Environmental Case Study
Arsenic in Drinking Water

When we think of water pollution, we usually visualize sewage or industrial effluents pouring out of a discharge pipe, but there are natural toxins that threaten us as well. One of these is arsenic, a common contaminate in drinking water that may be poisoning millions of people around the world. Arsenic has been known since the fourth century B.C. to be a potent poison. It has been used for centuries as a rodenticide, insecticide, and weed killer, as well as a way of assassinating enemies. Because it isn’t metabolized or excreted from the body, arsenic accumulates in hair and fingernails, where it can be detected long after death. Napoleon Bonaparte was recently found to have high enough levels of arsenic in his body to suggest he was poisoned.

Perhaps the largest population to be threatened by naturally occurring groundwater contamination by arsenic is in West Bengal, India, and adjacent areas of Bangladesh. Arsenic occurs naturally in the sediments that make up the Ganges River delta (see map). Rapid population growth, industrialization, and intensification of agricultural irrigation, however, have put increasing stresses on the limited surface-water supplies. Most surface water is too contaminated to drink, so groundwater has all but replaced other water sources for most people in this region.

In the 1960s, thousands of deep tube wells were sunk throughout the region to improve water supplies. Much of this humanitarian effort was financed by loans from the World Bank. At first, villagers were suspicious of well water, regarding it as unnatural and possibly evil. But as surface-water supplies diminished and populations grew, Bengal and Bangladesh became more and more dependent on this new source of supposedly fresh, clean water. By the late 1980s, health workers had become aware of widespread signs of chronic arsenic poisoning among villagers. Symptoms include watery and inflamed eyes, gastrointestinal cramps, gradual loss of strength, scaly skin and skin tumors, anemia, confusion, and eventually death.
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Why is arsenic poisoning appearing now? Part of the reason is increased dependence on well water, but some villages have had wells for centuries with no problem. One theory is that excessive withdrawals now lower the water table during the dry season, exposing arsenic-bearing minerals to air, which converts normally insoluble salts to soluble oxides. When aquifers are refilled during the next rainy season, dissolved arsenic can be pumped out. Between 30 and 90 million people depend on these contaminated water sources.

Discovering and understanding arsenic poisoning in Bangladesh required a combination of scientific insights from medicine and geology. Chemists and development experts are working to find solutions. A variety of inexpensive filters are being developed, using waste coal ash, sand, or clay fragments coated with chemicals that bind to arsenic, such as iron oxides or iron sulfates. These innovative strategies may save millions of lives and reduce the economic burdens of chronic illness in poor villages.

Arsenic-tainted water occurs around the world. In the United States it has been the subject of long and bitter legal disputes, because many city water supplies, especially in the American Southwest, rely on arsenic-tainted groundwater. In 1942, the U.S. government set the acceptable level of arsenic at 50 ppb. A 1999 study by the National Academy of Sciences found that this level produced a 1 in 100 risk for cancer—10,000 times the normally accepted risk level for cancer. The World Health Organization’s standard limit is much lower, at 10 ppb. For years, policy makers debated whether it was fair to force communities to install filters in municipal water supplies, or whether the public health costs of increased cancer and chronic illness justified the installation of filters. In 2002, public outrage over water quality, together with the economic cost of health care, convinced the federal government to lower arsenic limits to meet international standards.