

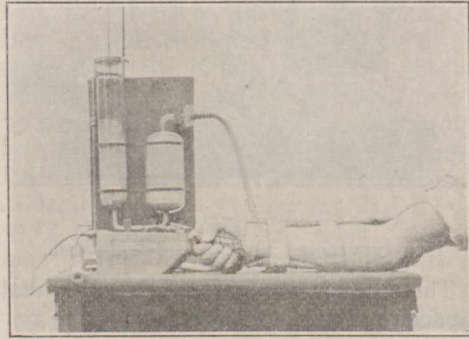
however, both in the well-known fatigability of muscle fibers, and in the localized pain felt in the muscles under the conditions of our experiments, good reason to look on the muscles themselves as the chief seat of fatigue effects. Electromyograms of rapidly fatigued muscles show a decrease in frequency of the action-currents, and an increase in amplitude of the individual action-currents. It may be argued on theoretical grounds that these observations are evidence that fatigue takes place at the neuro-muscular junction, although they might be explained by fatigue acting on the muscle fibers in a selective manner, raising the threshold of excitation more than it reduces the size of action-current."

McKeen, Cattell, and Stiles¹⁷ state that "muscular fatigue, as observed in the laboratory, is not usually due to an exhaustion of the power of contraction, but to a failure of the process of excitation in consequence of some sharply localized change." Bainbridge,¹⁵ in discussing the localization of the resistance in muscle, claims that beyond a certain point "the accumulation of acid prevents the complete restoration of the fibrils to their resting condition after each contraction, and the discharge of energy at each successive contraction diminishes." The point of view that is held, therefore, is that with the onset of fatigue there is introduced a resistance or region of decremental conduction, and thereby the threshold of the muscle fibers has been so raised that the nerve impulse fails to elicit contraction of the muscle. This factor, together with the stated increase in the lactic acid content of fatigued muscles and blood, bears a very intimate relationship to the experiments which will be cited.

Tests Conducted.

Recovery from any condition of fatigue, no matter what degree or type, is brought about by the circulatory and respiratory functions during the resting state. Lee and Aronovitch¹⁸ and ¹⁹ failed to confirm Weichardt's assumption of the existence of a specific toxin for fatigue. The ability of the muscle to perform additional work after "absolute" fatigue depends upon the removal of the free acid substances of fatigue from the mus-

cle by oxidation, restoration to its precursor or removal to other parts of the body by the circulation. The object of the tests conducted was to study the comparative effects of different forms of physical treatment in the recovery of the muscle from its fatigued state. The forms of treatment used were radiant heat, massage, and galvanism.



Amar's Poire Dynamographique.

Grip relaxed, bulb in hand extended by air pressure.

For this study two types of machines were used, (a) a specially constructed ergograph with which the flexors of the elbow joint were tested, and (b) Amar's "Poire Dynamographique" to test the flexors of the fingers. With the former, fifty-seven individuals were tested in two hundred and thirty-two experiments, and with the latter fifteen were tested in one hundred and twenty experiments. Discussion of the results secured will be confined to the studies made with Amar's "Poire Dynamographique" since it was only in this series that all types of physical treatment were applied. The apparatus was one in which flexion of the fingers was opposed by a stout rubber "pear" or bulb, inside which there was a considerable degree of air pressure caused by the support of a column of mercury weighing approximately seventeen pounds. The forearm was fastened in a sleeve and the ordinary myokinetic precautions were taken, in order to obviate the use of accessory groups. Complete maximum isotonic contractions of the flexors of the fingers was possible, the resistance of the bulb necessitating a force between four and five foot pounds to expel the air and raise the mercurial column. A float on top of the mercury