

ABSTRACTTHE NEUROPHYSIOLOGICAL CONTROL AND PHOTSENSORY MODULATION OF
SWIMMING IN A CERCARIA, Cercaria caribbea LXXI.

by

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Scanning and transmission electron microscopy revealed that Cercaria caribbea LXXI has a small body (70 μ m) with a pair of well-developed, rhabdomeric photoreceptors; and a large tail (4mm) with six longitudinal, striated muscle bands. Muscle cells had an outer myofibrillar region adjacent to the tegument and an inner sarcoplasmic region, prolongations of which, may form sarconeural junctions. Sarcomere lengths were consistent with invertebrate fast muscle fibres. Diffuse Z-bands and the presence of numerous mitochondria are consistent with slow muscle fibres, adapted for prolonged work output. Interneuronal junctions with abundant electron-lucent and electron-dense vesicles, and neuromuscular junctions with mainly electron-lucent presynaptic vesicles were demonstrated. The neuromuscular connection between the body and tail appeared to be restricted to a single axon, implying that modulation of tail activity by the body may involve simple triggering or level setting actions, rather than complex modulation.

The Falck-Hillarp Formaldehyde-Induced Fluorescence and the Gomori techniques indicated that the neuromuscular system utilizes primary catecholamines, serotonin (5-HT) and an acetylcholine-like transmitter. There were indications that 5-HT promotes activity and is held as a non-replenishable store, depleted through time within the cercarial tail.

Exogenous application of a range of neuropharmacological agents, profoundly affected survivorship of the organisms. Of the catechol-aminergic group, propranolol (1.1-40 μ M) and haloperidol (0.066 - 0.133mM) most effectively reduced population half-life (T_{50}). This was followed by the cholinergic agent, physostigmine (0.08-2.5mM). The gamma-aminobutyric acid antagonist, picrotoxin (0.08-2.5mM), only weakly affected T_{50} . Several drugs, especially reserpine (0.08-2.5mM), produced osmotic disturbances, leading to shortened life span. Survivorship was also dependent on pH, with a sharply defined tolerance range between pH 6 and 8.

Suction electrodes recordings of electrical activity in the tail revealed spontaneous spike potentials (0.2-0.6mV, 15-20/sec) superimposed on an underlying slow wave component. The effects of drugs on this activity were observed. 5-HT increased the amplitude and frequency of spike discharge from 0.2mV to 0.8mV and 15/sec to 25/sec, respectively. Physostigmine was the most effective reducer of both parameters. Indications were that cholinergic receptors in the nerve network may be excitatory nicotinic and inhibitory muscarinic; those at neuromuscular junctions may be excitatory muscarinic. Excitatory beta adrenergic and inhibitory dopaminergic influences were observed.

C. caribbea LXXI exhibited strong positive phototaxis. In response to light stimuli, the pigmented cercariae gave a maintained receptor potential with a small transient component. In the non-pigmented strain of C. caribbea LXXI, the photosensory receptor potential showed a large transient and a small maintained component. Drugs did not alter the photosensory response. A drug-induced decrease in linear translation towards a photic stimulus was therefore due to a disturbance in the neuromuscular system.