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Duration of Electrogram and of Mechanical Response of Turtle Ventricle.

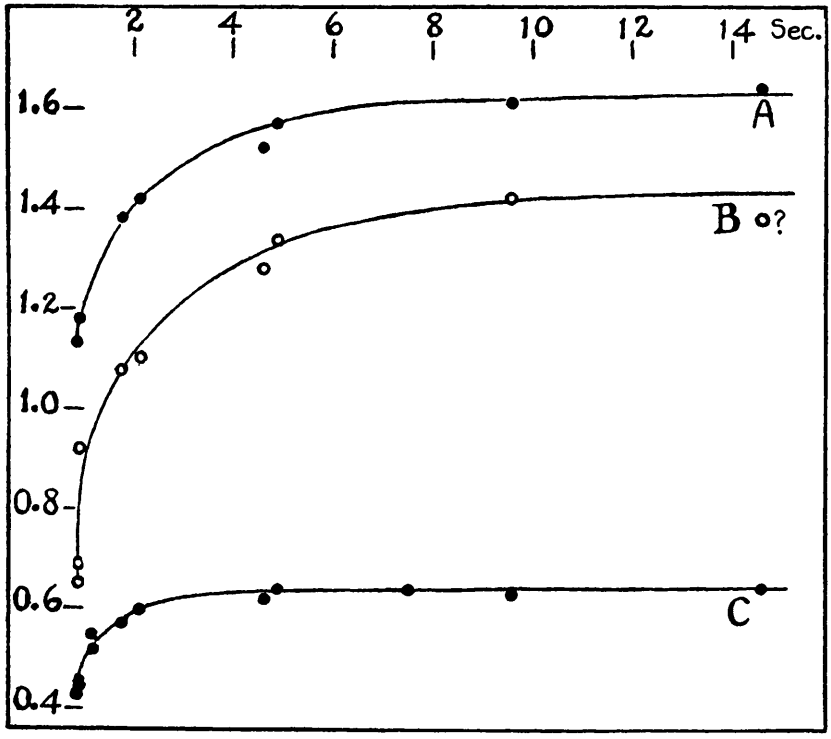
ROBERTA HAFKESBRING AND RICHARD ASHMAN.

From the Department of Physiology, School of Medicine, Tulane University.

The effect of varying rates and volumes upon the duration of the phases of the isometric contractions of the ventricle has frequently been investigated. The influence of these factors upon the duration of the electrogram, and particularly the correlation of mechanical and electrical changes, have not been so fully determined. It is with this correlation, and with certain effects of fatigue, that this abstract deals.

The excised turtle ventricle was perfused with slightly alkaline

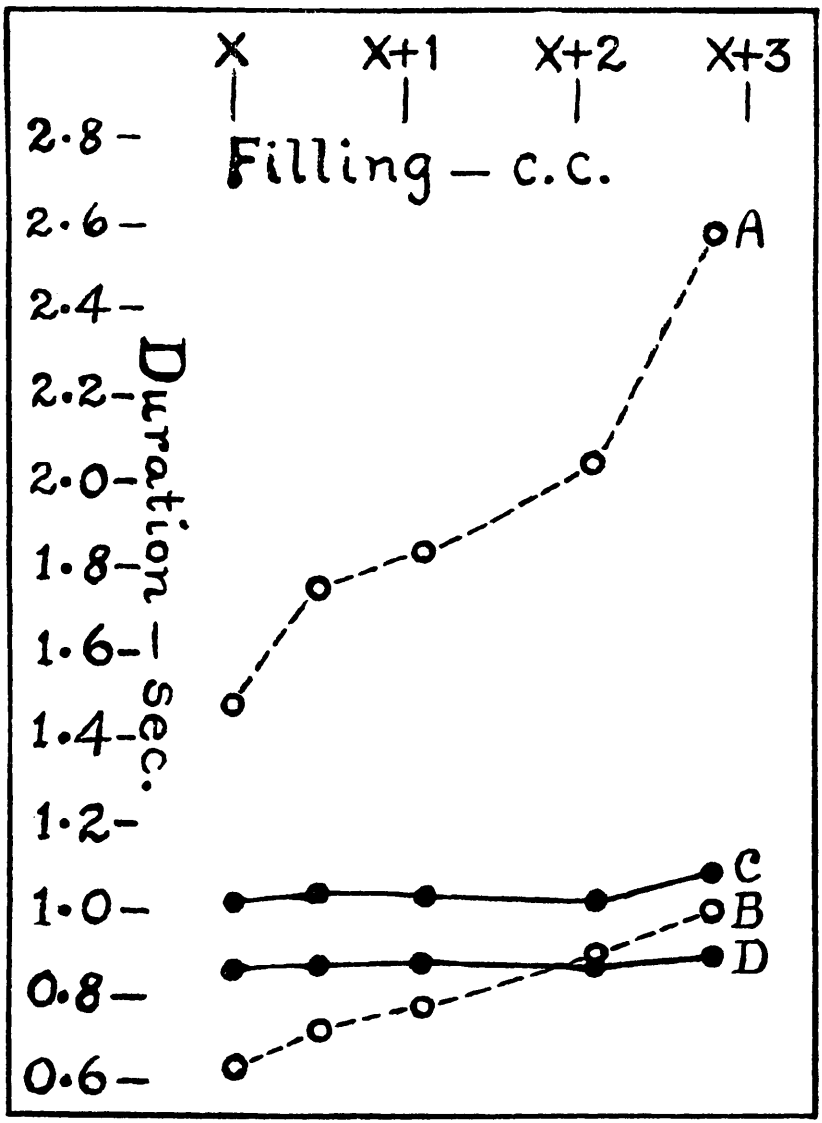
FIG. 1.



Abscissae, cycle lengths; ordinates, duration of the phase. A, total mechanical response; B, electrogram (R to end of T); C, phase of rising tension. Some evidence of fatigue is present.

(pH 7.5—7.8), well-oxygenated and strongly buffered Ringer's solution. During temporary suspension of perfusion, the isometric responses to single induction shocks at varying rates were recorded. Both mechanical and electrical responses were simultaneously photographed on the electro-cardiographic film.

FIG. 2.



X is the residual volume of solution remaining in the heart which has emptied itself; A, total mechanical response; B, phase of rising tension; C, electrogram (R to end of T); D, electrogram (apex of R to apex of T).

As illustrated in figure 1, the total duration of the electrical response (measured from the apex of the R-wave to the end of the T) and the duration of the phases of rising and falling tension within the ventricle are similarly influenced by changes in cycle length (rate).

In contrast are the effects of filling (fiber length) upon the durations of the electrical and mechanical responses. Contrary to previous report (turtle),[1] we find that increased filling, up to the limits of ventricular capacity, prolong the electrical response only very slightly or not at all.* The phases of rising and falling tension, on the other hand, increase with augmented filling (figure 2).

Fatigue has very striking effects. When the perfusion is inadequate and recovery processes incomplete there is with activity a progressive decrease in the duration of the electrogram and of the phases of rising and falling tension. With prolonged rest nearly complete recovery may occur.

When effects of rate change are studied in the unfatigued heart the maximum duration of the electrical and mechanical responses may be attained if the stimulus is applied as soon as relaxation is complete. Depending upon the degree of fatigue, these phases may remain shortened when the stimulus is applied long after the end of relaxation. The extent of relaxation is not, therefore, a factor controlling the duration of the response.

Our results indicate, we believe, that the important factor determining the duration of the electrogram is the chemical condition or degree of recovery of the muscle at the instant the stimulus is applied. The degree of filling, on the contrary, as stated above, influences the duration of the electrogram very slightly, if at all. The mechanical phases, on the other hand, are determined not only by the degree of recovery, but also by the extent of filling of the ventricle.

* In one or two instances a slight increase is indicated by our data. Generally, however, any change which may have occurred was within the limits of experimental error.

[1] Daly, I. de B., *Proc. of Royal Soc.*, 1923, B 95, 279.