

Abstracts of Memoirs

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY.

On the Ciliary Mechanisms and Interrelationships of Lamellibranchs. Part I: Some New Observations on Sorting Mechanisms in Certain Lamellibranchs.

By D. Atkins.

Quart. Journ. Micr. Sci., Vol. 79, 1936, pp. 181-308.

Accounts are given of the ciliary feeding mechanisms in *Nuculana minuta* (Müller); *Glycymeris glycymeris* (L.) and *Arca tetragona* Poli; *Heteranomia squamula* (L.), *Monia squama* (Gmelin), and *M. patelliformis* (L.); *Pteria hirundo* (L.); and *Solen marginatus* Montagu, *Ensis siliqua* (L.), *E. arcuatus* (Jeffreys), and *Cultellus pellucidus* (Pennant). These Lamellibranchs agree in possessing a certain ciliary sorting mechanism on the gills themselves, namely, adjoining tracts of frontal cilia beating in opposite directions on the same gill filament or leaflet. This occurs in *Nuculana* on the inner leaflets only; in the Arcidae and Anomiidae (with flat gills) on all filaments; in *Pteria*, *Solen* and *Ensis* (with plicate and heterorhabdic gills) on the ordinary and apical filaments only, and complicated by a difference in the direction of the frontal currents in the plical grooves and on the crests; in *Cultellus* (with flat gills) on both lamellae of the inner demibranch, but on the ascending lamella only of the outer demibranch.

Tracts of fine frontal cilia, beating continuously, convey particles intended for consumption, while tracts of coarse cilia, fully active only when stimulated, transport material intended to be rejected. In all, except the Protobranch *Nuculana*, unwanted material is carried to the ventral edges of the demibranchs, which are generally ungrooved or slightly grooved, rarely deeply grooved. In the Arcidae and Anomiidae the current along the edge is posterior in direction, so that such unwanted material as does not fall on the mantle is transported directly to the exterior. In *Pteria*, *Solen*, *Ensis*, and *Cultellus* the marginal current is oralward, but if the load be heavy much falls on the mantle, and is conveyed posteriorly by its recurrent tracts and finally rejected on sudden closure of the valves.

In the Anomiidae the sorting mechanism on the gills was not observed functioning satisfactorily under experimental conditions, in that there was

no appreciable transportation of intended food particles dorsally, and it would seem that members of this family mainly feed on particles brought directly to the broad dorsal food grooves by the water current set up by the lateral cilia.

In *Nuculana* the highly specialized method of sorting on the small gills seems to have been inherited from a form in which the gills played a considerably greater part in nutrition than they do in this Protobranch, which feeds largely by means of extrusible palp appendages. In *N. minuta* the strength of the inhalent and exhalent currents is augmented at intervals by dorsal contraction of the gills, in which there are striated muscle fibres.

In the Arcidae and Anomiidae the ciliary currents of the visceral mass and mantle are described in detail. In the section on the Anomiidae an Appendix is added on the hypobranchial gland of the genus *Monia*.

D. A.

Nouvelles Observations sur l'Acétylcholine et la Choline-Estérase chez les Invertébrés.

By Z. M. Bacq.

Arch. Internat. Physiol., Vol. XLIV, 1937, pp. 174-189.

The muscles of worms, sipunculi, molluscs and echinoderms are made to contract by acetylcholine. The muscles of sea anemones and crustaceans are insensitive to acetylcholine. Choline-estérase is present in the tissues and fluids of worms, sipunculi, molluscs and echinoderms. It exists in the muscles of the crustaceans, but it does not exist in the blood of the crustaceans or in the muscles of the sea anemones. It is absent from the blood of *Arenicola*. So far, experiments undertaken in order to demonstrate the existence of cholinergic nerves in Cephalopods have been unsuccessful. Acetylcholine and eserine are without action on the stellate ganglion of Cephalopods.

Z. M. B.

L'“Amphiporine” et la “Némertine” Poisons des Vers Némertiens.

By Z. M. Bacq.

Arch. Internat. Physiol., Vol. XLIV, 1937, pp. 190-204.

In the tissues of the nemertean worms *Amphiporus* and *Drepanophorus*, there exists an alkaloid “amphiporine” which according to its pharmacological and chemical properties may be classified in the nicotine group.

Amphiporine is not localized in the proboscis of the nemertine and is not, strictly speaking, a venom.

The tissues of most nemertines (particularly in the species *Lineus*) contain another substance deprived of nicotine-like action, but active at low concentration on the neuro-muscular preparation of the crab.

Z. M. B.

The Development of Isolated Blastomeres of the Ascidian Egg.

By Arthur Cohen and N. J. Berrill.

Journ. Exp. Zool., Vol. LXXIV, 1936, pp. 91-117.

Isolated half-blastomeres of *Ascidella aspersa* produce small tadpoles which possess 0 to 3 papillae, 0 to 2 sense organs, 20 to 22 notochord cells and 19 to 21 muscle cells. The normal tadpole developing from a whole egg possesses 3 papillae, 2 sense organs, 40 to 44 notochord cells and 38 to 40 muscle cells. The first three cleavages of the half-blastomere are strictly partial, but the sliding of the cells as their free surfaces are reduced to a minimum soon masks the characteristic pattern. Explanations are offered to account for the presence of as many as the full complement of papillae and sense organs which would fit both a determinate and regulative conception of the ascidian egg. The presence of partial cleavage and only half the normal number of notochord and muscle cells can only be accounted for on the basis of rigid determination. It is concluded that the eggs of this species should be considered as belonging to the determinate class, although regulation of a type dependent on the action of surface forces occurs.

A. C.

Heterogonic Growth in the Abdomen of *Carcinus maenas*.

By J. H. Day.

Report of the Dove Marine Laboratory (Third Series, No. 3), 1935, pp. 49-59.

From measurements of 560 specimens of *Carcinus maenas*, growth-ratios of individual abdominal segments were determined. These in turn were used to show the growth-gradients along the whole abdomen. While it is realized that these gradients in the abdomen are merely parts of a more general gradient permeating the whole body, it is evident that there is a growth-centre in the third abdominal segment of young individuals of both sexes. Mature crabs have a growth-centre in the sixth segment. The balance of evidence is in favour of the separate origin of the two growth-centres, rather than a gradual movement along the abdomen.

There is also evidence that the appearance and increasing influence of the growth-centre in the sixth segment is correlated with sexual development and in this connexion it is interesting to note that at the onset of sexual maturity there is a rise in growth-potential in the female and a fall in the male.

It is believed that this is the first recorded case of an organ, the abdomen, passing from the influence of one growth-gradient to another, the second of which is correlated with sexual development.

J. H. D.

**Observations on the Sporozoa Inhabiting the Gut of the Polychaete Worm
Polydora flava Claparède.**

By R. Ralph Fowell.

Parasitology, Vol. XXVIII, 1936, pp. 414-430.

Polychaete worms harbour some very characteristic Sporozoa; and *Polydora flava* is certainly no exception to the rule. A Coccidian—which is clearly an Eimeriid—is, perhaps, the most interesting parasite of *Polydora* owing to its striking resemblance to the Coccidia of higher animals; and it is also remarkable in being an intranuclear parasite. Unfortunately, the fate of the undivided contents of the oocyst is unknown.

The other parasites of *Polydora flava* include a dicystid gregarine, *Polyrhabdina polydora*, and a schizogregarine, *Selenidium axiferens* n. sp.; this organism possesses a remarkable axial tube which extends from one end of the body to the other and completely encloses the nucleus. The axial tube forms an integral part of the fibrillar complex, being connected, by whorls of radial fibrils spaced at regular intervals along the body, with a superficial system of longitudinal myonemes underlying the pellicular grooves. Schizogony and stages in sporogony, up to the formation of isogametes, are described; and association in *Polyrhabdina polydora* is recorded for the first time.

R. R. F.

Neuro-muscular Transmission in Crabs.

By Bernhard Katz.

Journal of Physiology, 1936, Vol. 86, pp. 45-46 P. and Vol. 87, pp. 199-221.

The electric excitability and the effect of different pharmacological agents on the neuro-muscular system of *Carcinus maenas* were investigated. The mechanical response of the flexor muscle of the dactylopodite in isolated walking legs, and the electric response of nerve and muscle were

recorded. Visible muscle contraction, during indirect stimulation, results from repetitive nerve excitation only. The majority of muscle fibres come into action at frequencies of 60–120 per sec. (20° C.). The gradation of the muscle response is controlled by the number of “facilitated” nerve endings, increasing statistically with frequency. The time constant k (Hill) in nerve excitation, determined from strength-duration curves (repetitive condenser discharges) for electric response of the nerve, or for threshold contraction of the muscle, is about 1 msec. at 20° C. The limb nerve gives prolonged multiple response to constant current both at make and break, due to its very slow accommodation process. The frequency of impulses varies with intensity of applied current up to an upper limit (about 300 per sec. at 20° C.), determined by the absolute refractory period. Calcium, in about fifteen times normal blood concentration, quickening the accommodation process, abolishes reversibly the multiple response. The nature of neuro-muscular transmission is investigated. Curare, acetylcholine and eserine have little or no effect on the neuro-muscular junction. Potassium applied to the neuro-muscular junction causes contracture, even in three times normal concentration. The initial part of the contracture is of a tetanic nature, being accompanied by rhythmic electric response. Magnesium, even in 2.5 times normal blood concentration, has a reversible curare-like blocking effect on the myoneural junction, and acts as an antagonist to potassium in respect of contracture. The electric response of the nerve is abolished by potassium, increased by magnesium, in about the same concentrations as those effective on the nerve endings.

B. K.

**Observations and Experiments on Sex-change in the European Oyster.
V. A Simultaneous Study of Spawning in 1927 in Two Distinct Geographical Localities.**

By J. H. Orton.

Mélanges Paul Pelseneer, Mémoires Mus. Roy. Hist. Nat. Belg., Ser. 2, Fasc. 3, pp. 997–1056.

In this study some 10,000 oysters from the Fal Estuary and some 5,000 from the River Blackwater were examined during and about the spawning season in 1927, giving mostly large weekly samples. An analysis for sex-proportions and spawning confirms and establishes the fact that on English beds at least 50% of the population above the age of three years mature annually as ripe females, mostly near the beginning of the spawning season, and become gradually expanded as they spawn during the season. Spawning began at different dates on both beds when the sea-temperature attained about 15° C.; a correlated study of seasonal

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variation in sea-temperature is given. Fluctuation in weekly percentage of premature and normal whitesick, greysick and blacksick are noted with their bearing on oyster-culture, and periods of development of larvae *in situ* in the parent in the sea are adduced from the results. The factors contributing to the spawning stimulus, the effect of temperature and salinity fluctuation on spawning, the theory of the time-calorie period of development in relation to spawning and other problems are discussed.

The female population on the Blackwater was exhausted to a minimum of 3% in August, whereas 20% of the population on the Fal were unexpended at the same time and failed to spawn effectively. A discussion of the phenomena and probable controlling factors is given. A study of the gross proportion of the population acquiring femaleness (including assumptions of the hermaphrodite phase) during the season, and of other problems, is being continued from the data obtained.

J. H. O.

The Photo-electric Measurement of Submarine Illumination in Off-shore Waters.

By H. H. Poole.

Rapp. and Proc. Verb. Cons. Internat. p. l'Explor. de la Mer., CI, 2^e Partie, 12 pp.

Photo-electric cells of the selenium rectifier type appear to be the most suitable at present available for the measurement of submarine daylight.

As a low-resistance circuit is essential for measurements in bright light, and it is difficult to combine this with adequate sensitivity in a galvanometer suitable for use at sea, the modified Campbell Freeth potentiometer circuit has been made use of. This combines zero effective resistance with a sensitivity extending to 10^{-9} ampère, and is virtually unaffected by the rolling of the ship.

A brief description is given of the marine equipment which has been found to be suitable.

The optical conditions affecting a submerged photometer are considered, and the need is pointed out for a suitable opal diffusing window in contact with the water. Notes are given of the colour filters used for isolating different parts of the spectrum.

Depth errors due to the drift of the ship must be guarded against, and the error due to shading reduced as far as possible by suspending the photometer from a spar projecting over the stern. The length of the spar is generally limited by motives of convenience, and by the extent of the ship's pitching motion.

The accuracy obtainable under water varies greatly according to the weather. As, however, the illumination generally falls by from 10 to 20

per cent per metre (or much more for red light) depth errors are likely to be as important as photometric errors.

The vertical extinction co-efficient found from the ratio of the illuminations at two different depths is a convenient index of the opacity of the water, although Petterson's direct method of comparison of the opacities of different waters possesses some important advantages.

H. H. P.

The Effect of Parasitism by Larval Trematodes on the Tissues of *Littorina littorea* (Linné).

By W. J. Rees.

Proc. Zool. Soc., London, 1936, pp. 357-368, Plates I-IV.

The effects produced by the following larval trematodes were studied: *Cercaria Himasthla secunda* (Nicoll), *C. littorinae* Rees, *C. lophocerca* Lebour, *C. emasculans* Pelseener and an ubiquitous cercaria (near *C. ubiquitousoides* Stunkard). The total percentage infestation varied considerably depending on local conditions, including the distribution and habits of the final hosts of these larvae.

Differences in the parasitization of the digestive gland and gonad by the different parthenitae were found to be due to three factors which are interdependent: 1. The nature of the parthenita, whether sporocyst or redia. 2. The size of the individual parthenitae. 3. The presence of a "blocking layer" formed by inactive sporocysts.

W. J. R.

An Investigation of the Post-Larval Development of the Shore Crab, *Carcinus maenas*, with Special Reference to the External Secondary Sexual Characters.

By C. J. Shen.

Proc. Zool. Soc., London, 1935, pp. 1-33, 28 figs.

The male and female crabs can be distinguished not only in the adult stage, but also in early post-larval stages, by means of the following three external sexual characters: (a) the pleopods, (b) the abdomen, and (c) the carapace.

The first character alone is diagnostic for all crabs; the second and third ones are applicable only within limits.

(a) *The pleopods* of the megalopa and first young crab stages do not show any remarkable sexual characters except a slight difference in size, but the sexes can be readily distinguished by means of the pleopods at the second young crab stage.

(b) *The abdomen* : The form of abdomen can be distinguished between the two sexes at about the fifth young crab stage.

(c) *The carapace* : The form of carapace in early post-larval stages exhibits no significant sexual differences. The growth-rate, however, is rather higher in the female as compared with the male from the fifth young crab stage onwards.

C. J. S.

New Species of *Zostera* from Britain.

By T. G. Tutin.

Journ. Bot., Aug., 1936, pp. 227-230.

A new species of *Zostera* belonging to section *Alega* was noticed during an investigation into the causes of the disease of *Z. marina* L. and named *Z. Hornemanniana*. It differs from *Z. marina* which is its closest ally in the narrow leaves, rounded or emarginate at the apex, with three primary and two marginal nerves, much smaller flowers and inflorescences, and in having the style twice as long as the stigmas and seeds only 2.5 mm. long. It appears to be fairly common round the coasts of the British Isles and Western Europe and occupies a distinct ecological niche. It usually occurs on soft mud in estuaries at rather high levels, though in one locality it grows permanently submerged. It keeps its distinctive characters in cultivation and is readily recognizable in the field, though herbarium specimens often present difficulties to the systematist. The chromosome number is twelve, the same as in the other two British species, the chromosomes closely resembling in size those of *Z. marina*. The plant is quite fertile and shows no evidence of hybrid origin.

T. G. T.

The Development of the Sabellid *Branchiomma vesiculosum*.

By Douglas P. Wilson.

Quart. Jour. Micro. Sci., Vol. 78, 1936, pp. 543-603.

The Sabellidae are a large and widely distributed family of Polychaetes whose mode of development is almost entirely unknown. In this paper the embryology of the well-known species *Branchiomma vesiculosum* Montagu is described in detail and illustrated for the first time. The larvae were obtained from artificial fertilizations and were reared through metamorphosis and for some time afterwards. The larvae are well provided with yolk and do not feed during their pelagic life, which lasts only eight or nine days. They have a prototroch, but no telotroch. In the last swimming stages the primary buds of the branchial apparatus arise on

the head in front of the prototroch ; the collar buds appear behind the prototroch. During metamorphosis tissues of the prototroch and larval parts of the head clump together to form a snout-like structure that gradually breaks up into pieces which are discarded. The young worm secretes a tube of mucus for itself on the bottom and later builds one with sand grains.

At metamorphosis there are generally three or four chaetigers of thoracic type already formed ; afterwards thoracic chaetigers are added in front of the pygidium until the adult number of eight has been attained. Succeeding segments are all abdominal in type. There is no change over from abdominal to thoracic constitution during normal development as has been reported for Serpulids, or as occurs in adult Sabellids during certain types of regeneration.

The early larvae of *Sabella pavonina* (Savigny) are shown to resemble closely those of *Branchiomma*.

D. P. W.

Observations on Pigmentary Co-ordination in Elasmobranchs.

By U. M. Wykes.

Journ. Exp. Biol., Vol. XIII, 1936, pp. 460-466.

Hogben's recent study of the pigmentary system of English Elasmobranchs showed that the colour responses of these fishes are under the control of two pituitary hormones. The experiments of Parker on *Mustelus*, however, have led him to conclude that in this fish melanophore contraction is brought about by nervous impulses.

The possibility of nervous control of pigmentary responses was investigated in *Raia brachyura*, *R. maculata*, *Rhina squatina*, and *Scyllium canicula*. No melanophore changes could be observed either macro- or microscopically after section of four consecutive spinal nerves in black or white adapted specimens, nor after electrical stimulation of spinal nerves, the haemal canal, or skin. Adrenalin, while having no effect on excised skin, was found to cause slight general pallor on subcutaneous injection. Possibly adrenalin injections affect the colour indirectly as a result of vaso-constrictor action. When the circulation in the tail and pelvic fins was impeded by an aortal ligature, melanophore changes were temporarily eliminated in these regions, though they could still be induced in the rest of the body.

These experiments suggest that, in the species investigated, the nerves play no part whatever in the control of background responses, which are under the exclusive influence of circulatory hormones.

U. M. W.

The Structure of Nerve Fibres in Sepia.

By J. Z. Young.

Journ. Physiol., Vol. LXXXIII, 1934, pp. 27-28 P.

The peripheral nerves of Decapod Cephalopods contain very large axons, those of *Loligo* approaching 1 mm. in diameter. These, as well as the smaller axons, are surrounded by nucleated sheaths. The substance of the axon is semi-fluid, and when the larger axons are cut their contents pour out from the end of the tube. A faint longitudinal striation is visible in the axon of the living nerve fibres, but there are no neurofibrils which can be followed for long distances.

J. Z. Y.

The Giant Nerve Fibres and Epistellar Body of Cephalopods.

By J. Z. Young.

Quart. Journ. Micr. Sci., Vol. LXXVIII, 1936, pp. 367-386.

In Decapod Cephalopods there is a system of giant nerve fibres which probably serve to produce rapid contractions of the muscles of the mantle. In *Loligo* the giant fibres in the stellar nerves arise in a special giant fibre lobe of the stellate ganglion, and they are syncytia, each being formed by fusion of the processes of a large number of nerve cells.

In Octopods there are no giant fibres, but in the position of the giant fibre lobe there is a small closed vesicle, coloured yellow in some species, to which the name "epistellar body" is given. The walls of this vesicle contain curious cells, the neurosecretory cells, whose general structure resembles that of neurons, but whose processes (axons) end blindly embedded in a homogeneous non-cellular matrix which fills the cavity of the epistellar body.

After removal of both epistellar bodies from *Eledone moschata* the animal shows general muscular weakness, which lasts for some days. It is suggested that the epistellar body has arisen in phylogeny from the giant fibre lobe and that the neurosecretory cells produce at their inner ends a hormone which passes into the blood stream.

J. Z. Y.

The Innervation and Reactions to Drugs of the Viscera of Teleostean Fish.

By J. Z. Young.

Proc. Roy. Soc., London, B., Vol. 120, 1936, pp. 303-318.

Faradic stimulation of the vagus nerve of *Lophius* or *Uranoscopus* is followed by movements of the stomach, whereas stimulation of the splanchnic nerve causes movements of the pyloric caeca and intestine.

There are no other motor nerves to the intestine other than those contained in the single pair of splanchnic nerves. Acetylcholine was found to cause a rise of tonus and initiation of rhythmic contractions in the muscles of the stomach, intestine, rectum and gall bladder, whereas adrenaline produced the reverse effects.

The walls of the ovary and urinary bladder receive motor fibres from the abdominal sympathetic ganglia, and these muscles are also usually caused to contract by acetylcholine and are inhibited by adrenaline. These results make it very difficult to draw any clear line between sympathetic and parasympathetic systems in fishes, and in particular they show that there is nothing corresponding to the sacral parasympathetic system of Mammals.

J. Z. Y.

The Structure of Nerve Fibres in Cephalopods and Crustacea.

By J. Z. Young.

Proc. Roy. Soc., London, B, Vol. 121, 1936, pp. 319-336.

The sheaths around the axons of Cephalopods are nucleated throughout, and the tissue of which they are composed resembles collagenous connective tissue. The axons may be nearly 1 mm. in diameter and each consists of a rather viscous fluid apt to flow out of the sheath if the latter be damaged. No definite neurofibrils traceable for long distances are present in the axoplasm, but there is a faint longitudinal striation which is visible during life and becomes much more definite if the axon be damaged in any way, presumably on account of the coagulation of longitudinally orientated micelles. It is estimated that 65-70% of the cross-sectional area of Cephalopod nerves is occupied by the axoplasm.

In the leg nerves of *Maia* each axon is surrounded by a continuous sheath, whose nuclei extend even to the innermost layers. There is some fat present, especially in the inner layers. The sheaths around the larger axons of *Maia* are very thick, consisting of many concentric layers. 60-70% of the cross-sectional area of the leg nerves of *Maia* is occupied by axoplasm.

J. Z. Y.