ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY

THE ANNELID PHOSPHAGEN: WITH A NOTE ON PHOSPHAGEN IN ECHINODERMATA AND PROTOCHORDATA

By E. Baldwin and W. H. Yudkin

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A new, arginine phosphate-like phosphagen is present in annelid and gephyrean worms.

A second phosphagen, possibly identical with creatine phosphate, has also been found in certain annelids but not so far in gephyreans. This second phosphagen sometimes co-exists with the first, but is found alone in some species.

The distribution of these two phosphagens does not appear to be correlated with physiological activity or with environmental factors.

Arginine could not be isolated from either of two annelid or one gephyrean species; a new base is, however, present in the guanidine fraction and has been isolated as the picrate. It has not yet been identified.

The significance of these observations is discussed in relation to the taxonomic status of the Annelida and Gephyrea. It is indicated that there exists a close relationship between these groups.

The new 'annelid phosphagen' is, apparently, confined to the Annelida and Gephyrea, which are thus chemically distinguishable from the Arthropoda and Mollusca.

Some new data are presented concerning the distribution of arginine and creatine phosphates in Echinodermata and Hemichordata, and the evidence concerning these two groups is reviewed with special reference to the echinoderm-hemichordate theory of vertebrate ancestry.

It is concluded that existing data support this theory, and that the new information concerning the phosphagens of the annelids serves to emphasize the wide divergence that exists between the segmented invertebrates and the true Chordata. E.B.

The Effect of Temperature on the Electrical Activity of the Giant Axon of the Squid

By A. L. Hodgkin and B. Katz

Journ. Physiol., Vol. 109, 1949, pp. 240–9

The giant nerve fibre of *Loligo* provides excellent material for measurements of the electrical characteristics of the surface membrane. The present paper contains an account of experiments dealing with the effect of temperature on the action potential. It is shown that the absolute magnitude of the action potential decreases with increasing temperature but that the resting potential remains practically constant over the range 0–20° C. The time course of the spike is greatly accelerated by a rise in temperature. The rate of decline of the spike appears to have a higher temperature coefficient than the rate of rise.

A.L.H.

The Effect of Calcium on the Axoplasm of Giant Nerve Fibres

By A. L. Hodgkin and B. Katz

Journ. Exp. Biol., Vol. 26, pp. 292-4, 1949

It is well known that a rod of axoplasm can be obtained by extruding the contents of a giant nerve fibre, and that if this is done in sea water, the axoplasm disperses rapidly. The present paper contains a brief account of experiments dealing with the effect of ions on this phenomenon. It is shown that dispersal of axoplasm from the giant axon of *Loligo* depends upon the presence of small concentrations of calcium. No dispersal occurs in isotonic calcium-free solutions of sodium or potassium chloride. A.L.H.

The Effect of Sodium Ions on the Electrical Activity of the Giant Axon of the Squid

By A. L. Hodgkin and B. Katz

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In recent years physiologists at Plymouth and at Woods Hole have made an intensive study of the giant nerve fibre of *Loligo*. One of the most interesting results of this work has been the finding that the action potential of a nerve fibre is associated with a reversal of potential difference across the surface membrane. For some time no satisfactory way of accounting for this effect

could be found, but it now appears that it may have an interesting explanation in terms of permeability and ionic concentration. Chemical studies have shown that potassium is concentrated in the interior of a nerve fibre whereas sodium is relatively dilute. Experiments described in the present paper suggest that the surface membrane is able to alter its ionic permeability in a remarkable manner during activity. In the resting nerve fibre the membrane appears to be more permeable to potassium than to sodium, and this has the effect of making the inside of the nerve fibre negative with respect to the outside. During activity the membrane does not break down, as was formerly supposed, but reverses the resting condition by becoming highly and specifically permeable to sodium. This change allows sodium to enter the nerve fibre faster than potassium can leave it, with the result that the inside of the nerve fibre becomes positive with respect to the outside. This state of affairs must be transitory, and it is suggested that the rise in sodium permeability is short-lived and that the membrane potential is restored to its resting level by an outward migration of potassium ions.

The 'sodium hypothesis' is supported by the following observations: (i) conduction of impulses is impossible in sodium-free media; (ii) the potential difference across the active membrane varies with the external concentration of sodium in the manner predicted by the hypothesis; (iii) the rate of depolarization of the nerve membrane can be varied over a wide range by altering the external concentration of sodium. A.L.H.

Internode Lengths in the Nerves of Fishes

By P. Kynaston Thomas and J. Z. Young

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Measurements of internodal distance and diameter were made on isolated nerve fibres dissociated in glycerin after formalin fixation and osmic acid staining. Several marine fishes were investigated, including *Raia clavata*, *Scyliorhinus canicula*, *Torpedo ocellata* and *Conger conger*.

In the lateral line nerves of the ray and conger eel, the distance between the nodes may reach 8 mm. on the largest fibres. In mammals the corresponding value is 1·5 mm. Internode length increases more rapidly with diameter in the lateral line branch of the vagus than in the branchial branches, and more rapidly in the lateral line nerves of larger than of smaller fishes. In lateral line nerves from fishes of different lengths the ratio of the maximum internode length to the length of the animal is approximately constant. There is not, therefore, a fixed internode length for each fibre diameter, the correlation between the variables being due to the fact that both are correlated with growth.

There is a sharply defined minimum internodal distance of about 0·2 mm. in the various fishes studied, and this is also found in other animal groups.

The conditions in fishes and other vertebrates are consistent with the view that internode length is determined when the nodes are first formed, possibly by surface tension, and later by the amount of growth in length of the nerve. When medullation takes place internode length is short, and is the same for all fibres. As growth proceeds, a relationship between internode length and diameter appears, such that the larger fibres have longer and the smaller shorter internodes. There is little change in the number of nodes after medullation; as the nerves elongate so, too, do the internodes. The occurrence of longer internodes on the larger fibres would be explained if the ultimately larger fibres became myelinated earliest. P.K.T.