SCIENCE NEWS of the week

The Trouble with Tracking Turbidity

Clear drinking water flowing from a household tap may contain large numbers of bacteria and other microorganisms, despite meeting standards set by the Environmental Protection Agency (EPA), say two researchers at the University of Missouri at Columbia (UMC). These bacteria, they say, although not necessarily harmful to human health, can affect the taste and smell of drinking water and contribute to the corrosion of water pipes.

The problem, says UMC civil engineer John T. O'Connor, is that water suppliers rely mainly on measurements of turbidity (water murkiness) to monitor a treatment plant's effectiveness in keeping bacteria from passing through a plant's filtering system into the finished water. The assumption is that filtering water to remove debris such as sand or clay particles also reduces the number of microorganisms that would otherwise be found in drinking water.

O'Connor and microbiologist Blaise J. Brazos contend that utilities should use microscopic techniques to count directly the number of bacterial cells present in both raw and treated waters. Such techniques would give utilities a better idea of how well treatment plants work, they say.

Recently, O'Connor and Brazos conducted the first major survey of its kind of water systems to determine the actual number of bacterial cells found in treated water. Using a technique well known in microbiology but rarely used in drinking water research, they counted the number of cells present in water samples by catching the cells in special filters, staining them with a fluorescent dye and observing them in ultraviolet light under a microscope.

In samples from 83 Missouri water systems, the direct count revealed from 1 million to 1 billion cells per liter in treated water. The researchers also observed that two treatment plants could have water with the same measured turbidity, yet one would be filtering out bacteria much more effectively than the other.

"It is incumbent upon us as waterworks scientists, engineers and professionals to find out why this can happen," O'Connor said last week at the American Water Works Association annual conference held in Washington, D.C.

Currently, EPA's "interim" drinking water regulations governing microbiological contamination specify turbidity as one of only two standards that must be met. Water, when it leaves a treatment plant, must have a turbidity below 1 NTU (a specially defined unit of measurement related to how much light is scattered by the particles in a sample of water).

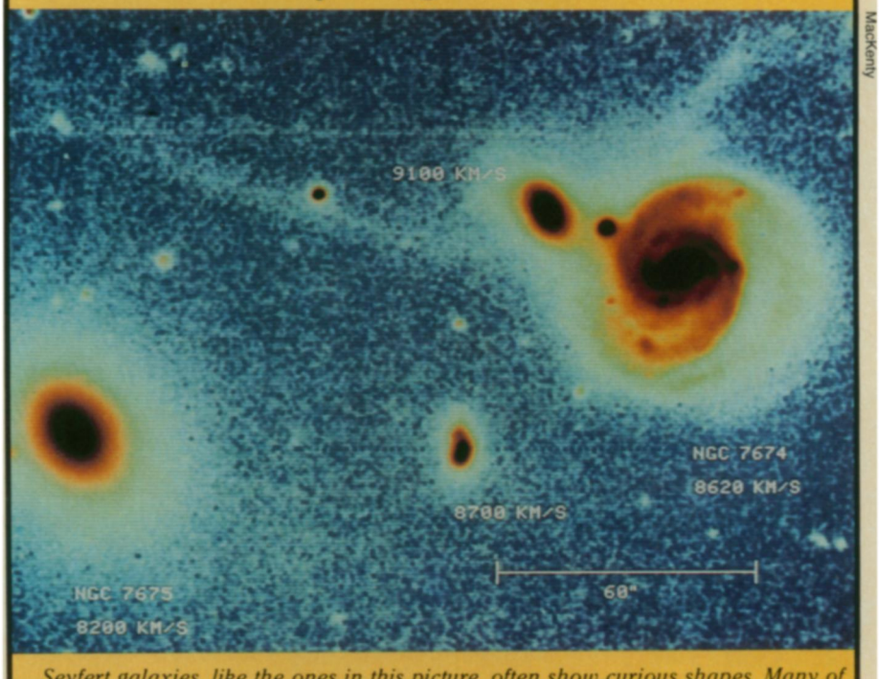
"The specific purpose of the turbidity standard was to encourage the filtration of surface water supplies," says Joseph A. Cotruvo, director of the criteria and standards division in EPA's drinking water office. "It was not intended as a quantitative measure of bacteria."

Cotruvo concedes that turbidity is not a good index of total bacterial content in water but argues that removal of turbidity correlates well with removal of bacteria known to cause disease. Historically, a combination of filtering and disinfection using chlorine has been effective in ensuring the safety of drinking water, he says.

Very little is known about the microorganisms that live in systems that carry drinking water, says O'Connor. In the past, most microbiologists assumed there was nothing there. "Because of what we are finding, we are now looking at the ecology of drinking water microorganisms," says Brazos. "It's a very dynamic and very diverse ecological system, much more so than people thought. These bacteria are responsible for tastes, odors, corrosion and many other problems."

Raymond H. Taylor of the California Water Service Co. in San Jose is one of many water-quality engineers who aren't convinced that turbidity measurements are useless. Moreover, he says, direct counting of bacteria has some inherent problems. "Most people feel that it doesn't

Of tides and Seyfert galaxies



Seyfert galaxies, like the ones in this picture, often show curious shapes. Many of their features seem to be the result of tidal interactions with other galaxies. One of those, NGC 7674, shows here two tails that seem to be the result of extreme tidal interaction with some other galaxy.

Seyferts are galaxies with particularly active and energetic nuclei. Astrophysicists believe them to be intermediate between "normal" galaxies, which have less activity in their nuclei, and quasars, which are considered the most energetic of active galactic nuclei. Astronomers have thought that Seyfert galaxies show evidence of tidal interaction more often than less active galaxies. The survey that produced this picture was done by John W. MacKenty of the University of Hawaii. It shows that 25 to 30 percent of Seyferts have such peculiar shapes. This result supports the opinion that they are involved in tidal interactions more often than are other galaxies. Astrophysicists believe that the source of the energy emitted by galactic nuclei is an engine powered by a black hole. Such tidal interactions may be a way of obtaining a continuous supply of gaseous fuel for the black hole.

MacKenty observed with the University of Hawaii's 88-inch telescope on Mauna Kea and presented his report in Charlottesville, Va., at the recent meeting of the American Astronomical Society. —D.E. Thomsen