

## Abstracts of Memoirs

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY.

### The Feeding Mechanism of the Cumacean Crustacean

*Diastylis Bradyi.*

By Ralph Dennell.

Trans. Roy. Soc., Edinb., Vol. LVIII, Pt. I, 1934, pp. 125-142.

*Diastylis* feeds on small food particles abstracted by the maxillary filter from a water current produced by movements of the maxillæ and maxillipeds. This current is secondarily aided by the outgoing respiratory current, and the assistance it gives to the filter current is much greater than in *Gnathophausia*. The large epipodites cause water to enter the branchial chambers through the mouth-parts, and pass it out anteriorly through the rostral siphon which is provided with a valve. In flowing forwards lateral to the mouth-parts the respiratory currents pass over the maxillary exites and extract water from the filter chamber.

A feature of the mouth-parts not possessed by the typical filtratory Malacostracan is a peculiar median process projecting into the filter chamber, and forming an abutment for the inner margins of maxillæ and maxillipeds.

The ancestral Cumacean probably had features in common with the primitive Lophogastrid Mysids *Gnathophausia* and *Lophogaster*, and in an account of the feeding mechanism of *Apsudes*, now in preparation for the press, an account will be given of the probable evolution of the Peracaridan feeding mechanisms from that possessed by a primitive Mysid-like ancestor which adopted mud-living habits.

R. D.

### On the Feeding Mechanism of Certain Marine Ostracoda.

By H. Graham Cannon.

Trans. Roy. Soc., Edinb., Vol. LVII, 1933, pp. 739-764.

*Asterope* is a purely filtratory feeder. A current of water is caused to pass through the valves of the shell by the vibratory activity of the maxillary epipodite beating against the first trunk limb. The hinder parts of these two limbs are thin flexible plates and act as a valve, allowing only a passage of water in an antero-posterior direction. The filter is

formed by the maxillules. The tips of the filter setæ are supported by the front edge of the first trunk limb. Food residue is scraped off the filter by a row of comb setæ developed on the anterior prolongation of the maxilla, and also by a spinous lobe on the mandible. The mandibular palp can flex back on to its spinous lobe, but cannot reach as far as the mouth. The food is passed on to the long setæ of the maxillary endites, which curve up into the mouth. Food passed to the mouth by these setæ is transferred into the œsophagus by the scythe-shaped process of the mandible. There is no labral gland secretion to entangle the food particles, and the labrum is correspondingly small.

Cypridina may feed on large food masses or on minute detritus, which it abstracts from a current of water produced through the valves by the same mechanism as in *Asterope*. Minute particles are retained on a barrage of setæ which converge towards the mouth and arise from the basal part of the maxillules, the maxillæ and first trunk limb. The same setæ transport the collected mass upwards into the mouth. The labrum is very large, and the slimy secretions of the labral gland entangle the suspended matter. The mandibular palps flex so that their clawed tips reach as far as the mouth. The biting jaws consist of the laterally working tips of the maxillules and subsidiary teeth, which work obliquely forwards on the exopodite of the maxilla.

Cytherella is a purely filtratory feeder. The mechanism of its feeding is closely analogous to that of *Asterope*, but the various processes are carried out by different limbs. A comparison between the two is shown in Table I.

H. G. C.

### **The Action of Potassium and other Ions on the Injury Potential and Action Current in *Maia* Nerve.**

**By S. L. Cowan.**

*Proc. Roy. Soc., B*, 115, 1934, pp. 216-260.

Analyses of *Maia squinado* blood serum and nerve show that the potassium concentration per 100 g. of water is at least thirteen times as great in the nerve as in the serum. The observed injury potential of *Maia* nerve was usually 30 millivolts; at 17°C a  $\pm 5$  p.c. reproducibility persisted for about two hours, precautions being taken to eliminate the "crush sealing over" effect (Gerard, 1930).

Potassium chloride rich solutions depressed both the injury potential and action current rapidly and reversibly. The potassium concentration required to abolish the action current was about five times that occurring in *Maia* serum; the depression of the action current could be partly

prevented by the addition of an equimolecular concentration of calcium chloride. Probably the reversible inexcitability which occurs in freshly dissected *Maia* nerves is due to an abnormal concentration of potassium ions at the external surfaces of the fibres; the potassium ions may escape either from the nerve or from the surrounding muscle fibres, as a result of small unavoidable injuries inflicted during the dissection.

Rubidium and caesium ions also produced a reversible abolition of the action current, but 2.0 rubidium or 3.2 caesium ions were required to give the effect of one potassium ion: the depressant action of these ions could be partly prevented by calcium ions.

Nerves which had been immersed in potassium rich solutions gave an approximately linear relation between the logarithm of the potassium chloride concentration and the depression of the injury potential, although higher concentrations than would be expected from the chemical analyses were required to make the potential zero. Probably the discrepancy is due to the difficulty of isolating for chemical analysis nerves uncontaminated by connective tissue and sea water, although other factors, such as the Donnan effect, may also have been appreciable.

Resting nerves in sea water leaked little potassium salt, but nerves stimulated to fatigue leaked considerable amounts. Assuming that the long-continued recovery heat production of these nerves is due to a "secretory" process whereby ions are restored to their original positions, the thermodynamical efficiency is calculated to be 0.02.

After severe asphyxia the conductivity of *Maia* nerves was only partly restored by the admission of oxygen; for more complete recovery, washing in sea water was also necessary. It is suggested that during the later stages of anoxia potassium salts may escape from the interior of the fibres.

S. L. C.

### **The Effect of Quaternary Ammonium Salts upon Nerve.**

*(Preliminary communication.)*

**By S. L. Cowan and H. R. Ing.**

*J. Physiol.*, Vol. *LXXIX*, 1933, pp. 75-82.

and

### **The Action of Quaternary Ammonium Salts on Nerve.**

**By S. L. Cowan.**

*Nature*, Vol. *CXXXI*, 1933, p. 658.

The action current was abolished in *Maia* nerves which had been immersed for a minute in sea water to which had been added tetramethyl or tetraethylammonium chloride in a concentration of 0.9 millimol per litre.

Using *Rana esculentia* and concentrations of tetramethylammonium iodide which readily produce a curariform paralysis but do not ordinarily affect either muscle or nerve, it was found that if a nerve was asphyxiated for about an hour after the abolition of the action current, then on the admission of oxygen the action current returned only for a short time if at all. Similar results were obtained with octyltrimethylammonium iodide and with strychnine methiodide, but with tetraethylammonium iodide in a concentration of 10 millimols per litre an increase in the galvanometer deflection due to the action current was observed.

S. L. C.

### A Physiological Study of Phosphagen in Plain Muscle.

By M. Grace Eggleton.

*J. Physiol.*, Vol. LXXXII, 1934, pp. 79-87.

The phosphagen present in the retractor muscle of *Mytilus edulis* is identical with argininephosphoric acid as regards its rate of hydrolysis in acid. A method for the rapid estimation of argininephosphoric acid is described, based upon its separation from pyro- and orthophosphate before hydrolysis. Both sodium pyrophosphate and muscle "pyrophosphate" are hydrolysed to a slight extent in N/20 acid at 28°C, a fact leading to error in the estimation of argininephosphoric acid by the method at present in general use.

In the resting aerated muscle the ratio of phosphagen to the sum of phosphagen and orthophosphate is 0.8. Fatigue induced by a series of contractions reduces this value to 0.45 and by a tetanus to 0.6. Rest under aerobic conditions restores the phosphagen to its original resting level, full mechanical recovery occurring at the same time. Under anaerobic conditions the ratio remains practically unchanged after the same period of recovery and the power of mechanical response is restored to only a slight extent. It is concluded that phosphagen bears the same close relation to activity in this plain muscle as it has previously been shown to do in skeletal and cardiac muscle.

M. G. E.

### The Structure and Relationships of Lamellibranchs possessing a Cruciform Muscle.

By A. Graham.

*Proc. Roy. Soc., Edinb.*, Vol. LIV, 1934, pp. 158-187.

A comparative anatomical description of the following species of bivalves belonging to the Tellinacea is given: *Gari tellinella*, *Tellina crassa*, *Macoma balthica*, *Scrobicularia plana* and *Donax vittatus*. All agree in

many important points, particularly in possessing a cruciform muscle but no other mantle fusions; a linguiform, byssiferous foot; long, separate, retractile siphons; an anterior retractor pedis muscle with one insertion on each valve and lying internal to the posterior retractor in the foot; a protractor pedis; an outer demibranch with large supra-axial extension; a fused style sac and intestine.

The Solenidæ, of which *Cultellus pellucidus* is described, have no cruciform muscle, but possess other extensive mantle fusions; a cylindrical foot without a byssus; short siphons, not retractile; anterior retractor pedis with two insertions on each valve and external to the posterior retractor in the foot; usually no protractor pedis; no supra-axial extension to the outer demibranch; no fusion of style sac and intestine.

*Solecurtus scopula* and *S. chamasolen* agree in all main points with the former group. The Solecurtidæ, till now associated with the Solenidæ, must be placed in the tribe Tellinacea.

A. G.

### **The Development of Certain Parasitic Copepoda of the Families Caligidæ and Clavellidæ.**

**By Robert Gurney.**

*Proc. Zool. Soc., London, 1934 (I), pp. 177-217. 43 Text-figs.*

In the development of *Caligus* there are two nauplius and five copepodid stages, of which stage I only is free. The last four are attached by a frontal filament which is extruded from the body of the free copepodid at the moult. This filament remains unchanged, a new basal part being added at each moult. *Trebius* differs from *Caligus* in having no frontal filament and no maxillipede in copepodid I. In *Clavella* there is one nauplius and one free copepodid stage. The latter attaches itself by a frontal filament, and the next stage develops within its skin, the skin being ruptured, but not cast off. The young *Clavella* clings to the end of the filament by the maxillæ, but the next stage is found attached by a bulla, which has no connection with the filament. There appear to be no further moults, and it is clear that the adult *Clavella* represents a pædomorphic copepodid of stage I or II.

R. G.

**Note on the Effect of Salts in the Determination of Phosphate in Sea Water by Denigès' Method.**

**By O. Gomez Ibañez.**

*J. Cons. int. Explor. Mer., Vol. VIII, No. 3, 1933, pp. 326-329.*

The work was made in order to determine the error due to other salts present in sea water.

A sample of sea water (of 35 ‰ salinity) was found to contain 8.4 mg.  $P_2O_5/m^3$ . To portions of this were added varying quantities of phosphate.

The total amount of phosphate was determined by Denigès' method and the colour comparisons were made by Hehner tubes. The correction for the blue colour of the water was applied.

Over a large range of concentration the salt error is independent of the phosphate concentration and is at least approximately proportional to the salinity.

O. G. I.

**Preservation of Sea Water Samples with Fluoride for Phosphate Estimation by Denigès' Method.**

**By O. Gomez Ibañez.**

*J. Cons. int. Explor. Mer., Vol. VIII, No. 3, 1933, pp. 329-330.*

The phosphate determination will be in error unless carried out within a short time of collection, or unless planktonic activity is stopped by some method which does not interfere with the analysis. Sodium fluoride has been found to be an excellent preservative for sea water samples for phosphate estimation.

When 1 cm<sup>3</sup> of a one per cent solution of pure sodium fluoride was added to 100 cm<sup>3</sup> of the sample, no change in phosphate could be detected. Experiments were made with and without this preservative directly and after adding 30 mgs.  $P_2O_5$  per cubic metre in samples stored during three months.

O. G. I.

**The Development of *Ophiocoma nigra*.**

**By N. Narasimhamurti.**

*Quart. J. Micr. Sci., Vol. LXXVI, 1933-34, pp. 63-88.*

This paper is in the nature of a reinvestigation of the development of an Ophiuroid. The material for this work was obtained by artificial fertilization at the Plymouth Laboratory. The paper embodies a complete history of development from fertilization to metamorphosis. Several

interesting observations have been recorded and the more important of these are :

1. A right hydrocœle arises in all the larvæ from the anterior coelom, in addition to the left hydrocœle, but does not assume a five lobed form in any case and degenerates as metamorphosis progresses.
2. A pericardial vesicle arises from the dorsal wall of the right anterior coelom as in Echinoids and Asteroids and persists in the adult as a thin-walled pulsating sac, its invaginated ventral wall forming the heart. Pulsations occur once in every 12 seconds in the ventral wall of the newly metamorphosed imago.
3. During metamorphosis the fifth lobe of the hydrocœle, instead of moving across the cesophagus upwards, slightly bends to the right to meet the first which travels down after traversing the cesophagus.
4. All perihæmal spaces are found to arise from the left posterior coelom.
5. The outer ends of the cylindrical cells of the stomach are vacuolated and stained black with Osmic acid owing to the presence of fat in them. The stomach at first appears as a solid mass in post-metamorphic stages, but later sends five projections alternating with the arms.

**Reaction of the Smooth Muscle of the Gastro-intestinal Tract of the Skate to Stimulation of Autonomic Nerves in Isolated Nerve-muscle Preparations.**

**By J. V. V. Nicholls.**

*J. Physiol.*, Vol. LXXXIII, 1934, pp. 56-67.

Faradic stimulation of the anterior gastric artery stimulates the gastric antrum and fundus ; of the superior mesenteric artery, the spiral intestine and colon ; of the inferior mesenteric artery, the rectum. These effects are not affected by ergotoxine. Ergotoxine alone stimulates the antrum, fundus and pyloric sphincter, but has no effect upon the spiral intestine, colon and rectum. The effect of adrenaline is not antagonized by ergotoxine in the case of the stomach, but is antagonized in the case of the spiral intestine, rectum and colon. Single and multiple break shocks and faradic stimulation of the vagus stimulate the cardiac and fundic regions of the stomach. These last effects are not inhibited even by large doses of atropine.

J. V. V. N.

**Formation de têtes dans la stolonisation des Polychètes syllidiens.**

**By Yô K. Okada.**

*Bull. Soc. Zool., France, T. LIX, 1934, pp. 388-405.*

In this paper the mechanism of head development is described in some Syllids, with special reference to the determination of the character of head in stolonization. In *Proceræ picta*, for example, the position of the new head is even indicated on the antero-dorsal side of the 14th setigerous segment before any sign of stolonization. But the irreversible determination of the head waits until indication of stolonization becomes fairly distinct. Even when the worm is cut across at one segment posterior to the position in question, tail regenerates instead. If, however, the plane of section passes through the middle of the 14th segment, heteromorphic head results. In the Syllinæ, where the head of the stolon appears with a wide range of segmental variation in the middle part of the body, the anlage is undifferentiated. In such cases the determination of the tissue in relation to the head is more retarded than in the preceding form. In other respects both agree well, and, after the determination, half anlage produces half head. Only the regulation of symmetry of eyes and appendages is still possible. Finally, pluri-cephalic specimens of *Typosyllis prolifera* are studied.

Yô K. O.

**Les possibilités de la régénération de la tête chez le Polychète, *Myxicola æsthetica* (Clap.).**

**By Yô K. Okada.**

*Ann. Zool. Jap., Vol. XIII, 1932, pp. 535-550.*

**Régénération de la tête chez le Polychète, *Myxicola æsthetica* (Clap.).**

**By Yô K. Okada.**

*Bull. biol. (Franc. et Belg.), LXVIII, 1934, pp. 340-381.*

Regeneration of the head is investigated in *Myxicola æsthetica* (Clap.). At Plymouth this Polychæte is easily obtainable and provides an excellent material for experiments of this kind. It can be kept alive for a long time in a small glass vessel filled with plain sea-water. The animal, in this condition, easily regenerates the head as well as the tail. Head regeneration is especially pronounced, the power being retained almost as far as the posterior extremity. When the communication of the ventral chain of nerve is severed, without, however, separating the anterior segments from the posterior ones, a lateral head frequently appears at the



point of lesion. In the anterior third of the body, the lateral head remains generally under-grown, but in the remaining two-thirds the head develops as well as in the normal case of regeneration on the anterior cut-surface. The lateral head can be induced not only singly but also several at a time, with the resulting production of multicephalic specimens. The head produced at a side can be brought to the posterior end by taking off the segments below that level by an oblique cut passing the base of the new head; thus results a specimen with a head at the anterior as well as the posterior end. Even a single segment gives rise to a worm, forming the head in front and the tail behind. The anterior regeneration is, as a rule, limited to a production of the head and one setigerous segment. (The anterior part will be completed afterwards through metamorphosis of the following segments to form thorax.) Further, segments longitudinally divided into halves can still regenerate the head in so far as these contain the ventral nerve. The intestine and other viscera attached to the septum take no part in the process, and these can be therefore eliminated from the pieces, without interfering with their power of regenerating head. Throughout the whole experiment no tail is regenerated except at the posterior extremity of the body when transversely cut.

Yô K. O.

### On the Excitation of Crustacean Muscle—I.

By C. F. A. Pantin.

*J. exp. Biol.*, Vol. XI, 1934, pp. 11-27.

By stimulating the nerve in *Carcinus* leg with alternating currents of increasing intensity a series of varied responses is obtained. Above the threshold a contraction is developed of a comparatively slow type. With increase of intensity of the stimulus the response fails, owing to the excitation of inhibitory nerves. But at still greater intensities contraction reappears. This contraction, however, is very rapid. Tetani developed from the slow contraction are easily inhibited. Tetani developed from the rapid contraction cannot be inhibited by superimposed stimuli.

The relation of the quick and slow contractions is considered. It is not possible to fatigue one without fatiguing the other. Experiments show that on suddenly releasing the tension of the muscle during a tetanus, the tension always redevelops in a manner similar to the development of tension in the quick contraction, even though the tetanus be developed initially by the slow contraction. The same contractile mechanism is involved in both cases.

The latent period of contraction on stimulation of the nerve is very long, and ranges from  $300\sigma$  at the threshold. That for direct stimulation of the

muscle is 7–10 $\sigma$ . Above the threshold the latent period shortens rapidly with increasing stimulus. Over this region the contractions are of the slow type. The latent period becomes asymptotic to 50 $\sigma$  as the intensity is increased. At this value the contractions are of the quick type. Inhibition is effective where the latent period begins to approach its asymptotic value.

It is suggested that all the varied phenomena observed are related to the power of summation of crustacean muscle ; that the slow contraction in response to a battery of stimuli is not due to a different contractile mechanism from the quick one, but that it is a summation effect by which a statistically increasing number of muscle fibres are brought into action as successive impulses pass down the nerve.

C. F. A. P.

**On the Nature and Functions of the Amœbocytes of *Ostrea edulis*.**

**By Shun-ichi Takatsuki.**

*Quart. J. Micr. Sci.*, Vol. LXXVI, 1933–34, pp. 379–431.

There are two kinds of corpuscles in the blood of the oyster ; one consists of granular, the other of hyaline amœbocytes. The granules are neutrophile with a tendency to become stained by the basic dyes *intra vitam*.

The amœbocytes of the oyster have important functions in connexion with the digestive mechanism and excretion. The phagocytic behaviour of the amœbocytes is prominent and there can be found the sucroclastic, lipoclastic and proteoclastic enzymes in the amœbocytes. These enzymes have an optimum pH quite different from the other digestive enzymes in the digestive tracts of the oyster.

There is no evidence of absorption either of soluble matter or of solid substances by the epithelium of the mantle cavity of the oyster other than by the agency of amœbocytes.

S. T.