Who speaks for science?

Public opinion is too often swayed by the wrong voices

by Dixy Lee Ray

Repeatedly over the past few years the American public has been subjected to a litany of catastrophes — to predictions of impending disaster that are claimed to be unique to modern civilization. The oceans are dying, the atmosphere is poisoned, the earth itself is losing its capacity to support life. The reported "hole" in the ozone layer is the most recent scare. Cancer, generally blamed on man-made chemicals, is rampant — so the doomsayers say. Warnings that in the past came from the pulpit and called for eternal punishment in the sulphurous fires of hell have been replaced by equally dire predictions that come from alarmist environmentalists who call for spending billions of dollars in order to avoid doom from the sulphurous effluents of industry. The anticipated catastrophes are our own fault, of course, blamed on the greedy and perfidious nature of modern man.

Well, it's all pretty heady stuff, but is it true? As with so many issues that involve technology, the answer is yes — and no — probably rather more "no" than "yes". What are our real environmental concerns? Cancer-causing chemicals? Radiation, including radon? Carbon dioxide, ozone, and the "greenhouse effect"?

Let's take a brief but hard look at each of these examples.

Recall that, with the exception of childhood leukemia (always tragic but relatively rare), cancer is a malady that afflicts predominately older adults and the aged. For most cancers — and there are many different kinds — the causes are complex, interactive, and may include genetic factors. If we are to look at the fatality records, the facts show that the total of carcinogenic substances targeted by the US Environmental Protection Agency (EPA), including chemicals in the workplace, in the environment, in food additives and industrial products, cause *fewer* than 8% of all cancer deaths in America. The best scientific evidence points to diet, viruses, sexual practices, alcohol, and, above all, tobacco as accounting for nearly all of the remaining 92%. Yet the public, by constantly reported innuendo against industrial chemicals and radiation, is encouraged to believe otherwise. Moreover, a proper look at cancer statistics shows that, aside from a sharp increase in lung cancer caused by cigarette smoking, there have been no significant increases in the rate at which people die from any of the common forms of cancer over the past 50 years. In fact, there have been significant decreases in some types of cancer, e.g., stomach cancer, during these decades of rapid industrialization and the introduction of new manmade chemicals.

Most of the public believes that cancer is caused by toxic substances created by industry. Why? Because they listen to the wrong spokesmen. And national television has elevated "sob-sister" journalism to a new dramatic high, with emotional, heartrending stories about cases of childhood leukemia and other individual or family tragedies as if they were epidemic. These stories capture public attention and play on natural sympathy — these reactions in turn affect the decisions and budgets of government scientific agencies. In an internal memo the EPA admits, with remarkable candour, "Our priorities, ... in regulating carcinogens appear ... to be more closely aligned with public opinion than with our estimated risks" — and with scientific evidence.

Our radioactive world

The simple fact is, we live in a radioactive world — always have, always will. Our bodies receive the impact of 15 000 radioactive particles every second; we don't feel them or suffer any ill effect from such bombardment. One of the difficult aspects of radiation phobia is that our ability to measure radiation has become so accurate and precise that it is now possible to detect unbelievably small amounts, e.g., one part per billion. How much or rather how little is that? How can we visualize one part per billion? One way is by analogy — one part per billion is equivalent to one drop of Vermouth in five railroad cars of gin! (A very dry martini?) Or — look at it another way — there are now about five billion people living on this planet. Therefore, one

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family of five persons represents one part per billion of the entire human population. And what about one part per trillion? That would be one thousand times less. When radioactivity from the Chernobyl accident in the USSR in April 1986 reached the West Coast of the United States, the popular press warned residents about the dangers of possible fallout, speaking of the number of picocuries of radioactivity detected in the high clouds, without ever explaining that one picocurie is one part per trillion and to receive from that "Chernobyl cloud" as much radioactivity as a patient would get in a diagnostic test for thyroid problems, a person would have to drink 63 000 gallons of the "radioactive" rainwater — a formidable task!

"... what the public perceives to be true, even if it is wrong, has enormous consequences ..."

Remember, everything is radioactive — our homes, buildings, everything we use. So is the forest primeval, our lakes, our streams, the ocean, and even our gardens. Because we have no human sense to detect radioactivity (no smell, sound, or sight reveals it), it has been like magnetism, gravity, or molecules; undetectable until instruments were built that can measure it with incredible precision. Now we know that even the ground we walk on is radioactive. In the words of Lord Marshall of the United Kingdom:

"In my own country, the United Kingdom, I would like to point out that the average Englishman's garden occupies 1/10 of an acre. By digging down one metre, we can extract 6 kilograms of thorium, 2 kilograms of uranium, and 7000 kilograms of potassium — all of them radioactive. In a sense all of that is radioactive waste, not man-made, but the residue left over when God created this planet."

It is radioactive decay that keeps the earth's core molten and provides warmth from inside that makes planet Earth habitable. It is the heat of radioactive decay that provides the driving force for movement of the earth's tectonic plates, and keeps the continents slowly moving and in turn contributes to both earthquakes and volcanic eruptions. Information about the essential and beneficial aspects of radioactivity, particularly in medical life-saving procedures, never reaches the public. Only the alarmists are heard. The negative effects of their warnings are serious, and, on the other hand, radon has become a national health problem because of our well-meant but stupid insistence on sealing up our homes and buildings to conserve energy, without consideration of possible ill effects. Fear of radioactivity rests squarely on ignorance.

The current scare is about carbon dioxide buildup, and the "greenhouse effect". It is true that the concentration of carbon dioxide in the atmosphere has been increasing. It is also true that the rate of carbon dioxide increase (and methane, hydrocarbons, sulphur oxides, nitrogen oxides, and a few other substances) is now approximately 1% per year. Since increases of carbon dioxide have also occurred in the geological past, without the help of human industry, it is unclear whether the burning of fossil fuel is the cause of the present increase, however much it may be adding to the current totals. Moreover, it is not known what the consequences, if any, of this increase may be or how long it may last. But this does not stop the doomsayers from hypothesizing radical climate transformations and other adverse effects in the future.

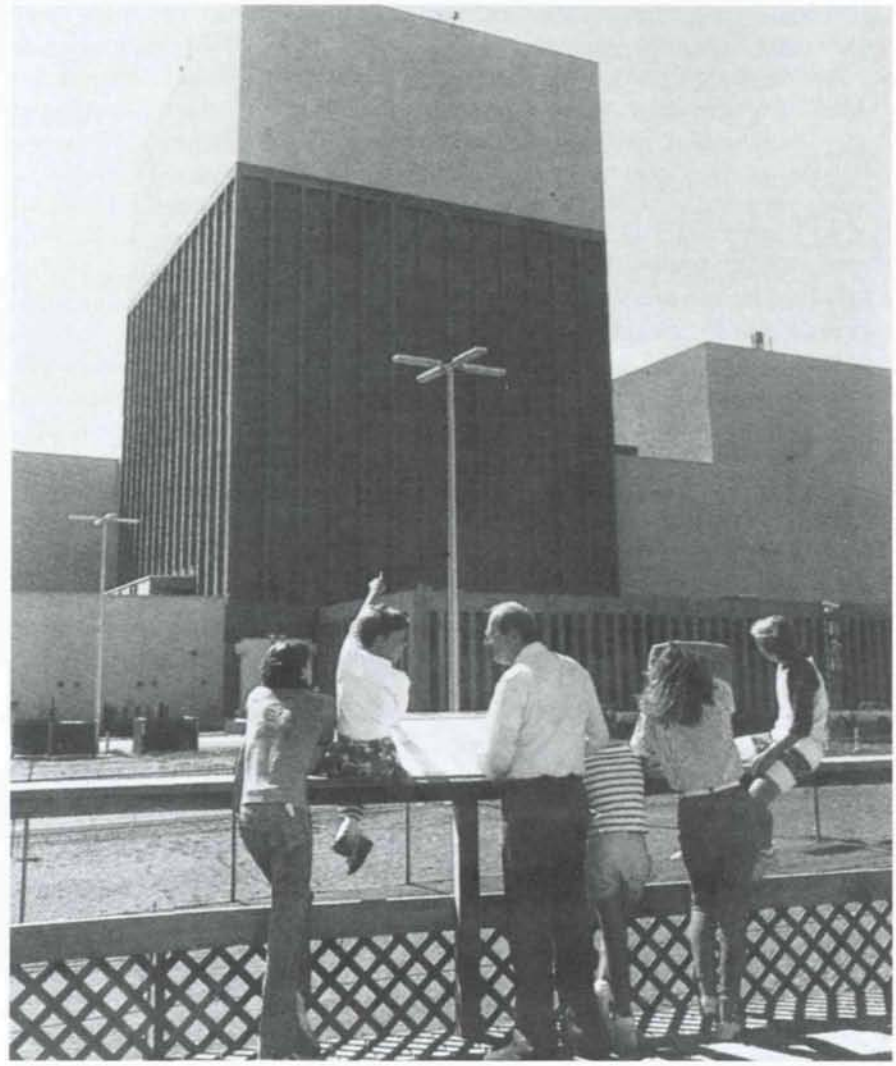
It is prudent to recall that the climatic history of our planet is one of often quite dramatic change. There have been ice ages, and warm periods lasting 800 years. There have even been shifts in the earth's polarity. And we know that drastic changes in climate can affect all living creatures, including humans. What we do not know is what caused severe climatic changes in the geological past, but we can be sure they were not due to human industrial activity. Most likely, the causes were and still are colossal cosmic forces, quite outside human ability to control them. Now that we live in an industrial, technological society, there is no reason to believe that such cosmic forces have ceased to exist. Why must we always blame modern man?

In these three areas of environmental concern (and in many others, including acid rain, the ozone layer, and pesticides), there is clearly a dichotomy between what is known and understood by the predominant body of scientific experts — and what the public believes because of the information it gets. But what the public perceives to be true, even if it is wrong, has enormous consequences since it is public opinion that determines how public funds are spent.

Education and the public

The answer to this vexing problem of what the public believes is always the same: educate the public. To which I respond with a simple question. How? It seems so reasonable to conclude that once people understand how good and safe and environmentally benign a technology is, they will accept, if not welcome, it. It seems reasonable to expect the public to be grateful for techniques that can mean responsible cures for environmental problems. But clearly it doesn't work that way because calm reason and alarmist environmentalism do not co-exist.

Also, how is the public going to know that the technology under consideration, like nuclear power, for example, is good and safe and environmentally benign? Will the public believe it on your say-so? Or on mine? — assuming of course that we have some way to com-



WPPSS nuclear plant visitors' centre in Washington state, USA. (Credit: WPPSS)

municate directly with the public. Is the plant manager a credible source of assurance to the public? Or do you think that:

- the generators of electricity are credible?
- the nuclear industry is credible?
- the chemical industry is credible?
- the representatives of government agencies are credible?
- research scientists and engineers are credible?

The course of public events, especially in nuclear science and now increasingly in the chemical industry as well, has, over the past 10–12 years, demonstrated that none of the groups just listed is trusted. The public is far more likely to believe the opponents of science and technology than to believe its supporters. If you are reluctant to accept that proposition, consider for a moment how you would fare on *Sixty Minutes* or *20/20* or *Crossfire* or any of the many US television and radio programmes where controversial issues, even highly complex technical ones, are treated in an adversarial debate-like format as if questions of scientific fact could be settled, not by evidence, but by argument. I have likened this way of informing the public in scientific matters to a hypothetical situation in which a television broadcast programme on criminal justice features a "balanced" panel made up of three judges and three criminals. That, of course, is being fair — presenting both sides. At least that is the way it works in science and technology. In such a format, the opposition always "wins" because whoever is against any technology has only to make a charge, however preposterous; he doesn't have to prove it. The burden falls on the supporter of science to prove that the charge is groundless. It is a difficult situation, and it is one that we tend to handle badly.

Teaching science

There was a time, in my long-ago youth, when experts were believed. It was a time when most people and most institutions were presumed to be well-meaning and honest until and unless proved to be otherwise. It was also a time of unprecedented increase in our

knowledge about the world, of belief in ourselves, and in our ability through understanding and logic to provide adequate solutions to technical problems. It was a time of optimism and progress. It was a time of improvement in the conditions of living that made our society and our nation the envy of the world. It was a time when the use of knowledge was expected, when the myriad applications of science through technology made living on this earth easier and better, and gave us more time to enjoy it by increasing our life span beyond three quarters of a century. The funny thing is, it's still that kind of time ... but it seems that hardly anyone enjoys it anymore. Too many have come to fear technology and to hate and reject anything nuclear or chemical-related. Despite all the evidence of our physical well-being beyond the dreams of all previous generations, we seem to have become a nation of easily frightened people, the healthiest hypochondriacs in the world!

What has brought this condition about? What has made us lament rather than rejoice, so quick to believe the worst about ourselves and so reluctant to recognize the good? Well, among other possible explanations, we have simply done a rotten job of teaching science. Oh, not to those students who will become scientists — we're quite good at that — but at the equally important job of teaching science to all those others, the overwhelming percentage of the student population who will not enter science or engineering as a profession; there we miserably fail.

And so, we must ask further, if not from the schools and colleges, where do most people get their information about science and about important applications of technology in modern society? The answer is easy: mainly from television, and, to a lesser extent, from the print media and radio. Who decides the content of this information? Not scientists, but reporters, news directors, and editors. It is said that Professor John Kemeny, chairman of the President's Enquiry into the Accident at Three Mile Island, commented after dealing with the press about his report:

"I left Washington fully expecting to read the following story someday in one of our morning newspapers. Three scientists named Galileo, Newton, and Einstein have concluded that the earth is round. However, the New York Times has learned authoritatively that Professor John Doe of Podunk College has conclusive evidence that the earth is flat."

Science and the media

If we want people properly educated in science, and therefore more competent to make rational decisions on technical matters that affect them, then we must learn more about the different worlds in which scientists and reporters live and work. We have to recognize that scientists, technologists, and engineers do not and cannot inform the public directly. The media informs the public. And in doing so, the media acts as an information filter. The bottom line is that science and the media must learn to work together for a common purpose, because there is simply no other mechanism that can provide the necessary scientific information to society for social decision-making. So far, unfortunately, this rapport between science and the media shows no signs of developing.

Consider the differences in the ways of working, of motivation, and of rewards for scientists and for reporters. First, the scientists. For them, the volume of work is far less important than its quality. Scientists work at their own pace. There is no intractable daily or weekly deadline. Scientists work within a well-recognized discipline which is only a small part of the scientific whole. A scientist's work is judged by his peers, and unless peer-approved, it won't be published. For a scientist, all funding and professional advancement is based on peer-reviewed work. For all of these reasons, therefore, scientists are very careful about making claims. Those who value their standing in their peer community will be cautious not to overstate, and feel compelled to provide context for what they say. This is often interpreted by the non-scientific community as uncertainty, doubt, hedging, or even as evidence of disagreement among scientists.

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In the media, however, a reporter's key to advancement is the volume of his work, maximizing minutes of air time or inches of print. Competition for time and space is fierce. For the reporter, deadlines are externally imposed, are short, and must be met. Narrow disciplines in journalism are non-existent; a reporter must cover them all. A reporter's work is judged not by his peers, but by an editor or news director and what attracts attention is of paramount importance. Good reporting is compact, without space for qualifications and context. On television, 60 seconds is the usual maximum for a story. Under such circumstances, reporters cannot read scientific papers. Most of their work is done on the telephone and they search out "experts" who will give them good one-liners.

Remember that the media are self-appointed defenders of the public faith, and most accept them in this role. Reporters inform the public because this is what the public expects. The fastest way for a reporter to succeed, to become established and recognized, is to raise the specter of imminent peril and then to take up the cudgels on behalf of society to deal with it.

There could hardly be two more disparate professions and it is no wonder that misunderstanding and misrepresentation arise. The good scientist strives to be precise by qualifying his statements and staying within the context of a scientific discipline. This is usually done in a deliberate manner. The good reporter strives for a fast response, for a compact statement that is reasonably accurate. Above all, a good reporter makes his statement in a manner designed to make the greatest impact on the audience. Therefore, information flowing from the scientific environment to the media environment inevitably suffers alteration and filtration and this affects public perceptions. In this regard, there appears to be three main problems:

- An understandable, though unfortunate, emphasis on conflict between technology and social interest makes good press, but often unnecessarily heightens anxiety. The public will accept bad news, but it has been conditioned to reject good news as whitewash.
- The persistence of false, exaggerated, or misleading information made believable by constant repetition. This leads to dissemination of what we call "factoids".* Phrases such as "PCBs cause cancer", "any level of radiation is harmful", and "acid rain is caused by sulphur dioxide from burning coal" are examples of factoids. There are dozens of factoids, that is, beliefs that have no evidence to support them. Some come about from the mistaken assumption that if two phenomena occur together or follow one another, they must represent cause-and-effect. Some come from an initial distorted opinion of a scientist desiring publicity for a cause or political position or from a zealous reporter trying to make a name for himself.
- Since good scientists limit their remarks within disciplinary boundaries, and good reporters extrapolate into a broad or common context, the result is often misinterpretation. "I was misquoted" says the scientist — and vows never to talk to a reporter again. Such a reaction is a mistake because it leaves the responsibility of communicating with the media to those scientists who avoid peer review for their work, have a mission or "cause", or are charlatans or quacks. Science has its quota of the latter just as does every profession.

It is up to good scientists to weed these phonies out, but we don't do it. While the respected scientific community judges very strictly those at the top of their profession, they simply ignore the incompetents and no-goods at the bottom.

Dr Ernest Sternglass, much quoted by the media on radiation matters, has never published his claims about the effect of low-level radiation in a peer-reviewed journal. In an article in *Esquire* magazine published in 1969, Dr Sternglass predicted that all children in the United States would die as a result of fallout from nuclear tests. Twenty years have passed and unfortunately for his credibility but fortunately for children, he was, and is, wrong. But his opinions, long since dismissed by knowledgeable scientists in his field, are still actively sought and quoted by the popular press. Until respected scientists, perhaps through their professional societies or through the US National Academy of Science, identify the purveyors of misrepresentation, we have only ourselves to blame for fear, misunderstanding, and the rejection of technology.

We should be very jealous of who speaks for science, particularly in our age of rapidly expanding technology. A misinformed or uninformed public can stop anything even when it is clearly in society's benefit. How can the public be educated? I do not know the specifics, but of this I am certain: The public will remain uninformed and uneducated in science until the media professionals decide otherwise, until they stop quoting charlatans and quacks, and until respected scientists speak up.

* For many of the thoughts presented here, and for the term "factoids", the author is indebted to the article, *The Different Worlds of Scientists and Reporters*, by G.I. Baskerville and K.L. Brown, published in the University of New Brunswick's *Forestry Focus* and reported in the Journal of Forestry.