

II. "Muscular Movements in Man, and their Evolution in the Infant: a Study of Movement in Man, and its Evolution, together with Inferences as to the Properties of Nerve-centres and their Modes of Action in expressing Thought." By FRANCIS WARNER, M.D., F.R.C.P., Physician to the London Hospital and Lecturer on Botany in the London Hospital Medical College. Communicated by Professor J. HUTCHINSON, F.R.S. Received June 12, 1888.

(Abstract.)

Movements as signs of brain action have long been studied by the physiologist; but before proceeding to give an account of the visible evolution of voluntary movement in man, it is necessary to define the different classes of movements seen, indicating the criteria by which the observer may be guided in the examples before him. Movements may be classed according to the parts moving, the time, and the quantity of each movement. These are the only intrinsic attributes of such acts. If the nerve-centres which send stimuli to the muscles are acting *in equilibrio*, the static outcome is seen in the postures resulting in the body; hence postures are signs of the ratios of action in the nerve-centres, and indicate their present state or mode of action. Typical postures and movements are described. A variation in the ratios of action in the centres leads to visible movement. Certain postures and movements are found by experience to correspond to certain recognised brain states. Movements may occur in combinations and in series; special combinations and series of movements determine the outcome of the action of which they are component parts. It is shown that the time of action in the various centres thus determines the outcome of the action, and is itself controlled by impressions received through the senses. When movements are seen, not controlled by present circumstances, they are probably the result of antecedent or inherited impressions; such are called spontaneous.

Section II. Evolution of Movements in Man.

The new-born infant presents constant movement in all its parts while it is awake, and this is not controlled by impressions from without. Graphic tracings of such movements are given. This spontaneous movement in the infant appears to be of great physiological importance, and is here termed "microkinesis." It is argued that the mode of brain action which produces microkinesis is analogous to the action producing spontaneous movements in all young animals, and to the modes of cell-growth which produce circumnutation in

young seedling plants. It is argued that as circumnutation becomes modified by external forces to the modes of movement termed heliotropism, geotropism, &c., so microkinesis in the infant is replaced by the more complicated modes of brain action as evolution proceeds.

The conditions of movement are then described, as seen at successive stages of development of the child, and it is shown that they become less spontaneous, and more under control of stimuli acting upon the child from without, while the phenomena termed memory and imitation are evolved.

Section III. Properties of Nerve-centres and their Modes of Action.

From observations made, descriptions are given of the modes of action and properties of nerve-centres in adult age, such descriptions being given in terms implying visible movements. Impressionability, imitation, and retentiveness are thus described. Nerve-centres are said to be "free" when only slightly stimulated. Delayed expression of impressions are seen when the visible outcome is delayed after the stimulus which produced it. Double-action is said to occur when a local effect and a distant one, occur from one impression. Compound cerebral action is said to occur, when the study of the visible movements indicates that successive unions of centres are in action, leading to a visible outcome well adapted to the primary stimulus which produced the series. When a slight stimulus leads to a spreading area of movements producing considerable force, the phenomenon is termed reinforcement.

From observations made, two hypotheses are put forward. It is suggested that when a well co-ordinated movement follows a slight stimulus, the impression produces temporary unions among the centres, preparing them for the special combinations and series of actions which are seen to follow. Such unions among nerve-centres appear to be formed when a period of cerebral inhibition, produced by a word of command, is seen to be followed by a co-ordinated series of acts. A graphic tracing indicating suspension of microkinesis to the stimulus of sight and sound is given. It is further suggested that the brain action corresponding to thought, is the formation of functional unions among cells, whose outcome is seen in the movements which express the thought, or its physical representation. Properties similar to those described in brain centres may be illustrated in modes of growth. Intelligence is then not a property of the brain, *per se*, but for its manifestation certain modes of brain action are necessary. In the special postures and movements described, a number of physical signs of brain states are offered to the clinical observer.