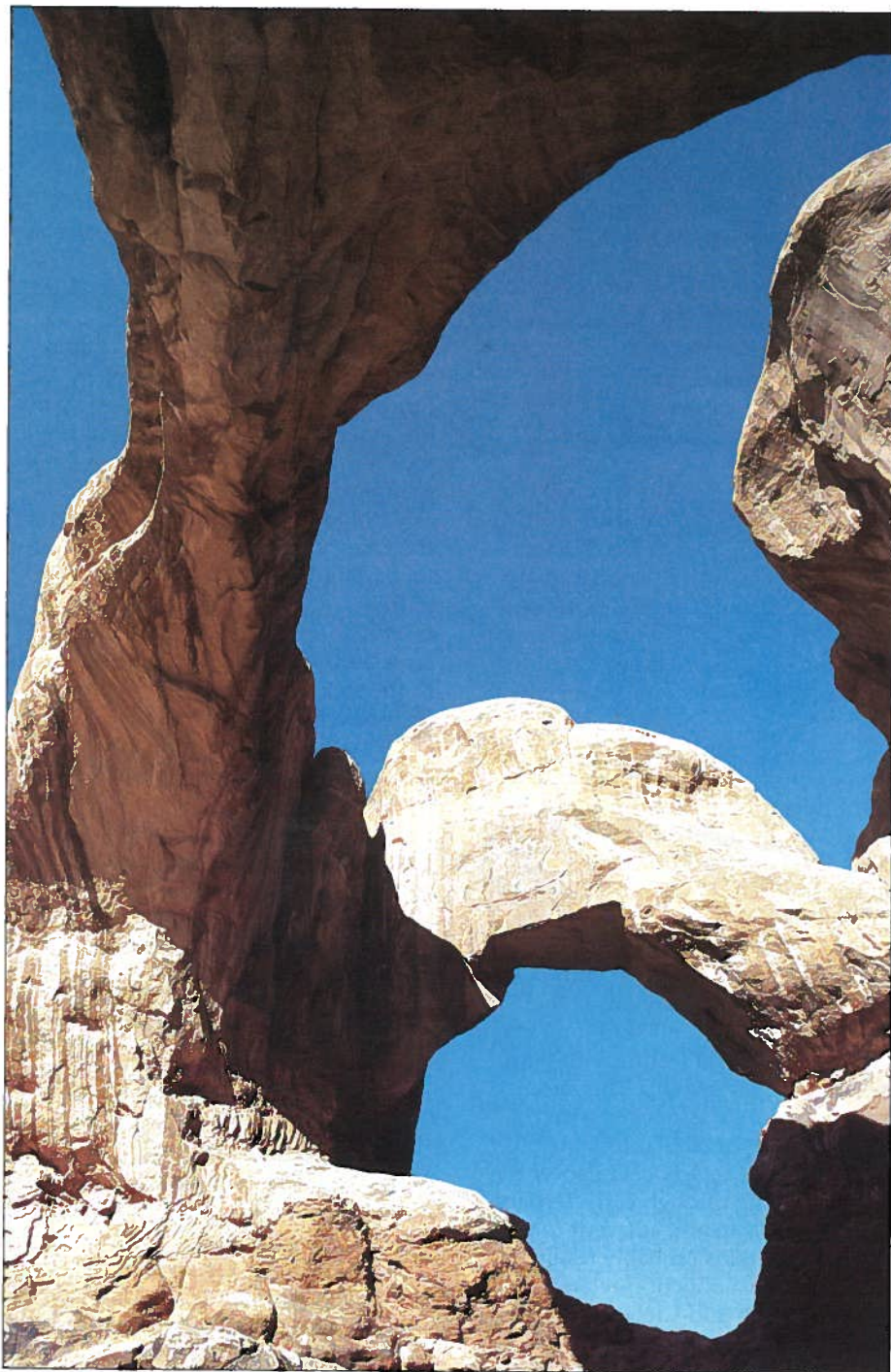


GSA TODAY

A Publication of the Geological Society of America

INSIDE

- Annual Environmental Forum to discuss ground-water pollution, p. 215
- Scientists making a difference, p. 220
- Southeastern and Cordilleran-Rocky Mountain Meetings, p. 227, 228



Double arch in eroded sandstone, Arches National Park, Utah.

Encounters with the Land

Lauret E. Savoy

Department of Geology and Geography, Mount Holyoke College,
South Hadley, Massachusetts 01075

October 1992 marks the 500th anniversary of Christopher Columbus's arrival in North America and his "discovery" of a "New World." Sailing west in an attempt to find an oceanic route to the Orient, Columbus encountered a very old, populated world, whose peoples had diverse and complex histories and cultures. Although the Americas had been visited by other transoceanic voyagers, this encounter in 1492 placed the Eastern and Western hemispheres into permanent contact, and the cultural consequences of this contact continue to unfold in the late 20th century.

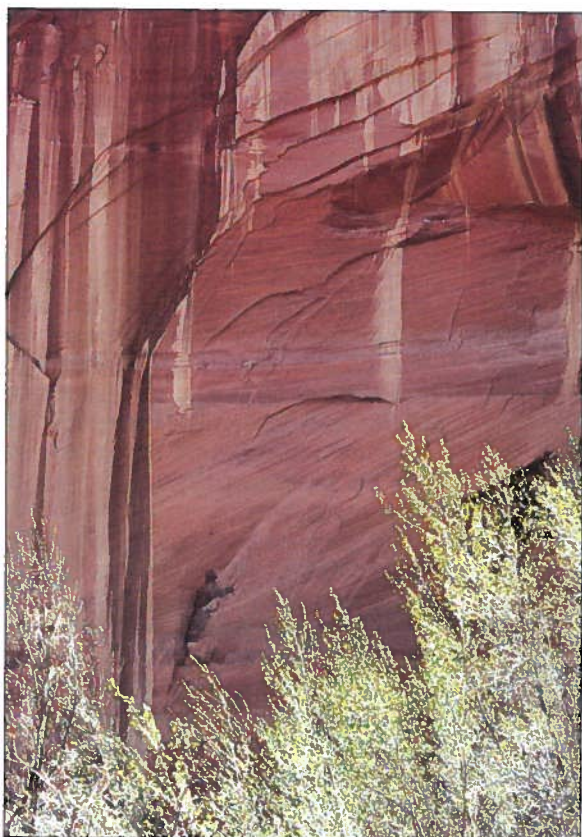
An exploration of America's past reveals that to a great degree the lifestyles of peoples and the history of exploration and settlement can be viewed in terms of encounters between landscape and culture. The occasion of the quincentenary presents an appropriate opportunity to consider the interaction between humans and the American landscape, particularly the West. This photographic essay presents selected aspects of the links between physical landscape and cultural landscape and very different perspectives on the American West—Native American landscape and tradition, and connections between physical setting and the history and direction of Euro-American exploration. The perspectives of different cultures reflect distinct approaches to knowing the Earth.

What is meant by "knowing the Earth"? Geology, as the scientific discipline that seeks to understand the Earth, has over the past two centuries

provided a type of knowledge of Earth properties, processes, and history based increasingly on analytic description, abstraction, and specialization. In *A Sense of the Earth* (1971), David Leveson asked if geology and geologists were aware of, or capable of, interpreting the Earth and the nature of Earth-human relationships—the "geologic experience"—to society. Rather than being a complete set of details, our knowledge of the Earth is informed by inquiry that extends beyond the confines of specialized scientific disciplines to a larger human experience.

Communicating an understanding of the history and place of Earth or landscape in human affairs has commonly fallen within the domains of historians, geographers, and anthropologists. Geologists can also be a part of this group and examine the role and impact of the science in society and the interdisciplinary nature of relationships between the Earth and humans in time and space. There are many connections beyond traditional boundaries of the discipline. For example, geologic setting strongly influences the paths of cultures. Second, great diversity in views of the Earth—from science to myth—exists among peoples of the world. Third, perspectives on landscapes are shaped by encounters with the land as well as expectations or preconceptions based on cultural images of the time. What did Euro-Americans seek and what did they see in the western lands? How was this an impetus for scientific (geographic and geologic) exploration? In addition, with regard to the American West, geographic and geological studies played a significant role in the historical development of the region.

Encounters continued on p. 216



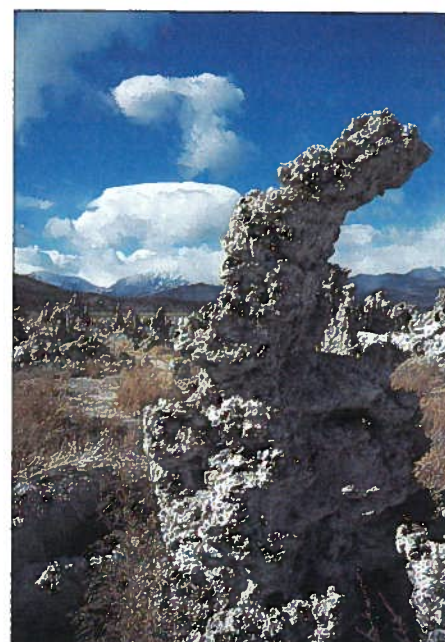
Desert varnish and cottonwoods, Escalante Canyon, Utah. "One learns a landscape finally not by knowing the name or identity of everything in it, but by perceiving relationships in it"—Barry H. Lopez.



Patterned rock,
Point Lobos, California.



Canyon walls, Capitol Reef National Park, Utah.



Tufa tower, Mono Lake, California.

NARRATIVE— A DIFFERENT LANDSCAPE

The part of the North American continent that we now call the American West is much more than a region of distinct physiographic provinces, and more than a physical record of the history of westward movement and expansion. At the end of the 15th century when Columbus landed in the Caribbean, the West had been explored, adapted to, and inhabited by diverse groups of peoples for thousands of years. The human record of occupation in the Four Corners region of the American Southwest (southern Utah and Colorado, and northern New Mexico and Arizona), for example, is long, if not continuous over this period (Martin et al., 1991; Cordell, 1985). Prehistoric inhabitants of cultural traditions such as Anasazi and Mogollon emerged later as Pueblo Indians, who remain in this area. To survive, or even flourish at times, in such a marginal environment with variable climate and unpredictable water resources required adaptive change.

The great diversity and distinctiveness of Native American cultures, lifeways, and environmental perspectives resist distillation into simple generalizations. It is true, however, that Indian America has not functioned in the same ways that Euro-America has, and cannot be viewed with the same assumptions (Turner, 1974, 1980; Bergon and Papanikolas, 1978; Matthiesen, 1984; Allen, 1986). The Native American West was (and is) a visionary and inclusive world in which landscape was a literal and spiritual home, and conceptions of the world were not narrowly tied to proof and evidence (Beck et al., 1977; Bergon and Papanikolas, 1978; Allen, 1986; Silko, 1986). The particularities of the land around a people—the canyons, mountains, and deserts—were commonly known with the precision of a mapmaker, as well as mystic and partner (Bergon and Papanikolas, 1978; Turner, 1980). The peoples' lifeways tended to erase the distinction between what was mythical (spiritual) and what was real; history, time, and space merged in views of the world—a world in which, for many, all beings were part of a living whole, part of the landscape.

Editor's Note

The feature article this month, "Encounters with the Land," commemorates the 500th anniversary of Columbus's landing in North America. As such, it is a departure from the usual science article.

Lauret E. Savoy is of African-American-Native American heritage. She received an A.B. in geology *cum laude* from Princeton University in 1981, her M.S. in earth sciences from the University of California, Santa Cruz, in 1983, and her Ph.D. from Syracuse University in 1990. She combines interests in the role of earth science in American culture (including visual arts and literature), perspectives on the Earth (focusing on Native American and African-American), environmental geology, sedimentology, and environmental stratigraphy. In addition, her landscape photography exhibits have been displayed in several galleries.

—E. M. Moores

The land, the sky, and all that is within them—the landscape—includes human beings. Interrelationships in the Pueblo landscape are complex and fragile. The unpredictability of the weather, the aridity and harshness of much of the terrain in the high plateau country explain in large part the relentless attention the ancient Pueblo people gave the sky and the earth around them. Survival depended upon harmony and cooperation not only among human beings, but among all things—the animate and the less animate, since rocks and mountains were known to move, to travel occasionally.

—Leslie Marmon Silko
(*Laguna Pueblo*), 1986, p. 85–86

For many American Indian cultures the land exhibits a sacred order that forms the basis of ritual, mythology, and oral tradition (Lopez, 1988). Oral narratives and communal ritual provide a collective, racial memory, maintaining and transmitting experience, custom, and world view from older generations to younger (Turner, 1980; Silko, 1986). Turner (1974) remarked that such narratives are, perhaps, as close as others can get to a sense of the way the natural world seemed to aboriginal Americans prior to European contact. In this sense, oral tradition is an important referential and historical base.

Landscape or geography plays central roles in narratives on boundaries, and the origin of things, places, and humans. As such, the land serves as a map defining physical area and mythical paths, protection, resource, way of life, and cultural reminder, among other things (commonly ineffable). Rather than reflecting primitive or uncomplicated beliefs, oral tradition is but one record of a people's organic relationship with the land, and may reflect a reality of landscape as vital as science or history.

Among the many people who subscribe to the belief that four mountains define tribal territory are the Navajos, all of the Pueblos, the Pima, and the Yuman tribes of the Gila River.... But mountains are more, much more, than boundary markers defining the tribal boundaries within which a people lives and carries on most of its meaningful, purposeful activities. The Pueblo people, for instance, believe that the four sacred mountains are pillars which hold up the sky and which divide the world into quarters. As such they are imbued with a high aura of mystery and sanctity. And this sacred meaning transcends all other meanings and functions. The Apaches, the most recent mountain dwellers among the southwestern Indians, believe that mountains are alive and the homes of supernaturals called "mountain people." They further believe that mountains are protectors from illness as well as external enemies, that they are the source of the power of shamans as well as teachers of songs and other sacred knowledge to ordinary humans, and that, finally, mountains are defenders as well as definers of tribal territory.

—Alfonso Ortiz
(*San Juan Pueblo*), 1973, p. 91–92

HISTORY— CONFRONTATION OF THE UNKNOWN

Euro-America of the late 1700s was essentially a narrow strip of land stretching along the Atlantic seaboard. To the west beyond the Appalachians lay the frontier, and the land beyond it was considered immense, if not infinite, virgin land. In fact, most Euro-Americans did not know what was west of the frontier, although explorers like Coronado (in the 1500s) had ventured across the continental interior, and settlements dotted the West Coast and the Southwest (Perrin, 1986). According to

Hector St. John de Crevecoeur in *Letters from an American Farmer* (1782), which was a best-selling account of early American rural life, "Many ages will not see the shores of our great lakes replenished with inland nations, nor the unknown bounds of North America entirely peopled. Who can tell how far it extends?" Even the map of the West in the first American geography book (1797) contained mainly blank spaces or mythical features (Goetzmann, 1982)—truly terra incognita.

The attempt to investigate western lands and resources through geographic and geological expeditions was but one of several major driving forces behind 19th century exploration and expansion. With the MacKenzie expedition (across western Canada in 1793), the Louisiana Purchase (1803), and the Lewis and Clark expedition (1804–1806), the trans-Mississippi West became more than a direction, a receding line of wilderness, or an immense unknown to Euro-Americans (Bergon and Papanikolas, 1978). The continental interior became a distinct region—immense but with boundaries and hints of geographic and ecologic variability.

Historians have pointed out that while the West was being discovered by Americans it was also being invented.

In the 1803 acquisition of the Louisiana Territory from France, the United States claimed almost 757 million acres of what is now the central and western regions of the country. The next step was to determine exactly what was out there. Lewis and Clark's mission was, in President Jefferson's view, political and economic, as well as scientific ("literary") in motive (Goetzmann, 1982, 1986). In this first official, government-sponsored scientific expedition, the Corps of Discovery was to locate "the most direct and practicable water communication across this continent for the purposes of commerce" by traveling up the Missouri River and crossing the Rocky Mountains to the Columbia River basin. Finding a navigable water route to the Pacific (the fabled Northwest Passage or elusive San Buenaventura River), would enhance territorial claim, as well as commerce with Asia and the Native Americans (Boorstin, 1965; Goetzmann, 1966, 1982, 1986). In addition to studying the Indians, Lewis and Clark were to investigate the "soil and face of the country" by noting the geography and identifying and collecting natural resources (including fur-bearing animals and minerals) that might be of commercial or scientific value.

As the first major Euro-American expedition to cross the continent, it established a new far western frontier for the United States, and focused America's attention on the interior of the continent beyond the Mississippi and the exploration of its geography and resources. Over the next 50 years this land of vast plains, mountains, and deserts became known to the nation primarily through the efforts of expeditions by Pike (1806–1807), Long (1820), Wilkes (1838–1842), and Fremont (1840s), other mapping reconnaissances of the Army's Corps of Topographical Engineers, and the travels of individual explorers or mountain men.

Historians have pointed out that while the West was being discovered by Americans it was also being invented (Boorstin, 1965; Goetzmann, 1966, 1986; Turner, 1980; Limerick, 1987,

1989). In this "confrontation of the unknown" (following Goetzmann, 1966), trans-Mississippi landscapes assumed almost mythical dimensions, as perceptions of these lands were based as much on myth as fact. The vagueness and uncertainty of the region were preserved for decades—the idea of the West as a wasteland prevailed well into the 1800s. Myths such as the arid plains beyond the 98th meridian as a Great American Desert or the yet-to-be-discovered transcontinental waterway, the old Spanish San Buenaventura River, died slowly. This mythical river finally did dry up, in a sense, with geographic discovery—John C. Fremont's expedition, in 1844, mapped the region between the Sierra Nevada and Wasatch Mountains (Utah) as a land of interior drainage, a "Great Basin," with no outlets to the sea (Boorstin, 1965).

What good was this western land then? Prior to the 19th century, and essentially beginning with Columbus, the West's immediate value was judged in terms of trade routes to the Pacific and Asia (Bergon and Papanikolas, 1978). The value of opening the western interior in the 19th century was ultimately translatable into the promise

of individual opportunity and national expansion and development (Limerick, 1987). Land was commonly viewed by many in terms of its potential for fur trade, agriculture, and, significantly, mineral resources. Mineral discoveries, including gold in California (1848) and silver in Nevada (1859), prompted rapid expansion and westward migration, and mining essentially put the West into the forefront of the nation's industrialized economy for a time (Limerick, 1987).

With the movement of emigrants in the mid- to late 19th century—and the "opening" of the West by railroads to settlement and industry—the country now required more specific and accurate information on the mining, agricultural, ranching, and timber potential (Viola, 1987). This need stimulated a new era of systematic, scientific exploratory surveys in the West (Goetzmann, 1966, 1982, 1986). Between 1867 and 1879, the federal government funded major expeditions in which assessments of the geology, geography, and mineral resources of the trans-Mississippi West were to be the principal objectives (Boorstin, 1965; Rabbitt, 1989). These surveys, led by John Wesley Powell, Clarence King, Ferdinand V. Hayden, and George M. Wheeler, covered an immense region that included the western plains, Rocky Mountains, Colorado Plateau, Great Basin, and Sierra Nevada.

Major questions and concerns about natural processes, geologic time, and human history emerged in this latter phase of western exploration, and represented what historian William Goetzmann has described as the "nation's 'coming of age' scientifically." Progress in the fields of geology and physical geography, as well as simply learning about the western landscape, owed much to the explorations and discoveries of the 19th century surveys. For example, J. W. Powell, who explored and named the Colorado Plateau region, investigated geologic processes and history of the Southwest,

Encounters continued on p. 218

ethnography of the Indians, and use of arid lands. He sought to understand large-scale landscape-shaping forces and, with his team of scientists, developed significant new ideas on the work of uplift and erosion (and time) and defined and advanced many basic principles and terms of geomorphology and structural geology. Powell's intense interest in the relationship of people to arid lands resulted in *A Report Upon Lands of the Arid Regions of the United States*, which proposed that viable settlement and land use strategies in the arid West could not follow the practices of the humid East.

Powell and other explorer scientists also produced literature that celebrated the western landscape "on its own terms" (following Bergon and Papanikolas, 1978).

Stand at some point on the brink of the Grand Canyon where you can

overlook the river, and the details of the structure, the vast labyrinth of gorges of which it is composed, are scarcely noticed; the elements are lost in the grand effect, and a broad, deep, flaring gorge of many colors is seen. But stand down among these gorges and the landscape seems to be composed of huge vertical elements of wonderful form. Above, it is an open, sunny gorge; below, it is deep and gloomy. Above, it is a chasm; below, it is a stairway from gloom to heaven....

The carving of the Grand Canyon is the work of rains and rivers. The vast labyrinth of canyon by which the plateau region drained by the Colorado [River] is dissected is also the work of waters. Every river has excavated its own gorge and every creek has excavated its gorge. When a shower comes in this land, the rills carve canyons—but a little at each storm; and though storms are far apart and the heavens above are cloudless for most of the days of the year, still, years are plenty in the ages, and an intermittent rill called to life by a shower can do much work in centuries of centuries....

We think of mountains as forming clouds about their brows, but the clouds have formed the mountains. Great continental blocks are upheaved from beneath the sea by internal geologic forces that fashion the earth. Then the wandering clouds, the tempest-bearing clouds, the rainbow-decked clouds, with mighty power and with wonderful skill, carve out valleys and canyons and fashion hills and cliffs and mountains. The clouds are the artists sublime....

The wonders of the Grand Canyon cannot be adequately represented in symbols of speech, nor by speech itself. The resources of the graphic art are taxed beyond their powers in attempting to portray its features. Language and illustration combined must fail....

—John Wesley Powell,
1895, p. 386–394.

Earth science is an open inquiry into the workings of nature. As scientists, we must also remember that geologic and geographic setting of regions—the physical landscape—has influenced or controlled patterns of

human exploration and settlement, as well as lifeways of peoples and their cultural landscapes. Knowledge of the Earth—the "geologic experience"—can have varied expressions beyond systematic scientific analysis. Ideally, a holistic perception of the Earth might include an understanding of the general concepts of how the natural world operates, a familiarity with the nature and methods of scientific inquiry, and a realization of the importance of earth science in everyday life and the interdisciplinary relationships between the earth and human existence.

REFERENCES CITED

- Allen, Paula Gunn, 1986, *The sacred hoop: Recovering the feminine in American Indian traditions*: Boston, Beacon Press, 311 p.
- Beck, Peggy V., Walters, Anna Lee, and Francisco, Nia, 1977 (redesigned 1990), *The sacred: Ways of knowledge, sources of life*: Tsalle, Navajo Community College Press, and Flagstaff, Northland Publishing Co., 365 p.
- Bergon, Frank, and Papanikolas, Zeese, eds., 1978, *Looking far west: The search for the American West in history, myth, and literature*: New York, New American Library, 476 p.
- Boorstin, Daniel J., 1965, *The Americans: The national experience*: New York, Random House, Inc., 517 p.
- Cordell, Linda S., 1985, *Why did they leave and where did they go?*, in Noble, David G., *Understanding the Anasazi of Mesa Verde and Hovenweep*: Exploration, Annual Bulletin of the School of American Research, p. 35–39.
- Goetzmann, William H., 1966, *Exploration and empire*: New York, Alfred A. Knopf, 674 p.
- Goetzmann, William H., 1982, *Explorer, mountain man, and scientist*, in *Exploring the West: 1803–1879*: National Park Service Handbook 116, p. 17–95.
- Goetzmann, William H., 1986, *New lands, new men: America and the second great age of discovery*: New York, Viking Penguin, Inc., 528 p.
- Leveson, David, 1972, *A sense of the Earth*: New York, Anchor Natural History Books, 176 p.
- Limerick, Patricia N., 1987, *The legacy of conquest: The unbroken past of the American West*: New York, W. W. Norton & Company, 396 p.
- Limerick, Patricia N., 1989, *Desert passages: Encounters with the American desert*: Niwot, University of Colorado Press, 218 p.
- Lopez, Barry, 1988, *Crossing open ground*: New York, Charles Scribner's Sons, 208 p.
- Martin, Debra L., Goodman, Alan H., Armelagos, George J., and Magennis, Ann L., 1991, *Black Mesa Anasazi health: Reconstructing life from patterns of death and disease*: Southern Illinois University Center for Archeological Investigations Occasional Paper No. 14, 314 p.
- Matthiessen, Peter, 1984, *Indian country*: New York, Viking Press, 338 p.
- Ortiz, Alfonso, 1973, *Look to the mountaintop*, in Ward, E. Graham, ed., *Essays on reflection*: Boston, Houghton-Mifflin.
- Perrin, Noel, 1986, *Forever virgin: The American view of America*, in Halpern, Daniel, ed., *On nature: Nature, landscape, and natural history*: San Francisco, North Point Press, p. 13–22.
- Powell, John Wesley, 1895, *Canyons of the Colorado* (republished in 1961 as *The Exploration of the Colorado River and Its Canyons*: New York, Dover, 400 p.).
- Rabbitt, Mary C., 1989, *The United States Geological Survey: 1879–1989*: U.S. Geological Survey Circular 1050, 52 p.
- Sekaquaptewa, Emory, 1981, *Wunuuqam: Ones who stand: Plateau*, v. 53, p. 18–23.
- Silko, Leslie Marmon, 1986, *Landscape, history, and the Pueblo imagination*, in Halpern, Daniel, ed., *On nature: Nature, landscape, and natural history*: San Francisco, North Point Press, p. 83–94.
- St. John de Crevecoeur, Hector, 1782, *Letters from an American farmer*: London, T. Davies.
- Turner, Frederick, ed., 1974, *The Portable North American Indian reader*: New York, Viking Press, 626 p.
- Turner, Frederick, 1980, *Beyond geography: The western spirit against the wilderness*: New York, Viking Press, 329 p.
- Viola, Herman J., 1987, *Exploring the West*: Washington, D.C., Smithsonian Books, 256 p.
- Manuscript received June 22, 1992; revision received July 6, 1992; accepted July 8, 1992.* ■

The Geological Society of America

Research Grants Program 1993



The primary role of the Research Grants Program is to provide partial support for research by graduate students at universities in the United States, Canada, Mexico, and Central America. GSA strongly encourages women, minorities, and persons with disabilities to participate fully in this grants program. Eligibility is not restricted to GSA members. New application forms are available each fall in the geology departments of colleges and universities offering graduate degrees in earth sci-

ences. Forms are mailed annually to GSA Campus Representatives and department secretaries and chairpersons in the United States, Canada, and Mexico. They are also available upon request from the Research Grants Administrator, Geological Society of America, P.O. Box 9140, Boulder, Colorado 80301. *Please use only the 1993 application and appraisal forms.*

Confidential evaluations from two faculty members are required from candidates for the M.S. or Ph.D. degree and must accompany applications submitted. PLEASE USE THE "APPRAISAL OF APPLICANT" FORMS, WHICH ACCOMPANY THE 1993 APPLICATION FORMS. Application forms will not be accepted by facsimile.

The Geological Society of America awarded \$315,769 in grants in 1992. The grants went to 248 students doing research for advanced degrees. The average amount awarded was \$1273. The largest grant was \$2500, but there is no predetermined maximum amount.

The Committee on Research Grants will meet in March to evaluate applications and award grants. In April, all applicants for grants will be informed of the committee's actions by the Executive Director of the Geological Society of America.

**ALL APPLICATIONS MUST BE SUBMITTED ON THE 1993 FORMS
AND POSTMARKED BY FEBRUARY 15, 1993**