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## Spectral sensitivity in a fresh-water Gastrotrich (*Lepidodermella squamatum* Dujardin)[1]

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*Summary.* Confronted with a series of alternative choices between environmental lights of different wavelengths, *Lepidodermella squamatum* Dujardin (Gastrotricha) shows a selective sensitivity towards coloured lights, especially blue, in preference to white light.

The fresh-water forms of phylum Gastrotricha are lacking in eyes and definite photoceptors. The cephalic refractile bodies or 'eyespots' described in some species probably have a static rather than a photoceptor function.

Until now nothing was known about the responses of fresh-water Gastrotrichs to differing conditions of environmental light. Adult samples of *L. squamatum* were used with the aim to clarify this aspect of the physiology of these organisms. Their behaviour was tested by confronting them with a choice between 2 different coloured lights. The alternative choices were: white/red, white/green, white/blue, white/no light, red/green, red/blue, green/blue.

The behaviour of the animals was observed by using a transparent cylindrical plexiglass container, 3 mm deep, 8 mm in diameter. The container was illuminated from below by reflected light from a tungsten lamp, diffused by means of an emery screen. In order to colour 1 of the 2 half-fields, colour filters (Kodak gel No.29, red; No.47a, green; No.61, blue) of defined wavelength (figure 1) were inserted between the light source and the bottom of the container. The intensity of energy of the light in the 2 half-fields was measured on the vertical of the container by means of a Kipp & Zonen CA1 type compensated thermopile connected to a Hewlett Packard voltmeter mod. 419 DC Null, and rendered equal with neutral filters. In this way the animals were confronted with the choice between 2 half-fields illuminated by 2 lights of different wavelengths but equal energy intensity (except, of course, in the case of the choice between white and no light). All tests were performed in a darkened room in order to exclude influences from environmental light.

During the tests slight variations may have been found in the temperature of the water in the container, in spite of the use of reflected and diffused light and the brief duration of the individual tests: however, they should not have influenced the results, since all the filters employed were completely transparent to IR-rays.

7 series of different alternative choices were offered, each series consisting of 50, 30 or 20 tests. The differences in the numbers of tests were owing to the difficulty of collecting the Gastrotrichs, and their fragility, which ruled out excessive handling. Each test lasted 5 min: 5 Gastrotrichs were placed on the border between the 2 half-fields and the number of animals present in each half-field was recorded every min.

The sign test was carried out on the distribution values of the animals in the 2 half-fields measured after the 1st and 5th min of each observation.

In 3 of the series of choices shown in the table (Nos 1, 2 and 6) the distribution appears casual after 1 min, but no longer so after 5 min. In the first 2 cases the half-field preferred is the coloured one as against the white-lit one; in the 3rd, on choosing between red and blue, after 5 min the Gastrotrichs are observed to prefer the blue area (figure 2). However, in the choice between white and blue light and green and blue light the distribution after 1 min is found not to be casual, and in both cases the preference is for the blue half-field.

Lastly, the tests performed on the choices between white light and no light, and between red and green light, showed no significant differences in the distribution of the animals at the beginning and the end of the tests.

Taken together these results would seem to show that *L. squamatum* has a selective sensitivity to coloured lights, especially to blue light (400–500 nm) as opposed to white light: they point to a tendency on the part of the animals to

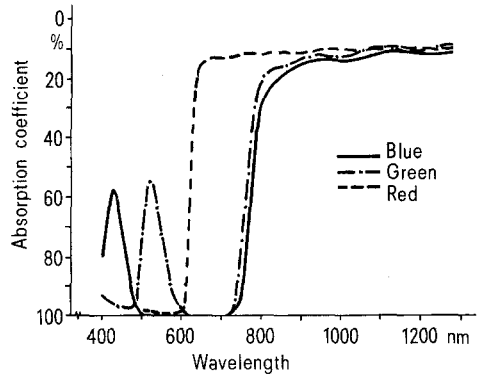


Fig. 1. Absorption curves of filters as a function of the wavelength of light.

Distribution of choices for each half-field by Gastrotrichs after 1 and 5 min in each series of observations and related probability values

| Experimental situation | No. of tests | 1st min | | 5th min | | p | p' |
|---|---|---|---|---|---|---|---|
| | | T | N | T | N | | |
| White/red | 50 | 26/24 | 126/124 | 11/39 | 89/161 | 0.10 | 0.00014 |
| White/green | 50 | 20/30 | 114/136 | 11/39 | 89/161 | 0.10 | 0.00014 |
| White/blue | 50 | 17/33 | 91/159 | 12/38 | 83/167 | 0.03 | 0.0004 |
| White/no light | 50 | 30/20 | 131/119 | 15/35 | 102/148 | 0.20 | 0.072 |
| Red/green | 20 | 8/12 | 43/57 | 11/9 | 51/49 | 0.504 | 0.824 |
| Red/blue | 30 | 12/18 | 69/89 | 6/24 | 56/94 | 0.181 | 0.002 |
| Green/blue | 20 | 4/16 | 37/63 | 1/19 | 24/76 | 0.012 | 0.002 |

T = Number of tests in which a majority of animals showed preference for one or the other of the half-fields after 1 min and 5 min from the start of the observations: N = number of animals observed in each half-field; p-p' = probabilities related to the values x or z in the sign test, assuming $H_0: P = Q = \frac{1}{2}$ ($\alpha = 0.05$), respectively after 1 and 5 min.

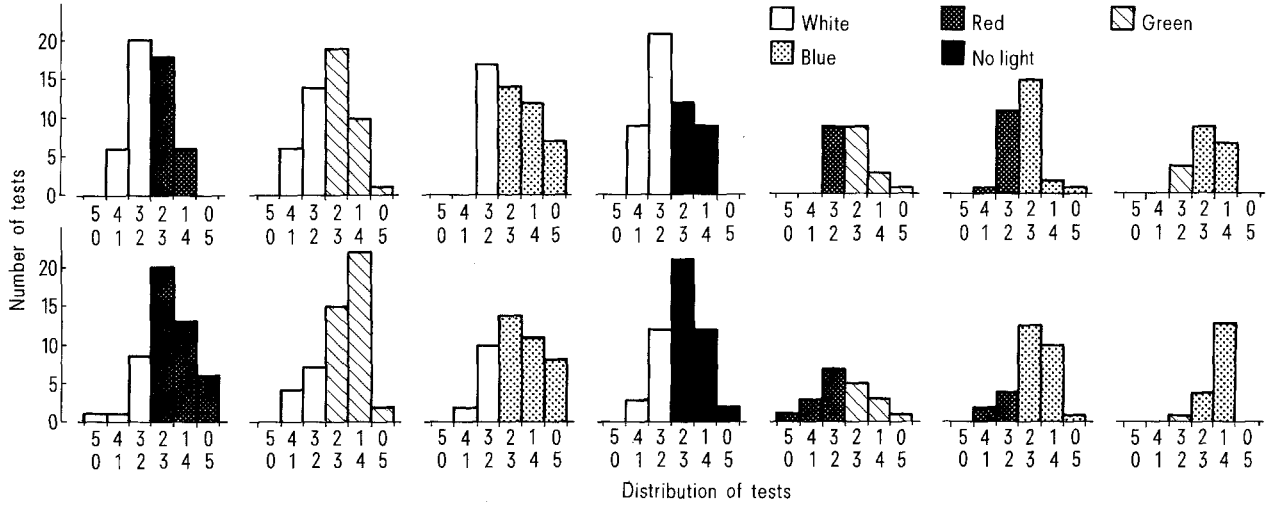


Fig. 2. Distribution of the results of the tests on the choice between pairs of coloured lights made by groups of 5 Gastrotrichs at the 1st min and 5th min of observation time.
The 2 series of values on the abscissa for each histogram represent the distribution in each of the 2 half-fields of the 5 Gastrotrichs used in the individual tests. For each pair of colours the decreasing values refer to the half-field whose colour appears on the left part of the histogram and vice versa. On the vertical axis is the number of tests in which a definite distribution was observed.

choose partial spectra in the direction of the shorter wavelengths rather than a continuous spectrum.

Since no other experiment of this type has hitherto been performed on Gastrotrichs, comparisons can only be made with observations recorded on Rotifers, which are systematically close to Gastrotrichs; nevertheless it must be borne in mind that almost all the species of Rotifers studied are provided with more or less developed pigmented ocella, which enables them to react to light stimuli in a more complex directional manner than the Gastrotrichs which lack these structures.

An increase in photosensitivity on diminishing the wavelength of the light has been observed by Viaud[3-5] in the phototactic behaviour of Rotifers. In their phototactic reaction Viaud points out, on the one hand, the capability for orientation which depends on the ocellus; on the other hand, a positive motor pulsion which is also found in blind species or those with rudimentary ocella *(Asplanchna, Hydatina)*. Viaud attributes the responsibility for this 2nd characteristic to a 'sens dermatoptique' not ascribable to any definite photoceptor but peculiar to the teguments.

The spectral sensitivity of 3 species of Rotifers was tested according to their positive phototactic reactions by Menzel and Roth[7]. They found that this sensitivity increased in reaction to the green (540 nm) and blue bands (460-440 nm) of the visible spectrum, and to the UV. They too suggest the existence of a 'dermal light sense'.

The spectral selective sensitivity towards the blue band (400-500 nm) shown by *L. squamatum* cannot be ascribed to definite photoceptors, but, rather, to a generalized type of photosensitivity analogous to the one found in some Rotifers.

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