Locomotion of *Amoeba proteus* After Standardizing Its Body Shape

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Summary

*Amoeba proteus* obliged to follow dark stripes in the form of Y may be studied in three repeatable simple configurations: 1. tail + 1 advancing front, 2. tail + 2 advancing pseudopodia, 3. tail + 1 advancing pseudopodium + 1 contracting pseudopodium. Formation of two advancing pseudopodia and the later conversion of one of them into a contracting pseudopod affect the rate of movement of all the other body parts in the manner predictable by the hydrodynamic concept of the endoplasmic flow in amoeba. An active front stops and begins to retreat when arriving to a constant distance from the posterior body end. The locomotion is disfavoured if new pseudopodia deviate from the former body axis at the angle wider than 35°.

Keywords: *Amoeba proteus*; Amoeboid movement.

1. Introduction

The variable number, size and shape of pseudopodia produced by a polytactic *Amoeba proteus* make extremely difficult any quantitative approach to their behaviour during the cell locomotion. For that reason the monotactic and orthotactic forms (see GREBECKI and GREBECKA 1978 for the terminology), which are monopodial with one advancing front, are sometimes considered as simplified model cells useful to elucidate some aspects of the motor behaviour. But in such models one important component of normal locomotion is completely absent, because they never have any contracting pseudopodia. Therefore, an attempt was made to produce the simplest standard model of a polytactic amoeba, that is a bipodial cell composed of the tail region and two pseudopodia, one advancing and one contracting. A possibility of controlling the cell shape and configuration has been provided by the technique of local stimulation of amoebae by light and shade, as it was recently applied by one of us (GREBECKI 1980). It was demonstrated in particular that amoebae follow the stripes of shade and then they assume the orthotactic form. If so, the simplest bipodal forms must be produced when amoebae are obliged to move along the dark stripes in the shape of Y. Initially they may develop only one front (Fig. 1 a). Two advancing pseudopodia are formed just after they cross the ramification (Fig. 1 b–d). One advancing pseudopodium and one contracting are present from that moment when the direction of further locomotion is eventually established (Fig. 1 d–f).

Such standardized amoebae may be used in future to analyze statistically the effects of a wide range of internal and external factors which probably play a role in locomotion. The experiments reported in the present study had more limited objectives: 1. to demonstrate that the model is operational, 2. to find which parameters determine the moment of conversion of one advancing pseudopodium into a contracting one, 3. to check the role of the angle at which new pseudopodia deviate from the former direction of locomotion, 4. to test again in such simplified and standardized cells our earlier conclusions (KŁOPOCKA 1982).

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3.1. Velocity and Size of Different Body Parts at a Constant Deviation Angle

In the first series of experiments amoebae were made to migrate along the dark stripes in form of Y with the