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Otto Schmitt's Contributions to Basic and Applied Biomedical Engineering and to the Profession

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Abstract—Otto Schmitt was one of the early giants in biomedical engineering. Best known in engineering circles for the Schmitt Trigger, he also made many other significant scientific contributions. Besides his scientific work Otto was involved in early organizational activities, which included the first large professional BME meeting in Minneapolis in 1958. A description of his many contributions will be presented along with a short video of Schmitt giving a tour of his laboratory, including the original Schmitt Trigger and the model he used to develop his vector ECG system.

Otto Schmitt is probably best known for his Schmitt Trigger circuit which is widely used, at least in functional form, in many electronic devices today. His contributions are very diverse and include developing an important technique to detect submarines during World War II that is still used today, creating one of the best vector electrocardiographic systems, and his strong interest in paranormal investigations[1]. He introduced the word "biomimetics" to the world in a paper in 1969, which appeared in Webster's Dictionary in 1974[1]. At the 1992 AAMI meeting, which awarded him the Laufman Prize, he presented a scholarly document with 12 action items for improving health care in this century [2]. This document included technical items such as home health care, but also surprisingly conscience and "prime features of quality of life, mind, spirit, and soul."

Besides his scientific work, he was involved in many organizational efforts. Before NASA there were four committees dealing with space and Otto was on three of the four and chaired the committee on Bioastronautics. In 1947, a joint committee of AIEE, IRE, and ISA organized annual conferences on electrical issues in medicine over the next 10 years. These conferences were only attended by a small group with a few dozen presentations per year. In 1958, Schmitt organized a theme based meeting on "biology and computers" at the University of Minnesota which had 70 papers and 400 attendees. He was the founding president of the Biomedical Engineering Society and the founding vice president of the Biophysical Society. Schmitt contributed greatly to the development of EMBS and was twice given the Morlock Memorial award, which is now renamed as IEEE-EMBS Career Achievement Award. In 1979 he was elected to the National Academy of Engineering and in 1987, he received the Centennial Medal from the IEEE.

In the presentation, a short video of Schmitt giving a tour of his laboratory showing many of his well known inventions including the original Schmitt Trigger along with his description, and the saline filled, thoracic shaped manikins Otto used to map the fields in order to develop his vector ECG system. A very interesting item in the video shows a subject in an electrically isolated seat, which Otto called his "electric chair." Schmitt connects a wire to the subject and increases the potential up to 18,000 volts, while recording subjective feelings as the potential is increased.

Schmitt's Ph.D. thesis in1937 was on the creation of an electronic nerve analog, which resulted in the development of the Schmitt Trigger. The circuit modeled the nerve membrane characteristics of capacitance and resistance and showed action potential propagation. He followed his Ph.D. work with a post-Doc in England with A. V. Hill. In this laboratory Otto worked closely with Alan Hodgin and Bernhard Katz. Both would later win Noble Prizes.

As an undergraduate when I visited his laboratory for the first time, I expected to see some great new ECG developments or similar research, but instead he focused on the Venus flytrap plant and described how it catches flies.

His last significant invention was a device to phase lock a subject's respiration to a submultiple of his/her heart rate. Originally, he wanted to control the influence of respiration on the ECG vector without breath holding, but later used this approach to study heart rate variability.

Telling Otto's life story is like the story of blind persons feeling different parts of an elephant, different people who knew Schmitt in different ways or under different conditions saw a very different person. Some saw him as a tough theoretically based scientist and others knew him as someone who would discuss at length paranormal issues. As many parts of Otto life as possible will be covered. Clearly, he was very important in developing biomedical and electrical engineering through both organizational activity and scientific contributions.

References

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