Part 3

Phase plot analysis

Introduction

It has been argued that independent controls of motility, i. e. those of sliding velocity and its switching, exist and can be affected chemically. New approaches based on phase analysis may useful in elucidating such control mechanisms of ciliary movement.

Materials and methods

Time course of shear angles presented in Part 1 and Part 2 was replotted taking angles on the abscissa and speeds on the ordinate. Both axises were normalized to the mean amplitude obtained from minimum and maximum points (five each).

Results and Discussions

Fig. 1 shows phase plots obtained from measurements of ciliary movement in intact larvae (A, B) and from those of isolated cells (C, D); Fig. 1 A and C under normal conditions and B and D in the presence of dopamine. Phase analyses shown

in Fig.1 will give new points of view of the inherent properties of ciliary beating. For example, emergence of attracters close to the abscissa responding to dopamine indicates position- specific inhibition of switching on (Fig. 1 C, D). Phase plots can not be matched with a single circle representing sine-generated bending wave but seems to be composed of clusters of different characteristics. Furthermore, transition between clusters does not always occur at positions of zero speed. These findings may indicate abrupt switching of mode of sliding-bending conversion within the axoneme.

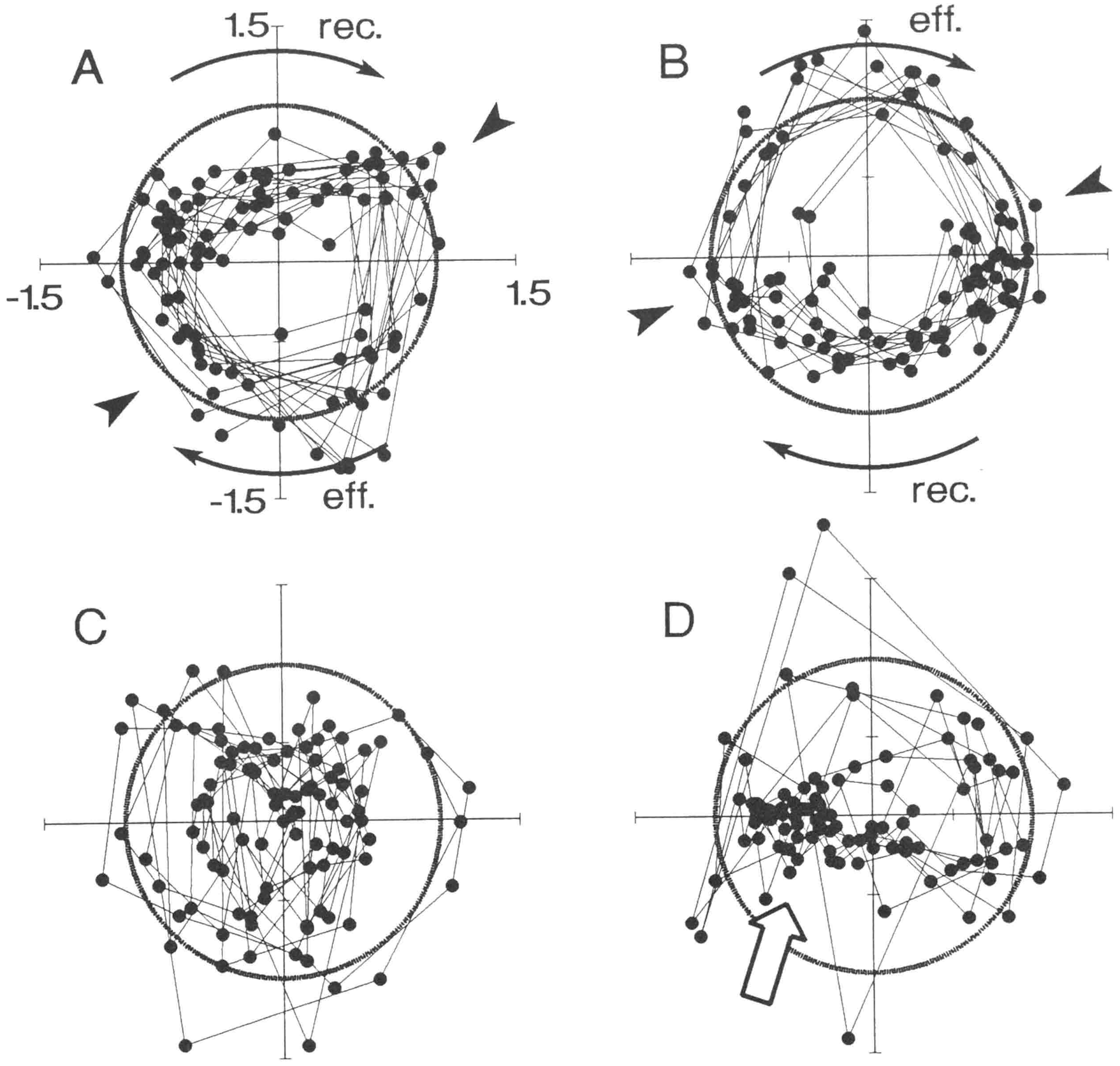

Fig. 3–1. Phase plots obtained from measurements of ciliary movement and normalized in intact larvae (A,B) and from those of isolated cells (C,D); A and C under normal conditions and B and D in the presence of dopamine. Circles representing sine-generated bending wave. Thick arrow in D indicates attracter. Arrowheads in A and B indicate transition between clusters.