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Formation of demarcation zones when bacterial population waves are drawn together

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1. SUMMARY

Many motile bacteria (for instance, *Escherichia coli*) inoculated at some point in a semisolid nutrient medium can form population waves: bands or rings. The formation of these motile structures is due to chemotaxis. The population waves when they are drawn together can form two types of non-motile structures. Firstly, the population waves can collide. Secondly, in certain conditions, the waves can slow down and stop without coming into contact directly with each other. In this way demarcation zones are formed. The mechanism of the occurrence of the demarcation zones has been unknown. In this paper we show that formation of these zones is due to lack of nutrients (which at the same time act as attractants) within the narrow gap between individual bacterial populations.

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2. INTRODUCTION

Many motile bacteria inoculated on semisolid nutrient medium form population waves characterized by an increased density of microorganisms [1] (Fig. 1). Simultaneous inoculation of bacteria at several points in the medium away from its boundary eventually forms a picture of circular waves drawing together. These waves propagate across the medium as more-or-less sharply defined bands. The formation of these motile structures is due to the ability of bacteria to accumulate (by chemotaxis) in regions of higher attractant concentration [2]. As the bacteria consume nutrients, their distribution in the medium changes. This then leads to migration of population waves.

There are two types of interaction seen when population waves (chemotactic rings) approach one another. First, chemotactic rings can collide. This type of interaction is shown in Fig. 1. Second, under certain conditions, the chemotactic rings slow down and stop without directly coming into contact [3–6]. Demarcation zones are formed in this way (Fig. 2).