

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE IN THE PLYMOUTH LABORATORY

BAKER, P. F. & POTASHNER, S. J., 1973. The role of metabolic energy in the transport of glutamate by invertebrate nerve. *Biochimica et Biophysica Acta*, **318**, 123-39.

The Na⁺-dependent component of glutamate influx in both crab nerve and squid giant axons is influenced by the metabolic state of the cell. In crab nerve, the only kinetic parameter that seems to be under metabolic control is the affinity for glutamate. Lowering the ATP level increases the apparent K_m for glutamate but seems to have no effect either on V or on the affinity for external Na⁺. The effects of metabolic poisons on glutamate influx in squid axons are not, and in crab nerve are unlikely to be, secondary to changes in membrane potential or internal Na⁺, K⁺ or Ca²⁺.

CARTER, N. & DANDO, P., 1973. Phosphoglucose isomerase in teleostean fish. *Biochemical Society Transactions*, **1**, 1263-4.

Conger conger L. white muscle and liver contain different glucosephosphate isomerases. Both enzymes show similar pH-activity profiles, have similar K_m values for fructose-6-phosphate at pH 6.5 and at pH 8.0 at 25 °C and are competitively inhibited by 6-phosphogluconate. The liver enzyme, PGI-A, from both *Conger* and *Gadus morhua* shows marked instability at elevated temperatures, in contrast to the muscle enzyme, PGI-B.

Comparative studies of molecular weights of glucosephosphate isomerases from several chordates gave similar values in the range 130 000-140 000.

COHEN, L. B. & LANDOWNE, D., 1974. The temperature dependence of the movement of sodium ions associated with nerve impulses. *Journal of Physiology, London*, **236**, 95-111.

The movement of sodium ions across the membrane of the squid giant axon was measured by the use of radioactive tracers. Unidirectional fluxes were measured at rest and when the nerve was stimulated. The difference was considered the extra flux associated with nerve impulses.

The extra influx in intact axons at room temperature was 5.5 p-mole/cm² impulse. At 6 °C the extra influx was 6.5 p-mole/cm² impulse giving a Q_{10} of 1/1.2.

In perfused axons a Q_{10} of 1/1.6 was obtained for the extra sodium influx in bracketed experiments on individual axons.

The Q_{10} of the extra sodium efflux associated with nerve impulses was found to be 1/1.2 in intact axons.

Hodgkin & Huxley had predicted a much larger temperature dependence for the extra fluxes. If this difference between prediction and experiment does not result from some experimental error, then the class of models for the ion fluxes suggested by Hodgkin & Huxley may be inapplicable.

DANDO, P. R., 1974. Distribution of multiple glucosephosphate isomerases in teleostean fishes. *Comparative Biochemistry and Physiology*, **47B**, 663-79.

Two glucosephosphate isomerases with different tissue specificities have been found in all groups of teleostean fishes, with the exception of the Clupeomorpha.

Breeding studies in plaice, *Pleuronectes platessa*, and flounder, *Platichthys flesus*, demonstrated that these enzymes were under the control of two independent autosomal loci.

Multiple alleles occur at one or both loci in the majority of the twenty-three species examined.

DENTON, E. J., 1974. On buoyancy and the lives of modern and fossil cephalopods. *Proceedings of the Royal Society of London, (B)*, **185**, 273–99.

For about 500 million years the cephalopods have been among the most successful of marine animals. Their evolution depended on the development of buoyant chambered shells, and the lives and behaviour of modern forms are also largely dependent on the particular solutions to the problem of buoyancy adopted.

There are striking similarities on the ways in which the shells of *Nautilus*, *Spirula* and *Sepia* are formed and used. These similarities, together with comparisons of the gross and fine structures of modern and fossil shells, give a firm base on which hypotheses about the lives of the fossil nautiloids, ammonoids and belemnoids can be made.

Although many modern squid are active and swim continuously to remain in mid-water, a very large number of oceanic squid have replaced the buoyant shells of the fossil cephalopods by tissues containing large amounts of ammonium. These 'ammoniacal' squid, although they are not readily caught in mid-water nets, are extremely numerous for they form the principal food of the approximately $1\frac{1}{4}$ million sperm whales still living in the oceans of the world.

HUGHES, G. M. & WOOD, S. C., 1974. Respiratory properties of the blood of the thorn-back ray. *Experientia*, **30**, 167–8.

Respiratory properties of the blood of *Raia clavata* were determined using samples obtained from intravascular catheters. Each sample was used for only two points on the oxygen dissociation curves since the properties change after half an hour. A Haldane effect ($\Delta \log P_{50}/\Delta p\text{H} = -0.25 \pm 0.03$) was found as well as a Bohr effect.

MEVES, H. & VOGEL, W., 1973. Calcium inward currents in internally perfused giant axons. *Journal of Physiology, London*, **235**, 225–65.

Voltage clamp experiments were carried out on squid axons perfused with an isotonic solution of 25 mM CsF + sucrose and placed in a Na-free solution of 100 mM-CaCl₂ + sucrose. Depolarizing voltage steps produced inward currents of 4–6 $\mu\text{A}/\text{cm}^2$ peak amplitude which decayed slightly during a 60 msec pulse; the inward current disappeared when the internal potential reached +50 to +60 mV and became outward for larger depolarizations. Tetrodotoxin (TTX) completely blocked the inward current and part of the outward current. No inward currents were seen with 100 mM-MgCl₂ + sucrose as the external solution. Substituting acetate for external chloride did not abolish the TTX-sensitive outward currents. It is concluded that the inward current is carried by calcium and the TTX-sensitive outward current by caesium ions, both moving through the sodium channel. The TTX-sensitive current reversed its sign at an average membrane potential of +54 mV. Raising the external calcium concentration or adding NaCl to the external solution increased this reversal potential; lowering the external calcium concentration or replacing the internal CsF by a sodium salt had the opposite effect. From the reversal potentials measured with varying external and internal solutions permeability ratios $P_{\text{Ca}}/P_{\text{Cs}} = 1/0.6$ and $P_{\text{Ca}}/P_{\text{Na}} = 1/10$ to $1/7$ were calculated.

RIEGEL, J. A., LOCKWOOD, A. P. M., NORFOLK, J. R. W., BULLEID, N. C. & TAYLOR, P. A., 1974. Urinary bladder volume and the reabsorption of water from the urine of crabs. *Journal of Experimental Biology*, **60**, 167–81.

Measurements have been made to determine the blood volume, bladder volume, clearance of ¹³¹I-sodium diatrizoate and U/H for diatrizoate in the crabs *Carcinus maenas* and *Macropipus (Portunus) depurator*.

Observed values of clearance blood volume and bladder volume in the two species at 18 °C were: Clearance (as % blood volume per day), *Macropipus* 56.1 ± 14.5; *Carcinus* 27.1 ± 5.8; Blood volume (as % body weight), *Macropipus* 21.0 ± 4.0; *Carcinus* 19.2 ± 3.0; Bladder volume (as % blood volume), *Macropipus* 12.1 ± 5.0; *Carcinus* 11.0 ± 8.0.

It is shown that the measured U/H differs from that to be expected if no reabsorption of water or secretion of diatrizoate occurs.

^{14}C -inulin and ^{51}Cr -EDTA are excreted in an essentially similar manner to ^{131}I -diatrizoate by *Carcinus*, implying that any active secretion of diatrizoate must be small in magnitude.

Injections of ethacrynic acid decrease the U/H ratio for diatrizoate relative to that in control *Carcinus* injected with sea water. In some *Carcinus* the concentration of diatrizoate in the urine comes to exceed that initially present in the blood. Both these points are taken, as support for the conclusion that water can be withdrawn from the primary urine of *Carcinus*.

STEBBING, A. R. D., 1973. Observations on colony overgrowth and spatial competition. In *Living and Fossil Bryozoa: recent advances in research* (ed. G. P. Larwood), pp. 173–83. Academic Press.

This paper describes the characteristics of two species of bryozoans which appear to prevent their being overgrown by other sessile animals. These are the peripheral calcareous margin of *Disporella hispida* and the long-spined zooids of *Electra pilosa*. Intraspecific competition and the fusion of colonial animals are discussed with some examples.

WHITFIELD, M., 1973. A chemical model for the major electrolyte component of sea water based on the Brønsted-Guggenheim hypothesis. *Marine Chemistry*, **1**, 251–66.

The Brønsted-Guggenheim hypothesis of specific ionic interaction is used to develop a chemical model for the major electrolyte components in sea water (Na^+ — K^+ — Mg^{2+} — Ca^{2+} — Cl^- — SO_4^{2-}) at 25 °C and 1 atm total pressure. The model is shown to be in essential agreement with models based on the Bjerrum ion-association hypothesis (e.g. Garrels & Thompson, 1962), with calculations based on the ionic hydration and cluster expansion theories of electrolyte solutions, and with available experimental evidence.

The Brønsted-Guggenheim model is computationally simpler than the currently accepted Bjerrum model and results directly in the conventional *total* single-ion activity coefficients that are most commonly required for calculations in sea water equilibria. The simple form of the equations should enable the model to be extended quite readily to cover a wide range of temperature, pressure and solution composition. However, applications are at present restricted by the availability of the appropriate interaction coefficients.

WHITFIELD, M., 1974. A comprehensive specific interaction model for sea water. Calculation of the osmotic coefficient. *Deep-Sea Research*, **21**, 57–67.

The specific interaction model for the major ionic components in sea water is extended to calculate the osmotic coefficient at ionic strengths up to 4 M at 25 °C and 1 atm total pressure. The calculations are shown to be sensitive to the 'closest approach' parameter (\bar{a}) in the electrostatic contribution to the osmotic coefficient. A procedure for calculating \bar{a} in sea water is outlined and a comprehensive self-consistent model for all the major sea water components is presented.