

to its destination in the muscles, but passes first to the ganglion, and is thence *reflected* from the sensory surface to the muscles.* This, which at first sight appears a round-about or cumbrous sort of process, is really the most economic that is available. For we must remember the enormous number and complexity of the stimuli to which all the higher animals are perpetually exposed, and the consequent necessity that arises for there being some system of co-ordination whereby these innumerable stimuli shall be suitably responded to. And such a system of co-ordination is rendered possible, and actually realized, through this principle of reflex action. For the animal body is so arranged that the innumerable nerve-centres, or ganglia, are all more or less in communication one with another, and so receive messages from all parts of the body, to which they respond by sending appropriate messages down the nerve-trunks supplying the particular groups of muscles which under the given circumstances it is desirable to throw into contraction. In other words, when a stimulus falls upon the external surface of an animal, it is not diffused in a general way throughout the whole body of the animal, so causing general and aimless contractions of all the muscles; but it passes at once to a nerve-centre, and is there centralized; the stimulus is dealt with in a manner which leads to an appropriate response of the organism to that stimulus. For the nerve-centres which receive the stimulus only reflect it to those particular muscle-groups which it is desirable for the organism, under the circumstances, to throw into action. Thus, to take an example, when a small foreign body, such as a crumb of bread, lodges in the windpipe, the stimulus which it there causes is immediately conveyed to a nerve-centre in the spinal cord, and this nerve-centre then originates, by reflex action, a highly complicated series of muscular movements which we call coughing, and which clearly have for their very special object the expulsion of the foreign body from a position of danger to the organism. Now it is obvious that so complicated a series of muscular movements could not be performed in the absence of a centralizing mechanism; and this is only one instance among hundreds of others that might be adduced of

* The term, however, is not a happy one, because the process is something more than the reflection of the original stimulus or molecular disturbance; the ganglion adds a new disturbance.