Chaos in Brain Function

Containing Original Chapters by E. Başar and T. H. Bullock and Topical Articles Reprinted from the Springer Series in Brain Dynamics

With 66 Figures

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Preface

The analysis of deterministic chaos is currently an active field in many branches of research. Mathematically all nonlinear dynamical systems with more than two degrees of freedom can generate chaos, becoming unpredictable over a longer time scale. The brain is a nonlinear system par excellence. Accordingly, the concepts of chaotic dynamics have found, in the last five years, an important application in research on compound electrical activity of the brain. The present volume seeks to cover most of the relevant studies in the newly emerging field of chaotic attractors in the brain.

This volume is essentially a selection and reorganization of contributions from the first two volumes in the *Springer Series in Brain Dynamics*, which were based on conferences held in 1985 and 1987 in Berlin. It also includes (a) a survey of progress in the recording of evoked oscillations of the brain both at the cellular and EEG levels and (b) an agenda for research on chaotic dynamics.

Although the first publications pointing out evidence of chaotic behavior of the EEG did not appear until the beginning of 1985, the presence of the pioneering scientists in this field gave the participants at the first conference (volume 1) a strong impulse toward this field. For me, as conference organizer, having been for a long time active in nonlinear EEG research, the integration of this topic was self-evident; however, the enthusiasm of the conference participants was greater than expected.

Just two years later, there were three times as many contributions to the second volume of *Brain Dynamics*, and the analysis of chaotic attractors belonged to the important building blocks. Here the topic "integrative functions of the brain" was dealt with in terms of several multidisciplinary approaches. The response to the conference was so favorable that two additional papers were added to volume 2, and the authors were highly cooperative in making revisions in and additions to their papers. The authors seemed not to be put off by the strong review procedure but rather to be motivated by it. One of the editors of volume 2, T. H. Bullock, insisted on methodological extensions and conceptual additions on the basis of extensive interaction with the authors and postconference communication among experts.

The stimulus to publish this supplementary volume lay in the interest expressed by several persons to learn about and to start research in this new field. At present it is still not easy to glean the relevant publications, distributed over several special journals and conference
volumes. For this reason, the editor and the publisher decided that a book of about 170 pages might more easily reach scientists working in this new field than the two full volumes covering a much broader spectrum of neuroscience.

Now greater than ever, we need new windows that can add to the growing list of techniques for comprehension of electromagnetic activity and local signs of change in the brain. In the “Epilogue” to *Brain Dynamics* volume 2 Bullock points out the importance of the new window as follows: “The contributions of Babloyantz, Rössler, Başar and Röschke, Skinner, Mpitsos, and others make me hopeful that we will soon see the dimensionality of many parts of the brain at the same time, second by second, in cats, catfish, and octopus, as rest changes into arousal, directed attention and recognition.” In fact, shortly thereafter it became possible to realize some of these wishes. It is my hope that this book as well will prove to address the genuine research questions of the future.

The editor wishes to express his sincere thanks to Professor T. H. Bullock for providing his constructive critique on the preliminary survey and for adding his agenda for research on chaotic dynamics to the present volume.

EROL BaşAR
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