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BOOK REVIEW: DISCORDANT HARMONIES, A NEW ECOLOGY FOR THE 21ST CENTURY

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DISCORDANT HARMONIES, A NEW ECOLOGY FOR THE 21ST CENTURY

Daniel B. Botkin. 1990 & 1992 (paperback)

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Daniel Botkin's recent book *Discordant Harmonies: A New Ecology for the 21st Century* (Oxford University Press) has aroused much interest. For a book that purports to lead ecology into the 21st century, the tone carries the unmistakable accents of the late 19th. As if transported back 100 years, one hears the voice of the Victorian Darwinians whose ideal of civilization depended essentially on the vigorous conquest of nature by science and technology. *Discordant Harmonies* echoes this approach: "We have the power to mold nature into what we want it to be." "Nature in the twenty-first century will be a nature that we make." "We do not take an engineering approach to nature, we do not borrow the cleverness and the skills of the engineer, which is what we must do...we need to instrument the cockpit of the biosphere." In North America, these messages resonate with the turn-of-the-century philosophy of Gifford Pinchot: control, manage, and use resources prudently. After 100 years of exploitation, Wise Use is still the watchword.

Botkin is a "population ecologist," meaning one who is primarily interested in tracking the ups and downs of species numbers while searching for their causes. During his career he has discovered that populations of elephants, moose, fish, sea otters and trees are inconstant over time. When left to themselves in nature they do not multiply to some fixed equilibrium point. Rather their numbers fluctuate, not regularly but in a random fashion. Thus populations tend to be unpredictable, their periodic swings corresponding more closely to the numbers thrown up by chance, as in a game of dice, than to any optimum target. If nature is inconstant, Botkin argues, then nature has no preferred state and offers humanity no fixed goals, no guidelines by which to navigate. Therefore people must take over the planet, wisely and prudently choosing the goals to be pursued, marshalling science and technology to the task of global management. Old myths and metaphors that stand in the way of this "factual" view of the world must be discarded. Then progress can be made, civilization can be advanced and the world made comfortable and pleasant for us all.

That Botkin sees the world through the lenses of a population ecologist is indicated by his simple equation of the behaviour of species populations with "Nature's" behaviour. But when he thinks about it, he asserts that nature taken in its largest sense is the biosphere. Are populations of animals and plants, then, good surrogates for "Nature;" i.e. for the biosphere or ecosphere? Does the inconstancy of population numbers mean that the ecosphere is itself inconstant? This poses a more fundamental question: What is the relationship between populations and the ecosphere?

The ecosphere (biosphere) is understood to be the planetary life-filled system, the world as a material entity that has evolved for 4.6 billion years or so. It is a structured object: the gaseous air overlying liquid sea and solid land, with organisms clustered primarily at the gas-liquid-solid phase boundaries. Much evidence that all parts are interactive and symbiotic is accumulating. The compositions of atmosphere, hydrosphere and lithosphere show unmistakable signs of organic contributions, just as organisms exhibit clear evidence in their bodies of endowments from air, water and soil. In order to understand the ecosphere it makes sense to divide it into volumetric sectors at various scales such as oceans, continents, regions and landscapes. If these divisions are to be *functional* parts, they must have the same structure-composition as the ecosphere: air over water/land enveloping organisms. Each ecosystem is a three-dimensional object amenable to study; a life-filled piece of terrain.

More popular with ecologists than ecosystems are their less complex and easier to isolate organic parts: groups of individuals of the same or different species co-occurring as populations or communities. But are assemblages of organisms *as such* fit subjects for scientific study?

Erroneous acceptance of populations

In the context of real Earth spaces (i.e. of sectors of the ecosphere), any population is a *selection of similar organic objects* abstracted from the functional ecosystem within which they dwell and without which they would perish. A population is a taxonomic category, usually defined as members of a particular species in contact with one another. It is an artifact of thought in the sense that no spatially associated cluster of organisms has an existence apart from the air-soil-water-food of the ecosystem that supports it. A population *per se* is not a functional *thing*. Botkin criticizes Clement's idea of the plant formation as a superorganism, and his words apply just as well to populations. "There is no inside and outside of a super-organism," he says, and "if there are not sharp boundaries then the superorganism cannot really exist." Like the Clementsian plant community, the population has no inside or outside, no physiology (internal) nor ecology (external) comparable to that of an *individual* organism or an *individual* ecosystem.

The erroneous acceptance of populations as fit objects-of-study stems from the fact that they can be counted and graphed. Although populations are not *structural-functional* objects they do have *compositional* characteristics that are easily quantified and mathematized. Once defined as "wolf packs" or "deer herds" or "aspen stands," the numbers can be tallied and analyzed for patterns and trends, for constancy and inconstancy, and for correlation with selected environmental "factors." For the most part this has proved to be a fruitless academic exercise. Botkin would improve the relevance of population studies

by better techniques of analysis: stochastic models, "smart" computers. These will also fail. No studies of populations *per se* can enlarge understanding, unless accompanied by close attention to the "units of nature on the face of the earth" that support and sustain species; i.e. without a primary focus on the geographic ecosystems within which species have evolved and are sustained. Therefore reliance on population numbers as counted over time to prove or disprove nature's capriciousness is wrong. Populations are not proxies for nature and so the primary but unstated thesis of the "New Ecology" collapses.

In fact, one section of the book dealing with endangered species lends support to the argument that Nature's ways cannot be judged by swings in population numbers, though the subversive implications is not recognized by the author. Comparing the imminent extinction of the California condor with the recovery of the whooping crane, he points to the importance of "habitat." That of the whooping crane is "intact and self-sustaining" in northern Alberta and along the Texas coast while the condor's habitat in California is virtually destroyed. We learn, he says, that "*the condition of the habitat is more important than simple population numbers* (emphasis added). "Conservation of endangered species is...understood to depend on the *idea of an ecosystem* rather than on simple analyses of populations."

According to the last statement, populations are real things to be analyzed. By contrast, ecosystem (the home ground or habitat of organisms) is "an idea" rather than a lively chunk of the ecosphere. In Botkin's lexicon, ecosystem is synonymous with "complexity;" i.e. with the vague communal food-and-shelter externalities of species and populations. He conceives the crane's summer ecosystem as *an idea* of complexity, not as the dependable calcareous wetlands in the boreal forest wherein the crane feeds and nests during the summer. Accordingly, the complex ecosystem that exists in the north woods "intact and self-sustaining" merits no standing in the debate as to nature's reliability, while the crane population - its migratory numbers fluctuating as it runs the gauntlet of guns and overhead wires - proves again Nature's inconstancy.

Nature's More Constant Face

Nature conceived as the ecosphere and its sectoral ecosystems presents a different face than the populations of organisms assumed to be its surrogates. Consider any terrestrial ecosystem such as a tract of native grassland, resembling a gigantic terrarium. It is based on a surficial geological stratum, a landform whose surface layer is soil: slowly changing and, within a human lifetime, reasonably constant internally and externally in the suite of organisms it supports. Above the surface the day-to-day weather is changeable but the climate shows many regularities: evapotranspiration exceeds precipitation, rains generally peak in June, frosts come in September. True the floristic and faunistic

composition varies in cycles of drought and of moisture, but though the ecosystem's populations of spear grass, gophers and hawks vary from year to year the densely complex system of several hundred species of plants and animals survives *as grassland*, balanced between the fixed and the fluid. Phrased another way, the "stage" of landform-soil and climate remains in place, the flora and fauna "actors" move back and forth between stage and wings, the 10,000-year "play" of the prairie ecosystem continues. Does the fact that June rains and a certain yield of grass cannot be *exactly* predicted a year ahead make nature inconstant and in need of engineering?

Botkin's answer to the above question is a resounding "Yes!" conveying the strong impression that he is looking for reasons to justify the managerial philosophy: Imperfect nature needs to be perfected by man. Scattered throughout the text are several dozen value statements which when pulled together form a theme discordant with the history of the ecosphere: Under the guidance of science and using the tools of technology, humankind will astutely set the goals for the entire planet, managing it wisely and prudently for the advancement of civilization. Thus the goal is *omniscience and complete control.* In this view, Nature is inconstant to the extent that so far man* (the andropocentrism is intended) has neither been able to predict - population by population, species by species - what numbers will be around next year, nor to intervene successfully as a manager to achieve set production targets.

A specific thesis of the book is that until very recently humankind has wrongly viewed the world as stable, as naturally in a state of equilibrium, as constant over time. Botkin is the latter-day prophet come to reveal the truth, exhorting the masses to reject the error of this static perspective. Although populations of animals are his chief examples, he also plots the ups and downs of various other phenomena to prove his hypothesis that nature is erratic and unreliable. For example, the patterns of temperature over the last million years show "no constancy or any simple pattern or regular cycle." A counter suggestion is that the graphed temperatures, fluctuating in the range of only six or eight degrees over the last million years, reflect remarkable stability. Again, Botkin reports that "the biosphere was assumed to be in a steady-state in regard to carbon (but) recent information shows - to the contrary - that the level of carbon dioxide in the atmosphere has varied over thousands of years." Maybe so at the level of parts per million, but evidence is that the gross composition of Earth's atmosphere - the proportion of nitrogen, oxygen and carbon dioxide - has been extraordinarily stable for hundreds of millions of years.

As a third example he discusses the history of the post-glacial vegetation in the Boundary Waters Canoe Area where paleo-botanical records show that the forest composition has changed half a dozen or more times since the ice withdrew. "If one's goal were to return the BWAC to its *natural* condition, which of these (post-glacial) forests would one choose?" he asks. The answer is obvious: Choose the forest of the last 1000 years, for it is certainly better tuned to

present-day physiography and climate than others that preceded it. Ignoring the ecology of landscapes, Botkin chooses not to countenance such an answer. It destroys his argument that capricious nature offers no guidelines and therefore management must respond only to *what people want*.

False Ideas

Botkin is criticizing ideas of *exact*, *precise*, *fixed* states of equilibrium in nature, a viewpoint that surely few hold today. At the same time he admits the lack of clear meanings for "constancy" and "stability" as applied to populations, communities and ecosystems, "and the difficulty increases in that order." Questions of scale in space and time, important but only briefly mentioned, would have clarified these concepts; for example, weather (short term) is inconstant and climate (long term) relatively constant. At any rate the evidence that up to the present time humanity has been misled by false ideas of stability, equilibrium and constancy is weak. The statement, "Until the past few years, the predominant theories in ecology either presumed or had as a necessary consequence a very strict concept of a highly structured, ordered and regulated, steady-state ecological system," seems to overlook the dynamic emphasis that from the beginning has dominated American ecology. The idea that perturbations such as fire and flood are an integral part of natural ecosystems is old hat. Perhaps the explanation for Botkin's repetitive sermon is that his chief targets are animal ecologists clinging to simple mathematical models of population growth: the logistic and Lotka-Volterra equations. But do improved models for the simulation of population fluctuations constitute a sufficient basis for "A New Ecology for the 21st Century?"

"The reasons why we have failed to manage wildlife and other renewable resources lie not in facts alone...but in beliefs hidden from view. We must confront the assumptions that have dominated our perceptions of nature." Botkin claims humanity is the victim of false myths and metaphors that have prevented everyone, including scientists, from facing the facts. The facts, he repeats, are that nature is inconstant, because at all scales of space and time everything keeps changing. Structures are ephemeral, only processes are constant. The old myths and metaphors, the false beliefs that prevent people from facing the facts, are two: nature conceived as divinely ordered and static, and nature conceived as a steady-state machine.

The new correct metaphor apparently is nature conceived as a computer, which Botkin labels an "organic" model. For example, bacteria can exchange DNA and therefore "they can be regarded as resembling *nothing more* (emphasis added) than memory bytes in a computer that operates at the planetary level...Computers are providing new metaphors not only for bacterial life, but also for our entire perception of life on Earth, from the way that we regard bacteria

to the way we view ecosystems and our entire planetary life-support system...In this and other ways, computers are revolutionizing our concept of nature, our perception of our relationship with nature, and our ideas about managing nature."

Here speaks a dedicated hacker, one who no longer sees a computer as a machine but as an organism! By conferring organic qualities on the computer Botkin can have it both ways: renouncing outmoded mechanistic industrial-age ideas while asserting that we need no longer oppose engineering and technologic progress. "Technology (read "the organic computer") places before us a new vista!"

The Serious Flaw

Under this thinly camouflaged "neo-mechanistic" view of nature lies a more serious flaw. In his critical analysis of "nature as divine order," Botkin examines the question of how science contributed to the misleading idea of a wonderfully ordered universe. How, in short, did *science* that deals with the "what" and "how" of things, not the "why" of metaphysics and religion, manage to support the insupportable? His explanation is that religious beliefs about the character of biological nature infiltrated science. The idea of a mismatch between a "scientific age" and myths with their "wrong perspectives" implies that only occasionally is science mislead by deeply buried false beliefs and that most of the time science yields purely objective culture-free truths. This is simply false. Science is a social pursuit and scientists are never immune to the deep beliefs of the culture within which they live. The classic oft-quoted example is the influence of the theories of Adam Smith and Malthus, in a milieu of burgeoning capitalism, on Darwin's idea of the centrality of competition as an evolutionary mechanism.

The other side of the decisive influence of culture over scientific findings is the primacy of theory over fact, of paradigm over what seems actual. Botkin is dismayed that people have not faced the facts but have instead been swayed by false theories. But all facts are theory-loaded - theory leads, facts follow. This is true at the most fundamental level of perception, where what we observe (factual vision) is conditioned by prior concepts, theories, beliefs. Psychologists tell us that "believing is seeing" not "seeing is believing." Botkin criticizes the ornithologist David Lack for searching out facts that fit his theory but this is what all of us do, scientists included. The facts that Botkin adduces in support of his "New Ecology" are those carefully selected to agree with the theory of nature's inconstancy which he has chosen to embrace. Critics who find his theory and the implications he draws from it shallow and perilous can find plenty of facts to falsify it.

The cultural milieu from which Botkin's deep beliefs and myths are inseparable

is the affluent consumer society of North America. As a card-carrying member he has to reject the idea of an ordered and well-balanced universe because if "nature knows best" then humanity's role is to back off, let it be, do nothing or at least interfere as little as possible in the ecosphere - which is anathema to the managerial society. Adoption of such a radical idea would put applied scientists, resource managers and technocrats out of work. On the other hand the idea of an inconstant and orderless nature where chance plays the major role fits perfectly with the managerial society whose purpose is to control, exploit and grow. In fact a changeable nature that exhibits no perfectly stable characteristics, no fixed equilibrium points, *demands* intervention everywhere. Therefore Botkin's repetitive message: Embrace technology and prepare to manage the world, species by species. "Under the new management," he says, "one starts with the question: How many sea otters are enough?" Nowhere in the book does he ask the more fundamental question: "How many people are enough?" Nowhere does he entertain the idea that humanity's role might be to keep ecosystems healthy, ministering to those in use like sensitive gardeners so that their creativity and productivity - for sea otters and everything else on Earth - can continue in the ancient proven way.

From the book's title to the last sentence beginning, "If nature in the twenty-first century will be a nature that we make," perceptive readers will recognize the goal to which Botkin would lead us - because everyone has seen it on Star Trek. It is called "the space and computer age," also known as the Age of Anthropocentric Techno-Control. That this vision of a brave new world can be spun off from the simple observation that populations fluctuate is a credit to Botkin's ingenuity.

Several of the goals for humanity that he proposes are commendable, such as preserving biodiversity: "the real focus of our efforts is the maintenance of life"; and maintaining the ecosphere: "people living within nature, neither poisoning it nor destroying its reproductive capabilities". His opinion is factual that "Life and the environment are one thing, not two, and people, as all life, are immersed in the one system", though elsewhere, by pronouncing, "Earth is not alive", he contradicts himself. His proposal that various kinds of wilderness should be preserved is praiseworthy, but the idea of management keeps intruding with never a hint that the solution might be the management of humans, in both their numbers and wants. The admonition to "minimize the use of new technologies when these lead to novel alterations of the environment" is pertinent, particularly for those who would engineer the Earth. He is honest in admitting ignorance of how the "dense complexity" of crowds of species across Earth's surface persists and has persisted for so long. The reason - that through the entire history of the planet no one species has tried to manage all the rest - did not occur to him.

Let us hope for a far wiser "New Ecology" in the 21st century than this; one that begins where Botkin ends with a commitment "to recognize the limits of our actions."

Further Reading

*Rowe, J.S. and B.V. Barnes. 1994. Geo-ecosystems and Bio-ecosystems. *Bull. Ecol. Soc. Amer.* 75(1): 40-41.

*Worster, Donald. 1977. *Nature's Economy, the Roots of Ecology*. an Francisco: Sierra Club Books.

See pages 170-178 for Botkin's views according to the Victorians.

Addendum: Humanity's Goals that the "New Ecology" will serve, quotes from *Discordant Harmonies*.

1) page 4: Constructive management that, if implemented, could achieve long-term uses of natural resources and enhance the environment in a way that could be both pleasing to us and necessary for the survival of life on the Earth.

2) page 11: People living within nature, neither poisoning it nor destroying its reproductive capabilities.

3) page 13: To build a great civilization in which our role in the environment is a positive one, managing sustainable natural resources and enhancing the quality of our environment... a new advance in understanding of our surroundings that leads to an advance in our civilization.

4) page 71: Wise management of nature.

5) page 89: To make wise use of nature...to seek some kind of harmony with our surroundings in the future.

6) page 122: Deal wisely with our surroundings.

7) page 154: Make wise use of natural resources.

8) page 171, Chap. ll: Managing the biosphere.

9) page 182: The maintenance of life...the maintenance of a biosphere that is desirable to human beings...to sustain the biosphere to meet conditions for the well-being of people.

10) page 183: A healthy biosphere (that) would vary within a set of conditions acceptable to us or necessary for the persistence of life.

11) 189: To make the Earth a comfortable home, for each of us individually and for all of us collectively in our civilizations.

12) 193: Manage nature wisely and prudently.

13) 200: Nature in the 21st century will be a nature that we make.

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