of the muscle.[13] Maggiora[1] (1890) appeared to have been the first to recognize this important factor in an estimation of maximum work, and found that, using Mosso's finger dynamometer, the work accomplished was thirty-two times as great when contractions were made at the ten-second rate, than when they were made every four seconds.

In any experiments with the ergograph there comes a time when the muscle fails to respond to cerebral stimuli. During the course of the work performed there is, naturally, before this point is reached, a time when the muscle is fatigued, and this state is spoken of as "relative fatigue," but when it can raise the weight no longer, nor shorten against the resistance, the condition is then designated as "absolute fatigue." If, however, the load or resistance is lessened, then the muscle is still capable of performing an additional amount of work. Finally, there comes a point when no further contraction is possible in response to voluntary stimuli, and this condition is called "exhaustion."

It has already been stated that the excess accumulation of the acid fatigue substances is the immediate cause of the limitation of the amount of work that can be done. At what part of the mechanism is this interference shown? Where do these products of metabolism prevent the muscles from responding to cerebral stimuli? Are they located in the cerebral tissue, the nerve, the synapse, at the motor end plate, or in the muscle? It is known that the combustion within the muscle is the cause of those products which bring about the limitation of work, but it is also known that the muscle still has the power of contraction in response to electrical stimuli even after voluntary stimuli fail to elicit a response.[13] Stiles,[14] however, points out that this is not conclusive evidence that fatigue must have developed at the motor end plates. "If the nerve cannot convey to the muscle stimuli of such a strength as those which we are able to apply directly, we need not refer to the functional elements at all. It is enough to say that the threshold has been raised to a level at which the standard nerve-impulses fail of effect." Hill and Lupton have shown that severe exercise may, however, lead to a state in which the lactic acid content is not far from its maximum. Mosso contended from this fact that the central nervous system was more easily fatigued than the nerve endings in muscle. Many experiments, however, since that time have served to invalidate the conclusions as to the fatigue of the central nervous system postulated by Mosso, Lombard, and Waller.[13] Bainbridge[15] holds that there are two types of fatigue, one originating entirely within the central nervous system, the other arising partly in the nervous system and partly within the active muscles, and states that "there is no clear evidence that the products of muscular activity take any part in bringing about fatigue of the central nervous system." There seems to be no doubt that the nerve fiber itself is practically indefatigable, the oxygen content probably being sufficient to oxidize fatigue substances.[1 and 13]

If, then, the immediate cause of the limitation of work is not in the cerebral tissue, nor the nerve fiber, what evidence is there in support of its localization at the synapse, the motor end plate or the myo-neural junction? Sherrington's[1] outstanding researches supported in part by Hurst, show that the first incidence of fatigue is at the synapse where the sensory neuron comes into functional contact with the motor neuron. While these experiments seem to be conclusive for the sensory and motor cycle, they present some difficulties in explanation of the phenomenon of limitation of work as the result of voluntary cerebral stimuli.

The traditional evidence in support of the localization of fatigue at the motor end plates has been seriously questioned as the result of recent experimentation and study. The "all or none" principle is valid for nerve and according to Stiles[14] "if the stimulus suffices to excite all the fibers, the resulting conduction has all the potency of which the nerve at the moment is capable." As previously stated, Stiles in this way explains the response of the muscle to a direct stimulus, which is greater than the nerve can transmit to cause the contraction of a fatigued muscle. Stanley Cobb and Alexander Forbes[16] in discussing the results of certain ergographic experiments on the flexors of the wrist state: "There is,