

Idio-Ventricular Periodicity.

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When the excised heart of the frog is perfused under certain conditions, the beats lose their normal regularity, and occur in periodic groups with a long pause between every two groups. This phenomenon was first investigated systematically by Luciani* in 1872, and, in consequence, the groups are often referred to as "Luciani groups." They are not infrequently seen in experiments in which a Symes cannula, inserted into the heart through the inferior vena cava or sinus venosus, is kept in place by a ligature tied between the sinus venosus and the auricles, in the position of the first Stannius ligature. When the ligature is tied, the auricles and ventricles cease to beat, but if the heart is excised and then perfused through the cannula by Symes's method,† the whole heart usually beats again, and the beats may show periodic grouping before settling down to a normal regularity. Sometimes, too, groups occur in hearts in which the perfusion by Symes's method has been going on for some time and the heart has been beating regularly.

The conditions of occurrence of the groups have been studied by several physiologists, and the general opinion seems to be, like that of Gaskell,‡ that they are due to an asphyxial state of the heart, that the pauses indicate a complete heart block, and that the groups of beats occur when the block has become only partial, so that some beats are able to get through from sinus venosus to auricles and ventricles.

In the course of some perfusion experiments which we have been carrying out, we obtained a tracing which, it seems to us, cannot be explained in this way. As it illustrates a phenomenon in connection with periodic grouping of which we can find no description, we put it on record in this note.

Experiment.—A cannula was inserted into the heart of a pithed female frog through the inferior vena cava, and the heart was secured to the cannula by a ligature passing round it in the groove between the sinus venosus and the auricles, and not including the aortic trunk. The heart,

* Luciani, 'Human Physiology' (translated by F. A. Welby), vol. 1, p. 302 (1911).

† Symes, 'Proc. Physiol. Soc., Jour. Physiol.,' vol. 43, p. xxv (1912).

‡ Gaskell, 'Text-book of Physiology' (edited by E. A. Schafer), vol. 2, p. 226 (1900).

attached to the cannula, was excised and perfused by Symes's method, with Ringer's fluid (NaCl 0.6 per cent., KCl 0.026 per cent., $\text{CaCl}_2 + 6\text{H}_2\text{O}$ 0.032 per cent.), at a pressure of about 4 cm. of water, and a tracing of the beats was taken by means of a lever, connected by a hook to the tip of the ventricle, and writing on the smoked surface of a revolving drum. Shortly after the perfusion was begun, the heart beats were normal and regular. As soon as it was evident that this normal regularity was established, the perfusion fluid was replaced by Ringer's fluid, containing *i-inositol* (1 in 750). In less than a minute after the inositol solution reached the heart, the beats showed periodic grouping. The heart was perfused with the inositol solution for 13 minutes, then with ordinary Ringer's solution for half-an-hour, and during the whole time grouping continued. After this the perfusion was ended by the solution's running out. Grouping ceased, and the heart beat regularly, the beats gradually diminishing in force and frequency. At this stage the experiment was concluded.

Interpretation of the Tracing.—Fig. 1, taken from a part of the tracing, is a type of the whole. It shows the ventricle beats arranged in groups, with pauses between the groups. The auricle beats are clearly seen and continue to occur at regular intervals during the ventricular pauses. Dr. Locke, who happened to be present while the experiment was in progress, drew our attention to the fact that, in the groups, the ventricle beats did not seem to bear a definite time relationship to the auricle beats. This is evident in the tracing, where, during the grouping, the contraction of the ventricle occurs at a variable time after that of the auricle, and may even synchronise with it. We have carefully measured and analysed this tracing, and we submit in fig. 2 a diagram which illustrates the essential points.

The vertical lines in the upper half of the diagram indicate the relative positions of the contractions of the auricles, those in the lower half the relative positions of the contractions of the ventricle during the same period of time. The intervals between the auricle contractions are practically equal; accordingly, when the auricle beats are obscured on the tracing by ventricle beats, we have inserted broken lines at this interval from the lines preceding and following them. Two ventricular pauses are shown, and a complete group between them.

It is evident that there is no definite time relationship between the contractions of the auricles and of the ventricle in this group, such as can be explained by a condition of partial heart block, and this is the same for all the groups; in fact, it is obvious that, during a part of the time, the ventricle was beating more frequently than the auricles.

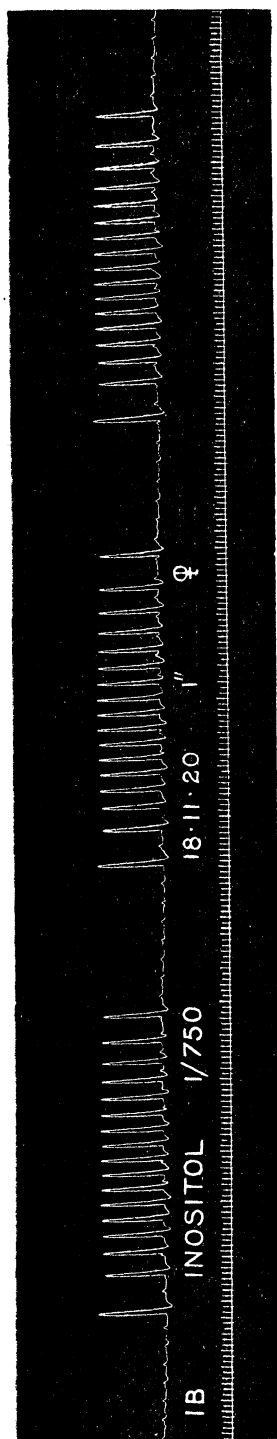


FIG. 1.—Tracing showing periodic grouping of the beats of the ventricle of the frog's heart. For explanation see text.

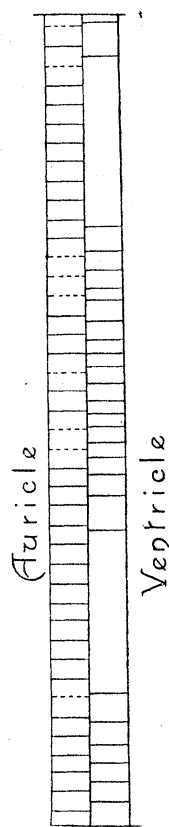


FIG. 2.—Diagram showing grouping of the ventricle beats, and the order in which the auricle beats and ventricle beats occur. For explanation see text.

The simplest explanation that occurs to us is that there was a complete heart block between the auricles and ventricle, the former continuing to beat regularly; and that the periodic grouping does not indicate a partial removal of the block but was a ventricular phenomenon; in other words, that this is an instance of idio-ventricular periodicity.

It must be understood that we do not advance this explanation for all cases of periodic grouping; all other tracings that we have seen are able to bear the usual interpretation. Moreover, it is beyond the scope of this note to discuss to what extent, if any, the result may have been due to the action of inositol.

Summary.

A perfusion experiment on the excised heart of the frog is described and discussed, in which periodic grouping occurred as an independent ventricular phenomenon.
