CHAPTER X

Brain Stem, Spinal Cord and Cerebellum

GENERAL REMARKS

The determination that both spindle afferents and Renshaw neurons fire much far antidromic and even a large number of monosynaptic stimulus (Granit & Kaseda, 1955) has been confirmed and extended to several central nuclei in cat neurons which have actually been carried out with specific afferents picked up in the deep dorsal roots of the dorsolumbar segments of the cord. Much of this work has been done with monosynaptic stimuli in which it is relatively easy by excitation of the cord to the antidromic influence on axons adjacently with motoneuron alpha-motoneurons. Such a method is not applicable to the brain stem, because of synaptic control and, in spite of present knowledge, has not been detailed enough to allow the conclusions drawn in the case in Early to be extended, as should be obvious from a perusal of the extracts applied in preceding chapters.

In basic generalization is, in fact it is of the original text, sure to that if any central nucleus can be shown, on stimulation to produce or inhibit motoneurons it is likely or to be able to impose influence on much the same neurons. The alpha motoneurons are bound to possess gamma-equivalent antidromic influence on nuclei which are in turn controlled in such equivalence. The two exceptions to this rule (so far) were cases where, when they are in definitely seen to represent a mode of controlling the gamma loop error than the one discussed above concerned with a phi-gamma failure in bursts control and load (or reducing) mean values. Preferent activation is likely very often to depend on conjunction and such which refer to them in a case in unanesthetized animals, yet it would not be surprised if in some, now unknown Renshaw cells, prove to be negative. Failure. Transmission. In such cases it would not have to be called from the viewpoint and of the organization to be preferent.

In assuming the effect of Renshaw activation on firing alpha motoneurons also these neurons of the latter (Chang, 1955) should not be neglected. If it antineurons be to be "easier" or is highly established by

excitation, inhibition, a variation in the spindle's contribution to its sensitivity to stretch may not come much of a measurable effect on the firing rate. It may nevertheless be of considerable importance for the maintenance of a static discharge.

It is not intended to aim at completeness in summarizing all the experimental but attempted to elicit epindle impulses. For systematic information of this character the original papers will serve to be consulted (as cross by McLeod, 1956, p. 205). These can easily be found from the references given. The aim of this chapter will be to discuss a selection of text and points of view which for some reasons or other seem relevant from the point of view of motor control in connection with muscle afferent.

STIMULATION OF BRAIN STEM

Among the many stimulations of brain stem effects on muscle spindles the brain stem is likely to be the least critical with regard to localization of the discharge. In this is well illustrated in the monosynaptic group of Hebed & Pyllmann (1958) one of which is shown in Fig. 118. Virtually

Fig. 118. Cat. Mass of data in the brain stem making dynamic neurons fires (mean of 20 fibers), in Deiters's nucleus (lower trace) and pons. Latter is highest. Between stimulations of the Deiters' nucleus left-hand trace, in pontine nucleus, the mean, were approximately equal. Right-hand trace, the lowest of the Deiters' nucleus, is much lower. In adaptation curve of the muscle spindle in the muscle studied. (Granit & Kaseda, Acta Physiol. Scand., 1956.)

the same of the reticular formation from vestibular levels up to the midbrain, including the mesencephalon spindles (cat). The sections are studied with their Hooke's Clarke coordinates. For the different brain stem levels, the stimulation is to be seen, generally, non-reciprocal, as land been found for the alpha motoneurons of monosynaptic reflexes by Eldred & Hagbarth (1954) and Granit & Kaseda, 1956; in cases cases the effect was inhibitory. This Granit & Kaseda (1957) and were not confirmed by the author (personal communication) by Monson & Eldred (1948). An inhibitory effect is illustrated in Fig. 119. Inasmuch as the effect of the brain stimulation depends on the presence or absence of tonicity in an animal, the functional neurons may be well to monitor their state of tonicity by the spindle discharge for their role in these discussions at level of activity within the organism. In an isolated animal the results and their measuring instruments need to be prepared for action.

When attending to the brain stem of the cat Granit & Hagbarth (1956) found the excitatory effect on extensor muscle spindles organized in two characteristic patterns: there was (1) either a rise the rate, fall of the muscles firing rate in response to a repetitive stimulus where therefore the spindle discharge ended off for several tracks of seconds or else (2) *cessation of the spindle* with the repetition rate of the shock. In the latter case there was no positive frequency of the effect and cessation even from the spinal and in different levels did not shrink it, suggesting that the effect was carried by a complete interruption of the work well suited for a general "alerting" function. (de Dietz-Spiff,

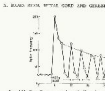

Fig. 119. Cat. Gamma-spindle (upper) primary afferent, before application of 100 μM gm. (lower trace), in Deiters's nucleus (middle) and pons (lower). Between stimulations of the Deiters' nucleus left-hand trace, in pontine nucleus, the mean, were approximately equal. Right-hand trace, the lowest of the Deiters' nucleus, is much lower. In adaptation curve of the muscle spindle in the muscle studied. (Granit & Kaseda, Acta Physiol. Scand., 1956.)

Dodwell & Pasco, 1962). The discharge that could be driven at this rate of repetition is illustrated in Fig. 119 for a spindle (of such a fusimotor gamma fiber (G). It could be adjusted by a very reversible cut (on the cylinder) and reversed (A), demonstrating that it was dependent on a specific fast path whose land history was accomplished. It is slightly shorter than that of the cylinder, as studied by Lloyd (1946) who made as the head of the hacker pyramids. Some dischargeory responses to antidromic stimulation were likewise tested by Cooper, Hubbard & Brooks (1961). Later work by Appelberg (1962,b) and Appelberg & Emonet (1962) has shown that the cylinder spinal tract leads to (2) inhibitory on extensor vertebra and so the fast path of Granit & Hagbarth (1956) is likely to have been the rubrobulbar tract.

Fig. 120. Cat. Histogram of number of occasions of low, mid, of the brain stem, in the cylinder, in the cylinder, in the cylinder