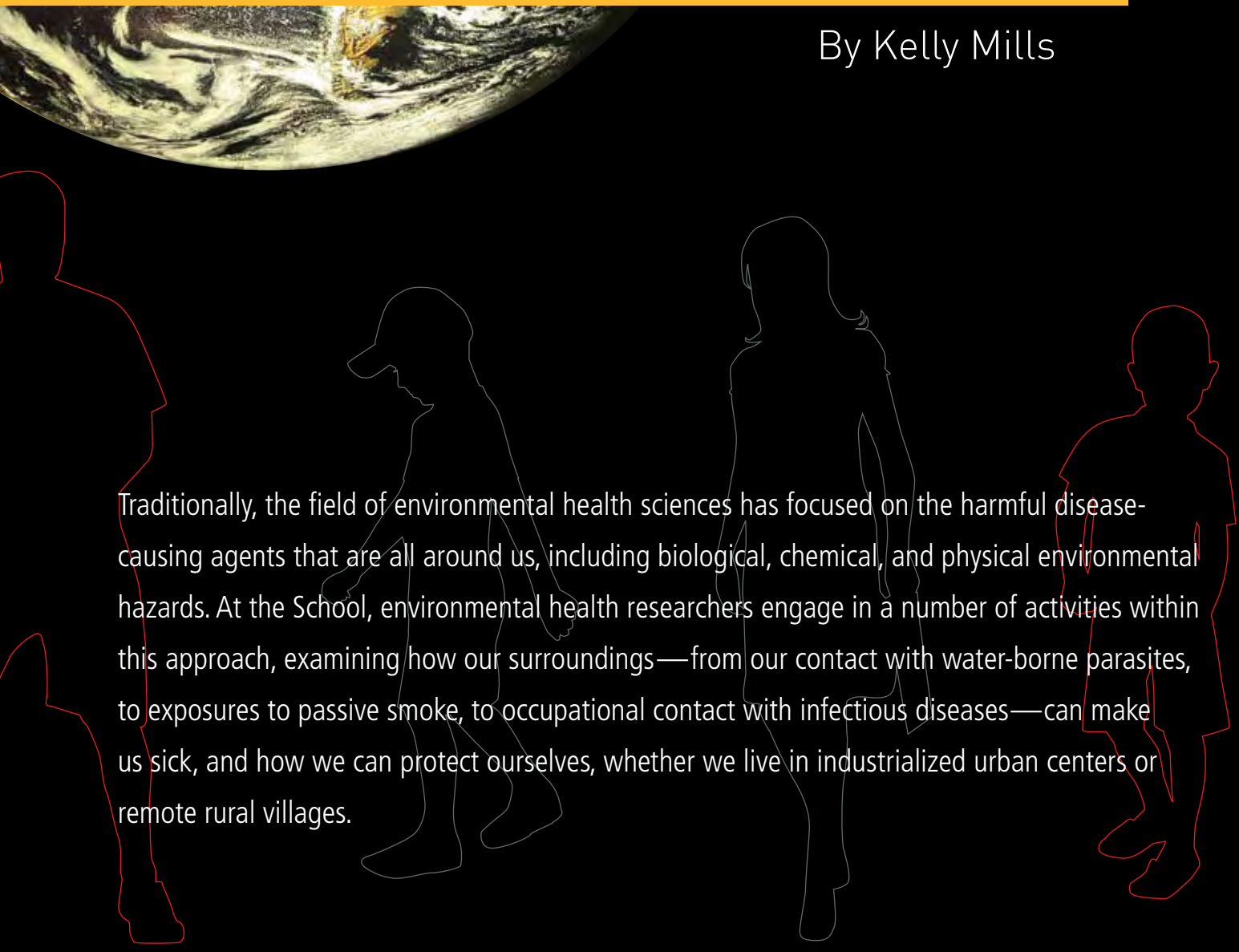
HAZARDS

in the Environment

By Kelly Mills



Traditionally, the field of environmental health sciences has focused on the harmful disease-causing agents that are all around us, including biological, chemical, and physical environmental hazards. At the School, environmental health researchers engage in a number of activities within this approach, examining how our surroundings—from our contact with water-borne parasites, to exposures to passive smoke, to occupational contact with infectious diseases—can make us sick, and how we can protect ourselves, whether we live in industrialized urban centers or remote rural villages.

DANGER IN THE WATER

Robert Spear first became interested in the parasitic disease schistosomiasis in 1992. Schistosomiasis is caused by a water-borne parasite, *schisto cercaria*, which is transmitted by aquatic or amphibious snails and causes cumulative damage to blood vessels surrounding the intestines or bladder. It is prevalent in many parts of the world, including China, the country where Spear, a professor of environmental health sciences, first learned about the disease and subsequently focused his research. Because the disease is generally not fatal unless untreated for years and affects poor people in the developing world, it receives little attention. Most previous national efforts aimed towards dealing with it have involved drug treatment—which is only a partial solution because after receiving treatment, people resume activities involving water contact and become reinfected.

An engineer by training, Spear, along with his students and Chinese colleagues, has focused on the environmental determinants of disease transmission and the associated environmental interventions for preventing the disease in rural villages. One of the areas Spear has researched is the appearance of the disease in geographic "patches." For example, in one village, 65 to 70 percent of the people might have the disease, while only 8 percent are infected in a village just two kilometers away. It has become clear that the reasons for these local differences in disease prevalence relate to agricultural factors like fertilization use, crop type, and the nature and operation of the irrigation system, as well as environmental temperature and rainfall patterns. These factors are summarized in an index the researchers call "internal potential" that is a property of an individual village. Researchers also discovered that "connectivity" is responsible for some of the variability. The irrigation system often connects villages, enabling the downstream transport of both the parasite and snail larvae. Also, some villages have a high degree of contact with each other through trade or familial ties, so that a village can be infected simply by the introduction of one water buffalo that carries the disease from another village.

"You can eradicate the disease in one village," says Spear, "but if the neighboring village has a high infection rate, the clean village stands a good chance of reinfection."

Both the local nature of internal potential and connectivity make it difficult to develop a broadly effective intervention strategy. Connected villages are sometimes in different counties and therefore fall under different jurisdictions. Often the locally effective intervention involves disparate government agencies, creating difficulties in cooperation and funding. For example, dirt irrigation ditches are a primary habitat for the snails, and pouring concrete irrigation ditches is one method of eradicating them. However, irrigation comes under the purview of government agencies responsible for agriculture, not public health, so they do not allocate funding for disease control.

The work of Spear and his colleagues has shown that in the mountainous areas of western China, successful interventions must be tailored to local conditions and often involve multiple strategies. This implies that public health workers need to be retrained to identify the local determinants of transmission, and government agencies have to cooperate and unify efforts.

One intervention that has been well-received is the introduction of biogas digesters in some farmhouses. Traditionally, families in the villages disposed of human waste and pig waste in a large pit, and then use the waste as fertilizer for agriculture, often spreading parasites. However, if a home has a biogas digester, the family can dispose of waste in the digester, and the decomposition of the waste in an anaerobic environment produces methane gas, which can be used as an energy source. The parasite is destroyed in the process, so the waste can be used safely as fertilizer.

Spear is continuing to work on schistosomiasis, with the objective of understanding the reemergence of the disease in a number of counties in Sichuan where it had formerly been suppressed to below detectable levels. A second new project utilizes genetic markers in the snail and the parasite to understand issues of connectivity at geographical scales greater than that of a village and its neighbors.

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1 *Undergraduate student Waiwai Hung collects a water sample from an irrigation ditch in rural Sichuan as part of a project to develop an improved method to detect* schisto cercaria *in water.*

2 *Three research teams were deployed to conduct surveys in 53 villages in an area where schistosomiasis was previously controlled and has recently reemerged. The team pictured includes Sichuan CDC staff, Jingyang County schistosomiasis control station staff, and three Berkeley students (Elizabeth Carlton, top left corner; Sacha Ferguson, lower left corner; and Waiwai Hung, lower right corner).*

3 *A woman spreads night soil (a mixture of human and pig waste) to fertilize her corn in a village in Sichuan. Because schistosome eggs are excreted in stool, night soil use can spread the parasite.*

Hazards, continued

HARMFUL SECONDHAND SMOKE

Public health has made many advances in the area of smoking, particularly in raising public awareness about the dangers of passive smoke. Historically, passive smoke studies focused on people living in a home with a smoker, but in the last 10 years, research has demonstrated that the workplace can be a primary site of exposure to secondhand smoke, and that there can be overlapping exposures. This has focused attention on the need for a more extensive exposure assessment. For example, one study a few years ago found an association between passive smoking and pre-menopausal breast cancer by separating studies with a comprehensive exposure assessment from those that isolated only home exposure.

On the forefront of smoking research and advocacy is professor of environmental health sciences **S. Katharine Hammond.** Her research, and the work of others in the field, has dramatically increased public awareness of the dangers of secondhand smoke. Ten to fifteen years ago, says Hammond, discussions about smoking centered on issues like adding non-smoking areas to restaurants. Last year, when Hammond worked with the World Health Organization and talked with health officials about ways to prevent exposures to passive smoke,

"they didn't even try to debate it," she says. "The tobacco companies keep bringing up the debate, but most of the health organizations are clear we need to move to a smoke-free environment." Now she believes the discussions will need to shift to protecting children exposed in the home.

PROTECTING HEALTH CARE WORKERS

Hospital workers are on the front lines as far as disease exposure, and they also have the potential to spread disease from one patient to another. **Mark Nicas,** an associate adjunct professor of environmental health sciences, has been investigating how effectively workers are protected from contracting respiratory diseases, and what strategies we need to employ in order to contain disease. For one study, he assessed how diligently three local hospitals followed protocols for isolating patients with tuberculosis. The protocols include admitting patients with TB or suspected of TB to a negative pressure room in order to minimize the spread of the bacilli through the air; having all health workers wear respirators when they enter the room with the TB patient; and requiring an annual TB skin test for hospital workers.

In another study, Nicas worked with a textile chemist, **Gang Sun,** who developed an anti-microbial finish for fabrics. The finish can be applied to hospital gowns and bed linens in order to reduce the transmission of disease from hand-to-mouth contact—when the disease is spread through particles on surfaces such as gowns. Nicas developed a conceptual model of how a health care worker might be infected, in order to determine what percentage of disease might be spread from surface particles, as opposed to airborne pathogens and droplet spray, or particles generally coughed onto another person. This information was then used to help determine whether the anti-microbial finish would be effective in minimizing the spread of disease. He found that surface contact could account for up to 50 percent of transmission.

Recently Nicas applied this model to seasonal influenza A, in order to determine whether flu prevention strategies recommended by health agencies—maintaining social distance and regular hand washing—would be sufficient for curbing the spread of the disease.

"The assumption has been that hand contact and droplet spray are the routes of transmission, and that inhalation is not an issue," says Nicas. The results of his calculations indicated that inhalation of airborne agents actually could account for a significant portion of disease spread, raising questions about the need for further preventative measures in stemming influenza infection.