in the 1980s, when it was found to cause life-threatening, chronic diarrhea in AIDS patients. In immunocompetent hosts the microbe typically causes a day or two of discomfort, with symptoms including nausea, vomiting, diarrhea, and cramps. Most sufferers need only oral rehydration until they recover.

"Crypto is a nasty nuisance, but not a large-scale public health menace," says DuPont, now at Baylor College of Medicine. Serologic evidence of past infection is found in 15% or more of Americans and nearly 100% of people in tropical areas with poor sanitation. "Here [in the United States] it probably causes many outbreaks of diarrhea in children at day care centers," Dupont said.

But to anyone with impaired immunity, the normally self-limiting illness can be fatal. At risk are patients taking immunosuppressive drugs (to treat cancer or prevent organ transplant rejection), anyone taking steroids, and older people.

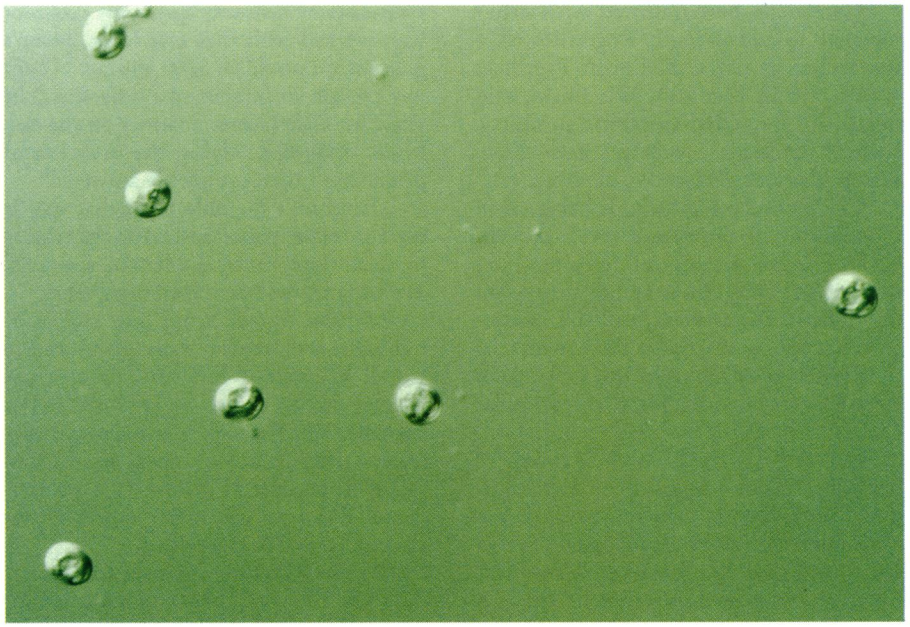
Recent guidelines from the CDC and the EPA say waterborne *Cryptosporidium* can be eliminated by boiling water for one minute or by using a home filtering device to screen particles less than one micron in diameter. Suitable are reverse-osmosis devices, those certified for "cyst removal" by the National Sanitary Foundation, and those labeled as "absolute" for one micrometer.

Point-of-use treatment doesn't satisfy NRDC, however. "Water suppliers shouldn't throw this problem in the lap of those at risk—the sick, the poor, and the elderly. Is it right to ask society's weakest members to boil their drinking water or buy a purifier?" Olson asks.

And expensive bottled water can't be assumed to be oocyte-free unless it's been distilled, properly filtered, or came from a protected spring or other pristine source, something consumers are relatively powerless to determine.

The cost of *Cryptosporidium*-free tap water will vary according to the size of the system, says environmental engineer Stig Regli of the EPA. For an existing major municipal system to add an additional filtering step, or more effective but costlier ozone disinfection would add $10 to $15 per year to a residential water bill, while patrons of small public or private systems might have to pay $100 or more per year, says Regli.

The CDC/EPA guidelines urge individuals who may be worried about *Cryptosporidium* to ask their health care provider about appropriate risk-reducing measures. Current data don't justify telling immunocompromised people to boil or avoid drinking tap water unless there's an outbreak, guidelines say, which warn that narrowly focusing on *Cryptosporidium* (or other single health risk) could draw attention from other potential opportunistic infections.



Frank W. Schaefer/EPA

Drinkable danger. New research shows that relatively small numbers of *Cryptosporidium* oocysts are enough to cause potentially severe infections.

Even the most motivated individual will find absolute safety from *Cryptosporidium* hard to attain. The CDC/EPA guidelines suggest, "Individuals who contact bottlers or filter manufacturers for information should request data supporting claims that a brand of bottled water or filter can meet the above criteria." No agency lists the brands of either safe bottled water or effective home water filter systems, though a list of filters meeting CDC/EPA criteria is available from National Science Foundation (1-800-NSF-8010).

This fall, water systems can enter a voluntary quality control program sponsored by the EPA and the American Waterworks Association, which will certify that they are doing everything feasible to keep the water safe. By participating, systems may shield themselves somewhat from liability if there's a *Cryptosporidium* outbreak similar to the one in 1993 in Milwaukee which incapacitated thousands and led to the deaths of several immunocompromised individuals. "Everybody wants to avoid another Milwaukee," says Regli.

But until and unless water systems eliminate *Cryptosporidium*, DuPont urges anyone with compromised immune function, including anyone over the age of 80, to boil their drinking water, invest in a certified filter, or seek out a reliable brand of bottled water.

Reviving Hemp

Many people know hemp (*Cannabis sativa*), which contains the psychoactive drug tetrahydrocannabinol, as the marijuana plant. But for centuries the Asian herb has been used to make rope or cord, especially large-diameter ropes for ships. Now attention is turning to the use of hemp to make paper.

"It's one of the best fiber sources [for paper] around," says John Ralph, professor of forestry at the University of Wisconsin-Madison. Hemp has long fibers which increase the strength of paper made from it.

Because cultivating marijuana plants is illegal, hemp cannot be grown in the United States. Hemp is widely grown in Hungary and China, and several firms import hemp paper into the United States. Etienne Fontan, a sales manager of the Virginia-based firm Ecolution, touts hemp's environmental advantages. Fontan says that producing hemp paper is more environmentally benign than producing paper from wood. Hemp doesn't require the chlorine bleach and acids used to make paper from wood pulp.

In April of this year, Tree Free EcoPaper of Portland, Oregon, made what it said is the first commercial U.S.-produced hemp-containing paper in 40 years. The paper, made at the company's Massachusetts paper mill, is composed of 10% hemp grown in Europe, plus other nonwoody and recycled materials. According to firm President Paul Stanford, the paper is a high-quality bond paper. Stanford said EcoPaper also plans to use imported hemp to make a lower-grade paper for copiers.

Hemp can be combined with other materials to add strength. Roger Rowell, a researcher at the U.S. Forest Products Laboratory in Madison, Wisconsin, said hemp can be added to plastic products, such as fan blades, to help stiffen them. Hemp fibers are also used in clothing.

The idea of using hemp is being taken seriously at governmental levels as well. Erwin Scholts, in charge of developing and diversifying agriculture at the Wisconsin Agriculture Department, called a conference last spring to explore the commercial possibilities of hemp. And the governor of Kentucky set up a task force with a similar goal.

But the law banning the growth of hemp is a major barrier to commercialization. "It's killing it," says Rowell about the law's impact on any potential hemp industry. Rowell gave up plans to grow the plant for research purposes when he learned about the strict security and record-keeping measures he would have to take.

Scholts said that it may be possible to develop hemp commercially by breeding in genetic markers, such as color, that would identify the crop. And scientists say that hemp lacking the psychoactive ingredient tetrahydrocannabinol can easily be bred.

The governor's task force in Kentucky, which studied hemp's commercial possibilities over six months, concluded in June that the crop had no value for the state's farmers. According to Scott Smith, a University of Kentucky agronomy professor who worked with that task force, hemp's gross return would be $200 an acre. "That's not enough to interest many farmers," he said. But Gale Glenn, a farmer on the task force, disagreed, saying the question of profit hasn't been completely answered.

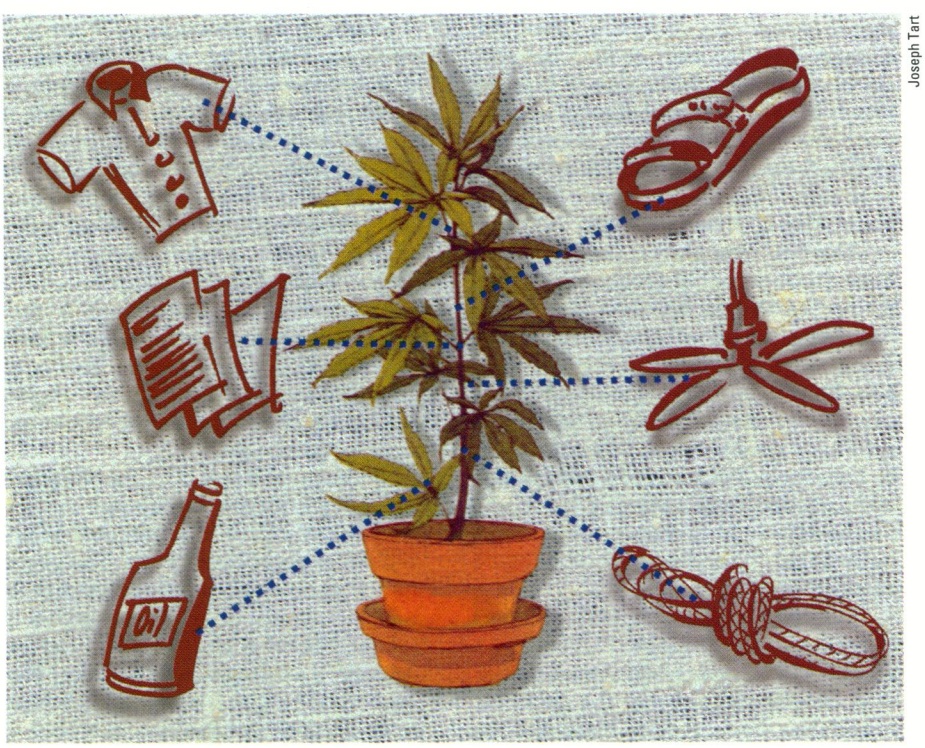
Hemp isn't the only plant that can be used to make paper and fiber-containing products. Jute, kenaf, and flax are also used, as is bagasse, the waste from sugar cane.

And the cost of hemp may simply be too high, compared to those plants and to wood, to make it very attractive in the United States, according to Rowell. For example, kenaf, which is used in specialty papers, sells for $.15 a pound, he said, and wood fiber sells at $.03–.05 a pound. Rowell estimates that hemp would sell for about $.50 and $.75 a pound.

William Lopatin, a project manager at the Ohio Hempery, which sells hemp-containing paper, acknowledged that hemp is expensive and that the price of other grasses would have to "go up dramatically" for hemp to be economical. Others say that hemp prices would decrease as markets for it increase.

Hemp advocates boast of the plant's environmental virtues, arguing that using hemp saves trees, that its pesticide demands are minimal, and that it helps hold soil, thus preventing erosion. However, should hemp be intensively cultivated as a cash crop, cautioned Smith, it would require nitrogen fertilizer, much the same as other cash crops. Another potential drawback is that hemp plants contain silica, which can damage paper-making machines.

Even though hemp may not be a problem-free crop, it's attractive enough for Scholts to explore. He is planning a second forum on hemp. "If this can be a valuable crop for American agriculture, we have to keep moving forward and investigating it," he says.



Joseph Tart

Hemportunities? Researchers, manufacturers, and government officials are all looking at possible uses for hemp including paper, clothing, and other products.

Mother's Milk

A study released in the April 1995 *American Journal of Public Health*, authored by NIEHS statistician Beth Gladen and epidemiologist Walter Rogan, shows evidence for a correlation between DDE levels in milk and shortened lactation in 229 Mexican women. DDE is the most stable derivative of the pesticide DDT, which is banned in most of the world, including the United States and Mexico. Since DDT is persistent in the environment, women, and consequently breast-fed babies, may still be subject to its effects.

Infants face serious health risks if their mothers suffer from shortened or failed lactation. Decreased lactation has been associated with increased infant mortality, especially in developing countries, but effects are also detectable in the developed world, including the United States. In developing areas where water may be contaminated, feeding babies with powdered milk instead of breastfeeding may leave them vulnerable to diarrheal diseases and other waterborne pathogens, leading to infant mortality. Even where the water is clean and does not present a hazard, many researchers believe that bottle-fed babies may be missing out on important health benefits of breastfeeding, including stronger immune function.

In a 1987 study, the North Carolina Breast Milk and Formula Project, researchers found that while DDE in milk did not show any direct effect on infants' health, those children whose mothers' milk carried high levels of DDE were breast fed for markedly shorter times than those with lower levels. To replicate the study, the authors chose an agricultural region of Mexico where DDE levels were likely to be high due to previous pesticide use—the town of Tlahualilo, in the northern state of Durango. The researchers used local medical personnel to administer questionnaires about the demographic and socioeconomic status of the mother, her medical and reproductive history, the pregnancy, the delivery, attitudes toward breast feeding, and the baby's feeding pattern since birth.