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**First Annual Cummings Colloquium on Environmental Law
Beyond the Balance of Nature: Environmental Law Faces the New Ecology**

***1 BEYOND THE BALANCE OF NATURE**

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The Cummings Colloquia on Environmental Law at Duke University were launched in 1996 by a generous gift in honor of Jasper L. Cummings, Jr., and by the leadership of Dean Norman L. Christensen of Duke's Nicholas School of the Environment and Dean Pamela B. Gann of Duke Law School. The mission of these annual Colloquia is simple but ambitious: to bring together diverse disciplines to confront the most difficult challenges in environmental law and policy.

The first of the Cummings Colloquia, held in April 1996, addressed the challenge to environmental law posed by the "new ecology." The new paradigm in ecology [FN1] rejects the traditional notion of nature resting in harmonious equilibrium, and offers instead a vision of restive nature--in perpetual flux, disturbance, and renewal. As Dean Christensen has recently written, "We tend to treat *2 the 'natural world' . . . as existing in some sort of long-term stasis. We assume that, when not upset by human impacts, [nature] will tend to return to some predetermined 'stable state,' much as a pendulum returns to its nadir position. During the first half of this century, the notion of ecosystem succession [to a stable] 'climax community' was one of the unifying principles of ecology. . . . [But now we know that] [e]cosystem change is inevitable. Ecologists now view landscapes as complex mosaics, patches undergoing continuous change" [FN2]

In short, there is no such thing as the "balance of nature." It is a romantic human notion inconsistent with empirical observation. Yet much of modern American environmental law has been based on the old equilibrium paradigm and is designed to preserve such a balance of nature. [FN3] I became intrigued by this anomaly in the early 1990s, and had written about it just as the Cummings Gift made it possible to convene a multidisciplinary discussion of its ramifications. [FN4] My goal in organizing the First Cummings Colloquium was thus to go "Beyond the Balance of Nature"--to take as a positivist premise the new non-equilibrium paradigm in ecology, and to ask the normative questions whether and how environmental law should be reshaped to match the new dynamic view of the way the world really works.

To this end we were privileged to host a sterling array of thinkers in ecology, law, philosophy,

government, economics, ethics, and several other disciplines of science, social science, and policy. The meeting brought together Daniel Botkin, the leading exponent of the "new ecology"; Dan Tarlock, the leading exponent of the incorporation of the new ecology into environmental law; and George Frampton, the leading public official charged with managing the interface of law and ecology. Joining these modern-day frontiersmen were Bryan Norton, a philosopher of science; Alyson Flournoy and Gerald Emison, experts on complexity and environmental law; Walter Kuhlmann, the attorney who has led the effort to make the new ecology legally binding on federal land management agencies; and Timothy Profeta, a joint Law-Environment graduate student at Duke University who is editor-in-chief of this journal. (The full agenda of speakers and commenters is presented in the Editor's Introduction to this volume.) Three students deserve special credit for helping to organize the Colloquium: our two inaugural Cummings Fellows in Environmental Law, Catherine Malinin Dunn '96 (herself a past editor-in-chief of this journal) and Timothy Profeta '97; and Jason Miner '98, who assisted on behalf of the Duke Environmental Law Society. All three are enrolled in Duke's highly selective four-year joint degree program in Law and Environmental Management.

I. Balance in Environmental Law

The "balance of nature" is not the only paradigm that has influenced American environmental law, but it is pervasive and potent. In this essay my main purpose is to chart the intellectual terrain of environmental law, and to suggest the contours of the uncharted territory into which we are heading "beyond the balance of nature."

I find the intellectual context for these discussions to be helpfully portrayed, with admitted oversimplification, in terms of three basic parameters: one's view of nature, one's view of the human role in nature, and one's view of the role of the state (law) in managing the interface between the first two.

These basic parameters--views of nature, of humanity, and of the role of law--form the vertical columns of Table 1. I then distinguish four salient combinations of these parameters, four "faces of environmental law," as indicated by the horizontal rows of Table 1. The modern challenge, as I will argue below, is to fill in Cell 4.C: to design an environmental law to match the new paradigm of dynamic nature.

Table 1: Four Faces of Environmental Law

	Parameters		
Faces	A. View of Nature	B. View of Humans	C. Role of Law
1.	Stable, vast and resilient, raw, fearsome nature	Separate from nature; morally superior to nature; exploit	Exercise human dominion over nature

2. Stable, in balance (absent Separate from nature; Exercise benign human disruption); morally superior to stewardship over fragile; wild nature nature; conserve
3. Stable, in balance (absent Separate from nature; Protect balance of human disruption); morally inferior to nature, untainted fragile; pristine nature by humans; preserve
4. Dynamic, in disequilibrium, Part of nature; ? interconnected, chaotic morally uncertain

Certain caveats are required. First, I label these four approaches by numbers because satisfactory verbal labels are elusive. The first row of Table 1 might be called the "pre-ecology" view: nature as vast and wild, "red in tooth and claw," with human society rightfully exercising dominion over nature. This view predates the systematic study of ecology that began in the 19th century; it sees nature as "the elements," a set of mysterious and capricious forces against which humans struggle for survival. Rows 2 and 3 both correspond to what might be called the "old ecology": models of a harmonious balance of nature which is disturbed by human interlopers. They differ in their attitude toward humans: are we benign conservators or malign *4 contaminants? Row 4 reflects what Botkin has called the "new ecology": nature in flux, and humans as one organism among many comprising the biosphere.

But the labels just proposed are unsatisfactory. The implication of temporal progression from "pre-" to "old" to "new" ecology is misleading; all of these faces appear today and all have played roles in the past. For example, both Row 1 (dominion) and Row 2 (stewardship) appear to have antecedents in the book of Genesis, far predating modern ecology. Row 4 (dynamism) has antecedents in the philosophy of Heraclitus and others, as Bryan Norton's essay in this volume points out. And all four faces are at work today, as I will mention in a moment.

Elsewhere I have proposed a more functional typology, labeling these faces of environmental law "separatist-dominion," "separatist-stewardship," "separatist-taint," and "holist," respectively. [FN5] These *5 labels are more accurate but also rather unwieldy. Most importantly, they indicate a common feature of the first three faces: a "separatist" or "dualist" belief that humans and nature occupy distinct realms. [FN6]

Second, the combinations of views outlined in Table 1 do not exhaust the full range and detail of all the real and possible approaches to the problem of environmental law. For example, one could believe that nature is dynamic (4.A) and that humans should exploit it (1.B & 1.C), or that humans

should conserve it for future generations (2.B & 2.C). And any one individual's views might not fit precisely into any of these boxes. I have tried here merely to sketch what appear to be the predominant combinations of views that have animated environmental law in this country. [FN7]

Third, the causal proposition embedded in Table 1--that deep-seated conceptions of nature and humanity's role powerfully shape the ends and means of environmental law--while intuitively attractive, is not the only plausible hypothesis explaining the contours of environmental regulation, and should be subjected to empirical examination. For now, my point is merely that the role of conceptions of nature and humanity is one among several important factors in the genesis of environmental law. Perhaps it is the most important factor, but I leave that debate to another conference. [FN8]

Whatever their labels, the four faces identified in Table 1--or at least the first three, so far--help capture the essence of the primary ideologies that animate American environmental law. Let me offer a few illustrative examples. [FN9]

The first face (dominion) is exemplified by the writings of Francis Bacon, who argued that nature should be "bound into service" and made a "slave." Bacon wrote that "[we must] endeavor to establish and extend the power and dominion of the human race itself over the universe [so that] the human race [[could] recover the right over *6 nature which belongs to it by divine bequest." [FN10] The close relationship of this ideology to American environmental law is evident in the attitude expressed by political leaders in the early 1800's. In his effort to remove native tribes from the Southeastern U.S., President Andrew Jackson asked the Congress: "What good man would prefer a country covered with forests . . . to our extensive Republic, studded with cities, towns, and prosperous farms, embellished with all the improvements which art can devise or industry execute, occupied by more than 12,000,000 happy people, and filled with all the blessings of liberty, civilization, and religion?" [FN11] Georgia's Governor chimed in, invoking "what civilized peoples had a right to possess by virtue of that command of the Creator delivered to man upon his formation--be fruitful, multiply, and replenish the earth, and subdue it." [FN12] Modern vestiges of this view are manifest in property rights rules that require land to be cleared in order to be owned, [FN13] in the Mining Act of 1872, [FN14] in debates about managing wildlife (particularly predators), [FN15] in the Herculean effort to control the flow of rivers like the Mississippi and those in California, [FN16] and in the general notion that environmental law should not constrain human exploitation of the environment--and indeed should insist upon such exploitation. A ripe example is the Forest Service policy that prohibits timber sales from being awarded to conservationists even if they submit the highest bid; only loggers need apply. [FN17]

The second face (stewardship) is closely related to the first (dominion), despite their conflicting recipes for law and ethics. Both draw on the dualist belief that humans are separate from and superior to nature. But while the first advocates subjugation of nature, the *7 second urges a caretaking role--more a gardener than a slave master. The origins of these two views are intertwined in a theological and historical debate about the proper interpretation of the Bible. Lynn White's famous essay argued that the book of Genesis was the source of the view articulated by Bacon and others that humans are separate from nature and should subdue nature; [FN18] but more recently others have argued that Genesis (and other texts of the Bible), when properly interpreted, instruct followers to serve as protective stewards for the rest of creation. [FN19] Without trying to settle that

debate, it seems clear that one strand of American environmentalism has embraced the notion that humans must conserve nature as a noble responsibility, a duty of stewardship owed to nature, to other (especially future) humans, and/or to God. Modern manifestations can be seen in the creation of the system of National Parks, and in at least some of the rhetoric of such important figures as John Muir, Teddy Roosevelt, Joseph Sax, [FN20] and Al Gore. [FN21]

The third face is, in my view, the most influential of these four faces in contemporary American environmental law. It is the ideology most closely associated with the tidal wave of environmentalism and environmental legislation that we have experienced since 1969. It rests on two foundational propositions: nature is in balance, and human action disturbs that balance. These propositions are the linchpin of the "old ecology," epitomized by George Perkins Marsh and Frederick Clements. Marsh wrote in 1864 that "[n]ature, left undisturbed, so fashions her territory as to give it almost unchanging permanence of form, outline, and proportion . . . In countries untrodden by man . . . the geographical conditions may be regarded *8 as constant and immutable." [FN22] It may seem odd that Marsh would insist on a static view of nature just as Charles Darwin was announcing (in 1859 and 1871) the idea that changes in nature induce evolutionary changes in species. But even Darwin evidently thought that environmental change and evolution occurred so gradually that it would be imperceptible to human observers: evolution had occurred in the past, giving rise to the present set of species, but change was not a meaningful attribute of current world. [FN23] Between the 1890's and the 1930's, Frederick Clements developed the view that while nature may change over time, ecosystems progress in "succession" to a "climax" state that thereafter remains in equilibrium unless disturbed. [FN24] As Norm Christensen suggested in the passage quoted at the outset of this essay, this "balance of nature" paradigm held sway as the orthodox view of the world from the beginning of the science of ecology in the mid-1800's [FN25] to about the 1960's--just when the modern environmental legislation was being written. [FN26] The normative view of humanity as an undesirable intrusion on natural balance is evident in Marsh's comment, and it is politically ascendant today. The most articulate modern exponent of this view is Bill McKibben, who has argued that the paramount goal of environmental law must be to preserve "pristine places, places substantially unaltered by man" lest "the idea of 'nature,' the separate and wild province, the world apart from man" be destroyed. [FN27]

*9 Much of the American environmental law enacted in the 1960's and 1970's reflects this third face. [FN28] Salient examples include the Wilderness Act of 1964, which defines wilderness areas as those "where the earthy and its community of life are untrammled by man," [FN29] and the apparent consensus view of both the majority and dissenting opinions in the landmark case of *Sierra Club v. Morton* that the goal of environmental law is to "preserve [[areas] uncluttered by the products of civilization." [FN30] Similarly, the Clean Water Act of 1972 defines "pollution" as "man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of water," [FN31] such that non-human sources of contamination (e.g., microbes) are not subject to regulation. [FN32] Moreover, section 303(d) of the act requires states to set quality-based limits on thermal pollution that will "assure protection and propagation of a balanced, indigenous population of shellfish, fish and wildlife." [FN33] Legislative mandates to achieve a balance of nature continue to be enacted today; the Florida Everglades Protection Act of 1995, for example, requires the state to set a phosphorous criterion and dictates that "[i]n no case shall such phosphorus criterion allow waters in the Everglades Protection Area to be altered so as to cause an imbalance in the natural populations of aquatic flora or fauna." [FN34]

***10 II. Blemishes on the Faces of Balance**

None of these three faces of environmental law is satisfactory. In light of the new ecology, all three pose serious scientific, ethical, and consequentialist problems. This does not mean that the first three faces are utterly devoid of value; they may contain insights worth considering and perhaps incorporating into a new environmental law regime. But in their current forms they do not fit the bill of a legal system appropriate to the new ecology. They cannot adequately fill Cell 4.C.

The first face, dominion, is unsatisfactory on scientific grounds because it inaccurately assumes that human conduct cannot cause lasting environmental damage; it assumes that human dominion is necessarily beneficial. It represents an ethic of hubris, disdain, and despotism. It is unappealing on consequentialist grounds because it is counterproductive and self-defeating: rampant human subjugation of nature would cause severe ecological damage and undermine the ecological systems that support human life. Dynamism in nature makes dominion essentially impossible and typically counterproductive. To take just one example, dominion-style efforts to keep rivers in static riverbeds and to control floods with high narrow levees have backfired: they worsen floods upstream and downstream, worsen ecological impacts as people build and farm in sensitive floodplain wetlands, and worsen property damages as those buildings and farms are then lost when the river, inevitably, overruns the static course. [FN35] Moreover, the dominion paradigm is ethically anathema to many because it places little to no value on nonhuman life. In many respects the conservation movement of the early 1900's (Row 2 of Table 1) and the modern environmental movement since the 1960's (Row 3) have both been vigorous counterreactions to the dominion paradigm.

The second face, stewardship, is more sympathetic to nonhuman life and more judicious about the consequences of environmental damage. But it, too, depends on a scientifically suspect dualism. And *11 in the eyes of those fervently committed to ethical respect for nonhuman life, the shift from slave master of nature to compassionate gardener is little progress. As Roderick Nash recounts, it is viewed by many as "kindly slavery" and "shallow ecology," and "compares to feeding the slaves well." [FN36] It is an ethic of benevolent despotism, of noblesse oblige. From a consequentialist viewpoint, the notion of caring for nature while tending the field is not encouraging, because human agriculture--through deforestation, misallocated irrigation, nonpoint water pollution, emissions of methane and nitrous oxides, and countless other pathways--has remade the face of the planet and generated as much environmental damage as any other human activity. That is not to say that feeding the growing human population does not justify its environmental impacts; it is just to say that an ethic of stewardship may not be adequate guidance to make such a judgment, nor to manage the complex interactions of human activities and ecosystems.

Certainly stewardship aspires to a more sophisticated and effective program of environmental management than simply gardening carefully. It might well be better for the world on ethical as well as consequentialist counts if humanity moved from a dominion model to an attitude of stewardship. It is just not clear what stewardship entails. It does not answer the hard questions, the difficult tradeoffs. It remains premised on a "balance" of nature, leading it to design stewardship programs in terms of maintaining a static equilibrium-- which, as I argue in this essay, is environmentally counterproductive. And it rebuffs the central question of whether humans are part of nature.

The third face, committed to preserving the balance of nature against human taint, raises numerous problems. First, like the dominion and stewardship approaches, it is based on an inaccurate view of the world. It is inaccurate both as to nature and as to humans. As to nature, it assumes and seeks to preserve a "balance" when the new ecology is teaching that there is no such balance. [FN37] Law cannot require "a balance of flora and fauna" not because it would be too difficult, but because the term is meaningless: populations of various organisms are perpetually in flux, landscapes change, climates change, and definitions of species and ecosystems change. [FN38] *12 What Darwin thought occurs very slowly turns out to occur very rapidly, all over the planet. [FN39]

Moreover, as to humans, the third face presumes them to be separate from and morally inferior to nature; its goal is to keep humans and the rest of nature separate (one hesitates to say "segregated," though the parallel with race relations is disturbing). Yet if we take Darwinian evolution seriously, humans (including human creativity) are every bit as much a product of nature as any other organism. We share ancestry with all other life on earth. As Roderick Nash puts it, "Darwin killed dualism." [FN40] Meanwhile, there is no untainted realm to preserve, because humans have in effect already touched it all: humans, like many other species, [FN41] are already intimately involved in ecological systems at many spatial and temporal scales. [FN42] The third face of environmental law despairs of these truths, for under that view if humans are natural they must be good, but if nature is spoiled by human contact it is not worth saving. The separatist-taint position has no way out of this dilemma unless it begins to make exceptions--to admit that what is "natural" (including humans) might not be good, and that what is touched by humans might still be worth protecting. Clearly the fact that rainforests have been altered by humans does not make them valueless; some other source of value, besides absence of human taint, must be in play. And if humans are part of nature, then human contact is not "taint" at all; nature is the interaction of multiple organisms, and environmental protection is justified for reasons other than the segregation of humans.

*13 Second, the third face of environmental law is ethically unsatisfactory. In a mirror image of the dominion view, which puts no weight on nonhuman life, the separatist-taint view appears to put no weight on human life. It reflects a dysfunctional ethic of guilt, blame, and self-loathing. While the first face sees humans as conquerors of the earth, the third face sees humans as a cancer on the earth; both see humans as outsiders, and neither makes room for ethically sophisticated judgments that account for both human and nonhuman life as part of life on earth.

The third face also mixes descriptive and normative judgments in a way that makes it vulnerable to political hijacking. The third face puts its eggs in protecting what is "natural," but the term "natural" has no objective referent; it is a human construct designed to cast a normative light on its subject. In Row 3, that light is flattering: nature is benign, pristine, elegant. But in Row 1 it was condemnatory: nature was raw, uncivilized, vicious, base. And the term "natural" has repeatedly been used to justify power relationships (often against progressive change), such as the "natural" role of women in society or the "natural" rights of landowners. "Natural" and "unnatural" are normative culture-bound terms deployed to connote right and wrong, not positivist terms describing ecological health. [FN43] Hitching one's environmental law to the prevailing fad for what is natural risks losing the value of that law when tastes change. One of my favorite recent examples is the effort to label cigarettes as "natural" (which, in a sense, they are, if made from organically grown tobacco). [FN44]

Finally, the separatist-taint view is unsatisfactory because it generates counterproductive consequences. A policy imposing an absolutist goal like "zero tolerance" of human-induced change in nature will shortly confront rapidly rising marginal costs and diminishing marginal benefits. But the errors of the separatist-taint approach are worse than inefficient; they are perverse. Attempting to preserve nature against human disruption actually causes disruption: for example, suppressing all forest fires in order to preserve the supposed climax equilibrium ecosystem turns out to disrupt the flow of nutrients generated by disturbance and renewal, and thereby to change the *14 forest ecosystem. [FN45] Attempting to preserve nature can lead to its demise: for example, trying to preserve species in their current but dwindling form (based on the "old ecology" notion that nature is in stasis) leads to their extinction, whereas human intervention could assist endangered species to adapt and survive by interbreeding (based on the "new ecology" notion that nature is dynamic and that species routinely interbreed and evolve). [FN46] Attempting to outlaw human intrusion invites risks from other sources: for example, banning chlorination of drinking water invites attack by waterborne microbes carrying gastrointestinal disease, [FN47] and banning human intrusion in nature suggests that humans should not intervene to ward off an incoming asteroid. [FN48] It is just not the case that nature is pristine and safe, a peaceable kingdom, whereas humans pose risk; in reality, both human and nonhuman life forms pose risk to one another (and nourish one another), in processes that ecologists call competition and mutualism. Isolating one species from all others is not a recipe for optimal ecosystem health (nor would that be "natural"). Preservation inescapably entails modification: protecting a landscape or a species, or walling off human contact, curtails or replaces the dynamic influences that the landscape or species would otherwise confront, and induces it to evolve in a new way. Change is inevitable, and what matters is not the false choice of preservation versus change, but the real choice of which changes are benign and which are adverse. That is a judgment absent from the separatist-taint and dominion paradigms.

A saving grace for the third face of environmental law might be its prophylactic capacity: granted that it is imperfect, still it allows government to draw a line that shall not be crossed. Approaches with less clarity might invite polluters operating in the shadow of the law to take judgments into their own hands and cause more damage than would be optimal, and they might allow one species--humans--to *15 engage in "self-dealing" against the interests of the larger biotic community on earth. [FN49] But any human legal system is made by humans, so until we can invite other species to participate in our democracy (assuming we should), we cannot avoid self-dealing; in that sense, protecting nature against humans is just favoring the ideology of some humans over the interests of other humans. More importantly, the prophylactic argument is seriously undermined by the perverse consequences for environmental health occasioned by the separatist-taint approach: if drawing a clear line causes more harm to ecosystems, clarity may not be worthwhile. It would indeed be ironic to construct a legal system premised on humans' capacity for judgment (as distinct from other species) and then to forbid such judgment, as the separatist-taint paradigm does. In any event, the prophylactic argument suggests that we should fine-tune the more judgment-based approach to account for imperfect compliance and the interests of

nonhumans, rather than codify a fundamentally unsound and incorrect view of the world. Because species (including humans) interact in complex ways, there is no such thing as "noninterference;" noninterference is interference of a different sort. The challenge is to distinguish adverse interference from beneficial interaction.

Table 2. Normative Dichotomies Akin to Human/Nature Dualism

Bad/Inferior	Good/Superior	Paradigm
Nature	Human	'Dominion'
Human	Nature	'Taint'
Body/Flesh	Mind/Spirit	'Spiritualism'
Savage	Civilization	'Dominion'
Civilization	Savage/Wilderness	'Taint'
Country	City	'Dominion'
City	Country	'Taint'
Act	Omission	'Taint'
Synthetic	Natural	'Taint'
Toxic	Safe	'Taint'
Sorry	Safe	'Precautionary Principle'

The human/nature dichotomy is one of a number of heuristic distinctions grasped by culture, and often embedded in the law, to sort the good from the bad, the higher (superior) from the lower (inferior). Table 2 recites a non-exhaustive list of such distinctions. Note that the normative ordering of these dichotomies can be reversed from one era or culture to another, as in the case of human/nature, civilization/savage, and city/country. It is easy to think of examples in religion, sociology, politics and literature corresponding to each of these dichotomies. Some, like Francis Bacon, Andrew Jackson, and Bill McKibben, are cited above. Aldous Huxley's *Brave New World* [FN50] is one among many modern testaments to the view that civilization is a corrupting force and the wild savage is pure and good.

These dichotomies are normative fictions which break down amidst the complex realities of dynamic nature and dynamic society. The categories are unhelpful in any sophisticated context. Some of us are "city mice," others are "country mice." Some kinds and impacts of "civilization" are desirable and others are not. There is no real distinction between "toxic" and "safe" substances, because all ***16** substances are toxic at some dose and in some contexts; what matters is the degree of harm caused by the interaction of dose, interindividual variability, multiple and cumulative exposures, and this risk relative to the exposure that would occur in the alternative (from substitutes). [FN51] The precautionary approach of being "better safe than sorry" is an appealing

dichotomy currently in vogue, and offers a useful reminder that environmental problems are often poorly understood; but it falters when one recognizes that there are risks both to inaction by regulators (market externalities) and to precautionary ***17** action by regulators (regulatory externalities). [FN52] The "act-omission" distinction has been so pervasively embedded in modern American law that we tend not to notice its relation to these other dichotomies until the legal system is confronted by the categorical conundra it invites (is failure to warn an act or an omission?) and the perverse incentives it creates for inaction, ignorance and atomization. We then begin to construct new liability regimes that replace the simple act/omission dichotomy with sliding-scale rules that balance consequences (Learned Hand's reinterpretation of negligence [FN53]) and with incentives to reduce risk regardless of whether the least-cost risk-avoider acts or omits to act (strict liability). The human/nature dualism in environmental law is the conceptual counterpart of the act/omission dualism in tort law, and we are now--in Cell 4.C--beginning to construct a legal regime that escapes this dichotomy and is based instead on consequences and on incentives to promote ecological health. [FN54]

III. The Condundrum of Cell 4.C

All of the first three faces of environmental law enumerated above-- Rows 1, 2 and 3 in Table 1--depend, more or less, on two assumptions (labeled "B" for "Balance"):

B1. Nature is stasis--the equilibrium assumption that nature rests in balance until humans enter the scene

B2. Humans are exogenous--the dualist assumption that humans are separate from nature (else human conduct could not ***18** be said to be disturbing nature, but would itself by definition be natural)

The "new ecology" rejects both of these assumptions and replaces them with two new propositions (labeled "N" for "New"):

N1. Nature is change

N2. Humans are endogenous

This eco-reformation, led by Daniel Botkin, Judy Meyer, Stewart Pickett, Peter and Rosemary Grant, Norm Christensen, and many others, amounts to an echo-revolution: the modern rediscovery of Darwin's deep insight that nature reinvents itself. [FN55] Just as "Darwin killed dualism," [FN56] future generations of scholars may recall astutely that "Botkin killed balance."

That leaves us in uncharted territory. If modern American environmental law is based on obsolete assumptions which are unsatisfactory because they are scientifically inaccurate, ethically troubling, and counterproductive, we need to find a better way. Yet the law has characteristically had a difficult time incorporating cutting-edge conceptual changes in science.

In terms of Table 1, the task before us to fill in Cell 4.C. The fourth face of environmental law remains lurking just beyond view, dancing furtively on the periphery of our cabined frame of mind, waiting to be recognized and sketched. What kind of environmental law should we construct to

match this dynamic, post- balance, post-dualist view of nature and humanity? This was the challenge taken up in the First Cummings Colloquium.

One thing should be clear: saying that nature changes and that humans are part of this change (propositions N1 and N2) does not mean that human-wrought change, being "natural," is therefore "good." This inference relies on the fallacy that "natural" means "good." One feature of Row 4 is that it avoids the normative connotations implicit in the old ecology, whether the "dominion" or *19 the "taint" mode. In the world of the new ecology, the fourth face of environmental law, the term "natural" is not helpful for distinguishing good from bad. [FN57] "Nature" and "natural" are no longer useful legal fictions (and they may no longer be useful scientific terms, either).

If humans are part of nature, then human actions--and other actions that affect the environment--must be judged on some other basis. I have argued previously that this new basis should focus on the ecological consequences of events, such as the rate and magnitude of change. [FN58] A consequentialist approach would impose limits--regulation--on all sorts of activities, but with the goal of improving overall well-being rather than the goal of preserving what is "natural." It would reflect an ethic of concern, empathy, and good judgment.

Some fear sacrificing "nature" under such a consequentialist balancing calculus, but a new consequentialist approach could well entail as much or even more protection as its predecessors. For example, a consequentialist calculus could protect more "untrammelled wilderness" than would the separatist-taint approach, if such wilderness is ecologically valuable--and especially if the taint paradigm would decline to protect ecologically rich areas which have already been touched by humans. A consequentialist approach would manage rivers and forests for ecological and economic health, not to force them into rigid stasis. A consequentialist approach to slowing species extinction would focus on conserving habitats and collective biological diversity, rather than the "old ecology" approach of saving individual species at the eleventh hour and sacrificing species whose boundaries would be modified by interbreeding. A consequentialist approach to pollution control would focus on the overall quality of air, water, and land, not whether changes have been induced by one species or another. A consequentialist approach would address the rates and magnitudes of environmental change, not the categorical classification of its origins. All the essays in this collection--especially those by Daniel Botkin, Bryan Norton, Walter Kuhlmann, and Alyson Flournoy--while differing in their views of the role of human change in nature, make the same point: that moderating the rates and magnitudes of environmental change is a crucial strategy for environmental law in the world of dynamic ecology. Most generally, a consequentialist approach would focus on risk analysis--that is, on the analysis of risks to human and ecological health.

*20 Furthermore, a consequentialist approach is not necessarily inconsistent with "preserving" some areas of "wilderness," without roads, buildings, and human habitation, because under a consequentialist approach society may well put value on preserving such areas as part of a portfolio of differentiated land uses. By the same token, a refined "stewardship" approach could come to resemble, in practice, the approach described in Row 4. If "stewards" abandoned the "balance" paradigm and viewed nature as dynamic, and moreover attached value to environmental protection for non-human ends, this combination of Rows 2 and 4 would veer toward the consequentialist model. [FN59]

Filling in Cell 4.C along these lines raises several additional questions. First, is it logistically possible? Daniel Botkin's essay in this collection answers an emphatic yes. He stresses the importance of designing environmental protection efforts in terms of empirical data, not assumed equilibria. And he illustrates the necessity of tailoring protective rules to the dynamic paths of complex multivariate systems. He argues for setting dynamic instead of static environmental goals: in one case study, he helped design optimal salmon harvest levels set not as a fixed annual allowable catch, but as variable limits corresponding to the fluctuating salmon populations produced by complex interrelated ecological and economic factors. This approach no doubt requires substantially greater investments in empirical data, monitoring, and systematic evaluation of outcomes.

Second, can law change as nature changes? As George Frampton and Alyson Flournoy point out in their essays, there is a strong tension here between accuracy and closure, agility and stability. More accurate and agile environmental laws would adjust continuously to more closely match ecological fluctuations, but human activities may demand some predictability, some certainty that the law today will be the law tomorrow. Indeed, dependable legal rules may be important to induce citizens to conserve ecological resources for the future, because uncertain legal rules could encourage a destructive race to extract short-term financial values, say by rapidly cutting timber. [FN60] At the same time, predictable license to exploit resources, without *21 constraints devised in light of new information about ecosystem vulnerabilities, would be undesirable as well.

The middle ground, Frampton argues, is a system of "adaptive management" in which the law itself follows a self-consciously evolutionary process: promulgation, experimentation, evaluation, and revision. This Darwinian environmental law holds the promise of substantially improved outcomes, at the cost of much more data and analysis. Tim Profeta's essay in this collection extends the adaptive management model, arguing that it performs best when environmental laws can be spatially non-uniform--when standards are tailored to optimize outcomes for each ecosystem, rather than imposed nationally (as is typical under current pollution control laws). Alyson Flournoy, examining the contrasting case of wetlands protection, argues that the current law focuses too narrowly on individual parcels of land, and should be broadened to allow watershed-wide planning for dynamic wetlands relationships. From opposite starting points, Flournoy and Profeta reach the same recommendation: policy scales that match ecological scales, instead of political or commercial boundaries.

Profeta argues that adaptive management of dynamic ecosystems requires Congress to delegate far more discretion to expert agencies, because only the latter can digest the data and track the multiple variables necessary to make sound judgments. Gerald Emison's essay in this collection applies the evolutionary model to pollution control laws, arguing that adaptation of the law is indispensable to accomplish successful results in a mathematically complex and potentially chaotic world.

A third question relates to how ecological consequences are judged. Frampton also insists that although science can quantify rates and impacts, it cannot dictate optima. Some basis for evaluating and weighing consequences must be combined with quantitative knowledge. Botkin is careful to say that the choice of optimal salmon harvests depends on social judgments about how much depletion of the fish population, and how much constraint on the industry, are desirable. Similarly, Frampton insists that federal resource managers need both science and values to make policy choices. But Dan Tarlock cautions against reliance on the moralisms of earlier environmental policy

(some of which I have attempted to display in Tables 1 and 2). He argues that the lesson of the new ecology is that environmental law must be based more purely on "science," not morals. Tarlock invokes a longstanding debate (and threatens to divide an uneasy alliance) between justifications for environmental ***22** law based on "cool analysis" and "moral outrage." [FN61] Still, he must find some place for issues of value. Put another way, does "science" include the social sciences that measure the public's valuation of environmental quality? If not, how to choose among quantitatively characterized outcomes? If yes, how to sanitize these public attitudes of simplistic moralizing?

Or should we? If the public believes in the "balance of nature" as an idealistic albeit romantic and unscientific notion, then in a democratic republic, on what basis do experts redirect environmental policy toward more ecologically effective but less publicly popular goals? One tack is to defer to popular will, arguing that it reflects a better basis for democratic policy (and even that it furnishes a more complete evaluation of hazards than experts would provide). [FN62] A counter move is to critique public attitudes as factually mistaken (and sometimes prejudiced), and to argue that in a progressive republic the government is obliged to filter out misinformed (and perhaps even misguided) public attitudes. [FN63] Another tack is to argue that the public preferences on which government should rely are not just the aggregation of today's private inclinations, but are the result of a political process of informed deliberation that shapes, rather than reflects, public norms. [FN64] Yet another approach is to argue that the values underlying environmental law should come not only from human interests but should encompass the interests of nonhumans as well. [FN65]

***23** The First Cummings Colloquium did not debate this question, but it is implicit or explicit in all of our perspectives. [FN66] Walter Kuhlmann's essay in this collection argues that the central choice is whether to consider nonhuman interests at least on a par with human interests when making ecosystem management choices. He worries that modern "ecosystem management" will just be a cover for the reassertion of an "imperial" ecology in which humans "colonize" ecosystems for human uses in terms of an anthropocentric calculus of value. This "imperial" brand of environmental law encompasses Rows 1 and 2 in my Table 1 above, those faces of environmental law which presume the superiority of humans over nature. Kuhlmann prefers a "foundational" or ecocentric approach, in which the interests of the ecosystem are taken into account.

Moreover, in contrast to Tim Profeta, Kuhlmann argues that adaptive management on an ecocentric basis requires less deference to federal agencies and more stringent judicial review of agency choices. He worries that calling humans part of nature and all nature "home" to all organisms will be a license for abuse, and he sees human/nature dualism as a firebreak against agencies allowing humans to overrun all ecosystems. [FN67] This difference in view reflects the dual role of federal agencies, drawing on both expert and political sources of authority. Profeta wants agency expertise unfettered; but Kuhlmann doubts that agencies will act as experts in the face of political pressures from constituent groups to favor human uses over nonhuman uses of forests. And the difference may also reflect the traditions at different agencies: Kuhlmann is particularly concerned with the U.S. Forest Service, which he argues has hidden behind its legal discretion in order to avoid incorporating new science into its policies. Profeta and Emison are concerned with EPA, which they argue has been constrained from employing the best science by Congressional edicts to adopt political and "old ecology" approaches.

***24 IV. Beyond Balance**

The First Cummings Colloquium on Environmental Law at Duke University has been a stirring stimulus toward a legal catharsis. Through rich multidisciplinary collaborations like these, we may see our way "beyond the balance of nature" to a new regime of environmental law that accommodates dynamism and discards the facile assumptions of the past, while devising a sturdy and successful system of environmental protection for the future.

Acceptance of the new ecology does not make the move to a fourth face of environmental law simple. It leaves us in a discomfiting state; there are no obvious bright-line boundaries, no simple categorical distinctions on which to base normative judgments. It is not clear what legal rules should accompany acceptance of the new ecology. We have some general markers in view, but no clear outline. A move toward environmental law based on rates and magnitudes of environmental consequences is near at hand, even already underway, but it raises new questions about practicality, about the stability of legal rules trying to match dynamic ecosystems, and about the values the law should apply to weighing such consequences.

The fact that the first three faces of environmental law have proved unsatisfactory is not sufficient to warrant adoption of a new approach, because the new fourth model of environmental law will also be imperfect. We must compare the real (not idealized) advantages and drawbacks of what we put into Cell 4.C with the real advantages and drawbacks of what lies in Cells 1.C, 2.C, and 3.C. Our aspiration should be to design a new form of environmental law that works better--or at least in a less unsatisfactory fashion--to meet the challenge of the new ecology. It must be superior in its science, its ethics, and its consequences. If we can construct such a legal system, we will be making dynamic progress.

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FN[FN1]. The landmark work is Daniel Botkin's *Discordant Harmonies: A New Ecology for the Twenty-First Century* (1990). An excellent synthesis is provided by Judy L. Meyer, *The Dance of Nature: New Concepts in Ecology*, 69 *Chi.-Kent L. Rev.* 875 (1994). See also Stewart T.A. Pickett et al., *The New Paradigm in Ecology*, in *Conservation Biology: The Theory and Practice of Nature Conservation, Preservation and Management* 60, 80 (Peggy L. Fiedler & Subdoh K. Jain eds., 1992); William K. Stevens, *New Eye on Nature: The Real Constant is Eternal Turmoil*, *N.Y. Times*, July 31, 1990, at C1; William K. Stevens, *Balance of Nature: What Balance is That?*, *N.Y. Times*, Oct. 22, 1991, at C4.

FN[FN2]. Norman L. Christensen, Jr., *Science and the Sustainable Use of Land*, in *The Use of Land* 273, 283-84 (H.L. Diamond and P. Noonan, eds., 1996).

FN[FN3]. See, e.g., Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 *Chi.-Kent L. Rev.* 847 (1994); A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 *Loy. L.A. L. Rev.* 1121 (1994); Jonathan Baert Wiener, *Law and the New Ecology: Evolution, Categories and Consequences*, 22 *Ecol. L. Q.* 325 (1995).

FN[FN4]. See Wiener, *supra* note 3.

FN[FN5]. See Wiener, *supra* note 3, at 338-57.

FN[FN6]. See Roderick Nash, *The Rights of Nature* 17-18, 70, 88-90 (1989).

FN[FN7]. For a much more thorough and historically rich survey of attitudes toward nature and humanity's role, see Nash, *supra* note 6.

FN[FN8]. Many historians view a society's conception of the human role in nature as the predominant force shaping the social rules that amount to environmental law. See, e.g., *Uncommon Ground: Toward Reinventing Nature* (William Cronon, ed., 1995); Luc Ferry, *The New Ecological Order* (Carol Volk, trans., 1995); Carolyn Merchant, *The Death of Nature: Women, Ecology, and the Scientific Revolution* (1980); Nash, *supra* note 6; Keith Thomas, *Man and the Natural World: A History of the Modern Sensibility* (1983); Donald Worster, *Nature's Economy: A History of Ecological Ideas* (2d ed., 1994).

FN[FN9]. Other examples are offered in the references cited *supra* note 3.

FN[FN10]. Francis Bacon, quoted in Merchant, *supra* note 8, at 169-72.

FN[FN11]. Andrew Jackson, message to the Congress of December 1830, quoted in Robert O. Keohane, *Commitment Incapacity, the Commitment Paradox, and American Political Institutions* 16 (1996) (working paper on file with the author).

FN[FN12]. Governor George C. Gilmer, quoted in Keohane, *supra* note 11.

FN[FN13]. See Wiener, *supra* note 3, at 341 & n.84 (citing rules of adverse possession in the U.S., and forest ownership in Brazil, which require land to be cleared as a predicate to secure ownership).

FN[FN14]. The Act predicates claims of ownership on aggressively mining the land, even where such exploitation is not economically efficient. See John Leshy, *The Mining Law* (1985).

FN[FN15]. See Wiener, *supra* note 3, at 342 & n.85.

FN[FN16]. See John McPhee, *The Control of Nature* 3-92 (1989); Jon Christensen, *California Floods Change Thinking on Need to Tame Rivers*, *N.Y. Times*, Feb. 4, 1997, at C4.

FN[FN17]. See *Trees Not for Sale to a Savior, Environmentalist Discovers*, *N.Y. Times*, Feb. 17, 1997, at 12.

FN[FN18]. Lynn White, Jr., *The Historical Roots of Our Ecologic Crisis*, 155 *Science* 1203, 1205 (1967). White's critique draws on Genesis 1:26-28, which exhort humans to "have

dominion over" and "subdue" life on earth.

FN[FN19]. Advocates of this view are collected and analyzed in Chuck D. Barlow, *Why the Christian Right Must Protect the Environment: Theocentricity in the Political Workplace*, 23 *Env'tl Affairs* 781, 791-809 (1996).

FN[FN20]. Joseph Sax, *Mountains Without Handrails: Recreation Policy for the Federal Lands*, 23 *Law Quadrangle Notes* (Univ. of Michigan Law School) 14 (1978).

FN[FN21]. Al Gore, *Earth in the Balance: Ecology and the Human Spirit* 243 (1992) ("In the Judeo-Christian tradition, the biblical concept of dominion is quite different from the concept of domination, and the difference is crucial. Specifically, followers of this tradition are charged with the duty of stewardship, because the same biblical passage that grants them 'dominion' also requires them to 'care for' the earth even as they 'work' it.").

FN[FN22]. George Perkins Marsh, *Man and Nature* 29 (1864), quoted in Botkin, *supra* note 2, at 54.

FN[FN23]. This interpretation of Darwin's view is explained in Jonathan Weiner [no relation to author], *The Beak of the Finch: A story of Evolution in Our Time* 6, 9 (1994).

FN[FN24]. See Nash, *supra* note 6, at 56-57.

FN[FN25]. Roderick Nash cites Ernst Haeckel as the originator of the term "oecologie," derived from the Greek "oikos" (house), in 1866. Nash, *supra* note 6, at 55.

FN[FN26]. See Bosselman and Tarlock, *supra* note 3. The historical allegiance of ecologists and environmentalists to the notion of "balance" is elaborated and critiqued by Botkin, *supra* note 1. I have speculated on several possible sources of the normative cast that human action is a malign taint on the balance of nature, but I know of no definitive historical explanation for this twist in the tale. See Wiener, *supra* note 3, at 343. Bryan Norton's essay in this symposium issue suggests that people have always had a deep-seated psychological need to see order, stability, and balance in the world. If so, one wonders why such a viewpoint would be so ingrained; did it once confer some evolutionary advantage? Attachment to the "balance of nature" may now be a heuristic framework of bounded rationality that is now producing irrational and undesirable errors in decisionmaking.

FN[FN27]. Bill McKibben, *The End of Nature* 48, 55 (1989).

FN[FN28]. See Wiener, *supra* note 3, at 344-345, for several examples, including such diverse settings as "takings" doctrine and food safety rules. See generally Bosselman and Tarlock, *supra* note 3.

FN[FN29]. 16 U.S.C. s 1131(c) (1988).

FN[FN30]. *Sierra Club v. Morton*, 405 U.S. 727, 728 (1972).

FN[FN31]. 33 U.S.C. s 1362(19) (1988). This distinction was quickly criticized by an expert panel, which said that under the Clean Water Act "pollution" is defined as "'man-made or man-induced' Thus, natural water quality appears to be regarded as a norm from which any deviation constitutes pollution. This is not a good standard on which to base the definition of pollution. In some places water is naturally toxic ... Man-induced changes ... can actually improve the usefulness of water" National Water Commission, *Water Policies for the Future* 69-71, quoted in Peter S. Menell & Richard B. Stewart, *Environmental Law and Policy* 450 (1994).

FN[FN32]. More stringent limits on substances and activities of human origin, as compared to toxins and processes of nonhuman origin, appear to be a systematic feature of modern American environmental law. See Lester B. Lave, *The Strategy of Social Regulation* 12 (1981); W. Kip Viscusi, *Carcinogen Regulation: Risk Characteristics and the Synthetic Risk Bias*, 85 *Amer. Econ. Rev.* 50 (1996) (Papers & Proceedings).

FN[FN33]. 33 U.S.C. s 1313(d)(1)(D) (1988). More generally, EPA is required to set quality-based standards to attain a "balanced population of shellfish, fish, and wildlife" (among other objectives) wherever technology-based effluent controls on point sources have proved inadequate to achieve this objective. See 33 U.S.C. s 1312(a) (1988).

FN[FN34]. Fla. Stat. Ann. s 373.4592(4)(e)(2) (West 1996).

FN[FN35]. See Christensen, *supra* note 16. Christensen quotes federal and state officials recanting "the values of 50 years ago--when we built dams upstream and straightened our rivers and put them in concrete channels," and recognizing that "rivers are going to flood and meander and shift their alignments," and that after a flood overruns a human levee system "we're starting to look at the big picture instead of just putting things back the way they were." *Id.* Says river expert Jeffrey Mount, "I think we should turn flood control on its head. We should seek flood promotion. Flooding in one place spares another." *Id.*

FN[FN36]. Nash, *supra* note 6, at 202.

FN[FN37]. See *supra* note 1.

FN[FN38]. Christensen, *supra* note 2, at 277.

FN[FN39]. See Weiner, *supra* note 23.

FN[FN40]. Nash, *supra* note 7, at 70.

FN[FN41]. A fundamental tenet of the new ecology is that not only does the environment modify organisms (Darwin's thesis of evolution by selection pressures), but organisms also modify the environment. See Meyer, *supra* note 1.

FN[FN42]. Human activities--recently but also over thousands of years--have remade landscapes we now think of as pristine (e.g., rainforests), and have emitted substances found

at all corners of the earth. See Botkin, *supra* note 1, at 194 ("there is no longer any part of the earth that is untouched by our actions in some way"); Carol K. Yoon, Rain Forests Seen as Shaped By Human Hand, *N.Y. Times*, July 27, 1993, at C1 (stating that "virgin" forests were cleared and burned by humans hundreds or thousands of years ago); David W. Steadman, Prehistoric Extinctions of Pacific Island Birds: Biodiversity Meets Zooarcheology, 267 *Science* 1123 (1995) (suggesting that humans caused mass extinctions thousands of years ago); Reservoirs May Be Altering Speed of Earth's Orbit, *Raleigh News & Observer*, March 3, 1996, at 13A (reporting that by slightly shifting the global distribution of surface water away from the Equator, human reservoirs may have kept the earth spinning slightly faster than it otherwise would and slightly shifted the earth's axis).

FN[FN43]. See Cronon, *supra* note 8.

FN[FN44]. Kathleen Donnelly, The New Buzz Word in Cigarettes? *Natural*, *Raleigh News & Observer*, Feb. 18, 1996, at 7E.

FN[FN45]. See Botkin, *supra* note 1, at 153-54; Ashley Schiff, *Fire and Water: Heresy in the Forest Service* (1962).

FN[FN46]. See Wiener, *supra* note 3, at 339 & n.74; Stephen J. O'Brien & Ernst Mayr, Bureaucratic Mischief: Recognizing Endangered Species and Subspecies, 251 *Science* 1187 (1991).

FN[FN47]. Susan Putnam and Jonathan Baert Wiener, Seeking Safe Drinking Water, in *Risk versus Risk: Tradeoffs in Protecting Health and the Environment* 124-148 (John D. Graham & Jonathan Baert Wiener, eds., 1995).

FN[FN48]. See Wiener, *supra* note 3, at 351-354. The separatist-taint paradigm cannot deal with such dangers; it lamely asks which is "natural," the asteroid or the human response. But that unanswerable riddle is the wrong question. The issue is whether the world will be better off if we let the rock hit or if we intervene (recognizing that there are risks to both options).

FN[FN49]. I am indebted to Robert Keohane for exploration of this point.

FN[FN50]. Aldous Huxley, *Brave New World* (1956).

FN[FN51]. See M. Alice Ottoboni, *The Dose Makes the Poison: A Plain-Language Guide to Toxicology* (2d ed. 1991); George M. Gray & John D. Graham, Regulating Pesticides, in John D. Graham & Jonathan Baert Wiener, eds., *Risk versus Risk: Tradeoffs in Protecting Health and the Environment* 173-92 (Harvard Univ. Press 1995).

FN[FN52]. The point that "better safe than sorry" is an inadequate heuristic for making good judgments is articulated in Howard Margolis, *Dealing with Risk* 75-79 (Univ. of Chicago Press 1996). The need to compare the health and environmental risks of not regulating ("target risks") with the health and environmental risks caused by regulating ("countervailing risks"), and ways to do so, are presented in John D. Graham & Jonathan Baert Wiener, eds.,

Risk versus Risk: Tradeoffs in Protecting Health and the Environment (Harvard Univ. Press 1995). Specific examples of harm caused by the "precautionary" approach are analyzed in Frank Cross, Paradoxical Perils of the Precautionary Principle, 53 Wash. & Lee L. Rev. 851 (1996). Systematic approaches to "market externalities" and "regulatory (or "derived") externalities" are developed in Charles Wolf, Markets or Governments: Choosing Between Imperfect Alternatives (MIT Press 1988), and Jonathan Baert Wiener, The Nosocomial State (forthcoming).

FN[FN53]. U.S. v. Carroll Towing, 159 F.2d 169 (2d Cir. 1947).

FN[FN54]. See Wiener, *supra* note 3, at 350-57.

FN[FN55]. That nature undergoes some change may not have been a revolutionary insight, but Darwin's appreciation that the environment modifies itself through perpetual selection pressure was one of the few true conceptual scientific revolutions. Thomas S. Kuhn, *The Structure of Scientific Revolutions* 171-72 (2d ed. 1970); Freeman Dyson, *Imagined Worlds* (forthcoming 1997).

FN[FN56]. Nash, *supra* note 6, at 70.

FN[FN57]. See Worster, *supra* note 8, at 432.

FN[FN58]. See Wiener, *supra* note 3, at 350-57.

FN[FN59]. Still, it would derive from a quite different ethical starting point: human superiority.

FN[FN60]. See Robert T. Deacon, Deforestation and the Rule of Law in a Cross-section of Countries, 70 *Land Econ.* 414 (1994) (suggesting insecure property rights induce more rapid deforestation); David A. Dana, Natural Preservation and the Race to Develop, 143 *U. Pa. L. Rev.* 655 (1995) (same).

FN[FN61]. See Robert V. Percival, et al., *Environmental Regulation: Law, Science and Policy* 67-69 (2d ed., 1996).

FN[FN62]. See Donald Hornstein, Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis, 92 *Colum. L. Rev.* 562 (1992); Lisa Heinzerling, Political Science, 63 *U. Chi. L. Rev.* 449 (1995) (reviewing Stephen Breyer, *Breaking the Vicious Circle: Towards Effective Risk Regulation* (1993)); Clayton Gillette & James Krier, Risk, Courts, and Agencies, 138 *U. Pa. L. Rev.* 1027 (1990); Kristin Shrader-Frechette, *Risk and Rationality: Philosophical Foundations for Populist Reforms* (1991). Note that valuations based on public preferences, such as "willingness to pay" estimates derived from markets or contingent valuation surveys, incorporate public perceptions of risk.

FN[FN63]. See Breyer, *supra* note 62; Frank B. Cross, The Public Role in Risk Control, 24 *Envtl. L.* 887 (1994).

FN[FN64]. See Cass R. Sunstein, Preferences and Politics, 20 *Philosophy & Public Affairs* 3 (1991); Cass R. Sunstein, Endogenous Preferences, *Environmental Law*, 22 *J. Legal Studies* 217 (1991).

FN[FN65]. See Christopher Stone, The Environment in Moral Thought, 56 *Tenn. L. Rev.* 1 (1988). Stone argues that nonhuman interests should be morally "considerable," and attempts to answer critics such as Mark Sagoff who have questioned how humans would divine the interests of nonhumans. Stone's argument is not as radical a departure from utilitarian thought as one might think. Indeed, Jeremy Bentham argued that utilitarianism should incorporate the preferences of nonhuman organisms. Nash, *supra* note 6, at 23.

FN[FN66]. This will be the topic of the Second Annual Cummings Colloquium on Environmental Law, held at Duke during the 1996-97 academic year.

FN[FN67]. This argument is a variant of the "prophylactic" justification for the "taint" paradigm, discussed above.

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