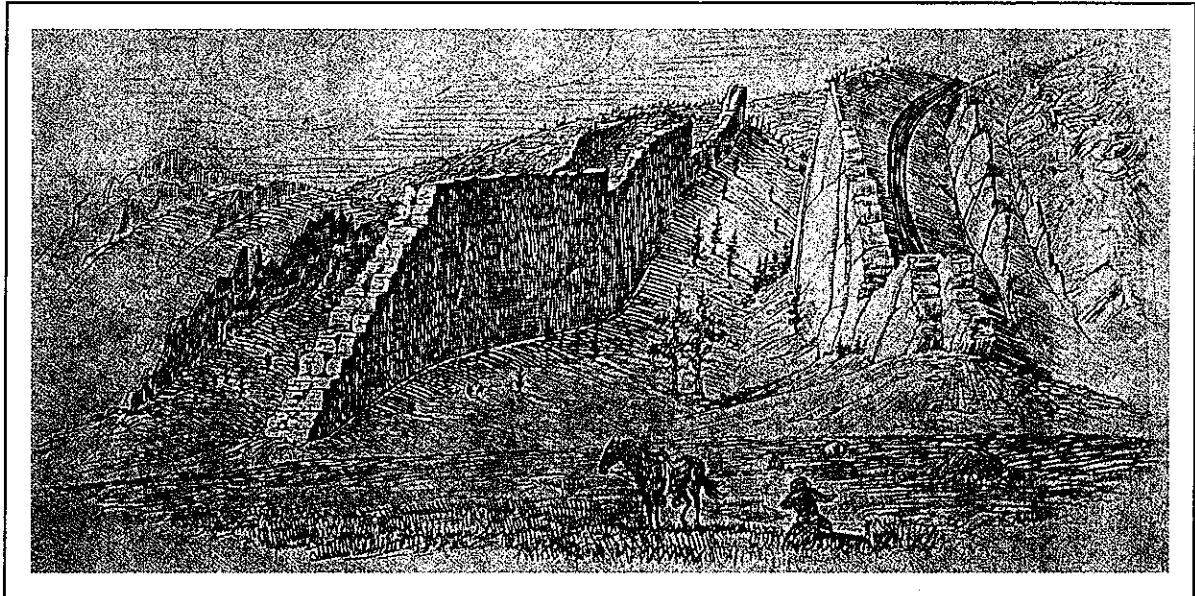


Yellowstone Science

A quarterly publication devoted to the natural and cultural sciences



A Western Spirit of Place
Documenting Diversity
Waste Stream Studies
The Mountain Fox
Fecal Ecosystems

Volume 1

Number 3

Bars of soap from park hotels, gathered for recycling. Jim Peaco/NPS



The Good, the Bad, and the Unglamorous

Environmental historians have chronicled centuries of evolution in our attitudes toward nature. Practically every viewpoint that now exists has existed for centuries, but there has been big changes in balance. For example, a century ago, only a few people would have found anything good to say about wolves; now the wolf is among the most popular (not to say fashionable) of wild animals, star of countless prints, T-shirts, and magazine covers.

Yellowstone exemplifies many of these changes in attitude. For half a century, managers attempted to protect the “good” animals (elk, deer, bison, and other herbivores) from the “bad” ones (the carnivores, especially wolves, mountain lions, and coyotes). Animals

were easy to judge, according to what they ate; ambivalence in bear management over the years must be seen as a consequence of trying to come to terms with an omnivore that could either touch your heart or try to remove it, depending upon the circumstances.

We still haven’t achieved an egalitarian perspective on all life forms, of course. It’s much easier to fund research on the charismatic megafauna than on the anonymous rodent, but we have progressed, and some of that progress is displayed in this issue.

Michael Foos’s study of *Pilobolus* reveals to us a remarkable, near-odyssean life cycle lost to our sight until now. Our interview with Pete Feigley of the Conservation Data Cen-

ter shows the extent to which ecological egalitarianism has become a part of the public conscience. And the news item about our garbage habits is as revealing of how Yellowstone Park works as anything else we could publish.

We dearly love a good brown-eyed mammal story (such as Bob Crabtree’s), or a good humanist essay (such as Dan Flores’s), but all this talk of fecal ecosystems and waste streams keeps us on our toes, and reminds us of how far we have to go. Until we’ve run articles on diving beetles, biogenesis, lichen, rare and endangered soils, and many other underappreciated aspects of Yellowstone, we haven’t begun to strike a real balance.

PS

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The Beartooth fox; see page 13

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On the cover: Devil's Slide, a prominent landmark along the Yellowstone River a few miles north of Yellowstone National Park, as drawn by Henry Elliott, a member of the 1871 U.S. Geological Survey of the Territories under Ferdinand Hayden. Elliott's drawings, now a part of the Yellowstone Park Museum Collection, illustrate the essay by Dan Flores beginning on page 6.

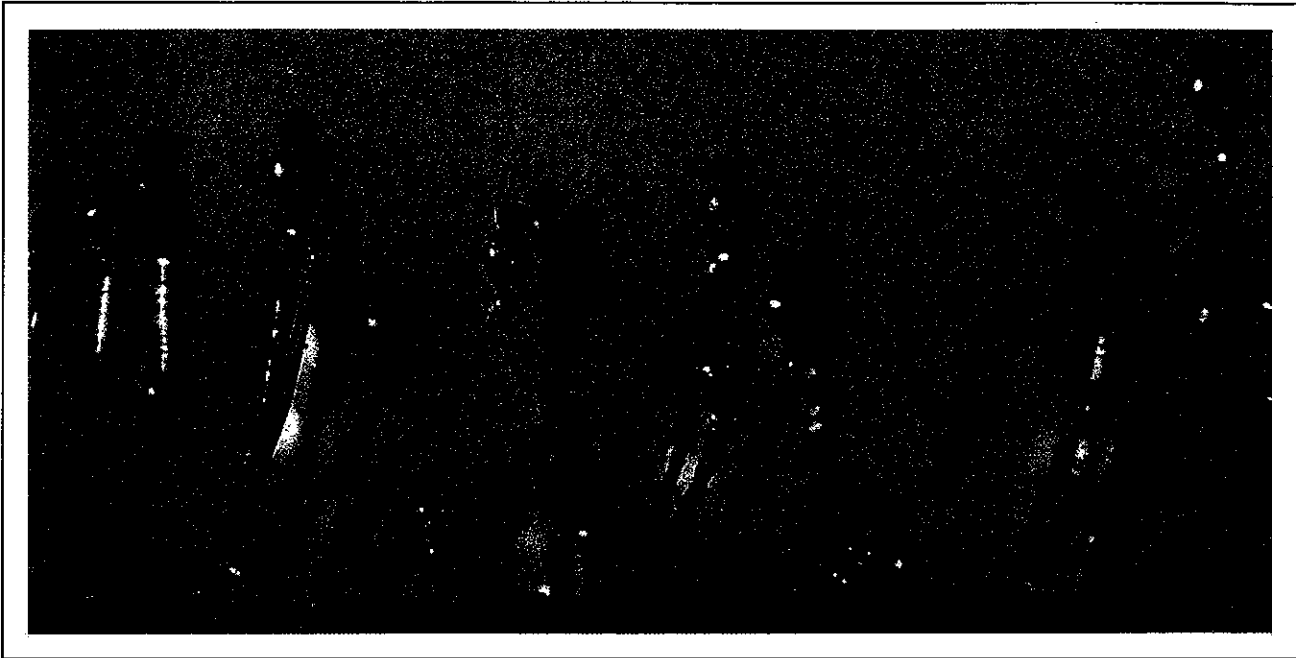
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Pilobolus Ecology

*Fungal forests, fecal ecosystems,
and the wild ride of lungworm larvae*

by **K. Michael Foos**

Yellowstone National Park is an area famous for largeness: large landscapes, large geysers, large bears, large buffalo, and large crowds. Even many of the mushrooms are large, some having caps that measure more than eight inches across. But it is also an area of small things. There are small insects, small crystals, and some plants so small they are almost impossible to see.

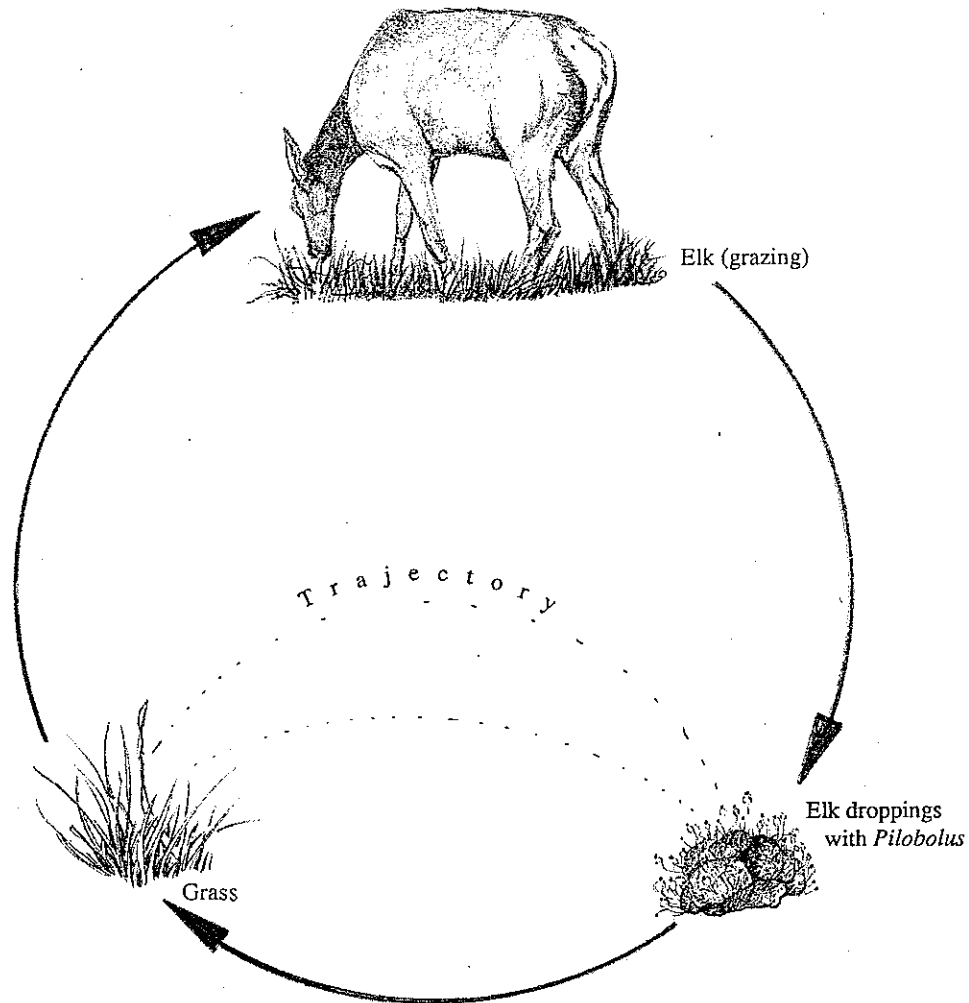
One of the most intriguing of these small things is a fungus known as *Pilobolus* (pronounced pie•lob•olus). Very few visitors have ever seen it, but its influence on ecological processes in Yellowstone is both powerful and complex. While individual stalks are visible

with the naked eye (they range from 1 to 10 mm in height), they are hardly conspicuous. Even when hundreds or thousands of these “sporangiophores” arise close together like a minute forest of glistening trees, they can only be seen by careful examination.

Being small does not mean they are unimportant, however. *Pilobolus* is one genus of many fungi that cause the decomposition of animal wastes, processors of the huge quantities of fecal matter that the park’s famous wildlife produce daily. All species of *Pilobolus* grow on droppings from herbivores, and all but one are found exclusively on animal droppings.

Pilobolus is widespread; it has been identified on all continents. In Yellowstone, the fungus is found in forests, meadows, geyser basins, near developed areas, and even in campgrounds. It has been found growing on the droppings of pronghorn, bison, mule deer, elk, bighorn sheep, and moose.

The life cycle of *Pilobolus* begins when an herbivore, such as an elk, defecates and fungal spores within the dropping begin to grow. The thallus, or body, of *Pilobolus* is a filamentous network of thousands of hyphae (like tiny roots on a tree) that penetrate throughout the dung. This mass of filaments is much like bread mold, but it is deep



The life cycle of *Pilobolus* begins when an animal excretes fecal material with spores. These spores utilize nutrients within the dung while decomposing it. After 4 or 5 days, reproductive structures develop, each topped with a sporangium. Each sporangium is discharged away from the dung pile, where ungulates are more likely to graze. Other organisms, such as lungworm larvae, may be carried with each sporangium. Eventually, a passing elk may consume *Pilobolus* spores (and lungworm larvae), which move through the elk's digestive tract and are eventually excreted to begin the cycle again.

within the droppings and does not cover its surface until the fungus produces the reproductive structures that begin to rise from the surface of the dropping a few days after it hits the ground.

Because herbivores and *Pilobolus* have different nutritional needs, it is possible for both to obtain nutrition from the same forage or browse. First, the animal eats the plant and its digestive tract uses the components it can; then the fungus uses what's left. Elk and the other large grazers are able to use nutrients found in forage, but the fungus cannot. Only when the plant material has undergone the grazer's digestive processes is it in a form that the

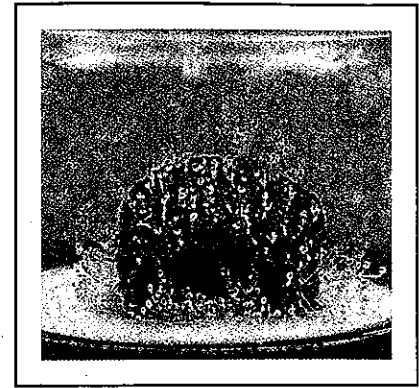
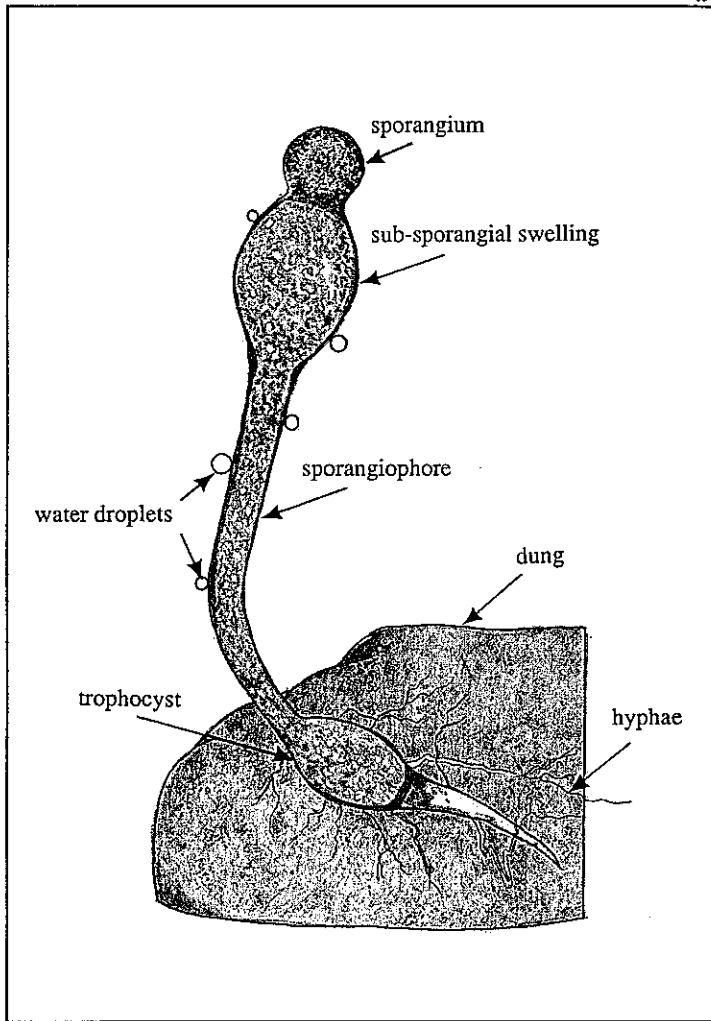
fungus can benefit from.

The symbiosis between the fungus and the herbivore goes even further than food processing. The dark coloration of animal droppings is important for this fungus. *Pilobolus* grows best at temperatures ranging from 85 to 95° F (29.5 to 35° C), well above the typical ambient temperature in Yellowstone. But when the sun strikes fresh animal droppings, their dark coloration allows them to absorb enough solar energy to produce the heat needed to stimulate *Pilobolus* to grow.

Pilobolus usually grows hyphae for four or five days before the fungal mass is large enough to support reproductive

structures. Then, at night, under the appropriate temperature, moisture, and nutritional conditions, just below the surface of the droppings, specialized cells among the hyphae develop into stalks called sporangiophores. Soon these sporangiophores can be seen rising from the surface of the dung like candles on a birthday cake.

In some species of *Pilobolus*, the stalk, or sporangiophore, may be as high as 100 mm (about 4 in.), but species in Yellowstone are rarely more than 10 mm high (still quite large considering that the stalk is made of a single cell). As the stalk reaches its maximum height, a head, or sporangium, develops, con-



Pilobolus spores grow hyphae throughout the fecal material. Among the hyphae, a specialized cell, called a trophocyst, expands into a single-celled sporangiophore which supports a sporangium containing spores. A swelling beneath the sporangium bursts, sending the sticky sporangium as much as 8 feet away.

taining spores that will eventually produce more *Pilobolus*.

After the sporangium develops at the top of the sporangiophore, the area just below the sporangium swells until it is shaped like a lens. At dawn, sunlight is focused through this swelling onto the growing portion of the sporangiophore, causing uneven growth that aims the sporangium toward the sun. As the sun rises, the sporangiophore follows it across the sky toward its zenith. By mid- to late-morning, the sporangium separates from the rest of the sporangial structure and is violently discharged.

The discharge is caused by increased cell pressure in the portion of the sporangiophore just below the sporangium. When discharged, the sporangium is blown away with a great deal of force, sometimes traveling more than six feet vertically and eight feet horizontally. Because the sporangiophore follows the

sun, the head is aimed skyward at the time of discharge.

The sporangia need to be consumed by a passing ungulate in order to complete their life cycle, and this is why the discharge is so important in their life cycle. Grazing animals do not feed in the immediate area of fecal piles, and so *Pilobolus* could not survive unless its spores were able to get beyond that ungrazed area.

Most of the sporangia land on grasses or other foliage that are the primary foods of herbivores; the sporangia are covered with a sticky material, and adhere to whatever they hit. This shotgun mechanism of spore dispersal ensures that sporangia will be in a good position to be eaten by another herbivore. As the herbivore consumes the plant material and *Pilobolus* together, the spores contained within the sporangium begin the same trip through the

animal's digestive tract that has been taken by countless generations of its ancestors.

The highly mobile herbivore also contributes to the dispersal of *Pilobolus*, traveling from site to site as it spreads its fungus-laden droppings across the landscape. By including a trip through an herbivore as a part of its life cycle, *Pilobolus* not only guarantees that its spores are embedded in the very nutrient source they need to grow, but ensures that the spores will be widely distributed.

There is yet another complex relationship in this story, one involving fungus, elk, and a third organism. The third organism is a roundworm, and its presence may help explain a part of a complex disease cycle in Yellowstone.

Lungworm disease, sometimes called parasitic bronchitis, is caused by the roundworm, *Dictyocaulus viviparus*. This roundworm has a complex life cycle with several different stages of growth. As the name of the disease implies, adult lungworm inhabit the air passages (lungs, bronchioles, and trachea) of their host, where they lay their eggs. As the elk coughs up these eggs and then swallows them, they begin their passage through the animal's digestive tract along with *Pilobolus*. As the eggs pass through the elk, they de-

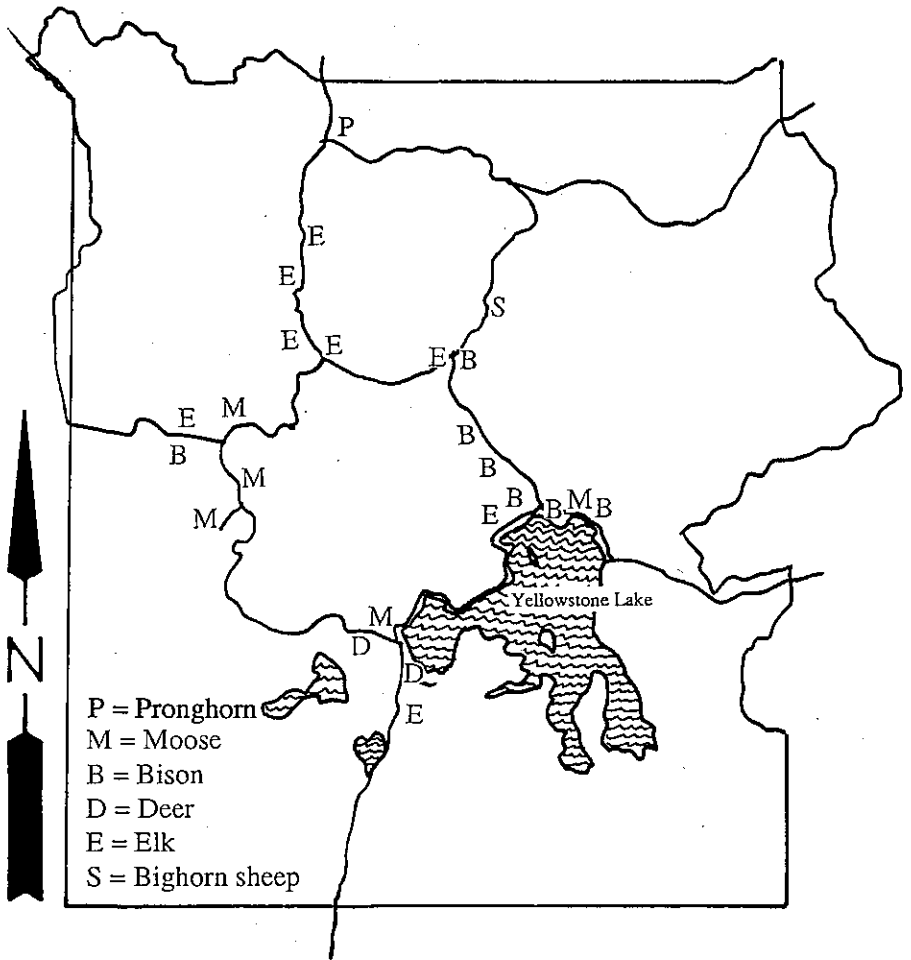
velop through two of three larval stages. The third larval stage, known as L3 larvae, is the infective stage and develops in the animal droppings. Under normal environmental conditions, this third larval stage develops in four to six days after leaving the animal—about the same development time as *Pilobolus*.

Also like *Pilobolus*, L3 larvae are attracted to sunlight; they move in a slow writhing motion toward the sun. Considering that these larvae are only about 1/3 mm long and move very slowly, they don't go very far—rarely as much as an inch from where they were dropped with the dung. However, as the larvae move toward light, they will crawl up any developing sporangiophores they come upon. Under a microscope, they weave like miniature cobras as they attempt to climb the tiny stalks of developing sporangiophores.

The environment within the sporangium is very good for L3 larvae; the sporangial wall provides protection from drying and ultraviolet radiation. This means that the larvae are nicely protected until the sporangium is discharged, launching the larvae into flight. Larvae that could normally never move more than a fraction of an inch get a free ride of several feet.

When a sporangium adheres to the foliage it landed on, any larvae in the sporangial mass stick there as well; animals eat the foliage and its two tenants, the sporangia and larvae. The sporangia go about their life cycle as described earlier, and if the grazing animal is susceptible to lungworm disease, the larvae will develop into adults within the lungs and repeat their own cycle again as well.

While we don't know how important *Pilobolus* is in the disease cycle of lungworm disease in elk, its role in the disease cycle of cattle lungworm disease has been described in many studies. From our work in Yellowstone, we have shown that in every specimen examined for both organisms from which L3 larvae have been isolated from elk droppings, at least one isolate of *Pilobolus* is also present. In some cases, all three species of the fungus found in Yellowstone have been isolated from a single elk infected with



Pilobolus fungi have been isolated (collected and grown in the laboratory) from many areas of Yellowstone Park. Three *Pilobolus* species have been isolated from fecal material of six different ungulate species.

Dictyocaulus L3 larvae.

In the 300 years since it was first scientifically described, nine species of *Pilobolus* have been identified. The three of these species isolated in Yellowstone National Park are *Pilobolus crystallinus*, *P. kleinii*, and *P. roridus*. All three species have been repeatedly isolated from many areas of the park and from droppings of several different herbivores. All three of these species have similar life cycles and appear to have similar impacts on the environment.

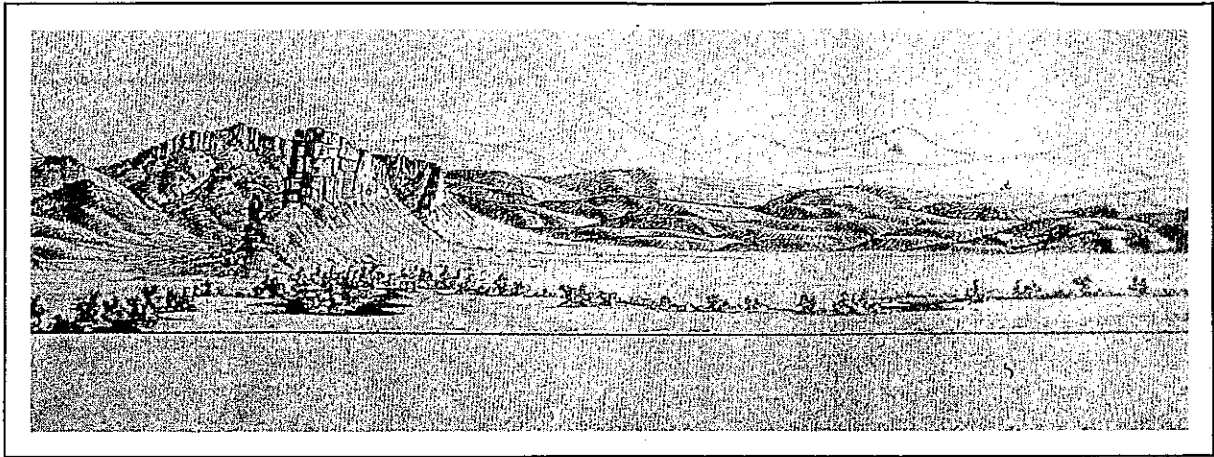
For all the local studies of *Pilobolus*, there has never been a systematic study of the geographic distribution of the organism. The current work being done in Yellowstone is part of a systematic study of the biogeographical distribution of *Pilobolus* and the identification and characterization of habitats within

which the organism thrives. As we learn more about where it lives and how widely it is distributed, we will be able to identify more clearly its role in the ecosystem and the relative importance in its various activities. While its role in fecal decomposition and in the distribution of lungworm larvae seem to be well described, we do not know what other ecological processes it may participate in during its extraordinary travels.

K. Michael Foos is Professor of Biology and Chairperson of the Natural Science and Mathematics Department at Indiana University East, Richmond, Indiana. He has been conducting *Pilobolus* studies in Yellowstone for eight years.



"Mouth of Beaver Head Canyon," in southwestern Montana, by Henry Elliott, 1871



Spirit of Place and the Value of

by Dan Flores

"The crucial question of the modern world is,
'How are we to become native to this land.'"

Paul Shepard, in Max Oelschaefer, ed., *The Wilderness Condition*

In recent years it has become clear to researchers, administrators, and the public that most of the scientific and resource-management issues facing Yellowstone National Park are in fact regional issues. Terms such as ecosystem and bioregion are a daily part of current dialogues relating to the park, its care, and its study. All of these dialogues, whether about geothermal resources, ungulate migratory patterns, fire, endangered species, or any other issue, have significant humanities components that may be difficult to quantify but are of great importance.

Dan Flores, an environmental historian who has focused on regional cultures and their interactions with ecological systems, presented this paper on December 11, 1992 at the "Humanities and the Greater Yellowstone Ecosystem" workshop at Montana State University. It was so well received, and has so many immediate applications to the issues facing Greater Yellowstone, that we persuaded him to allow us to reprint it here. Ed.

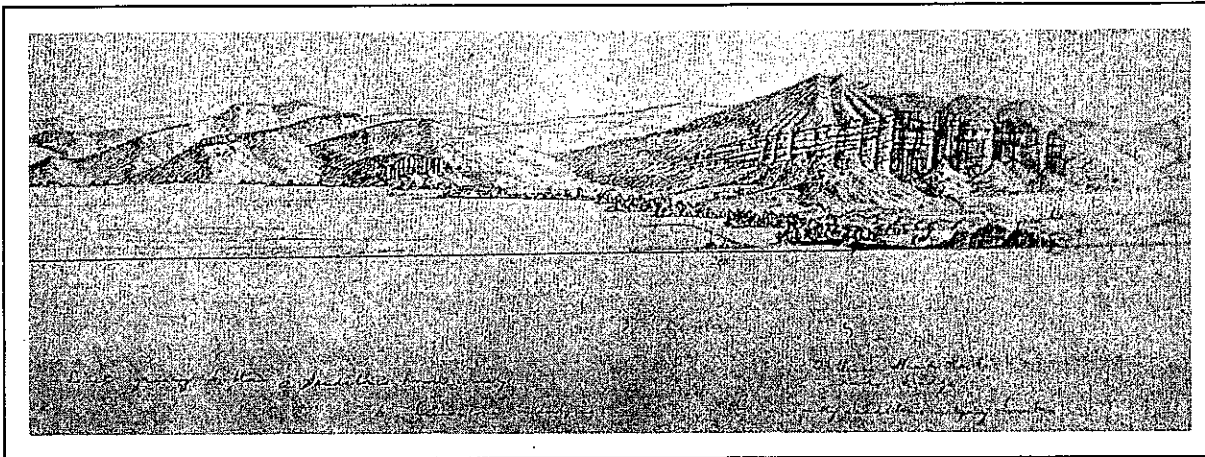
I moved to Montana six months ago and find myself, for the third time in my life, engaged in the process of being assimilated into a landscape and a place. As a typically transient American, I have of course actually lived in more than three places in my life. And had I been in Laramie or Sheridan, Wyoming, for more than half a year, or Austin or Sante Fe longer than mere summers (perhaps more significant, had I lived outside rather than in those towns) likely I would know *more* country, bones and soul. As it is, only northwest Louisiana 'round about Shreveport, and the High Plains canyon country south of Amarillo, Texas, have so far claimed me truly and intimately.

In at least one of these places I consciously went native while an adult, so that I was able to observe the process and write a book that was, in effect, the natural history of a spirit of place. As animals whose evolutionary trajectory kept us intimately aware of local and regional landscapes until only the last few symbolic seconds of our species'

life, we are still hardwired to experience the sort of landscape energy that undergirds place. This "spirit of place," or "sense of place" as Wallace Stegner would have it, is not an easy phrase to define. And yet I think it is a tangible phenomenon—one that has been noticed and studied for a long time now, and a phenomenon whose investigation may help explain some of the agonizing the modern American West is enduring.

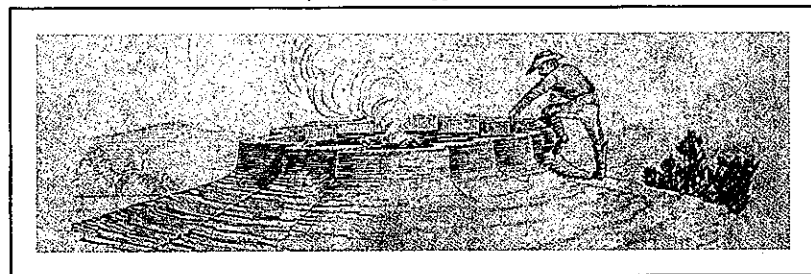
Let me say first what I do *not* mean when I use the phrase "spirit of place." "Spirit" as I am using it here does not refer to supernatural entities or qualities, but rather to essential and activating possibilities, to the vigor or the inspiration that something—in this case "place"—can impart. In the meaning that I am attributing to it here, "place" essentially means "space" (landscape) plus people. Spirit of place, in other words, is grounded in the human interaction with local environments. So investigating spirit of place is an approach for puzzling over the wonderfully diverse ways that women and men

"Beaver Head Rock and Bridge," in southwestern Montana, by Henry Elliott, 1871



Nature in the American West

"Geyser Crater, Upper Basin," now known as Teakettle Spring.



have both lived in and reacted to spaces in the landscape.

In the social sciences the term "place" is in effect a synonym of "region." I would suggest that in a more economics-oriented way, spirit of place has long been studied under the relatively mechanistic hubris of *regionalism*. This kind of regional study is, in fact, an old topic in history. In the early 20th century anthropologists like Clark Wissler and Ellen Semple argued that in pre-Columbian America, Indian cultures had arranged themselves across the continent according to general ecological boundaries (what we would call biomes or ecoregions today), so that in pre-contact North America we had a "Desert Southwest Cultural Region," a "North-eastern Woodland Cultural Region," and so forth. Regionalism (or "sectionalism") once dominated the study of American history. After penning his famous Frontier Thesis in 1893, historian Frederick Jackson Turner spent much of his remaining career on a book called *The Significance of Sections in*

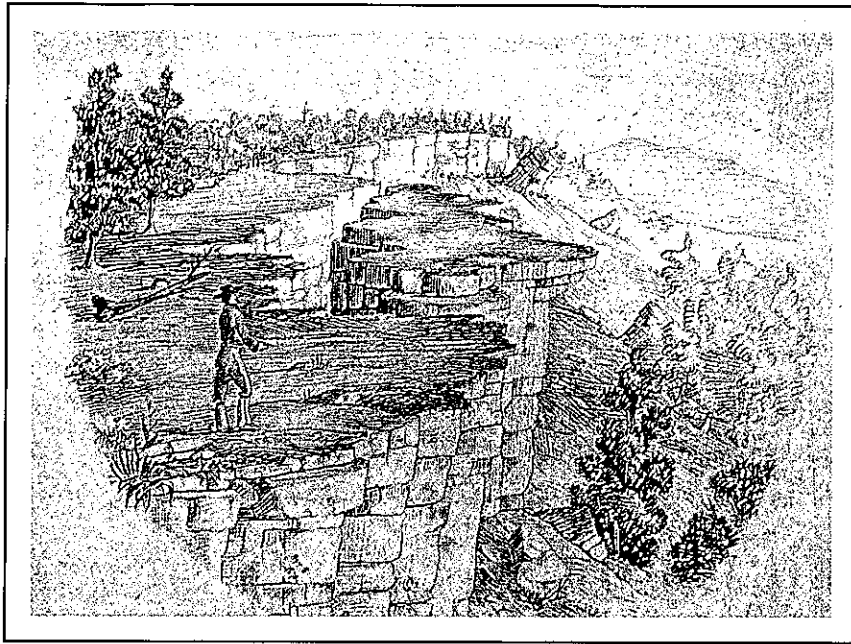
American History. In it he further refined thinking about the East, the South, and the West, divvying the West, for example, into four distinctive regions: the Plains, the Rockies, the Deserts, and the Coast. With the continuing spread of the Modern Industrial Age, however, most scholars expected regionalism worldwide to become a casualty of the homogenizing qualities of the global market economy. But like the prognostications of Vanishing American Indians, that prediction seems to have been premature. The emergence of environmentalist bioregionalism and the current fragmentation in Europe indicate just how powerful a force regionalism still is. Two million years of hunting and gathering immersion in place can't be purged from us easily, it would seem!

In its combination of words the phrase "spirit of place" thus refers to a more modern—one might even say more holistic—technique for examining the interaction between humans and slices of nature. Beyond mere local econo-

mies, that ought to include more esoteric interactions like art, literature, religion, and environmental adaptations, and how they are influenced by the activating inspirations of particular landscapes.

Let me say now that whether landscapes do or do not actually exude a spirit or energy that human beings actually do sense and react to is not demonstrable by any science I am aware of. Beyond simple, universal ideas about balance and harmony, aesthetics among humans seem primarily derived from culture. Yet until fairly recently in history, most human cultures fashioned themselves around the premise that nature was locally and uniquely enspirited. One example from the American West is that of the Pueblo Indians of northern New Mexico, who built rock "amplifiers" atop the Jemez and Sangre de Cristo mountains to direct the creative energy of the mountains towards their villages. The Pueblos, in other words, entertained no doubts about the energy hologram they occupied.

There is also the phenomenon of at-



Drawings accompanying this essay are by Henry Wood Elliot, an artist with the 1871 U.S. Geological Survey of the Territories under Ferdinand V. Hayden. Elliot's art is not as well remembered as that of fellow survey party member Thomas Moran, whose western landscapes became such an important force in defining esthetic attitudes toward these raw western settings, but Elliot did important journeyman work on the expedition, producing dozens of drawings that were at once diagnostic and evocative. The originals are part of the Yellowstone National Park Museum Collection. Elliot's original captions are given, along with commentary. Left: "Old hot spring. Limestone shelving off by frosts, etc."

tachment to home places, which the geographer Yi-Fu Tuan calls "topophilia." In his book *The Territorial Imperative* of a quarter century ago, Desmond Morris pointed out that territoriality springs from the reptilian brain, the most ancient part of the human mind. And as Diane Ackermann has written more recently in *A Natural History of the Senses*, the evidence is that human evolution is so tied to topography, that our multiple senses continue such rich receptors and our brains such vivid recallers of natural signals, that all humans react emotionally to familiar home places. This emotional attachment occurs on an ascending spectrum of size scales: from hearth to locale, and even to more artificial creations like states and nations.

On the subject of topophilia, I think I would agree with Yi-Fu Tuan on several other scores. Topophilia happens most naturally not in these large creations but in places small enough to be learned well—local landscapes of familiar rocks and soils, the remembered sounds of local birds, the peculiar cycle of local seasons, the cyclically-occurring smells of conifer forests sunned to summer fragrance, or the pungent smell (almost a taste) of valley cottonwoods in the fall. But there are at least three other qualities that make up the kind of interaction with place I have become fascinated with, and that drive the rest

of this essay. One is the necessity of sinking roots. "Place is pause," Tuan writes in his book *Space and Place*, an idea all of our modern literary Bioregionalists, from Gary Snyder to Wendell Berry, echo. In the American West, many of our roots are yet shallow, a possible explanation for why so much of what passes for "explanation" of the West is actually myth (think of "the Great American Desert" or "Rain Follows the Plow") imposed by those who scarcely knew the region. Transiency is rare among many peoples around the world, but is a common trait of Americans, engendering a kind of rootlessness that inhibits developing a sense of place. Transiency also inhibits a second element in developing a sense of place, and that is a shared sense of history. Whether it takes the form of mythology, folklore, or historical literature makes no difference. Where history is too short or too diffuse, spirit of place is weak, still much in flux.

But it is the role that value systems play as a kind of human template in spirit of place that is most interesting of all.

When they have studied what I am calling spirit of place, historians have done so primarily by studying modes of production, using theoretical constructs like environmental determinism or possibilism to explain how particular economies emerge in particular places.

Or, they have utilized systems theory or central place theory when they have wanted to demonstrate how places are influenced by outside forces. Yet, as I've said, our reactions to landscape have not just been economic. They have also been aesthetic, creative, mythic, and entirely sensual. They have led to indigenous art, such as the painting and folk art traditions of the modern Southwest or the literary renaissance of the Northern Rockies, that express spirit of place symbolically and metaphorically. Yet even in these artistic responses—perhaps more especially in these responses—spirit of place occurs within the context of history and cultural evolution.

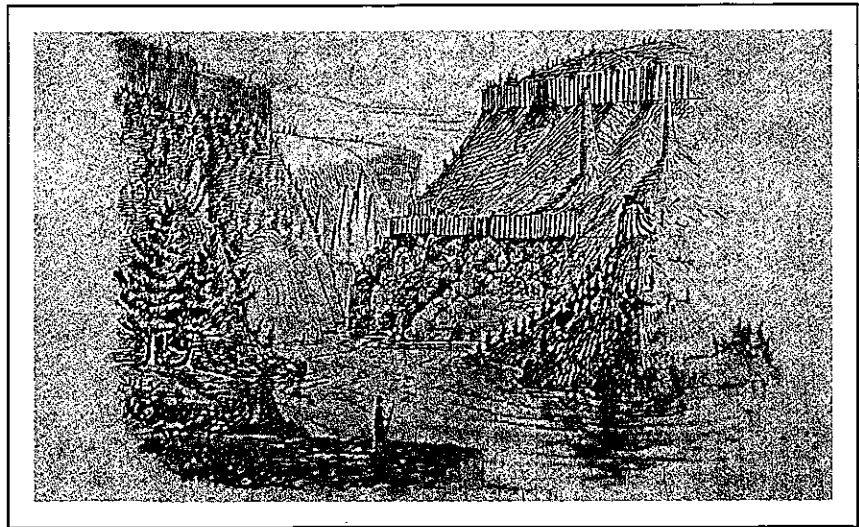
Let me say that in another way so that no one gets the impression that I am advocating a kind of environmental determinism. Despite our "hard-wired" biology, human perceptions and the values we place on nature are so culturally driven that we ought not to believe that certain environments exert an irresistible pull of one kind or another. Think of the diverse lifestyles on the Great Plains across the past 12,000 years. All those cultures were reacting to the same *space*, yet they created different *places*. Even in the life of a single culture, spirit of place changes over time. The phenomenon is dynamic, not static.

So in this tour of how spirit of place

operates, we have to consider the culturally inherited value systems (the human "software") that have to do with how humans perceive nature. Spirit of place of one kind or another no doubt exists everywhere humans have paused long enough to feel a topographic pull, but the shape and feel and taste of it will be very different from one society to the next. The upper stretches of the Ruby River or the Clark Fork in Montana no doubt fostered a kind of emerging spirit of place in the early years of Bannack or Butte—but it was a very different one from the spirit of place the New Mexican Pueblos felt in the valley of the Rio Grande, or the Mountain Crows experienced in their Absaroka homeland, or the 400 year-old Hispanic culture feels about the Southwest.

If the modern American West can be understood to function as a region with its own diverse spirits of place, then it might be useful to try to define what values of human thought have helped create our contemporary places in the West. When we speak today of "nature," "wilderness," even "ecosystems" or "sacred places," are we speaking of abstract realities or of agreed upon fictions springing from particular value systems? And what does it mean for the West as place when one set of values confronts another, perhaps newly emergent set?

Perhaps what distinguishes Euro-american thought about nature most has been the two-thousand year perception in Western Europe of nature as a storehouse of natural resources, a storehouse that stands independent from humans, and which was specifically created for our use. This anthropocentric idea, as a host of writers have demonstrated—perhaps most accessibly Clarence Glacken in *Traces on the Rhodian Shore*, Max Oelschlaeger in *The Idea of Wilderness*, and Clive Ponting in his recent *A Green History of the World*—can be traced to a succession of ratchet-like changes in the evolution of human societies beginning as far back as the Neolithic Revolution of 10,000 years ago. This abandonment of the green and leisurely world of gathering/hunting for the much harder work of agriculture and the settled life of



villages and towns set in motion an initial separation of humans from wild animals, wild plants, and an intensive knowledge of local bioregions. In the literature of many modern writers, this constituted the true "fall" of humanity, cast symbolically in the Bible as the expulsion from the Garden.

The continuing development of Western ideas and values proceeded (this is a shorthand version) with the Greek idea of the existence of a human soul that is separate from the worldly realm; the Judaic idea that since humans were the only life form made in the image of God, only they possessed souls; and the Christian exorcism of the pagan *genii locii* (local spirits) from the world, a step that desacralized nature and made its conquest possible. Then came the secularization of the great mysteries of nature via the Scientific Revolution and an empirical method that initiated a general investigation of the natural laws. The Western Age of Reason (17th century) and The Enlightenment (18th century) furthered the machine metaphor for nature with Rene Descartes' model of animals as mere machines lacking either souls or consciousness, and Descartes' methodology of examining the world scientifically by starting with the known and proceeding from there. Because nature has proven so very complex, Descartes' reductionist method has tended to fragment knowledge, to divide nature into pieces for study, so that the overall tendency of science has been to lose sight of the whole.

"Basaltic columns resting upon pebbly conglomerates and granites, canyon below mouth of Tower Creek." This is the area near present Calcite Springs Overlook along the Yellowstone River.

The emergence of individualism and capitalism, both linked to what the historian Walter Prescott Webb called "The Great Frontier"—the European conquest of the world and its incorporation into the global market economy—was the next step in the development of the Western conception of nature. In effect, Adam Smith saw to it that individual greed in the interest of the community good became a dominant Western value. Thus, by the 19th century, when the American West was being overrun by Euroamericans and the outlines of our present land-use system for the West were being drawn, the progression of ideas and values peculiar to the dominant Euroamerican culture began to interact with the landscape energy emanating from the Great Plains, the Rocky Mountains, the Western deserts. The result was the skeleton of spirit of place in the modern West.

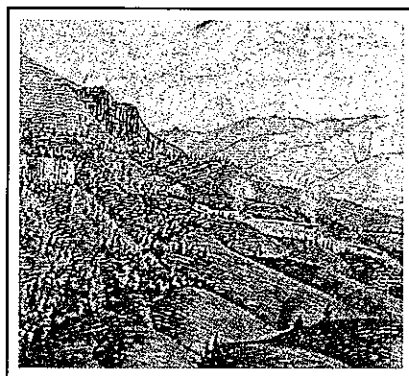
This skeletal framework included, we might have to admit, some pretty peculiar ideas. Euroamericans did not apprehend, or would not admit, that the continent they wrested from the native peoples was in fact a human-shaped one. We know better today. We know, for example, that at least 12,000 years of human interaction had profoundly shaped the ecology of North America—from Paleolithic involvement in the

massive ecological simplification that saw some 32 genera of large animals go extinct around 10,000 years ago (and that left our modern keystone species in place in the West), to the use of fire and other land-use modification strategies by 300 generations of Indian peoples. And yet, powerful European ideas like "Virgin America" and "Wilderness" profoundly shaped the way Americans looked at the natural world.

But by the middle of the last century Euroamericans were being shaped by some new values and ideas. The most important of them was the Romantic backlash against the Age of Reason. The Romantic Movement, begun a century earlier in Europe and influencing Americans only after about 1825, stressed intuition and emotion, which could be experienced in a transcendent way in nature as nowhere else. Mountains, regarded as chaotic warts on the landscape by Europeans during the Middle Ages, now could be and were appreciated aesthetically.

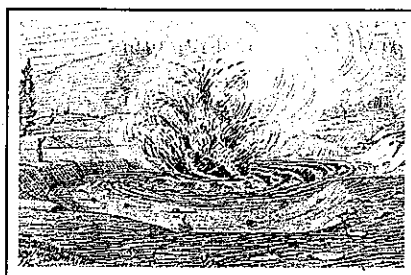
Americans also were influenced by their sense of cultural inferiority with respect to Europe, and that—coupled with aesthetic appreciation and a growing perception that there were lands in the West that were economically marginal—led to American leadership in the creation of national parks. In creating national parks, what Americans were most interested in, perhaps all the way through the early 1930s, was preserving monumental landscapes that demonstrated to the world that America was a morally superior nation because it occupied a larger-than-life, aesthetically superior continent. The implication was that a superior culture—great music, art, literature, and architecture—would emanate from such surroundings. Since monumentalism had little to do with ecology, we got artificial, linear boundaries for our parks. On the other hand, in a society where nature had become secularized, the great early national parks like Yellowstone and Yosemite began to function—and still do—as the great sacred places of American culture.

Here on the cusp of the 21st century we are still hauling all of this human baggage—a very long baggage train



"Hot springs on Gardner's River (Seen from mountains at Forks of Gardiner River)," shows the Mammoth Hot Springs area from above the mouth of Lava Creek.

extending 10,000 years and farther into the past—that we have internalized both culturally and individually, and that we are towing along with us like a brontosaurus tail. Our current struggles over relatively new ideas like Greater Yellowstone or Northern Continental Divide ecosystem protection, biodiversity, and biocentrism, have much to do with disjunctions between these internalized values and newer ones that represent a further maturing of Western spirit of place. The result has been an increasingly contentious society in the West lately. Think of it this way: Contentiousness in the modern West centers around such jarring collisions as managing for new values like ecosystem protection or natural fires, parks that were created and set in motion by older, 19th century values. Or asserting ideas like the innate rights of all life, the advantages of biodiversity, or the spiritual value of wilderness, in a cultural milieu still dominated by unquestioning acceptance of traditional anthropocentric or cost-benefit models. Or recognizing how profoundly humans



"Mud Geyser Yellowstone River, July 27th, 1871."

have occupied and shaped this continent, while managing a wilderness system based on the ancient Western ideas that humans exist apart from nature and that America was a virgin land.

I began by speaking of spirit of place because it embodies so clearly human values engaged in a dialectic with the land. The defining essence of spirit of place is not just that it occurs on a bioregional level, or that humans ought to stay put and sink roots, or even that sense of place requires a shared awareness of history to flower fully. The most important thing about spirit of place is that cultural values and human imagination determine it as much as landscape does—and that it exemplifies history's greatest lesson: everything is always changing.

As scientists have been so willing to point out, history's great flaw is that it is explanatory, but not predictive. Yet something, obviously, is happening in many parts of the West as we eye the 21st century. What Thomas Kuhn a quarter century ago referred to as a "paradigm shift"—a base change in values that occurs when sufficient anomalies crack open a long-accepted worldview—seems to have found fertile soil in many areas of the public lands West. The resulting tension between the past and the emerging future, between the old, internalized values and the new environmentalist ones, is manifest not merely in hoarse debate but in what I think may be more predictive venues, art and literature particularly, that have long sensed an impending sea change.

Perhaps what it all means is that after taking a hard look at ourselves and the places we've created in the vast, stunning, sunlit spaces of the American West, we are starting to assimilate, starting at last to go native. Through a shift in Western spirit of place, the most haunting landscapes on the continent may be finding a new voice.

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