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# A predictive model for color pattern formation in the butterfly wing of *Papilio dardanus*

*This paper is dedicated to Professor Masayasu Mimura on his sixtieth birthday.*

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Previously, we have proposed a mathematical model based on a modified Turing mechanism to account for pigmentation patterning in the butterfly wing of *Papilio dardanus*, well-known for the spectacular phenotypic polymorphism in the female of the species (Sekimura, *et al.*, Proc. Roy. Soc. Lond. **B 267**, 851–859 (2000)). In the present paper, we use our model to predict the outcome of a number of different types of cutting experiments and compare our results with those of a model based on different hypotheses.

## 1. Introduction

Pigmentation patterns on lepidopteran wings, which cover the whole dorsal and ventral wing monolayers, can be complicated in structure and they are sometimes used for identification of species. However, owing to the pioneering work of Schwanwitsch (1924) and Süffert (1927) on the nymphalid ground plan, the complicated patterns on the wings can be understood as a composite of a relatively small number of pattern elements (for details, see Nijhout, 1991). In spite of these simplifications, the problem of color pattern formation in wings is still not fully resolved and there exist few mathematical models to account for the diversity of color pattern in wings except for some specific features.

Among them, the development of eyespot patterns is the best understood mechanism at present. Nijhout (1990) presented a model for eyespot formation based on experimental evidence, in which a spatial distribution of sources and sinks of pattern organisers is firstly set up and the organising centers induce color patterns in their surroundings. Nijhout succeeded in producing point-like patterns in the exact locations of the organizing centers by an activator-inhibitor mechanism (Meinhardt, 1982) that assumes that the

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