

## Abstracts of Memoirs.

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY.

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### **The Determination of Zinc in Water by means of Sodium Diethyldithiocarbamate.**

**By W. R. G. Atkins.**

*Analyst*, Vol. 60, 1935, pp. 400-401.

Zinc may be estimated turbidimetrically in water supplies, in concentrations of from 0.02 to 25 parts per million, using a 0.1 per cent aqueous solution of the reagent. The turbidity disappears in ammoniacal solution, but a turbidity caused by lead does not. Iron may be removed as described by Callan and Henderson. A sample of water from a galvanised iron tank was found to contain 5 p.p.m. For the estimation of zinc in sea water see this Journal, Vol. XX (No. 3), p. 625.

W. R. G. A.

### **Photo-electric Measurement of Submarine Illumination: an Outline of the Methods and their Results.**

**By W. R. G. Atkins and H. H. Poole.**

*Report of Fifth Pacific Science Congress, III*, 1933, pp. 2129-2139.

Since reviews of the subject in general had already been given in the Journal of the International Council for the Exploration of the Sea (Atkins, 1926 and 1932), the present review deals mainly with recent work. Two methods are suitable for use at sea in a small ship under average weather conditions. Seasonal changes have been studied and the penetration of light of various wave-lengths from dark red to ultra-violet has been measured. The results have applications in the study of photosynthesis, the movements of the zooplankton, and the production of vitamin D.

W. R. G. A.

### **The Photo-electric Measurement of the Diurnal and Seasonal Variations in Daylight and a Globe Integrating Photometer.**

**By W. R. G. Atkins and H. H. Poole.**

*Phil. Trans. Roy. Soc., London, A*, 235, 1936, pp. 245-272.

The exposure of plane, tubular and spherical surfaces are considered in relation to the measurement of daylight by sodium, potassium and

selenium cells, and by photo-sensitive liquids. Curves show the variation of the sensitivity of the cells with wave-length in a mean noon sunlight spectrum. A Burt sodium cell and a Cambridge "thread recorder" were used to get daily records, twenty of which are reproduced. The curves for 1930 have been measured to give vertical illumination integrals in kilolux hours. The monthly percentages of the annual illumination integral ranged from 1.25 for December to 16.0 for July. The ratio of vertical sunlight to vertical sky light ranges up to about 3.0, as found with a sodium cell. Much larger ratios are obtained with a selenium cell. The vertical illumination with sun at 45° varies greatly, even on cloudless days, but averaged 102 kilolux, using a sodium cell. A globe photometer is described, which by means of a horizontally mounted selenium cell and triple diffusing surfaces gives readings independent of the altitude and azimuth of the source.

W. R. G. A.

### **The Developmental Stages of Three English Barnacles.**

By **R. Bassindale.**

*Proc. Zool. Soc., London, 1936 (1), pp. 57-74.*

In an attempt to determine the life-history of the common English barnacles, cultures of each of six species were set up. The three successful cultures showed a marked plant growth. The three species reared (*Balanus balanoides* (Linn.), *Chthamalus stellatus* (Poli) and *Verruca stroemia* (O. F. Müller)) each had six naupliar or metanaupliar stages. This is followed by a cypris stage which settles on the sub-stratum and metamorphoses into the young adult. This development accords with the previous accounts of the life-history of *Balanus perforatus* Brugière and *Lepas fascicularis* Ell. & Sol., but not with that of *Balanus crenatus* Brugière in which Herz found eight stages prior to the cypris.

Development, excluding the duration of the cypris stage, takes from two to three weeks. The successive stages show gradually increasing size and complexity of setation.

The sizes and setation of each stage are given together with notes on the discrimination of the larvæ of different species and on the breeding periods of the adults.

R. B.

### **The Action Potentials in Maia Nerve before and after Poisoning with Veratrine and Yohimbine Hydrochlorides.**

By **L. E. Bayliss, S. L. Cowan and Donald Scott, Jr.**

*J. Physiol., Vol. LXXXIII, 1934, pp. 439-455.*

The action potentials were recorded by means of a paraphase fed push-pull output amplifier, driven from the A.C. mains, and a moving

iron oscillograph. In nerves from the walking legs of *Maia squinado* there are at least two sets of fibres in which impulses are conducted with very different velocities. At 12° C. the velocity of the faster impulse is about 2·5 m. per sec. and that of the slower impulse about 1·0 m. per sec. Nerves poisoned with veratrine show a prolonged after-potential which begins immediately after the spike, rises slowly for at least 200 msec., and gradually disappears in half an hour. Nerves poisoned with yohimbine show a positive after-potential, immediately succeeding the spike potential, which may last up to 0·2 sec.; these are not due to changes in the depolarized region, since they can be produced by treatment of the uninjured part of the nerve.

L. E. B.

### Some New Forms of Visual Purple found in Sea Fishes, with a Note on the Visual Cells of Origin.

By L. E. Bayliss, R. J. Lythgoe and K. Tansley.

*Proc. Roy. Soc., London, B, CXX, 1936, pp. 95-113.*

A number of new forms of visual purple have been found in sea fishes, which have maxima of absorption between 505  $m\mu$  and 545  $m\mu$ . The absorption curves were obtained by a null-point photoelectric spectrophotometer, which is capable of giving accurate readings with 0·5 c.c. of solution and with a light intensity insufficient to bleach the visual purple. Alterations in the form of the absorption curve may occur as a result of "bleaching" of yellow substances in the control (bleached visual purple) solutions; alterations may also occur as a result of extracting with distilled water instead of digitonin.

A histological examination of the retinae was made. The relative numbers and structure of the rods and cones; the movements of the visual cells as a result of light- and dark-adaptation; the movements of the pigment epithelium; and the staining reactions for visual purple are described.

The variety of visual purple carried by a species can be related neither to the available data on the depth which that species normally frequents, nor to the ancestry of the species, nor to the histology of the retina of origin.

L. E. B.

**Action Potentials in Nerve of Sepia.****By J. Yule Bogue and H. Rosenberg.***J. Physiol.*, Vol. LXXXIII, 1934, pp. 21P-22P.

The action potentials of the fin and stellar nerves (postganglionic fibres of the stellate ganglion) were recorded. The central ends of these nerves were stimulated electrically (i.e., the preganglionic fibres in the ganglion preparation). Both nerves showed a fast and a slow wave, but the time relations were different in the two cases. In the stellar nerve the fast wave rises to its peak in 0.8 msec. and lasts 2 msec. The following slow wave attains its crest in 2.5 msec. and continues for 8 msec. The maximum negativity is 3 and 2 mV. resp. With a strong stimulus a second quick wave is obtained which is generally superimposed on the slow wave. Apparently the fast and the slow wave are independent. They originate in the stellate ganglion since stimulation of the stellar nerve gave no appreciable antidromic impulse. Owing to the synaptic delay the velocities of the waves from mantle connective to stellar nerve appear to be small: 3.5 m. per sec. for the fast and 2.3 m. per sec. for the slow wave. In the fin nerve the time relations of the fast wave are of the order of those of the slow wave in the stellar nerve. But its velocity is comparatively high (5.1 m. per sec.) and decrementless in fresh nerves; that of the slow wave is 2.6 m. per sec. During repetitive stimulation the absolute refractory period of the quick fibres is shorter than 5 and longer than 2.5 msec. It is suggested that the fast wave of the stellar nerve is generated in the giant fibres and associated with rapid movements of the mantle muscle.

H. R.

**Electric Excitation of the Fin Nerve of Sepia.****By L. Bugnard and A. V. Hill.***J. Physiol.*, Vol. LXXXIII, 1935, pp. 425-438.

The action currents of the mantle connective nerve of Sepia, entirely non-medullated, have been measured with a moving coil galvanometer in response to low frequency repetitive stimulation.

The strength-duration curve is of usual form, the quantity of electricity required for constant excitation becoming constant at short times. At 20° C. "the characteristic time" for excitation by minimum energy is 3 to 5 msec., about ten times that for frog's sciatic.

Distance between electrodes has little effect on the strength-duration curve within the range 1.5-20 mm. Size of stimulating electrodes,

frequency of excitation have little or no effect. Transverse excitation with linear fluid electrodes, has a large effect, reducing "the characteristic time" to one quarter of that for longitudinal excitation.

The injury potential of the fin nerve is about 20 mvolts. It can be reversibly reduced by increased K-ion concentration. Increased K reduces or abolishes excitability but does not change the form of the strength duration curve. The nerve can be fatigued, recovery occurs in air.

L. B.

### **A System of Rational Units for Reporting Nutrient Salts in Sea Water.**

**By L. H. N. Cooper.**

*J. Cons. int. Expl. Mer., Vol. VIII, 1933, pp. 331-334.*

The milligram-atom of minor constituents per cubic metre of sea water is proposed as unit of measurement, e.g., the milligram-atom of P would be used instead of the mg. of P, P<sub>2</sub>O<sub>5</sub> or PO<sub>4</sub><sup>'''</sup>. It is claimed that the proposed system would much simplify the reporting of data and that it employs the unit used by plants and animals in building up their structure. Tables are given to show the effect of the change.

(Following the publication of this paper, the subject has been considered *in extenso* by a sub-committee of the International Council.)

L. H. N. C.

### **Iron in the Sea and in Marine Plankton.**

**By L. H. N. Cooper.**

*Proc. Roy. Soc., London, B, CXVIII, 1935, pp. 419-438.*

2:2':2''-Tripyridyl, recently prepared by Morgan and Burstall, forms a co-ordination compound with ferrous-iron possessing an intense violet colour. This has been applied to the direct determination of iron in sea water. Without preliminary concentration 1 mg. per cubic metre (1γ per litre) of Fe may just be determined and conditions may be adapted for the determination of ferrous-iron, "reducible iron," which includes ferrous- and ferric-ions and some of the iron in suspension, total iron present in all forms, total iron in water freed from particulate and much of the colloidal iron by passage through a Zsigmondy membrane filter and, by difference, iron in particulate form. The method is sensitive, reliable and rapid and fluorides do not interfere.

The amount of iron in true solution as ferric and ferrous ions is very small, probably less, possibly much less, than 2 mg. per cubic metre. Most of the iron is present in particulate form, the amount of which varies greatly. The probable formation of ferrifluoride and its effect on

the iron system is discussed. Thermodynamic data for the hydroxides have been used to derive the limiting solubilities of ferrous- and ferric-ions in sea water. The concentration of free ferric-ion has been found unlikely to exceed  $10^{-12}$  mg. per cubic metre.

Seasonal determinations have been made with 2:2'-dipyridyl on the amount of iron in quantitative catches of plankton and compared with the amount of phosphorus. Diatoms require several times as much iron as phosphorus whereas the iron requirements of zooplankton, particularly Ctenophores, are much smaller. The plankton catches were richest in iron at the height of the spring diatom outburst. When the plants are eaten by herbivores, the excess of iron over requirements is excreted and becomes available more or less quickly for another growth cycle. A diagram is given illustrating tentatively the cycle of iron in the sea.

L. H. N. C.

### **The pH and CO<sub>2</sub>-combining Capacity of Maia Blood.**

**By S. L. Cowan.**

*J. Physiol.*, Vol. LXXXIV, 1935, pp. 53P.-54P.

Kerridge determined the pH of Maia blood at various partial pressures of CO<sub>2</sub> and found that CO<sub>2</sub>-binding capacities calculated from her figures were in agreement with the experimental volumes determined by Parsons and Parsons if it was assumed that pK, in the Henderson-Hasselbalch equation had a value of 6.5 at 13° C. However, Buch, Harvey, Wattenberg and Gripenberg have shown that the use of the Henderson-Hasselbalch equation to calculate pH values of sea water is justified only if a correction is made for the depressant effect of the salts present on the activity of the bicarbonate ion. If a similar salt correction be applied to Maia blood, which is approximately isotonic with sea water, then the pH figures calculated from Parsons and Parsons results are 0.4 pH unit lower than those determined by Kerridge. If the discrepancy is real, it is in the wrong sense to be explained by the formation of unionized carbon dioxide-hæmocyanin compounds.

S. L. C.

### **Quaternary Ammonium Salts and the Action Currents in Nerve.**

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

*J. Physiol.*, Vol. LXXXIV, 1935, pp. 90-110.

The following solutions of purified quaternary ammonium salts were without effect on the action current in Maia nerve : tetramethylammonium iodide, 1.50 millimols per litre ; tetramethylammonium chloride, 1.50

millimols per litre ; strychnine methiodide, 1 millimol per litre ; strychnine ethiodide, 10 millimols per litre. Curarine chloride, 5 millimols per litre was also ineffective. Silver chloride saturated sea water depressed the action current in crab nerve slightly. A 50 millimolar solution of tetramethylammonium chloride in silver chloride saturated sea water or a 5 millimolar solution of curarine chloride in silver chloride saturated sea water abolished the action current.

A solution containing 10 millimols per litre of purified tetramethylammonium chloride or 3 millimols per litre of curarine chloride did not curarize crab nerve-muscle preparations.

The following solutions of purified quaternary salts were without effect on the action current in frog nerve, even when the nerve was asphyxiated after the poisoning and allowed to recover in oxygen : tetramethylammonium chloride, 2 millimols per litre ; tetramethylammonium iodide 2 millimols per litre ; octyltrimethylammonium iodide, 2 millimols per litre ; strychnine methiodide, 1 millimol per litre. However, contact of any of these solutions with solid silver chloride could render them effective in diminishing or abolishing the action current : this explains Cowan and Ing's previous results (1933), and carefully purified salts are without effect.

Tetraethylammonium iodide solutions probably increased the area (galvanometer deflection  $\times$  time) in crab nerve and certainly did so in frog nerve. In the latter case asphyxiation did not augment the effect.

S. L. C.

### The Life History of *Sacculina*.

By J. H. Day.

*Quart. Journ. Micr. Sci.*, Vol. 77, 1935, pp. 549-583.

From the statistical analysis of a year's samples of an infected population of the crab *Portunus holsatus* Fabricius it was concluded : first, that crabs may be infected by *Sacculina* at any age ; secondly, that the developmental sequences in the life history of the parasite are dependent not on the season but possibly on the phases of the host ; thirdly, that the internal development of the parasite lasts nine months, and that the first batches of larvæ appear three months later.

Two separate experiments showed that the evagination of the parasite does not take place at an ecdysis of its host.

It is suggested that an anomalous group of highly modified male crabs without externæ but containing living parasitic roots are " scarred crabs " that have moulted ; further, that such modified crabs will in time regenerate externæ. Experimental and histological evidence supports

this suggestion, but it is not held that the theory of regeneration is completely proved.

An account is given of the effects of *Sacculina* on the secondary sexual characters of *Portunus holsatus*. Only male crabs are dealt with. It is shown: (a) that various degrees of modification are possible; (b) that the percentage of infection increases among large crabs; (c) that the smaller the crab the greater the liability to maximum modification; (d) that the maximum amount of modification which is possible decreases among larger crabs.

J. H. D.

### **The Irritability of Non-Medullated Nerve.**

**By R. W. Gerard.**

*J. Physiol.*, Vol. LXXXIII, 1934, pp. 24P.-25P.

The irritability of the non-medullated leg nerve of *Maia* was explored with rectangular or condenser current pulses of various intensity, duration and frequency, the action potential of the nerve serving as indicator of response.

The time characteristics are very long—even at 0.5 sec. duration no true rheobase is reached; and whereas the response to alternately directed short intense stimuli at 220/s is double that to unidirectional ones at 110, the response is entirely wiped out if longer weaker pulses are used. At shorter times, the voltage-duration curve tends to become straight (log-log plot) with a slope near, but less than, 45°. In this, as also in the influence of interelectrode distance and of cathode size on the curve, this non-medullated nerve resembles myelin-free muscle rather more than it does medullated nerve.

R. W. G.

### **Chloride and Total Osmotic Pressure in the Blood of Marine Teleosts.**

**By Allan L. Graffin.**

*Biol. Bulletin*, Vol. LXIX, 1935, pp. 245-258.

An effort has been made in this study to obtain data upon the plasma chloride and total osmotic pressure ( $\Delta$ ) of the blood of marine teleosts under their normal conditions of existence in the sea. For this purpose hook-and-line specimens, bled immediately after catching, have been used as the best available material. Studies upon pollack, cod, sculpin, flounder, mackerel, and conger indicate an appreciable physiological range of variation in both chloride and  $\Delta$ , with no detectable correlation between the two in any given species. The average plasma chloride for



many species studied has been found to vary from 150.6 millimols (pollack) to 172.6 millimols (conger) per litre. Supplementary chloride data upon specimens removed from the Naples aquarium and upon *Orthogoriscus mola* (from a large tunny-net) are reported.

It has further been demonstrated that both plasma chloride and delta are as a rule considerably elevated in fishes caught on a long line or by net, and in fishes bled only after a delay and rough handling. It is emphasized that this represents a serious source of error in studies upon normal osmotic pressure relationships and upon the relative tonicity of the body fluids in marine teleosts.

Certain of the Labridæ have been found to contain in their plasma a blue or green pigment.

A. L. G.

### **Renal Function in Marine Teleosts. I. Urine Flow and Urinary Chloride.**

**By Allan L. Grafflin.**

*Biol. Bulletin, Vol. LXIX, 1935, pp. 391-402.*

The present observations upon urine flow and urinary chloride in marine teleosts have led to the following conclusions: (1) that freshly caught sculpins and flounders, under fairly ideal and constant experimental conditions, show a rather wide variation in the rate of urine flow and the urinary chloride concentration; (2) that there is no direct relationship between the rate of urine flow and the urinary chloride concentration. When examined in conjunction with previously recorded observations, particularly those of Pitts (1934), the present data apparently justify a third conclusion: (3) that while all marine teleosts apparently have the *capacity* to excrete a chloride-free urine, and in their normal habitat do so in the majority of instances, they not infrequently excrete variable, and at times considerable, amounts of chloride in the urine under normal physiological conditions.

A. L. G.

### **The Locomotory Rhythm of the Dogfish, *Scyllium canicula*.**

**By J. Gray and A. Sand.**

*J. Exper. Biol., Vol. XIII, 1936, pp. 200-209.*

To determine whether the muscular co-ordination of the swimming rhythm depends on proprioceptor reflexes, or whether it is entirely central in origin, cinematographic records were made of a dogfish in which the

somatic muscles were denervated over a region of twelve segments at the level of the anterior dorsal fin. The fish was clamped by the denervated region. Analysis of the record shows that during normal swimming and also when the fish is excited by tactile and nociceptive stimuli, the movements of the anterior and posterior trunk regions are strictly co-ordinated. The spinal preparation, similarly treated, gave the same result. When, however, the spinal cord is transected at two levels, behind the medulla and at the level of the anterior dorsal fin, the anterior and posterior portions of the preparation exhibit independent rhythms, and the excitation of one portion by peripheral stimulation leaves the rhythm of the other portion unchanged. These observations furnish clear evidence that the locomotory rhythm of an intact or spinal dogfish is determined by the intrinsic activity of the spinal cord without the participation of proprioceptor arcs.

A. S.

**Spinal Reflexes of the Dogfish, *Scyllium canicula*.**

**By J. Gray and A. Sand.**

*J. Exper. Biol.*, Vol. XIII, 1936, pp. 210-218.

When the spinal cord of the dogfish is transected behind the medulla, a preparation is obtained which survives in the laboratory tanks for many weeks. The spinal dogfish does not maintain its equilibrium, and is unable to feed, but its respiration is normal, and its reflex activity vigorous. The fish displays a persistent undulatory rhythm which is maintained as long as the animal survives. Since the motor paths from the head to the trunk are severed it is possible to anchor the fish by its snout in a shallow tank, and record the undulatory rhythm and the reflex responses of the trunk on a kymograph or cinematographically. When undisturbed the spinal fish maintains a spontaneous rhythm at a frequency of about 40 per minute, and of uniform amplitude. By means of appropriate mechanical stimulation of the trunk or fins the rhythm may be accelerated, augmented, or arrested. Acceleration is induced by light tactile stimulation of the trunk or fins. Increase in amplitude and reduction in frequency of the waves is achieved by strong pressure applied to the tail, while pressure applied to the body by means of a clamp brings about an arrest of the rhythm, which emerges again when the clamp is removed.

A. S.

**Studies on Living Protoplasm. I. Streaming Movements in the Protoplasm of the Egg of *Sabellaria alveolata* (L.).**

**By J. E. Harris.**

*Journ. Exp. Biol.*, Vol. XII, 1935, pp. 65-79.

The movements of the granules in centrifuged (unfertilised) eggs of *Sabellaria* have been found by cinematographic observations to be determined largely by powerful currents in the protoplasm. These produce displacements of the granules far in excess of those which would be expected if they were merely particles undergoing random Brownian movement. The extent and magnitude of the streaming movements were estimated. In addition to a fairly rapid streaming over the whole egg at the rate of 30 per minute, there is also a number of smaller localised vortices described at a much slower speed (1 to 4 per minute). The general streaming movements are similar in appearance to the phenomenon of endoplasmic cyclosis.

Superimposed upon this directed motion there is a typical random movement of the particles (Brownian movement). The extent of this can be roughly estimated, and leads to a calculated value of 0.2 C.G.S. units for the hyaloplasmic viscosity, a result in fair agreement with values obtained by independent methods. On the basis of these observations it is suggested that the reactions of living protoplasm are chiefly confined to the optically structureless hyaloplasm.

J. E. H.

**Note concerning a Measuring Plankton-Net.**

**By H. W. Harvey.**

*J. Cons. int. Expl. Mer.*, Vol. X, 1935, pp. 179-184.

A meter is described which measures the volume of water which has passed through a silk net which may be either towed or lowered and raised vertically.

The catch of phytoplankton, from a volume of water which has been measured by the meter, may be assessed from its content of yellow-green pigments, which readily dissolve in acetone.

A rapid method of measuring the pigment content of the catch in terms of arbitrary units of plant pigment is described. The arbitrary unit is related to numbers of two species of diatoms.

H. W. H.

**The Pigmentary Effector System. Part VII. The Chromatic Function in Elasmobranch Fishes.**

**By L. Hogben.**

*Proc. Roy. Soc., London, B, CXX, 1936, pp. 142-158.*

The pigmentary effector system of the integument in Elasmobranchs consists of dermal xanthophores, dermal melanophores, and epidermal melanophores.

Two species of *Scyllium* (*catulus* and *canicula*), *Rhina squatina* and two species of *Raia* (*maculata* and *brachiura*) exhibit contraction of all three types when kept in a container with white sides, and expansion when kept in one with black sides. The "background" response, which is macroscopically striking in *Rhina squatina* and *Raia brachiura*, but not so in the two species of *Scyllium*, is visually controlled.

The background response develops gradually and requires several days to reach its maximum. Some species of Elasmobranchs, e.g. *Raia clavata*, like the black axolotl, do not exhibit a pronounced white background response.

Within twenty-four hours after operation, total removal of the pituitary gland in all the species mentioned results in complete pallor, which persists till death. The operation can be carried out without any interference with swimming movements or other evident signs of disturbance or damage to the C.N.S., and the fish will survive at least two months.

The same result follows removal of the neuro-intermediate lobe with or without the pars ventralis.

Removal of the pars ventralis alone does not abolish the white or black background response.

Posterior lobe extracts free of pressor and oxytocic activity induce complete expansion of Elasmobranch pigment cells.

Removal of the anterior lobe alone appears to abolish the white background response. The indefinite demarcation of this lobe may be the explanation of partial recovery which ensued in one case.

L. H.

**Über die Determination im Verlaufe der Eiachse bei Seeigeln.**

**By Sven Hörstadius.**

*Publ. Stazione Zoologica, Naples, Vol. 14, 1935, pp. 251-479.*

These investigations were carried out at the zoological stations of Naples, Roscoff, and Plymouth. There is one animal and one vegetative gradient in the sea-urchin egg (Runnström). In this paper, first the normal

gastrulation has been studied ; then these gradients have been analysed, by isolating different layers of the egg and by adding them to each other in different ways. We can follow, how some properties decrease from the animal towards the vegetative pole, and *vice versa*. In a fragment the regulation takes place in such a way that the gradients become more concentrated at the poles. The interactions between the different parts of the eggs are studied. The most vegetative material can induce endoderm formation in animal, presumptive ectoderm, material. On the other hand, the animal forces can suppress the vegetative ones, if the former are too greatly in excess. The differentiation of a harmonic larva is not due to the absolute amount of animal and vegetative material present, but to the relative amounts : there must be a certain equilibrium between them for typical differentiation to proceed. The most vegetative material (the micromeres), when implanted in the side of an entire egg, induces a supplementary archenteron, and forms a supplementary skeleton. When implanted at the animal pole of an animal half, the micromeres may cause the reversal of the polarity of the egg-axis.

S. H.

### **Curarization in the Neuro-muscular System of Crabs.**

**By Bernhard Katz.**

*J. Physiol.*, Vol. LXXXVI, 1936, pp. 14P.-15P.

The neuro-muscular system of *Carcinus maenas* is unaffected by curare, while Mg, in relatively low concentrations, has a "curarizing" action. Normally, the majority of neuro-muscular junctions in crabs do not transmit a single nerve impulse ; the muscle fibres need batteries of nerve impulses before responding. Lopicque's theory of curarization is discussed ; the curarizing effect of Mg in crabs cannot be interpreted from the standpoint of this theory.

B. K.

### **The Physiology of Contractile Vacuoles. I. Osmotic Relations.**

**By J. A. Kitching.**

*J. Exper. Biol.*, Vol. XI, 1934, pp. 364-381.

Marine Peritrich Ciliates showed an increase in body volume, and a great increase in the rate of output of fluid from the contractile vacuole, when they were treated with hypotonic sea water. The greatest increase was about  $\times 70$ , in 10% sea-water. On a return of the organism to 100% sea-water the rate of vacuolar output returned approximately to its

original value, and the body shrank to its original size or less. Fresh-water *Peritricha* showed a decrease in rate of vacuolar output when subjected to mixtures of fresh-water and sea-water. Theoretical reasons are advanced in favour of the view that the osmotic concentration of the vacuolar fluid is very low, in which case the contractile vacuole may be regarded as a mechanism of osmotic control. It is suggested that marine and estuarine *Peritricha* only maintain their internal osmotic pressure significantly higher than that of the external medium when in hypotonic sea water. The rate of vacuolar output of marine *Peritricha* in 100% sea water is very low, and it is unlikely that it maintains any great difference of osmotic pressure between the internal and the external media.

J. A. K.

### **The Physiology of Contractile Vacuoles. II. The Control of Body Volume in Marine *Peritricha*.**

**By J. A. Kitching.**

*J. Exper. Biol.*, Vol. XIII, 1936, pp. 11-27.

From experiments in which a large part of the salts of sea-water were replaced by an osmotically equivalent amount of glycerol, urea, or cane sugar, it is concluded that the body surface of marine *Peritricha* is relatively impermeable both to these substances and to the neutral salts of sea water. Cyanide and sulphide in very low concentrations (the pH being carefully controlled) were found to inhibit the secretory activity of contractile vacuoles, while alcohols and urethane were only effective in much higher concentrations. It is possible that there is a direct connexion between vacuolar activity and respiration. When the contractile vacuole of a marine *Peritricha* which was in dilute sea-water was stopped by the addition of cyanide, there was a further increase in body volume. This further increase was greater the more dilute was the sea-water, down to 10%, and may be regarded as a measure of the body volume control effected by the contractile vacuole. Return of the organism to dilute sea water of the same concentration but without cyanide led to rapid recovery and great activity of the contractile vacuole, which was accompanied by a decrease of body volume to a value somewhat less than it had been before cyanide treatment. The extent of this body volume decrease was quantitatively in accordance with expectation having regard to the known rate of vacuolar output. The permeability of the body surface to water was estimated as 0.05-0.10 cubic micra per square micron per atmosphere per minute.

J. A. K.

### **The Importance of Larval Mollusca in the Plankton.**

**By M. V. Lebour.**

*J. Cons. int. Explor. Mer., Vol. VIII, 1933, pp. 335-343.*

A survey of mollusca in the plankton based mainly on the work on gastropod larvæ carried on during the last few years at Plymouth. It is shown that molluscan larvæ are extremely important economically, serving as food for many animals including fishes. Some are always to be found in the plankton, different species in different seasons. The gastropod larvæ from the outside water are usually larger than the shore forms and very well adapted to a planktonic life, having a large velum and long larval stage.

M. V. L.

### **Larval Crustacea (Decapoda and Stomatopoda) Expedition S.A.R. Prince Léopold of Belgium, Duke of Brabant, to the Extreme East (1932).**

**By M. V. Lebour.**

*Bull. Mus. Roy. d'Hist. Nat. Belgique, T. X, No. 8, 1934.*

Some little-known larvæ from the Philippine Islands are briefly described, although only approximately placed in their systematic positions, the adults to which they belong being not as yet known. The larvæ include pagurids, brachyurids and one stomatopod.

M. V. L.

### **Stomatopod Larvae.**

**By M. V. Lebour.**

*Résultats Scientifiques du Voyage aux Indes Orientales Néerlandaises de LL.AA.RR. le Prince et la Princesse Léopold de Belgique, Vol. III, Fasc. 16, 1934, pp. 9-17.*

Four specimens of stomatopod larvæ are recorded, one being a post-larval stage almost certainly belonging to *Gonodactylus chiagra*, the others being *Squilla* larvæ the adults of which are not known.

M. V. L.

### **The Life-History of *Dromia vulgaris*.**

**By M. V. Lebour.**

*Proc. Zool. Soc., London, 1934, pp. 241-249.*

An account of the larval stages of *Dromia vulgaris*, including pre-zoea, first, second and fifth zoeæ and megalopa. The pre-zoea was hatched from the egg and the first and second zoeæ obtained from these. The fifth

(last) zoea was found in the Plymouth plankton in September 1933 (two specimens, each on a separate occasion), and the megalopa was obtained from one of these. It is very unusual to find these larvæ at Plymouth although the adults are occasionally brought in. The larval characters show clearly that *Dromia* should not be included in the *Brachyura*, but is much more closely related to the *Anomura* having affinities with the *Thalassinidea*, although it probably should not be included in either of these last groups but placed separately and not in the direct line of descent from the *Brachyura*.

M. V. L.

### The *Echinospira* Larvæ (Mollusca) of Plymouth.

By M. V. Lebour.

*Proc. Zool. Soc., London, 1935, pp. 163-174.*

An account of the larvæ of two species of *Lamellaria*, two of *Trivia*, one *Erato* and one *Velutina* from Plymouth. All these have *Echinospira* larvæ, the transparent accessory shells serving as floats. *Velutina* has the *Echinospira* shell gelatinous, the two species of *Trivia* and *Erato* differing from the *Lamellariidæ* in the form of the *Echinospira* but showing a close relationship. It is probable that their natural position is nearer to *Lamellaria* than to the true *Cypræas*.

M. V. L.

### Notes on the Plymouth Species of *Spirontocaris* (Crustacea).

By M. V. Lebour.

*Proc. Zool. Soc., London, 1936, pp. 89-104.*

An account of a new species of *Spirontocaris* (*S. occulta*) compared with *S. cranchii*. The two have probably been confused hitherto as they are outwardly much alike. *S. cranchii* differs from *S. occulta* in the absence of mandibular palp and in having six segments in the carpus of the second leg instead of seven. The larvæ of the two species also differ and are easily separated. Both were hatched from the egg and later stages were obtained from the plankton. Post-larvæ and young stages were reared from the last larvæ. The mandibular palp in *S. occulta* appeared late and was absent altogether from the first young stage, showing probably the dwindling of a useless organ. A comparison with the genus *Thor* is made.

M. V. L.



**A Third List of Parasitic Copepoda of Plymouth with Notes.****By W. H. Leigh-Sharpe.***Parasitology*, Vol. XXVI, 1934, pp. 112-113.

In addition to new local species, an account and figures are given of the erosion made by *Lernæopoda bidiscalis* on the clasper of the tope.

W. H. L.-S.

***Epibrachiella impudica* (Nordmann) (Copepoda).****By W. H. Leigh-Sharpe.***Parasitology*, Vol. XXVII, 1935, pp. 101-106.

An account of the animal and appendages of both sexes. Amendments of Wilson and Nordmann in the male; confirmation of the work of Harrison Matthews. New reasons for erecting the genus *Epibrachiella*. Characters of the female overlooked by all but Brian. Discrepancies between Scott's diagnosis and his own specimens in the British Museum. Differences between young and adult forms.

W. H. L.-S.

**Some New and Rare Lernæidæ (Copepoda) from Plymouth.****By W. H. Leigh-Sharpe.***Parasitology*, Vol. XXVII, 1935, pp. 107-110.

Record of *Hæmobaphoides ambiguus*. Erection of the new genus *Saucissona*, with a description of a new species, and to include Scott's *S. [Lernæa] lumpi*. Description of a new species *Lernæocera mulli*.

W. H. L.-S.

***Anchistrotos laqueus* n. sp. A Parasitic Copepod of *Serranus cabrilla*.****By W. H. Leigh-Sharpe.***Parasitology*, Vol. XXVII, 1935, pp. 266-269.

Diagnosis of Brian's genus *Anchistrotos*. Description of a new species with appendages. A comparison with *Bomolochus bellones*.

W. H. L.-S.

### Two Copepods (*Lernæenicus*) parasitic on Clupea.

By **W. H. Leigh-Sharpe.**

*Parasitology*, Vol. XXVII, 1935, pp. 270-275.

Descriptions of *L. spratta* and *L. encrasicoli* with appendages. Occurrence at Plymouth and elsewhere. First record of the eye in British species. Presence of two pairs of maxillæ (first pair absent in American species).

W. H. L.-S.

### The Respiratory Rate of *Gammarus chevreuxi* in Relation to Differences in Salinity.

By **Otto Löwenstein.**

*J. exp. Biol.*, Vol. XII, 1935, pp. 217-221.

The brackish water amphipod *Gammarus chevreuxi* is found in ditches in a salt marsh at the mouth of the River Plym. It lives in water, the salt content of which varies continually owing to tidal flooding from the estuary and to the inflow of fresh water and rain. In connection with the question of osmoregulation the oxygen consumption of this apparently euryhaline animal was measured in 25 per cent sea-water and after transfer into 100 per cent sea-water. The respiratory rate was found to be approximately 20 per cent lower in sea-water than in 25 per cent sea-water which is a concentration occurring in the natural habitat. Anæsthetized animals showed the same percentage decrease as unanæsthetized animals.

The change in oxygen consumption takes place immediately after the transfer and remains constant thereafter. It is completely reversible.

A comparison with the unanæsthetized respiratory rates of the related fresh-water species *G. pulex* and marine *G. marinus* shows that the rate of oxygen consumption of the brackish-water form *G. chevreuxi* in 25 per cent sea-water lies between the two others.

O. L.

### The Significance of the Spontaneous Discharge from the Horizontal Ampulla of the Dogfish.

By **Otto Löwenstein and A. Sand.**

*J. Physiol.*, Vol. LXXXVI, 1936, pp. 43P.-44P.

The activity of the horizontal ampulla during rotation in the horizontal plane was investigated by obtaining oscillographic records of the action potentials in the branch of the eighth nerve supplying this ampulla. The ampullary organ maintains a spontaneous discharge of impulses in

the absence of rotatory stimulation. During ipsilateral rotation the discharge is increased, and when rotation is stopped the discharge returns again to its resting level. Contralateral rotation abolishes the spontaneous discharge, but on stopping a prolonged outburst of after-discharge occurs. By virtue of its spontaneous activity the ampulla is able to discriminate left and right angular acceleration. The two opposite ampullæ work antagonistically and therefore the quantitative effect of rotation is greater at the centre than at the receptor on either side. The observations furnish an explanation of reflex eye-muscle responses which have been found to occur in unilaterally operated fishes.

A. S.

### The Swimming and Feeding of Certain Calanoid Copepods.

By A. G. Lowndes.

*Proc. Zool. Soc., London, 1935, pp. 687-715.*

In recent times there has been a marked tendency to over-stress filter-feeding among crustacea in general and it has been maintained by several writers that the feeding of the Calanoid copepods in particular is automatic and non-selective. The animals are supposed to feed automatically as they swim.

Nine common species were examined critically. Limb-movement being investigated chiefly by ultra-rapid cinema photomicrography while the nature of the food was ascertained chiefly by an examination of the gut-contents.

Work on the gut-contents had been done by well-known workers both at Plymouth and Millport and it is somewhat surprising that this work has been disregarded.

Three of the species investigated occurred in fresh water, and it was definitely established that *Diaptomus gracilis*, though living in ponds abundantly supplied with floating algæ, was yet descending periodically and feeding on Desmids growing on the bottom of the pond.

*Calanus finmarchicus* itself feeds in a variety of ways. For long periods it does not feed at all. It is suggested that the so-called feeding currents set up by the Calanoid copepods are really respiratory in effect.

The female of *Euchaeta norvegica* feed almost entirely on *Calanus finmarchicus*.

One important point must be taken into consideration. Gurney has recently re-classified the Calanoid copepods and regards the Centropagina and not the Calanina as the more primitive group, and the former group with Centropages itself are certainly raptorial. Thus even if the Calanina were exclusively filter-feeders there is little reason for regarding the process as being the more primitive one.

A. G. L.

**Some Measurements of the Brightness of Various Parts of the Sky by means of a Rectifier Photo-electric Cell.**

By H. H. Poole and W. R. G. Atkins.

*Sci. Proc. Roy. Dublin Soc.*, 1933, Vol. 21, pp. 1-8.

A selenium cell was used which gives results not differing greatly from the visual scale. It was mounted in place of the mirror in an old reflecting telescope. Two figures show the variation of the brightness of the sky with altitude for various azimuths relative to that of the sun, under different meteorological conditions. As compared with a very clear blue sky the effect of haze, and to a greater extent that of light cloud, is to (a) increase the illumination from all parts of the sky above about  $10^\circ$  altitude, (b) increase the relative proportion of high-angle light, and (c) increase the relative brightness of the sector containing the sun, and hence greatly to increase  $V_d$  the vertical illumination from the whole sky. For a perfectly uniform sky the ratio  $V_d/I_d$  is 0.5, where  $I_d$  is the total diffuse illumination. With a clear sky  $V_d/I_d$  was rather less than this, while the reverse was true with a cloudy sky. Except near the sun the sky illumination on bright summer days was about 1-4 metre candles (lux) per square degree. White clouds may give 7 lux, about 10 times the brightness of a deep blue sky, or 3.5 times the brightness of a candle flame which is about 2 lux per square degree.

W. R. G. A.

**Measurement of the Current Generated by a Rectifier Photo-electric Cell.**

By H. H. Poole and W. R. G. Atkins.

*Nature*, Vol. CXXXIV, 1934, p. 810.

**The Measurement of the Current Generated by Rectifier Photo-Cells.**

By H. H. Poole and W. R. G. Atkins.

*Sci. Proc. Roy. Dublin Soc.*, 1934, Vol. 21, pp. 133-139.

A description is given of a modified form of the circuit described by Campbell and Freeth. The modification consists in the deduction of the current from a potentiometer setting and the resistance in the circuit, instead of its direct measurement. For this use was made of the potentiometer-amplifier-telephone null-point apparatus devised for work at sea. This enables accurate measurements to be made of a range of illuminations from a small fraction of a metre-candle up to full sunlight while preserving all the advantages of a zero-resistance measuring instrument. It is especially suitable for work at sea.

W. R. G. A.

## The Standardization of Photo-electric Cells for the Measurement of Visible Light.

By H. H. Poole and W. R. G. Atkins.

*Phil. Trans. Roy. Soc., London, A, Vol. CCXXXV, 1935, pp. 1-27.*

Constants relating to nineteen vacuum emission and rectifier cells have been tabulated. As light sources the following were used: open solid carbon arc; vacuum sub-standard filament lamp at 2360° K; artificial "mean noon sunlight" derived from the latter by interposing special liquid filters. The cells were also compared in mixed daylight. For sodium and potassium cells only the arc gives a scale of values reasonably close to the visual; this method is suitable for other emission cells and for rectifier cells. Selenium rectifier cells have colour sensitivities close enough to that of the eye to allow of the use of the mean noon sunlight source. Close agreement is given by the selenium cell standardized in artificial sunlight and the potassium cell in arc light, when both are used to measure bright mixed daylight.

Vacuum potassium and sodium cells maintained their sensitivity constant for over five years; a selenium cell has remained constant for over a year. The sodium and potassium cells maintained a rectilinear proportionality between illumination and current up to full summer daylight. The curvature of the illumination/current characteristic of rectifier cells is important and must be allowed for.

W. R. G. A.

## Observations on the Embryonic and Larval Development in *Sacculina* (Rhizocephala) in Changed Osmotic Conditions of Medium.

By M. Ramult.

*Bull. Int. Acad. Pol. Sci. et Lettr. Cracovie, 1935, pp. 87-109.*

The eggs and larvæ of *Sacculina carcini* were investigated as to the ability to develop in hypo- and hypertonic sea-water and sodium-chloride solutions. The eggs of the above-named species, which pass as a rule their embryonic development in the maternal mantle cavity, were artificially extracted out of the latter just after having passed from the ovary (before entering the cleavage). They developed normally in such conditions till the Nauplius-stage not only in normal sea-water but also in sea-water solutions of the concentration from 2.45 per cent to about 4.1 per cent of mineral constituents. The 4-blastomeres stage proved to be more resistant to the osmotic and chemical changes of the outer medium than the freshly laid egg, as it could develop till the Nauplius

stage in 1.75 per cent sea-water. In pure NaCl solutions the freshly laid and artificially extracted *Sacculina* eggs can develop in the concentrations from 2.45 per cent to about 4.1 per cent but only to the 4-cell stage. The Nauplius larvæ can pass the metamorphosis till the Cypris stage in hypotonic sea-water solutions from 2.45 per cent of mineral constituents upwards.

The resistance power in the eggs and larvæ of *S. carcini* to hypotonicity seems to be in accordance with the resistance power of the host of this parasite, i.e. *Carcinus maenas*, which lives in normal sea-water as well as in hypotonic brackish waters of estuaries and of western part of Baltic Sea.

M. R.

**The Strength-duration Curves of two Non-Medullated Nerves.**

**The Excitation of Medullated and Non-Medullated Nerves by Currents of Short Duration.**

By H. Rosenberg.

*J. Physiol.*, Vol. LXXXIII, 1934, pp. 23P.-24P., Vol. LXXXIV, 1935, pp. 50-69.

These investigations concern comparative measurements of excitability in different types of nerves. Strength-duration curves of medullated amphibian and mammalian nerves, and of non-medullated nerves of invertebrates, were recorded for semi-maximal electrical responses of the nerves stimulated by single condenser discharges of graded voltage and discharge time. Ballistic deflections of a moving-magnet galvanometer were used as index of response. The main result is that below a certain discharge time, varying in different types of nerves and under different conditions, the minimum quantity of electricity required for excitation is constant. This quantity is of the order of  $10^{-9}$  coulomb in medullated nerves (sciatic, ulnar and phrenic of frog, cat and dog) and of  $10^{-7}$  to  $10^{-6}$  coulomb in non-medullated nerves (limb nerve of *Maia* and fin nerve of *Sepia*). The characteristic time which corresponds with the minimum of energy is about the same for frog's and cat's sciatics at the same temperature, but twice as great in the dog's phrenic where the fibre diameter is smaller. In *Sepia* nerve this time is about 1.4 msec., in *Maia* nerve about 10 msec. These values concern electrode distances of 10 to 15 mm. When the electrode distance is diminished from 15 to 3 mm. in non-medullated nerves, the characteristic time, as well as the chronaxie, decrease by about 25 per cent. The minimum quantity is distinctly greater for short than for long distances, and the difference increases with increase of discharge time.

H. R.

### Electrotonus in the Fin Nerve of Sepia.

By J. Yule Bogue, H. Rosenberg and J. Z. Young.

*J. Physiol.*, Vol. LXXXVI, 1936, pp. 6P.-7P.

In view of the importance of electrotonus in the excitation process electrotonic potential changes in the main trunk of the non-medullated fin nerve of Sepia were recorded by means of a direct coupled amplifier and a mechanical oscillograph. The distances between the distal leading to and the proximal leading off electrodes were 2.5 to 8 mm. At short distance the electrotonus showed a comparatively small quick component at make of the polarizing current and rose then slowly to a certain level. The duration of this rise was of the order of 0.05 sec. at 2.5 mm. distance. After break there was a similar rapid drop which was also followed by a gradual decline of a similar total duration as that of the rise. Apparently the phenomena were of the same order in an- and catelectrotonus. But owing to the strength of the polarizing current, the catelectrotonic curve was distorted by a superimposed action-potential wave while this interference was negligible in the anelectrotonic curve because of the anode block. (Measurements proved that stimulation occurred at the cathode.) With increase of the distance the quick component vanished and the rate of rise of the slow component decreased. At a medium distance half the maximum was attained about fifty times slower than in the frog's sciatic.

H. R.

### The Trematode Parasites of *Turritella communis* Lmk. from Plymouth and Naples.

By Miriam Rothschild.

*Parasitology*, Vol. XXVII, 1935, pp. 152-170.

Six new species of closely related cercariæ of the Rhodometopa group are found in *Turritella communis* from Plymouth (20 fathoms) and Naples. Their outstanding morphological characters are (a) the elaborate excretory system (122 or 144 flame cells) in which the much-branched excretory vesicle itself grows forward after the development of the main collecting tubules, (b) the highly specialized longitudinal and lateral fin folds of the tail, (c) the pink pigment often present anteriorly. The excretory granules are an important specific character. Development occurs in redia-like sporocysts which multiply by fission and budding. They possess salivary glands and a fifth (most internal) layer to the body wall.

The cercariæ swim upwards on emerging. In a tube 30 feet high *C. pythionike* reaches the top in five hours. As the life of the cercariæ

is fifty hours the intermediate host may be found even among the plankton. *C. doricha* only rises about 10–15 feet.

Infection experiments with thirty-six species of animals from the *Turritella* grounds proved negative. (*C. doricha* made abortive attempts to penetrate the fins of *Pleuronectes platessa*.) Three hundred and fifty of these animals were dissected, but no metacercariæ were found pertaining to these cercariæ.

M. R.

**New Developments in *Gammarus chevreuxi*, Sexton.**

By **E. W. Sexton and A. R. Clark.**

*Nature*, Vol. CXXXIII, 1934, p. 27.

For many years the wild *G. chevreuxi* found in the salt marsh, Chelson Meadow, were considered a homogeneous black-eyed population. More recently, conditions have changed in the draining ditches which they inhabit, affecting the depth, salinity and temperature. Great variability appeared and it soon became clear that heterozygosity must exist in the stock, although so far, only black-eyed specimens had ever been found.

Now, for the first time, direct evidence has been obtained, in the  $F_1$  from a female which had mated and laid eggs in the wild. That it was heterozygous and had mated with a heterozygous male, was shown by its brood, which consisted of nine black-eyed young to two red-eyed recessives.

E. W. S.

**First Appearance of Red-eye in the Wild *Gammarus chevreuxi*, Sexton.**

By **E. W. Sexton, A. R. Clark and G. M. Spooner.**

*Nature*, Vol. CXXXVI, 1935, p. 836.

Heterozygosity in the wild *Gammarus* population was proved for the first time in 1934 by the appearance of red-eyed recessives in the  $F_1$  from a pair newly brought in. In 1935 the final proof was obtained from an October dredging, which consisted of one red-eyed amongst two thousand black-eyed animals.

E. W. S.

**The Early Development of the Nemertean *Cephalothrix rufifrons*.**

By **J. E. Smith.**

*Quart. J. Micr. Sci.*, Vol. LXXVII, 1935, pp. 335–381.

A description is given of fertilization, early cleavage, gastrulation and early organogeny of the nemertean *Cephalothrix rufifrons*. A direct development is followed in which the “anlagen” appear and develop



without metamorphic changes. In this respect, the larva of the Palæonemertini, as represented by *Cephalothrix*, is to be regarded as a less-specialized form than the *Pilidium* or *Desor* larva of other anoplous nemerteans.

Although the enoplous nemerteans also have a direct development the developmental processes exhibit a marked telescoping in that all the organ "anlagen" are represented in the blastula or gastrula. This latter type of direct development is considered to be even less closely related to the direct development of the Anopla than is the development through the *Pilidium* or larva of *Desor*.

The unspecialized larva of *Cephalothrix* is represented as a primitive form reminiscent, in many respects, of the platyhelminth condition, particularly in the absence, until late in development, of an anus and in the endodermal nature of the hind-gut.

J. E. S.

### The Measurement of "Accommodation" in Nerve.

By D. Y. Solandt.

*Proc. Roy. Soc., London, B, CXLIX, 1936, pp. 355-379.*

Experiments are outlined by which Hill's (1935 and 1936) theory concerning the time-constant of "accommodation" in the electrical excitation of nerve is verified. The predicted linear relation between relative threshold and time-constant of exponential rise of current was found for certain motor nerves of frogs, fishes, crabs, lobsters and man. The slope of this line has been shown by Hill to be the reciprocal of  $\lambda$ , the time-constant of "accommodation." Measures of  $\lambda$  were thus obtained on a variety of nerves under various conditions. The sciatic nerves of normal winter frogs (*Rana esculenta* and *Rana temporaria*) showed an average value of  $\lambda=35$  msec. at room temperature. Fish had somewhat larger values of  $\lambda$ , averaging between 11 and 20 msec. Crabs and lobsters had values of  $\lambda$  between 800 and 7690 msec. The average value of  $\lambda$  for the human ulnar nerve was 58 msec. Increasing the concentration of calcium or potassium around a frog's nerve either by injecting the chloride into the animal, or by adding it to the Ringer's solution used to soak the preparation was found to lower  $\lambda$ . In the case of normal winter frogs injected with more than 100 mg. of  $\text{CaCl}_2$ ,  $\lambda$  was as small as 6 msec. Magnesium acted similarly but more slowly, while strontium and barium also had the same effect but to a lesser degree. Increasing the ionized calcium concentration in the environment of a crab's nerve, or of the human ulnar nerve, was found to lower  $\lambda$ . Decreasing the calcium ion concentration in the environment of frog's sciatic nerve was found to

raise  $\lambda$  till, in the absence of calcium, it approached infinity. No other treatment (except a lowering of temperature) was found by which  $\lambda$  could be increased. Decreasing the calcium-ion concentration in man, by the ingestion of alkali, increased the value of  $\lambda$ . The effect of calcium on  $\lambda$  is much greater than on  $k$ . This shows that the time-constants of "accommodation" and of "excitation" are independent.

D. Y. S.

### Development of *Patella vulgata*.

By F. G. Walton Smith.

*Phil. Trans. Roy. Soc., B, CCXXV, 1935, pp. 95-125.*

An account is given of breeding habits and methods of rearing the larva together with a brief explanation of the technique employed in embedding and sectioning the various stages of development. Development is described from early stages of segmentation up to the stage at which the post-larva casts off the larval shell and becomes a miniature limpet. Formation of the mesodermal rudiments and their subsequent transformation into kidney and pericardium rudiments is explained, and the origin and development of heart, nervous system, alimentary canal and liver, sensory organs, radula sac, and pedal glands are described. A suggestion is advanced as to the mechanism responsible for larval torsion, and the new points briefly summarized.

F. G. W. S.

### Some Remarks on North Atlantic Non-Pelagic Polystilifera.

By G. Stiasny-Wijnhoff.

*Quart. J. Micr. Sci., Vol. LXXVII, 1934, pp. 167-190.*

Description of three Polystilifera Reptantia: *Uniporus borealis* (Punnett) from Davis Strait, *Hubrechtonemertes lankasteri* (Hubrecht) from the American waters and *Punnettia splendida* (Keferstein) from the neighbourhood of Plymouth. The material of *Uniporus borealis* existed in the original series of Punnett, whose description needed some more extensive details of some organs, as brains and cerebral organs. *Hubrechtonemertes lankasteri* is *Drepanophorus lankasteri* of the Challenger expedition; this species was insufficiently known. To settle its relation to the other Polystilifera the original material of Hubrecht was studied.

Both these species belong to the Reptantia with atrium and with the type of cerebral organ that is characteristic of the Inæquifurcata.

*Hubrechtonemertes* is nearly related to *Paradrepanophorus* and not to *Uniporus*, as some authors supposed.

*Punnettia splendida* has been studied from material collected at the Plymouth Laboratory. McIntosh identified it with *Cerebratulus spectabilis* Quatrefages from Sicily; Hubrecht supposed it to be identical with his Mediterranean *Drepanophorus rubrostriatus* and Bürger united all these species in one. The detailed study of the Mediterranean and the English material showed that McIntosh was right when he took the Channel-material as different from Hubrecht's *rubrostriatus*. The original name of Keferstein ought to be used for the English Nemertean, that is not known from anywhere beyond the English Channel.

G. S.-W.

### Vergleichende Untersuchungen über das Periphere Nerven-Muskel-System von Crustaceen.

By C. A. G. Wiersma.

*Zeitschrift für vergleichende Physiologie*, 19, 1933, pp. 349-385.

The abductor and adductor muscles of different crustaceans were studied. The adductor shows two kinds of contractions: a twitch and a slow contraction. When stimuli near the threshold of the twitch are given either no contractions results or the contraction is large (*Astacus*). Stronger stimuli increase the height of contraction suddenly, in step-like fashion. It is reasoned that this sudden increase is due to a repetitive discharge in the motoric nerve fibres.

Strength-duration curves for several crustaceans were determined, each having several steps. In different crustaceans different numbers of impulses seem necessary to produce the same effect, namely, the closing of the claw. The muscle action currents were recorded; for the higher steps of the twitch several tops were found. When a slow contraction occurred there always appeared a long series of tops in the action current record; these tops grow in size but diminish in frequency, though they never equal those of the twitch in height.

In the abductor both contractions may also occur, but the twitch is much more difficult to obtain.

A working hypothesis to cover the results is given.

In experiments on inhibition only the abductor could be readily inhibited.

C. A. G. W.

**On the Nature and Permeability of Chitin. II. The Permeability of the Uncalcified Chitin Lining the Foregut of Homarus.**

**By C. M. Yonge.**

*Proc. Roy. Soc. London, B, Vol. CXX, 1936, pp. 15-41.*

As shown in the first paper in this series, the integument of the Decapod Crustacea consists of a thick, underlying chitinous layer, and a thin superficial cuticle which is not chitin but contains a lipin. The former is formed by the epithelial cells, the latter by the tegumental glands.

Permeability of this membrane where, as in the foregut, it is uncalcified, is profoundly modified by the presence of the cuticle. When this is intact fatty acids penetrate much more quickly than the strong mineral acids, HCl or HNO<sub>3</sub>, and ammonia more quickly than the strong alkalies, NaOH and KOH. After removal of the lipin both acids and alkalies pass through in the order of their degree of dissociation.

The passage of chloride with divalent cations is greatly inhibited when the cuticle is intact and distinctly more in the direction cuticle to chitin than in the opposite direction. There is the same difference between the passage of Ba (OH)<sub>2</sub> and that of KOH, NaOH or LiOH. These differences disappear after the lipin has been removed.

Glucose penetrates "fresh" membranes very slowly but rapidly after the removal of the lipin. In fresh membranes permeability is notably lowered at the iso-electric point of the cuticle and after removal of the lipin at that of the chitin. Permeability through both types of membranes is influenced by hydrogen ion concentration and also by the action of specific ions other than hydrogen.

Fat solvents penetrate fresh membranes suspended in air but only in the one direction, cuticle to chitin.

Unimpregnated chitin forms a freely permeable membrane, the presence of the cuticle converts this into a membrane with variable degrees of permeability, which has certain properties analogous with those of the living cell membrane.

The significance of both chitin and cuticle in the life of the animals possessing them is discussed.

C. M. Y.