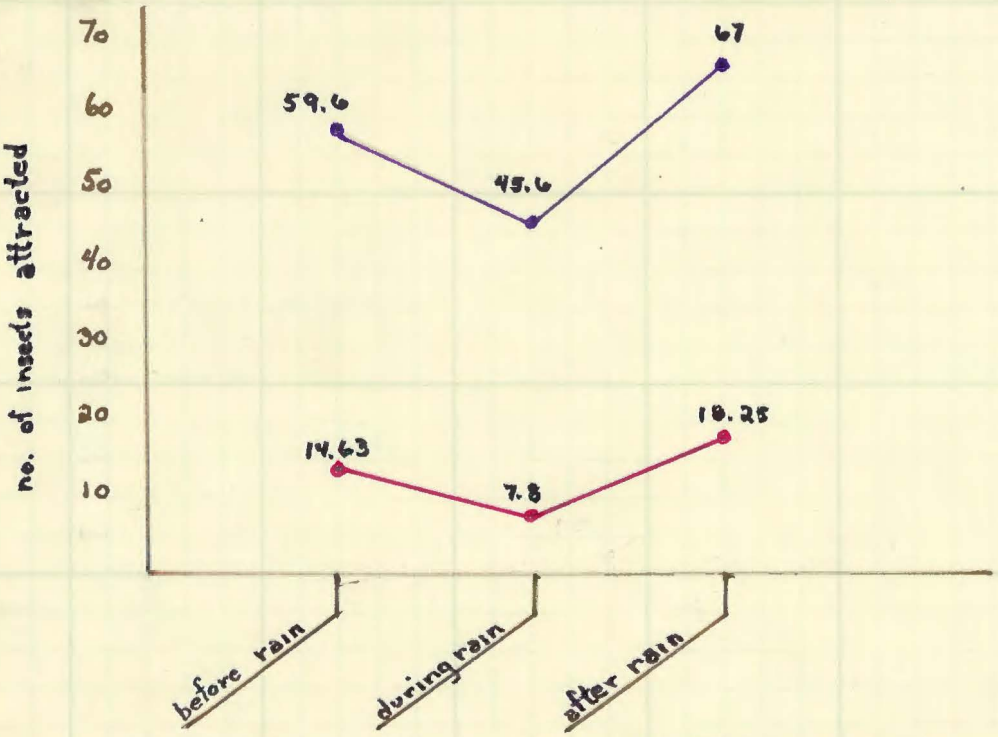
U.V.	58.12
WHITE	14.06



Relationship between light source, amount of moonlight, and number of insects attracted.

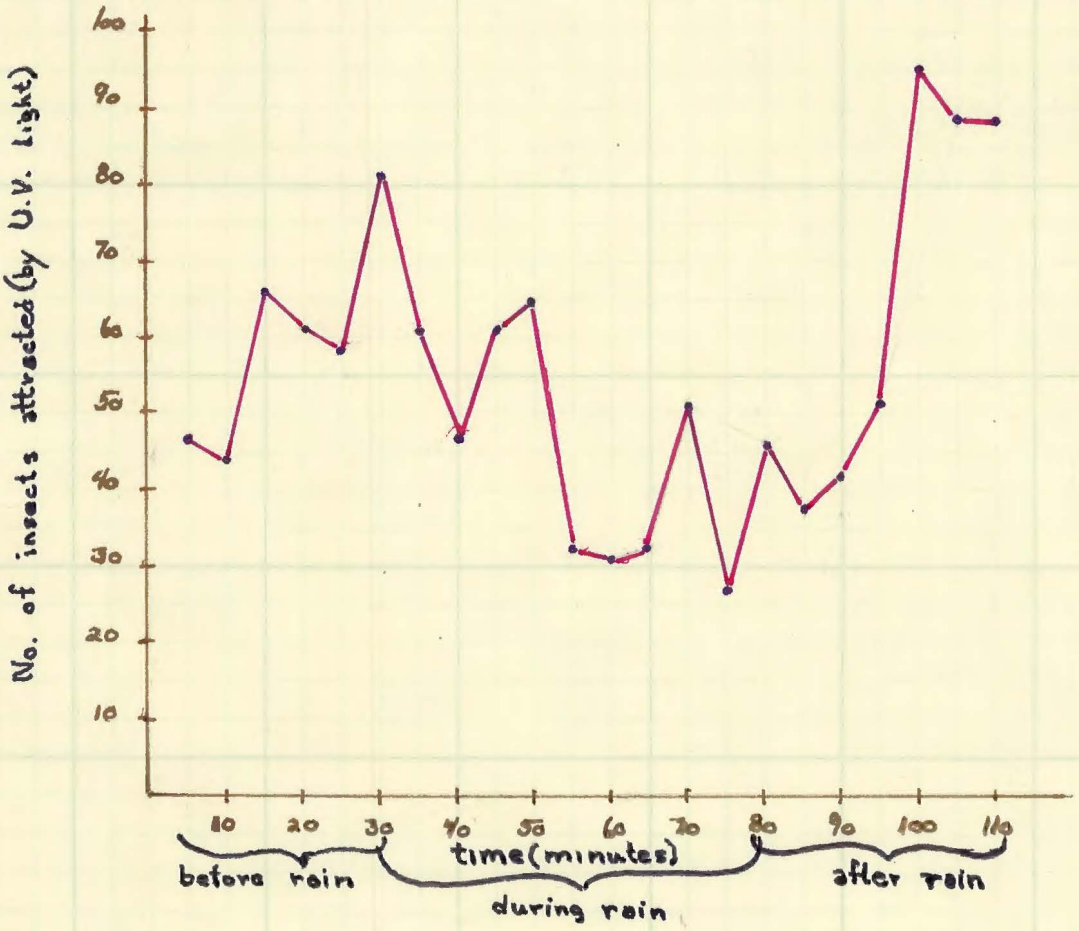


Relationship between average number of insects, caught in five minutes, to light source and amount of moonlight.



Relationship between rain, light source and number of insects caught.

Ultraviolet light
white light



Graph showing actual number (not averages) of insects attracted by ultraviolet light during 110 minutes. This includes 30 minutes before and after the rain. Refer to Data, Part B, column III.