Donald C. Wold

High Energy Physics and Environmental Health:

A Note by a Metropolitan University Physicist

Effective communication with community leaders and public officials at local, state, and federal levels is essential if faculty and administrators of metropolitan universities are to be successful in accomplishing their unique mission. However, examples of involvement by physical scientists are rare. This brief report describes multidirectional communication and linkages established by a physicist at the University of Arkansas at Little Rock in connection with plans for a high energy astrophysics experiment that led instead to a proposal for a Resource Recovery Project.

In a recent issue of *Metropolitan Universities* (Winter 1994) Daniel Johnson describes multidirectional communication in the metropolitan university as "linking the university with public officials and agencies...in a network that fosters the flow of information and encourages interaction and partnership in addressing important community issues." Linkages between metropolitan university social and behavioral science faculty, community leaders, and public officials are increasingly common in response to the need to address local and regional social problems. However, there are far fewer examples of relationships and communication between metropolitan university physical scientists, the business community, and public policy makers focused on addressing environmental health. This report illustrates one example of such multidirectional communication by describing linkages established by a physicist at the University of Arkansas at Little Rock (UALR) in connection with a high energy astrophysics experiment proposed for an abandoned barite mine site. The proposal raised numerous public policy issues, including environmental health concerns affecting both the project scientists as well as those people who live along the creeks and river into which the contaminated water from the mine pit area flows. Acid drainage from this site has existed for over 50 years. As an example of a metropolitan university physicist's role in public policy issues, this personal chronicle also indicates the complexity of the interactions when questions of environmental health and public policy are raised. In the end, these interactions resulted in a proposal for a resource recovery project to demonstrate viable technologies for recovering clean water from an abandoned heavy metal mine.

GRANDE Project

In 1987, an international group of physicists was formed to investigate the important new fields of neutrino and gamma-ray astrophysics. The group included over 30 scientists from universities and research institutes in the United States, Poland, and the then Soviet Union. The goal of the collaboration was to construct the world's largest, most advanced **G**amma-**R**ay **A**nd **N**eutrino **DE**tector (GRANDE), a unique detection facility that would make important contributions to these exciting new fields of science. After an extensive nation-wide search, an abandoned barite mine about 45 miles from Little Rock was selected as the most suitable site for the proposed facility.

Environmental Health

From the inception of UALR's involvement in the GRANDE project, attention was given to the environmental issues raised by discharging contaminated water from an abandoned mine. Work done over a five year period in preparing the various GRANDE proposals resulted in much useful environmental data. The open-pit mine and underground barite mine are located in the upper drainage basin of Chamberlain Creek near Magnet Cove, Arkansas. The water in the pit (almost 4 billion gallons in 1995) and the abandoned mine spoils around it form the headwaters region of Chamberlain Creek. For a typical rainfall of 55 inches per year, about 0.5 million gallons per day are added to this volume by the surface and groundwater systems that drain into the pit. Consequently, acid mine drainage has been a problem for people who live along Chamberlain Creek.

When the initial hydrologic studies were done in 1988, the stage or elevation of the surface of the water in the pit was about 77 feet below the lowest known point along the shore, where an unregulated discharge of water would overflow into Chamberlain Creek. Now, seven years later, the stage is only 15 feet below that point. As the stage continues to rise, the water in the pit itself becomes a more obvious point source for acidic water containing heavy metals sulfates in the Chamberlain Creek basin and downstream reaches, including the Ouachita River from which the city of Malvern draws its drinking water.

Preliminary sampling in 1988 of water in the Chamberlain Creek barite pit indicated that water quality does not meet national secondary drinking standards for chloride, iron, manganese, pH, sulfate, sodium, and total dissolved solids. If water overflows from the pit, these discharges will cause concentrations of chlorides, sulfates, and total dissolved solids in Chamberlain Creek to exceed the guidelines for regulatory compliance to discharge water, and cause concentrations to exceed the applicable criteria in the tributary streams.

The contamination of water filling abandoned mines with barite and other heavy metal ores is a nationwide problem. Heavy metals pose a significant threat both to human health and safety and to aquatic environments. Some metals are neurotoxicants (lead, mercury, cadmium), while others form potentially carcinogenic organometallics.

There are currently more than 300,000 abandoned hard rock mine sites in the United States that pose a threat to health and the environment due to acid mine drainage. Runoff containing acids, metals, and chemicals from abandoned mine sites has contaminated more than 12,000 miles of rivers and streams and more than 180,000 lakes and reservoirs. Surface and groundwater contamination by heavy metals is a problem at numerous sites within the United States. Thus substantial exists interest in so-called resource recovery: finding ways of purifying the water and, at the same time, capturing the valuable heavy metals in the liquid.

Resource Recovery Project

In 1993, the district chief of the U.S. Geological Survey drew the attention of UALR physicists to a pilot Resource Recovery Project at Butte, Montana, using water from an abandoned copper mine. The project was being conducted by the Office of Technology Development in the Office of Environmental Management in the U.S. Department of Energy (DOE). This information led the UALR scientists to engage in discussions with Arkansas Congressman, Jay Dickey, and with representatives of DOE to explore the possibility of a project similar to the one in Montana. In April 1994, a proposal for a resource recovery project in Arkansas was completed and split into two parts, one requesting federal funds from DOE and the other requesting state funds through the Arkansas Energy Office. These pending proposals have been endorsed by the Board of Directors of the Industrial Development Corporation of Hot Spring County. The Industrial Development Corporation would be involved in the execution of right-of-access agreements for collecting water samples and monitoring water level. Furthermore, right-of-way agreements and leases would be required for demonstrating technologies at pilot-scale. The agreements and leases would be between the landowners and the Industrial Development Corporation of Hot Spring County, not the University of Arkansas at Little Rock.

The proposed Resource Recovery Project will evaluate, test, and demonstrate technologies for reclaiming clean useable water and marketable mineral resources from water in the Chamberlain Creek barite pit. The project will focus on resource conservation; end-use of the recovered water and mineral resources, including industrial, commercial, and agricultural uses; and nonuseable by-product minimization. Resource recovery/remediation costs for the water will be determined using economic analyses of each technology and the costs offset by recovered resources.

The goals and technical objectives will be carried out by the Office of Technology Development in the U.S. Department of Energy, and MSE, Inc., the DOE contractor at Butte, Montana. As an outgrowth of its experience with the Montana Resource Recovery Project, the latter is qualified to assist with the technology screening, selection, and implementation for the water in the barite pit.

Information transfer resulting from the technology demonstrations at the barite pit and its associated groundwater system will provide the following benefits:

First, the data gathered will assist in selecting the most appropriate and cost-effective technologies for recovering the water for beneficial uses. Second, the project will demonstrate which mineral resources are recoverable in marketable quantities, if any, and qualities from the water in the pit. Finally, the data gathered will provide the direct benefit of developing and assessing technologies that may be used to recover similar water resources found on DOE lands and those near abandoned mine sites.

This demonstration project will be watched closely by other communities with similar problems. Although the immediate beneficiaries will be the local residents, the state and nation as a whole will benefit from the project. The project itself would not be possible without the active participation of numerous individuals at the University of Arkansas and the community.