THE RHINOCEROS BEETLE *(ORYCTES RHINOCEROS L)* IN CEYLON

PART II B—Phototaxic Responses of *(Oryctes rhinoceros L)*

"No light" versus "coloured light"

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Introduction

Part II A of this study by the senior author, dealt with the responses of *Oryctes* to a choice of light transmitted through ground glass and coloured light emitted from a series of filters used in the experiment. The present study was undertaken in order to ascertain whether *Oryctes* preferred darkness to the same series of coloured light, as emitted through the filters, used in the previous experiment.

Materials and Methods

The apparatus, the filters and the method employed were the same as described in Part II A of this work.

Design of Experiment

First replicate—

Left hand side	*Right hand side*		*Left hand side*	*Right hand side*
No light	Dark red	—	No light	Day light blue
Dark blue	No light	—	Dark green	No light
No light	Day neutral	—	No light	Light neutral
Light red	No light	—	Light green	No light
No light	Purple	—	No light	Orange
Yellow	No light	—	Ground glass	No light

Second replicate—

Dark red	No light	—	Day light blue	No light
No light	Dark blue	—	No light	Dark green
Day neutral	No light	—	Light neutral	No light
No light	Light red	—	No light	Light green
Purple	No light	—	Orange	No light
No light	Yellow	—	No light	Ground glass

Third replicate—

No light	Dark red	—	No light	Day light blue
Dark blue	No light	—	Dark green	No light
No light	Day neutral	—	No light	Light neutral
Light red	No light	—	Light green	No light
No light	Purple	—	No light	Orange
Yellow	No light	—	Ground glass	No light

No pre-determined sequence of use of filters was employed.

The results obtained are tabulated below in Table I.

TABLE I

Beetle counts taken in the three compartments of the apparatus during the 24-hour periods of exposure

Replicate	*No. of beetles used*			*No. of beetles collected in NO LIGHT Compartment*			*No. of beetles collected in coloured LIGHT Compartment*		
	Total	♂ *Male*	♀ *Female*	*Total*	♂ *Male*	♀ *Female*	*Total*	♂ *Male*	♀ *Female*
							Dark Red		
1 ..	24	10	14	19	7	12	3	2	1
2 ..	16	4	12	7	2	5	7	2	5
3 ..	24	4	20	11	4	7	11	4	7
							Light Red		
1 ..	12	6	6	8	5	3	4	1	3
2 ..	12	5	7	8	3	5	3	1	2
3 ..	12	5	7	6	4	2	4	0	4
							Dark Blue		
1 ..	12	3	9	1	0	1	11	3	8
2 ..	12	1	11	7	0	6	2	0	2
3 ..	12	4	8	1	0	1	10	3	7
							Day Light Blue		
1 ..	12	5	7	7	2	5	1	1	0
2 ..	12	4	8	1	1	0	7	2	5
3 ..	12	3	9	6	1	5	1	0	1
							Day Neutral		
1 ..	12	6	6	7	4	3	5	2	3
2 ..	12	6	6	6	5	1	6	1	5
3 ..	12	6	6	6	2	4	5	2	3

Replicate	No. of beetles used			No. of beetles collected in NO LIGHT Compartment			No. of beetles collected in coloured LIGHT Compartment		
	Total	♂ Male	♀ Female	Total	♂ Male	♀ Female	Total	♂ Male	♀ Female
							Light Neutral		
1 ..	12	5	7	3	1	2	8	3	5
2 ..	12	6	6	8	3	5	1	1	0
3 ..	12	6	6	9	4	5	3	2	1
							Dark Green		
1 ..	12	6	6	7	2	5	0	0	0
2 ..	12	5	7	10	4	6	0	0	0
3 ..	12	6	6	5	2	3	4	2	2
							Light Green		
1 ..	12	6	6	4	1	3	8	5	3
2 ..	12	5	7	4	0	4	4	2	2
3 ..	12	6	6	4	3	1	5	1	4
							Orange		
1 ..	12	5	7	4	1	3	3	2	1
2 ..	12	6	6	4	2	2	4	3	1
3 ..	12	8	4	8	5	3	2	2	0
							Purple		
1 ..	12	6	6	10	5	5	1	0	1
2 ..	12	7	5	7	3	4	5	4	1
3 ..	12	6	6	3	2	1	1	0	1
							Yellow		
1 ..	12	3	9	1	0	1	10	3	7
2 ..	12	6	6	11	5	6	0	0	0
3 ..	12	9	3	5	4	1	3	2	1
							Ground Glass		
1 ..	12	5	7	5	0	5	3	2	1
2 ..	12	7	5	3	3	0	2	1	1
3 ..	12	6	6	4	2	2	5	2	3

No pre-determined sequence for use of coloured filters was employed. The filters were chosen at random. It will be noted that in this experiment ground glass was also compared with no light.

Analysis of the Results

The factor subjected to statistical treatment was the percentage of beetles attracted to the different colours. Although some colours were split up into components such as light and dark, for purposes of analysis, the factors were combined, just as in the analysis of the results of the previous experiment.

TABLE II

Percentage of beetles attracted to different colours

Colour	*Replicate* 1		*Replicate* 2		*Replicate* 3	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
Blue ..	50.0	50.0	40.0	36.8	42.9	47.1
Neutral (light and day) ..	45.5	61.5	16.7	41.7	33.3	33.3
Red ..	18.8	20.0	33.3	36.8	44.4	40.7
Green ..	41.7	25.0	20.0	14.3	25.0	50.0
Orange ..	40.0	14.3	50.0	16.7	25.0	0.0
Purple ..	0.0	16.7	57.1	20.0	0.0	16.7
Yellow ..	100.0	77.8	0.0	0.0	22.2	33.3

The above data was transformed into "natural sines" in order to ensure "normality of distribution".

Table III below gives the transformed data.

TABLE III

Percentage of beetles attracted to different* colours transformed into "natural sines"

Colour	*Replicate* 1		*Replicate* 2		*Replicate* 3	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
Blue ..	30	30	24	22	25	28
Neutral (light and day) ..	27	38	10	25	20	20
Red ..	11	12	20	22	26	24
Green ..	25	15	12	8	15	30
Orange ..	24	8	30	10	15	0
Purple ..	0	10	35	12	0	10
Yellow ..	90	51	0	0	13	20

*Units are in degrees.

TABLE IV

Analysis of Variance

Source	*D.F.*	*S.S.*	*M.S.*	*V.R.*
Replicate	2	852	426	1.56
Main effect				
Colour	6	1497	250	—
Sex	1	78	78	—
Interaction				
Colour × Sex ..	6	640	107	0
Error	26	7107	273	—
Total	41	10184	—	—

TABLE V

Treatment means " Colour "

Colour	*Mean*	
	Sine	%*
Red	19.2	32.9
Purple	11.2	19.4
Yellow	29.0	48.5
Blue	26.5	44.6
Neutral (light and day)	23.3	39.6
Orange	14.5	25.0
Green	17.5	30.1

Critical difference = 19.6 *Retransformed

TABLE VI

Treatment means " Sex "

Sex	*Mean*	
	Sine	%*
Male	21.5	36.7
Female	18.8	32.2

Critical difference = 10.5 *Retransformed

Results

(1) The main effects and the interactions are not even suggestive of significance.

(2) Percentage attraction to different colours shows no significant differences.

(3) There is no sex bias to colour.

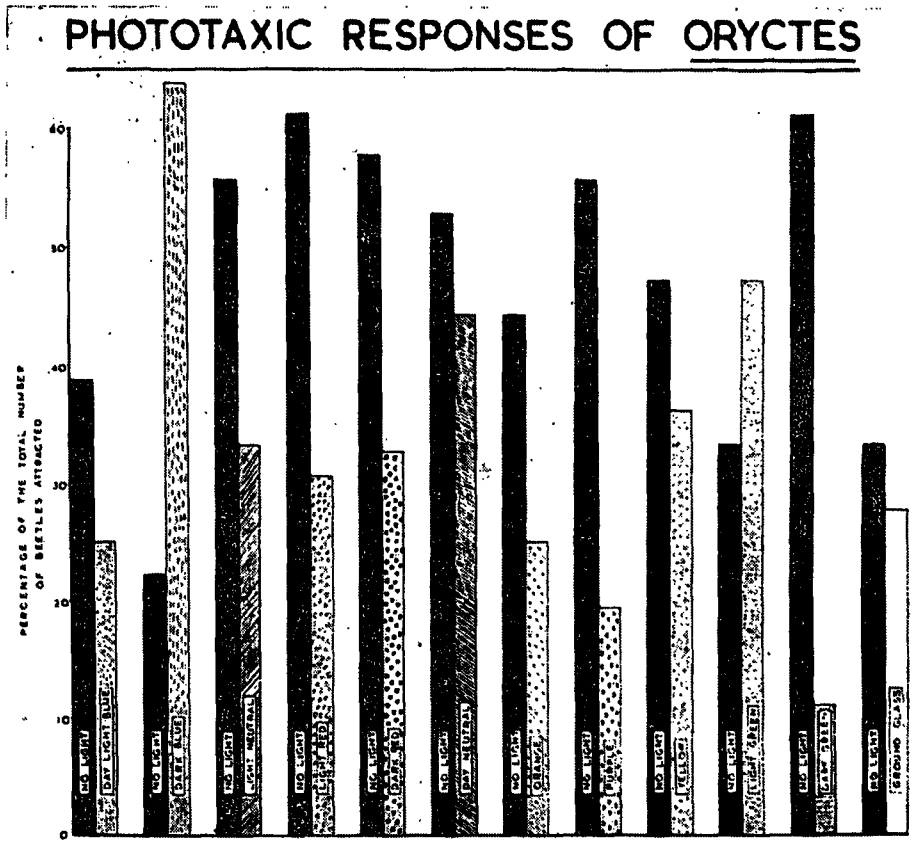

PLATE I

Responses of *Oryctes* when given the option of coloured light and darkness.

Discussion

In this experiment the same apparatus as well as an identical procedure was used as in the previous experiment described in Part II A. In this experiment we found out that when *Oryctes* were given the option between white light (as emitted through ground glass) and coloured light, they were found to move to red light and purple. We have in this experiment given *Oryctes* the option of no light (amounting almost to darkness) and coloured light and found that although they move towards blue light, the numbers in which they do so are not statistically significant.

Although it is known that flight of *Oryctes* takes place towards sun-set and after dusk, our findings do not reveal that the change of light intensity that occurs at sun-set is a stimulus initiating such flight. However, it must be in mind that the analysis of variance has certain limitations in that what we try to find out from it was what percentage of beetle from a given source would be attracted to either of the alternatives which were coloured light and no light. In Part II A we found that when beetles were given the option of white light and coloured light, from a source of beetles, more beetles were attracted to white light.

Since there is a change of intensity of light at the time flight takes place, and beetle flight does occur during this period we have carried the analysis further in order to ascertain what the pre-disposing factors are to beetle flight and to use these findings in light traps.

In Part II C we have analysed the figures comparing the percentage attracted to coloured light, ground glass and no light.

Summary

(1) Although *Oryctes* is attracted to blue light when given the option of coloured light and no light, the finding is not statistically significant.

(2) The presence of darkness has not been a necessary pre-requisite for the flight of *Oryctes*.

Acknowledgements

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References

(1) Goonewardene, H. F. — The Rhinoceros beetle (*Oryctes rhinoceros L.*) in Ceylon, Part II A, Phototaxic responses of *Oryctes rhinoceros L.* — white light versus coloured light.

(2) Goonewardene, H. F. — The Rhinoceros beetle (*Oryctes rhinoceros L.*) in Ceylon, Part II C, Phototaxic responses of *Oryctes rhinoceros L.* — comparative study of the responses to coloured light, no light and white light.