

Presidential Address¹

DEAN F. MARTIN²

A reprinted article in a recent issue of *Aquatics* reminds us that we have a new villain, now, and the author wonders why (Anon., 1986). Answers are provided, but I think they miss the mark. But first, some background.

Once, long before my time, the villain of a popular play was easily recognizable because he was completely dressed in black. And he would confront the beautiful blonde heroine cowering in the corner of the set, and render that immortal line, "Why do you fear me, Nellie?" whilst he carefully twirled his long black handlebar mustache. The answer would usually become apparent to all, including Nellie as he roped her to the railroad track, prepared to push her over the precipice, or contemplate a fate worse than that.

The answer to the question, of course, was that Nellie didn't know what to expect, but she knew she wouldn't like it anyway.

And in that respect, times haven't changed so much, though the scenario has, and though we have more stalwart heroes and heroines (presumably all members of APMS), but we have a new villain to go with the new scenario.

The new villain of the piece is called "chemicals", sometimes "pesticides", and sometimes "herbicides". Now, back to the question, "Why do you fear me, Nellie (or Tom, Dick or Harry)?"

Again, the answer is ignorance. And, presumably, the response offered in the reprinted article was risk analysis . . . comparison of risk from ingestion of certain chemicals and comparison with the risk of daily life.

All this sounds great, but the presentation of risk comparison misses the basic target. How informed is the average person about science? Scientifically literate?

The answer is startling to many who have not yet read the summary of a recent national telephone survey (Krieger, 1986). Jon D. Miller, who is director of the Public Opinion Laboratory at Northern Illinois University, presented his results at a meeting of the American Association for the Advancement of Science in Philadelphia (May, 1986).

"There is more consensus on what constitutes scientific illiteracy than on what constitutes scientific literacy", according to Miller.

Sounds ominous, the reality is worse. According to the survey 28% of the respondents had little understanding of the term *molecule*, about 60% had little understanding of the term *DNA*. Herbicide and pesticide were not on the list, but surely these are a few levels above molecule.

The survey results get worse before they get better. About one-fifth of the respondents have a poor attitude toward planning toward the future because "It is not wise to plan ahead because many things turn out to be a matter of good luck or bad luck anyway." Some 40% believe that some numbers are especially lucky for some people. Try explaining molecules, herbicides, and risk based upon statistical analysis to them. Over 40% of the respondents believed that the rocket launchings and other space activities have caused changes in our weather and "It is likely that UFOs that have been reported are really space vehicles from other civilizations."

Thus, there is good reason to wonder about the practicality of in-house newsletters describing risk analysis, or risk analogies when the White House favors a chemical program dealing with the "Chemical People"—a synonym for consumers of illegal drugs that has galled members of the American Chemical Society.

To return to the survey, there is good news mixed in with the bad. A remarkable 81% of respondents accepted plate tectonics, which may be a tribute to the better publicity that geology has received on Nova and similar programs.

Finally the mixed news. 53% of the respondents had an attitude problem—they agreed with the statement, "Because of their knowledge, scientific researchers have a power that makes them dangerous." On the other hand, about 60% had a deference to experts and leaders ("In this complicated world of ours, the only way we can know what is going on is to rely on leaders and experts who can be trusted").

Assuming that the survey has general validity, which is always a questionable assumption, what are we faced with? Bad news and good? We have roughly a population one-third of whom believes in astrology to a greater extent than would seem plausible, that believes in luck and lucky numbers, but knows precious little about molecules.

Possibly we should not take a survey too seriously before wondering how many persons accurately and reasonably answered a telephonic survey that interrupted their dinner hour, or their favorite quiz show. We might well hope that the bad news of ignorance is the result of carelessness and an artifact of the survey system.

On the other hand, as one who has taught, or tried to teach, chemistry for nearly thirty years, I am not so surprised about the level of ignorance concerning chemistry and chemicals. The select group that we see in beginning college chemistry courses is faced with more remedial work than we should care to admit. The average American household reportedly watched television 53 hours each week during the first quarter of 1986. That translates to 7 hours and 36 minutes a day (Zacks, 1987). I doubt that they spend a large portion of that time watching programs that describe the nature of herbicides and their importance

¹Presented at the 27th Annual Meeting of the Aquatic Plant Management Society held 12-15 July 1987 in Savannah, Georgia.

²Professor of Chemistry, and Director, Chemical and Environmental Management Services (CHEMS) Center, Department of Chemistry, University of South Florida, Tampa, FL 33620.

in detail. Though such programs exist, they are limited in number and volume.

The term "chemical" has a bad connotation to more persons than we would care to realize, despite public relations efforts by members of the American Chemical Society, Chemical Manufacturers Association, and others. I was startled by a suggestion made by a resident, who lives near USF and who wrote: "Children can understand . . . that chemicals don't belong in the body" Cicchelli, 1986). Her suggestion, while well intentioned, reveals that she fails to understand that we are composed of chemicals, that we consume chemicals, mostly good and produce them. The thought that a chemical such as water doesn't belong in the body would have come as a considerable surprize to the writer. Her suggestion is revealing of how little some persons understand about chemistry and chemicals.

To return to the opening question, "Why do you fear me, Nellie?" The answer is ignorance, coupled with good cause. We are ignorant of many of the chemicals that we encounter. The top fifty chemicals, that is those that are produced in the greatest amount, ranging from sulfuric acid to synthetic ethanol, are probably well studied, and their toxic properties are well known. Most of them never come near us. Stumm and co-workers (1983) estimated that about 60,000 chemicals are in daily use and their number increases by about 1,000 to 1,500 per year. It could be worse, the number of new organic compounds increases annually by 30,000; apparently most do not come near us in daily use. Unfortunately, our detailed knowledge of chemicals and their toxicity is more limited than we would like think, owing to the cost of toxicological studies. Perhaps 3,000 of the 60,000 chemicals in daily use have been thoroughly tested.

That number includes the seven herbicides that seem to be available to control all of the aquatic plants that members of our Society are faced with managing.

While we are limited in our knowledge of toxicological properties, we are faced with a curious paradox noted by Bruce Ames of the Ames test: The challenges posed by eating our daily consumption of nature's pesticides, "i.e. defense agents produced by plants," is likely to be several grams per day—probably at least 10,000 times higher than the dietary intake of man-made pesticides" (Ames, 1983).

Those of us who use or support the use of herbicides, then, face four major problems.

First, the survey that I described would indicate that we face an audience that is dependent on science, but is not scientifically literate.

Imagine the task that we face in trying to discuss with the general public some issues concerned with herbicides. We may be having discussions of by-products with an audience that believes in lucky numbers, discussions of isomers with an audience that does not understand molecules, discussions of NOEL (no observable effect level) with an audience that does not realize that water is a chemical.

Second, they are not primarily print-oriented, if the data concerning television are to be believed. Some of our messages that are conveyed through Society publications and through CAST publications inevitably face limited, but important, audiences.

Third, we are part of a litigious society. Japan as a nation has as many lawyers as we have in the State of Massachusetts alone. Japan has produced far more engineers. The percentage of students majoring in engineering in Japan is 20%, in the United States it is 5% (Rohlen, 1986). There is clearly, to me, and I hope to you, an inversion of values. I would not support the recommendation made to Jack Cade in Shakespeare's *Henry VI, Part II, Act IV, Scene II*, "First thing we do, let's kill off all the lawyers." But I would suggest that our lawyer-engineer ratio versus Japan's is not without consequences concerning the impact of herbicides, how one does business, and even how one tries to teach.

Finally, because of our eating habits, we may be in more danger from nature's pesticides than from our own, considering the generally greater potency of naturally occurring pesticides vis-a-vis synthetic ones, and considering the relatively greater concentration of natural pesticides in our daily diets.

Joseph Conrad once noted, "We live as we die—alone." We are faced with daily individual decisions, individual responsibilities, and often without support. But in matters of herbicides and their application, I should like to hope that we do not live alone, rather that we live as an effective Society, dedicated to intelligent solutions to complex problems, dedicated to solving a real problem of considerable ignorance concerning chemicals. That is in major part why we are here today, and it is the strength of our Society.

In summary, we have a population that is concerned with herbicides and what they may do to non-target species, but it is a population that would appear to be scientifically illiterate on some key aspects, a population that distrusts researchers, but interestingly enough, this same population defers to leaders and experts who can be trusted. The Aquatic Plant Management Society has those leaders and those experts. Leadership and expertise in the proper and effective use of herbicides is a tradition of our Society, and it must be our future as well. If it continues to be, then all other problems we face can be overcome.

LITERATURE CITED

- Ames, B. N. 1983. Dietary carcinogens and anticarcinogens. *Science* 221:1256-1263.
- Anonymous. 1986. Death in the dose. *Aquatics* 8(2):9.
- Cicchelli, S. 1986. Chemical better term for drugs. Letter to editor, *Tampa Tribune*, September 15, p. 12-A.
- Krieger, J. H. 1986. Scientists seek to define, determine scientific literacy. *Chem. Engr. News*. 64(23):37-38.
- Rohlen, T. P. 1986. Japanese education. *Am. Scholar* 55(1):29-43.
- Stumm, W., R. Schwarzenbach, and L. Sigg. 1983. From environmental analytical chemistry to ecotoxicology—A plea for more concepts and less monitoring and testing. *Angew. Chem. Int. Ed. Engl.* 22:380-389.
- Zacks, R. 1987. News Update TV Guide 35(19):A-23.