

Cardiac electrophysiology: Past, present and future

Part I

Introductory remarks

It was not an easy task to find a suitable way to celebrate Silvio Weidmann's 65th birthday and his retirement as head of the Institute of Physiology in Berne and from his academic duties. However, since Silvio Weidmann was one of the pioneers in the art of applying microelectrodes to heart cells, it seemed appropriate to bring together his friends and collaborators both past and present for a symposium on cardiac electrophysiology in Bern.

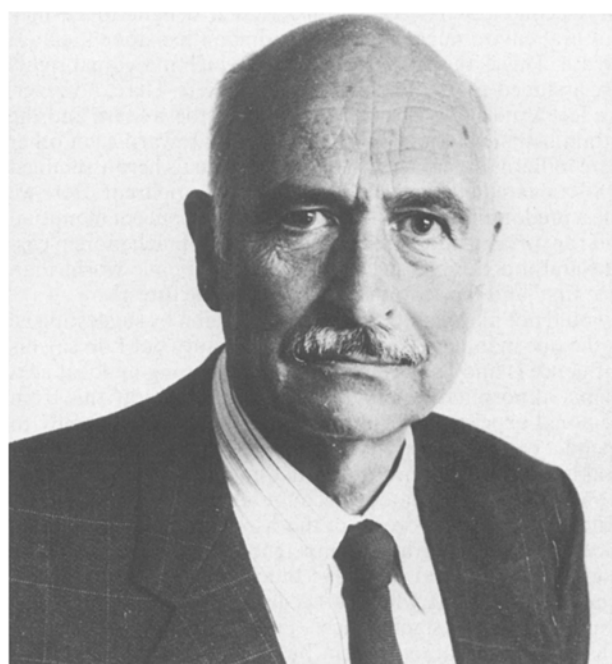
From its humble beginnings some 37 years ago, when the first Purkinje fiber action potential was recorded by Draper and Weidmann, cardiac electrophysiology has since spread to some 200 laboratories throughout the world. Despite the now large size of the family of cardiac electrophysiologists, a great number of them have spent some time, ranging from a few hours to years, in Silvio Weidmann's laboratory in Bern. It is the desire of the contributors to this symposium, which took place from September 10–11 1986 in Bern, to express their gratitude and admiration to Silvio Weidmann not only as a person, but also as an outstanding scientist. We would also like to extend our thanks to the editors of *Experientia*, who made this tribute possible.

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A statement of appreciation and presentation of a perspective honoring Silvio Weidmann

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I much appreciate this opportunity to acknowledge both a personal and a scientific debt to Silvio Weidmann. In doing so I wish to present a perspective, a concept of the significance of this meeting and why he should be honored. I shall attempt to do so by three statements.

First, only a few here have personally seen the full scope of scientific events of this century. There has been a rebirth of the age of humors: now we know the heart as well as other tissues produces them. In this century endocrinology attained its maturity. Neuroendocrinology was born and is no longer in its infancy. The cytologists of the early decades became geneticists and we have now the awesome and somewhat frightening potentials of genetic and bioengineering.

The concept of the synapse developed and the battle between those believing in humoral transmitters and those adhering to electrical transmission of excitation and inhibition across tissue junctions was fought and lost by the electrophysiologists. All this and more has occurred in the fields of physiology. What has happened in cardiology?

During the early decades of this century cardiology was in the doldrums – at least intellectually. To be sure electrocardiology developed, cardiac catheterization was introduced, the pacemaker was invented and has come into common use as has coronary bypass. Cardiac transplants have been successful. I do not denigrate these extremely important developments nor do I say they were not products of the intellect.

But they were technological, clinically useful developments – not primarily academic nor stimulating to the mind that probes for fundamentals.

However in 1949–50 Dr Weidmann introduced transmembrane, 'intracellular', recording from heart cells and initiated a new era of intellectual interest in the heart and its mechanisms of function. He effected a 'marriage' of the Purkinje fiber and the giant axon of the squid. He established a chain of thought in cardiology unified with the tradition of thought of Helmholtz, Du Bois Reymond, Mateucci, Bernstein and its modern aspects – the ion flux theories of Hodgkin and Huxley. Dr Weidmann would be the first to insist that others, several of whom are here, made magnificent contributions to this development of 'intellectual' cardiology but Silvio has been the leader. It has already been stated that many, many papers written relative to the heart and its components have begun thus: «Dr Weidmann has shown» –. He opened many doors for many people and provided new techniques which many of you came here to learn.

My second observation is this. It is a delight to be in a cultural environment that Dr Weidmann has done much to create. This is the age of 'rights' – in which individual rights are assumed to predominate over all others. Here, however, we feel a mutual concern, an interest in the welfare and the attainments of others. Your friendliness toward each other here in Bern, the friendship of the individuals here assembled – Silvio's students and associates – is very apparent. Here we see a predominance of Prince Kropotkin's concept of mutual aid for survival and accomplishment – it is much more pleasant and much more successful in the academic world than 'me first' and the attitude of survival of the fittest.

I would not like to embarrass Dr Weidmann by suggesting he is the one man here devoid of human frailty but I do say his influence is and has been strong in developing an ideal academic atmosphere wherever he has been. I know this from personal experience. When I invited him and his family to spend a year in Brooklyn as a Visiting Professor I felt considerable uneasiness concerning what might happen to them. It would be inappropriate to recount all the humorous occurrences and pleasant events of this association. They adapted nicely and demonstrated competence in dealing with life in New York. We did not have much to offer Silvio but he quickly assembled what he needed and quietly conducted experiments of significance. I remember these accomplishments and admire them but the point I would like to make is that while with us in Brooklyn Silvio exerted the same influence he has imprinted here in Bern. Both he and Ruth create a spirit of goodwill among men and provide an example and ideal that by contiguity improves the quality of life and of scientific accomplishment.

The third component of the perspective I present relates to the future. Dr Weidmann was primary among the leaders in the use of the type of thought and methodology which led to

the formulation of this organization interested in 'cardiac cellular electrophysiology'. The group has prospered, developed a vocabulary and a focus of attention peculiarly its own. But what of the future – what is the future potential and destiny of the present interests? In my opinion something new will soon be needed. What will be the leadership that will open new areas for exploration – will you all have to become protein or lipid chemists, molecular biologists –? Perhaps it will be the old leadership that again generates the new. Silvio still possesses that power; he has told me that he does not like to do the usual things, to follow along the common way. He likes to try new ideas that often do not work out well but this probing of the barriers, this search leads to progress. Continual success in discovery is too much to expect of any man but there is the obligation to try and Silvio will do that and will succeed if not in discovering the new himself, at least in helping others to do so.

If I may presume to suggest a continuation I will say that there needs to be another unification, a marriage of those who study membrane potentials, the reactions of the heart cell, the integration of excitation and response with those who deal with humors, receptors and the cell's metabolic processes. The heart is not only a contractile organ, a pump, but also an emitter of humors that affect not only its own action but also distant organs such as the kidney and function of its tubules. Interest here has focused on the unification of action of demonstrable physical subdivisions of cardiac fibers that permits uninterrupted conduction. A related concern is how the heart contributes to the integration that unites all body parts and their components in the service of the totality. The heart directed by the autonomic nervous system has been assigned the responsibility of signalling to us the significance of events and situations. Aristotle suggested that the brain creates the 'cold humors' (reason) that control the 'fiery humors' of the heart (emotions). The heart, as those who study conditional reflexes know, signals to us the need for alarm, the need for anger or resolve to oppose those things men should oppose. The heart signals the need for sympathy as Galen suggested long ago. Sympathy is the power that unites us and will be the salvation of man if that is possible. As scientists and humanists this integrative directive power of the heart should not be ignored.

It is appropriate that I link this third theme with the first and second. Dr Weidmann has opposed the wrongs men inflict on others. He has demonstrated and inspired the sympathy which we all hold for each other. Our hope and intent is to move with Silvio Weidmann, whom we honor because of the past, into an even brighter future dominated by the types of virtue Silvio has shown us.

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The conduction of the cardiac impulse 1951–1986

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Summary. The study of the propagation of the cardiac impulse during the last 35 years is reviewed with special attention to the contributions of Silvio Weidmann and his colleagues. Special emphasis is placed on the need to prove that the cardiac impulse is transmitted electrically, even when it is conducted under very abnormal conditions.

Key words. Cardiac electrophysiology; cardiac action potential; history of cardiac electrophysiology.

When our hosts invited me to take part in this event they suggested that I give a talk entitled 'Development of Cardiac Electrophysiology Over the Last Three Decades'. I demur-

red, partly on the ground that the topic was unmanageably large. The title I have chosen may, however, require a bit of explanation. Had I used as a title 'The Propagation of the