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Invasion of the Dollar Snatchers: The Aliens Have Arrived and We Are Paying the Price

A Plague of Rats and Rubbervines: The Growing Threat of Species Invasions. Yvonne Baskin. Island Press, Shearwater Books, Washington, DC, 2002. 330 pp., $25.00 (ISBN 1559638761 cloth).

A Plague of Rats and Rubbervines is a courageous and largely successful attempt to summarize the immense environmental and economic impacts of invasive alien species on a planetary scale. The scope of the book is staggering, encompassing viruses, grasses, insects, and pigs. Indeed, one of the few weaknesses of the book is its nearly overwhelming avalanche of examples. Although a more explicit map through the labyrinths of the subject might have been helpful, Baskin provides enough road signs and rest stops to make the journey compelling. Just when the reader risks losing track of where the story is going amid a staccato review of impending, ongoing, or historic disasters, Baskin imposes a bit of structure or a welcomed in-depth account to illustrate a central point.

In addition to presenting the problems created by moving organisms around the globe at an evolutionarily unprecedented pace, Baskin promises to offer solutions. And it is here that the book becomes a bit disappointing. To be fair, the difficulty is more scientific and institutional than literary, and one ought not to fault the messenger. Indeed, if the author is a tad optimistic, she is also scrupulously honest. In summarizing the state of knowledge, Baskin admits, "So far, then, we have neither a Holy Grail nor a set of powerful formulas for predicting invasion success." In fact, we don't have much of a clue at all. This might be a bit harsh, but it seems that the best that ecologists have come up with is a theory of recidivism (past invaders are likely to be repeat offenders), a general rule that "more is worse" (the larger the founding population, the more likely it is to establish), and a self-evident notion of probability (the more often an organism arrives, the better its chances of succeeding).

If ecologists have only a vague sense of what is happening, policymakers and economists are in even worse shape. At several points, Baskin notes that society should shift the risk burden of invasive species to those who benefit from international trade and travel. This "polluter pays" principle seems reasonable, but we are left with a fuzzy notion that somewhere within the toolbox of civil fines, criminal penalties, special taxes, mandatory insurance, fees, and bonds must lie the means of constructing a coherent defense. The supposedly model systems of Australia and the Galapagos Islands appear to be marginally effective and enormously expensive. The analogy of "holding back the tide with a squeegee" seems disappointingly apt.

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I read with particular interest the section on biological control, an area of my own professional interest. Baskin managed a remarkably evenhanded treatment of a polarized set of issues. She suggests that the field of biocontrol has cleaned up its act from the early days of introducing cane toads and mongooses, noting that "modern codes of conduct formalized in the 1990s direct researchers to seek out single-minded natural enemies that attack only the intended target." But she admits, "The days of using vertebrates with broad appetites for biocontrol are not all behind us," describing the recent release of exotic carp to control an outbreak of snail-borne parasites on catfish farms. Baskin goes on to point out that, "since the 1990s, ecologists have increasingly taken classical biocontrol to task for the real or potential damage that invertebrate agents have inflicted on native species." She neatly puts both this contention and the "show me the damage" defense of the biocontrol community into perspective, noting that "despite the flurry of such reports, direct evidence on nontarget damage by biocontrol agents has been hard to come by, especially because there are not many people looking, certainly not the agencies that released the bugs in the first place."

The book targets the general public, or at least the environmentally conscious segment of society. If the book is intended for a primarily US market, then the use of metric units is a mistake. Most people in the United States, can't picture a 6-meter-high wall of shrubby vines or convert 100 kilometers into miles. Telling people that a particular weed infests 5 million hectares is not very informative; few of my undergraduates know the approximate area encompassed by an acre, let alone a hectare. For that matter, big numbers become meaningless without a context. Baskin reports that foreign ballast water pours into our ports at a rate of 9 million liters per hour—most people don't know how much a liter is, and if they did, they almost surely couldn't comprehend the volume of 9 million of them. On the other hand, she does convert the 5.33 billion metric tons of seaborne trade in the world into a line of 18-wheelers circling the earth 60 times. That's a lot of stuff.

Baskin claims that her writing curbs the "lurid excesses" of popular accounts that refer to our warlike efforts to "battle noxious, exotic green cancers that establish beachheads and overrun natives." Fortunately, she reneges on her promise—or at least she stretches its limits. Although she avoids melodramatic prose, she writes with conviction. Numbers don't motivate people, but the passion that infuses Baskin's descriptions of the effects of alien invasive species on native landscapes and people might. Occasionally her prose becomes a bit hyperbolic (e.g., "Today, Darwin would find all of the world's temperate grasslands...utterly transformed by invasive plants") or even technically erroneous (e.g., including gypsy moths and scale insects in a list of "spineless predators"), but overall her passion arises from a solid, scientific understanding of the nature and severity of the issues.

My only substantive disappointment with the level of scholarly work in the book is Baskin's brief venture into environmental ethics, which concludes, "It would be hard to claim on purely philosophical grounds that a kokako is intrinsically better, more natural, or more valuable in New Zealand than a starling or a rat." In fact, there is considerable ethical basis for claims of inherent value of native species. It is mistaken to cavalierly dismiss the field of environmental ethics, when such arguments underpin the social values and individual behaviors that Baskin hopes to change. But the damage to her case is not fatal: Whether or not introducing starlings and rats is "wrong" in a moral sense, such invasions are clearly economic, social, and cultural disasters.

I am not sure that the average reader will have the patience to wend his or her way through 330 pages of dreadful news, with only a glimmer of hope. Despite Baskin's attempt to foster optimism, the overall sense is—unfortunately but perhaps honestly—one of drowning in a rapidly rising tide of alien species. Stopping this species or eradicating that one seems to be an expensive and exhausting delay of the inevitable. If there is any cause for hope, it lies in the efforts of writers such as Baskin, who are willing to conduct extensive research and present information in a manner that is generally accessible to the public. Indeed, the most effective solution might be to quarantine the members of Congress (or whatever governmental body is appropriate) and release our leaders only after they've demonstrated that they've read and understood *A Plague of Rats and Rubbervines.*

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WILL GENES SURVIVE GENOMICS?

The Misunderstood Gene. Michel Morange, trans. Matthew Cobb. Harvard University Press, Cambridge, MA, 2001. 222 pp., $24.95 (ISBN 0674003365 cloth).

Misunderstood, maligned, malicious, mutant, mistranslated, and demystified, genes have been central to biology for over a century. Morange joins the notable company of Evelyn Fox Keller (2002), Richard Lewontin (2000), Celeste Michelle Condit (1999), and Jose Van Dijck (1998) in questioning the current excitement over the complete sequencing of the human genome and in providing a complex perspective on intricacies of the relationship between genotype and phenotype. What informs all five of these critics is a deep appreciation for the science of genetics and a desire to instantiate our comprehension in a way that is as free as possible from the eugenicist heritage of human genetics. Thus, Morange is especially concerned with reductionistic interpretations of knockout experiments ("targeted gene inactivation") and asserts that we must "face the problem of determinism squarely...to go beyond it" (p. 7).

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As a biologist and a historian of science, Morange seamlessly navigates both experimental detail and social history with a careful retelling. His analysis invokes plurality, complexity, and diversity, and he cautions us to "be wary of hasty explanations and simplistic schemas" (p. 61). In fact, he labels many popular understandings and newspaper coverage as promoting "dangerous fantasies" and as being "mistaken."

While converting *La Part des Génes* to *The Misunderstood Gene* is not equivalent to translating Proust, Cobb has maintained some syntactical features of the original French that make it somewhat difficult for American readers. Numbered lists abound throughout the book, and often one has to follow three or four subpoints within a particular paragraph that elaborates just one item in a series. On the other hand, Morange frequently gives more attention to European intellectuals (including references to original works in French and German) than do most American molecular biologists, which is often refreshing and illuminating. Nonetheless, most American biologists will find the material familiar and the analysis interrogative rather than authoritarian.

Morange covers an impressive amount of detail on experiments meant to elucidate the genetic basis of behavior, mental illness, development, aging, disease association, and cancer. While his own research is on embryonic heat shock transcription factors, among other topics, he is not prone to self-promotion or self-citation; instead he draws on the work of many laboratories. Furthermore, this is a fresh analysis that is not derivative of his previous book, *A History of Molecular Biology* (Morange 2000a), although he did publish a review article on gene function (Morange 2000b) that made the same basic argument presented here. In *The Misunderstood Gene,* he elaborates significant details of conflicting reports in the primary literature on the interpretation of gene function from molecular, cellular, and organismal studies.

The book has 10 chapters, with most of the detailed analysis presented in chapters 4 through 8. Chapter 4 focuses on diseases originally thought to be caused by single genes, such as sickle cell anemia, Williams syndrome (a neuropathology), and Alzheimer's disease. Chapter 5 describes *in vivo* versus *in vitro* experiments on genes involved in detoxification of dioxin in the liver, in Lesch-Nyhan disease, in cytoarchitecture (but not tensegrity), and in signaling networks. Chapter 6 explores long-term potentiation of synapses in the brain, Benzer's temporal mutants in *Drosophila,* and a critique of "cognitive kinases" (p. 90). Chapter 7 looks at oncogenes and cancer, several Nobel Prize–winning discoveries on the relationship of genetic regulation and development, the role of telomerases in life span and aging, and apoptosis and the existence of "death genes" (p. 122). Finally, chapter 8 focuses on behavior through circadian "rhythm genes" such as *period, timeless,* and *clock;* on the relationship of sexuality and personality to general mutations "that primarily affect vision, olfaction, or the emission or detection of auditory signals" (p. 131); on transcription factors involved in sexual differentiation; and on a critique of the "gay brain" hypothesis (p. 134), genomic imprinting, heritability and IQ, and altruistic behaviors.

Throughout, Morange imputes to researchers self-preserving scientific behavior, errors of inference, and neglect of work by opponents or investigators with radically different approaches. While his critiques are not gossipy, they do have the effect of suggesting a certain authorial omniscience that can become wearing, especially because of an underlying flag-waving for logical positivism.

Morange emphasizes the biological sources of many of these difficulties in inference-making—intergenic redundancy, multiple pathways and compensation, feedback loops, and the differences between susceptibility and realization in a particular context—while taking on Weissman's heritage of somatic and germ-line dichotomy: "Thus, the strict division between maternal and genetic factors, beloved of certain biologists, is clearly artificial" (p. 73). He concludes chapter 8 with homage to Waddington's "metaphor of a landscape to describe gene action during development" (p. 152).

Some of his observations seem insightful and sound: "A genetic diagnosis not only affects one person, it affects several" (p. 166). But shortly thereafter, his conclusion that "this link between genes and proteins is not primordial, it is not consubstantial with life" (p. 168) and that "we can regret the passing of the RNA world in which two fundamental characteristics of life—self-replication and the organization of complex molecular structures—were expressed by a single type of macromolecule" (p. 169) seems to be merely political rhetoric. Morange here ignores the intertwined evolutionary history of the relevant "eusemantic molecules," to use Zuckerkandl and Pauling's (1965) language, and 35 years of careful phylogenetic analyses of nucleic acids and proteins. He instead confers ultimate status on speculations about the RNA world. These are not the only examples of omissions; while Morange gives great attention to *in vitro* and *in vivo* experiments, he virtually ignores the insights of population and quantitative geneticists. He gives passing lip service to multifactorial and multigenic (p. 50) models of the inheritance of complex traits as well as to the concept of penetrance (p. 75) but never invokes epistasis, pleiotropy, or polygeny explicitly. Furthermore, his apposition of population and molecular genetics screens off readers from extremely fruitful work in molecular population genetics, QTL (quantitative trait locus) analysis by molecular quantitative geneticists, and molecular phylogenetic systematics.

Morange cites the "rediscovery of the cell...[as] a major level in the integration of biological processes (and thus in their explanation)" and declares that it "was probably the most important change that has taken place in molecular biology since its rise in the 1950s" (p. 160). While I applaud this holistic move to combine structure and function in context, I would argue that Morange, like many other molecular biologists, inadequately discusses the primary integrative theory for the past 150 years, namely evolution. Homology of sequences has afforded us the opportunity to systematically test hypotheses such as endosymbiosis (with major ramifications for the whole inter-

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nal organization and compartmentalization of cells), orthologous versus paralogous functioning of isoenzymes or protein subunits, and whether function is primitive or derived. Morange largely ignores the bioinformatic revolution, which is based on inferences drawn from sequence evolution. He might have heeded his own words: "As with virtually all conceptual changes, most people did not even notice" (p. 160). However, he does cite some of the conclusions of this work throughout the book. For example, on page 98 he states, "Moreover, evolution has not conserved isolated genes but rather pathways and entire networks of developmental genes—functional modules," and on page 99, "These organisms use the same molecular mechanisms to construct themselves as did their long-dead common ancestor. The resemblance of genes is a mark of a homology in the construction of organisms."

Nonetheless, I wholeheartedly agree with Morange's conclusion that "we should abandon the naïve idea of a single one mutation, one disease relation" (p. 52). And besides recommending his book *The Misunderstood Gene*, and other recent books by Richard Lewontin, Evelyn Fox Keller, Jose Van Dijck, and Celeste Michelle Condit, to general readers, I would strongly recommend that students in standard genetics classes read at least one of these informative critiques of the excesses of geneticists' claims.

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