

ABSTRACTS OF MEMOIRS

RECORDING WORK AT THE PLYMOUTH LABORATORY

BRYAN, G. W., 1979. Bioaccumulation of marine pollutants. *Philosophical Transactions of the Royal Society (B)*, **286**, 483–505.

Bioaccumulation of pollutants can occur from sea water, from suspended particles, from sediments and through food chains. The rate at which accumulation occurs in an organism depends not only on the availability of the pollutant but also on a whole range of biological, chemical and environmental factors. The ultimate level which is reached is governed by the ability of the organism to excrete the pollutant or, alternatively, store it. This latter course often leads to the attainment of very high concentrations and sometimes no equilibrium level is ever reached. Two particular topics which are considered are the biological amplification of pollutants along food chains and the development of tolerance which sometimes occurs.

HOWARTH, J. V., RITCHIE, J. M. & STAGG, D., 1979. The initial heat production in garfish olfactory nerve fibres. *Proceedings of the Royal Society (B)*, **205**, 347–367.

A study has been made of the temperature changes associated with the passage of a single impulse in the non-myelinated fibres of the garfish olfactory nerve: and the time course of these temperature changes has been compared with the time course of the electrical events during the action potential. As in other non-myelinated nerves studied the observed temperature changes result from a biphasic initial heat production consisting of a transient evolution of heat (the positive heat) followed by a rapid heat reabsorption (referred to as the negative heat). There is no evidence of any additional phases of initial heat production. At 0 °C the measured positive initial heat is 224 $\mu\text{cal/g}$ impulse (937 $\mu\text{J/g}$ impulse); and the corresponding negative initial heat is 230 $\mu\text{cal/g}$ impulse (962 $\mu\text{J/g}$ impulse). The residual initial heat is very small, being about $-6 \mu\text{cal/g}$ impulse ($-25 \mu\text{J/g}$ impulse). In the range 0–10 °C there is no significant effect of temperature on the magnitude of either the positive or the negative phases of heat production. The experimental thermal records were analysed to determine the true time course of the temperature changes in the nerve undistorted by the recording system. The time course of the temperature changes does not fit with that of the transmembrane voltage change as represented by the monophasic compound action potential recorded externally from the same point on the nerve. A better fit is obtained if the temperature changes are compared with the square of the voltage change in accordance with the view that the heat derives almost wholly from free energy changes and entropy changes in the membrane capacity. The best fit is obtained if it is assumed that the membrane potential does not discharge to zero during the action potential but that at the peak of the action potential the charge (and hence the p.d.) across the membrane capacity retains about 24 % of its resting value.

RUBINSON, K. A. & BAKER, P. F., 1979. The flow properties of axoplasm in a defined chemical environment: influence of anions and calcium. *Proceedings of the Royal Society (B)*, **205**, 323–345.

The flow properties of axoplasm have been studied in a defined chemical environment. Axoplasm extruded from squid giant axons was introduced into porous cellulose acetate tubes of diameter roughly equal to that of the original axon. Passage of axoplasm along the tube rapidly coated the tube walls with a layer of protein. By measuring the rate of flow back and forth along the tube, the rheological properties of the axoplasm plug were investigated at a range of pressures and in a variety of media. Axoplasm behaves as a classical Bingham body the motion of which can be characterized by a yield stress (θ) and a plastic viscosity (η_{pl}). In a potassium methanesulphonate medium containing 65 nM free Ca^{2+} , θ averaged $109 \pm 46 \text{ dyn/cm}^2$ and η_{pl} $146 \pm 83 \text{ Poise}$. These values were little affected by ATP, colchicine, cytochalasin B or by replacing K by Na but were sensitive to the anion composition of the medium. The effectiveness of different anions at reducing θ and η_{pl} was in the order $\text{SCN} > \text{I} > \text{Br} > \text{Cl} > \text{methanesulphonate}$. θ and η_{pl} were also drastically reduced by increasing the ionized Ca. This effect required millimolar amounts of Ca, was unaffected by the presence of ATP and was irreversible. It could be blocked by the protease inhibitor

TLCK. E.p.r. measurements showed that within the matrix of the axoplasm gel there is a watery space that is largely unaffected by anions or calcium.

SCOTTISH MARINE BIOLOGICAL ASSOCIATION/MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM, INTERTIDAL SURVEY UNIT, 1978. Survey of the littoral zone of the coast of Great Britain. 2. Report on the shores of Devon and Cornwall. By H. T. Powell, N. A. Holme, S. J. T. Knight and R. Harvey. [130 pp. 14 maps, 17 pls.]. SMBA/MBA Intertidal Survey Unit. (Nature Conservancy Council Contract Report.)

Introductory sections describe the history of intertidal investigations in Devon and Cornwall, and a general description of the geology and geography, climate, and hydrography, is given. The biology of the intertidal zone is discussed in relation to the environment, and species with fluctuating or limited distributions are discussed. Pressures on the coastline resulting from land usage, including recreation and industry, and the effects of pollution, are assessed. Twelve sites considered to be of primary marine biological importance are described, and a further seventeen of secondary importance are listed.

SHAW, M. K., 1979. The ultrastructure of the clamp sclerites in *Gastrocotyle trachuri* and other clamp-bearing monogeneans. *Zeitschrift für Parasitenkunde*, **59**, 43–51.

The ultrastructure of the clamp sclerites of *Gastrocotyle trachuri* and several other clamp-bearing monogeneans has been described for the first time. The clamp sclerites are composed of a moderately electron-dense material in which there are embedded denser fibrils which join together to form a randomly orientated three dimensional structure. The number and size of these fibrils varies from species to species. The structure of the clamp sclerites is compared with the ultrastructure of other platyhelminth sclerites.

SHAW, M. K., 1979. The ultrastructure of the clamp wall of the monogenean gill parasite *Gastrocotyle trachuri*. *Zeitschrift für Parasitenkunde*, **58**, 243–258.

The clamp wall of *Gastrocotyle trachuri* has been found to consist predominantly of radially orientated myofibres. Nearly all the myofibres appear to be almost completely filled with myofibrils; these being of two kinds, thick and thin ones arranged in a manner similar to that observed in other platyhelminth muscles. Nothing resembling dense bodies was observed within the fibres, but at both ends of the fibres electron dense attachment plaques are present. These attachment plaques appear to have a dual function acting both as hemidesmosomes and as attachment points for the thin filaments. The detailed structure of the fibres suggests that the clamp wall is in fact composed of single radially orientated sarcomeres.

The possible role of the clamp wall in the attachment of the parasite to its host is briefly discussed.

SOUTHWARD, E. C., 1979. Horizontal and vertical distribution of Pogonophora in the Atlantic Ocean. *Sarsia*, **64**, 51–55.

New observations of Pogonophora of the N.E. Atlantic, combined with earlier studies in the N.W. Atlantic and Caribbean, show that on both sides of the ocean there is a division into upper slope-, lower slope-, and deep-water species. The European side has a distinct group of species living in the Mediterranean outflow (1000–1500 m). Lower-slope species are geographically widespread. Deep-water and upper-slope species are more restricted in their distribution.

TURNER, D. R. & WHITFIELD, M., 1979. Control of seawater composition. *Nature, London*, **281**, 468–469.

Our earlier proposal that solid-state chemistry is the major factor determining the partitioning of the elements between sea water and crustal rocks is illustrated by a comparison between two groups of similar electronegativity, the lanthanides and the 'lithium group' (Li, Mg, Ca, Sr). It is shown that the striking difference in long term behaviour in seawater (the 'lithium group' accumulate while the lanthanides are scavenged) cannot be accounted for by differences in solution chemistry. It is proposed that the solid-state process of ion capture is the major cause of the observed differences.

WHITFIELD, M., 1979. The mean oceanic residence time (MORT) concept – a rationalization. *Marine Chemistry*, 8, 101–123.

The properties of a well-stirred ocean at steady state are considered and are used to define the scope of the mean oceanic residence time (MORT) concept. Simple relationships are established between the electronegativities of the elements and their mean oceanic residence times (\bar{t}_Y) on the assumption that sea-water composition is controlled by general adsorption/desorption reactions at the surface of oxygen-dominated mineral lattices. The elements are divided into three categories (depleted, pre-equilibrated and enriched) according to their behaviour on transfer from river water to sea water. The nature of the elements in each category and their \bar{t}_Y values are discussed. On the assumption that the transfer kinetics are first order, the rate of removal of material during the approach to steady state following a step change in input is used to calculate the residence time distribution function $E_Y(t)$. The solutions for equations showing the response of the oceanic reactor to square pulse, sinusoidal and exponential changes in the input are given in a dimensionless (reduced) form which makes them generally applicable. The MORT concept as developed here enables the steady state composition of the oceans and the sensitivity of that composition to fluctuations in the input to be calculated to within an order of magnitude from the electronegativities of the elements and the rate of input of material.

WHITFIELD, M. & TURNER, D. R., 1979. Critical assessment of the relationship between biological, thermodynamic and electrochemical availability. In *Chemical Modelling in Aqueous Systems* (ed. E. A. Jenne), pp. 657–680. Washington, D.C.: American Chemical Society. (ACS Symposium Series, No. 93.)

It is seldom possible to relate the biological availability of a particular element (i.e. its ability to influence biological processes) simply to changes in its stoichiometric concentration. This paper considers two concepts that have been used to provide chemical analogues of the biological availability of trace metals. The thermodynamic availability of an element in solution is defined as the activity of the particular chemical form that is taken up preferentially by the organism. The electrochemical availability is defined as the fraction of the total metal concentration that is available for electro-deposition at an electrode immersed in the solution during the timescale of the plating process. The implications of these definitions when related to conventional measurement techniques (using ion-selective electrodes and anodic stripping voltammetry respectively) are considered for the determination of 'available' lead in artificial sea water. The analysis is also extended to consider the uptake of ionic lead from solution by a spherical, unicellular 'model' organism. Discussion of the balance struck between the rate processes associated with uptake, release and assimilation are used to define conditions under which the chemical analogues are relevant to biological availability.