

# This Week's Citation Classic®

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Durrer D, van Dam R T, Freud G E, Janse M J, Meijler F L & Arzbaecher R C.  
Total excitation of the isolated human heart. *Circulation* 41:899-912, 1970.  
[University Department of Cardiology and Clinical Physiology, Wilhelmina-Gasthuis, Amsterdam, The Netherlands]

The excitation patterns of seven resuscitated human hearts perfused by the Langendorff technique were studied by multiple unipolar and bipolar recordings. Records from as many as 870 sites on the endocardium, in the transmural zone, and on the epicardium were made; ischemic maps were constructed. Three endocardial areas were the earliest excited, and the epicardial excitation pattern reflected the intramural accession fronts. [The *SCC*® indicates that this paper has been cited in over 350 publications.]

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Dirk Durrer, as a young graduate physician in the war-ravaged city of Amsterdam, began the practice of medicine and early on became engrossed with electrocardiography. In part, this stemmed from reading the work from Frank Wilson's laboratory in America, which endeavored to explain the genesis of the electrocardiogram in mathematical terms. In 1946 Durrer was invited to the University of Amsterdam's Department of Academic Cardiology, where he pursued his interests in electrocardiography with vigor and attracted brilliant young Dutch physicians to work with him.

His own dissertation (1952) was on the excitation of the heart. He realized that if the electrocardiogram was to be understood, detailed studies of the intramural spread of the excitation were required. This in turn required improved techniques of recording. For the intra-

mural spread problem, a perforated needle was designed with electrodes spaced along its length. And for the recording problem, he had the help of the physicist, van der Tweel. The needle, described in 1953,<sup>1</sup> became known as the "Durrer needle."

The *Classic* paper on the total excitation of the human heart, written with van Dam, Freud, Janse, Meijler, and Arzbaecher, appeared in the June issue of *Circulation*, of which I was the editor, and reflected 20 years of experience with the recording techniques. Records from as many as 870 sites of the electrode pairs were utilized. The amount of time needed to analyze the data, without the use of advanced computer technology, and to construct isochrones from which the activation fronts could be readily visualized, was clearly enormous.

The paper was recognized immediately as an authoritative one, and it ended many arguments stemming in part from species differences. In addition to the electrophysiologic triumph, the techniques used in resuscitation and perfusion of the hearts deserve commendation. This success was due, I believe, in considerable part to the skill and experience of Meijler with the Langendorff preparation.

I believe electrocardiologists worldwide will approve and be pleased with the designation of this paper as a *Citation Classic*. One of the coauthors, Freud, has died of heart disease; the others continue their productive careers. Durrer himself died March 2, 1984. His students and friends arranged a symposium in his memory and honor this past May in Amsterdam. At the time of this meeting, a volume of selected papers from the Durrer laboratory became available.<sup>2</sup>

1. Durrer D & van der Tweel L H. Spread of activation in the left ventricular wall of the dog. I.

*Amer. Heart J.* 46:683-91, 1953.

2. Meijler F L & Burchell H B, eds. *Professor Dirk Durrer: 35 years of cardiology in Amsterdam. A selection of papers and full bibliography.* Amsterdam: North-Holland, 1986.