

Outline, Neurobiology 635

Action Potential 1: Hodgkin and Huxley, Squid Giant Axon and "Whole Cell" Voltage Clamp

I. Recording Techniques - extracellular vs. intracellular (AC vs DC)

II First Recording of Action Potentials

JZ Young, 1937 - Anatomical Description of Squid Giant Axons

Hodgkin & Huxley, 1939 - record AP using Squid Giant Axon

- fast rise (depolarization)
- spontaneous reversal
 - undershoot from RP
 - return to RP

III Action Potential: Na⁺, K⁺ currents

- Voltage Clamp Technique

- **Hodgkin, Huxley, Katz, 1952**

- self inactivating Na⁺ current, reversible
- delayed K⁺ current
 - not self inactivating
 - non-reversible (rectifying)
 - became known as "Delayed Rectifier"
- Pharmacological confirmation - **Hille, 1970**
 - TTX - blocks Na⁺ channels
 - TEA - blocks K⁺ channels

1984 - Na⁺ channel cloned

1988 - K⁺ channel cloned

Papers: Ionic Currents of Action Potential

- Young JZ (1937) *Proc. Roy. Soc. Lond. B.* **121**, 319. (discription of giant axon of squid *Loligo forbesi*).
- Hodgkin AL & AF Huxley (1939) Action potentials recorded from inside a nerve fibre. *Nature* **144**, 710-711. First recording ever of action potential.
- Hodgkin AL & AF Huxley (1945) Resting and action potentials in single nerve fibres. *J. Physiol.* **104**, 176-195.
- Keynes, R.D. (1951) Ionic movements during nervous activity. *J. Physiol.* **114**, 119-150.
- Hodgkin AL, AF Huxley & B Katz (1952) Measurement of current-voltage relations in the membrane of the giant axon of *Loligo*. *J. Physiol.* **116**, 424-448. discription of voltage clamp experiments.
- Hodgkin AL & AF Huxley (1952) Currents carried by sodium and postassium ions through the membrane of the giant axon of *Loligo*. *J. Physiol.* **116**, 449-472.
- Hodgkin AL & AF Huxley (1952) The components of membrane conductance in the giant axon of *Loligo*. *J. Physiol.* **116**, 473-496.
- Hodgkin AL & AF Huxley (1952) The dual effect of membrane potential on sodium conductance in the giant axon of *Loligo*. *J. Physiol.* **116**, 497-506.
- Hille B (1970) Ionic channels in nerve membranes. *Prog. Biophys. Mol. Biol.* **21**, 1-32.
- Armstrong CM Bezanilla F (1977) Inactivation of the sodium channel II. Gating current experiments *J. Gen. Physiol.* **70**, 567-590. (Multistate Model of Na conductance)