titer of the serum and is on an average about 12 times as great as the agglutinin titer of the control eye tissue juice.

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An Internal Electrocardiographic Lead.*

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The increased interest in chest and precordial leads, which are semi-direct leads tapping the cardiac action current from points close to the anterior surface of the heart, prompted the authors to seek an equivalent lead portraying more intimately the electrical phenomena at the posterior surface and base of the heart. A lead taken from the back of the chest fails to do this, for unlike the front, where there is only ½ inch of tissue intervening between heart and electrode, there is usually 4 inches of intervening tissue posteriorly.

The difficulty was overcome by making use of the fact that the esophagus is closely attached to the posterior pericardium throughout its extent. A non-polarizable German Silver electrode, shaped somewhat like the Rehfuss tip, to which a thin flexible German Silver cable was clamped, served as an internal electrode. The cable was insulated throughout its length by rubber tubing. This electrode was swallowed in turn by 6 normal subjects, very much like the Rehfuss tube, its descent being checked by fluoroscopic examination. The esophageal electrode was connected to the right-arm side of the galvanometer, and the left-arm electrode (a flat 1 inch disc) lead to some point distant from the heart, such as the left leg or right arm of the subject.

When the internal or exploring electrode lay at the level of the auricles, the electrocardiogram demonstrated uniformly a peculiar deflection, a very sharp, steep, rapidly moving deflection, which arose from the rounded portion of the P-wave, and which was almost as tall as the QRS deflection, which it resembled. (See Fig. 1.)

The high complex described above is interpreted as the "intrinsic"

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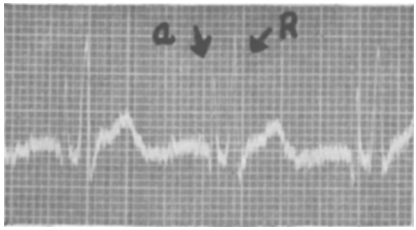

FIG. 1.
Electrocardiogram of normal male with internal electrode in lower esophagus behind the left auricle, and external electrode at a point distant from the heart, the right forearm. Note the very sharp intrinsic auricular deflection (a) which resembles the QRS complex. (R)

deflection of the underlying auricular musculature. It resembles very closely the auricular complexes that Lewis[1] obtained by leading off directly from the exposed auricle of the dog. That the deflection shows this intrinsic character is not surprising, considering that the internal electrode lies only about ¼ inch from the auricular surface, making the lead almost a direct one.

This internal lead is of great theoretical interest, since it permits study of parts of the heart, the base and the auricles, which have received very little direct study in man, and which are not readily accessible in animals, even after operation. Numerous problems related to the nature of the excitation wave in the auricles in health and disease can be studied directly by this method. The authors, for example, determined by use of the "intrinsic" auricular deflection the speed of conduction of the excitation wave in man's auricles. This study will be reported later.

We have not found any mention in the literature of the use of the *lower* esophagus as a semi-direct lead for the study of the auricles; although the *upper* esophagus and lower rectum were used as a simple *indirect* lead in dogs by Rothberger and Winterberg[2] in 1913. They were studying experimentally produced extrasystolies by the use of bi-axial leads, *i. e.*, a lead perpendicular to the conventional lead I.

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1 Lewis, T., Meekins, J., and White, P. D., *Phil. Trans. Royal Society*, **1914**, Series B, **205**, 375.

2 Rothberger, C. J., and Winterberg, H., *Pfluger Arch. f. d. ges. Physiol.*, **1913**, **154**, 571.