

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT PLYMOUTH LABORATORY

BAKER, P. F., 1968. Recent experiments on the properties of the Na efflux from squid axons. *J. gen. Physiol.*, Vol. 51, pp. 1728-98.

The sodium efflux from squid axons has been shown to consist of at least three components, the relative sizes of which depend both on the metabolic state of the axon and on the ionic composition of the external medium. One component is dependent on external calcium ions and is most prominent in Na-free sea waters based on lithium. It is unaffected by high concentrations of ouabain. This is in marked contrast to the other two components, both of which are completely inhibited by low concentrations of ouabain. In unpoisoned axons the ouabain-sensitive sodium efflux is largely dependent on and in exchange for external potassium ions; but in axons which have been partially poisoned, so they contain ATP but very little arginine phosphate, the sodium efflux no longer requires external potassium ions, and internal sodium ions now exchange in a one-for-one manner with external sodium ions. All three components of the sodium efflux are absent from axons which have been completely poisoned by cyanide.

P.F.B.

COHEN, L. B., KEYNES, R. D. & HILLE, B., 1968. Light scattering and birefringence changes during nerve activity. *Nature, Lond.*, Vol. 218, pp. 438-41.

By using a signal-averaging device to observe very small effects, the findings of D. K. Hill (working at Plymouth in 1949), and others, on the changes in the amount of light scattered by crustacean nerves caused by the passage of impulses have been greatly extended. In a *Maia* nerve the light scattered at 90° increases by about 1/20,000 and then decreases with a time course similar to that of the compound action potential; there is also a slower and longer-lasting decrease as described by the earlier workers. In the squid giant axon, the light scattered at 45° decreased by about 1/400,000 during the spike, with a lag of about 0.25 msec after the rising phase.

Changes in the birefringence of nerves that are relatively somewhat larger have also been observed. With a *Maia* nerve placed between crossed polars at 45° to the plane of polarization, the amount of light passed showed a decrease during each impulse of about 1/2000; in the squid giant axon the decrease was about 1/150,000. Experiments on squid axons under voltage-clamp conditions showed that the birefringence was closely dependent on membrane potential, but increased more steeply on hyperpolarization than it decreased on depolarization.

R.D.K.

COOPER, L. H. N., 1967. Stratification in the deep ocean. *Sci. Prog., Lond.*, Vol. 55, pp. 73-90.

By improving the resolving power of the available chemical methods, the deep ocean has been found to be stratified. Zones in neutral adiabatic equilibrium alternate with zones where density and other properties change rapidly. A stringent statistical study of error of measurement was required throughout, and only since 1960 did we have sufficiently dependable methods. The vertical sampling interval was reduced by stages to 10 m and finally to 3 m. The evidence for stratification and also for

density inversions is presented graphically. The sequence of analyses made upon replicated oxygen samples was randomized to give confidence that differences were real. An apparently wild set of duplicate oxygen analyses is presented as probably correct and consequent on cascading and lamination during the very cold winter of 1963. Fourteen theorems are stated to provide a basis for further work, together with a rider on possible breeding habits of pelagic copepods to show how the theorems of stratification may be applied in ecological studies.

L.H.N.C.

COOPER, L. H. N., 1968. Scientific consequences of the wreck of the 'Torrey Canyon'. *Helgoländer wiss. Meeresunters.*, Bd. 17, pp. 340-55.

Two papers delivered at the Heligoland Symposium on 'Biologische und hydrographische Probleme der Wasserverunreinigung in der Nordsee und angrenzenden Gewässern' held between 19 and 22 September 1967 are summarized and amplified with later information.

Implications of the 'Torrey Canyon' disaster affecting international law and enforcement were developed. The need was stated for an international 'fire brigade' ready to deal with pollution at sea or on a coast. The value of craie de Champagne, as used by the French, was discussed together with the role possibly played by *Noctiluca miliaris*. Observations on the wind drift of the oil, also reported in the Plymouth report, were further discussed.

L.H.N.C.

DIGBY, P. S. B., 1967. Pressure sensitivity and its mechanism in the shallow marine environment. In *Aspects of Marine Zoology, Symp. zool. Soc., Lond.*, No. 19, pp. 159-88.

The sensitivity of marine invertebrates to small changes of hydrostatic pressure is discussed. The presence of lipoids on crustacean cuticle and other biological surfaces suggests that gas layers or vesicles, too small to be visible, may often occur. Experiments on normal cuticle and on cuticle charged with gas produced electrolytically supports this view; in normal *Leander* and *Palaemonetes* bubbles of gas can sometimes be produced by damage as if from an unseen surface film. Pressure sensitive behaviour in crustacea and other invertebrates is readily abolished by damage to the surface and by the application of too great a pressure, suggesting a surface layer of gas. But pressure sensitivity is not destroyed by 'Teepol', an excellent wetting agent, and it is abolished reversibly by 'Cetavlon' and by urea which are adsorbed on cathodic surfaces and block cathodic action, by hydrogen peroxide which oxidizes electrolytic hydrogen, and by transfer of the crustaceans to a higher salinity which reduces their potential and thereby reduces electrode action. This suggests that pressure sensitivity arises from an electrode effect, compression of hydrogen produced electrolytically on the outer surface reducing polarization. Comparable effects arise with pairs of metallic electrodes in the absence of lipid, current flow through them being sensitive to pressure in the absence of visible gas. This sensitivity arises at the cathode and is abolished by the same reagents which abolish pressure sensitive behaviour in living crustaceans, suggesting identity of the fundamental mechanism in the two cases.

P.S.B.D.

GEORGE, J. D., 1968. The effect of the 1962–63 winter on the distribution of the cirratulid polychaetes, *Cirratulus cirratus* (Müller) and *Cirriformia tentaculata* (Montagu) in the British Isles. *J. Anim. Ecol.*, Vol. 37, pp. 321–37.

An investigation of the effects of the 1962–63 winter on the distribution of the two common British cirratulid polychaetes showed that there has been no major reduction in range of *Cirratulus cirratus* (Müller), although small distribution changes have taken place and populations have decreased. The range of *Cirriformia tentaculata* (Montagu), on the other hand, has greatly reduced, the worm having virtually disappeared from the south and east coast of England and from north and west Wales.

The disappearance of *C. tentaculata* in these regions was correlated with the exceptionally low temperatures that occurred there during the 1962–63 winter. Temperature tolerance experiments confirmed that *C. tentaculata* was unable to withstand these very low temperatures for more than a few hours although *Cirratulus cirratus* was far more resistant. Even so, coastal temperatures were sufficiently low in Sussex and in certain parts of Essex to account for death of *C. cirratus* in these areas. In addition, scour by ice was a likely cause of decrease in numbers of *C. cirratus*.

The physiological explanation for the greater cold-hardiness of *C. cirratus* was discussed as also were the possible ways in which low temperatures caused the death of the two species.

Methods of recolonization of areas ravaged by the severe winter were investigated and possible paths of recolonization were indicated.

J.D.G.

MANWELL, C. & BAKER, C. M. A., 1968. Genetic variations of isocitrate, malate and 6-phosphogluconate dehydrogenases in snails of the genus *Cepaea*—introgressive hybridization, polymorphism and pollution? *Comp. Biochem. Physiol.*, Vol. 26, pp. 195–209.

Cepaea hortensis (Müller) and *C. nemoralis* (L.) (Gastropoda: Pulmonata) share several enzyme variants when the two species occur sympatrically in one location.

Several of the dehydrogenase polymorphisms in *Cepaea* resemble those reported in various vertebrates in that heterozygotes have three electrophoretically separable zones, the middle one being a 'hybrid' isozyme.

Cepaea are not only highly polymorphic in visual characters but also in many of their proteins; this variability is discussed in relation to the genetic load problem, the variability in other species, and the ability of certain snails to resist habitat modification and some pesticide contamination.

C.M.

WICKSTEAD, J. H., 1967. Pelagic copepods as food organisms. *Proceedings of the Symposium on Crustacea* held at Ernakulam, 12–15 January 1965, pp. 1460–5. India: Marine Biological Association of India.

This paper refers particularly to pelagic copepods supplying food for fish larvae and human beings. Facts and figures given are based on the author's experience in the Indo-Pacific region. The abundance of copepods is indicated in terms of numbers and biomass, and their advantages as food organisms are discussed. It was pointed out that although there was a pronounced size mode at 0.7–0.8 mm., the biomass is distributed over a reasonable size range. The so-called critical period of fish larvae is discussed. Copepods help fish to get through this phase by being available and suitable as food almost from the point of hatching up to 4 cm long, which is past this critical

phase. Concentrations of copepods are such that the fish larvae need expend a small amount of energy only to catch a copepod.

From the human food aspect, the quality of copepods is discussed. On a dry-weight basis they are about 60% protein. All the essential amino acids are present in about the same proportions as in a hen's egg. It is calculated that a single net, having a mouth aperture of 9 m², can, by using tidal flow, catch a quantity of copepods representing about 5200 g of protein a day. On the basis of an adult requirement of 70 g of protein daily, this represents the daily protein requirement for 75 adults. Some departures from these figures are given, with reasons. The catch would need to be processed. Although probably not a very profitable venture financially, it is suggested that such a source of first-class protein should be examined more closely.

J.H.W.

WICKSTEAD, J. H., 1968. Temperate and tropical plankton; a quantitative comparison. *J. Zool.*, Vol. 155, pp. 253-69.

A survey of zooplankton was carried out at the Plymouth station L4, a temperate water station. This survey could be reasonably directly compared with similar, tropical, plankton surveys at Zanzibar and Singapore. The three stations, two tropical and one temperate, have each been sampled regularly over a period of 13 months, using the same type of apparatus, worked by the same person in the same way, and analysed by the same person in the same way. Plankton analyses at L4 were taken a little further than at the tropical stations; ash measurements were made and also an assessment of the protein content, in terms of total nitrogen. When possible water samples were taken at L4, figures being given for temperature, salinity, density, transparency (Secchi disc), silicate and phosphate content.

Taking into account the different rate of 'turn-over' of the plankton, the final assessment was that the tropical stations were between five and ten times richer than the temperate station.

J.H.W.