THE TRAGI-COMEDY OF THE COMMONS: EVOLUTIONARY BIOLOGY, ECONOMICS AND ENVIRONMENTAL LAW

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"[A]ll thinking is finally a comparison"[1]

Like every culture, every discipline has a creation myth that defines its view of the world. Creation myths are important because they define what we see and what we fail to see. In recent years, environmental law in America has been dominated by a creation myth that subtly inculcates the perspective of economics. What follows is a different view of environmental law based on a view of human nature drawn from evolutionary biology. The evolutionary and the economic perspectives are not inconsistent, but complement one another by emphasizing different aspects of human nature.

I. PERSPECTIVE FROM ECONOMICS

In American environmental law, our reigning creation myth comes from a remarkable parable entitled "The Tragedy of the Commons," published in 1968 by Garrett Hardin.[2] Hardin argues that selfish herders would place more and more cows on the commons until its carrying capacity was exceeded and all would perish.

Hardin's view of human nature as narrow-minded and selfish

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[1] HAVELOCK ELLIS, THE DANCE OF LIFE 102 (Riverside Press, 1923).

[2] *See* Garrett Hardin, *The Tragedy of the Commons*, 162 SCI. 1243 (1968).

(sometimes called *homo oeconomicus*[3]) has dominated the understanding of environmental problems in the United States. The problem Hardin identified has a variety of names— "market failures," "collective goods problems," "uninternalized externalities," and the prisoners dilemmas.[4] Congress even cited the "Tragedy of the Commons" in the legislative history of the 1969 National Environmental Policy Act.[5] Excerpts from Hardin's article have been featured prominently in many environmental law casebooks.[6] At an American Association of Law Schools seminar on teaching environmental law in 1983, every professor of environmental law in attendance said he or she used the "Tragedy of the Commons" as a paradigm for explaining environmental law.

There is just one problem—Hardin was wrong! Or, better said, his account of human nature is incomplete and too simplistic.[7] One should not judge Hardin too harshly for simplifying a complex problem. All thinking utilizes "summatory fictions,"[8] simplified models of the world that are useful for some purposes but not for others. For example, Adam Smith's vision of "economic man" was a merely "valid artifice,"[9] a useful fiction, that illuminates some aspects of "observed phenomena" at the inescapable cost of suppressing other valid insights. Adam Smith himself "based his moral theory on a totally different kind of man."[10]

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[3] *See* E. Donald Elliott, Contributions of Ethology and Evolutionary Biology to Modifying the Model of Human Nature in US Law, *in* F. Haft, H. Hof, & Wesche, (ed.): Bausteine zu einer Verhaltenstheorie des Rechts, (Baden-Baden: Nomos-Verlag, (2001, in press)(papers presented at Volkswagen Foundation Interdisciplinary Conference on contributions of behavioral science to the model of human nature in law "Interdisziplinäres Kolloquim zur Schwerpunkt "Recht und Verhalten" der Volkswagen-Stiftung Beitrage der Sozial – und Verhaltenswissenschaft zur Menschenbild des Rechts").

[4] ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION LAW, SCIENCE AND POLICY 53-54 (Aspen Law & Business, 2d ed., 1996).

[5] *See Effects of Population Growth on Natural Resources and the Environment: Hearings Before a Subcommittee of the House Committee on Government Operations*, 91st Cong. 1st Sess. 131-39 (1969) (reprinting a copy of *The Tragedy of the Commons* in the Appendix to the Report). Hardin also testified in person before the subcommittee. *See id.* at 90.

[6] *See, e.g., id.*at 45; *See also* Garrett Hardin, *The Tragedy of the Commons, in* FOUNDATIONS OF ENVIRONMENTAL LAW AND POLICY 4 (Richard L. Revesz ed., 1997).

[7] Hardin himself apparently recognized that human societies might be capable of saving themselves, because he argued for various regulatory solutions to the tragedy, including private property or other forms of government regulation. His theory was, however, incomplete in that he invoked legal regulation *deus ex machina* without explaining how the selfish, narrow-minded herders that he had envisioned as exemplars of human nature were able to create an enlightened state capable of acting in the larger interest of the community. *See infra* note 34.

[8] ELLIS, *supra* note 1, at 98.

[9] *Id.* at 99.

[10] *Id.*

No model can be a complete representation of its object. By definition, a model is simpler than the thing that it represents. Modeling necessarily brings some features to the fore at the price of suppressing others. The proper question, therefore, is not whether Hardin's model is correct, but whether it is useful for particular purposes. The simplified model of human actions as selfish and unenlightened is highly useful for explaining many observed phenomena. One thesis of this article, however, is that we have learned Hardin's lessons too well in American environmental law at the turn of the century. While Hardin's insight is a useful "summatory fiction" for explaining certain aspects of human behavior and environmental problems, there are other "views of the cathedral"[11] that are suppressed by Hardin's account of the sources of environmental problems from an economic perspective.

In her influential 1986 article, "The *Comedy* of the Commons,"[12] Yale Law School Professor Carol Rose provides a strong counter-point to Hardin by pointing out that human societies holding property in common do not in fact always destroy nature and themselves in the way that Hardin posits. Instead, societies sometimes develop cultural and other non-regulatory ways of regulating their relations with the environment.[13]

In actuality, neither Hardin's picture nor Rose's picture is entirely accurate. As we learn more about environmental history, we are increasingly discovering that human history is rife with examples of both successes and failures by human communities to understand and cope with environmental problems that threaten their long-term survival.[14] Perhaps the accepted term should be called neither the comedy nor the tragedy, but the "tragi-comedy of the commons." This term would reflect that human beings sometimes solve their

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[11] Guido Calabresi & A. Douglas Melamed, *Property Rules, Liability Rules and Inalienability: One View of the Cathedral*, 85 HARV. L. REV. 1089 (1972).

[12] *See* Carol Rose, *The Comedy of the Commons: Custom, Commerce, and Inherently Public Property*, 53 U. CHI. L. REV. 711 (1986)(emphasis added). *See also* Susan Jane Buck Cox, *No Tragedy on the Commons*, 7 ENVTL. ETHICS 49, 60 (1985); Raymond Hames, Game Conservation or Efficient Hunting?, *in* CAPTURING THE COMMONS: ANTHROPOLOGICAL CONTRIBUTIONS TO RESOURCE MANAGEMENT 92 (J. Acheson & B. McCay, eds., U. Arizona Press, 1987).

[13] *See generally* Rose, *supra* note 12.

[14] For examples of both environmental successes and failures, see JARED DIAMOND, THE THIRD CHIMPANZEE: THE EVOLUTION AND FUTURE OF THE HUMAN ANIMAL 317-338 (1992). *See* WILLIAM CRONON, CHANGES IN THE LAND: INDIANS, COLONISTS AND THE ECOLOGY OF NEW ENGLAND (1983). *See also* Conrad Totman, *The Forests of Tokugawa Japan: A Catastrophe that was Avoided*, 18 TRANSACTIONS OF THE ASIATIC SOC'Y OF JAPAN-3d 1 (Tokyo 3d ser., 1983)(contrasting sustainable forestry in Japan with over-foresting in Haiti producing economic devastation).

environmental problems and live in harmony with nature (an equilibrium that today we call "sustainable development"), but in other instances, they fail to solve them and destroy the natural world upon which their own survival depends.

What explains why human communities sometimes succeed and sometimes fail to develop a sustainable relationship with their environment? Neither Hardin's theory nor Rose's fully addresses what factors actually determine whether a particular society will end in environmental tragedy. To explain why some societies destroy their environment and others do not requires a broader perspective on human nature.

II. PERSPECTIVE FROM EVOLUTIONARY BIOLOGY

In 1982, leading environmental lawyer and law professor Bill Rodgers challenged his academic colleagues to "bring people back"[15] into legal analysis by developing a richer view of human nature than the simple model of human motivations posited by economics. Since Rodgers' 1982 challenge, legal scholars are increasingly drawing on accounts of human nature drawn from evolutionary biology as well as economics to explain legal phenomena.[16] This is not to suggest that human beings are "just like" other animals. Even compared to our closest primate relatives, human beings often utilize distinctively human ways to solve evolutionary problems that we have in common with other animals. For example, our large brains and well-developed capacities for culture and language cause us to use adaptive strategies that can often be seen only in simpler, more rudimentary parallels among other primates. Nonetheless, sometimes we humans can see ourselves best by comparing our *differences*, as well as our similarities,[17] to the strategies used by other animals, particularly our closest primate relatives, in coping with evolutionary problems that we all share.

From the standpoint of evolutionary biology, environmental law[18] *is a*

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[15] William D. Rodgers, *Bringing People Back: Toward a Comprehensive Theory of Taking in Natural Resources Law*, 10 ECOLOGY L. Q. 205 (1982).

[16] The literature linking law and evolutionary biology is available through the Gruter Institute, http://www.Gruterinstitute.org, and the Society for Evolutionary Analysis in Law, *http://*www.sealsite.org. For review articles, see E. Donald Elliott, *Law and Biology: The New Synthesis?*, 41 ST. LOUIS. U. L. J. 595 (1997); Owen D. Jones, *Evolutionary Analysis in Law: An Introduction and Application to Child Abuse*, 75 N. C. L REV. 1117 (1997).

[17] *See* E. Donald Elliott, *Evolutionary Models in Law: Pro's and Con's in* LAW AND EVOLUTIONARY BIOLOGY: SELECTED ESSAYS IN HONOR OF MARGARET GRUTER ON HER 80TH BIRTHDAY 111, 113 (Lawrence Frolik ed., 1999)(arguing that "the *differences* between biological evolution and legal evolution ... are [often] the most enlightening").

[18] In actuality, environmental law is a rich amalgam of policies. Here I am concerned only

particular adaptive response by a parasite to facilitate the survival of future generations by preserving an adequate supply of its host.[19] A parasite is an organism that draws its sustenance from a larger biological system rather than manufacturing it.[20] Various species of parasites use different strategies for regulating their relationships with the host. Many merely reproduce rapidly with no awareness that they may eventually overwhelm and kill their host—and thereby also kill themselves.

All parasites face a common evolutionary problem of whether they should restrain their own reproduction in order to avoid "killing the goose that lays the golden egg." If they are too successful in reproducing, they can overwhelm the host, killing it and themselves.[21] Paradoxically, however, uncontrolled reproduction is not always an unsuccessful strategy. Sometimes the optimal reproductive strategy for a parasite in a particular situation is to reproduce as rapidly as possible, without regard to the consequences for killing off the host. This high virulence strategy works best when there are plenty of other uninfected hosts available as targets. The higher transmission rates associated with higher virulence and rapid reproduction can more than offset the disadvantage to the parasite population of the unfortunate fact that particular host organisms die quickly, as long as there are plenty of healthy potential victims around to infect.[22] However, as the

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with the core function of environmental law (which is also what concerned Hardin): preserving natural resources so as to sustain life for future generations. *See* EDITH BROWN WEISS, IN FAIRNESS TO FUTURE GENERATIONS: INTERNATIONAL LAW, COMMON PATRIMONY, AND INTERGENERATIONAL EQUITY *passim* (1989)(arguing, especially in the first and last chapters, that this norm of preserving resources for use by future generations is widely accepted by legal systems around the world and should be recognized as international law).

[19] *See* Elliott, *supra* note 16, at 603-604.

[20] *See* RANDOLPH M. NESSE & GEORGE C. WILLIAMS, WHY WE GET SICK: THE NEW SCIENCE OF DARWINIAN MEDICINE 41 (1994)("parasites secure their resources from the host and then use them for their own maintenance, growth and reproduction"). Professor Owen Jones has pointed out to me that there is also a narrower connotation of a "parasite" that requires that the "host" must be another organism. Whether the environment qualifies as an "organism" remains controversial; J.E. LOVELOCK, GAIA: A NEW LOOK AT LIFE ON EARTH (Oxford, 1979). *But see* SLANTED TRUTHS: ESSAYS ON GAIA, SYMBIOSIS AND EVOLUTION (2d ed Lynn Margulis, et al. (forthcoming January 15, 2001) (criticizing so-called "Gaia hypothesis" that earth is a living organism). Thus, I have used the broader term "biological system" rather than "organism" in defining a "host." No substantial argument in the text, however, hangs on whether environmental law is literally an application of the host-parasite relationship or the comparison is merely an analogy.

[21] For an accessible summary of evolutionary strategies in host parasite relationships, see JARED DIAMOND, GUNS, GERMS AND STEEL: THE FATE OF HUMAN SOCIETIES 198-203 (Norton, 1997). *See also* NESSE AND WILLIAMS, *supra* note 20; CARL ZIMMER, PARASITE REX: INSIDE THE BIZARRE WORLD OF NATURE'S MOST DANGEROUS CREATURES (2000).

[22] In analyzing evolutionary strategies, it is important to remember that in evolution

parasite becomes more and more successful and infects a larger and larger percentage of the available hosts, the situation changes. Scarcity develops and the optimal strategy gradually shifts in favor of less virulent parasites (those that reproduce less rapidly or produce less toxins, and thus keep their hosts around longer). These less virulent forms of the parasite become more successful in reproducing and eventually dominate the population. Thus, Amherst University biologist Paul Ewald has argued that as the HIV virus that causes AIDs spreads into a larger proportion of the population, it can be expected to become less virulent.[23]

Similarly, when human populations are small and environmental resources are plentiful, a "frontier mentality" typically develops that shows little or no concern for preserving natural resources and managing the environment. However, as limits to growth become more obvious, human beings may themselves become less virulent in their relationships to their natural environment. The high-virulence strategy is an application of what biologists call an r-strategy as opposed to a K-strategy in reproduction[24] K-strategists are animals like humans and elephants that have few offspring but invest a great deal of energy in their care and well-being; r-strategists are animals such as insects or many fish that have large numbers of offspring, but invest little or no energy in their care after they are spawned.[25] In general, as hosts (environmental resources) become more scarce, K-strategies that invest in the welfare of future generations by deferring present consumption become more successful.

Human beings adapt their relationships with the host using different mechanisms than does the HIV virus. Human beings may use their intelligence, which gives them great abilities to imagine alternative states of the world and thus potentially to foresee and modify the effects of their actions. One of the distinctive features of the evolutionary strategies played by human beings as opposed to other animals is that humans frequently solve evolutionary problems by using their brains, and by learning and teaching others. They also use

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"success" is measured from the standpoint of the survival and replication of genes rather than the survival of individual organisms. For an accessible explanation, see generally RICHARD DAWKINS, THE SELFISH GENE (Oxford, 1976).

[23] *See* Paul W. Ewald, *The Evolution of Virulence*, SCI. AM. 86 (April, 1993); Paul W. Ewald, *Transmission Modes and The Evolution of Virulence*, 2 HUM. NATURE 1 (1990). *See generally* PAUL EWALD, EVOLUTION OF INFECTIOUS DISEASES (Oxford, 1993).

[24] *See* TIMOTHY H. GOLDSMITH, THE BIOLOGICAL ROOTS OF HUMAN NATURE: FORGING LINKS BETWEEN EVOLUTION AND BEHAVIOR 59-60 (Oxford Univ. Press, 1991).

[25] *See id.*

their capacity for language and their abilities to form cultures and social structures to overcome evolutionary problems. Other animals, particularly non-primates, tend to solve evolutionary problems in different ways, such as by altering their physical structures. As psychologist Margaret Donaldson puts it, "[t]he devising of novel purposes comes readily to us [humans] because we have brains that are good at thinking of possible future states – at considering not merely what is but what might be."[26]

In addition, human beings have developed complex cultural tools, such as morality, religions, and law, to a far greater extent than other animals.[27] Humans are therefore able to use these methods for coordinating collective action, whereas other primates typically emphasize social structures such as dominance hierarchies to a greater degree.[28] Human beings have become the most successful species on the planet in large part because they use their large brains and capacity for communication to form adaptable cultures and social structures to overcome evolutionary problems.

Species that preserve their hosts can be said to be engaged in a particular kind of reciprocal or cooperative relationship between parasite and host. These cooperative exchanges between parasite and host to the mutual advantage of both are a form of "symbiosis."[29] Familiar examples of host-parasite symbiosis are domesticated animals or agriculture. The parasite/farmer defers present consumption of the host in order to reap long-term benefits. The expression "eating one's

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[26] MARGARET DONALDSON, HUMAN MINDS: AN EXPLORATION 9 (Penguin, 1992).

[27] For examples of similar behaviors among other animals, see generally FRANS DE WAAL, CHIMPANZEE POLITICS: POWER AND SEX AMOND APES (rev. ed., 1998); FRANS DE WALL, GOOD NATURED: THE ORIGINS OF RIGHT AND WRONG IN HUMANS AND OTHER AMINALS (Harvard Univ. Press, 1996).

[28] *See id.* DeWaal's work on primate social structure and "morality" is fascinating both for the similarities and for the differences that he identifies between human societies and those of our closest primate relatives.

[29] JOHN MAYNARD SMITH, THE THEORY OF EVOLUTION, 199-120 (Canto ed., 1993)(describing symbiotic parasite bacteria that provide flagellate propulsion to the protozoan *Myxotricha paradoxa*); NESSE & WILLIAMS, *supra* note 20, at 78 (describing toxic fungus that grows on tall fescue grass thereby protecting it from herbivores). On symbiosis generally, see LYNN MARGULIS, SYMBIOTIC PLANET: A NEW LOOK AT EVOLUTION (Science Masters Series, March, 2000); SYMBIOSIS AS A SOURCE OF EVOLUTIONARY INNOVATION: SPECIATION AND MORPHOGENESIS (Lynn Margulis & Rene Fester, eds., July 1991).

For a fascinating albeit loose argument that symbiosis is the basic underlying principle that drives history, see ROBERT WRIGHT, NONZERO: THE LOGIC OF HUMAN DESTINY 5-6 (2000)("History's basic trajectory ... is [n]ew technologies arise that permit or encourage new, richer forms of non-zero sum interaction; social structures evolve that realize this rich potential – that convert non-zero-sum situations into positive sums."). Unfortunately, Wright does not use the term "symbiosis," but instead uses the game-theory concept of "non-zero sum games," i.e. interactions that benefit all participants. *See id.*

seed corn" captures this idea that investing for greater long-term benefits may require sacrificing consumption in the short run.[30]

Primatologist Frans de Waal has shown that three different kinds of reciprocities underlie sharing behaviors in certain of our primate relatives.[31] De Waal labels these three different bases for exchange of resources as "symmetry-based reciprocity," "attitudinal reciprocity" and "calculated reciprocity." In symmetry-based reciprocities, animals exchange benefits by happenstance without any awareness. For example, fruits may achieve a benefit when their seeds are spread to distant locales in the feces of animals that have eaten the fruit but without awareness on either side that an exchange of benefits has taken place. In attitudinal reciprocity, animals form general affinities for one another but do not calculate the costs and benefits from particular exchanges. Calculated reciprocity is much more like the traditional exchanges envisioned by economics, in which animals appear to maximize benefits by rewarding those who cooperate with them and retaliating against those who do not.

All three types of reciprocities can potentially coordinate relationships between parasites and hosts. For example, in some situations, adopting a nomadic lifestyle may result in a symmetry-based reciprocity that tends to preserve the environment by giving it time to recover, but the humans engaged in this practice may have no awareness of the effects of their migratory behaviors on the environment. Or certain humans (sometimes disparagingly called

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[30] One can either eat the corn today or plant it to reap greater rewards later. Economists make this same distinction between consumption and investment. Psychologists refer to it as "deferred gratification." Bertrand Russell saw the ability of humans to delay immediate gratification in order to invest for the future as the basis of civilization. *See* BERTRAND RUSSELL, A HISTORY OF WESTERN PHILOSOPHY AND ITS CONNECTION WITH POLITICAL AND SOCIAL CIRCUMSTANCES FROM THE EARLIEST TIMES TO THE PRESENT DAY 15 (1975) ("The civilized man is distinguished from the savage mainly by *prudence*, or to use a slightly wider term, *forethought*. He is willing to endure present pains for the sake of future pleasures, even if the future pleasures are rather distant. This habit began to be important with the rise of agriculture; no animal and no savage would work in the spring in order to have food next winter, except for a few purely instinctive forms of action, such as bees making honey or squirrels burying nuts. In these cases, there is no forethought; there is a direct impulse to action which, to the human spectator, is obviously going to prove useful later on. True forethought only arises when a man does something towards which no impulse urges him, because his reason tells him that he will profit by it at some future date. Civilization checks impulses not only through forethought, which is a self-administered check, but also through law, custom and religion.").

[31] *See* Frans B. M. de Waal, *Attitudinal reciprocity in food sharing among brown capuchin monkeys*, 60 ANIMAL BEHAVIOR 253, 259-60 (2000). Professor Wolfgang Fikentscher of the Law Faculty of the University of Munich has pointed out to me that De Waal's triad resembles the distinction in anthropology between generalized, balanced and negative reciprocities. Letter from Prof. Fikentscher, January 25, 2001.

"tree huggers") may engage in attitudinal-based reciprocity with the environment because they have developed a general emotional affinity for the environment, but not necessarily one that is based on specific "tit-for-tat" exchanges. And finally, in an extreme form of calculated reciprocity, humans may conduct a cost-benefit analysis that leads them to conclude that preserving the environment in particular cases is in their long-term best interest. Differences in the types of reciprocities underlying the protection of the environment may explain why some environmental appeals are couched in terms of "moral outrage" and others as "cool analysis."[32]

While different types of reciprocities *may* be successful in coordinating relationships between host and parasite, there is, however, no guarantee that parasites will necessarily be capable of adapting successfully to changing environmental conditions, even when it is in their interest to do so. For example, because exposed humans develop immunity to the measles virus, "measles is likely to die out in any human population numbering fewer than half a million people [because] [o]nly in larger populations can the disease shift from one local area to another, thereby persisting until enough babies have been born in the originally infected area that measles can return there."[33] In other words, measles as a species is particularly susceptible to fall prey to Hardin's tragedy of the commons.

III. WHAT EVOLUTIONARY BIOLOGY CLARIFIES.

What difference does it make whether one views environmental law from the perspective of evolutionary biology as opposed to economics? In many instances, the two explanations are congruent. After all, evolutionary biology agrees with economics in predicting that human beings will be motivated at least in part by the desire to accumulate material wealth. There are, however, several important phenomena that are difficult to explain from an economic perspective, but may be more clearly understood from the perspective of evolutionary biology. It is difficult if not impossible to explain how environmental law (or for that matter, any other forms of public interest law or other -- regarding governmental policy) is enacted from the standpoint of economics. This embarrassment is evident in Hardin's work: he does

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[32] De Waal's distinction between "attitudinal reciprocity" and "calculated reciprocity" may help to explain why environmentalists tend to divide into "moral outrage" and "cool analysis" camps. R. PERCIVAL, ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE AND POLICY 67-68 (Little Brown, 2d ed. 1996)(contrasting two competing styles of thinking about the environment in the U.S. today as "moral outrage" versus "cool analysis").

[33] DIAMOND, GUNS, GERMS AND STEEL, *supra* note 21, at 203.

not explain *how* a community might institute private property or other forms of regulation to protect the environment; he merely posits that they may do so *deus ex machina*.[34]

Economics models people as motivated by accumulating wealth and other forms of personal satisfaction. A very convoluted explanation[35] is needed to explain why someone thus motivated to accumulate personal satisfaction or wealth would altruistically sacrifice present consumption in order to benefit future generations as environmentalism often requires.[36] Explanations of environmental law from the standpoint of evolutionary biology are much more straightforward. Evolutionary biology conceives of human motivations primarily in terms of "reproductive success," which it conventionally measures by the frequency of ones' genes surviving in the second generation of offspring.[37] The lodestar of reproductive success has its own problems,[38] but it certainly provides a more straightforward explanation for why people would be willing to sacrifice present consumption in order to promote the welfare of their

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[34] In Greek tragedy, a god would sometimes appear mysteriously through a trapdoor to resolve the plot. Thus, the phrase "*deus ex machina*" (literally, the "god in the machine") has come to refer to any "any artificial or improbable device resolving the difficulties of a plot." RANDOM HOUSE WEBSTER'S UNABRIDGED DICTIONARY (1999). By contrast, political scientists and lawyers influenced by evolutionary biology have produced theoretical accounts of the emergence of the state. *See* ROGER MASTERS, THE NATURE OF POLITICS (1989) (focusing especially on Chapter 5, "The Biological Nature of the State"); Roger Masters, *Evolutionary Biology, Political Theory and the State*, 5 J. SOC. BIOL. STRUCT. 439 (1982).

[35] One possible move is to define protecting future generations as a source of satisfaction in the present. *But see* Arthur Leff, *Economic Analysis of Law: Some Realism About Nominalism*, 60 VA. L. REV. 451 (1974). For another attempt to explain other-regarding behavior in the form of environment legislation within the paradigm of economics, see E. Donald Elliott, et al., *Toward a Theory of Statutory Evolution: The Federalization of Environmental Law*, 1. J. LAW, ECON. & ORG. 313 (1985). This branch of economics, which uses game theoretic models to explain the evolution of cooperation, forms a bridge to evolutionary biology, which is also centrally concerned with how cooperation emerges in groups. *See infra* note 40.

[36] Not all expenditures to protect the environment sacrifice net present social welfare. Some are good investments in the sense that they produce economic benefits greater than their costs. However, even in the case of environmental measures that do produce economic benefits greater than their costs, the persons bearing the costs are only rarely the same as those receiving the benefits. Thus, most environmental measures are hard to explain from the standpoint of a selfish *homo economicus*.

[37] MATT RIDLEY, THE RED QUEEN: SEX AND THE EVOLUTION OF HUMAN NATURE 4 (MacMillan, 1993)("...reproduction is the sole goal for which human beings are designed; everything else is a means to that end")

[38] *See* DIAMOND, THE THIRD CHIMPANZEE, *supra* note 14, at 96 ("...it is no longer controversial to conclude that natural selection caused animals to evolve behaviors, as well as anatomical structures, that tend to maximize the numbers of their descendents. Few scientists doubt that natural selection molded human anatomy. However, no theory has caused such bitter divisions among my fellow biologists today as the claim that natural selection likewise molded our social behavior."). *See also* Elliott, *Law and Biology*, *supra* note 16, at 613.

children and grandchildren by leaving them a healthy environment which is more likely to insure the survival of their genes.[39] From a biological perspective, then, environmental restraint is understandable as a form of "altruism," sacrificing personal selfish goals in order to benefit closely-related kin and secure the survival of one's own genes. Altruism in this sense is a subject that biologists have studied extensively.[40] This is not to say, however, that protecting the environment can be left to our altruistic instincts alone; on the contrary, elsewhere the author has argued that environmental *law* and other forms of legal regulation can be understood as communal solutions to the problem of too little altruism built into us by biology to enable us to live successfully in our current circumstances.[41]

A biological explanation of environmentalism in terms of altruism also helps to explain why people are particularly motivated by rhetorical appeals that problems may affect the environment of our "children and grandchildren" but tend to discount problems with longer time horizons.[42] It also helps to explain why environmental rhetoric is often dominated by appeals to protect human health as opposed to other environmental values.

The perspective from evolutionary biology also emphasizes different factors as contributing to the successful adaptations of communities and therefore implies different prescriptions than does the economic perspective. This difference in perspective can be illustrated by a few quick re-tellings of Hardin's fable from an evolutionary perspective about how three different hypothetical communities attempted to cope with increasing environmental scarcity.

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[39] The idea that simple explanations are preferable to more convoluted ones is called "Ockham's Razor," after William of Ockham who is credited with inventing the concept in the 14th century; it was popularized by Newton, who called it the first rule of science. *See* CHARLES VAN DOREN, A HISTORY OF KNOWLEDGE: PAST PRESENT AND FUTURE 209 (1991).

[40] The classic piece is W. D. Hamilton, *The Genetical Evolution of Social Behavior*, 7 J. THEORETICAL BIOLOGY 1 (1964). *See also* JOHN MAYNARD SMITH, *supra* note 29, at 193; Robert Trivers, *The Evolution of Reciprocal Altruism*, 46 Q. REV. BIOL. 35 (1971); Robert Axelrod & William D. Hamilton, *The Evolution of Cooperation*, 211 SCI. 1390 (1981).

[41] *See* Elliott, *Law and Biology*, *supra* note 16, at 610.

[42] *See, e.g.* ROBERT ORNSTEIN & PAUL EHRLICH, NEW WORLD NEW MIND: MOVING TOWARD CONSCIOUS EVOLUTION (1989). Professor Lawrence Frolik has mounted a similar argument that government or other legal or communal protection of retirement savings are needed because human beings are not suited by biology to assess long-term issues such as planning for their old age accurately. *See* L.Frolik, Introduction, *Law and Evolutionary Biology*, *supra* note 17. *See also* Owen D. Jones, *Time-Shifted Rationality and the Law of Law's Leverage: Behavioral Economics Meets Behavioral Biology*, 95 NW. U. L. REV. (forthcoming 2001).

Fable I –The K Strategy Under Environmental Scarcity

As herders placed more and more cows on the commons, a wise prophet named Rachael Carson arose among the people, proclaiming that God was offended if any family had more than three cows. Many people flocked to this prophet and heeded her teachings. Eventually the wise and powerful King Enviro I became a convert to the new religion, and used his soldiers to enforce cow rationing. This policy was successful for many years and the community lived in harmony for a time with its surroundings. Eventually, however, even three cows per family would prove to be too many and the commons was under great stress. But the community adapted to the new situation and survived and prospered, first by taking over adjoining lands, and then later, by inventing new technologies (such as feedlots and agriculture) that permitted greater cow density (and human population) per acre of commons.

There is no guarantee, however, that human beings or any other species will necessarily find and adopt a successful evolutionary strategy. Consider a second, equally plausible re-telling of Hardin's fable:

Fable II–The R Strategy Under Environmental Scarcity

As herders placed more and more cows on the commons, a wise prophet named Cassandra arose among the people, proclaiming that God was offended if any family had more than three cows. Some people flocked to this prophet and heeded her teachings, but others were greatly offended by her challenge to their established status and wealth. This aristocracy conspired against her and she was stoned to death. Within a few years, her movement died out, and her message was forgotten. A few years later, the community itself died out in a great famine.

A lack of foresight (or its communal equivalent, a lack of social acceptance when an individual with foresight does arise) is a fatal flaw that may prevent a community fatal from successfully implementing environmental conservation even when it is in its interest to do so. But it is not the only flaw that can prevent developing a successful equilibrium with the environment. Here is third plausible re-telling of the Hardin fable:

Fable III–The K Strategy With Regulatory Failure

As herders placed more and more cows on the commons, a wise prophet named Rachael Carson arose among the people, proclaiming that God was offended if any family had more than three cows. Many people flocked to this prophet and heeded her teachings. Eventually the wise but uncharismatic King Enviro I became a convert to the new religion, and promulgated a decree

to enforce cow rationing. However, the people were sorely vexed by King Enviro's policies and he had not the personal popularity or debating style to sustain them. The people rose up in rebellion against him, overthrowing him and placing his nephew, King Comfortable II, on the throne. Within a few years, the community died out in a severe famine.

Wise environmental policies can fail because government (or other regulatory institutions) are not strong or effective enough to carry them out successfully.

To the chagrin of environmentalists, an evolutionary perspective must acknowledge that not all communities can be expected to place a high priority on investing to preserve their environment for future generations. Whether it is in their interest to do so will depend upon their situation and particularly upon whether resources are perceived as plentiful or scarce. However, as environmental scarcity develops, (1) foresight and intelligence, (2) communication and social consensus, (3) effective social coordination and government, and (4) technological developments *can* – but do not necessarily – create the possibility that herders may *solve* the problem of the commons. (Some even argue that because humans are the only species capable of consciously managing the environment on a worldwide scale, we have a moral responsibility to do so for the benefit of other species as well as ourselves.[13])

However, the process of a community successfully adapting to environmental scarcity can go awry at any of several crucial stages. There can be failures of foresight, failures of government, and failures of technology. Any one of those failures may prevent the community from successfully solving the problems of the commons, even when it would be in its interest to do so.

A review of both success stories and failures in the history of human communities adapting to the problem of environmental scarcity led Pulitzer Prize winning author Jared Diamond to draw the following general lessons about the factors that explain when communities successfully solve the problem of the commons and when they do not:

> [S]mall, long-established, egalitarian societies tend to evolve conservationist practices, because they've had plenty of time to get to know their local environment and to perceive their own self-interest. Instead, damage is likely to occur when people suddenly colonize an unfamiliar environment ...; or when people acquire a new technology whose destructive power they haven't had time to appreciate ....

[13] ORNSTEIN & EHRLICH, *supra* note 12.

> Damage is also likely in centralized states that concentrate wealth in the hands of rulers, who are out of touch with their environment.[44]

IV. TOWARD A TWO-PERSPECTIVE PARALLAX

Should discussion of host-parasite relationships and adaptive strategies replace analysis of market failures and externalities? Not in my view.[45] Both have valuable contributions to make to describing a reality that is more complex than either model. Each brings some features into focus while suppressing others.

The Tragedy of the Commons has had a remarkable influence on shaping the ways that we think about environmental law. Like any model, it highlights certain aspects of reality at the price of suppressing others. It defines the things we see and the things that we overlook in ways that are sometimes called "the social construction of reality." Ironically, perhaps the economic view of human nature as selfish and short-sighted has achieved its greatest dominance in environmental law. As a result, environmental lawyers tend to systematically undervalue the importance of non-coercive, non-regulatory approaches to protecting the environment.[46] Another implication of adding the evolutionary perspective on environmental problems to the economic one is to re-emphasize the importance for human communities of developing means to foresee the future consequences of human decisions on the environment. An economist might recommend instituting private property to give people greater incentives to protect the environment, whereas an evolutionary biologist might recommend passing a statute such as the National Environmental Policy Act (NEPA)[47] to institutionalize the role of the

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[44] DIAMOND, THE THIRD CHIMPANZEE, *supra* note 14, at 335-36.

[45] *See* Elliott, *Evolutionary Models in Law*, *supra* note 17, at 125 (arguing that law professors should have a "portfolio" that includes both economics and evolutionary biology).

[46] *See* E. Donald Elliott, *Environmental TQM: A Pollution Control Program that Works!*, 92 MICH. L. REV. 1840 (1994)(review of Quality Environmental Management Subcommittee President's Commission On Environmental Quality, Total Quality Management: A Framework For Pollution Prevention (1993)).

[47] The National Environmental Policy Act of 1969, 42 U.S.C. §4321 et seq. requires, inter alia, that recommendations for major Federal actions significantly affecting the quality of the human environment shall be accompanied by an "environmental impact statement" assessing, among other things, the anticipated "environmental impact" of the proposed action. *See* 42 U.S.C. §4332(C)(i). Many other countries around the world have also adopted similar environmental look ahead requirements; DAVID HUNTER, JAMES SALZMAN & DURWOOD ZAELKE, INTERNATIONAL LAW AND POLICY 366 (1998)("Many international instruments, international institutions, and over sixty countries now require some form of EIA [Environmental Impact Assessment]. States are increasingly recognized to be under a general

prophet in warning communities of the consequences for their progeny of impending environmental tragedies. Of course, the two recommendations are not mutually exclusive; they merely highlight different aspects of a complex adaptive process.

We see the world through our parables. Ironically, the power and success of Hardin's vision has caused it to crowd out other important ways of looking at the world that also have insights to contribute.

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obligation to assess the environmental impacts of their activities . . . .").