Precious Water

L.G. KETCHUM

Dr. Charles Gerba

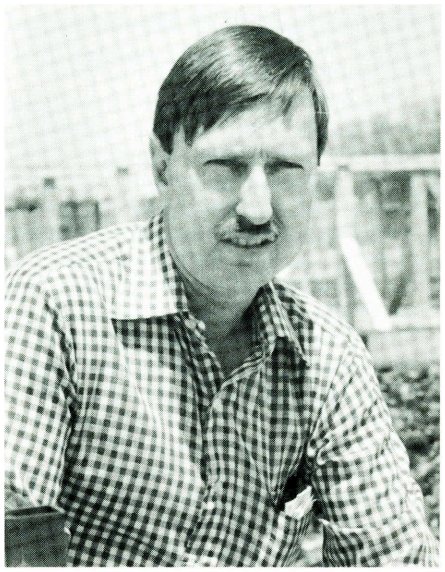
Groundwater Safety

Almost half of all the waterborne disease outbreaks that occur each year in the United States are due to contaminated groundwater. More than 95 percent of them are believed to be caused by microorganisms, with only about 5 percent being caused by chemicals. Surveys around the country have shown that almost half of all rural drinking water wells are contaminated by fecal microorganisms; and because of their extremely small sizes, viruses such as hepatitis have great potential for contaminating groundwater.

Our research is aimed at studying how microorganisms get into groundwater and how long they survive. We know that viruses may enter groundwater from septic tanks, sludge disposal on farm land, and irrigation with wastewater. Moreover, we have demonstrated that correlating the rate that water flows through the ground with the temperature of the soil enables predictions to be made about how far water must travel before disease-causing viruses will be killed.

We hope our research will effect water usage within the next ten years. We would like it to enable communities to safely and more widely use sewage effluent for irrigating agricultural land, golf courses, parks, and playgrounds, and homeowners to safely irrigate home lawns and gardens using recycled household bath and laundry water.

Charles P. Gerba, Ph.D. and
Susan M. Kutz, Ph.D.
Nutrition and Food Science



A. TERTIG

Dr. Martin Karpiscak

L.G. KETCHUM

Water Hyacinths floating on the surface of water act as a biological filter, clarifier, and purifier of many contaminants.

Aquatic Agrisystems for Wastewater Treatment

Water hyacinths floating on the surface of water act as a biological filter, clarifier, and purifier of many contaminants. Most purification occurs in the root zone, where the fibrous and feathery roots provide a medium for bacteria that are capable of renovating wastewaters. To find out how suitable they are in the treatment of metropolitan wastewater, the Pima County Wastewater Management Department, in cooperation with the Office of Arid Lands Studies, is conducting a study to evaluate them for the secondary and tertiary treatment of sanitary sewage in Tucson's arid environment.

The test facility has six relatively shallow tanks. Five of them are five feet deep and measure about 30 x 200 feet each; the sixth is about 40 x 212 feet, and is nine feet deep. The treatment capacity of the pilot facility ranges from fifty thousand to one hundred thousand gallons each day, depending on the research procedure being conducted and the quality of the water being treated.

The Tucson area now generates about forty-three million gallons of sanitary sewage every day, but projections for thirty years hence estimate an output of 110 million gallons daily. The present combined treatment capacity of Pima County's existing facilities at Roger Road, Ina Road, and Randolph Park is fifty-six million gallons daily. With the information obtained from the pilot aquatic treatment facility, public officials will be able to make decisions regarding the use of hyacinths in future public wastewater treatment and utilization projects in the county.

Martin Karpiscak, Ph.D.
Arid Lands Studies

Precious Water

Water Requirements of Groundcover Species for Use in Central Arizona

Studies aimed at determining how much water groundcovers need to function well in a landscape situation are being carried out at the Boyce Thompson Southwestern Arboretum near Superior, Arizona. They were conducted in 1988 at the arboretum's newly constructed water-use research plots, creation of which was substantially funded by a grant from the Arizona Nursery Association. *Myoporum parvifolium*, from Australia, and *Dalea greggii*, from the Chihuahuan Desert, were tested at 100 percent, 75 percent, 50 percent, and 25 percent of the volume of water actually evaporated from a class A evaporative pan located at the site.

Myoporum grew most at the higher irrigation regimes, but actually performed best at the lowest irrigation level. The plants grew less than those given more water, but their color was better and they showed no yellowing or dieback, as did those irrigated at the 100 percent regime. Infrared measurements of leaf temperature showed that even when watered at the lowest irrigation regime, the plants were still transpiring and leaves were quite cool.

Dalea greggii also grew better at the higher irrigation levels, with the most growth at the 100 percent treatment. Although all plants survived, those irrigated at 25 percent of pan evaporation were sparse and showed definite signs of water stress. Infrared temperature measurements showed increasing water stress as the amount of water applied decreased. The *Dalea* had not completely covered the soil surface when the experiment began. For that reason, 75 percent of pan evaporation can be considered as adequate for establishment of the *Dalea*. Maintenance needs are probably lower and will be studied this year.

William R. Feldman, Ph.D.
Boyce Thompson
Southwestern Arboretum
Alex K. Niemiera, Ph.D.
Arizona State University

Using Copper to Disinfect Water

Recent research in our laboratory has revealed that the presence of trace quantities of copper, especially in conjunction with small amounts of chlorine, act as a highly potent disinfectant. Although previously unrecognized, the use of copper pipes has been furnishing protection to homeowners for decades against the presence of disease-causing microorganisms. We have found that both bacteria and viruses are killed by low levels of copper in the water.

We have also found that the addition of copper to swimming pools can result in a dramatic decrease in the need for chlorine to control the growth of microorganisms. Its use results in less eye irritation and fewer skin and respiratory problems. As a result of our research, copper disinfection units have been installed recently in some of the nation's largest university swimming pools.

Copper appears to be particularly effective against *Legionella*, the bacterium that causes the serious Legionnaire's (respiratory) Disease. The bacterium is only transmitted environmentally from aerosols and is generated by industrial cooling towers, hot tubs, and shower heads. Our research with copper has demonstrated more-reliable and low-cost methods for control of the organism in those environments.

Charles P. Gerba, Ph.D. and
Moyasar T. Yahya
Nutrition and Food Science

Point-of-use Water Treatments

Household methods of improving water quality have been available for several centuries. Dramatic surges of interest in household or point-of-use water treatment systems and in the bottled water industry have been witnessed in recent times, as reflected in booming sales. Both developments have resulted from consumers' concerns about the quality of their drinking water; they are continually being bombarded with media reports about the health hazards associated with lead, toxic chemicals, and micro-organisms in the water that comes from the faucets in their homes.

Many new and innovative methods have been developed for the treatment of water on a small scale to ensure its quality. Generally, consumers receiving their drinking water from utilities need not worry about the quality of the water as it must meet strict federal governmental standards. However, consumers are generally unaware that there are no federal testing standards to ensure the efficacy of point-of-use treatment devices—only the state of California has established testing requirements for such devices.

Our laboratory has been actively engaged in the development of federal guidelines and in the testing of point-of-use treatment devices that are designed to make the water micro-biologically safe for human consumption. We are evaluating newly-developed devices—such as reverse osmosis, demand-release disinfection, and thermal-activated units—for their abilities to remove viruses, bacteria, and parasites.

Charles P. Gerba, Ph.D.
Nutrition and Food Science