J. Neurol. Neurosurg. Psychiat., 1960, **23**, 262.

THE BABINSKI SIGN

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It seems that when studying the problems of the Babinski sign, we do not draw sufficient attention to its technical aspects. The appearance of the sign is conditioned by the action of an external stimulus applied by means of an instrument. The efficiency of a stimulus depends therefore on some variable factors, so that the result of a stimulation is not always easy to appreciate. An important demonstration of modern methods of objective appreciation is furnished by the electromyographic studies of Kugelberg (1948).

Babinski (1898) and Goldflam (1904) both described the slow nature of the toe sign, but the explanation of this slowness as an after-discharge in the receptors or in the reflex centre is not satisfactory. Kugelberg adds here a new argument that the centripetal impulses are conveyed by two groups of fibres, the conduction velocity of which is not equal; the impulses conveyed in the C fibres reach the spinal cord one to two seconds later than those in the A fibres; the course of the Babinski sign is therefore diphasic.

This slowness of the reaction is now generally considered as a characteristic feature of the toe sign, but I do not agree with this opinion. The time sequence of the Babinski sign varies according to both the type of stimulus and the state of reflex excitability. The rapid form of the reaction, which appears for instance as a short jerk of the big toe, at the end of a stimulation, is not uncommon, and cannot be considered the exception. Between the slow tonic form and the rapid response may be observed various intermediate patterns, so that the great variability of the sign must depend on the summation of the stimuli applied (Szapiro, 1958).

The diphasic course of the reflex is dependent, as Kugelberg demonstrated, by an interval of one to two seconds between the two volleys of impulses reaching the spinal cord. Experience teaches us, however, that the duration of the motor effect is often shorter than the total duration of the two phases, including the interval between them. When this short type of reaction occurs, it seems probable that the impulses reaching the spinal cord in the second phase do not lead to a visible result: as a result of insufficient excitation of the spinal centre an adequate summation cannot be reached.

In August, 1957, I began to elicit the plantar reflex by the following special method.

Before performing the necessary stimulation I place the toes (II to V) of the foot examined in a position of plantar flexion and maintain them in this position forcibly during the provocation of the reflex (Fig. 1). My reasons for this are the following: (1) In this position movement of the big toe is more easily observed. (2) It seems to me that this posture would increase the excitability of the big toe extensors.

A passive flexion of the toes directly increases the excitability of their extensors in conformity with the rule of Uexküll. As the extensors of the toes II to V and those of the big toe have a common innervation (the deep branch of the peroneal nerve), the increase of the reaction should overlap the two groups of extensors to include the big toe extensors.

In the normal conditions of examination, the

FIG. 1.—Method used for eliciting the plantar response. Passive stretching of the II-V toe extensors increases the excitability of the extensor movement of the hallux.

normal plantar reflex consists in plantar flexion of all the five toes, therefore, also of the toes II to V. The state of passive flexion of the toes II to V, maintained during the stimulation of the sole, decreases the excitability of their flexors and increases that of their extensors. According to the rule of Uexküll, the stretched muscles contract first, in this case the extensors of the toes. The extension of the toes II to V, however, is not possible, as they are immobilized by the examiner's left hand, so that the efficiency of a centrifugal volley exciting the extensors of the toes can operate only on the big toe.

Gonda (1945) and others obtained the extension of the big toe following a passive flexion of the toes II to V, *i.e.*, after the proprioceptive stimulus. According to Gonda, his sign is positive in the case of a grave pyramidal lesion. One cannot exclude, however, that even in the mild cases a certain effect is obtainable, namely a subliminal excitation, inefficient *per se* but exerting some facilitating influence. During my investigations I did not realize the resemblance of my method to that of Gonda. The special aim of the technique I propose is to effect the combination of two long-lasting stimuli, one exteroceptive and one proprioceptive.

The exteroceptive stimulus I applied was commonly one of medium intensity, but an increase of the stimulus intensity can lead to: (*a*) an earlier appearance of the reflex, (*b*) an increase of the intensity of the motor effect, (*c*) the appearance of the Babinski sign which was not elicited by a weaker stimulus. A strong stimulus, however, may provoke some defence reaction which can interfere with the proper plantar reflex. The practical value of my method depends on obtaining a fuller reflex without increasing the intensity of the applied stimulus, namely, via an increase of excitability of the extensors of the big toe.

The intensifying of a motor effect, obtained as a result of this method, varies according to type of case. In order to explain this fact, a reference to Wilder's law of initial values may be useful. Joseph Wilder (1957) stated the existence of "a definite relation between the level of the function at the start of the experiment and the outcome of the reaction". The higher the initial level, the weaker the answer to the factors strengthening the function; the more intensive, on the contrary, is the answer to the factors suppressing this function. According to Wilder, a particularly high initial value can bring a paradoxical reaction and that is why a strong initial plantar flexion of the toes II to V may condition their tendency to an extension in the plantar reflex (see the rule of Uexküll). With regard to the Babinski sign, this means that the factors strengthening the motor effect, *i.e.*, the proprioceptive facilitation, are the more efficient, the lower the level of initial value, *i.e.*, the weaker the effect of a simple exteroceptive stimulation of the sole.

The increase in the excitability of the effector muscle is, however, artificial and one may ask whether it can provoke the appearance of the abnormal toe sign when there is a normal pyramidal tract. In answer to this question, I have never obtained the Babinski sign in cases in which it ought not to be expected, for instance in the muscular dystrophies and the polyneuritides. The proposed method seems to be effective only when spinal reflex excitability is pathologically altered.

Summary

The nature of Babinski's sign is discussed and a revision is advised of the classical view postulating a characteristic slowness of the big toe's reflex extension.

A new method is proposed for eliciting the plantar reflex which depends on a combination of an adequate exteroceptive stimulus along with a proprioceptive stimulus which increases the effector's excitability.

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