

piece of equipment. The real problems have been things like crossed lines of authority, confusion, inability of standard operating procedures to solve problems, and an ineffective integration of political and military decision making. Certainly, survivable communications are desirable, if they are cost effective. But the common infatuation with the communications engineering aspects of command and control is all too reminiscent of the drunk who looks for his lost keys under the streetlight because that is where he can see the clearest."

In a short final chapter Bracken looks to the future. Naturally enough, he indicates a need to control *alerts* as much as weapons—that is, to focus on the operational aspects of strategic forces on both sides. Other observers have addressed the problem too. In a little noted paper of 1971, Judith A. Merkle envisioned the Moscow-Washington "hotline" as a merger of the strategic command-and-control systems of the two nations. Today, efforts are being made to enhance this capability by establishing "crisis centers" staffed by Soviet and American officers who, together, would analyze threat data gleaned from the system in order to avoid misinterpretation. We wish them success.

For the present we have *Command and Control of Nuclear Forces*, well written and deserving to be well read. [WV]

FUTURE WATER

by John R. Sheaffer

and Leonard A. Stevens

(William Morrow and Company; 269 pp.; \$14.95)

Albert L. Huebner

In 1972, Congress passed amendments to the Federal Water Pollution Control Act (FWPCA) that were hailed as a dramatic change in direction. Although water quality had been deteriorating for many decades, the legislation set the clear goal of clean, potable water all across America by 1985. The chief architect of the new law, Senator Edmund Muskie, insisted that "streams and rivers are no longer to be considered part of the waste treatment process." Restoration of this national resource would be achieved either by keeping pollutants out or by complete recycling.

Despite expenditure of nearly \$50 billion in federal, state, and local funds, the goal will not be reached. According to Sheaffer

and Stevens, entrenched interests in water treatment welcomed the vast increase in funding while ignoring the call for a change of direction. Rivers continue to be used as dumps for wastewater and other pollutants; downstream users count on dilution and expensive treatment systems to restore the upstream discharge to something approximating drinkable water.

As elation over passage of FWPCA turned to disenchantment, water problems proliferated. In many urban areas, aging water systems are literally disintegrating. Boston and Cleveland lose nearly 20 per cent of their water supply because of leaks that have now become floods. New York City can't even assess its system accurately. The city's five boroughs are supplied by two large tunnels half a century old; shutting them down for inspection is impossible until a third tunnel, presently held up by legal and financial difficulties, can be completed.

Water supplies are in similar trouble in the rich farmlands that presently feed America and some of the rest of the world as well. In the Great Plains, the vast Ogallala aquifer that sustains the nation's agricultural heartland is being depleted by irrigation on a grand scale. And the Colorado River water that nourishes the Southwest will be significantly "overappropriated" when the Central Arizona Project is completed in the late 1980s.

Sheaffer and Stevens point out that "the groundwater overdraft in some areas causes what may be the most dramatic symptom of the impending crisis: subsidence." As water is withdrawn, the earth contracts and the surface subsides. In California's San Joaquin Valley, land has subsided by as much as thirty feet. Some sections of metropolitan Houston have dropped below sea level. But the most striking illustration is a number of "sinkholes" that developed in Florida, the largest creating a sudden chasm 125 feet deep and 400 feet across.

The authors of *Future Water* attribute these pervasive—and growing—water crises to flagrant misuse of what is, for the most part, a plentiful resource. They deplore the prevalent linear systems, which use this resource once, then dispose of it, frequently spending enormous sums both to reach out for distant water and to move the wastewater out of sight without restoring its quality.

The central theme of *Future Water* is the need to develop a water ethic "based on the understanding that the pollutants of water are really valuable resources out of place." Sheaffer and Stevens advocate circular systems that reuse wastewater, allowing nat-

ural processes in soil, plants, air, and sunshine to extract these resources in ways that enhance the production of food, fiber, and energy, with clean water as a byproduct.

Although circular systems are not widely used, their effectiveness has been amply demonstrated. At the turn of the century, sewage was pumped from Berlin to settling ponds at the highest points of four farms outside the city. The wastewater, used for irrigation, gave up its rich nutrients to the soil. The thoroughly earth-filtered water was collected by drainage pipes and returned as *potable* water to the Spree River, from which it had come. Similar systems operated successfully in France and England. Closer to home, San Francisco saves its clean water and simultaneously relieves some of its sewage burden by using wastewater to beautify Golden Gate Park; a sewage treatment plant, built in the park more than fifty years ago, contributes nutrient-rich effluent to irrigate grass, shrubs, and flowers and sludge to condition the soil.

The application of modern soil science can further improve these effective circular systems. Sheaffer and Stevens cite a number of impressive examples, such as the Muskegon Country project that has been operating in Michigan for over a decade. Codesigned by Sheaffer, this wastewater management system takes over thirty million gallons of sewage from thirteen municipalities, including the heavily industrialized city of Muskegon, and converts it to potable water by filtering it through the soil of a large farm. The cost of treatment is low, the sale of feed corn brings in over \$1 million a year, and the system actually turns a profit for the taxpayers.

Future Water argues that "the circular approach to water and wastewater can offer a new era in managing our most precious resource," if present inertia can be overcome. The book concludes with a plea for open debate between both sides in the treatment controversy. That debate—long overdue—could be a major step toward reversing the tragic deterioration of the nation's water supply.

There is an important footnote. If water problems are becoming more acute in the U.S., in much of the Third World there is already a severe crisis that is creating enormous health hazards and crippling development. More than a third of the way through the U.N.'s Water and Sanitation Decade, improvements have been modest at best. Circular systems seem to hold out an especially broad range of benefits for underdeveloped countries. *Future Water*, although directed at problems in the U.S., could have a far wider impact. [WV]