

before investigations on other toxins of different properties were completed.

It may be added that, contrary to Schliephake's brief statement<sup>5</sup>, the viscosity of serum from defibrinated ox blood, protected from undue heating, was not altered after exposure to a 3.6 m. field. The frequency-independent effect predicted by Krasny-Ergen can be expected to occur only during exposure.

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<sup>1</sup> See, for example, Curtis, W. E., Dickens, F., and Evans, S. F., *NATURE*, **138**, 63 (1936).

<sup>2</sup> Szymanowski, W. T., and Hicks, R. A., *J. Infect. Dis.*, **50**, 1 (1932).

<sup>3</sup> Hicks, R. A., and Szymanowski, W. T., *J. Infect. Dis.*, **50**, 466 (1932).

<sup>4</sup> Krasny-Ergen, W., *Radiologica*, **1**, 136 (1937).

<sup>5</sup> Bateman, J. B., and Rosenberg, H., Report of the Intern. Congr. for Short Waves, Vienna, 1937, p. 129. There are some misprints in the numerical values.

<sup>6</sup> Schliephake, E., "Kurzwellentherapie", p. 52 (2 Ed., Jena, 1934).

### Classification of Taxes and Kineses

IN recent years, the study of animal reactions to elementary physical stimuli has extended greatly, both in the laboratory and in the field. During this process, it has been necessary to modify somewhat Kühn's<sup>1,2</sup> classification based on the externally observable characteristics of locomotory reactions of this kind. Recent work by Ulyott<sup>3</sup> indicates a way in which the classification and terminology can be considerably simplified and improved.

Working on the light reactions of a planarian, *Dendrocoelum lacteum*, Ulyott showed that the classical avoiding reaction<sup>4</sup> can be regarded as a special case of a more generalized reaction. If *Dendrocoelum* is tested in a smooth gradient of light which has no horizontal component, as it moves towards the brighter end it makes increasingly frequent turning movements; if the animal is kept in constant stronger light, the initial higher frequency of turning falls off owing to sensory adaptation. This combination of differential frequency of turning and adaptation leads to aggregation in regions of lower light intensity, provided that the gradient is of suitable steepness. This behaviour can scarcely be described as an avoiding reaction (cf. *Paramecium*, Jennings<sup>5</sup>). Nevertheless, the same mechanism is probably involved when the animal shows an avoiding reaction at the edge of a shadow. The terms *avoiding reaction* and *trial and error* are thus objectionable, not only because they describe a particular form of the reaction and not its general form, but also because they are not sufficiently objective. The term *phobo-taxis* is objectionable too, because the prefix *phobo-* is in common use in English, with an anthropomorphic implication, and because the reaction given this name is the only undirected one which is called a *taxis*.

We therefore propose the following modifications of the nomenclature. Variations in generalized, undirected, random locomotory activity due to variations in intensity of stimulation are *kineses*. Such variations can be of two kinds, namely, changes in linear velocity, and changes in rate of change of direction (Ulyott's *R.C.D.*) or angular velocity. We

propose to divide *kineses* into (a) ortho-*kineses* (ὄρθός—direct, forward)—variations in linear velocity (previously called simply *kineses*); and (b) klino-*kineses* (κλίνω—to deviate)—variations in angular velocity. The prefix *klino-* is free from anthropomorphic implication. The whole word *klino-kinesis* can be used to describe the kind of reaction discussed by Ulyott, as well as other 'avoiding reactions' and 'phobo-taxes' which have not yet been demonstrated to be either like or unlike it in their details.

If this change is made, the word *phobo-taxis* can disappear, and the word *taxis* can be reserved for directed reactions, formerly called *topo-taxes*. This last word, therefore, also becomes unnecessary, and it is the more desirable to drop it because it is so similar to *tropo-taxis* in appearance and sound. We thus propose to add two prefixes to the nomenclature, in *ortho-kinesis* and *klino-kinesis*, and to remove two, in *phobo-taxis* and *topo-taxis*, so that the classification is clarified without becoming more cumbersome.

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<sup>1</sup> Kühn, A., "Die Orientierung der Tiere im Raum" (Jena, 1919).

<sup>2</sup> Fraenkel, G., *Biol. Rev.*, **6**, 36 (1931).

<sup>3</sup> Ulyott, P., *J. Exp. Biol.*, **13**, 265 (1936).

<sup>4</sup> Jennings, H. S., "Behaviour of the Lower Organisms" (London, 1906).

### Variations in Copepod Development

AN interesting phenomenon has just been brought to my notice on reading a paper by Martin W. Johnson on the development stages of *Eucalanus elongatus*<sup>1</sup>.

In a paper which I published last year<sup>2</sup>, I described the early stages of this copepod from material taken off the west coast of Scotland. The two descriptions correspond very closely except in one particular, for whereas I found only five stages in the nauplius life (the earliest corresponding to other calanoid nauplii at Stage II), Johnson finds all the six stages represented. Since Gurney in the Discovery Report No. 9 (1934) finds a similar state of affairs in *Rhinocalanus* (that is, only five nauplius stages), I am led to the conclusion that with *Eucalanus* there is a difference in the development between California, where Johnson's material was obtained, and the west coast of Scotland.

In searching for an explanation of these differences, it is natural to turn to the hydrographical conditions of the areas concerned. The Eucalanids are warm-water forms and exist in the colder regions only by virtue of the warm-water currents which bring them there. In both Gurney's material and mine the specimens were taken from water of which the temperature was some 10° lower than that of the area supplying Johnson's material. It seems, therefore, not impossible that the suppression of stages in development might be correlated with temperature, and further observations in this direction should prove of interest, especially as the incubation period of the eggs of *Calanus* appears to be lengthened by