Physiology, Promiscuity and Prophecy at The Millennium: A Tale of Tails

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by B J West

Studies of Nonlinear Phenomena in Life Science – Vol. 7

Physiology, Promiscuity and Prophecy at The Millennium: A Tale of Tails

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Preface

One of the last papers by Elliott Montroll was published in 1983 in collaboration with Michael Shlesinger titled, "Maximum entropy formalism, fractals, scaling phenomena, and $1/f$ noise: a tale of tails". This paper was part of a program of research that the three of us had, in various combinations and separately, been engaged in over the decade of the seventies and which Michael Shlesinger and me, again both separately and together when we can, continue into the present. These lectures, while not being chronological, nor in fact not just focusing on our own work, is in that tradition of story telling. Therefore I freely steal the pun in the title.

The tale concerns the uncertainty of knowledge in the natural, social and life sciences. We address the tails in many phenomena in these lectures, including the long-range properties of DNA sequences, the correlations in human gait, the long-time memory in the beat-to-beat interval in the human heart, the patterns over time in the birth of babies to teenagers and in the sexual pairings of homosexual men, to name a few. It will become apparent that these phenomena are so complex that no one is able to understand them completely. However, it shall also become apparent that we can gain insights and partial knowledge about such complex phenomena by applying certain overarching strategies that do not require a detailed mechanistic understanding of the phenomena being studied. These strategies include the development of models using fractal stochastic processes, chaotic dynamical systems, and the fractional calculus; all of which we tie together using the concept of scaling, and therein hangs the tale.

The perspective adopted in most science textbooks forces a dogmatic presentation, so it is difficult to question the facts and laws being presented. In addition such questioning is often actively discouraged in order that all the information thought to be important can be transmitted from the teacher to the student. In these lectures questions are encouraged, in part because that is how science progresses and, in part, that is what makes science fun. Therefore I shall attempt to make it clear from the beginning that there is no "right answer" to the general questions posed. Rather than answers, there are clues, indications, suggestions and tracks in the snow, as there always are at the frontiers of science. It is from this frontier that we draw our topics for discussion, and so it is no wonder that the knowledge is uncertain and our understanding is incomplete. In truth no one at present understands these things completely, but with hard work someday you the reader might.

Bruce J. West
Denton, Texas
July 4, 1998

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