Preface

In 1987 a book that I wrote with Evangelia M-Tzanakou of Rutgers University, *Neuroelectric Systems*, was published by New York University Press. Sometime before this manuscript was completed it occurred to me that one ought to write a book, about the nervous system, for the lay person.

Of course, many books of this type have been written by life scientists, but a book written by a biomedical engineer would be different. Although some of my relatives and best friends are life scientists, there *are* two cultures. The world in general and the nervous system in particular look quite different to an engineer than they do to a life scientist.

I proceeded to generate a manuscript without equations (or, at least, nothing more complicated than Rate $\times$ Time = Distance). It was a challenge, a very enjoyable challenge, to explain the nervous system from an engineering perspective to the intelligent lay person. Alas, the manuscript was unpublishable. Even a literary agent did not help. Lay persons were undoubtedly interested in the nervous system, but not as seen through the eyes of an engineer.

Undaunted, I enlisted the aid of my daughter Alice, who is one of the life scientists that has a Ph.D. in biology. Alice made a semi-infinite number of changes, adding and subtracting so much material that it was only fair to call her a co-author. Unfortunately, this fooled nobody. The revised manuscript remained too heavily flavored by an engineering viewpoint.

Finally, I sent the manuscript to a publisher of *engineering* books—namely, IEEE PRESS. The PRESS's reviewers said, "Put the equations back, and you will have something that is viable!" I went even further—I cheerfully gathered up my favorite homework and exam questions, the residue of 25 years of teaching neuroelectric systems, and added Problems at

the end of each chapter. (This includes answers to those exam gems that were formerly carefully guarded.)

One final change was made. One of the reviewers, Murray Eden of NIH, opined that most of the mathematics should be presented in appendix form at the end of each pertinent chapter. I am grateful to Dr. Eden for this excellent suggestion.

As the chapter headings indicate, the book begins with the basic components of the nervous system—with sensory receptors, neurons and their dendrites, and skeletal muscle circuits. This is followed by the more complicated auditory and visual systems. Finally, the climax—the brain—is considered. The 12 chapters correspond to a three-credit biomedical engineering course on the nervous system.

What is the engineering perspective? It is one in which each physiological system is simplified until it can be analyzed mathematically, followed by presentation as a simplified model.

The material in the book has been shaped by a myriad of students and colleagues—at the Polytechnic Institute of Brooklyn (now Polytechnic University) until 1972; at Rutgers University from 1972 to 1979; at Tel Aviv University from 1979 to 1983; and at the University of South Florida (as a "Visitor") since 1983. The manuscript was also modified in accordance with the helpful comments of some six "anonymous" reviewers, in addition to those of Dr. Eden.

I am thankful to the people of USF for their cooperation—especially Tom Smith and Dr. Elias Stefanakos of the Electrical Engineering Department, and Dr. Michael Kovac, Dean of Engineering. Special thanks are also due to the editorial staff of IEEE PRESS, notably Executive Editor Dudley Kay, Production Supervisor Denise Gannon, and Production Editor Karen Miller, without whose expertise this project could not have come to fruition.

Above all, Alice and I are grateful to Ruth, mother and wife, who was one of the "intelligent lay persons" who undertook to read the first few chapters of the first manuscript.

Sid Deutsch
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Ever since I can remember, my father always answered my "why" and "how" questions about the world. No matter what he was doing, he always had time to give me a scientific explanation for some phenomenon of our environment. No question was ever answered by that oft-quoted phrase: "Look it up!" I still remember his description of Einstein's theory of relativity that we discussed when I was a preteen. When he came to me with the suggestion that I broaden his engineering interpretation of the nervous system, I was delighted. I saw this as my chance, in turn, to help him understand the whys and hows of the nervous system from the biologist's point of view.

Biology relies so completely on experimentally proven facts. In contrast, I saw the book as a series of gross approximations about various aspects of the nervous system which had as starting points these facts. It was fascinating to me that in this way—using logical mathematical expressions and formulas—one could attempt to explain biological data. I suppose it is the dialectic of starting with some basic observations, developing a theory—in this case often a mathematical model—to explain the facts, and from this, designing better experiments so as to learn yet more facts which in turn will lead to a better mathematical description or model, and so on, until the "absolute" truth about the nervous system is known. It is my hope that this book will serve as a unique point of view about the nervous system that can stimulate both new research and new theories. I also hope that it can lead to a greater understanding of the nervous system by being valuable to both the bioengineer and the neurophysiologist.

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