

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY

NOTES ON THE NERVOUS SYSTEM IN THE STOMATOPODA.

IV. MUSCLE RECEPTOR ORGANS

By J. S. ALEXANDROWICZ

Publ. Staz. Zool. Napoli, 1954, Vol. 25, pp. 94-111

In *Squilla mantis*, muscle receptor organs have been found in the extensor muscles of the six thoracic and six abdominal segments. They are composed of thin muscles and nerve cells. In ten segments there are two muscles and two nerve cells on each side. The muscles of each pair differ in their structure. In a certain region of the muscles there is an intercalated tendon common to the two muscles. The nerve cells differ in their size and mode of ramification of their dendrites.

Differences in structure of the muscle receptor organs which might have a relation to their response at different stretch thresholds are discussed.

J.S.A.

THE EYES AND THE PHOTONEGATIVE BEHAVIOUR OF *NEPHTYS* (ANNELIDA, POLYCHAETA)

By R. B. CLARK

J. exp. Biol., 1956, Vol. 33, pp. 461-77

Three types of photoreceptor are found in the Nephtyidae: inverted, single-celled ocelli in pigment cups embedded in the brain, similar cells, though without pigment cups, anterior to the brain, and possibly epidermal photoreceptors. Morphological and experimental evidence suggests that the prostomial receptors of *Nephtys* are homologous with the eyes of *Nereis* and that they are involved in the same types of behaviour. The frequency with which *Nephtys* swims is, within limits, a linear function of the light intensity. Although the ganglionic eyes are directional receptors the worm does not orientate itself in a light beam; presumably the light reaching them is too diffuse. In the very small species *N. cornuta* the eyes are close to the surface of the brain and the worm does orientate itself in a light beam. Swimming is an essential prelude to burrowing, and the brighter the light the more frequently the worm swims and the sooner it is buried. Activity in light can be inhibited by stimulating receptors on the dorsal surface of the animal by contact.

R.B.C.

DEEP WATER MOVEMENTS IN THE NORTH ATLANTIC AS A LINK
BETWEEN CLIMATIC CHANGES AROUND ICELAND AND BIOLOGICAL
PRODUCTIVITY OF THE ENGLISH CHANNEL AND CELTIC SEA

J. mar. Res., 1955, Vol. 14, pp. 347-62

AND

HYPOTHESES CONNECTING FLUCTUATIONS IN ARCTIC CLIMATE
WITH BIOLOGICAL PRODUCTIVITY OF THE ENGLISH CHANNEL

By L. H. N. COOPER

Deep-Sea Res., 1955, Suppl. to Vol. 3, pp. 212-23

These two papers, which need to be read together with the paper in the *Journal* on assessing the age of oceanic water with carbon-14, present a group of hypotheses to explain fluctuations in biological productivity of the English Channel, in terms of changes in Arctic climate. The first paper describes the conditions under which heavy and cold Norwegian Sea water spills over the ridges east and west of Iceland into the Atlantic to create two new water masses. The courses of these are followed down into the deep Atlantic. In each case the water is held to the right banked against the eastern side of the Reykjanes Ridge and the continental slope of East Greenland respectively. Room in the ocean for this sinking water has to be found by upward displacement of water which is already there. This upward displacement will carry the deep stock of nutrients towards the upper layers where wind-driven and thermohaline mixing processes—which are always operating—may bring them into the illuminated zone. When cold Arctic winters cause much recruitment of cold heavy water to the Norwegian Sea, a chain of events is initiated which will enrich the surface waters. Following mild Arctic winters the loss from the surface layers in temperate latitudes by sinking of detritus and defecation at depth of vertical migrants, cannot be made good by upward displacement.

This, however, is only one part of the mechanism. The second paper develops a complementary one.

The overflows into the Atlantic are believed to occur not as smooth steady streams of water but as intermittent surges. In the Atlantic these surges will behave as balls or boluses of water and may be considered to have some of the properties of an elastic solid. Whilst sinking beneath the lighter enveloping water and especially when the under-lying sea-bed or continental slope is very dissected, the boluses may initiate internal waves of considerable amplitude and energy. It is postulated that these waves may travel great distances in the ocean with little attenuation. When they strike another continental slope, particularly a dissected one, much of the energy of the internal wave system is likely to be destroyed by mixing of the waters bathing the slope. The resulting homogenization of these slope waters will tend to carry nutrients upwards

and heat downwards. This chain of events will also be favoured by cold Arctic winters and weakened by mild ones.

From the basic hypotheses it is easy to derive further ones which are capable of test by observation and experiment in the ocean.

L.H.N.C.

DEMONSTRATION OF SMALL-SCALE WATER-CURRENTS
BY MEANS OF MILK

By D. J. CRISP and A. J. SOUTHWARD

Nature, Lond., 1956, Vol. 178, p. 1076

During work on the behaviour of barnacles it was found that ordinary cow's milk offered a better means of detecting small-scale water movements than the commonly used suspensions of carmine or graphite. The animals were observed or photographed against a black background and the milk was injected into the water above from a row of fine jets. The density of the milk could be varied by dilution with the water or by alteration of the cream content; normally it remained suspended in trails, resembling thick smoke in air. The method was used to measure the water currents set up by the cirral movements of barnacles, and to establish the presence of a through current in the mantle cavity during normal beating of the cirri.

A.J.S.

LA CONTAMINATION DES POISSONS ET LE PROBLÈME
DES EAUX POLLUÉES

By A. GUELIN

Annales Inst. Pasteur, 1954, T. 86, pp. 303-9

It has been previously reported by the writer that the intestine of fishes caught offshore in the Mediterranean is free from enterobacteria, whereas in those caught in the littoral zone there is an intestinal flora similar to that in man or in warm-blooded animals.

The waters sampled far from any shore are as a rule free from bacteria and intestinal bacteriophages found in the littoral zone. The question arises how far the bacteriological aspect of the viscera of fishes is correlated with the sanitary state of waters in which they live.

Sixty-one specimens of *Ctenolabrus rupestris*, in which no infestation could be ascertained in preliminary examination, were contaminated with either *Enteramoeba coli* or with coliphage. In a week's time all these fish had freed themselves completely from the contaminating agent.

These results show that the investigation of the enterobacteria and enterophages in fishes could give information as to the possible pollution of the waters in which the animals live.

A.G.¹

¹ This abstract has been translated from the French.

STUDIES OF SERPULID TUBE FORMATION.

II. THE CALCIUM-SECRETING GLANDS IN THE PERISTOMIUM OF
SPIRORBIS, *HYDROIDES* AND *SERPULA*

By R. H. HEDLEY

Quart. J. micr. Sci., 1956, Vol. 97, pp. 421-7

In a previous paper the author described the calcium-secreting glands in *Pomatoceros* and gave an account of the pre-secreted component of this serpulid's tube. This study has been extended to three other British serpulids and the structural variation of the calcium-secreting glands has been demonstrated.

In *Spirorbis* the gland is tubular, in which the gland cells have unusual extensions projecting into the lumen, whilst in *Hydroides* the gland is a simple tubule. *Serpula* has glands which are tubulo-racemose and similar to those found in *Pomatoceros*.

An unusual arrangement is found in *Serpula* where, in addition to the two calcium-secreting glands, there are two ventral calcium sacs in the posterior part of the peristomium. These also secrete calcareous material and contribute towards tube formation.

R. H. H.

ACTIVE TRANSPORT OF CATIONS IN GIANT AXONS
FROM *SEPIA* AND *LOLIGO*

By A. L. HODGKIN and R. D. KEYNES

J. Physiol., 1955, Vol. 128, pp. 28-60

In giant axons from *Sepia* and *Loligo* the efflux of labelled sodium ions and the influx of potassium ions have been shown to be greatly reduced by metabolic inhibitors (dinitrophenol, cyanide and azide) or by cooling to a low temperature. Sodium influx and potassium efflux are relatively little changed under these conditions. Metabolic inhibitors also have little effect on the resting potential and action potential, or on the rapid sodium movements associated with the passage of impulses. Removal of potassium ions from the external medium reduces the sodium efflux to about one-third, the effect being immediate in contrast to the delayed action of inhibitors, and the absolute size of the decrease in efflux being about equal to the decrease in potassium influx caused by inhibitors.

It is concluded that in addition to a permeability system which allows ions to move down electrochemical gradients during electrical activity, there is a secretory mechanism driven by metabolism which ejects sodium and absorbs potassium against the electrochemical gradients. Conduction of impulses,

but not recovery, can take place if the secretory mechanism is put out of action with inhibitors. Sodium efflux and potassium influx are coupled, but do not seem to be linked rigidly.

R.D.K.

EXPERIMENTS ON THE INJECTION OF SUBSTANCES INTO SQUID GIANT AXONS BY MEANS OF A MICROSYRINGE

By A. L. HODGKIN and R. D. KEYNES

J. Physiol., 1956, Vol. 131, pp. 592-616

A microsyringe is described which enables precisely determined volumes of fluid to be injected into squid giant axons uniformly over distances of 3-20 mm. The volume injected is about $1/25$ of the axon volume per unit length. The performance of the microsyringe was tested by injecting dye solutions. Methylene blue and eosin were observed to diffuse radially through the axoplasm, but more slowly than in free solution.

Injection of small quantities of KCl did not have any marked effect on the membrane potentials. Injection of similar quantities of NaCl reduced the reversed potential at the crest of the spike by an amount which fitted with that calculated from the change in concentration ratio. Injections of magnesium and tubocurarine chlorides had no great effect on the axons. Injections of calcium liquefied the axoplasm and tended to block conduction.

When $^{24}\text{NaCl}$ was injected, a steady rate of extrusion of labelled sodium was established within a minute. The diffusion coefficient of sodium in the axoplasm can have been very little less than in free solution, and the sodium pump must operate with a lag of not more than a few seconds. The sodium efflux was blocked in the usual way by inhibitors. It was established that over short periods the sodium efflux was directly proportional to the internal sodium concentration, but that the proportionality factor declined with a time constant of about 5 h.

R.D.K.

TEMPERATURE AND MACKEREL MOVEMENTS IN THE INSHORE WATERS OF TORBAY, DEVONSHIRE

By L. A. J. JACKMAN and G. A. STEVEN

J. Cons. int. Explor. Mer., 1955, Vol. 21, pp. 65-71

The arrival and departure date of mackerel in the Torquay area show a close correlation with sea surface temperature.

In the period 1945-53 inclusive mackerel made their first appearance inshore when the sea temperature was within the range $11.1-11.6^{\circ}\text{C}$. In six different years the temperature was exactly 11.6°C and on those occasions when it differed a reading of 11.6°C was made either one day before or one

day after the recorded appearance of the fish. Departure records for the years 1941 to 1953 show a range of 12.2°–13.9° C.

In no year did the fish arrive before a well-marked thermocline had formed at E₁. Conversely, on departure the thermocline had almost always broken down completely.

This fact will be more closely observed in future years.

L.A.J.J.

SEASONAL CHANGES IN THE PHYTOPLANKTON AS INDICATED BY SPECTROPHOTOMETRIC CHLOROPHYLL ESTIMATIONS 1952–53

By PAMELA G. JENKINS

Deep-Sea Res., 1955, Suppl. to Vol. 3, pp. 58–67

Chlorophyll determinations were continued on the phytoplankton of the English Channel from September 1952 until August 1953 at depths from 0 to 70 m, the species being identified by culture. Minima 2 mg/m³ occur in winter and June. Maxima at particular depths can occur in March, April or May. In 1952, 34.2 mg/m³ was a maximum in the surface, whereas in 1953 cell sinking gave, in May, 78.8 mg/m³. The autumn maximum in September 1952 was 21.1 mg/m³.

Collodion filter disks varied from dark grey or chocolate to a light sandy colour and showed phytoplankton, fibres, copepods and other animals. Copepods were about 300,000 per square metre column down to 70 m in April.

Fifty-four species of Bacillariophyceae were recorded. As before *Skeletonema costatum*, a *Navicula* and *Nitzschia closterium* were the most common. Six Chlorophyceae, five Chrysophyceae, one Cyanophyceae and three Cryptophyceae were found. In the first class a *Chlorella* sp. was commonest and in the second a species of *Coccolithophora* grew in each sample. *Phaeocystis globosa* grew from January to May. *Hemiselmis rufescens* appeared again.

P.G.J.

COLLOIDAL PROPERTIES OF THE MESOGLOEA IN SPECIES OF *LEUCOSOLENIA*

By W. C. JONES

Quart. J. micr. Sci., 1956, Vol. 97, pp. 269–85

Isotonic potassium nitrate solution causes a rapid collapse of the oscular tubes of species of *Leucosolenia*: the cells dissociate and the mesogloea swells and disperses. Differences in the time of collapse of tubes from different specimens, or tubes derived at different times from the same specimen, suggest that the mesogloea varies in its initial degree of firmness. Replacing the collapsing tubes in sea water results in the immediate stiffening of the

mesogloea and the previously swollen cells shrink and form characteristic rod-like processes. The mesogloea seems to be secreted by the choanoderm, since just beneath this layer it may be more readily swollen by the potassium nitrate. Its dispersion can be prevented by first immersing the tubes for a time in slightly acidified sea water. Other neutral salt solutions also soften the mesogloea, but vary considerably in the time taken for the onset of plasticity. Their ions can be arranged in three lyotropic series which indicate that the mesogloea is an organic hydrophilic colloid similar to, for example, chondroitin sulphate.

The experiments show that the mesogloea has an important skeletal function.

W.C.J.

THE INTRACELLULAR CALCIUM CONTENTS OF SOME INVERTEBRATE NERVES

By R. D. KEYNES and P. R. LEWIS

J. Physiol., 1956, Vol. 134, pp. 399-407

A method is described for the determination in biological samples of 1 μg or less of calcium. Analyses of (a) axoplasm extruded from freshly dissected squid axons, and (b) whole *Carcinus* nerves which had been soaked in Ringer's solution containing various amounts of calcium, showed that in both types of invertebrate nerve the internal calcium concentration is of the order of 0.5 m-mole/kg wet weight.

R.D.K.

EVIDENCE FOR A MECHANORECEPTIVE FUNCTION OF THE AMPULLAE OF LORENZINI

By R. W. MURRAY

Nature, Lond., 1957, Vol. 179, pp. 106-7

The responses of the ampullae of Lorenzini of *Raia clavata* were investigated electrophysiologically. The spontaneous frequency of discharge of single units could be increased or decreased by stimuli which increased or decreased the pressure within the ampullae themselves relative to that outside. The responses showed partial adaptation and opposite after-effects. Possible functions of the ampullae are discussed.

R.W.M.

PHYSIOLOGICAL CONTROL OF LUMINESCENCE IN ANIMALS

By J. A. C. NICOL

Luminescence of Biological Systems, pp. 299–321. 1955. Washington: American Ass. Adv. Sci.

A review is presented of various methods known to be operative in the regulation of the luminescent responses of animals. Intensity, duration and iteration are possible variables. Control is direct (excitation acting directly on intracellular photogenic processes), or indirect, involving glandular secretion (extracellular luminescence) or movement of screening devices (symbiotic organs).

Various examples are given, and some new data presented for luminescence in ctenophores, the glow-worm and *Pyrosoma*.

J.A.C.N.

THE NERVOUS ANATOMY OF THE BODY SEGMENTS
OF NEREID POLYCHAETES

By J. E. SMITH

Phil. Trans. B, 1957, Vol. 240, pp. 135–96

An account is given of the anatomy of the giant and fine fibre systems of the nerve cord of nereid polychaetes and of the constitution of the four pairs of serially repeated segmental nerves.

The fine fibre internuncial systems are designed to transmit excitation ventro-dorsally in the cord and (by means of six longitudinal tracts) along its length. Most of the sensory and motor fibres effect their internuncial connexions within the cord in the dorsal half of the neuropilar substance. The nervous arcs which involve fine fibre internuncials are described in detail. They appear to have a more obviously direct nervous continuity than those involving giant fibres, a circumstance which is discussed in relation to previously established excitation characteristics of the two systems and their role in bringing about locomotory movements and 'escape' responses.

All the segmental nerves are 'mixed'. Their sensory fields and, in some instances, their motor distribution are described. There is, on the sensory side, anatomical evidence of the canalization of afferent excitation from a large number of widely separated sensory endings into a small number of centrally directed tracts. On the motor side the dispersal of excitation to the various muscle systems is brought about by the interpolation of relay neurons into the peripherally directed motor tracts which, at their origin from the cord, contain very few fibres. The possible significance of the small number of motor and internuncial neurons in the cord is discussed.

J.E.S.