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One Unconsidered Form of the Part Played by the Nervous System in the Development of Disease

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It is readily observed that, in walking, flexure of one of the anterior limbs of an animal is accompanied by a simultaneous flexure of the crossed posterior limb; at the same time both remaining limbs are extended and serve as a support to the body. In man, similar relations between upper and lower limbs are maintained in the form of additional movements of hands in walking.

It is known that these movements are made automatically, *i.e.* unconsciously. This is easily shown by removal of an animal's brain using the method of the prominent English physiologist, Sherrington, *i.e.* at the level between the anterior and posterior corpora quadrigemina. Such an animal cannot move independently. Its legs are extended like sticks and are in a state of a sharply marked extensor stress. The flexor response of one of the anterior limbs, produced by electrical or mechanical stimulation, is followed by a simultaneous relaxation in the crossed posterior limb like that observed in normal walking. In the remaining limbs the stress is increased. Marie et Foix showed that these regularities, stated by Sherrington, may also be revealed in men in cases of affection of the nervous system.

We studied the reaction of the limbs to the inflammatory process in animals (cats) decerebrated according to Sherrington's method. The process was evoked by subcutaneous injection of turpentine into the foot. It was found that under the action of the inflammatory process the extensor stress of the limb of the decerebrated animal disappears, and it becomes flaccid. If the inflammatory process spreads not only upon the foot but also upon the leg and thigh, the limb remains flaccid. If the inflammation is localized, instead of an extensor stress there is soon developed a stress in the flexor muscles—the leg is in the flexor posture.

It is curious that inflammation of the limb, as well as its electrical and mechanical stimulation, is followed by a change of the stress in the remaining unaffected limbs. Still more important is the fact that if the inflammatory process evoked in the animal before decerebration was already healed and the animal moved normally, decerebration made soon after healing produced changes of stress in the limbs similar to those observed in cases where the process of inflammation was at its height. The obtained evidence enables us to draw a series of conclusions which are so much the more important because inflammation is one of the most frequent reactions of the tissues of the organism to various injuries, and it is by inflammation that the overwhelming majority of affections is manifested.

(1) Inflammation different from mechanical or electrical stimulation causes *prolonged and persistent* excitation in the nervous system. Instead of the transient changes of stress in the legs of decerebrated animals which is caused by electrical or mechanical stimulation, a persistent change of the tonus is observed. Traces of this excitation may be detected in the nervous system also, some time after healing of the process at the periphery.

This prolonged stimulation produced by the inflammatory focus explains the fact that *the affected limb may maintain an unusual posture for a long time.* While interpreting this reaction in a wide sense as a psychologically comprehensible tendency to take care of the injured organ, we do not pay attention to the fact that in a healthy state it is impossible to maintain the organ in a forced position for a long time—the sense of fatigue comes very soon.

The automatic character of this reaction is also evidenced by the fact that it occurs in decerebrated animals as well.

(2) Stimulation produced by the inflammatory process as well as electrical or mechanical stimulations causes reaction not only in the injured limb but also in other concomitant limbs.

In the normal, uninjured nervous system this additional part of reaction remains latent, being compensated by the nervous system. This has not been taken into consideration by the modern pathology. Meanwhile, the "restricted," "local" character of pathological reactions is the result of the enormous work of the organism in concealing additional nonmanifested components of the reaction. Without such a compensation, *inflammation in the hand should unavoidably result in limping.*

(3) The organism is forced to compensate, to conceal also *the traces* of excitation left by the inflammatory process in the nervous system. As shown above, decerebration of the animal performed soon after healing of the pathological process disturbs this compensation, and, in spite of the healing of the injury, the leg takes the posture which earlier had been due to inflammation. Thus, the recovery of the animal, the restoring of normal function of the injured limb, is determined not only by *healing of the tissue injury,* as is assumed now in general pathology, but also by *compensation of traces of the pathological excitation in the nervous system.*

Thus, the above data reveal a new form of participation of the nervous system in the pathological process as well as in the process of recovery. A number of particular conclusions drawn from these experiments concerning alterations of the predilection type of the posture of limbs in central paralysis and the mechanism of reflex and fixation contractions are reported in another paper.

References

1. CREED, R. S., DENNY-BROWN, D., ECCLES, J. C., LIDDEL, E. G. T., and SHERRINGTON, C. S. *Reflex activity of the spinal cord.* London: Oxford Univ. Press, 1932.
2. FRANKSTEIN, S. I. *Bull. exp. Med. Biol.*, 1943, No. 10–11, 12; 1944, Nos. 9, 10, 11; 1945, No. 1–2; *Chirurgia*, 1944, No. 8.
3. SPERANSKY, A. D. *A basis for the theory of medicine*, 1935.