

ABSTRACTS OF MEMOIRS

RECORDING WORK AT THE PLYMOUTH LABORATORY

BONE, Q. & MACKIE, G. O., 1975. Skin impulses and locomotion in *Oikopleura* (Tunicata: Larvacea). *Biological Bulletin. Marine Biological Laboratory, Woods Hole, Mass.*, **149**, 267-86.

The skin covering the tail and hinder trunk region of *Oikopleura* propagates impulses at 15-21 cm/s. Spread is non-decremental and unpolarized. The impulses are of short duration (8-12 ms) and in general resemble skin impulses in hydromedusae more than those of amphibian and tunicate tadpole larvae.

The skin was examined by optical and electron microscopy. The cells are connected by gap junctions. Impulses are assumed to spread by direct current flow from cell to cell.

Electromyograms of tail activity during three behaviour patterns (pumping, swimming, and house rudiment expansion) are analysed in relation to neuromuscular histology. There appear to be at least two classes of pacemakers, both located in the caudal ganglion. There is no evidence that proprioceptive feedback is required for maintenance of rhythmic activity; and isolation of the tail from the trunk, which contains the cerebral ganglion, does not affect rhythmicity. The system differs fundamentally from the locomotory systems of *Amphioxus* and fishes.

Skin pulses evoke swimming bursts in intact animals or briefly accelerate pre-existing rhythms. The conduction pathway from skin to caudal ganglion is shown to be a pair of nerves running from the latter to a receptor located in the skin at the back of the trunk. No other nerves end in the skin. Cutting these nerves blocks the response.

As in other cases, the conducting epithelium here functions as an extension of the afferent pathway, mediating an escape response following tactile stimulation.

FÄNGE, R. & JOHANSSON-SJÖBECK, M.-L., 1975. The effect of splenectomy on the hematology and on the activity of δ -aminolevulinic acid dehydratase (ALA-D) in hemopoietic tissues of the dogfish, *Scyliorhinus canicula* (Elasmobranchii). *Comparative Biochemistry and Physiology*, **52A**, 577-80.

The effects of splenectomy on some haematological parameters and on the activity of ALA-D in some tissues of the dogfish, *Scyliorhinus canicula*, were studied.

Splenectomy induced an immediate decrease in haematocrit which recovered after 3 weeks.

Haemoglobin content and the mean corpuscle haemoglobin concentration did not change during the period.

No difference in the total WBC count was observed. However, the relative abundance of spindle cells and blast cells decreased, while neutrophilic and eosinophilic granulocytes increased.

In the blood the ALA-D activity decreased during the first 2 weeks, then it increased, reaching the control level after 3 weeks. There was a successive increase of ALA-D activity in the epigonal organ, the organ of Leydig and the kidney.

LIDDICOAT, M. I., TIBBITTS, S. & BUTLER, E. I., 1975. The determination of ammonia in seawater. *Limnology and Oceanography*, **20**, 131-2.

A simple phenolhypochlorite method for the estimation of ammonia in seawater obeys Beer's Law over the concentration range 0-20 $\mu\text{g-atoms NH}_3\text{-N l}^{-1}$; the standard deviation on a set of samples containing 4 $\mu\text{g-atoms NH}_3\text{-N l}^{-1}$ is 0.04.

MACDONALD, S., 1975. Hatching rhythms in three species of *Diclidophora* (Monogenea) with observations on host behaviour. *Parasitology*, **71**, 211–28.

Eggs of three species of *Diclidophora* were incubated in alternating 12 h periods of light and darkness at 13 °C. Eggs of *D. merlangi* collected at Arbroath hatched during the illumination period with most larvae being recovered in the first 4–6 h; some evidence of a seasonal difference in hatching of these eggs was found. Eggs of *D. merlangi* collected at Plymouth hatched with a peak of larval recovery in the 2 h period before the light came on. Eggs of *D. luscae* hatched over 'dusk' while those of *D. denticulata* hatched after the light was switched off. Neither mechanical disturbance nor the proximity of host tissue caused hatching in *D. merlangi* or *D. luscae*. Observations on the behaviour of the host fishes suggest that the hatching rhythms are adapted to specific host behaviour patterns.

ROBERTS, B. L. & WITKOVSKY, P., 1975. A functional analysis of the mesencephalic nucleus of the fifth nerve in the selachian brain. *Proceedings of the Royal Society (B)*, **190**, 473–95.

Microelectrode recordings were taken from neurons of the mesencephalic nucleus of the fifth nerve (mes. v) and from the fifth motor nucleus of decerebrate dogfish (*Scyliorhinus* and *Mustelus*) in response: to electrical stimulation of the peripheral branches of the trigeminal nerve; to electrical excitation of the mes. V tract and in response to mechanical stimulation of the lower jaw. Responses were recorded from cells in the optic tectum at depths of 1400–2000 μm which were driven directly by peripheral nerve stimulation, at latencies of 1.2–2.8 ms, even above 300 Hz. These cells had axons which entered only one of the three main peripheral branches of the trigeminal nerve. Other cells, located at the caudal limit of the nucleus, were driven antidromically by electrical stimulation of the cerebellum. The axons in the peripheral branches supplied high-threshold, non-spontaneous, slowly adapting mechanoreceptors of the teeth and perioral skin; there was no evidence of a projection to any type of muscle receptor in the jaw musculature as is found in mammals. The mes. V neurons could also be excited synaptically, with a latency of about 12 ms, by single low-frequency shocks or by pairs of shocks, separated by 4–10 ms, applied to the same branches of the trigeminal nerve; the sensory nucleus of the fifth nerve was apparently involved in this pathway. When the mesencephalic pathway was stimulated monosynaptic e.p.s.p.s were recorded from the trigeminal motoneurons. Because those mes. V neurons which have peripheral branches can be activated in two ways, each functions both as a primary sensory cell and as an interneuron.

SKIRROW, G. & WHITFIELD, M., 1975. The effect of increases in the atmospheric carbon dioxide content on the carbonate ion concentration of surface ocean water at 25 °C. *Limnology and Oceanography*, **20**, 103–8.

Equilibrium thermodynamics is used to assess the influence of predicted fossil carbon dioxide injections on the carbonate ion concentration in the oceanic mixed layer at 25 °C. The calculations indicate that a tenfold increase is required in the atmospheric partial pressure of carbon dioxide to reduce the carbonate ion concentration to a level where calcite would begin to dissolve. This is at least three times the highest predicted partial pressure for atmospheric carbon dioxide. This result contradicts a number of recent claims that the calcite saturation level would be attained within the next 30 years. Such rapid removal of carbonate ions is only possible if the mixed layer is grossly out of equilibrium with the atmosphere.

WHITFIELD, M., 1975. An improved specific interaction model for seawater at 25 °C and 1 atmosphere total pressure. *Marine Chemistry*, **3**, 197–213.

Equations recently developed by Pitzer are applied to a seawater model on the assumption that only interactions between ions of opposite charge sign are significant. This model is shown to give good agreement with available experimental data for the osmotic coefficient and for the mean-ion activity coefficients of the major electrolyte components. The results are compared with the predictions of the ion-association model and with a number of models using the concept of specific

ionic interaction. The relative merits of the various models are discussed. Pitzer's original equations are modified to enable the calculation of conventional single-ion activity coefficients. These values are compared with those obtained on the basis of alternative conventions and an encouraging measure of agreement is observed. It is concluded that the new model introduces a fluency into the specific interaction approach that should greatly facilitate the incorporation of trace components into future models.

WHITFIELD, M., 1975. The extension of chemical models for sea water to include trace components at 25 °C and 1 atm pressure. *Geochimica et Cosmochimica Acta*, **39**, 1545–57.

Chemical models for sea water based on the Brønsted–Guggenheim hypothesis of specific ionic interaction and on the ionic interaction equations of Pitzer are extended to encompass a range of trace constituents. Conventional single-ion activity coefficients of 23 trace components in sea water are listed over a range of ionic strengths (0.2–3 M) together with the ionic interactions that have been accounted for in their calculation. It is suggested that these data might provide the basis of a coherent (hybrid) model for sea water incorporating many of the advantages of the ion-association and specific interaction models.

WHITFIELD, M., 1975. Sea water as an electrolyte solution. In: *Chemical Oceanography*, 2nd edn (edited by J. P. Riley & G. Skirrow). Vol. 1, pp. 43–171. London: Academic Press.

This chapter shows how far we have progressed in the development of a general quantitative theory of marine chemistry. The aim throughout is to shed light on the chemical fine structure of sea water and to treat it as a mixture of individual ionic components rather than as a composite sea salt. The complexity of sea water is reached in easy stages from pure water by considering in sequence solutions at infinite dilution, solutions containing a single electrolyte and electrolyte mixtures.

The final sections deal with sea water itself and take a critical look at the various procedures for calculating the chemical potentials of the solutes and the solvent. Throughout the emphasis is on the use of thermodynamics to describe the properties of sea water as a closed system at equilibrium.

WITKOVSKY, P. & ROBERTS, B. L., 1975. The light microscopical structure of the mesencephalic nucleus of the fifth nerve in the selachian brain. *Proceedings of the Royal Society (B)*, **190**, 457–71.

A description is provided of the mesencephalic nucleus of the fifth nerve (mes. V) and its axonal projections in the brains of dogfish (*Scyliorhinus*, *Mustelus*) and rays (*Raja*), based upon light microscopic observations. The mes. V nucleus contains 800–1100 cells distributed about the mid-line at the ventral surface of the optic tectum. Each cell gives rise to a stout axon which courses laterally, then posteriorly on the ipsilateral side; the collected axons divide at the caudal extreme of the tectum into a medial bundle which enters the ventral granular eminence of the anterior cerebellar lobe, and a lateral bundle which enters the medulla and leaves the brain via the fifth nerve root. The medial bundle arises from a cluster of mes. V neurons at the posterior limit of the nucleus which comprise about 15 % of the nuclear population. The cerebellar projection ascends the anterior lobe and appears to end in close proximity to Purkinje cell perikarya. A typical mes. V perikaryon is oval, flattened dorsoventrally with average dimensions of 41 μm \times 56 μm . It emits a few stout dendrites from its dorsal surface which extend no more than 75 μm from the cell body. Processes from deep tectal cells and collaterals from commissural fibres appear to make synapses upon mes. V perikarya. In addition, neighbouring mes. V neurons often form clusters and also contact each other via short dendrites. A small subpopulation of mes. V. neurons gives rise to stout, ventrally directed processes which enter the ependymal layer and ramify within it. These may have a neurosecretory function.