injury to the intraventricular conducting system, directly or through interference with the coronary circulation, is a possible cause.

Similar treatment produced no changes in the electrocardiograms of five other patients with aortic syphilis. In twenty patients with primary and secondary lues intensive arsphenamine treatment produced no electrocardiographic abnormalities. A study of about sixty patients with primary and secondary lues has convinced us that reliable clinical or electrocardiographic evidence of involvement of the heart or aorta during this stage of the disease is decidedly rare.

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Factors influencing distribution of potential differences, produced by heart-beat, at surface of body.

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In order to understand the influence of the position of the electrocardiographic electrodes upon the form of the electrocardiogram it is necessary to have some idea of the laws which govern the flow of electric currents in solid conductors.

When a constant difference of potential is produced in a thin conducting sheet of infinite extent, the potential (V_1) of any point of that sheet is determined according to the following equation: $v_1 = \frac{Q}{2\pi dk} \log_e \frac{r_1}{r_2}$ in which Q is the quantity of electricity flowing in unit time, d the thickness of the sheet, k the conductivity of the material of which the sheet is composed, and r_1 and r_2 the distances of the point from the sink and the source respectively. In dealing with the difference in potential between two points at a given instant the expression $\frac{Q}{2\pi dk}$ may be replaced by k. Then

[1] Electrokinetics, *Ency. Brit.*, 11th Ed., ix, 216.

$$v_1 - v_2 = k\left(\log_e \frac{r_1}{r_2} - \log_e \frac{r_3}{r_4}\right)$$

in which r_3 and r_4 are the distances of the second point from the sink and source respectively. In the case of a solid conductor a similar expression holds:[2]

$$v_1 - v_2 = k_1\left[\left(\frac{1}{r_1} - \frac{1}{r_2}\right) - \left(\frac{1}{r_3} - \frac{1}{r_4}\right)\right]$$

in which the letters r_1, r_2, r_3, and r_4 have the same significance as before.

The body is not a conductor of infinite extent, nor can it be assumed that all body tissues have the same conductivity. The potential differences produced by the heart are not constant. Nevertheless, the potential differences produced by the heart-beat within the body or at its surface are determined by factors similar to those which appear in the equations given above.

Within the heart during the period of its electric activity a great number of sinks and sources exist. It may be demonstrated theoretically and experimentally that the differences of potential produced by the heart-beat at the body surface are of much greater magnitude in the immediate neighborhood of the heart than at a distance from it. If one electrode be placed over the heart, the position of the second electrode, so long as it be placed at a distance from the heart, has comparatively little effect upon the form of the ventricular electrocardiogram. Under these circumstances the curve obtained resembles those obtained in animals by placing one electrode upon the exposed heart and the other upon the chest wall. When one electrode is placed nearer the heart than the other, that part of the heart which lies nearest this electrode exerts a preponderating effect upon the form of the resulting curve. Leads of this type are semi-direct leads. The principles underlying Einthoven's equilateral triangle do not apply when the electrodes are placed near the heart.

Other factors remaining unchanged, an increase in the conductivity of the body tissues as a whole or an increase in the conductivity of the heart muscle or of tissues lying near the heart will decrease the magnitude of potential differences at the body surface. This may explain the small amplitude of the electrocardiogram in certain patients with edema, ascites, hydrothorax, or pericardial effusion.

[2] Pierce, B. O., *Newtonian Potential Function*, Ginn & Co., 3rd Ed., 248.