

In Memoriam Robert Plonsey 1924-2015, Scientist, teacher, gentleman and friend

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Abstract. Professor Robert Plonsey was an eminent scientist. He developed the theory of bioelectromagnetism, especially he made numerous and important contributions to the understanding of the origin of biopotentials recorded from heart, muscle, and nerve tissue. Professor Robert Plonsey passed away on 14.3.2015. In the 10th International Conference on Bioelectromagnetism in Tallinn, Estonia on 16.-18.6.2015 it was arranged Robert Plonsey Memorial session. This article is based on the presentation in that session.

Keywords: Robert Plonsey, Memorial Session, Internaional Congress on Bioelectromagnetism

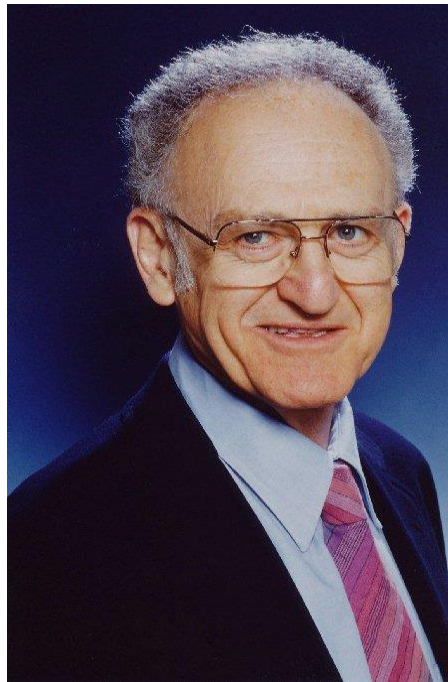


Figure 1. Robert Plonsey 1924 – 2015.

1. Introduction

Professor Robert Plonsey passed away on the 14th of March 2015 in Chapel Hill, NC, in the age of 90 years. He was born in New York City, Bronx on the 17th of June 1924. He was very notable person in the discipline of bioelectromagnetism. In addition to his important scientific merits he was Honorary President of the International Society for Bioelectromagnetism and member of the Scientific Advisory Board of the International Journal of Bioelectromagnetism. Therefore in the 10th International Conference on Bioelectromagnetism in Tallinn, Estonia on 16.-18.6.2015 it was arranged Robert Plonsey Memorial Session. It included talks of Jaakko Malmivuo, Yoram Rudy, Craig Henriques and Olaf T. von Ramm. Yoram Rudy and Craig Henriques gave their presentation on video. This article is

based on the author's presentation in that session. This is a very personal approach to the memory of my good friend.

2. Family tree and birthplace

Robert Plonsey's parents were Louis Plonskey born 1896 and Betty Vinograd born 1898. They were both born in the Russian Empire. After they moved to the United States, Louis Plonskey changed his name to Plonsey, to sound more American. Louis Plonsey was salesman by profession and Betty worked as a comptometrist for a department store. Comptometer was a mechanical calculator used for calculating the finances.

3	191 R.	Butler, Benjamin	head	0	M	W	44	M	4	Russia	1	Na same
4		① Minnie	wife	1	F	W	40	M	10	Russia	1	Na same
5		Milton	son	2	M	W	19	S	10	New York	1	Na same
6		Elaine	daughter	2	F	W	18	S	10	New York	1	Na same
7	192 R.	Schon, Max	head	0	M	W	44	M	10	Poland	1	Na same
8		Matilda	wife	1	F	W	42	M	10	New York	1	Na same
9		Louis L.	son	2	M	W	18	S	10	New York	1	Na same
10		Judith A.	daughter	2	F	W	17	S	10	New York	1	Na same
11	193 R.	Kelovitz, Louis	head	0	M	W	39	M	10	Russia	1	Na same
12		① Bessie	wife	1	F	W	38	M	10	Russia	1	Na same
13		Beatrice	daughter	2	F	W	18	S	10	Ohio	1	Na same
14		Yelba	daughter	2	F	W	16	S	10	New York	1	Na same
15		Limix - Eddie	partner	2	M	W	26	M	10	New York	1	Na same
16		① Betty	wife	1	F	W	25	M	10	Russia	1	Na same
17	194 R.	Russ, Nicholas	head	0	M	W	57	M	10	Mass.	1	Na same
18		① Anna	wife	1	F	W	57	M	10	New York	1	Na same
19		Wylkin	son	2	M	W	21	S	10	New York	1	Na same
20	195 R.	Plonsey, Louis	head	0	M	W	44	M	10	Russia	1	Na same
21		① Betty	wife	1	F	W	42	M	10	Russia	1	Na same
22		Robert	son	2	M	W	15	S	10	New York	1	Na same
23		Gloria	daughter	2	F	W	11	S	10	New York	1	Na same
24	196 R.	Munko, George	head	0	M	W	44	M	10	Poland	1	Na same
25		① Belle	wife	1	F	W	39	M	10	Poland	1	Na same
26		William	daughter	2	F	W	17	S	10	New York	1	Na same
27		Jowen	daughter	2	M	W	13	S	10	New York	1	Na same
28	197 R.	Barkovitz, Harry	head	0	M	W	46	M	10	Russia	1	Na same
29		① Helen	wife	1	F	W	41	M	10	Russia	1	Na same
30		Joseph	son	2	M	W	17	S	10	New York	1	Na same

Figure 2. Sixteenth Census of the United States: 1940, Population Schedule 6218, State: New York, County: Bronx. Plonsey, Louis, Betty Robert and Gloria on rows 20 – 23.

In the U.S. the Plonsey family lived in New York City, in Bronx in the address 1728 Crotona Park East. Robert was born on 17.6.1924. He had four years younger sibling Gloria, living now in Portland, OR. Robert's mother Betty taught Robert mathematics at home..

In 1948 Robert Plonsey married Vivian Vucker, who was also born in Bronx in 1924. They had one son, Dan, born in 1958. Vivian studied at University of Wisconsin, graduating with honors, her degree in sociology and psychology. She was very socially oriented and served as a social worker. Vivian passed away in 2011.

Robert Plonsey's one notable relative was Edgar Villchur (1917-2011) who invented the acoustic suspension loudspeaker

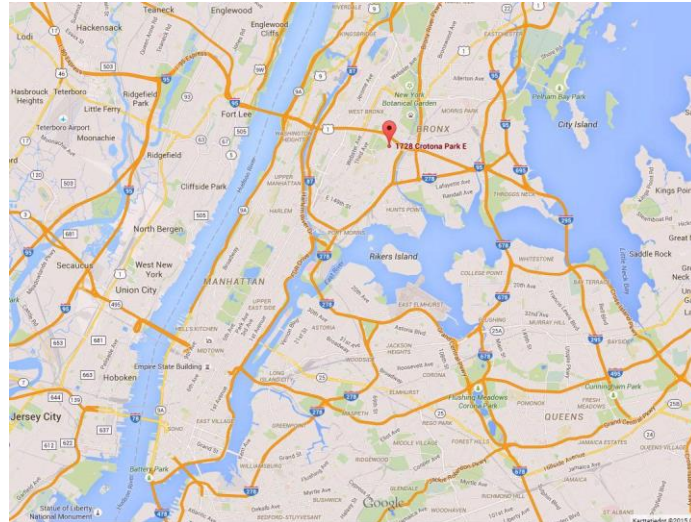


Figure 3. New York City, Bronx, 1728 Crotona Park East. The address of the family of Louis and Betty Plonsey where Robert was born.

3. CV

Robert Plonsey studied at Cooper Union School of Engineering in New York, graduating with Bachelor's degree in electrical engineering in 1943. After serving in the Navy during World War II, he returned to school and obtained an MEE degree from New York University in 1948. After obtaining his PhD from University of California, Berkeley, in 1957 Robert Plonsey became assistant professor of electrical engineering at Case Institute of Technology (later to become Case Western Reserve University) in Cleveland. Robert Plonsey also attended the Case Western Reserve University School of Medicine in Cleveland, where he completed a year and a half of MD. During the time when he served as professor at Case Western Reserve University he authored one the first books on applying of electromagnetism to problems in biophysics entitled "*Bioelectric Phenomena*" (1969). In 1983, Robert Plonsey moved to Duke University to join the faculty of Biomedical Engineering, where he continued as the Pfizer Pratt University Professor of Biomedical Engineering until retirement in 1996 (<http://fds.duke.edu/db/pratt/BME/faculty/robert.plonsey>).

4. Publications

2.2. Papers

Robert Plonsey published large number of important publications in bioelectromagnetism. The number of his most important publications on the Duke University website is 136 and in PubMed 103.

2.2. Books

Dr. Plonsey was famous for applying electromagnetic field theory to biology. He researched on bioelectric phenomenon, especially the electrical energy of nerves and muscles. His most influential work was on the electrical properties of the heart. He co-authored very influential books like:

- *Principles and Applications of Electromagnetic Fields*, coauthored with Robert Collin (McGraw-Hill, 1961)
- *Bioelectric Phenomena* (McGraw-Hill, 1969)
- *Engineering Contributions to Biophysical Electrocardiography*, co-edited with Theo Pilkington, (IEEE, 1982)
- *Bioelectricity: A Quantitative Approach*, coauthored with Roger Barr (Springer, 2nd Ed., 2000. 3rd Ed., 2007)

- *Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields*, coauthored with Jaakko Malmivuo (Oxford University Press, 1995) [Malmivuo and Plonsey, 1995] .

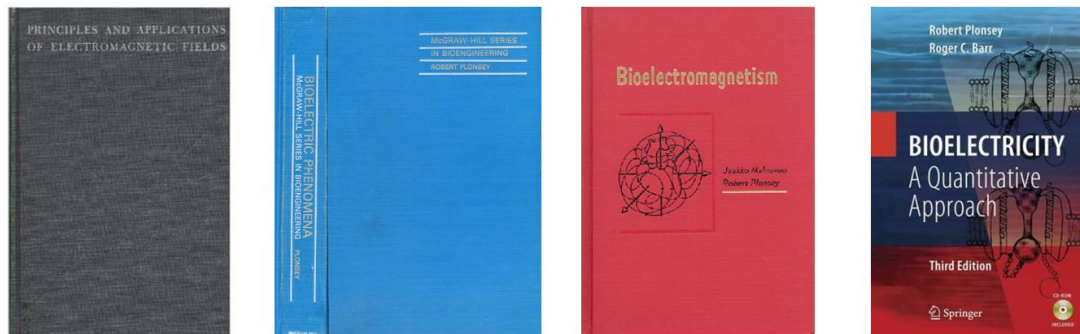


Figure 4. Covers of the following books:

- *Principles and Applications of Electromagnetic Fields*
- *Bioelectric Phenomena*
- *Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields*
- *Bioelectricity: A Quantitative Approach* (3rd ed.)

2.2. Awards

The numerous scientific contributions of Robert Plonsey were awarded with numerous prizes and distinctions.

Table 1. Prizes awarded to Robert Plonsey

Year	Award
1979	William Morlock Award from the IEEE Engineering in Medicine and Biology Society
1984	Centennial Medal from the IEEE Engineering in Medicine and Biology Society
1988	ALZA Distinguished Lecturer from the Biomedical Engineering Society (BMES)
1997	Merit Award from the International Union for Physiological & Engineering Science in Medicine
2000	Millennium Medal from the IEEE Engineering in Medicine and Biology Society
2004	Ragnar Granit Prize from the Ragnar Granit Foundation
2005	Theo Pilkington Outstanding Educator Award from the American Society for Engineering Education
2013	IEEE Biomedical Engineering Award

Dr. Plonsey was a fellow of the American Association for the Advancement of Science and was elected as a member of the National Academy of Engineering in 1986. He has received numerous prestigious awards from the IEEE, notably the Centennial Medal in 1984, the Millennium Medal in 2000 and the 2013 IEEE Biomedical Engineering Award.

Dr. Plonsey served as president of two of important societies in biomedical engineering: the IEEE Engineering in Medicine and Biology Society (EMBS) from 1973-1974 and the Biomedical Engineering Society from 1981-1982. He was founding member of the International Society for Bioelectromagnetism in 1996 and was also appointed as Honorary President of the Society. [5]

In 1986 Robert Plonsey was nominated member of the National Academy of Engineering, “*For the application of electromagnetic field theory to biology, and for distinguished leadership in the emerging profession of biomedical engineering*”.

5. Science

Robert Plonsey made numerous and important contributions to the field of biophysics, particularly the understanding of the origin of biopotentials recorded from heart, muscle, and nerve tissue. His book *Bioelectric Phenomena* (1969) was the first one written on this topic. This was a landmark in this discipline. At Duke University, Bob collaborated closely with Roger Barr. They were among the first to apply the bidomain model to study propagation of electrical impulses in the heart.

In 1963 Bob Plonsey derived a lead-field theoretic proof for the principle of reciprocity which was first published by Helmholtz in 1853[Helmholtz, 1853]. This publication did bring the reciprocity theorem to the modern mathematical notation [Plonsey, 1963]. One milestone was his publication on the independence of bioelectric and biomagnetic fields in 1972, [Plonsey, 1972]. Though he in this publication was not able to completely solve the problem, it was very stimulating for research in biomagnetism.

6. Teacher and friend

I moved to Stanford University to the biomagnetism group for 1974-1976. Robert Plonsey was in the advisory committee. Then I got to know him personally. David Geselowitz and Richard McFee were also members of the committee.

I had the pleasure to give Preconference courses on Bioelectric and Biomagnetic Phenomena with him in connection to several international congresses. The first one we gave in connection to the “XIV International Conference on Medical and Biological Engineering and VII International Conference on Medical Physics” which was arranged in Espoo, Finland, August 11-16.1985. The course was organized in Tampere University of Technology, which is about 150 km north from Helsinki and where I served as Professor of Bioelectromagnetism since 1976.

The next Preconference course I organized in connection to the 10th Nordic-Baltic Conference on Biomedical Engineering and 1st International Conference on Bioelectromagnetism 9.-13.6.1996 Tampere, Finland. This conference was especially directed to the Baltic States which had recently regained their independence.

Similar Preconference course we organized in connection to the 11th Nordic-Baltic Conference on Biomedical Engineering 6.-10.6.1999 Tallinn, Estonia.

7. Book on Bioelectromagnetism

On the basis of the close co-operation in teaching which I had had with Robert Plonsey I suggested to him that we should jointly write a textbook on bioelectromagnetism. For my great joy he accepted this offer and our close co-operation started. It lasted for several years until the publication of the book in 1995. Though we did live far away from each other and no e-mail was then available, the co-operation was very intensive and productive. As an example I may mention that in 1993 I served as Visiting Professor in Sophia University, Tokyo, Japan. The time difference between Tokyo and Duke University, Durham, NC was 12 hours. We worked with the manuscript so that when I had prepared some new material I sent it with telefax in the evening from Tokyo to Bob Plonsey to Duke. It was then morning in Durham and Bob could work with it that day. Then he sent his output in his evening with telefax to me to Tokyo. That was my morning on the next day.

8. International Conferences on Bioelectromagnetism, ICBEM

The aforementioned 10th Nordic-Baltic Conference on Biomedical Engineering at Tampere continued the series of Nordic Conferences on Biomedical Engineering. I added the concept “Baltic” to the conference title to offer for the colleagues in the Baltic States, which had recently regained their independence, an opportunity to create international contacts.

Encouraged from the very pleasant and successful co-operation with Robert Plonsey in the Preconference course education and especially in the book project I decided to arrange this as a joint conference on biomedical engineering and bioelectromagnetism. Robert Plonsey served as co-chairman

of the Scientific Committee of these two conferences. Almost half of the submissions to this joint conference were to the 1st International Conference on Bioelectromagnetism. Robert Plonsey participated actively to the arrangements of this double conference by attracting important international speakers to it. The series of International Conferences on Bioelectromagnetism continued biannually so the 10th ICBEM was arranged in Tallinn, Estonia in June 2015. (<http://www.isbem.org/conferen.htm>)

In this connection it should be mentioned that Robert Plonsey was also involved in the arrangement of several other important conferences in biomedical engineering. One which way be mentioned was the 14th Annual International Conference of the IEEE Engineering in Medicine and Biology Society in Paris in 1992. This was the first annual IEEE conference which was arranged outside the US.



Figure 5. Vivian and Bob were very social. In this photo they are discussing with participants of the 1st International Congress of Bioelectromagnetism in Tampere in 1996. (Vivian in white dress.)

9. International Journal of Bioelectromagnetism, IJBEM

In the 2nd ICBEM in 1998 in Melbourne, Australia, I suggested that a free access scientific journal to the Internet should be established. The first issue of this journal, the International Journal for Bioelectromagnetism was published in next year 1999. Robert Plonsey was elected to the Scientific Advisory Committee of this journal.

10. Epilogue

Craig Henriques wrote in the obituary of Bob Plonsey on Duke University website:

“Bob was great scientist, teacher and a gentleman, and he will be missed by all that were fortunate to know him”.

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