REVIEWS

Win-Win Ecology, By Michael L. Rosenzweig; Oxford University Press, 2003; 211 pages, $27.00; ISBN 0-19-515604-8

Win-Win Ecology deals with the problem of reduced biological diversity of animal and plant species due to their being driven to extinction by loss of habitat caused by humans taking over all but a small fraction of the Earth's available space. The author provides an elaborate scientific treatment to explain and quantify how very serious (and perhaps even devastating) this problem is, and will become in the near future, but this is done only in Chapters 8, 9, and 11 of the 12 chapter book. The downbeat character of this treatment is more than counter-balanced by the upbeat message of hopefulness in the rest of the book.

The author concedes at the outset that when ecological benefits come into conflict with human economic concerns, the economic concerns normally win. His solution is to find and implement ways in which ecologically-responsible activities result in economic and lifestyle benefits rather than penalties. He calls this "reconciliation ecology" which he defines as the science of inventing, establishing, and maintaining new habitats to conserve species diversity in places where people live, work, and play. The first seven chapters of the book are full of successful examples of this reconciliation ecology.

One such example is a U.S. program now in operation for making back yards of homes attractive to wild life and wild flora, while improving their attractiveness to people and saving on maintenance costs and efforts (e.g. lawn mowing). Another example is roof gardens on Berlin houses that do not need watering, fertilizing, or mowing. There is an extensive description of successful ecological improvement programs at Eglin Air Force Base in Florida without compromising the wide variety of military activities there; these programs also promote recreational activities, including fishing and hunting.

There are several examples where the benefits involve making money. A large cattle ranch in Utah utilized wild life (deer, elk, and moose) management to convert parts of the land into a hunting area bringing in substantial license fees from hunters. A program for saving the almost extinct vicuna in Peru has resulted in a flourishing population of vicunas yielding substantial income for their very valuable fleece. A salt marsh was created near Eilat in Southern Israel which has become an important stop for birds migrating between Europe and Africa, resulting in a flourishing and profitable tourist attraction.

There is a chapter on hidden costs that are avoided by ecologically beneficial procedures, even though such procedures may increase direct costs. One example is where the direct economic benefits of using chemicals in agriculture are more than balanced by loss of top soil that this causes. Other hidden costs discussed include air and water pollution, and building roads to accommodate forest exploitation. Ecologically devastating improvements in efficiency of coffee growing in Latin America led to collapse of coffee prices, with the result that coffee growers suffered large economic net losses. Social costs are also worthy of consideration; for example, large agro-businesses may be more efficient than a system of family farms, but the author considers the loss of family farms to carry a social cost that far over-balances the benefits of the improved efficiency.

One chapter deals with small things people can do to accommodate wildlife living with them, and benefit from its presence. For example, the Eastern Bluebird in the U.S. is being saved by constructing nest boxes that they can use without interference from their starling and sparrow

enemies. Analogous situations are described for saving leopard frogs, butcherbirds, and natterjack toads.

Another chapter deals with "happy accidents" where technological developments led to ecological benefits. Crocodiles in the U.S. were saved from extinction by warm water discharges from a Florida nuclear power plant. Draining lands to allow farming in the Czech Republic led to ponds which spawned a profitable fishing industry, with a side effect of saving a population of otters. An architectural design movement in Israel and a bridge design in Texas saved local populations of bats by providing habitats for them.

There is a chapter on "reservation ecology" - setting aside wild areas such as national parks to leave undisturbed or for limited use, and "restoration ecology" - restoring areas to their original wild condition. But these are characterized as "fighting for crumbs", not important enough to be truly effective.

As very much a non-expert, this book left me confused. If the situation is as grim as the author portrays it in Chapters 8, 9, and 11, I cannot understand how the counter-measures discussed in the remaining chapters can come close to resolving the problem. These remaining chapters describe the saving of a few local populations of selected species whereas the problem involves the extinction of millions of species - the prediction is that 95% of all species will soon become extinct. How, then, can the author exude so much upbeat optimism? The only avenues for optimism that I can see are that his estimates of extinction rates are perhaps greatly exaggerated, or that mankind can thrive with only 5% of the species our world now contains. But the author seems certain that neither of these provides an escape from the problem. He seems to believe that the measures described in the first seven chapters will be expanded to save the situation. It seems to me that this would require at least a million-fold expansion of these measures during the current century, which I would judge to be completely incredible.

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Report of the American Physical Society Study Group on Boost-phase Intercept Systems for National Missile Defense: Scientific and Technical Issues, By a Study Group: David K. Barton, Roger W. Falcone, Daniel Kleppner (Co-chair), Frederick K. Lamb (Co-chair), Ming K. Lau, Harvey L. Lynch, David E. Moncton, L. David Montague, David E. Mosher (Staff director), William C. Priedhorsky, Maury Tigner, and David R. Vaughan

Report available online at http://www.aps.org/public_affairs/popa/reports/nmd03.html
Will be published later as a supplement to an issue of Reviews of Modern Physics.

Much delayed, the report of this American Physical Society (APS) study group was finally made available to the public on July 15th. Matching up with the long title is a bulk of over 400 pages—though for those with shorter attention spans, there are two levels of executive summaries available as well. Indeed, the news coverage of the report has not gone beyond the abstract. To wit, intercepting intercontinental ballistic missiles (ICBMs) shortly after launch (boost-phase) is technically difficult, requires interceptors of similar size to the ICBMs, is susceptible to simple countermeasures, and is likely to be obsolete by the time it is deployed as faster (solid-fueled) ICBMs become available. The three-year study is far more than its executive summary, however. It contains elegant condensations of the physics of rockets, radars,

atmospheric beam propagation, and guidance command loops, just to mention a few of the topics considered. It is a thorough manual to the science and engineering of a boost-phase missile defense.

For the most part though, readers are concerned with the central conclusions of the report—that boost-phase intercepts of ICBMs from the chosen "rouge nations" of Iraq, Iran, and North Korea are highly problematic if not completely absurd. Other than sticking with the politically charged "Axis of Evil," policy statements are studiously avoided. Most people reading the report can easily draw their own conclusions in that direction. Challenges to the report also are likely to be of a political nature, rather than of a technical nature. Since the study was initiated, the national missile defense plan (and budget) has become increasingly entrenched by the Bush administration, the Republican-controlled Congress, and a Pentagon confident in its expanding missile defense monies.

Returning to the technical issues that are at the heart of the study, the panel concluded that:

- Defense of the entire United States might be feasible against liquid-fueled ICBMs (such as the expected first generation North Korean ICBMs), but not likely to be practical against faster, solid-fueled follow-on missiles.
- Space-based interceptors might be technically possible, but would need to be very large and very numerous. Such an expensive system would also require space-launches far in excess of current and projected launch rates.
- Airborne lasers might have some utility against the vulnerable liquid-fueled rockets, but are unlikely to be effective against solid-fueled rockets.
- Even successful intercepts of inbound missiles present serious problems with the ballistic flight of the missile payload. That payload will fall short of its target, but that may well be onto (friendly) populated areas.
- The fundamental difficulty (beautifully illustrated in the study report with maps of missile defense launch areas) amounts to the short window of time to detect, commit to a launch against, and accelerate to reach an enemy rocket.
- The technical problems of any of these systems are large, so any boost-phase intercept system would take significant time to deploy. The study indicates perhaps 10 years before an effective system could be built.
- Within that time, the named opponent countries are expected to have solid-fueled ICBM technology, rendering the defense obsolete.
- The US Naval Aegis anti-air and anti-missile system (most famous for "successfully" shooting down an Iranian civilian airliner) has some capability against sea-launched missiles aimed at the United States, provided the Aegis destroyer or cruiser is within a few tens of kilometers of the ballistic missile launching ship or submarine.

Anyone with interest in the technical aspects of any of these issues is well advised to download the PDF file from the web and start reading. (Printing the tome takes most of a ream of paper and a three-ring binder.) It is difficult to imagine anyone but the savviest military insider not learning something useful or interesting from this work. The authors of the study have come from a wide range of backgrounds to produce this document, which draws on declassified military data and analyses but explains systems in the terms and style of physics publications. A serious reader could spend quite a few years with the references…

By limiting the scope of the boost-phase defense (for example, to only protect Hawaii against a North Korean rocket), it gets somewhat easier. Supporters of the missile defense programs are likely to latch onto these sorts of limited goals as "first steps." It will be interesting to observe how this study report is used in the debate over missile defense. Do the serious technical

problems carry weight with the President, the legislators, and the military-industrial complex? Do the mildly favorable comments about protecting limited areas, or the limited capabilities of an airborne laser and the Aegis system give supporters of national missile defense an "in?" How much does missile defense even have to do with the technical objectives? Does this report spell the end of boost-phase intercept enthusiasm? We know the answer to the last question only, and that answer is "no." That may give us a hint as to how the other questions will be addressed over the next few years.

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Freedom Evolves, By Daniel C. Dennett, Viking, New York, New York, (2003), 247 pp, $24.95, ISBN 0-670-03186-0

Daniel Dennett sets out to prove that free will is real and has evolved over eons according to the laws of nature. Much of the book is devoted to defining free will--or rather, why the usual notion of free will is uninteresting--and its relationship to determinism. `From Dennett's perspective, the traditional definition of free will as the ability possessed by a creature to willfully change the trajectory of its life---even in a deterministic universe---is a metaphysical definition which is no longer useful. He argues convincingly that the insertion of indeterminacy (quantum or otherwise) does not lead to free will as defined above.

To show this, Dennett goes over the arguments of Robert Kane (*The Significance of Free Will* and *Responsibility, Luck, and Chance: Reflections on Free Will and Indeterminism*) who argues that free will depends on the existence of self-forming acts (SFAs) that contain the essence of free will and ultimately stem from a fundamental indeterminacy as found in quantum mechanics. In particular, for a genuine SFA to occur, there must exist alternative possibilities (AP's) at the moment that the SFA takes place, namely, the agent should have other real options that he chooses not to exercise. To achieve the SFA, there must also arise a random, indeterminate event in the agent's brain somewhere between the moment of input of all elements that contributed to the SFA, and the moment of output when the decision prompted by the SFA becomes evident through the agents actions. Dennett points out that you can always make that time interval so small that no SFA can be found. Ultimately, the mechanisms producing SFAs and their identification become impossible to determine. Dennett doesn't prove that SFAs do not exist; rather he argues that their existence is irrelevant.

Dennett's ultimate goal is to show that notions of self and morality can emerge from evolution. Once a sense of self has evolved, an agent can be assigned responsibility for its actions performed out of its own free will. Dennett's discussion on the evolution of morality is largely based on game theory such as the prisoner's dilemma where two suspects under interrogation in separate rooms are each told that their partner has confessed. If the two suspects resist the temptation to squeal---i.e., if they are both "cooperators"---they will both get short jail sentences. If one of the prisoners implicates the other in a confession---making him a "defector"---while the other does not (the cooperator), the defector will go free while the cooperator will receive a long sentence. If they are both defectors and implicate each other, they will both get long sentences. Dennett argues that groups of cooperators will tend to flock together and on average will have better chances of survival than groups of defectors or mixtures of defectors and cooperators. Morality will spring up from these groups of cooperators whose social interactions eventually lead to a sense of self and responsibility.

The point at issue in *Freedom Evolves* is never whether free will can exist in a deterministic world. Instead, Dennett explores how a sense of responsibility for one's action can evolve naturally. Indeed, in the last chapters of the book, Dennett attempts to show that a more naturalistic definition of free will is a sounder foundation on which to build a judiciary. However, he doesn't succeed in showing that this approach would result in a remarkable improvement in the dispensation of justice.

With regards to the writing style of the book, Dennett relies far too much on Socratic dialogue to make his points; asking four or five consecutive questions (a typical occurrence) made the book more difficult to read than if Dennett had simply laid out his arguments. On a related note, he spends too much time answering questions that he assumes the reader has, and in reading certain sections of the book, one gets the feeling of witnessing an argument between Dennett and invisible haranguers. In fact, many parts of the book are unnecessarily wordy and could have been presented in a simpler manner. This said, I do think this book a worthwhile read to anyone interested in questions of free will as seen in the light of modern science.

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