

Overview

The last ten years have been exciting for the science of aquatic toxicology. The intent of the tenth symposium was to reflect on past accomplishments of a decade and to consider what new directions are needed for the future.

During the past ten years we have watched the field of aquatic toxicology grow from its infancy and a need to deal with acute problems to a mature field of science capable of dealing with long-term and sophisticated issues of national importance. Ten years ago there was a feeling of crisis; rivers burned, fish kills made the headlines, and legislative tools had just been put in place for effective enforcement. The science of aquatic toxicology was just emerging and was learning how to assist the nation in solving its water quality problems.

Many of the papers in the early symposia dealt with methods and case studies. Over the years many of the acute problems have been effectively eliminated. Consequently, the emphasis has changed to the long-term chronic perturbations that can have just as damaging an environmental and economic effect. An example of such an effect has been the destruction of the Rock Bass fishery in the Chesapeake Bay. Apparently a combination of eutrophication, point and nonpoint pollution, habitat destruction caused by development, and overexploitation has destroyed an important economic resource. Sediment contamination, acid precipitation, groundwater pollution, and hazardous waste sites have all gained increasing emphasis. Consequently, the prediction of long-term effects has become more and more important. More recently biotechnology has opened the door to many new scientific frontiers and offers the prospect of new chemicals including medicines, pesticides, growth hormones, and industrial chemicals. Biotechnology also holds promise as a means for hazardous waste site and effluent cleanup through the modification of microbial communities to enhance biodegradation. At the same time it offers the prospect of new effluents and the release, either accidentally or intentionally, of genetically altered microorganisms. This presents a challenge to the scientific community to find appropriate ways to assess the risk associated with biotechnology without stifling creativity.

The symposium certainly reflected the state of aquatic toxicology in 1986. The leadoff session, "Aquatic Toxicology: Ten Years in Review and a Look to the Future," may eventually be looked upon as a marker for the end of the adolescence of aquatic toxicology. *Dickson* described the change in emphasis of the papers of each volume, showing the shift from new methods to refinements and papers coupling laboratory and field experiments. Many of the speakers emphasized the rapid progress of the science and the cooperation of its participants from government, industry, and academia. The last speaker, *Mount*, looked to the future and emphasized that aquatic toxicology needed to evolve into a science able to offer alternatives, risks, and technologies to preserve what has already been accomplished coupled to a responsiveness to the future.

Sessions on biotechnology and paleolimnology set off two aspects of aquatic toxicology new to most participants. Biotechnology is in many ways a game with a different set of ground rules and detection technologies. Risk assessment must take into account the reproductive potential of the organisms and the promiscuous nature of genetic exchange among procaryotes. Paleolimnology is a way of looking at truly long-term changes in ecosystem dynamics, on a range from tens to thousands of years.

Sediments constitute an enormous problem in the assessment and evaluation of hazard. The

session on sediments was dominated by papers characterizing sediments, evaluating risks, and managing dredge material. Several papers concerning sediments and dredge materials were also included in the poster session.

The poster session received an increased emphasis in the tenth symposium. The session took advantage of the opportunity for hands-on demonstrations of techniques and the chance to interact with the experimenter. Among the demonstrations was the video by *Sabourin* and *Dawson* on the use of *Xenopus* embryos for the screening of materials for teratogenicity. Posters on biomonitoring, sediment toxicity, microcosm research, and the evaluation of chronic toxicity were also presented.

Sessions on the biomonitoring of complex effluents, environmental monitoring and exposure assessment, short-term indicators of chronic toxicity, laboratory and field comparisons, aquatic toxicology, waste site hazard assessment and biodegradation, and research beneficial to the standards-setting process all indicate the diversity of the field. The examples below serve to illustrate the diversity of the symposium. *Van der Schalie et al.* demonstrated the benefits of using parameters other than ventilatory frequency in monitoring the effects of trinitrobenzene on bluegill sunfish. Progress on interlaboratory testing on the Standardized Aquatic Microcosm was presented by *Taub*. In the hazardous waste site arena, *Portier* presented data on the enhancement of PCB degradation by the enrichment of the bacterial inoculations using aminopolysaccharides.

This short overview reflects the state of the science of aquatic toxicology in 1986. This diverse field incorporates parts of many disciplines including ecology, chemistry, physiology, algology, and limnology, to mention only a few. Compared to the many disciplines, the number of aquatic toxicologists is relatively few.

Attendance at the symposia has remained about 200 for the last several years. However, aquatic toxicology has played a crucial and influential role in the progress made in the improvement in the environment during the last decade. The research emphasis is now moving on to new problems and to finding long-term solutions for environmental contamination.

We see several areas of basic research that need to be addressed. Aquatic toxicology is still to a large extent an empirical science. Only a small body of work exists on developing a theory of how toxicants affect ecosystems. A suitable theory would be of dramatic practical impact. Such a workable theory would help to extrapolate a series of data from a microcosm to a larger ecosystem. Short-term methods could be modified, if necessary, to more accurately present information relevant to evaluating risk to an ecosystem. Toxicity of complex effluents is a crucial research area. Most chemicals enter an ecosystem as a mixture or soon become part of the complex mix of synthetic and natural chemicals that exist in the environment. We need to learn how to assess the hazard of chemical mixtures. Clean up of waste sites is an issue of national importance. Biological methods have the potential to reduce costs and in some cases make cleanup possible in environments inaccessible to current methods. In the near future organisms with altered genomes will be entering the environment. An understanding of the potential, if any, of these organisms for disruption of ecosystem processes or the degradation of toxic materials needs to be understood. Aquatic organisms are already playing an important role in the search for alternatives to using mammals as test organisms. Research in this area will also emphasize the need for aquatic toxicologists to look closely at mechanisms and physiological parameters related to toxicity and environmental health.

Aquatic toxicology has an interesting future ahead. But we are also concerned that a new generation of scientists may not be coming forward to participate. Currently, the mechanisms of support for graduate students do not meet the need, and recruitment into the science appears to have slowed. Members of the community of aquatic toxicology need to encourage and find support for the new generation. There are a lot of existing problems yet to solve, and we need to put in place the basic research structure that will enable us to deal effectively with the key issues that

will face our nation ten years from now. In short, we have an exciting future ahead and need to insure that the next generation of researchers is being developed to continue the work that has begun.

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