13245

Rôle of the Auricles in Ventricular Filling of the Tortoise Heart.

STEPHEN W. GRAY. (Introduced by F. R. Steggerda.)
From the Department of Physiology, University of Illinois, Urbana.

Studies of the tortoise heart *in situ* were made with a view to determining the extent to which ventricular filling is due to auricular systole. From observation it was obvious that such an effect existed, although it was difficult to show by means of a kymograph and lever system.

The cinematographic method, originally employed by Takeuchi[1] and Strughold[2] and lately Gray and Steggerda,[3] was used to record size changes and resulted in a clear picture, free from artifacts of inertia and overthrow common to mechanical systems. Pictures were taken at 8 per second and various diameters of the ventricle and auricle in each picture were measured under a binocular so that any change in diameter could be plotted graphically and used for further study.

In a typical curve from a slowly beating heart there is shown a definite increase in ventricular size just prior to systole. In all cases this coincides with the contraction of the auricles as indicated by the curve of auricular diameter. To examine the possibility that this auricular effect might be exaggerated by the absence of the restraining influence of the pericardium, experiments were done in which the beating heart was photographed through the pericardium. The measurements showed no difference between these hearts and those in which the pericardium had previously been removed. To further test the validity of this auricular effect on ventricular filling, the auricles were ligated in such a manner as to allow a clear passage for the blood from the sinus venosus to the ventricle, but at the same time preventing blood from entering the fundus of the auricles. By this operation, the mechanical effect of the auricular systole was abolished without impeding the path of either the blood or the excitation wave. The presystolic dilatation due to the auricular systole was completely absent, but the remaining part of the ventricular beat was relatively unchanged.

When the relation of the auricular contribution to ventricular

1 Takeuchi, K., *J. Physiol.*, 1925, **60**, 208.

2 Strughold, H., *Am. J. Physiol.*, 1930, **94**, 641.

3 Gray, S. W., and Steggerda, F. R., PROC. SOC. EXP. BIOL. AND MED., 1938, **39**, 269.

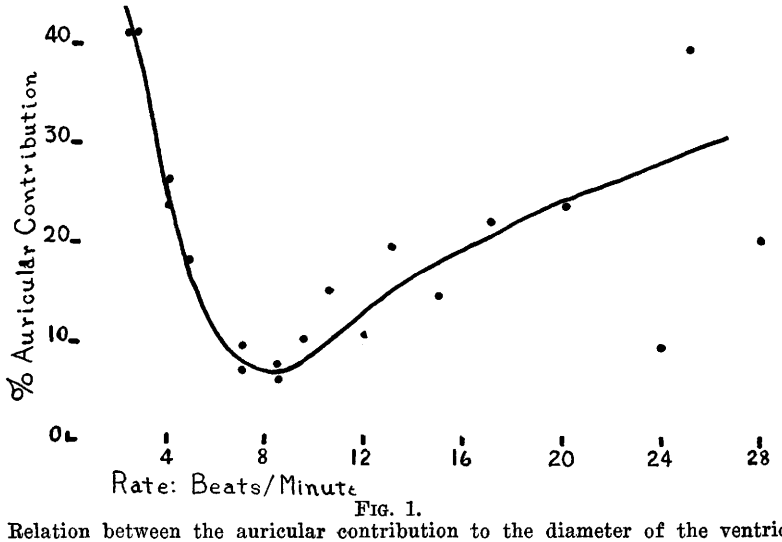

FIG. 1.

Relation between the auricular contribution to the diameter of the ventricle and the rate of the heart beat.

size was compared in hearts beating at different rates, the effect of the auricles was found to be markedly different. From Fig. 1, it is shown that with a rate of about 8 beats per minute, the auricular contribution amounts to from 7 to 10% of the ventricular diameter. However, as the rate varies in either direction from this figure, the action on the ventricular size is increased so that at 3 beats per minute, as well as at 25 per minute, the auricular contribution is about 20% to 40% of the total ventricular diameter. The figures represent linear change and not actual volume changes which would be rather greater as the increase takes place in 3 dimensions. As to an exact explanation for these differences, little can be said at the present time, but it would seem that there is an optimum rate at which the ventricle is doing its greatest amount of work and the auricles their least. The rate of 8 per minute corresponds roughly with the environmental temperature of 20 to 25°C.