

# Ancient Teachings, **MODERN LESSONS**



(clockwise from far left) Steven Lansing, PhotoDisc; Joshua Rosenthal

**I**n recent years, researchers have looked for areas where indigenous knowledge, also called local or traditional knowledge, can meet modern science for better environmental health. A 1999 conference titled “Science for the 21st Century—A New Commitment” that was cosponsored by the United Nations Educational, Scientific and Cultural Organization (UNESCO) produced a declaration recognizing that “traditional and local knowledge systems, as dynamic expressions of perceiving and understanding the world, can make and historically have made a valuable contribution to science and technology.”

The declaration suggested that as a fund of cultural heritage and empirical information, indigenous knowledge should be preserved and researched. The conference called on the International Council for Science—a Paris-based nongovernmental organization composed of 98 multidisciplinary national scientific research councils and 26 international single-discipline scientific unions—to study how tra-

Signs of the times. A Balinese water temple in Lake Bratan (far left) is the site of community rituals that help keep traditional planting and irrigation systems in good working order. Across the globe, a Tzeltal woman shares knowledge of medicinal plants with researchers in Chiapas, Mexico (bottom, near left).

ditional knowledge might best relate with science. (One tool for doing this is ethnography, the study and systematic recording of human cultures.) More recently, researchers shared results at the Seventh International Congress of Ethnobiology, held at the University of Georgia in Athens in October 2000.



These efforts have sparked warnings from those who view them merely as gestures of political correctness—gestures that, while validating minority cultures, threaten to compromise the rigor of the scientific method. Perhaps more importantly, critics say that unmerited trust in tradition can endanger human health. A month before the UNESCO conference, the 17 May 1999 issue of *Forensic Science International* published an analysis of forensic data from Johannesburg, South Africa, where traditional remedies containing toxic substances were cited as causes for over 200 deaths in a five-year period. And a 14 October 1999 *Nature* editorial responding to the UNESCO conference declaration acknowledged that traditional knowledge deserves more respect from modern science than it has received, but noted that “such acceptance also requires due caution and a rigorous assessment of more and less deserving forms of traditional knowledge.” The editorial further warned that integrating different forms of knowledge would not be easy.

For one thing, indigenous knowledge rarely comes in the form of scientific data.

Often it involves complex narratives. Yet as viewers of detective dramas know, even a tangential discussion can sometimes yield important clues. In her 1997 book *The Spirit Catches You and You Fall Down* about the health care received by a young Hmong girl in California with epilepsy, Anne Fadiman wrote, “The Hmong have a phrase, *hais cuaj txub kaum txub*, which means ‘to speak of all kinds of things.’ It is often used at the beginning of an oral narrative as a way of reminding the listeners that the world is full of things that may not seem to be connected but actually are; that no event occurs in isolation; that you can miss a lot by sticking to the point; and that the storyteller is likely to be rather long-winded.”

Fadiman proceeds to show how the girl’s immigrant family and cultural origins in Southeast Asia—and her American doctors’ approach to them—seriously influenced the treatment she received. The girl’s family interpreted her doctors’ behavior as uncaring and regarded the medical treatment with suspicion; thus, they decided to forgo the recommended treatment. It is a story of contrasting ways of understanding health, and it’s a situa-

tion that is likely to occur more and more often as populations spread across the globe.

### Drug Discovery: The Greatest Interest?

Perhaps the greatest interest in indigenous knowledge comes from its potential for discovering new drugs and new uses for indigenous medicines. The ethnobotanical approach to drug discovery has experienced a resurgence in recent decades [see *EHP* 105:1186–1191 (1997)] and has yielded many new medicines, including several that the National Cancer Institute considers

### Capturing the past in Chiapas.

(clockwise from bottom right) One Mayan healer blesses the collaborative efforts of healers and scientists to protect medicinal plants and share the knowledge of their uses, while another labels plants growing in a garden of medicinal species. Taking advantage of modern resources, community members discuss health matters with a visiting physician in the Mayan village of Balun K’anal.



(clockwise from bottom right) Joshua Rosenthal; Joshua Rosenthal; Luisa Maffi

promising for the treatment of AIDS, cancer, and other serious illnesses.

Joshua Rosenthal, a program officer for the NIH International Cooperative Biodiversity Groups (ICBG), notes that traditionally used compounds have yielded new antimalarial drugs (for example, artemisinin is derived from the herb *Artemisia annua*, also known as sweet Annie or qing hao and long used in Chinese medicine to combat fevers), painkillers (a potent alkaloid from the skin of the frog *Epipedobates tricolor*—used to make poison darts for immobilizing small animals—is being tested at Abbot Laboratories), and anti-diarrheal medicines (such as Normal Stool Formula from Shaman Pharmaceuticals, which uses the sap of the Amazonian rain forest tree *Croton lechleri*).

In addition to the drugs themselves, says Rosenthal, indigenous knowledge can help to identify mechanisms of action for therapeutic agents. “In starting from the knowledge that something works when tested in broad-based functional assays,” he says, “we have the opportunity to discover new molecular targets that we might not have identified using approaches that begin with our current understanding of a disease.”

The ICBG program, begun in 1992, aims to integrate drug discovery, biodiversity conservation, and sustainable economic benefits for populations where new drugs are found. Starting from the broad outline of the United Nations Convention on Biological Diversity—a 1992 global agreement that recognized the need for drug discovery to provide fair returns to the places where drugs originate and support in the form of financial, political, and other incentives for communities to conserve the natural sources of new medicines—the ICBG developed regional research groups in Latin America, Africa, and Southeast Asia.

The program is a partnership in which traditional knowledge can guide the search for new medicines and support decisions for research follow-up. In turn, modern medicine channels research findings back to traditional healers and communities. Under the program, scientists propose studies and approach traditional healers for insights on how they use plants, which may lead to broader medical application of natural compounds. The pairing of scientists and traditional healers varies depending on the program and the study proposed.

Achieving a feasible, equitable solution hasn't been easy. The convention provided an important framework and recognition of the relationships between drug discovery, ecosystems, and traditional knowledge. However, its implementation has often mired in national politics, according to Rosenthal. Constructing agreements among

international companies, universities, national governments, and local communities that return benefits to source communities without obstructing the research process is very difficult. “Very few countries have been able to do it yet,” he notes. In one instance, well-intentioned researchers encountered a politically charged atmosphere in Chiapas, Mexico, where minority indigenous groups, stung by previous injustices and a lack of respect for their customs, moved to block sharing of their traditional knowledge with Western medicine.

Efforts to compare the effectiveness of scientific and traditional systems have had limited success. In Suriname, one study aimed to compare the rate of drug discovery of an ethnobotanically led process with that of a conventional approach of random biologic assays. It found a slightly higher success rate for the traditional approach, but the study encountered two main difficulties. First, the biologic assays skewed the basis for comparison toward the modern drug discovery model because those assays screen mainly for illnesses faced by temperate-zone populations, and not for health problems such as malaria or tuberculosis that are far more common in the tropics where the plants grow. Second, the fast turnover in the types of bioassays used by pharmaceutical companies—sometimes a complete change in a matter of months—meant that there was no consistent bioassay benchmark for compounds studied even a year apart. “It's difficult to get a comparison of all the samples hitting the same screens,” Rosenthal says.

What the ICBG has found are promising areas of interchange between traditional systems and modern medicine, not only in the drug discovery process but also in creating channels for information exchange between very different knowledge systems. In Central and West Africa, researchers have worked with traditional healers' unions, providing opportunities for the healers to learn about Western medical research and exploring the potential of traditional medicine for treating HIV/AIDS and malaria. A network of medical professionals from both systems has emerged, with leadership from Maurice Iwu, a Nigerian-born ethnopharmacologist. Iwu is working on a treatment for infection with the Ebola virus using a traditional West African chewstick (a tooth cleaning instrument) made from the *Garcinia kola* tree.

Shaman Pharmaceuticals, a small company based in South San Francisco, California, notes its debt to indigenous knowledge from the start. “[Indigenous] knowledge greatly reduces the number of plants that we screen intensively and increases our potential for success,” observes Steven King, the company's senior vice president for ethnobotany and

conservation. Shaman takes pains to create new paths for sharing the benefits of the discovery process and provides direct reciprocal payments to the communities it works with. But because money alone isn't always the best way to share profits with a remote community with no bank, Shaman also uses other means including public health projects that provide potable water. Such projects are managed by the company's nonprofit foundation, The Healing Forest Conservancy.

“Historically, ethnobotany and forest conservation projects have not been conducted with public health and medical projects,” King and coauthors noted in the 1996 book *Valuing Local Knowledge: Indigenous People and Intellectual Property Rights*. But when modern industries such as mining, oil extraction, and logging damage ecosystems where promising plants are found, there can be grave environmental health effects, including contamination of streams and drinking water with toxic runoff from mines.

Public health projects can address these impacts, for example by providing clean water and preventive medicine. The Healing Forest Conservancy has provided clean water for Quechua villages in Ecuador and Dayak villages in Indonesia. According to King, such projects, when integrated thoughtfully, can complement indigenous medical systems. For example, projects can involve local people in project planning and implementation, and can address health priorities that they identify.

Still, the narrowly focused discovery process used by most pharmaceutical companies is poorly suited for gauging other values of indigenous knowledge. For a more systematic look, Rosenthal points to a new NIH grants program through the National Center for Complementary and Alternative Medicine, called Traditional, Indigenous Systems of Medicine. Begun in 2000, the program is intended to fund examinations of systems of traditional knowledge such as the Indian system of Ayurveda, American Indian medicine, traditional Chinese medicine, and Latin American folk medicine with the goal of increasing the quality of clinical research evaluating the efficacy of such traditional, indigenous systems of medicine. Such studies must, according to the program's announcement, study the system in the cultural context of its origin and as adopted and adapted in other cultures.

### **Nutrition and Ecosystem Knowledge from the Past**

While the path from ethnomedicine to new drugs is fairly direct, other sciences are also using ethnographic methods to assess indigenous knowledge for health benefits. Nutrition and agriculture may also benefit



by exploring farmers' crop-breeding choices and local nutritional strategies. At the ethnobiology conference in Georgia, plant breeder Mary Eubanks, president of Sun Dance Genetics in Durham, North Carolina, and adjunct professor of plant genetics at Duke University, proposed that archaeobotanical investigations into the cultivation history of maize can yield safer, more robust varieties free of the potential health risks of genetically engineered varieties.

Traditional cultivation practices use naturally occurring genetic variation and a wider genetic base, making the varieties they yield less vulnerable to diseases and pests. By contrast, a genetically engineered crop has a narrower genetic base and therefore less variability to defend the crop from devastation by pests and disease that could cause food shortages and thus nutritional deficiencies. In the March 2000 issue of *Latin American Antiquity*, Eubanks and her coauthor observed that "the evolution of maize is intricately interwoven with culture history and environmental change." They emphasized that "the more we know about important crop plants, their relationships to their wild relatives . . . and how and under what conditions humans exploited and altered them . . . the greater our chances will be for identifying beneficial genes from wild plants"—and possibly recovering beneficial traits lost over time.

Elsewhere, anthropologists have found lessons for modern agriculture in traditional landscape management systems. In Indonesia, Bali's volcanic slopes and deep ravines make it difficult to irrigate rice fields. Traditionally the Balinese have diverted water through tunnels—some longer than a kilometer—to networks of canals and aqueducts. These networks are coordinated by rituals at community "water temples" across the island. Besides formalizing who takes care of each stretch of canal, the rituals bring together the people who maintain the system. While at a temple for a ritual, canal managers might discuss the sequence of opening locks, fields to be inundated, water volume, and other group decisions to be made. The hierarchy of water temples starts upstream at the volcanic Lake Batur and extends down to the smallest group of water users, about the size of a neighborhood.

With the introduction of modern farming practices in the 1970s and 1980s, however, agricultural scientists advised farmers to plant modern rice varieties, which can produce higher yields but which also require more fertilizers and pesticides. They also advised farmers to plant their fields independently, without waiting for communal workdays or synchronizing with others who use the canals.

In the mid-1980s Steven Lansing, an ecological anthropologist doing field research in Bali, heard farmers complain of rising pest damage to rice crops. Pest outbreaks were hurting rice yields despite the introduction of the modern varieties and cropping patterns. By 1987 rodent infestations were more serious than they had ever been before. Continued crop losses were threatening the area's nutritional status and introducing other risks of disease from the rats that infested the crop fields.

To assess the effects of various influences on the situation, Lansing and a computer expert developed a computer model of two river systems in southern Bali based on hydrology, rice growth, pest dynamics, and social/behavioral factors, including the community water temple rituals. Using the model, Lansing found that the water temple network managed water resources more effectively and kept pest damage low. By clustering planting and harvesting of nearby fields, the network created a sort of artificial ecosystem that kept pest populations in check. The computer model showed that the rice system reached a stable level of high productivity after several seasons of such management. Under the fragmented, random planting schedule of the introduced method, pest problems increased both in the model and in the rice fields. These results helped convince officials that the communal water temple network had important benefits.

Stuart Plattner, a program director at the National Science Foundation, which supported the work, observed that Lansing's research started from a traditional ethnographic perspective and followed connections that emerged between religion and irrigation, undeterred by officials who insisted that the two were unrelated. "Things that we think are separate are not at all separate," Plattner wrote in a 6 April 1997 article in the *Earth Times*. "Steve Lansing has been tremendously successful in making that point." Balinese scientists have since presented the experience of combining new and traditional agricultural technologies at international workshops.

Studies in which indigenous knowledge and modern science meaningfully complement each other remain few, but other promising examples come from Canada's far north. Researchers there have documented environmental health from both indigenous and scientific perspectives. Studies funded by the West Kitikmeot/Slave Study Society, a non-profit partnership of government, industry, aboriginal, and environmental organizations, have monitored the effects of mining and other development on the environment and people in the area between the Great Slave Lake in the Northwest Territories and Bathurst Inlet to the north in Nunavut. In

that area, indigenous peoples such as the Dogrib, Dene, and Inuit predominate. Outside influences have heavily impacted the health and social conditions of these groups and have prompted many of them to look within their traditional systems for solutions.

One pair of studies in the late 1990s examined caribou migration patterns using satellite collars placed on each herd's leader in one and traditional oral narrative accounts from Dogrib elders in the other. Dogrib elders advised wildlife scientist Anne Gunn in developing the satellite-collar study, and information from the Dogrib traditional knowledge study of caribou was placed in a geographic information system database for further analysis.

Caribou provided a natural starting point for collaboration: elders and scientists shared concerns over declining caribou population and habitat, and indigenous groups in the region have long relied on caribou for nutrition, cultural health, and identity. The groups' diet and materials for clothing and shelter comes from caribou (some use the animal's skins for tipis, for example). Perhaps more importantly, the groups interpret the health of their society through their relationship with the caribou and take pride in their ability to hunt and track. In that way, caribou give them a sense of belonging and order. (When placed in new surroundings without bearings on where to find caribou, for example, some groups lose a sense of purpose; alcoholism rates are often higher among these groups.)

The two studies correlated closely on migration patterns and showed that traditional Dogrib methods for diverting caribou from mine sites—where they risk exposure to toxic residues—were effective. Other studies have tracked the health effects of mining with community observations about contaminated plant, wildlife, and water resources and adverse symptoms experienced by mine workers. A *State of Knowledge* report posted on the society's Web site at <http://www.wkss.nt.ca/> synthesizes these studies.

The West Kitikmeot/Slave Society even studied how Dogrib place-names convey information about biologic features of the people's natural surroundings. A 1998 report by the Dogrib Renewable Resources Committee titled *Habitat of Dogrib Traditional Territory: Place Names as Indicators of Bio-Geographical Knowledge* documents indigenous knowledge of the area as a baseline for tracking changes in ecosystems. In documenting over 2,100 sites, the study found that Dogrib place names such as "gooseberry lake" and "red-throated loons on big fish lake" signaled facets of habitat and local biodiversity that have since been incorporated in habitat maps based on satellite images.



### Where Language, Health, and the Environment Overlap

For Luisa Maffi, an anthropological linguist, the place-name study confirms that language is a vital key to indigenous peoples' community health. "The obvious fact is that much of knowledge, if not all, is encoded in language," says Maffi, who is also president of Terralingua, a nonprofit research group that conducts studies on ecosystems and cultural diversity in order to support maintenance of that diversity. Their studies involve ethnographic interviews and local participation in ecosystem inventories.

Maffi says that the number of languages in an area can be a good indicator of cultural range, which in turn is linked to the store of knowledge of a given ecosystem and its biological diversity. "If you look at a map of the world's biodiversity hot spots and overlay on that a map of linguistic diversity, you see a striking overlap," she says. That suggests a correlation between the number of discrete cultures in an area and biological diversity.

Terralingua has explored that correlation globally in a project with the World Wide

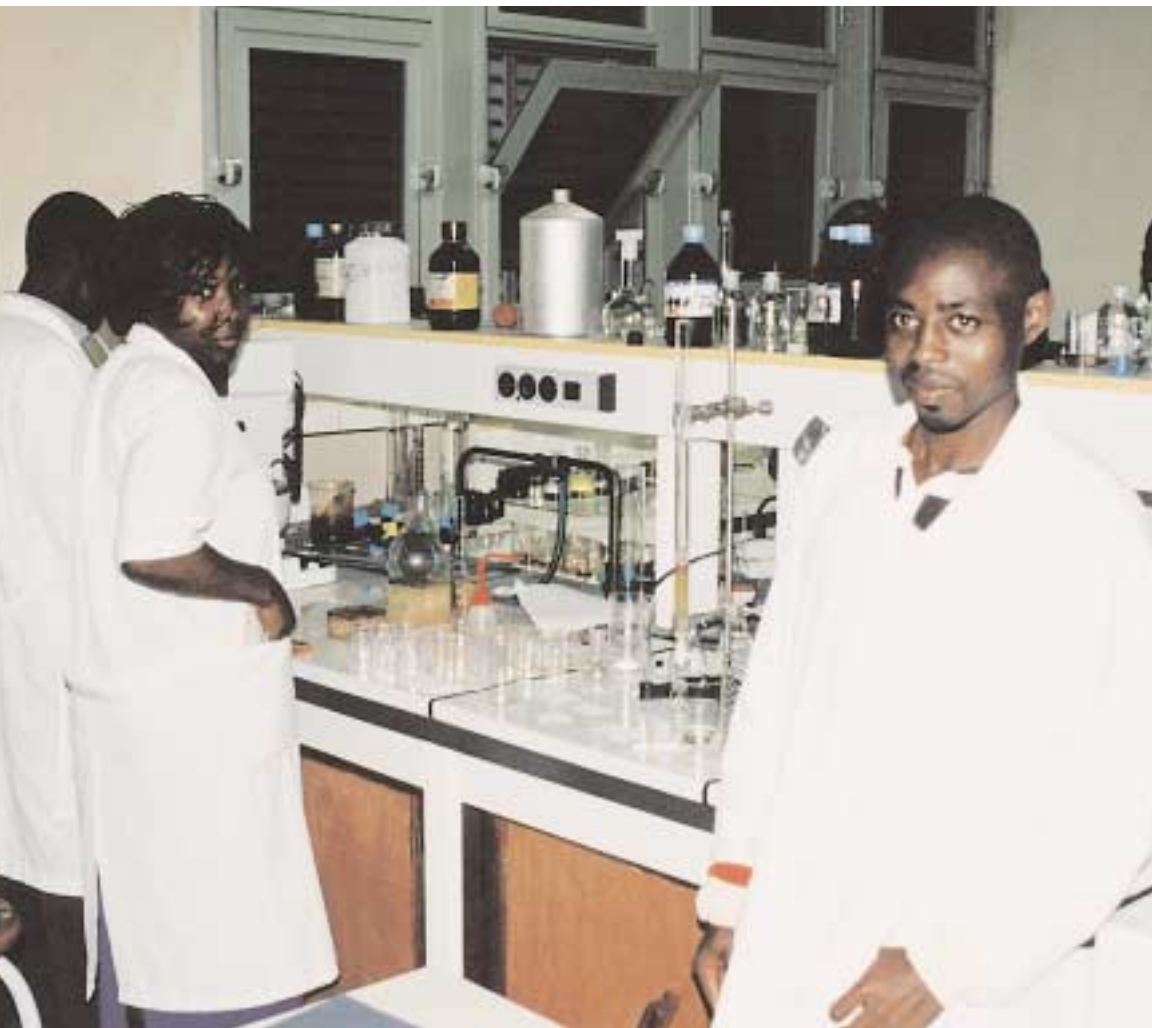
Fund For Nature International that mapped biocultural diversity as a step toward sustaining ecosystems. On a smaller scale, the group's Sierra Tarahumara Diversity Project aims to understand those interrelationships in a part of northern Mexico where mining and logging have degraded the environment and undermined local cultures by discouraging the use of native language on the job and presenting Western consumer goods that may entice young workers away from Tarahumara customs. Indigenous societies in the Sierra Tarahumara depend on both subsistence agriculture and a wide array of local plant and animal species for their survival. Project researchers have met with Tarahumara communities to assess priorities, document the linkages among biologic, cultural, and linguistic resources, assess local impacts of commercial activities (including tourism), and suggest various alternatives. The project aims to advance basic scientific research as well as conservation planning.

Besides expressing how people understand their environment, Maffi finds that people's words express how they perceive

Where the past meets the present in Bali. (clockwise from bottom right) Traditional ceremonies performed in a network of Balinese water temples are crucial for maintaining a successful system for planting and irrigation of rice crops. The results of computer simulation models of the water system provide much to discuss between researchers and the water temple priests.

symptoms of illness. When a minority language is marginalized, that can affect the quality of health care the speakers receive. In the Chiapas region of Mexico, Maffi found that the Tzeltal Maya had a sophisticated range of terms for describing symptoms in their language (distinguishing a wheezing cough from a hacking cough, for example). Yet when a field medic would visit the village and ask the townspeople about their illnesses in Spanish, she said, "People would be completely unable to talk about it, to convey the





subtleties that they could in their own language.” That chasm, she says, together with the medic’s impatience with local customs, seriously affected the quality of health care they received.

### Community Health

A community’s environmental health therefore depends not just on integrating local knowledge with scientific understanding, but on recognizing the differences in power and access enjoyed by different cultures. Many indigenous cultures exist at the margins of mainstream society, tend to be poor, and often lack political clout in managing natural resources or influencing the allocation of funds for their public health care, education, and other needs. In a November 1999 speech, Gro Harlem Brundtland, director-general of the World Health Organization, said, “Indigenous peoples continue to be subject to systematic denial of their fundamental human rights—to cultural identity, to land, to liberty, to health, and to life itself.”

This disparity supports society’s mandate for cultural competence among health professionals today, according to Richard Levinson, associate executive director of programs and policy at the American Public Health Association (APHA), a nonprofit professional organization. “Cultural competence means that health professionals need to understand the cultural characteristics of the groups from which their patients come,” says Levinson. Physicians treating the Hmong family of Anne Fadiman’s book, for example, needed a basic familiarity with the Hmong community’s approach to health and illness in order to understand how to treat them. Levinson says that in the United States that concept has extended beyond immigrant groups to include long-naturalized populations such as Latino and African-American communities, which may trust their local experience more than outside health professionals.

Dwight Conquergood, an associate professor of performance studies at Northwestern University in Evanston, Illinois, who in 1985 was a young ethnographer at a refugee camp

in Thailand, demonstrated this principle at a community level by engaging Hmong values and customs in a campaign to eradicate rabies. Efforts by the camp’s medical staff to get pets inoculated produced no results. Fadiman’s book relates that Conquergood organized a “rabies parade,” with Hmong participants and characters from Hmong folktales explaining the etiology of rabies. The day after the procession, wrote Fadiman, “The

Lessons out of Africa. (clockwise from bottom right) Traditional medicines are sold at stands in Cameroon, where such remedies provide a popular alternative to Western treatments. Researchers at Cameroon’s University of Dschang analyze the chemical constituents of West African medicinal plants. The new and old ways come together in the pharmaceutical sciences department of the University of Jos in Nigeria, where both medical doctors and traditional healers serve on the faculty.

vaccination stations were so besieged by dogs—dogs carried in their owners' arms, dogs dragged on rope leashes, dogs rolled in on two-wheeled pushcarts—that the health workers could hardly inoculate them fast enough."

Anthropology has also supplied methods for applying community-based knowledge to environmental health research. Elizabeth Guillette, an anthropologist with the Center for Bioenvironmental Research at Tulane and Xavier Universities in New Orleans, Louisiana, has applied those methods to gain valuable information related to long-term pesticide exposure. In some cases, ethnographic interviews helped to guide the direction of research. For example, mothers in a Mexican pesticide exposure study begun in 1995 repeatedly noted that their children engaged in less play than the parents recalled from their own childhoods. That led Guillette to investigate the children's abilities through directed activities. She found that pesticide-exposed children indeed did have less endurance and coordination than lesser-exposed children [see *EHP* 106:347–353 (1998); *EHP* 108(suppl 3):389–393 (2000)].

Again, channeling study findings back to the community is an important but often neglected part of the research process. "It does not have to take a lot of time," Guillette says, and it can yield further benefits. She presented her results on pesticide exposure to the study groups in the Mexican cohort and has since noticed a decline in home use of pesticides.

Community-based initiatives to monitor environmental health foster collaboration between Western science and indigenous knowledge. In Canada, the Dogrib and neighboring Dene have launched ambitious efforts that include technical training, counsel by elders in documenting local knowledge, and developing indicators of nutritional status, economic development, and mining conditions. Residents have helped to identify hazardous waste sites for cleanup and mapped their locations for others to view on the Nunavut Planning Commission's Web site, located online at <http://npc.nunavut.ca/>. Similar efforts are under way among the Mohawk Nation in Akwesasne, New York [see *EHP* 106(suppl 3):833–840 (1998)].

### Considering the Merits of Two Systems

Still, questions remain: Why should efforts by small groups, many with problems rarely found in industrialized societies, concern the broader medical community? These would not seem to be promising sources of health wisdom as indigenous communities tend to have shorter life expectancies than the mainstream population and are more

likely to suffer from problems such as emerging infectious diseases that are less common in the rest of the population. And why should scarce research funds be used to assess nonscientific approaches to health?

Levinson responds that indigenous peoples are not just marginal groups with remote illnesses. A continuing rise in travel and immigration brings new people—along with their beliefs about the medical conditions they face—to industrialized countries. According to the American Medical Student Association, a national student-run organization, generalist physicians can soon expect more than 40% of their patients to be from minority cultures. The association offers training material on cross-cultural competency in a downloadable document titled *Module on Cross-Cultural Issues in Health*, located online at <http://www.amsa.org/programs/ccimain.cfm>.

"[The United States has] always been a nation of immigrants," says Levinson, inextricably tying it to the health concerns of groups around the world; health concerns that appear distant now will eventually be ours, he maintains. "In terms of health, we really have one world," he says, adding that an international flow of emerging infectious diseases means that insular attitudes about these illnesses must change.

As for why to consider indigenous knowledge, Levinson reiterates the importance of health professionals understanding where their patients come from so they will be alert not only to possible dangers but also to possible benefits as well. Many traditional customs, such as practicing yoga and taking herbal remedies, have a healthy effect. "The problem," says Levinson, "is when the practices are harmful, for example native drugs that contain toxic substances or rituals that may prevent appropriate diagnosis or treatment. Either way, good treatment requires awareness of these factors."

Experiences from ethnomedicine, ecosystem management, and community health all suggest that health professionals in the twenty-first century may gain new tools by innovatively combining the best of science with the best of the old ways. These lessons are not lost on the medical professionals in California who dealt with Lia Lee, the Hmong girl with epilepsy. In a response to a review of Fadiman's book in the March–April 1998 issue of *Pediatric Nursing*, June L. Harney Boffman, who worked in the Merced County Medical Center during the period covered by the book, urged that nurses, doctors, and social workers recognize the power of belief. "Knowing is in the context of one's world," Boffman wrote. "This should never be overlooked in the future."

David A. Taylor

When it comes to the environment . . .

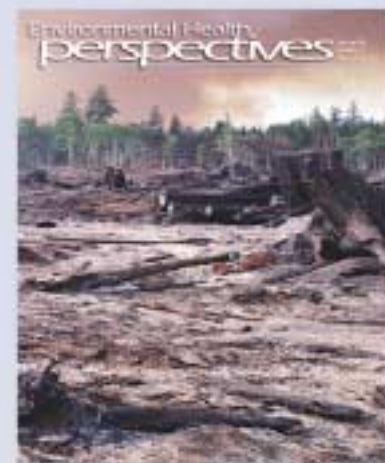


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