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Developmental Aspects of the Electrocardiogram.

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(Introduced by Shields Warren.)

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By means of the technique previously described¹ a series of electrocardiograms of the developing chick embryo from the fourth to the fifteenth days inclusive, were taken.

Three distinct waves are seen as early as the fourth day, which apparently represent P, R, and T waves. The recorded voltages with a circuit resistance of 4500 ohms are $P = .025$ millivolts, $R = .05$ millivolts, and $T = .05$ millivolts at this stage of development. By the seventh day the cardiogram assumes the shape that it maintains throughout the period of incubation.

The alpha lead is always the lowest in amplitude. The P and R waves are upright. Frequently the T wave originates directly from the R and is upright or diphasic.

The beta lead shows upright P and R waves. The S wave may be present and varies from 0.3 to 1.0 millivolt. The T wave is usually the wave of greatest amplitude, going up to 2 millivolts in the 14-day hearts. It is usually inverted, resembling a fish hook in shape. When the S wave is present the T takes its origin directly from it before the isopotential has been reached.

The gamma lead resembles the beta very closely, though its amplitude is lower.

The rates vary from 50 to 120, generally in the neighborhood of 60. For the individual heart the rate is constant. Arrhythmias are frequently found, the commonest type being the sino-auricular block. Coupled beats are not infrequent. Ventricular extra systoles are rare. Nodal rhythm has been found with the P wave occurring in the crest of the T.

Complete correlation of the developmental morphology with the electrocardiograms depends on recording tracings before the fourth day of incubation, as the 4 chambers and septa are present by this time. The finding of 3 waves on the fourth day correlates with this fact.

¹ Pollack, H., *PROC. SOC. EXP. BIOL. AND MED.*, 1930, **28**, 61.