

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY

THE FORCE EXERTED BY ACTIVE STRIATED MUSCLE DURING AND AFTER CHANGE OF LENGTH

By B. C. Abbott and X. M. Aubert

Journ. Physiol., Vol. 117, 1952, pp. 77-86

A study of the tension changes during enforced stretch of activated dogfish muscle has been made. Isolated coraco-hyoid muscles at 0° C. were stretched at constant speed during tetanic stimulation. Tension changes and work done were recorded. The events during stretch proved not to be merely the converse of those during shortening, for the tension rise during an imposed stretch depends on the distance moved and hardly at all on the speed of movement, in contrast to the changes observed during shortening. This was different from the findings of Levin & Wyman (1925) on the same muscle, and the discrepancies are discussed; but the results were similar to those obtained with frog muscle.

The readjustment of tension after constant speed stretches and shortenings was followed when stimulation was continued after movement had ceased. The tension moved toward but remained appreciably different from the isometric value at the final length; above after stretch, below after shortening; the differences increased as the speeds of movement were smaller. If stimulation was interrupted long enough for tension to drop to zero the normal isometric value was exerted when excitation was resumed. The evidence indicates that shortening or lengthening offset the internal structure of the muscle perhaps by altering some crystalline orientation and so affects the final tension at any length, giving this hysteresis-like effect. B.C.A.

MUSCLE RECEPTOR ORGANS IN THE ABDOMEN OF *HOMARUS VULGARIS* AND *PALINURUS VULGARIS*

By J. S. Alexandrowicz

Quart. Journ. Micr. Sci., Vol. 92, 1951, pp. 163-99

Nerve cells, connected with special muscle units which are considered to be muscle receptor organs, are described in *Homarus vulgaris* and *Palinurus vulgaris*. In each of the six abdominal segments there are two muscle receptor organs on each side, situated at the level of the superficial dorsal muscles. The

muscle components of these organs are independent of the ordinary muscles. Each of them has its own nerve cell sending several processes to the muscle, and its axon into the ganglionic cord. Differences in the structure of the muscles and in the appearance of nerve cells are described, indicating that the two muscle receptor organs on the same side are of a different kind. Apart from the nerve cell each organ is supplied by at least three kinds of nerves.

In the ganglionic cord of the embryonic lobster a tract is described composed of the axons of the receptor cells. J.S.A.

NOTES ON THE NERVOUS SYSTEM IN THE STOMATOPODA.
I. THE SYSTEM OF MEDIAN CONNECTIVES

By J. S. Alexandrowicz

Pubbl. Staz. Zool. Napoli, Vol. xxiii, 1952, pp. 201-14

Unpaired nerve trunks running between the longitudinal connectives of the ganglionic chain have been found in *Squilla mantis*. The nerves arising from these trunks carry two kinds of fibres. The supplying of the alary muscles of the pericardium by one kind reveals their motor character. The fibres of the second kind give off numerous branches ending in neuropile-like networks which spread over the wall of the blood sinus and in the sheaths surrounding the nerves. In the sixth thoracic segment the nerves with the ensheathing connective tissue and the neuropile-like terminations form an organ in the shape of a bar suspended across the blood sinus between the flexor muscles. It is suggested that the second kind of nerves may have a neurosecretory function. J.S.A.

VITAMIN C RESERVES OF BRITISH TROOPS IN ENGLAND AND SCOTLAND
DURING THE WINTER AND SPRING, 1941-42

By W. R. G. Atkins

(Late Captain, Royal Army Medical Corps)

British Journ. of Nutrition, Vol. 5 (nos. 3 and 4), 1951, pp. 275-86

The object of the work was to study the vitamin C reserve in relation to the prevalence of gingivitis and scurvy or antecedent conditions. The general plan of investigation was drawn up by Major-General D. T. Richardson, C.B., M.C., K.H.S., Director of Hygiene. Two hundred recruits—representing the civilian population—and four hundred soldiers were examined in early winter and again in late spring. Their mouths were examined by the late Brigadier H. Stobie, Consulting Dental Surgeon to the Army, whose report showed no

connexion between incidence of gingivitis and vitamin C reserve in these 1200 men. There was no scurvy.

Recruits showed more vitamin C than soldiers, so that even in spring their reserves were greater than those of the soldiers had been 4 months previously in winter.

Both recruits and soldiers from the country were superior to those from industrial areas. Only 1 % of recruits remained unsaturated after five or six doses of synthetic vitamin C, whereas in spring soldiers of Scottish Command (Glasgow) showed 34 % unsaturated after five doses and 21 % after six. It appeared desirable to increase the vitamin C supply to troops in winter. One test with forty-three men showed that saturation was reached more rapidly in those who had the vitamin dose after breakfast rather than before it.

W.R.G.A.

THE RELATION BETWEEN THICKNESS OF CLOUD LAYERS AND THEIR TRANSMISSION OF LIGHT

By W. R. G. Atkins

Quart. Journ. Roy. Met. Soc., Vol. 77, 1951, pp. 659-62

Apparent minimal cloud-transmission percentages for Bircham Newton, Norfolk, are plotted against vertical distribution of clouds observed from aircraft, and tenths of cloud cover, the latter being indicated by modifications in the line joining the points showing base and top of each cloud layer. With under 20 % transmission great cloud thickness is possible, but with over 30 % no great thickness of low cloud occurs. Percentage frequencies of minimal cloud transmission are given for a year. Making use of Hewson's calculations for reflexion, absorption and transmission of solar radiation for droplets of $40\ \mu$ (fog) and $10\ \mu$ (cloud) for various water contents it was found that the observed transmissions of morning fog at Bircham Newton in May were in accord with $1.0\ \text{g./m.}^3$ water content, whereas transmission by thick cloud during a depression in May, and by layers of cloud another day were probably due to droplets of $10\ \mu$ at $0.1\ \text{g./m.}^3$ concentration.

W.R.G.A.

PHOTOELECTRIC MEASUREMENTS OF THE SEASONAL VARIATIONS IN DAYLIGHT AT PLYMOUTH FROM 1947 TO 1949

By W. R. G. Atkins and Pamela G. Jenkins

Quart. Journ. Roy. Met. Soc., Vol. 78, 1952, pp. 70-5

Daylight received on a horizontal surface has been measured for 14 years using a Burt vacuum sodium cell and a Cambridge thread-recorder galvanometer. Mean monthly values of daily maxima, in kilolux, are tabulated, also

mean monthly values of illumination in kilolux hours. These are compared with similar measurements at Kew in 1947 and 1948, got with a selenium cell. The kilolux hours for each month are shown as a percentage of individual years, with mean values for 14 years and percentage range for variation. Annual totals were 108, 124 and 122 megalux hours for 1947, 1948 and 1949 respectively with 116 as the mean of the whole series. Between these and sunshine or rainfall there is no simple relation. Cloudless days are not the brightest owing to downward reflexion from clouds. Darkest days in each month commonly show 17-40 % as many kilolux hours as do brightest, though smoke pollution may reduce illumination to 5 %. W.R.G.A.

MUSCULAR AND HYDROSTATIC ACTION IN THE SEA-ANEMONE
METRIDIUM SENILE (L.)

By E. J. Batham and C. F. A. Pantin

Journ. Exp. Biol., Vol. 27, 1950, pp. 264-89

The mechanics of muscular action and hydrostatic action are discussed in the sea-anemone *Metridium senile*. This animal exhibits a great variety of body shapes which are brought about by continual slow muscular activity. The action of most of the muscles is very slow, isotonic contraction of the parietal muscles requiring 40-60 sec. to reach its maximum and many minutes to relax. The body-wall is capable of extension of about 400 % but there are limits to extensibility in the normal animal. The mechanisms by which the animal itself increases or reduces extension by controlling its coelenteric volume are described. Pressure changes in the coelenteron which occur during activity show that both retraction and extension of the column are active processes involving a rise in pressure which enforces reciprocal extension of the opposing musculature. The relation of normal activity and shape to the coelenteric pressure is shown. This average pressure is extremely small, about 2-3 mm. of water. In a moderately filled unstimulated animal the natural muscular contractions are accompanied by a rise in pressure not generally exceeding 6-7 mm. of water. The isometric pressure which the body-wall can develop in the coelenteron has been estimated. Pressures developed during natural contractions demand muscular tensions in the body-wall ranging between 20 and 50 % of the isometric tension. An estimate is deduced from the coelenteric pressure of the isometric tension developed by the circular muscle of the column. This is about 3.5 g./cm. of body-wall transverse to the muscle. Extensive responses of the powerful retractor muscles involve much greater pressures than those against which the column muscles can operate. Development of these muscles is related

to the necessity of speed of action. Muscular action in a hydrostatic skeletal system is contrasted with that in the jointed skeletal system of vertebrates and arthropods.

C.F.A.P.

INHERENT ACTIVITY IN THE SEA-ANEMONE *METRIDIUM SENILE* (L.)

By E. J. Batham and C. F. A. Pantin

Journ. Exp. Biol., Vol. 27, 1950, pp. 290-301

Methods of observing and analysing continual muscular activity of the sea-anemone *Metridium senile* are discussed. This activity is so slow that it is rarely appreciated by the eye as movement. The activity of the column consists of a sequence of reciprocal contractions of the parietal muscles and the circular muscle coat. The activity of different parts of the body-wall may show striking co-ordination, a contraction of one part of the parietal musculature is usually followed by a contraction of the others. In other cases there may be no trace of co-ordination. Co-ordination takes place through one part of the body-wall acting as leader. The other parts of the body-wall follow this contraction with long delays. There is evidence that the delay is of local origin. One sector usually maintains leadership for long periods but from time to time the site of leadership changes. Evidence is given that the activity is inherent and continues unaltered in the absence of external stimulation. There is considerable variation in character and extent of activity in different animals and at different times.

C.F.A.P.

PHASES OF ACTIVITY IN THE SEA-ANEMONE *METRIDIUM SENILE* (L.), AND THEIR RELATION TO EXTERNAL STIMULI

By E. J. Batham and C. F. A. Pantin

Journ. Exp. Biol., Vol. 27, 1950, pp. 377-99

Basic activity in the sea-anemone *Metridium senile* has been studied and analysed in detail. Under constant conditions the animal exhibits continual slow inherent activity. The pattern of this activity varies in character from time to time and these different patterns of activity have been termed phases. A change of phase may be initiated by certain stimuli such as ingestion of food. In contrast with the direct responses such as the retraction reflex, the stimulus does not directly maintain a phasic response; it merely initiates a new phase, and the activity pattern of the latter is maintained long after the initiating stimulus. Phase changes also differ from simple reflex in that the threshold for their initiation varies enormously in different animals and in the same animal at different times. Locomotion is another phasic activity which

may be initiated by various stimuli or may take place spontaneously in the absence of evident external stimuli. The alternating phases of expansion and contraction occur frequently and their relation to diurnal and other rhythms is discussed. Daily illumination can often initiate and control regular daily phases of contraction. In complete darkness and constant environmental conditions, alternating phases of expansion and contraction may still take place. It appears that a periodic stimulus such as daily illumination acts by 'setting the pace' of this inherent alternating phase change. Experiments show that continual and varying patterns of inherent activity play an important part in the behaviour of *Metridium*. Phasic activities are less easily observed than direct responses because they are so slow, but they play an essential part in behaviour patterns such as food capture, and they tend to be relative to a future possible event rather than to a past stimulus. C.F.A.P.

THE ORGANIZATION OF THE MUSCULAR SYSTEM OF *METRIDIUM SENILE*

By E. J. Batham and C. F. A. Pantin

Quart. Journ. Micr. Sci., Vol. 92, 1951, pp. 27-54

The muscular system of *Metridium* consists of fields of relatively short muscle fibres. These form a connected network and can shorten to about a fifth of the extended length. Deformation of the body-wall is described and is shown to be controlled in part by the contractility of the muscle-fibres, and in part by the properties of the mesogloea. A longitudinal contraction of the body-wall is accompanied by thickening of the mesogloea and buckling which throws the layer of circular muscles into folds. A natural limit to the extension of anemone tissue is reached when the muscle-layer is completely unbuckled. The function of the muscle-fields is analysed and the muscular plan of the pedal disk is compared with the tube foot of *Asterias*. A significant functional similarity is found in the operation of vertical, oblique and radial muscles bearing on the adhesive disk. Finally, the functional organization of the oral disk and tentacles is discussed. C.F.A.P.

ULTRAVIOLETTABSORPTION DER MEERESALGEN

By Richard Biebl

Ber. Deutsch. Bot. Ges., Bd. 65, 1952, pp. 37-41

In the summer of 1951, at the Marine Biological Laboratory in Plymouth, experiments were made with a Unicam photoelectric quartz spectrophotometer to determine the absorption of the green alga *Ulva lactuca*, the red algae *Porphyra umbilicalis* f. *laciniata*, *Phycodris rubens*, *Polyneura hilliae*, and

of the brown alga *Dictyota dichotoma*, by exposing their thalli to light of wave-length ranging from 400 to 800 m μ and to ultraviolet rays of 200–400 m μ .

The resulting diagrams show that the absorption of visible light corresponds to what has already been recorded in the literature. The results of the measurements on the absorption of light in the ultraviolet region, however, are new. They show characteristic absorption curves between 290 and 400 m μ for each alga, though with partly opposite trends for red algae and green algae. But typical absorption of green, red, and brown algae could be found when exposing them to light of wave-lengths ranging from 200 to 290 m μ . Such absorption curves are flat and run almost parallel.

It is of ecological interest that these findings fit the fact that algae in their natural surroundings are at best exposed to rays of 300 m μ upwards, whereas they are never reached by shorter wave lengths. R.B.

SOME EXPERIMENTS WITH THE COMMON HERMIT CRAB (*EUPAGURUS BERNHARDUS* LINN.), AND TRANSPARENT UNIVALVE SHELLS

By L. R. Brightwell

Proc. Zool. Soc. Lond., Vol. 121, 1951, pp. 279–83

Between 10 and 24 July 1950, experiments were made at the Plymouth Laboratory with glass univalve shells, as originated by the late Richard Elmhirst at Millport. The shells used were perfect replicas of *Buccinum* and the work of Mr J. G. Brett of Rugby.

Eupagurus readily accepted the shells, often leaving a natural shell for the counterfeit. The commensal worm (*Nereis fucata*) similarly accommodated itself. It invariably approached from behind, climbing over the body whorl and slipping over the lip with utmost stealth, the hermit being normally antagonistic to it. Once safe within the apical whorls the worm is accepted with indifference, and freely helps itself to food from between the pagurid's foot-jaws. The worm can be independent of the crab indefinitely, if well supplied with food.

Tests seemed to show that, of potential enemies, swimming crabs at least rely much on sight. A ravenous *Portunus puber* at once rushed at the naked abdomen of a hermit, but was baulked by the glass shell. *Eupagurus*, when hungry, will freely search the interior of the anemone *Calliactis*, as encountered attached to the borrowed shell of another hermit, or living, as it often does, quite independently.

A hermit having the terminal joint of its great claw crushed did not discard it at the breaking plane, but picked it clean of muscular tissue L.R.B.

THE STRUCTURE AND FUNCTION OF THE BASEMENT MEMBRANE MUSCLE SYSTEM IN *AMPHIPORUS LACTIFLOREUS* (NEMERTEA)

By J. B. Cowey

Quart. Journ. Micr. Sci., Vol. 93, 1952, pp. 1-15

The body-wall of *A. lactifloreus* has the following structure from the outside inwards.

(i) A basement membrane of five to six layers immediately underlying the epithelium. Each layer consists of right-hand and left-hand geodesic fibres making a lattice, whose constituent parallelograms have a side length of from 5 to 6 μ . The fibres are attached to one another where they cross; so there can be no slipping relative to one another.

(ii) A layer of circular muscle fibres running round the animal containing two systems of argyrophil fibres—one of fibres at intervals of 10 μ running parallel to the muscle-fibres and the other of fibres running radially through the layer from the basement membrane to the myoseptum.

(iii) A myoseptum which is identical in structure with a single layer of the basement membrane.

(iv) A layer of longitudinal muscle, whose fibres are arranged in layers on each side of a series of longitudinal radial membranes.

Membranes identical in structure with the basement membrane invest the nerve cords, the gut, the gonads, and the proboscis.

The interrelations of argyrophil and muscle fibres in the muscle layers are described and their functioning discussed.

The system of inextensible geodesic fibres is analysed from a functional standpoint. The maximum volume enclosed by a cylindrical element (cross-section circular), of such a length that the geodesic makes one complete turn round it, varies with the value of the angle θ between the fibres and the longitudinal axis. When θ is 0° the volume is zero; it increases to a maximum when θ is 54° 44' and decreases again to zero when θ is 90°. The length of the element under these conditions varies from zero when θ is 90° to a maximum (the length of one turn of the geodesic) when θ is 0°.

The body volume of the worm is constant. Thus it has a maximum and minimum length when its cross-section is circular and at any length between these values its cross-section becomes more or less elliptical. It is maximally elliptical when θ is 54° 44', i.e. when the volume the system could contain, at circular cross-section, is maximal. From measurements of the ratio of major to minor axes of this maximally elliptical cross-section, the maximum and minimum lengths of the worm relative to the relaxed length and values of θ at maximum and minimum lengths are calculated. The worm is actually unable to contract till its cross-section is circular; but measurements of its

cross-sectional shape at the minimum length it can attain, permit calculation of the theoretical length and value of θ for this cross-sectional shape.

Calculated values of length and the angle θ agree well with the directly observed values.

J.B.C.

THE BLOOD SYSTEM IN THE SERPULIMORPHA (ANNELIDA, POLYCHAETA).
I. THE ANATOMY OF THE BLOOD SYSTEM IN THE SERPULIDAE. II. THE ANATOMY OF THE BLOOD SYSTEM IN THE SABELLIDAE, AND COMPARISON OF SABELLIDAE AND SERPULIDAE. III. HISTOLOGY

By Jean Hanson

Quart. Journ. Micr. Sci., Vol. 91, 1950, pp. 111-29; pp. 369-78; Vol. 92, 1951, pp. 255-74

The anatomy and histology of the blood system in a number of serpulids and sabellids from Plymouth and Naples have been investigated: *Serpula*, *Hydroides*, *Vermiliopsis*, *Pomatoceros*, *Salmacina*, *Protula*, *Apomatus*, *Spirorbis*, *Sabella*, *Potamilla*, *Branchiomma*, *Dasychone*, *Amphiglena*, *Fabricia*, *Jasmineira*, *Dialychone* and *Myxicola*. In both families one can distinguish a central blood system in which a true circulation is probably maintained, and a peripheral blood system of predominantly blind-ending vessels which are alternately empty and full, receiving their blood from the central system and then returning it along the same channels. The central blood system is built on the same plan in both families, but the peripheral system is variable, especially amongst the sabellids. The variations are partly attributable to differences in body size. The functions of subepidermal and coelomic capillaries and the blood supply to the muscles of the body-wall are discussed. In both families all vessels possess a three-layered wall consisting of an endothelium, a skeletal coat, and a peritoneum containing muscle fibres which lie transversely to the long axis of the vessel. The structure of these three coats is described in detail. Blood cells are absent in all genera.

J.H.

THE SODIUM AND POTASSIUM CONTENT OF CEPHALOPOD NERVE FIBRES

By R. D. Keynes and P. R. Lewis

Journ. Physiol., Vol. 114, 1951, pp. 151-82

A method is described for determining sodium and potassium simultaneously, in quantities down to 0.3 and 3 μg . respectively. The technique used was 'activation analysis', which involved irradiation of the tissue samples in a neutron pile for a week, followed by β - and γ -counts to determine the amounts of ^{42}K and ^{24}Na which had been formed.

Figures were obtained for the sodium and potassium concentrations in

freshly dissected 200 μ *Sepia* axons, and for the rate of loss of potassium and gain of sodium in axons kept in sea water at about 10° C. Estimates for a further series of axons which had conducted about 120,000 impulses before being analysed, showed that during activity there was a net gain of 3.8 $\mu\mu\text{mol. Na/cm.}^2/\text{impulse}$, and a net loss of a roughly equal quantity of potassium. Analyses of samples of axoplasm extruded from 500 μ squid axons gave very similar results. Measurements of the chloride content of the axoplasm samples showed a considerably smaller net gain on stimulation.

These results provide direct confirmation for the 'sodium hypothesis' of nervous conduction, put forward by Hodgkin, Huxley & Katz. R.D.K.

COLOURS OF MARINE ANIMALS

By J. A. Colin Nicol

School Science Review, Vol. XXXIII, 1952, pp. 208-18

A general account is given of coloration in marine animals, and of the pigments and structural modifications which are responsible. Either may be responsible for the colour of a particular animal, or both may play a complementary role. The principal pigments responsible for external colours are carotenoids, porphyrins, indole pigments, melanins, quinones, purines, and various protein substances. The distribution and biological implications of some of these substances are discussed. Structural colours are due to interference effects, and may be seen in the iridescence of various animals. Morphological and physiological colour changes are distinguished, and the significance of adaptive coloration to certain species is considered. The article concludes with a series of references which provide an introduction to the bibliography dealing with the subject. J.A.C.N.

A NEW SUBTERRANEAN GAMMARID (CRUSTACEA) FROM BRITAIN

By G. M. Spooner

Proc. Zool. Soc. Lond., Vol. 121, 1952, pp. 851-9

Niphargus glenniei is a new species of the subterranean genus *Niphargus* discovered in limestone caves near Buckfastleigh, S. Devon, where it was first collected by Brig. E. A. Glennie of the Cave Research Group. A detailed description is given. The species is small, and the male sex has not yet been recognized.

The nearest possible relatives on the continent are *N. arndti*, known from four localities in Silesia, and *N. nolli*, known from two localities in the upper Rhineland, both small species in which the mandibular palp shows an unusual simplification. However, differences between *N. glenniei* and these

two species are considerable, and the resemblances may conceivably be but the effect of convergence.

Schellenberg's genus *Niphargellus* is not to be considered valid, an opinion enhanced by the discovery of *Niphargus glenniei*.

The existence of this distinct new species was indeed unexpected, in view of the poverty of the British subterranean arthropod fauna and the lack of endemic forms. G.M.S.

THE RESPIRATORY SIGNIFICANCE OF THE CROWN IN THE POLYCHAETE
WORMS *SABELLA* AND *MYXICOLA*

By G. P. Wells

Proc. Roy. Soc., B., Vol. 140, 1952, pp. 70-82

The tube of *Sabella pavonina* is irrigated by means of piston-like waves travelling tailwards along the worm's body, a process which is hardly affected by decapitation. The tube of *Myxicola infundibulum* is not irrigated at all. After bisection of tubeless worms at the junction of thorax and abdomen, the oxygen consumption of both halves together is greatly depressed in *Myxicola* but is unaffected in *Sabella*. The conclusion is drawn that the body of *Myxicola* depends largely on the crown for its oxygen supply while that of *Sabella* normally derives its oxygen from the irrigation current through the tube. The results are discussed in relation to the differences in anatomy, and in the ability to survive and regenerate after injury, between the two worms.

G.P.W.