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# S. Albeverio, V. Jentsch, H. Kantz (eds.): Extreme events in nature and society. (The Frontiers Collection)

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**Rudi Podgornik**

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Extreme or extraordinary occurrences are rarely, if ever, the basis of scientific theories. In fact more often than not they spawn wild speculations and untestable hypotheses. The obvious example is provided by the flutter of butterfly wings producing a the catastrophic storm a continent away. Nevertheless, it is almost by definition that these occurrences are extremely important just as they are rare which is the source of their fascination. Since science has already tackled subjects that some time ago would be deemed to be totally and unequivocally outside of its boundaries, such as dynamical chaos, causal nonlocality, quantum indeterminacy etc., why not delve also into the nature of extreme events or the Xevents as the contributors to this scholarly volume prefer to refer to them. Properly defined and delineated Xevents can be analysed, or at least an attempt at their analysis can be made, which is completely within the realm of well developed scientific methods. This is I believe the final message of the varied scholarly contributions to this volume.

More than just applying different well established formal methods to various Xevents, this volume also sets out to prove, rather less successfully I am afraid, that there is an emerging and unifying interdisciplinary science, the science of extreme events, that links the various Xevents among themselves. The points in favor of this view are very few, I believe, and one could certainly argue that by their very definition, Xevents manage to defy attempts at unification.

The volume "Extreme Events in Nature and Society" is a collection of 15 papers influenced by recent workshops on complex systems research and specifically by the NSF sponsored "XE: Extreme Events" workshop, held in Boulder, CO, in 2000 at the Institute for the Study of Society and Environment (ISSE). This is however not a collection of papers delivered at that particular workshop. It contains various contributions by authors from equally varied fields, both in terms of their scope as well as methods, that are trying to shed some light on the various aspects of Xevents.

R. Podgornik (✉)
Laboratory of Physical and Structural Biology, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, MD 20892-0924, USA
e-mail: podgornr@mail.nih.gov

The book is divided into three parts: General Considerations, Scenarios and Prevention, Precaution and Avoidance. The first part sets a kind of a stage for Xevents. Most of the papers in this part deal with either the mathematics of rare events, extreme value statistics and large deviation theory, or the underpinnings provided for the extreme events by the idea of self organized criticality and the fundamental question of whether Xevents are exogeneous or endogeneous.

D. Sornette, who is one of the contributors to this volume, concludes that endogeneous and exogeneous mechanisms have different dynamics and illustrates this with various examples including shocks in book sales and in financial markets. According to Sornette, endogeneous rare events are apparently followed by a power law relaxation which is slower than in the case of exogeneous peaks. The slow dynamics of endogeneous rare events implies that the dynamics are dominated by internal cascades that take a long time to relax. In the financial realm Sornette analyses in detail the precursors of rare events or financial crashes that he has studied for quite a while. The log-periodic behavior preceding financial crashes is argued to be a characteristic of endogeneous crashes whereas the absence of this precursor dynamics appears to characterize an exogeneous event. It remains to be seen if the log-periodic precursor dynamics really differentiates endogeneous from exogeneous Xevents in more general contexts than in financial analysis.

The second part of this volume is dedicated to case analyses of various phenomena that could be classified or variously conceived as Xevents. They include epilepsy, extreme geological events, extreme atmospheric events, extreme events in the physics of ocean waves, extreme events in material fracture, computer simulations of opinions and extreme events in network dynamics. Obviously the list is not, and cannot be, exhaustive, but merely represents an idiosyncratic cross-section through the various scientific disciplines in a search for the unexpected and extreme.

I must say that all of the contributions to the second part of this volume are very informative and even if one does not subscribe to the philosophy that Xevents share a unifying principle, are a delight to read. To my idiosyncratic set of criteria the chapter on freak ocean waves of the Gaussian seas certainly comes very close to be the case study of an Xevent. E.J. Heller analyses giant waves of heights between 20 and 30 m, which occur recurrently, but nevertheless rarely, on the high seas. Since the physics of ocean waves, current eddies and wind generation of waves are fairly well understood, the freak ocean waves stand a good chance to be understood in terms of first principles. From Heller's theory of these waves one appears to be able to predict the frequency of such events in certain parts of the oceans.

The last part of this volume deals with prevention, precaution and avoidance and is probably furthest removed from the more fundamental aspects of Xevents that have motivated the analyses in earlier chapters. The contributions to this part deal with modeling and cost-benefit analysis of mountain hazards, written of course by Swiss snow and avalanche specialists, prevention of surprise in an evolving economy and disaster response management. Obviously again we are far from fundamental aspects of extreme events, in the realm of dealing with, and analyzing mostly social consequences, especially those connected with the various constraints provided by our multifaceted social environment.

One thing that I can say for this volume is that it is definitely informative. Especially the second part would be, I believe, closest to the mindset of an average physicist. With respect to the question of whether there is sufficient material here for a unifying view of extreme events, I choose to remain a skeptic. There is no doubt, however, that physical and mathematical methods can be applied in contexts that would seem fairly exotic to their discoverers and other interested scientists.