Neural Circuit for Crayfish Escape

2013/01/08

Tatsuo Okubo

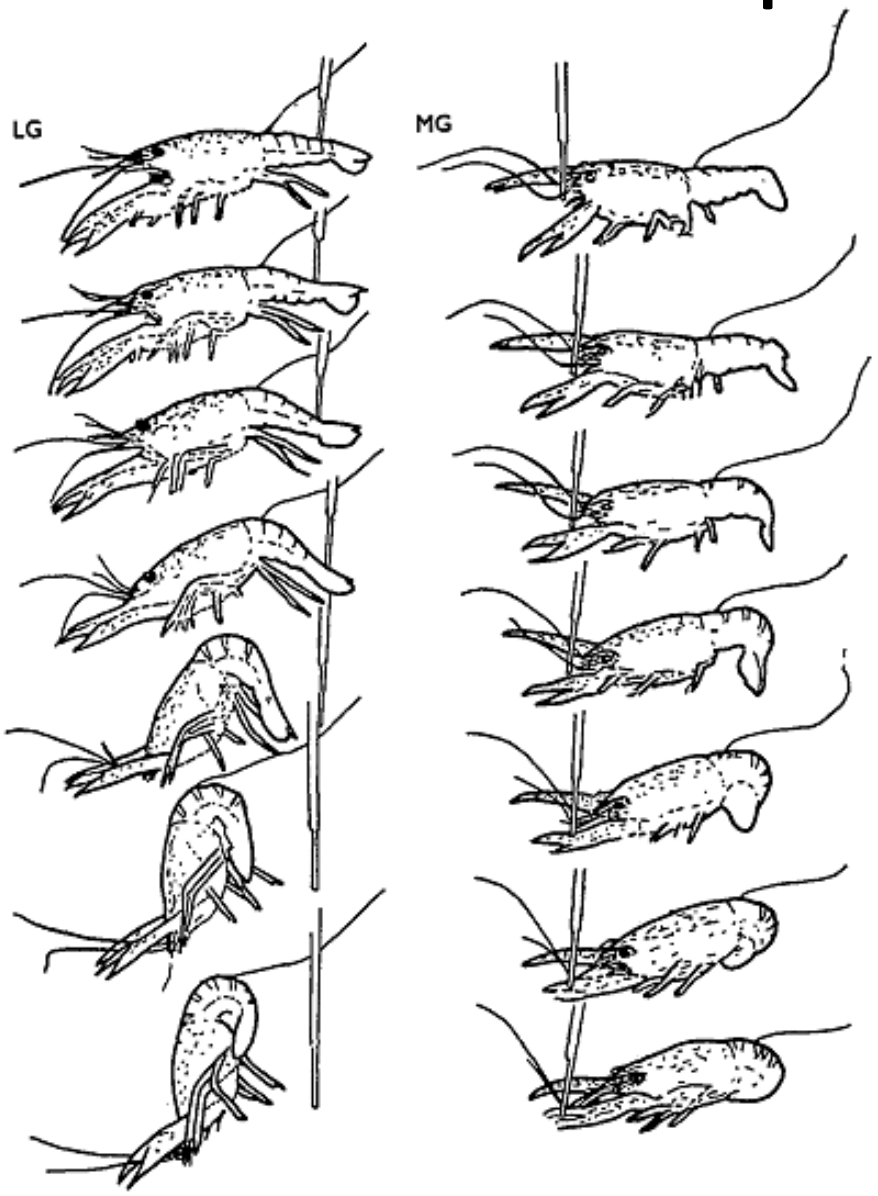
Crayfish needs to escape!

Jens herberholz (U. Maryland)

Escape behavior

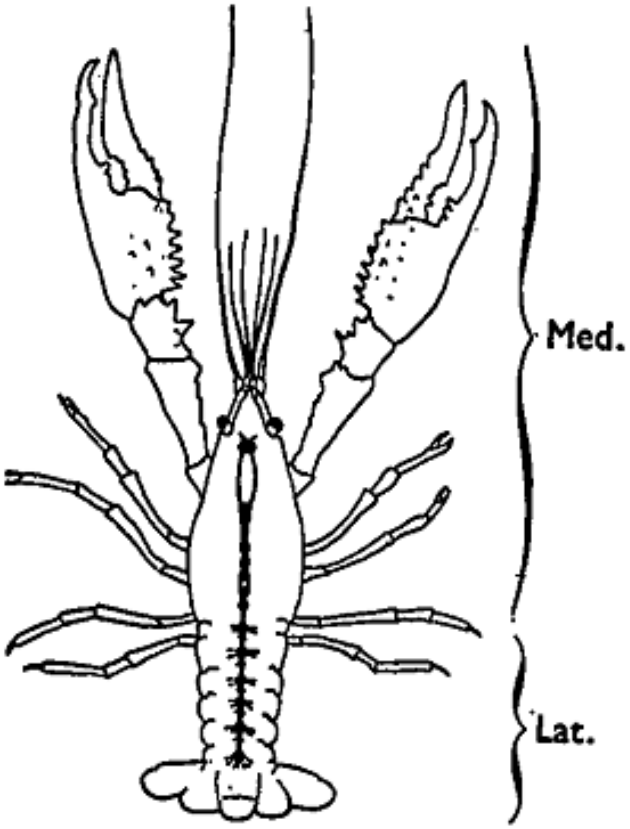
Toshiki Nagayama (http://s-crawfish.kj.yamagata-u.ac.jp/stereotyped.html)

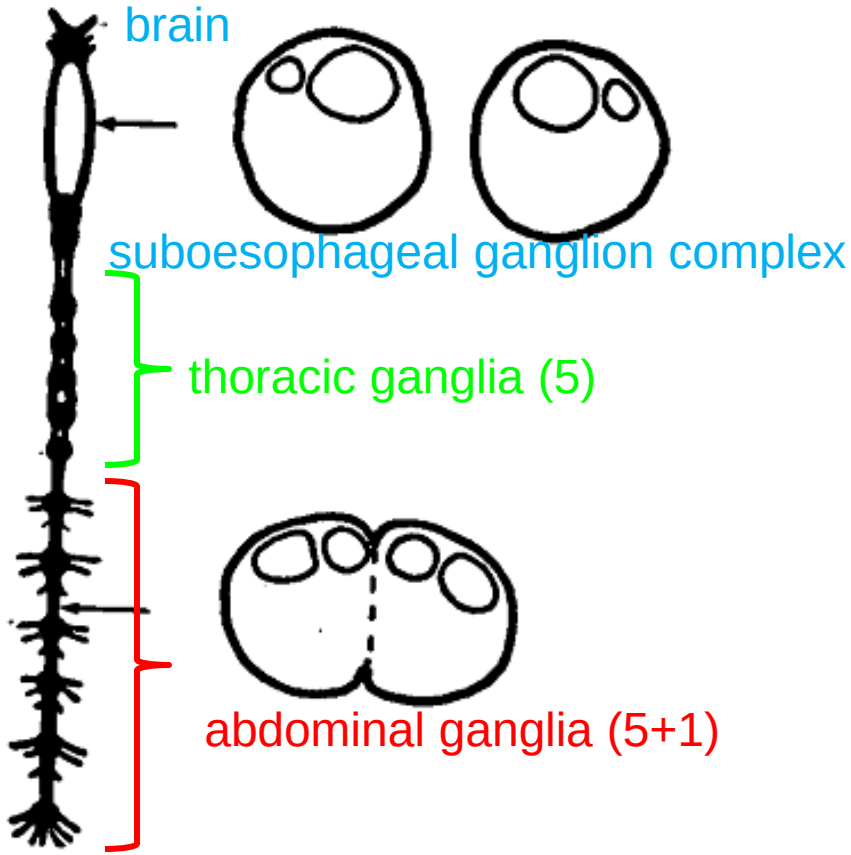
LG vs MG escape



Wine & Krasne (*J Exp Biol*, 1972)

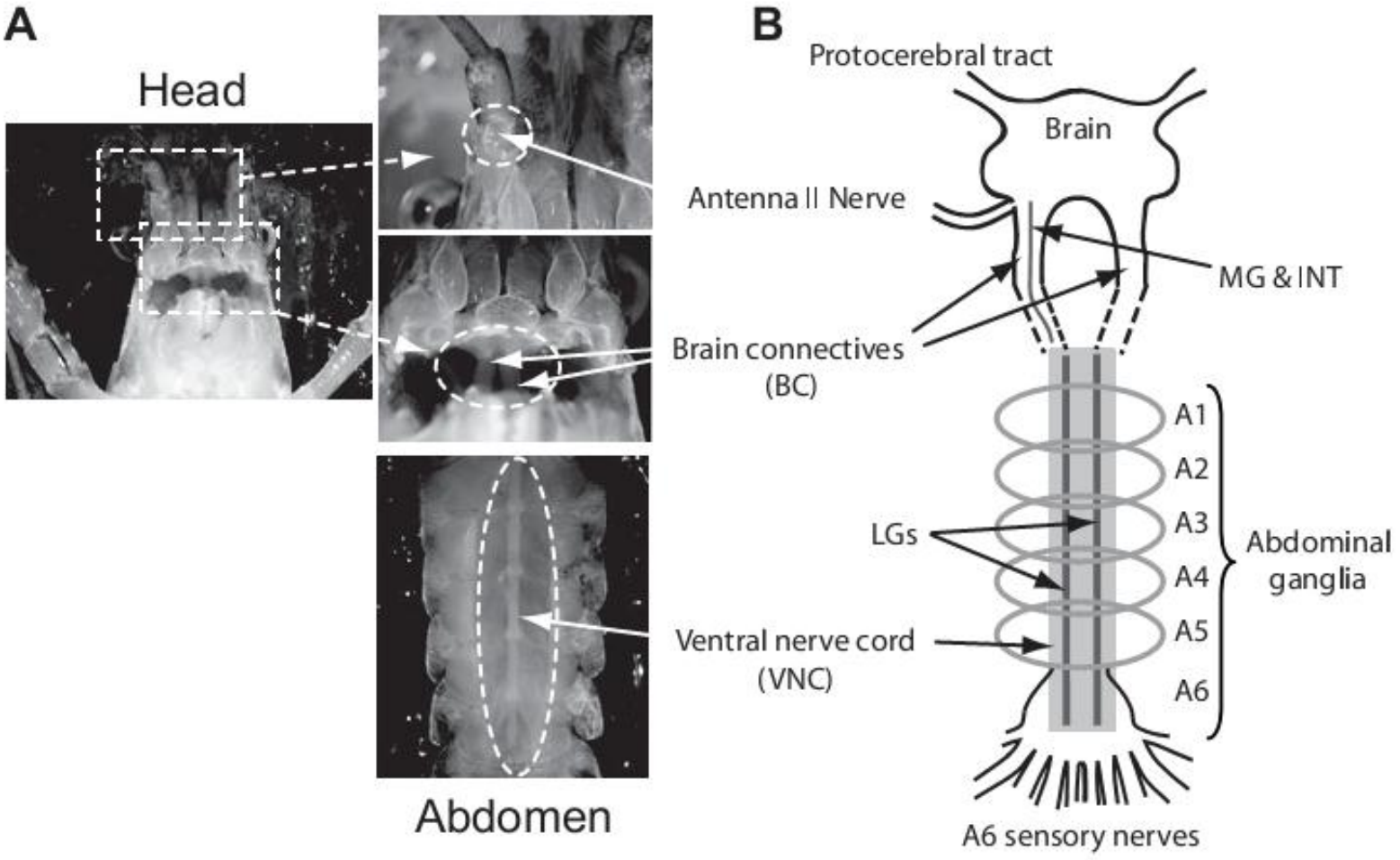
The crayfish nervous system





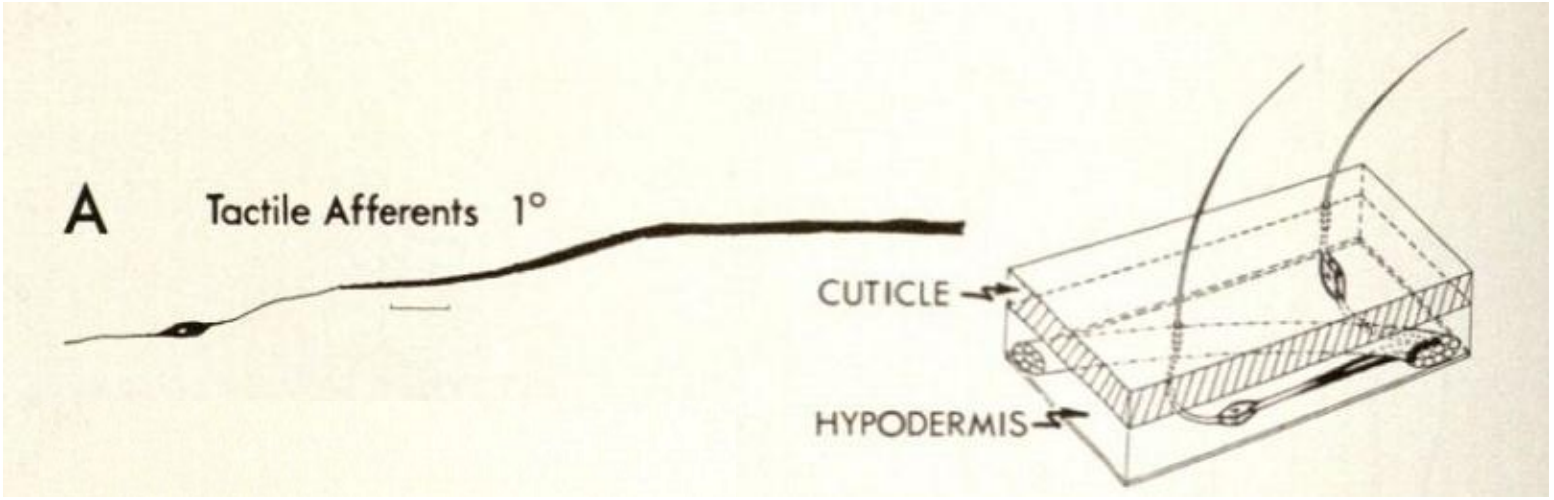
Wine & Krasne (*J Exp Biol*, 1972)

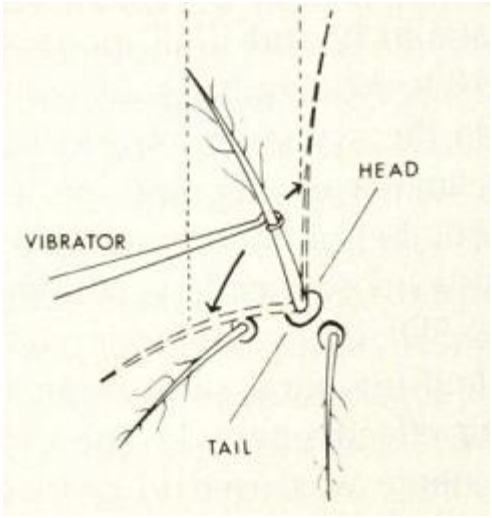
The crayfish nervous system

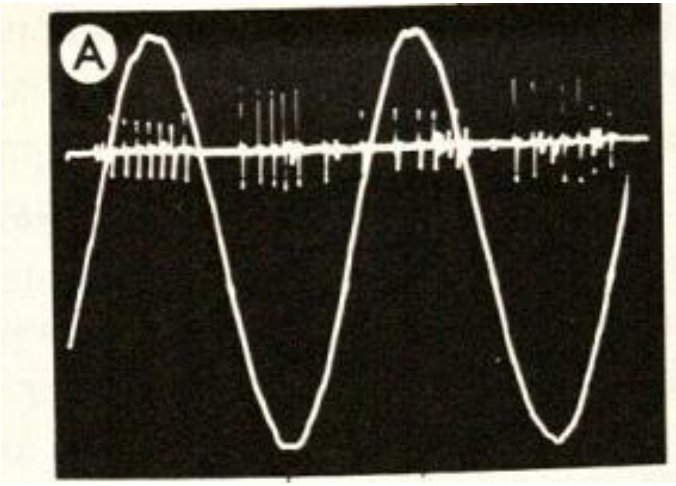


Liu & Herberholz (J Neurophysiol, 2010)

Tactile sensory neurons (TSCs)

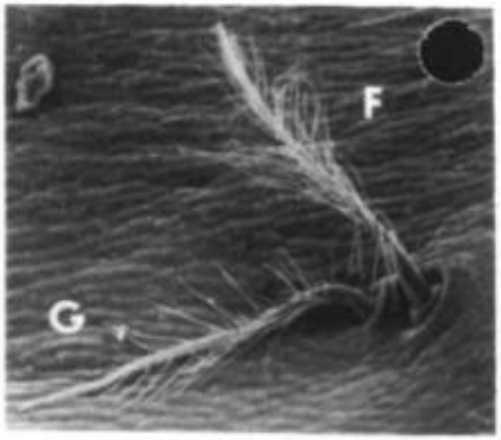


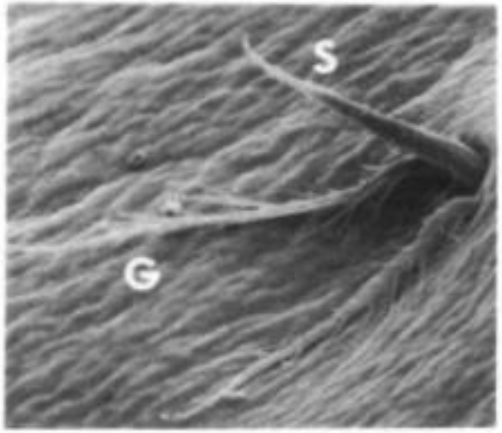


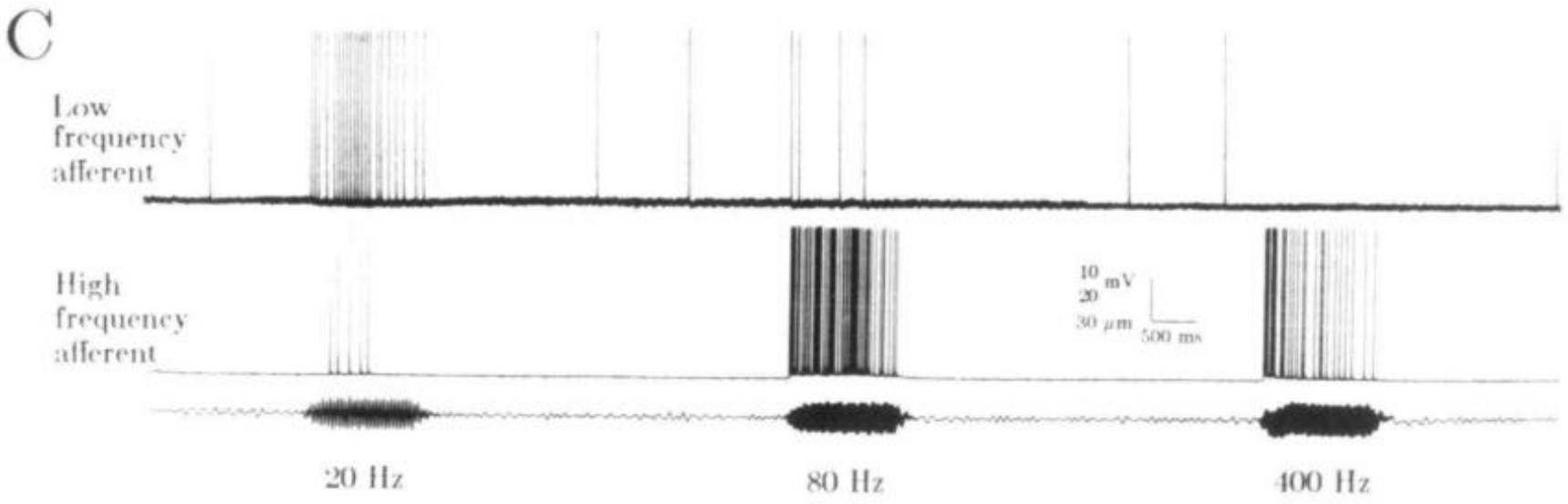


Wine & Krasne (1982)

Mechanosensory hairs

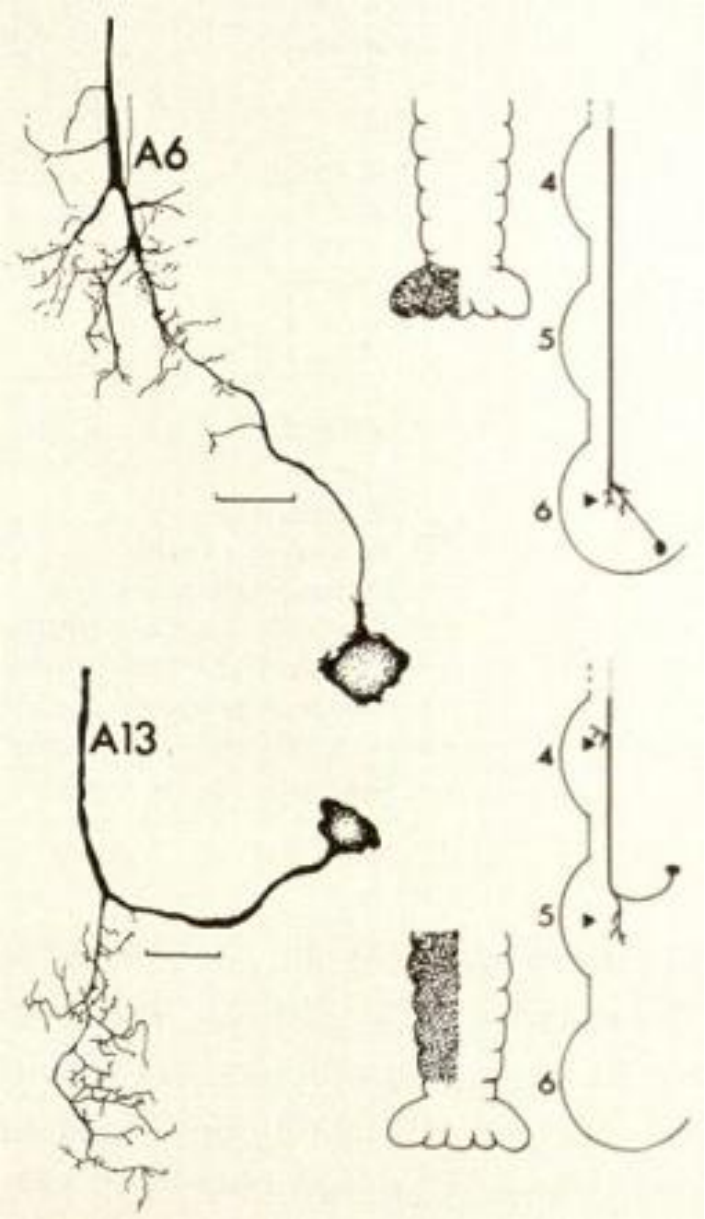


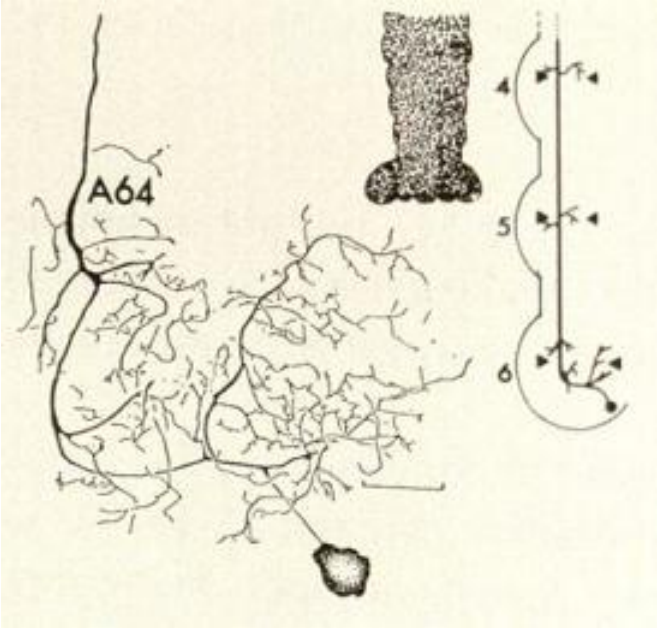




Wine (*J Exp Biol*, 1984)

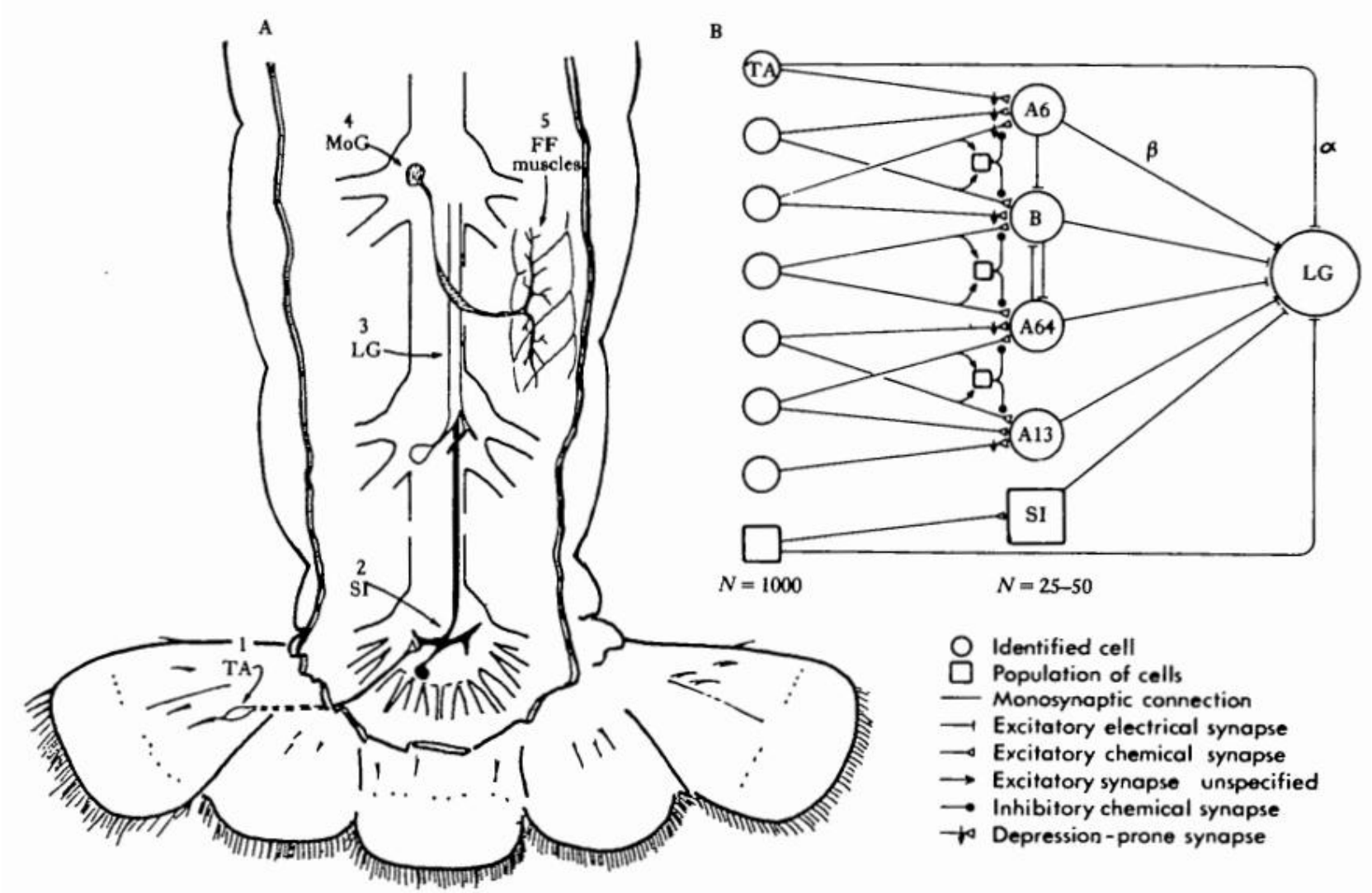
Sensory interneurons (SIs)





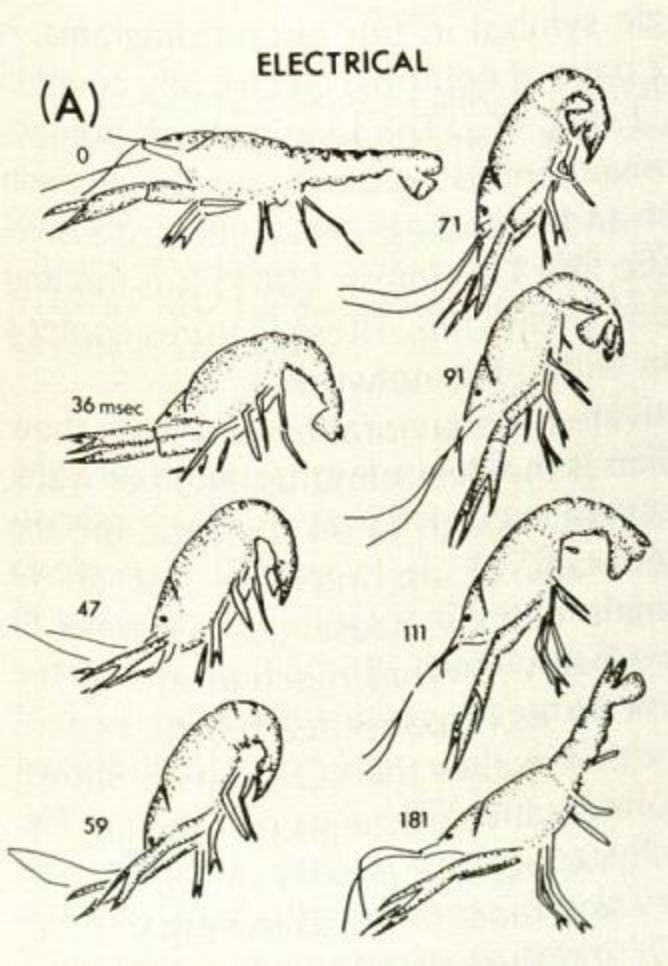
Wine & Krasne (1982)

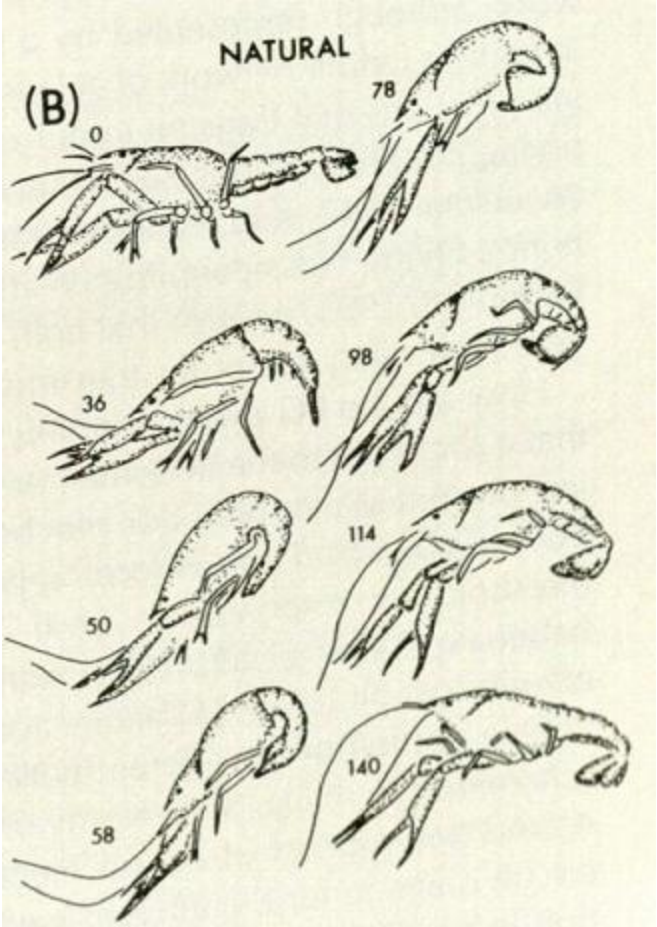
Neural circuit for escape



Wine (*J Exp Biol*, 1984)

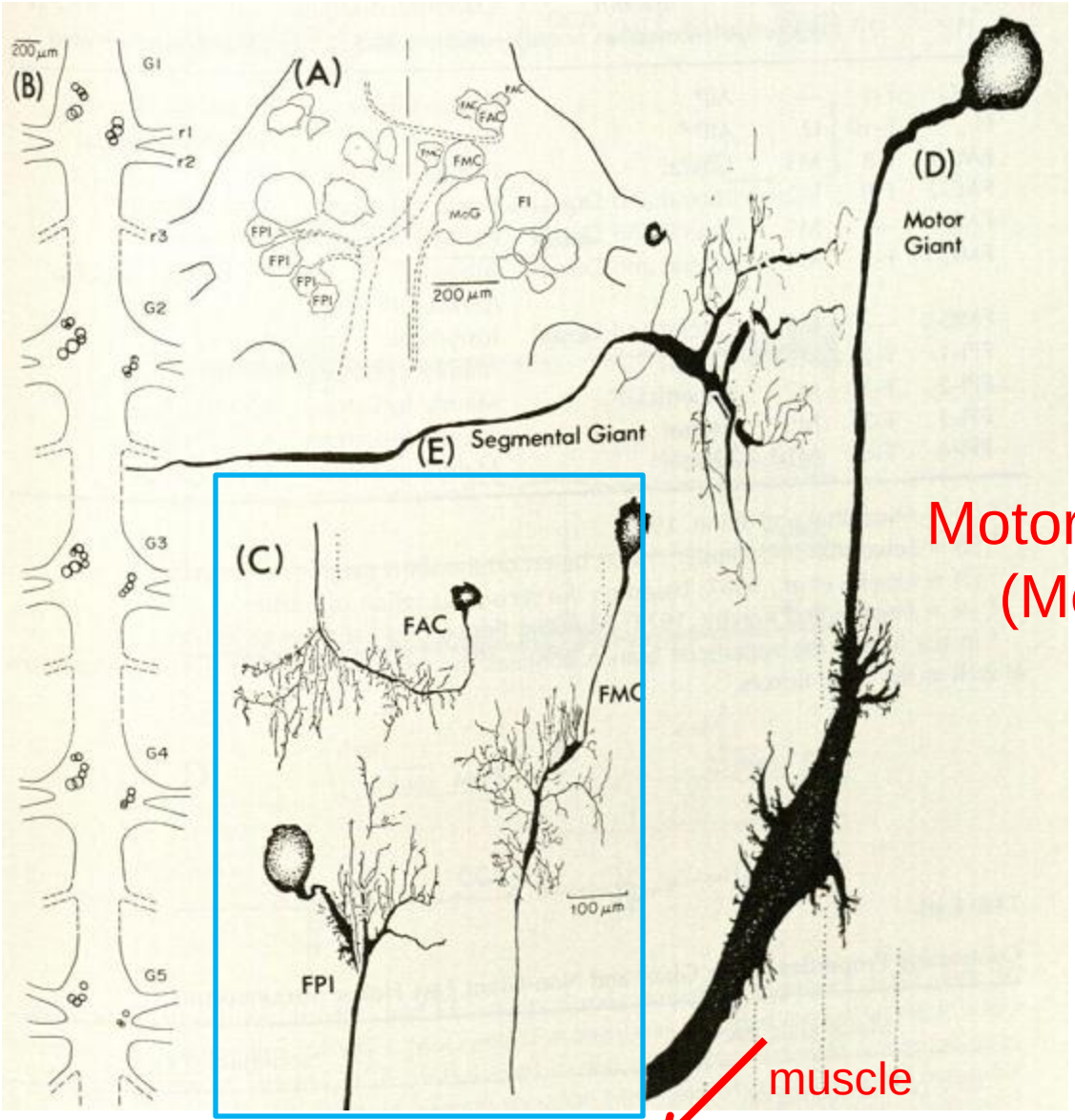
MG stimulation vs natural escape





Wine & Krasne (1982)

Motor components of the circuit

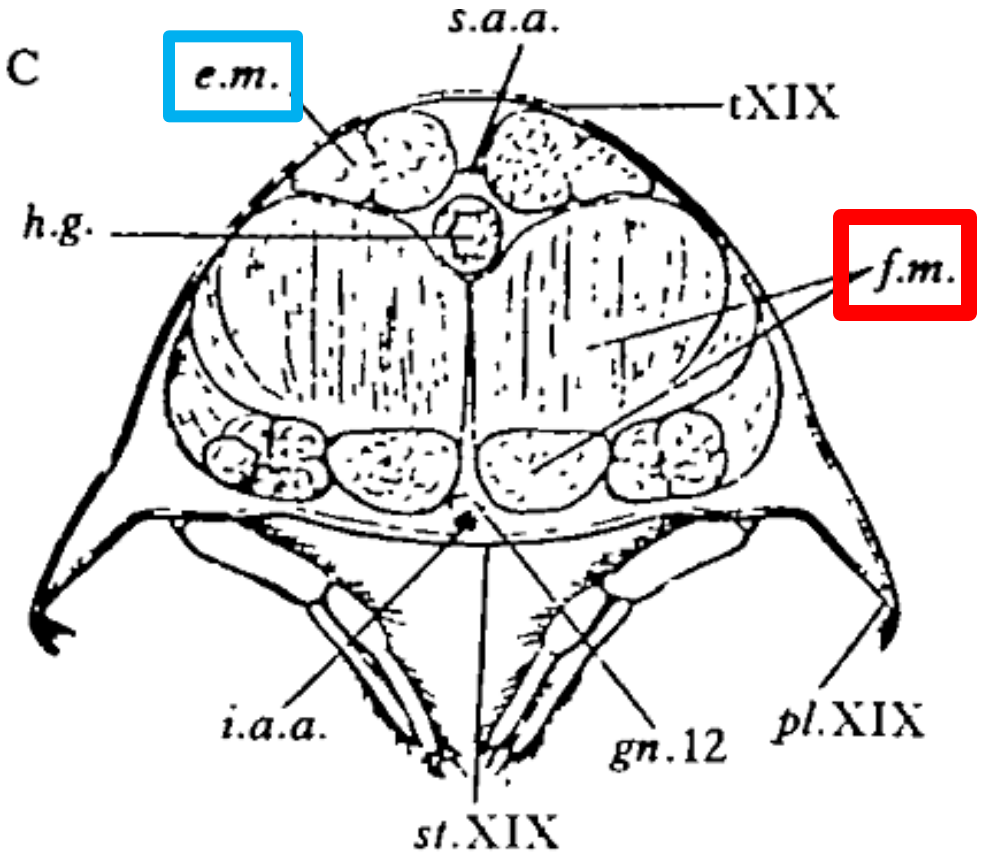


Motor Giant (MoG)

FF motor neurons

Wine & Krasne (1982)

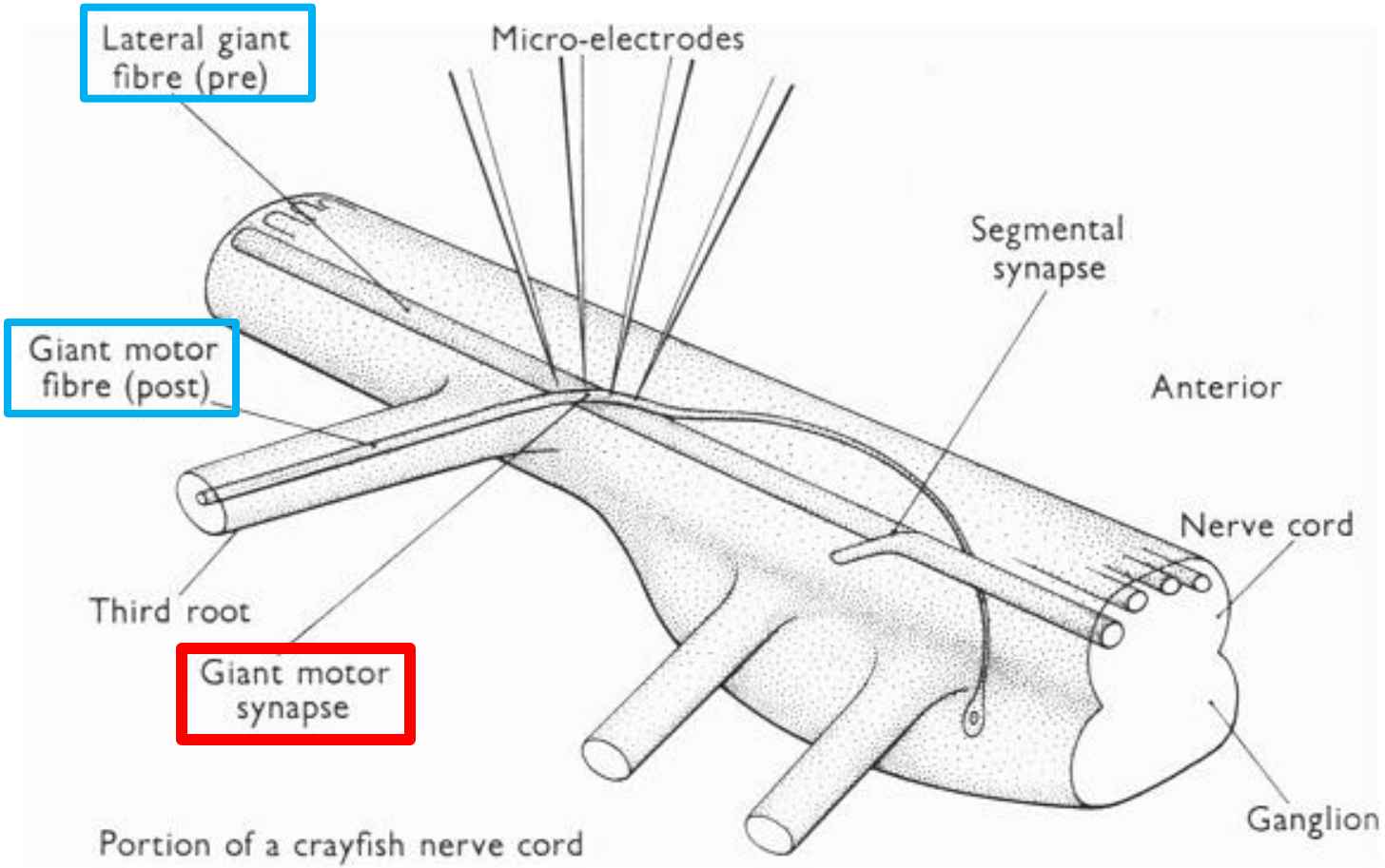
Fast flexor muscles are important for escape



Cross section of the abdomen

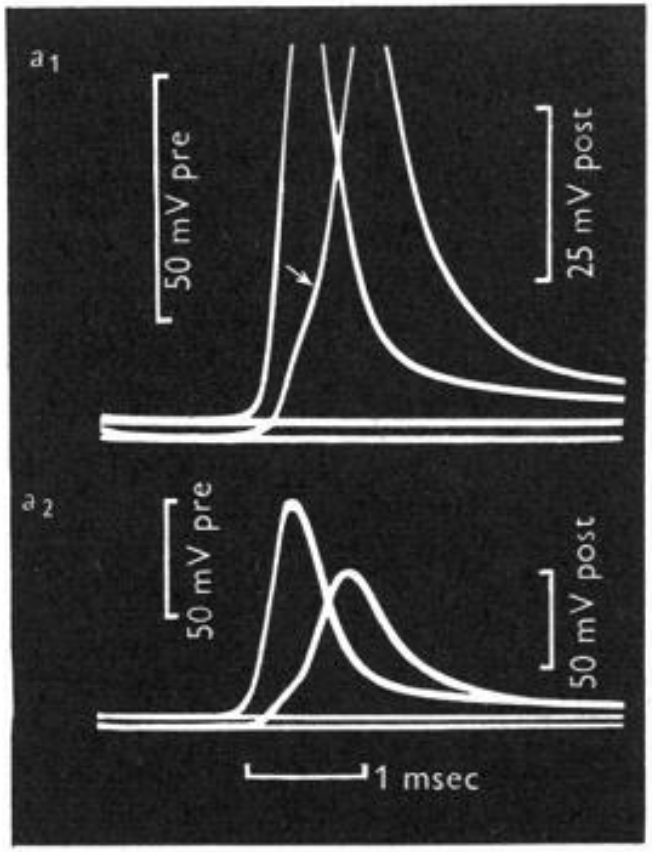
Wine (*J Exp Biol*, 1984)

First electrical synapse found!!

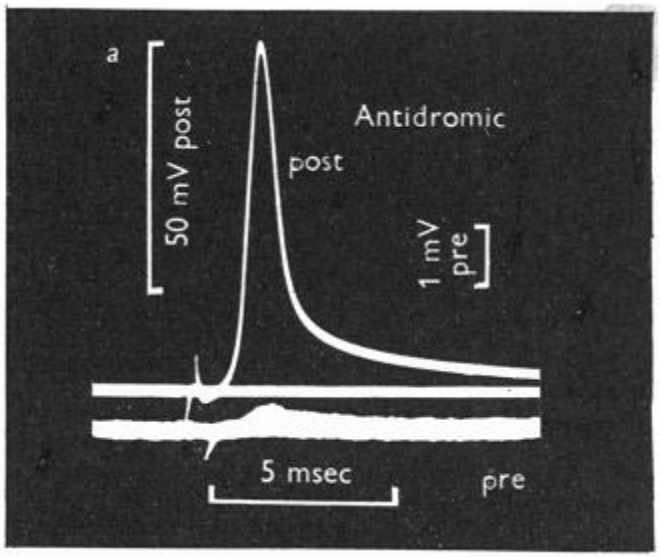


Furshpan & Potter (1957)

Rectifying electrical synapse

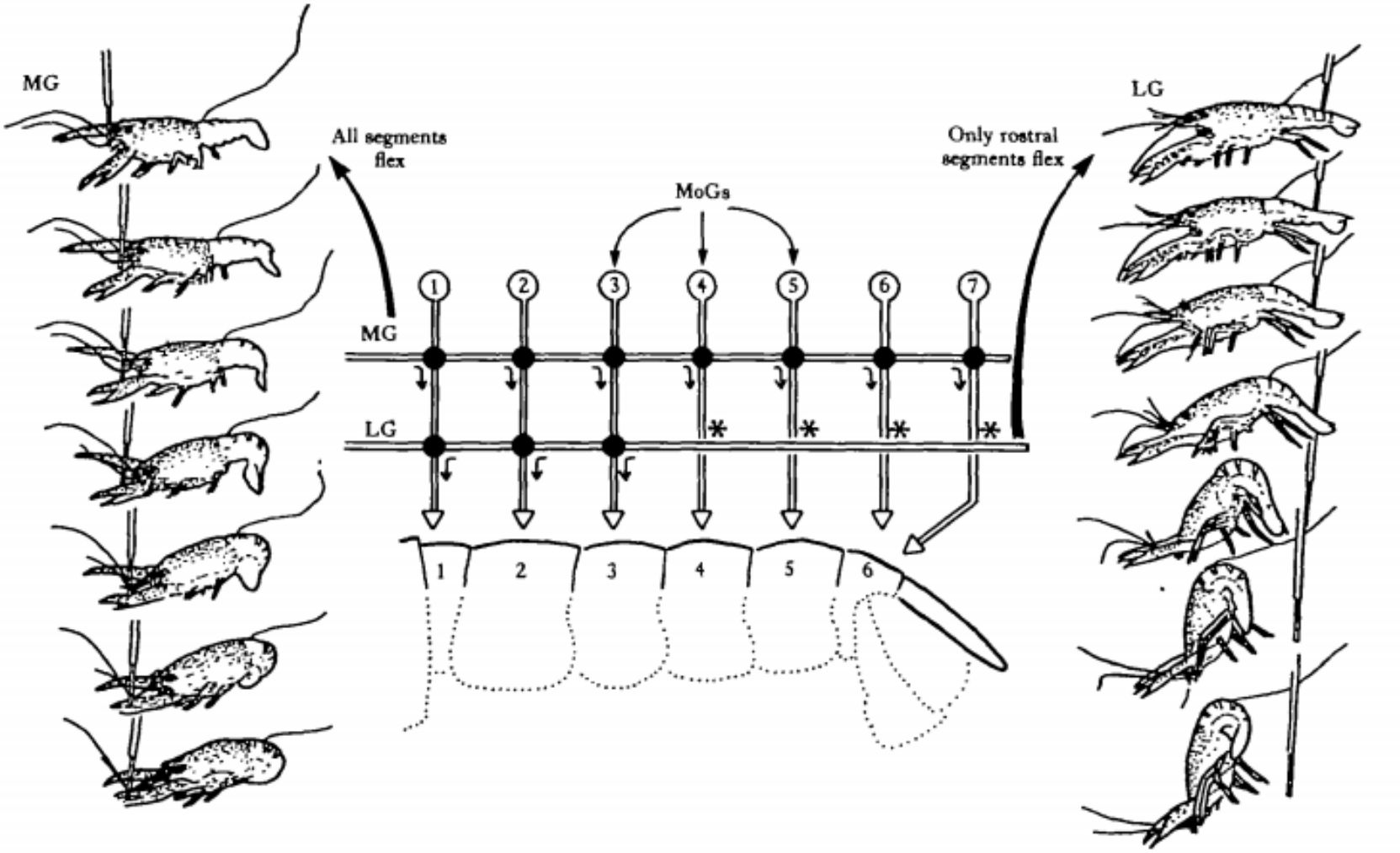


Very short latency



Furshpan & Potter (1957)

Neural connectivity explains the difference between MG and LG



Wine (*J Exp Biol*, 1984)

Habituation of escape

Toshiki Nagayama (http://s-crawfish.kj.yamagata-u.ac.jp/habituation_behaviour.wmv)

Experimental setup

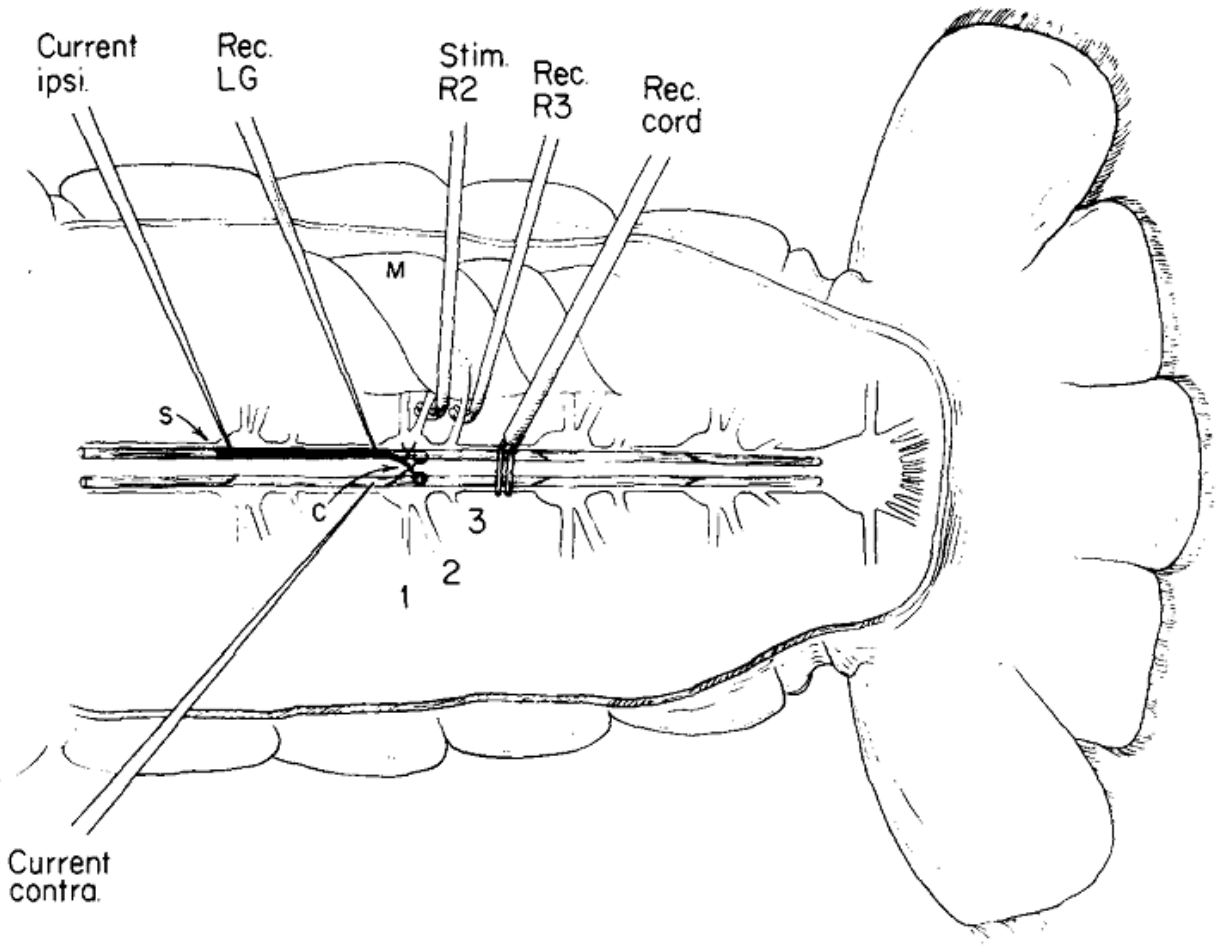
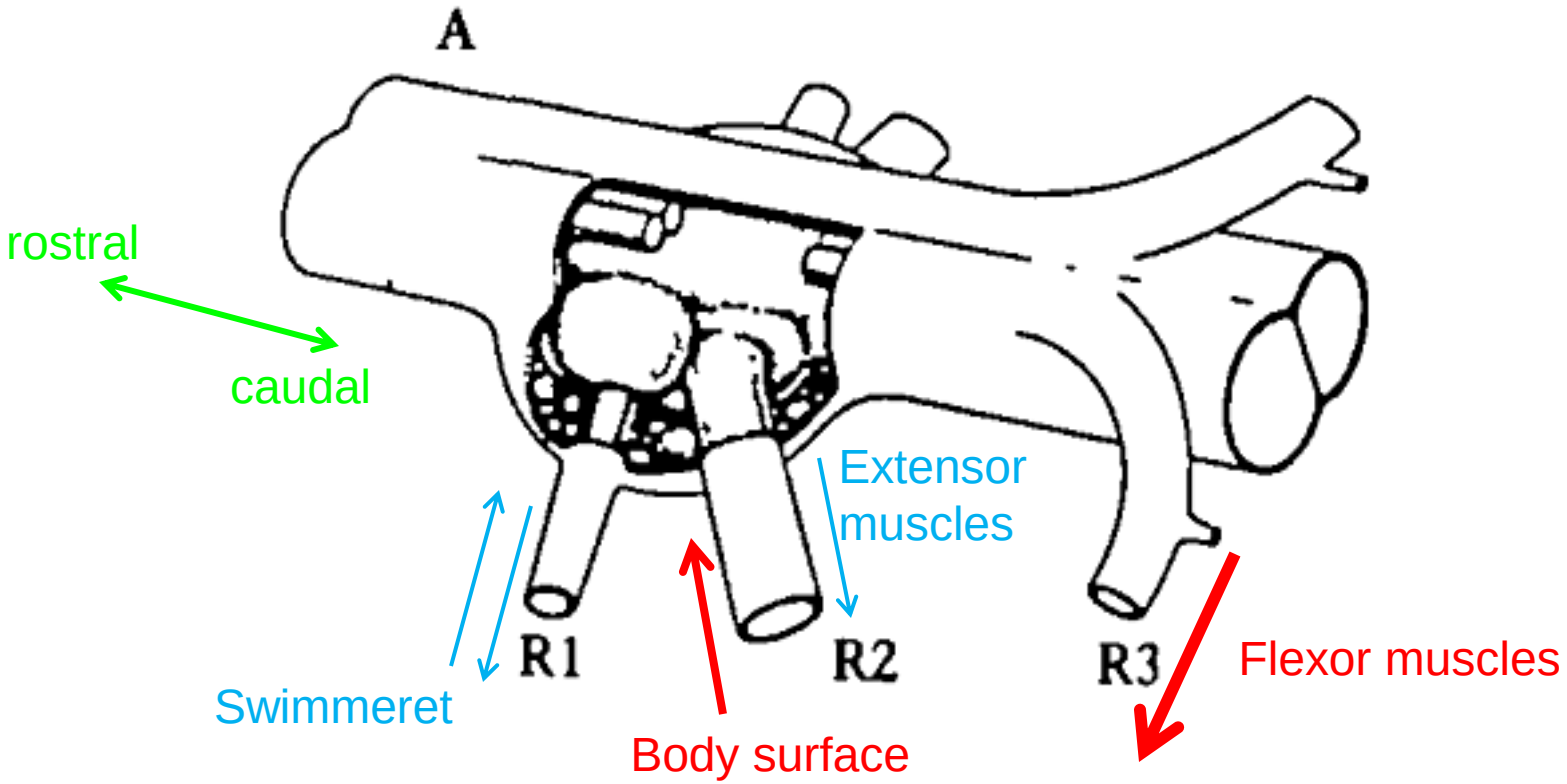


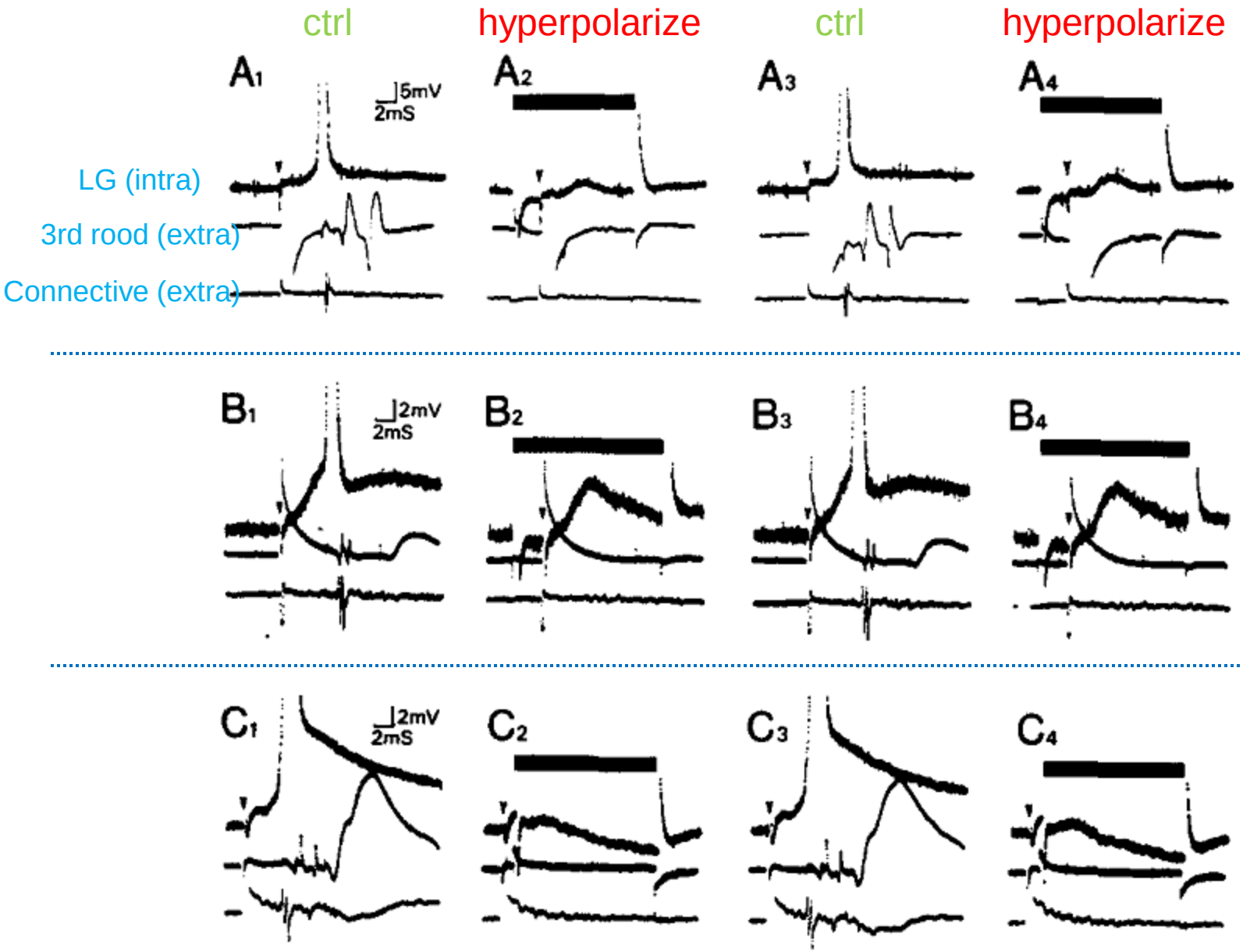
Fig. 2. Dorsal schematic view of the abdominal nerve cord in situ showing the lateral giant fibers and typical positions for stimulating and recording electrodes. S, septal; C, commissural synapse; M, flexor musculature; R2, 2nd root; R3, 3rd root.

Olson & Krasne (*Brain Research*, 1981)

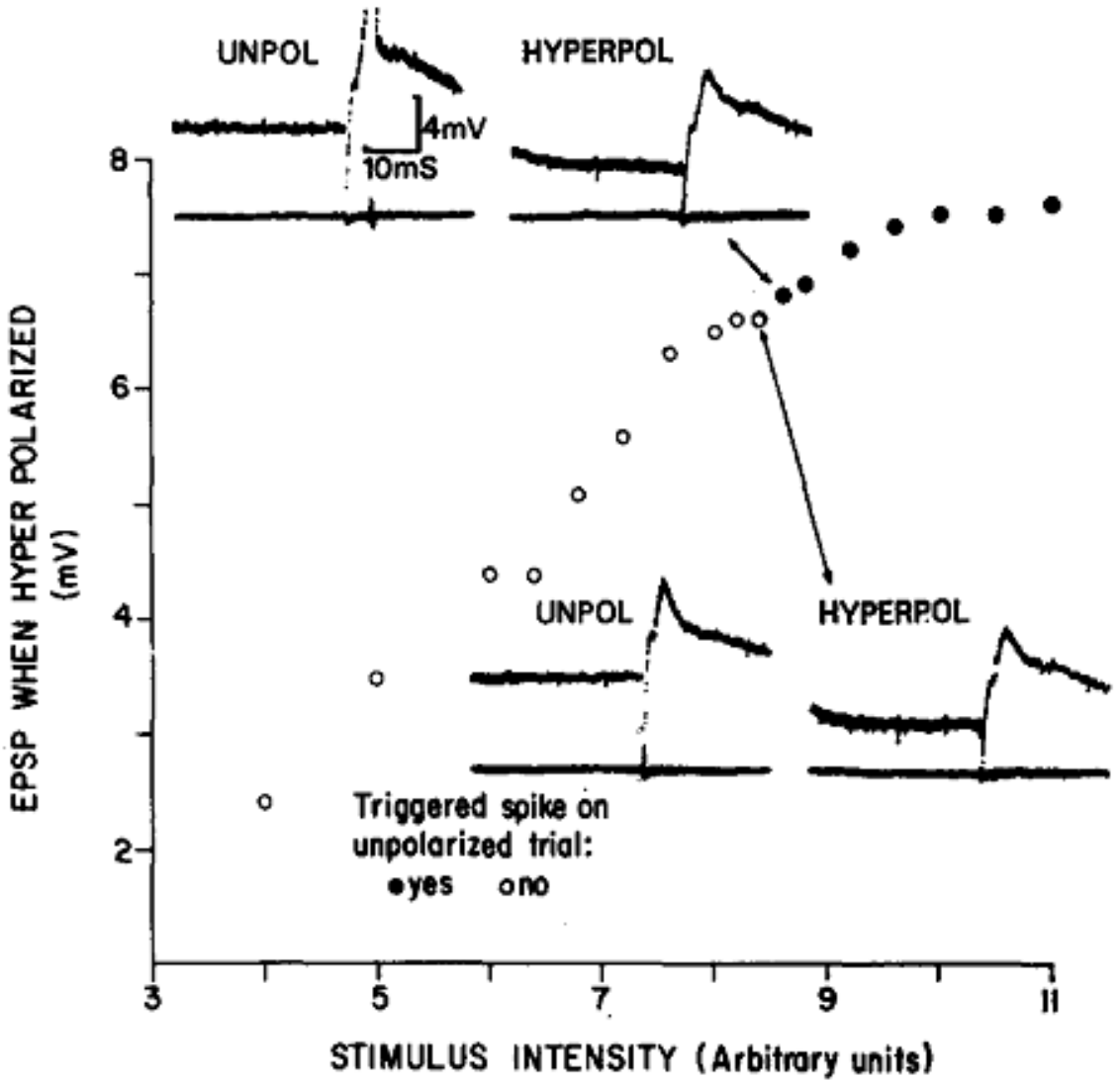
Three roots connect ganglia with periphery



Wine & Krasne (*J Exp Biol*, 1984)



Olson & Krasne (*Brain Research*, 1981)



Olson & Krasne (*Brain Research*, 1981)

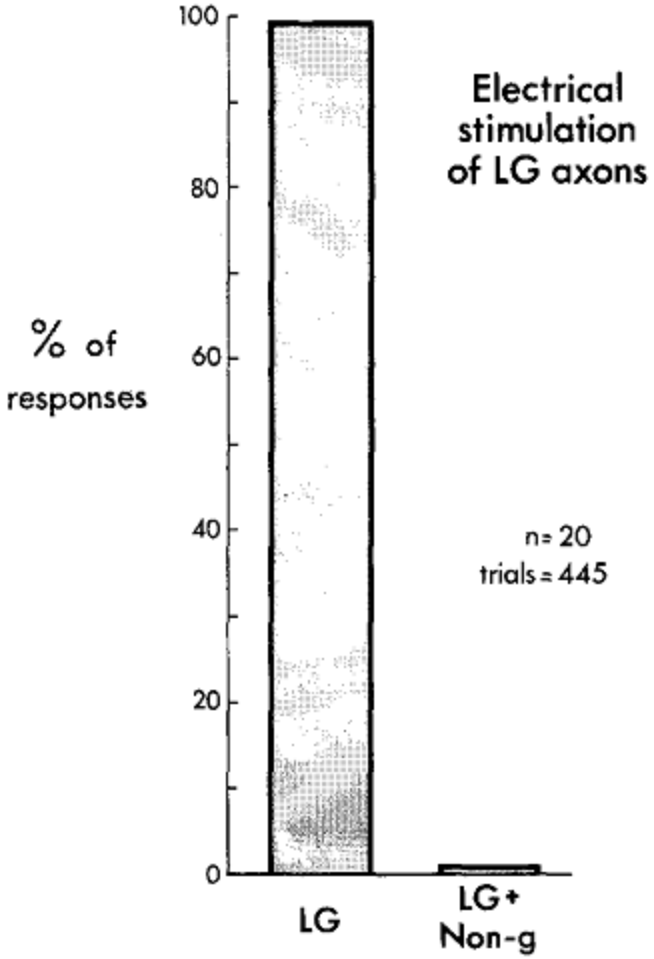
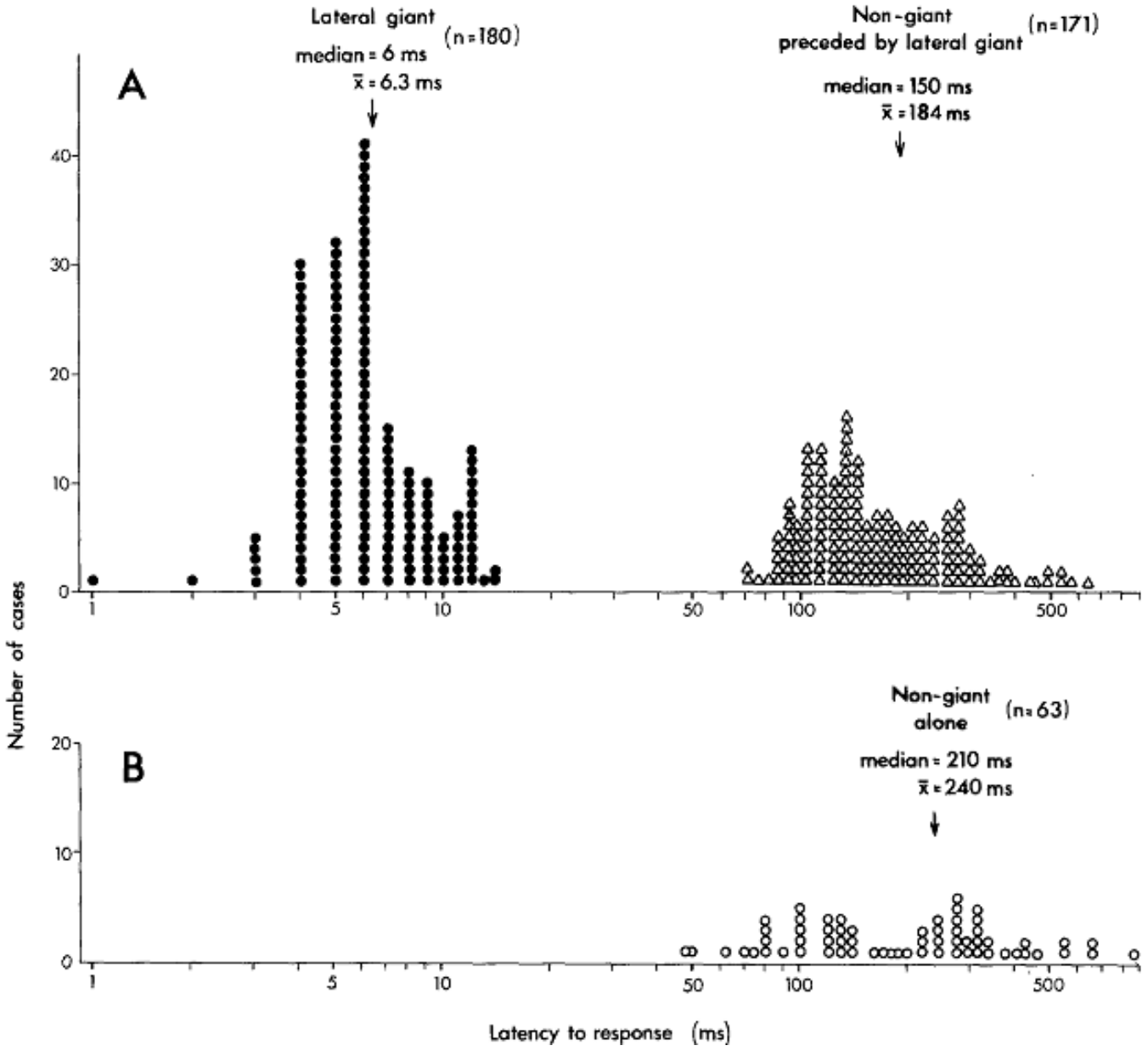
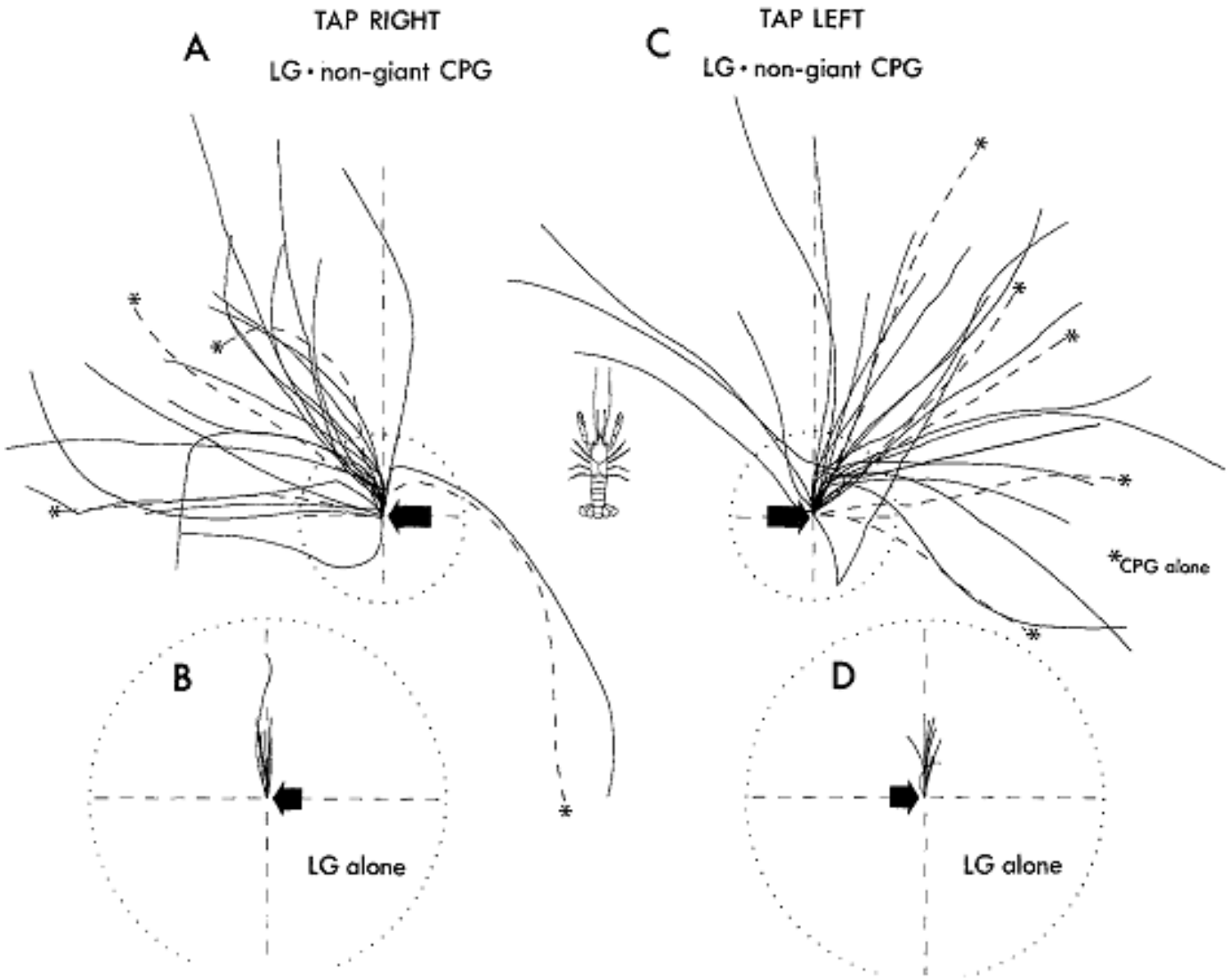


Fig. 4. Central stimulation of the LG axons rarely activated the non-giant system. On more than 99% of all trials, the response to triggering the LG axons via implanted electrodes was a single tailflip. These results were obtained from the same group of animals that provided the data for Fig. 2; taps and electrical stimuli were interspersed

Reichert & Wine (*J Comp Physiol Biol*, 1983)



Reichert & Wine (*J Comp Physiol Biol*, 1983)



Reichert & Wine (*J Comp Physiol Biol*, 1983)

Crayfish fight!

Toshiki Nagayama (http://s-crawfish.kj.yamagata-u.ac.jp/fight.wmv)