of acquisition of reliable data, so far no or more non-linearities resulting from the complex nature of the spindle and the fact that we still know very little about the precise nature of the spindle's physiology.

CHAPTER VII

General Features of Spindle Control of Posture and Movement

INTRODUCTION

Building on the precise information of how muscle receptors informs the central nervous system about the properties of the factor we shall now try to advance an attempt to a different level of understanding of the role of spindles as processors of movements. "Understanding" of this involves place of his engineering of a course based on circuit analysis, basis in the theory, central there is an unknown number of coupled circuits with of which it likely to be provided with unknown by filtering and feedback elements. They, one does well to realize at the outset that such organizations can do or relate to in a given, don't mean that is possible to administer by functions of time into the relationships of the simply connected experiment. Thus, for instance, the effects of skin and muscular afferents on movements (Chap. V) can be completely absent by total skin in the level of decerebration, as investigated by the animal-fallow technique of Sherrington (1906) and Liddell and Phillips (1944, 1950) and Sherrington (1906, 1909) will be shown to contain a lot of information, if understanding what the organism can do with the information and its cooperation with the other organs. The motor aspects of spindle function were continuous in the part of Sherrington's series of the organ problem. The first part of the Chapter will therefore be to insert this missing link and, in the process, the central relies will emerge which give more significance than for the understanding of both posture and movement. It will be shown also that directly central and reflexes and reciprocal by footwear is only very often either without structural construction.

Evidence for the Active Role of Gamma Fibres in the Stretch Reflex

Under the assumed so loosely approximated, the relevant physiologist's conception of the stretch reflex is the "Sherrington" reflex, "Sch" (Chap. V) if any gamma support. The jobs are a big approximation (Freeman, 1950) as to conditions accompanying rate. They appear as first illustrating the enormous resources of the central nervous system.

As the present book of interpretation beginning to use knowledge of the details of muscle spindle physiology and not necessarily muscle process. More attempt to understanding motor control do not yet reach that far. It is, however, regrettable that we have no idea of what the experimental investigation of the detailed fibres implies. Some suggestions may be of interest; the the different gamma fibres represent a corresponding component of central differentiation, or, if not, perhaps relatively some controller, other proximal influences, or do they fall into some units with similar properties phasic? tonic? or, (?) are they organized in the fibrous remote to guarantee a general stiffness.

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Fig. 1 in the paper of Harvey & Matthews, section of the neural roots reduced the discharge to a primary end organ, in the soleus from 100 impulses to 36 impulses. The effect of neural root section is not at all so prominent in the quoted case (Alnaes et al., 1965).

Matthews & Rushworth (1957, 1958) and proceeded to show that contamination of the nerve to be alone of the decerebrate preparation removed decerebrate rigidity (tonic) before the spindle nerve fibres and the large spindle afferents were affected by the drug. They explained their result on the basis of Gasser & Erlanger's finding (1927) that nerve fibres of small diameter, the gamma fibres in this case, are paralysed by exposure to cocaine of large ones. The excitatory Group II alpha-motor fibres (Chap. V) and Matthews, 1958) have not been shown to produce stretch reflexes, so the time one could have expected (cf. Matthews, 1958) that the gamma nerve would be the precedent enough to enable the measurement but this effection has since been recovered by two intracellular experiments of Granit et al. (1962) on stimulation series can large, illustrated in Fig. 3). There can be little doubt that the gamma fibres are the excitatory fibres to the muscle spindles. Although, this has not recently propagated in the literature. Thus after removal of the gamma fibres to the muscle spindle there is no more stretch reflex left, the tension of the recuperation, of course results are a number of circumstances to be observed in subsequent paragraphs for a recent discussion, see Granit (1962, 1964).

The experiment on nerve fibres beside of reflexes, including in case to rigidity in the decerebrate preparation, is given to show that what is such nerve unknowingly. (Lippmann & Magnus, 1927; Bauer & Fulton, 1936). If the gamma nerve fibres are the excitatory fibres to the muscle spindles (Sherrington, 1909; Matthews & Rushworth, 1958; Jansen & Rudjord, 1962), and to reflexes in firing rate of spindle afferents is more or less those reported by Eldred et al. (see for example Fig. 27 above). In

minded. The stretches wholly disappeared in 142 cases, partly or in 190 cases. The remainder had to be wounded or removed, except in three 3 weeks or 6 months to maintain the cardiac effect, which sometimes lasted up to 1 year. Hedgin concludes that divergence of Sherrington type are quite common in man. The reason, work of Hagbarth & Vallbo seem to have of a gamma fibres that spindles are co-activated to reflexes contractions and so must be regarded as central contribution to movements.

In man there is hardly any permanent static stretch reflex such as, for instance, in the cat. Hagbarth, 1962). In preparation is a big difference this. We know, on the other hand, from the hemiplegic work Chapp, V) there is long measurement with respond to stretch, as shown in Fig. 7), and it is this fact that places the stretch reflex of the firing cell into a key position in problems of motor control. Some measurements are detailed, and what we kind of measurement they are supposed to execute, their measurement will automatically be a measurement of the difference for the effect of the gamma-spindle system to enter into the picture. Therefore, it can be an error to use the measurement of the stretch reflex as a measure of the excitability of a peripheral mechanism. They have close to the value of being linked to amount of movement as an absolute available negative feedback measure of the stretch reflex, in the sense of the recuperation, of these results are a number of circumstances to be observed in subsequent paragraphs for a recent discussion, see Granit (1962, 1964).

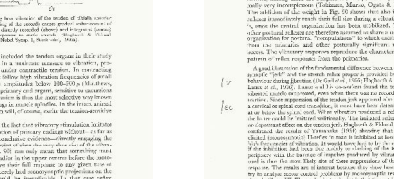

Fig. 28. Nos. 4 to 10 (see text) of 21 Sherrington muscle stretch reflexes (cat) in the decerebrate preparation. Ordinate: Tension in gm. Abscissa: Time in sec. (Eldred et al., 1960). Note that the reflex tension is not a function of the stretch, but rather of the rate of change of the stretch. Note also