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About ISEM

The International Society for Ecological Modelling (ISEM) promotes the international exchange of ideas, scientific results, and general knowledge in the area of the application of systems analysis and simulation in ecology and natural resource management. The Society was formed in Denmark in 1975, and today has chapters in Germany, Italy, Japan, and North America. ISEM Sponsors conferences, symposia, and workshops that promote the systems philosophy in ecological research and teaching, and in the management of natural resources. The Society publishes the newsletter ECOMOD, and its members frequently contribute articles to the official scientific journal of the Society, *Ecological Modelling*.

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Perspectives: OECOLOGIA EX MACHINA?

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Most articles appearing in *Ecological Modelling* deal with mechanistic models of coupled ecological processes. On occasion models will include stochastic variation of boundary conditions or parameter values. Does our emphasis on mechanism mean that, as ecologists, we regard ecosystems as naught but machines? How could it be otherwise when the reigning paradigm is neo-Darwinism. Darwin himself, an ardent admirer of Newton, consciously endeavored to keep his explanations mechanistic in nature. Fisher, Haldane and others, who brought about the "Grand Synthesis", pried open Darwin's theory enough to inject stochasticity; however, chance and indeterminacy were relegated strictly to the scale of molecules and atoms. The ensuing view of evolution that conventional biology would impress upon us seems to me a bit schizoid — one's perspective is constantly and suddenly shifting back and forth from the mechanistic macro-world of Newton to the chaotic nether world of Boltzmann.

The chief trouble, however, is that this mechanistic emphasis doesn't get us very far in understanding and predicting how ecosystems change. True enough, mechanistic models do provide helpful insights into many counter-intuitive phenomena. I, for one, will continue to work with such models and (I hope!) publish my results in *Ecological Modelling*. But we should begin to acknowledge that almost every time models of several coupled processes are used to predict outcomes in developing ecosystems, the results are... well, catastrophic! In fact, the track record of mechanistic models is so consistently poor in this regard that theorists like Peter Abrams are now providing analyses that suggest mechanical analogs *can't* predict results whenever adaptive populations are part of the system (as they invariably are).

A possible way out of our conundrum has been suggested by someone whom most regard as a conservative figure in the Philosophy of Science. None other than Karl R. Popper is now urging scientists to revamp their views on causality. Whereas neo-Darwinism depicts a world that is causally open only at the extremes of scale, Popper envisions a universe that is causally open at *all* levels. Instead of seeing an event as the inevitable outcome of some mechanism, or force, Popper writes about the "propensity" for an event to occur *within a particular context*. Propensity he sees as a Bayesian, or conditional probability that, when enmeshed in a deterministic environment, degenerates into a "force". At the opposite limit of no environmental influence, propensity fades into unconditional stochasticity. What is crucial to note is that Popper does not invoke probabilities merely to quantify our ignorance about an event (epistemology). Rather, he sees indeterminacy as *essential* to the event itself (ontology). In blunt terms, ecosystems are *not* machines!!

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analysis and subsequent reporting takes longer still. Thus, the production of a text on the 82/83 El Niño "only" seven years after its occurrence is in fact a considerable feat of academic prowess.

The book reviews ecological consequences from both marine and terrestrial points of view. The marine coverage is somewhat more complete, including chapters on ocean nutrients and productivity; coral disturbance and mortality; fisheries; marine iguana; seals and ocean kelp. In the terrestrial context, chapters review the impact of this intense El Niño on sea birds (including two "refugee" boobies); the El Niño-induced drought impact on a Panamanian semi-deciduous forest; and the repercussions for Peruvian desert floras affected by the same event

I find this textbook fascinating. I have the usual complaints about heterogeneity of typesetting and diagrammatic material, but the editing seems to have been thorough and the index is fair-

ly complete. Most importantly, I discovered many aspects of global ecology as it affected by ENSO. These range from Pacific coral reefs, which had enjoyed uninterrupted growth for several centuries, being devastated (98% mortality) by this single ocean/atmosphere event; giant sea kelps uprooted by heavy winter seas; and albatrosses, penguins and sealions greatly stressed by the breakdown of their normal food chain.

Overall, I recommend this text to anyone interested in El Niño or its consequences.

It is a jolly good read

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In analogy to the transition from Newtonian to Quantum Physics, Popper suggests that we shift our focus in ecology away from the location of the ecosystem in some putative mechanical phase space and toward the distribution of conditional probabilities of possible system outcomes. Having made such a shift, it becomes clear why mechanical models were inadequate to the task of depicting development. Mechanical models occupy either a shrinking (point and limit cycle attractors) or constant (strange attractors) domain of phase space. Consequently, when one samples mechanical outputs over a sufficiently long interval of time for the purpose of estimating probabilities, the results converge to static distributions. But the crux of Popperian development concerns *changes* in probability distributions.

Myron Tribus has defined "information" as "anything that causes a change in probability assignment." Seen through this lens, information theory becomes an organic adjunct to probability theory, the bread and butter of ecology. Through unfortunate historical accident, information theory was discredited in the eyes of most ecologists during the early 70's. It now must be rehabilitated if we are at all to make any progress in quantifying Popper's propensities, and thereby ecological development.

Certainly, some readers will wonder, "If mechanical cause is insufficient, then whence the or-

ganization we see in ecosystems?" I have argued that mutualistic configurations of propensities behave in the fashion of Aristotelian formal cause when they impart order to developing systems. Robert Rosen in his recent book, *Life Itself*, goes even further to suggest that such "self-entailment" acts in the capacity of final cause.

Soon after the turn of the century physicists began to abandon the mechanical world view with its promise of arbitrary precision in favor of a theory that holds nature itself, and not just our measurement of it, is imprecise. In the end, however, quantum physics yielded better predictions than were hitherto possible. I find it more than a little ironic that as biologists we cling like sheep to a mechanical view of nature. Instead, as ecologists, we should seize the enviable opportunity to open the eyes of the world to propensities and to a new conception of nature. To paraphrase David Depew and Bruce Weber, from their forthcoming book, *Darwinism Evolving*, "Clements had it backwards. Ecosystems are not superorganisms; organisms are superecosystems!" Ecology, long the neglected stepchild, is about to take center-stage.

The Editor invites responses to Perspectives articles from readers for subsequent publication in *Ecomod*.