Stretch reflex

- Sir Charles Sherrington
  - stretch reflex prove that the nervous system has to talk to each other work separately and these different messages get integrated
  - popularized the term and meaning of synapse
  - allows for flexibility through integration

The stretch reflex

- the brain is cut at the midbrain so that there is no forebrain
  - the result is that the brainstem and spinal cord are unchecked
  - there is no descending modulation
- the cat has a force transducer on the muscles and once the table starts to move and stretch the tendon, the muscle contracts to correct

Reflex depends on nerve to muscle

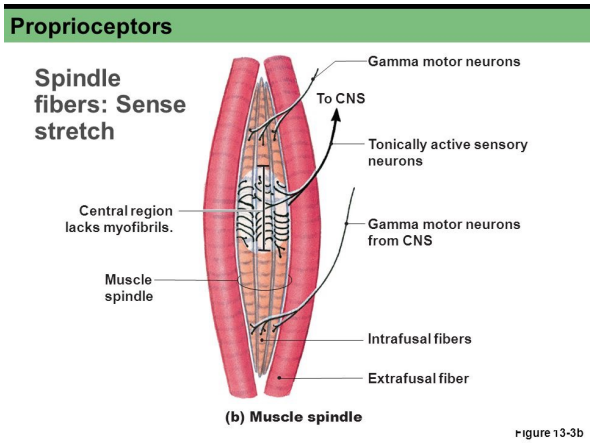
- he cuts the nerve and finds out that the contract of the muscle is actually nervous in character
- active contraction that is nervous system dependent

Reflex integration

- when looking at the antagonist muscle, we see that we are **creating our own stimulus that we respond to**
- coined the term proprioception
- synapses and things

The scratch reflex and its refractory period

- receptive neurone -> proprio-spinal neurones (inter neurons) -> final common path (motor neurons that allow you to scratch)



Muscles

- have **extrafusal fibers** and **intrafusal fibers** within them
- what contracts the muscles are the extrafusal fibers

- they come in bunches that are called **muscle spindles** and within them there are some number of intrafusal fibers
- muscles spindles are types of receptors that **detect changes in the length** of the muscle

Intrafusal fibers

- has polar regions that are contractile
    - but the stretch is dependent of the diameter and the diameter of these fibers are so small it basically has no strength
- has an equatorial region that is not contractile
- circling around the equatorial region is an afferent that sits in the dorsal root that is called the 1a afferent
- 1a afferent: its job is to figure out how stretched the intrafusal fiber; this is where we get our information about muscles
    - Vallbo: experiment doing extracellular recordings from afferents, each blip is the extracellular signal of an action potential
    - responds both **to the stretch and velocity of that stretch**

What happens when we add a **load** to the muscle?

- this means adding a weight in the form of resistance to a muscle
- the resistance stretches the muscle and the muscle spindles within have 1a afferents that are excited by the load and then it comes into the dorsal root and goes directly into the ventral horn to synapse directly onto the motor neuron
- servo mechanism: keep one level that you always return to

Synergists

- muscles that work together to perform an action
- in addition to the reflex pathway that we are discussing, information also goes to motor neurons that innervate synergist muscles

Ia inhibitory interneuron

- inhibits antagonist muscle
- makes this a disynaptic reflex

Gamma motor neurons

- the alpha motor neuron innervates the extrafusal muscles
- the gamma innervates the polar regions of the intrafusal muscles
- there are also gamma motor neurons that go to the homonymous muscle; this partnership is called the **alpha-gamma co-activation**

Gamma loops

- some parts of the motor system prefer this unequal excitation of gamma over alpha and that area is the cerebellum
- what do you see in person that loses their cerebellar function?
    - you get floppy! you need low levels of excitation to give your muscles tone

M response and H reflexes

- M response is bidirectional but the muscle contracts faster bc there is no latency period
- as the M response grows, the latent H reflex shrinks

Advantages of the stretch reflex?

- we have both physiological flexors and physiological extensor muscles (with respect to gravity)
- anything that opposes gravity is a physiological extensor
- the amount of the stretch is the in and the contraction is the out
    - out/in = gain

Ian Waterman- the man who lost his body