

ABSTRACTS OF MEMOIRS

RECORDING WORK DONE AT THE PLYMOUTH LABORATORY

ABBOTT, B. C., HILL, A. V. & HOWARTH, J. V., 1958. The positive and negative heat production associated with a nerve impulse. *Proc. roy. Soc., B*, Vol. 148, pp. 149-87.

'Initial' heat production in non-medullated nerve (*Maia*) has been re-examined with improved instruments. A single impulse at 0° C gives an observed deflexion corresponding to two distinct phases of heat: (a) heat production of about 9×10^{-6} cal/g nerve within 20 msec of the impulse, immediately followed by (b) heat absorption of about 7×10^{-6} cal/g nerve lasting about 300 msec. The net heat of 2×10^{-6} cal/g nerve confirms previous estimates. Heat is contributed by many fibres of varied diameter and velocity of propagation. As a result the positive and negative phases of heat production are, to some extent, masked by the asynchronous arrival at the thermopile of impulses of different velocity. Using probable assumptions for propagation velocity the corrected positive and negative heat production becomes about 14×10^{-6} and 12×10^{-6} cal/g nerve respectively.

In the discussion some possible sources of the heat are considered. The discharge and subsequent recharge of the membrane capacity, though giving positive and negative heat of the observed magnitude have the wrong time relations to be the source of the heat recorded in the present experiments. Heat of mixing in the trans-membrane exchange of Na and K ions may contribute part of the positive heat. The heat production accompanying chemical events in the membrane during its cycle of permeability change is suggested as a likely source of heat, positive and negative.

J.V.H.

ABBOTT, B. C. & LOWY, J., 1958. Contraction in molluscan smooth muscle. *J. Physiol.*, Vol. 141, pp. 385-97.

Certain mechanical and thermal events during activity of long-fibred smooth molluscan muscles have been studied. In all cases the speed of shortening was found to be related to load during isotonic contraction in a manner approximating closely to Hill's characteristic equation. It was also observed that shortening of stimulated muscle is accompanied by extra heat production proportional to shortening. In the smooth muscles studied, the constant a for shortening heat differs from the value a in the characteristic equation.

The smooth muscles develop greater tensions, have a slower maximal shortening velocity, a smaller maintenance heat rate, and relax more slowly than any other type of muscle hitherto studied.

Following a release during the plateau of an isometric tetanus, re-development of tension decreases with speed of release. Fall of tension after stretch of tetanised muscle also decreases with speed of stretch. For a given extent of lengthening, the maintained tension increase above isometric is more pronounced than in vertebrate skeletal muscle, i.e. the active smooth muscles show a greater rigidity.

The ability of the smooth muscles to maintain high tensions economically is discussed in terms of their slow relaxation, small maintenance heat rate, and the extent of 'setting' within the contractile material as a result of activity. Tension is assumed to be maintained by spontaneous random excitation of the muscle, rather than by a special 'catch' mechanism.

J.L.

ABBOTT, B. C. & LOWY, J., 1958. Mechanical properties of *Helix* and *Mytilus* muscle. *J. Physiol.*, Vol. 141, pp. 398-407.

Experiments with smooth muscle preparations from *Helix* and *Mytilus* have shown that maximum isometric tension is developed at about the longest length reached by the muscles in the animal's body (reference length). When stretched beyond reference length, the muscles exert resting tension. This is not due to spontaneous activity.

Relaxation, following isometric contraction, and stress relaxation (decay of tension following rapid stretch of resting muscle) are not identical processes as claimed by Bozler. Their time courses differ and stress relaxation is not significantly affected by changes in temperature.

J.L.

CARLISLE, D. B., 1958. Niobium in Ascidians. *Nature, Lond.*, Vol. 181, p. 933.

Niobium has been shown to be present in some species of Ascidians. In *Molgula manhattensis* some individuals possess vanadium, others niobium. The two elements do not appear to be present in significant amounts in the same individual.

D.B.C.

CARLISLE, D. B. & HUMMERSTONE, L. G., 1958. Niobium in sea-water. *Nature, Lond.*, Vol. 181, pp. 1002-3.

There is enough niobium in inshore sea water to supply the needs of those ascidians which have been shown to contain it. The method is described for detecting small amounts of the element in sea water. The different samples vary between 0.005 and 0.1 $\mu\text{g/l}$.

D.B.C.

DENTON, E. J. & WALKER, M. A., 1958. The visual pigment of the conger eel. *Proc. roy. Soc., B*, Vol. 148, pp. 257-69.

New methods of studying the spectral absorption of intact retinæ are described. Using these methods the retina of *Conger conger* (L.) has been studied and the retinal spectral absorption curves are compared with those obtained on retinal extracts made with digitonin solution. The retina of the conger, like that of deep-sea fish, is golden in colour, its absorption curve being similar in shape to that of frog rhodopsin but with its maximum displaced about 16 $\text{m}\mu$ towards the blue end of the spectrum. The absorption curve of unbleached retinæ is displaced about 4 $\text{m}\mu$ towards the red end of the spectrum from the absorption curve of unbleached retinal extract, but, when an estimated correction for possible yellow impurities in the extract is made, this displacement is only one of 2 $\text{m}\mu$. The change in optical density of the dark-adapted retina on bleaching with strong white light is 0.6 at $\lambda = 484 \text{ m}\mu$: this probably represents a retinal density for unbleached pigment of about 0.8. The visual pigment in the intact retina is approximately twice as effective as simple calculations based on extracts would predict. The absorption of light by the retina is dominated by the principal photosensitive pigment, whilst the screening of the rods, due to the absorption of light by the layers of retina lying between the rods and the internal limiting membrane, is trivial.

E.J.D.

NORTH, W. J. & PANTIN, C. F. A., 1958. Sensitivity to light in the sea-anemone *Metridium senile* (L.): adaptation and action spectra. *Proc. roy. Soc., B*, Vol. 148, pp. 385-96.

The sea-anemone *Metridium senile* responds to illumination by local contraction of the longitudinal musculature, particularly of the parietal system. No specific receptors have so far been identified for this response. The phenomena of light and of dark adaptation are shown by the photoreceptive mechanism. The action spectra of white individuals show a maximum at about 490-520 m μ . Relative to this the sensitivity in the region 550-600 m μ varies in different individuals. The possible presence of two distinct photosensitive systems is mentioned. Sensitivity decreases very rapidly beyond 600 m μ . Action spectra of the white, red and brown coloured varieties of the species are compared in relation to the absorption spectra of tissues obtained from the three types. It is concluded that the pigments which give the characteristic body colour in the red and brown varieties act as filters. Comparison with the white variety indicates that these pigments probably do not act as specific photosensitive substances. It is pointed out that the differential sensitivity of the coloured varieties appears to have no selective influence on the occurrence and distribution of the different coloured varieties.

C.F.A.P.

ROBSON, ELAINE A., 1957. The structure and hydromechanics of the musculo-epithelium in *Metridium*. *Quart. J. micr. Sci.*, Vol. 98, pp. 265-78.

Musculo-epithelial cells in the mesenteries of the sea-anemone *Metridium senile* contribute both to the muscle-field above the mesogloea and to the epithelium. The epithelial elements are connected to the muscle fibres by vertical protoplasmic strands, and the intervening space is occupied by fluid. This subepithelial fluid forms a thin layer between the epithelium and muscle-field.

Epithelial elements from contracted mesenteries are taller than those from stretched tissue. As the area of the mesentery decreases during contraction, a reversible change from pavement to columnar epithelium takes place. The epithelium is able to follow rapid contractions without delay, owing to the hydrostatic action of the subepithelial fluid in thrusting it outward. Although considerably elastic, the epithelium does not appear to be active during contraction or relaxation and is moved passively.

Only the coelenterates possess true musculo-epithelium, and it may be modified, as in certain regions of *Metridium*. Analogous systems occurring in higher animals are discussed. It is possible that the subepithelial fluid of *Metridium* not only functions hydrostatically, but that it and the mesogloea fluid together form an 'internal medium' providing some degree of biochemical co-ordination.

E.A.R.

SUTTON, MURIEL F., 1957. The feeding mechanism, functional morphology and histology of the alimentary canal of *Terebella lapidaria* L. (Polychaeta). *Proc. zool. Soc. Lond.*, Vol. 129, Part 4, pp. 487-523.

The food of *Terebella lapidaria* is collected by the mucus-secreting tentacles and passed to the upper lip and thence to the mouth. The lower lip is not concerned with food ingestion; its function is to provide mucus and cement for tube building.

The complex musculature of the lower lip has been described and separate coelomic cavities within upper and lower lip regions noted. The musculature of upper and lower

lips together with the varying pressures of the coelomic fluid in upper and lower lip regions and in the thorax are responsible for lip movements.

The structure of the alimentary canal has been described in some detail, and, in particular, an account has been given of a complex type of mucous secretion involving a glandular epithelium and an adjacent glandular tissue. In no part of the alimentary canal is there a peritrophic membrane, *sensu stricto*.

The possible course of evolution of the arthropod alimentary canal from that of a polychaete ancestor is discussed.

M.F.S.