A NOTE ON THE CLASSIFICATION OF ELEMENTARY BEHAVIOUR PATTERNS

by

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Studies of the reactions of animals to diffuse or directional stimuli have shown that there exist certain characteristic behaviour patterns. These investigations have already aided in the identification of receptor organs and in the study of their acuity. The problem of the evolution of these patterns and the consideration of their possible relations with patterns of neuromuscular coordination require that they should be clearly defined. This has been attempted many times; the classification of KÜHN and its revision by FRAENKEL and GUNN (1940) are among the most recent. It is the purpose of this note to see how subsequent investigations may modify ideas contained in the latter classification. Consideration is limited to reactions to non-directional stimuli.

FRAENKEL and GUNN recognise four types of reaction which would permit organisms to react to non-directional stimuli; namely orthokinesis, klinokinesis, klinotaxis and tropotaxis. It will be suggested below that the definitions of some of these categories require greater generalisation, and that they should be subdivided for clarity.

KINESES

GUNN, KENNEDY and PIELOU (1937) have defined ‘variations in generalised, undirected, random locomotory activity due to variations in intensity of stimulus’ as kineses. They have recognised two types of kinesis—orthokinesis where there are variations in ‘linear velocity’ and klinokinesis where there are changes of angular velocity.

Orthokinesis may be expressed by variations either in speed or activity or both. In reviewing orthokinetic behaviour GUNN (FRAENKEL and GUNN,

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pointed out that while the activity component alone had been found by Young (1935) to contribute to the photo-negative behaviour of lampreys, the reactions of Porcellio scaber (Latreille) to humidity involved both the speed and activity components of orthokinesis. More recent studies have emphasised further the dissociability of these two factors. Both speed and activity components are found in the response to humidity of Oniscus asellus L. (Waloff, 1941), Agriotes larvae (Lees, 1943) and Peripatopsis moseleyi (Burseil and Ewer, 1950); in similar circumstances Tenebrio molitor L. shews only an activity response (Gunn and Pielou, 1940) and Armadillidium vulgare Latreille a simple speed orthokinesis (Waloff, 1941).

It is important here to recognise that the aggregation in a gradient produced by such a simple orthokinetic mechanism is a dynamic equilibrium. This is well brought out in the derivation by Thorpe et al (1947) of a formula which they use to compute the expected intensity of an orthokinetic reaction. Only in extreme conditions will this simple type of orthokinesis lead to complete aggregation in a gradient.

An essentially similar type of non-uniform distribution can be obtained by simple klinokinesis. Ulliyott (1936) discusses the problem in the following terms:

'If the r.c.d. (rate of change of direction) were some function of the absolute light intensity, the behaviour of the animal could be compared satisfactorily with that of a molecule of gas in a temperature gradient .... On the average it will be found for greater lengths of time at the cooler end of the gradient, but it is just as likely to be moving towards the hotter end of the gradient as in the opposite direction.'

The dynamic equilibrium characteristic of such a system is clear. Burseil and Ewer (1950) have found such a simple klinokinesis in Peripatopsis 2).

The simple treatment of orthokinesis as a dynamic equilibrium developed by Thorpe et al (1947) would however lead to deceptive results if any adaptation occurs in speed or activity. This arises from the use of basal values for mean speed, determined in uniform conditions. Clearly these basal values will not normally be applicable to the conditions in a gradient, for the mean speed of an animal moving towards the preferred region will be tending to fall while that of an animal moving away from the preferred

2) Simple klinokinesis is possibly also shewn by Porcellio. Waloff (1941) has recorded the number of right angle turns per unit time made by the animal at different humidities. If these values are reduced to degrees of turning per unit length of track (angular deviation), it is found that there is a much greater angular deviation at the higher humidities. There is however some evidence for a slow adaptation. Whether this is significant statistically is not however discussed.