2th International Conference on Public Communication of Science and Technology (PCST)
Madrid, Spain, 21-24 May 1991

"DIALOGUE: A STEP BEFORE SCIENCE LITERACY"

ROBERT A. LOGAN

SCIENCE JOURNALISM CENTER/UNIVERSITY OF MISSOURI

CONFERENCIA CPCT 21-24/5/91

Dialogue: A Step Before Science Literacy

Abstract: The last decade of the 20th century finds science and journalism at a crossroads with the American public. Both institutions are concerned about the decline of literacy and its impact on the ascribed credibility of science and journalism in the U.S. The erosion of popular support for both professions is accompanied by poor public knowledge about how scientific inquiry is conducted and how news is manufactured.

The well accepted strategy to enhance the credibility of science and improve the public's appreciation for science is to improve the public's science literacy. But differences between scientists and journalists have emerged in recent years, because reporters and editors refuse to participate with scientists in well-coordinated and orchestrated strategies to improve the public's science literacy.

This essay introduces the rift between scientists and journalists to enhance the public's knowledge about science and focuses on assumptions about improving science literacy. It is argued that improving science literacy provides a questionable premise to base the public understanding of science. It is proposed that scientific as well as journalistic credibility will be enhanced by a new dialogue between scientists and the public that helps the public adapt to scientific and technological change rather than current efforts to improve the public's knowledge about science, or boost science literacy. The introduction of initiatives to improve scientific literacy is seen as viable only after the public's voice regarding science, technology and change is returned to a more participatory status.

The author hopes that better remedies to improve the public's understanding of science, science literacy and journalistic credibility would be welcomed by scientists, journalists and the public, especially if current strategies are ill-grounded and not efficacious.

Robert A. Logan, Ph.D.
Associate Professor
Director, Science Journalism Center
University of Missouri-Columbia
P. O. Box 838
Columbia, MO. 65205 USA

Presented to: International Conference on Public Communication of Science and Technology, Madrid, Spain, May 21, 1991.

Introduction

The last decade of the 20th century finds science and journalism at a crossroads with the American public. Both institutions are concerned about the decline of literacy and its impact on the ascribed credibility of science and journalism in the U.S. There is serious public scrutiny of basic science research and routine journalistic inquiry, which is currently illustrated by equivocal public support for big science endeavors, such as the human genome project, and support for governmental efforts to limit journalistic access during the winter, 1991 Persian Gulf war. First Amendment freedoms for scientists and journalists to publish freely are seen as in unprecedented jeopardy by distinguished jurists (Forer, 1987). There also is serious public concern about the ethics and internal self-controls of both professions (e.g. the falsification of scientific data represented by the David Baltimore case and the recent incidents of falsifying news reports. The erosion of popular support for both professions is accompanied by poor public knowledge about how scientific inquiry is conducted and how news is manufactured (AAAS,1989a; Broder, 1987).

The well accepted strategy to enhance the credibility of science and improve the public's appreciation for science is to improve the public's science literacy. The American Association for the Advancement of Science (AAAS) began an unprecedented public education initiative in the late 1980s and has produced a series of reports to explain the scientific principles within math, biological, physical and health sciences (AAAS, 1989a; AAAS 1989b). To America's leading scientists, who took part in the AAAS project, the restoration of public respect for science was underpinned by improving the public's understanding of science. Public education and improved science literacy is unquestionably seen as *the* antidote to declining public support for science as a social institution.

But differences between scientists and journalists have emerged in recent years, because reporters and editors refuse to participate with scientists in well-coordinated and orchestrated strategies to improve the public's science literacy. This essay introduces the rift between scientists and journalists to enhance the public's knowledge about science and focuses on assumptions about improving science literacy. It is argued that improving science literacy

provides a questionable premise to base the public understanding of science. It is proposed that scientific as well as journalistic credibility will be enhanced by a new dialogue between scientists and the public that helps the public adapt to scientific and technological change rather than current efforts to improve the public's knowledge about science, or boost science literacy. The introduction of initiatives to improve scientific literacy is seen as viable only after the public's voice regarding science, technology and change is returned to a more participatory status.

The essay takes a cultural approach to media studies as defined by McQuail (1989, p.57-78) and recommended by Carey (1989). Cultural approaches to news media studies explore the hidden assumptions within professional axioms. Such influences are seen as vital to assessing the news media's role in society and its interactions with social institutions. In the spirit of constructive criticism, the author hopes that better remedies to improve the public's understanding of science, science literacy and journalistic credibility would be welcomed by scientists, journalists and the public, especially if current strategies are ill-grounded and not efficacious.

The Public Understanding of Science and Science Literacy

Hazen and Trefil (1991) find that the first priority in improving the public understanding of science is to improve the public's science literacy. Hazen and Trefil maintain that it is illogical to expect public confidence, interest, inquisitiveness, or support for science to improve until many citizens are better grounded in basic scientific principles. They define science literacy as understanding some facts, vocabulary, concepts, history and philosophy about atomic structure, chemical bonding, evolution, DNA, particle physics, the earth's cycles and ecosystems.

Similar assumptions about improving public literacy undergird John Miller's important surveys that provide evidence of the American public's poor understanding of science (Miller, 1989, 1987, 1983). Studies of high school and college students released by the National Science Foundation in spring, 1990 demonstrated a steady decline in student interest in science and projected a shortage of scientists and engineers in all relevant sub-disciplines within the next 20 years (Council of Scientific Society Presidents, 1991). The purpose of these surveys is to

gather information to help scientists target public information campaigns and assess demographic pockets of knowledge. The more public knowledge is categorized as deficient within demographic factors such as age, sex, educational background, and religious training, the more the impact of educational efforts is exhibited and remedies can be refined.

It is hoped that by better informing the public, some popular misunderstandings of many key scientific-public policy issues such as, food safety, nuclear energy safety; air and water safety; assessing man-made versus natural risk; will improve and public support for the scientific community will be enhanced significantly.

AAAS' longstanding commitment to press cooperation evidences that news media coverage is seen by many scientists as integral to improving the public's interest and knowledge about science. It is well accepted within most scientific organizations that the American public receives most of their information about science and medicine from newspapers, radio, television and magazine coverage (AAAS 1989a; Council of Scientific Society Presidents, 1991; Ciba Foundation, 1987). In spring, 1990 the U.S. Council of Scientific Society Presidents (CSSP) asked scientists in more than 50 disciplines to enhance press-science relations. CSSP cited the crisis in public misunderstanding of science and noted that improved press cooperation was critically needed to help inform the public about science.

While CSSP and AAAS probably speak for most American scientists, a faction believes that after 50 years of popularizing science, journalists have succeeded only in trivializing and misinforming the American public about science, technology and medicine (Burnham, 1987; Trachtman, 1981; Prewitt, 1982). John Burnham (1987) maintains that the public understanding and support for science was far superior a century before the news media decided to regularly cover science, technology and medicine. Burnham adds that public superstitions and support for pseudo-science have increased in the latter part of the 20th century as a direct result of sensational news coverage. Philip Handler, former President of the U.S. National Academy of Sciences speaks for some frustrated scientists, particularly in industry, when he writes that, "antiscience attitudes perniciously infiltrate the news media" (Wilkins and Patterson, 1991, p. ix).

Ironically, most science and medical journalists enthusiastically endorse broadly based efforts to interest the public in learning about science and medicine. For newspaper journalists, the decline in literacy and interest in what Innis (1951) called the "written tradition" are very serious professional issues that jeopardize the future of the commercial print media industry. The American Society of Newspaper Editors, the American Newspaper Publishers Association and foundations representing many news media firms routinely finance broadly based efforts in schools and civic groups to stimulate renewed interest in reading and encouraging literacy. Within the professional organizations in science and medical writing, there is widespread agreement that professional standards should be raised (Cohn 1989a, 1989b; Perlman, 1974; Russell, 1986). Organizations such as the National Association of Science Writers, Society of Environmental Reporters and the American Medical Writers Association, are committed to improving the accuracy, diversity, comprehensiveness and overall quality of science, medical and environmental reporting. Opinion leaders such as Cohn (1989a, 1989b), Russell (1986), and Franklin (1986), encourage their peers to better understand statistics, epidemiology, investigate claims, write with more clarity, and comprehensiveness.

But science writers also believe that it is professionally irresponsible to join with scientists and physicians to plan how to educate the public about science and argue that it is a serious interference with journalism ethics to directly participate in literacy efforts (Council of Scientific Society Presidents, 1991). Scientists are often surprised to discover that journalists will not cooperate with scientists and physicians and public officials to plan news reporting strategies to achieve literacy goals. This confuses scientists and physicians who wonder why journalists so clearly see inter-professional cooperation as interfering with their professional standards and identity?

Schudson (1978) explains that journalists will rarely participate in planned, public educational strategies because reporters and editors believe it is their professional obligation to decide what is news and set a daily news agenda without any direct influence from news sources. Gans (1979) notes that the tradition of professionalism in American journalism carefully separates news reporting from public relations at the specific level where news is planned

within news rooms. Although journalists routinely report on events that are brought to them by public relations organizations which represent scientific associations, industry, government or public interest groups, U.S. reporters believe their credibility and integrity are most compromised if they take part in strategies where the presentation and selection of news is initially planned with sources.

To frame the issue differently, a distinctive feature of the American news media is to avoid the type of developmental journalism that is routinely practiced throughout the rest of the world. In developmental journalism, it is the news media's responsibility to work with social institutions to plan public education campaigns. But Merrill (1974) notes that in the U.S., the freedom for journalists to decide what is and what is not news is probably the most sacred of all professional traditions. The refusal of journalists to join science literacy efforts, in other words, is inherent in the social libertarian tradition of American journalism and is not going to change, even if the intent of science and physicians is acknowledged to be high minded.

Obviously, a refusal to take part in direct public educational efforts to improve science literacy creates an impasse between scientists and journalists. The U.S. scientific community often find it hypocritical that journalists depend on scientists for news and then, will not participate in campaigns to improve public understanding. The refusal of journalists to work together with the scientific community also makes it extraordinarily difficult for scientists to remedy science literacy deficiencies in the U.S.

Yet, the purpose here is to examine the assumption that improving the public's science literacy is the appropriate strategy to boost public interest in science in the first place and to raise the issue that the scientific community's dismay about press cooperation may be pointless.

The underpinnings of science literacy and critique of classical liberalism

Almost a decade ago Yankelovich (1982) first discussed the importance of the *a priori* assumption among scientists that the accuracy, appeal and comprehensiveness of science information in the news media therapeutically influenced the information environment about science and the American public's support for investing tax monies in science. To Yankelovich (1982), the extent of the acceptance of this scenario was manifest by how it provided the

context for inter-professional dialogue about the public's understanding of science. Nine years later, science literacy problems are still seen as resolved by informing the public about the basics of science in an appealing fashion and removing superstitions and erroneous information through the press (where alleged falsehoods are advanced.) Although the news media are blamed by scientists and journalists for prior poor accuracy, sensationalism, trivializing science, misunderstanding of risks and poor interpretation of scientific data, the press also is seen as a key conduit to public enlightenment (Ciba Foundation, 1987; Council of Scientific Society Presidents, 1991). Science literacy is seen by most scientists and journalists as enhanced by removing the news media's "contaminating" influences, such as inaccurate, superficial reporting, and replacing them with more precise, interesting reporting that is illustrated by colorful charts, graphs and drawings (Ciba Foundation, 1987; Franklin, 1986; Hart, 1984). The presentation of highest quality of science news in the news media not only enhances science literacy. Science literacy itself is perceived to prompt increasing public respect, credibility and support for both science as well as the news media, who provide citizens with new knowledge (Ciba Foundation, 1987; Council of Scientific Society Presidents, 1991; Krieghbaum, 1967).

The author previously noted (Logan, 1991, 1985) that the assumptions science and journalists make regarding the therapeutic social impact of news reporting are rooted in liberalism, especially as it has been applied to ideas about social learning theory and press responsibility in the U.S. Briefly, the Jeffersonian notion of liberalism maintains that human beings are rational (instead of irrational or rationalizing) and have the innate capacity to make rational decisions (Brown, Brown and Rivers, 1978; Altschull, 1984; Logan, 1989). The capacity of human beings *to be rational* is dependent on the quality and diversity of information to which persons are exposed. The Jeffersonian notion of the press advances its vital influence on the course of human knowledge, reason and democratic decision making (Brown, Brown and Rivers, 1978; Altschull, 1984; Logan, 1989). By providing a high quality and diversity of information, Jefferson believed that the press cultivated social reason and prompted enlightened public policy in a democracy (Brown, Brown and Rivers, 1978; Altschull, 1984; Logan, 1989). Without a "responsible" press, or a news media that provides high quality, diverse

information, the capacity of society both to be literate and to reason was unhinged. In the 20th century, Jeffersonian ideas and the assumptions upon which they are based formed the basis of social responsibility theory of the press, which is the dominant paradigm of news media criticism in the U.S. (Brown, Brown and Rivers, 1978; Altschull, 1984; Logan, 1989).

Tobey (1971) and Haff (1976) explain how social responsibility theoretical assumptions undergirded the origin and traditions of science writing in the U.S. From its inception 70 years ago, Tobey (1971) found that the popularization of science was seen by science writers *as a public good* . Science writing was invented to popularize science to advance public knowledge, improve lay literacy, increase the respect of journalism and science as social institutions, and help the public reach more "rational" or scientific decisions about science and other public issues in American life. With the proviso that journalists - not scientists- should decide what is science news, the responsibility of reporters to help readers understand and thereby, create goodwill for science was rarely questioned (Krieghbaum, 1967; Greenberg, 1974, Haff, 1976; Tobey, 1971).

A striking example of the unequivocal acceptance of the correlation between accurate, interesting and comprehensive science writing and the advancement of public interest, knowledge and influencing attitudes has been its formalization into independent and dependent variables within science and biomedical public campaign research (Simpkins and Brenner, 1984; Pettegrew and Logan, 1987). In campaign effects research, the variables at issue are: (a) how news media content influences public interest about science or medicine; (b) if attitudes become more favorable toward science and medicine and the media source; and (c) whether new attitudes lead to actual behavioral changes such as ceasing smoking or taking better care of one's heart (Simpkins and Brenner, 1984; Pettegrew and Logan, 1987). The idea that repeated public exposure to accurate medical news prompts popular awareness, learning, interest and support for medicine (and therapeutically influences medical habits) is taken for granted.

It was William Stephenson (1973) who first questioned if Jeffersonian liberalism could be utilized as a foundation for research, or professional concepts, regarding the public

information, the capacity of society both to be literate and to reason was unhinged. In the 20th century, Jeffersonian ideas and the assumptions upon which they are based formed the basis of social responsibility theory of the press, which is the dominant paradigm of news media criticism in the U.S. (Brown, Brown and Rivers, 1978; Altschull, 1984; Logan, 1989).

Tobey (1971) and Haff (1976) explain how social responsibility theoretical assumptions undergirded the origin and traditions of science writing in the U.S. From its inception 70 years ago, Tobey (1971) found that the popularization of science was seen by science writers *as a public good* . Science writing was invented to popularize science to advance public knowledge, improve lay literacy, increase the respect of journalism and science as social institutions, and help the public reach more "rational" or scientific decisions about science and other public issues in American life. With the proviso that journalists - not scientists- should decide what is science news, the responsibility of reporters to help readers understand and thereby, create goodwill for science was rarely questioned (Krieghbaum, 1967; Greenberg, 1974, Haff, 1976; Tobey, 1971).

A striking example of the unequivocal acceptance of the correlation between accurate, interesting and comprehensive science writing and the advancement of public interest, knowledge and influencing attitudes has been its formalization into independent and dependent variables within science and biomedical public campaign research (Simpkins and Brenner, 1984; Pettegrew and Logan, 1987). In campaign effects research, the variables at issue are: (a) how news media content influences public interest about science or medicine; (b) if attitudes become more favorable toward science and medicine and the media source; and (c) whether new attitudes lead to actual behavioral changes such as ceasing smoking or taking better care of one's heart (Simpkins and Brenner, 1984; Pettegrew and Logan, 1987). The idea that repeated public exposure to accurate medical news prompts popular awareness, learning, interest and support for medicine (and therapeutically influences medical habits) is taken for granted.

It was William Stephenson (1973) who first questioned if Jeffersonian liberalism could be utilized as a foundation for research, or professional concepts, regarding the public

understanding of science. How can self-righting principle be advanced an exemplar for public communication strategies, Stephenson (1973) asked, when the concept has been discredited as an explanation for communication within science? Some of the most influential, contemporary philosophy of science literature advances that the theory of value free information, open debate and the authority of best evidence is an erroneous depiction of communication within science (Graham ,1981; Kuhn, 1970). Graham and Kuhn argue that the evidence and reason are rarely the proximate cause of change and ascribed credibility within scientific disciplines. In contrast, they counter that science occurs within the parameters of subdisciplines that are strongly influenced by the subjective values of researchers. The credibility of research is often less linked to the evidence a study presents than its capacity to reinforce established concepts. Graham (1981) adds that there are underlying highly subjective values that permeate all scientific disciplines and the progression of research in science is clearly influenced by extrascientific, or social considerations.

To make progress in the public communication of science, Yankelovich (1982) continued, both scientists and journalists first should recognize that in the public sphere as in science: (a) information quality is not necessary linked to increased knowledge, or attitude change; (b) reference or epistemic groups influence how persons perceive science and (c) interest, and commitment to learning about science is instigated by the common values which epistemic groups share. Yankelovich (1982) found that the public for science is not a mass, but tens of thousands of epistemic groups each with a varying form of knowledge, predispositions, attitudes, cultural, religious and regional values. Each epistemic group influences popular perceptions of science in the same way that knowledge, predispositions, attitudes, and values influence schools of thought and perceptions within scientific disciplines.

An instructive way to illustrate Yankelovich's conclusions (about the role of the mass media and epistemic groups in learning about science) is to briefly review the United Nations' efforts to introduce scientific innovations in developing nations. In the entire debate about the public understanding of science and science literacy, no author I am aware of has taken the experiences and critique of the United Nation's modernization campaigns as an exemplar to evaluate public

understanding issues. This is especially surprising since the largest ongoing experiment in introducing human beings to new applied science and technological ideas, practices and habits in has occurred globally through the U.N.'s development project since 1948.

The collective experience of the U.N.'s extension programs both abandoned original concepts of social learning that were based on liberalism and replaced them with a concept of science communication that is consistent with Graham, Kuhn and Yankelovich's perspectives. Rogers (1971, 1981) explains that the U.N. once invested heavily in modernization campaigns that utilized a few mass media sources to therapeutically influence public awareness, interest, knowledge, attitudes and adoption of innovations. The modernization campaigns were a pragmatic operationalization of social learning theory and assumed that a high quality of widely available mass media information that would be sufficient to convince persons to eat a more balanced diet, drink safer water and use a new hybrid seed. But, Rogers notes these assumptions proved universally unfounded and were rapidly abandoned because the campaigns (and their proponents -- government experts, media sources and scientific authorities) were perceived as either high handed, authoritarian or paternalistic by the public. Habte (1983) explains that modernization substituted values such as civic virtue, individual responsibility, family, respect for workmanship, sacrifice and loyalty to one's epistemic group, for rapid adoption to change, consumerism and the authority of medical and technological evidence over traditional culture. The transfer of innovations, which was at one time perceived as socially therapeutic and value free, was seen in most nations as laden with hidden values. Even under the most advantageous communication circumstances, Rogers noted, the transfer of new technological ideas via mass media met with more social resistance than acceptance. To put this less politely, the unilateral use of the news or mass media to influence popular science literacy and adoption of technological innovations was a global failure.

To improve public response, the U.N.'s developmental agencies first abandoned modernization assumptions and the theories upon which they were based. After two decades with little success, most U.N. development agencies substituted new approaches to mass communication that were based on a broader theory of media and the public. In essence, Rogers' diffusion theory and its

successive modifications since the early 1970s, conceive the public as divided into epistemic groups and recognize that the transfer of science and technology is always a transfer of values. To facilitate the communication of science and technology, mass media publicity is supplemented by a person-to-person efforts to introduce opinion leaders within epistemic groups to scientific or technological innovations. Person-to-person rapport is seen as vital to the project's success because it enables a transfer of authority, interest and commitment from experts to citizens. Once opinion leaders adopt new scientific ideas as their own, a degree of commitment that prompts more interest, knowledge seeking and behavioral change emerges. The use of the mass media also shifts from a vertical to a horizontal model - where the former top-down, experts to citizens model is supplemented by reverse approaches.

To Improve Science Literacy

Returning to the public communication of science in the U.S., the immediate problem is to recognize how the current emphasis on science information cultivation and circulation undermines both public interest in learning about science and public confidence in science and journalism.

By consistently advancing the idea that the public needs to be more literate (informed) about science, the scientific community is arguing that if persons understood science better, the superstitions, errors and misconceptions that are manifest in public opinion and lack of support for science might disappear. By urging the public to be more scientifically literate, that is, scientists advance that argumentation is qualitatively different when persons are informed about science. When persons are informed, argumentation is seen as based on more exact knowledge, is more elevated, rational, socially therapeutic and may reach the optimal solution. In contrast, when persons are uninformed, argumentation is seen as based on enthnocentric error, is irrational and rarely reaches an optimal solution.

The problem with these arguments is the more knowledge becomes a precondition to contribute to public arguments: (a) the more it shuts off public debate about science; (b) the more the public is inadvertently removed from participating from most public debates about science; (c) the more a hierarchy of vertical communication patterns (from experts to citizens) is

reinforced and (d) the more the debate about science excludes a discussion of public values in the U.S. .

Inadvertently, American scientists and journalists have created a vertical, top-down hierarchy without a recognition or discussion of the implicit values in scientific adoption, or the inherent resistance that is created by a one-way communication apparatus. In addition, the American public are scolded that they are scientific illiterate and indirectly told that they have less *standing* to participate in public discussions as a result.

It is precisely this type of communication arrangement that blocked the success of the diffusion of science in developing nations for many years and is the barrier to public understanding in the U.S.. To remedy problems in public interest and knowledge about science, American scientists and journalists might follow the U.N.'s example and establish a better public dialogue about science and biomedicine. A dialogue about science should invite people to participate, encourage persons to discuss science in a non-scientific fashion, and gives standing to the opinions of non-scientists. Similar to the U.N.'s efforts to contact opinion leaders within epistemic groups, scientists might discuss (not lecture about) science within churches, civic organizations, union halls, schools and small public forums throughout the U.S. Within the news media, journalists might write about science's impact on a person's religion, one's beliefs, one's lifestyle, the life of a neighborhood, a community and a culture. A journalists might cover how science and biomedical developments force most persons to adapt to change, or how technological and scientific progress brings individual and social stress. This type of coverage should supplement - not replace - routine (and still needed) coverage of important research findings and profiles of scientists. But a secular approach to science coverage makes the affected public the sources about science, and what is on the public's mind becomes news in lieu of what scientists and journalists think is important.

Such an unconventional approach to journalism (in a different news arena) recently has been advocated by David Broder, the senior political correspondent for the Washington Post. Broder (1987, 1991) partially blames voter apathy on the press corps overemphasis on the agendas of politicians, political experts and other journalists and underemphasis on understanding voters.

Broder claims that the agendas of voters are frequently different than politicians, political experts and journalists and the state of political culture and life in American communities and homes is what interests most citizens. By switching to cover voters, Broder explains, the news media encourages political parties to generate a two-way discussion between politicians and voters, which generates increased voter interest, participation in politics and higher credibility for politicians and journalists. A similar dialogue among the press, scientists and citizens is advocated by Stephenson (1973) as having a correspondingly therapeutic social impact.

Above all, as Stephenson (1973) noted almost two decades ago and John Dewey (1927) noted 84 years ago, both scientists and journalists need to recognize that public dialogue - not literacy - is the requisite to popular interest, commitment and understanding about science. As Lasch (1991b, p. 1) explains:

> What democracy requires is a public debate, not information. Of course, it needs information too, but the kind of information it needs can be generated only by vigorous public debate. We do not know what we need to know until we ask the right questions, and we can identify the right questions only by subjecting our own ideas about the world to the test of public controversy. Information, usually seen as the precondition of debate, is better understood as its by-product. When we get into arguments that focus and fully engage our attention, we become avid seekers of relevant information. Otherwise we take in information passively - if we take it in at all.

In biomedicine alone key public policy decisions are to be made in the near future about issues such as:

the equitable quality and delivery of medical care, particularly in rural areas and to the urban poor
the increasing cost of private medical insurance
the cost and desirability of more comprehensive national health insurance
the social and economic cost of better indigent care
high infant mortality rates
the social and economic cost of life support medical technology
when is a person dead?
when is a person born?
the increasing cost of malpractice insurance for physicians and other providers
the increasing incidence of malpractice suits against physicians and other providers
the deterioration in provider-patient relations
the eroding public respect for physicians and other providers
the eroding public confidence in physicians and other providers
diminishing morale among physicians about the future of their profession
interference with a physician's autonomy to make independent clinical judgments
the high cost of organ transplantation, AIDS treatment, emergency medicine, intensive care

conception and contraception technology
the wisdom of the cost of mapping the human genome
emphasis on public research support for cancer and heart disease research at the exclusion of other diseases
appropriate regulation and cost of drugs
differences in salaries among medical specialities and subspecialities
dearth of family practitioners
status of nurses in health care delivery system
declining interest in medical careers
impact of government and insurance regulations on quality applied patient care
use of computer diagnostic tools in applied patient care
patient right of privacy versus national data bank of medical records
epidemiological information versus a patient's right of privacy
the social and economic cost of geriatric care.

How can a consensus about any of these issues be reached unless there is a serious exchange of values about each issues among physicians, scientists, religious officials, and the general public? Does not each issue contain considerable extrascientific dimensions and does not the science about each issue also manifest subjective components? Will not scientist and physicians be more appreciated if they communicated (shared more vulnerabilities) about the extrascientific components of their work and ideas? How can a consensus about these issues be possible without a full discussion of the public's attitudes? Will not a dialogue about these issues prompt more interest in learning about biomedicine than press reports that relay expert panel conclusions? As long as science is perceived as high handed, paternalistic and the news media remain disinterested in what persons think about science and biomedicine, how can scientists and physicians expect more interest, knowledge seeking and support for science?

To improve the public's science literacy, the first step is for scientists and the public to share vulnerabilities (the tacit, subjective dimensions) about science and discuss science's impact on modern life. Scientists need to understand the extent that science has changed the very nature of how persons perceive nature, time, space, distance, travel, health human relations, family relations progress, and traditional culture. Scientists also need to acknowledge that the social anomie and alienation that Jacques Ellul (1964) predicted is occurring in the West. As Ellul (1964) thought, it is sophisticated non-scientists who find science unapproachable and wish to ameliorate the impact of science and technology upon modern life.

To spark the public's inquisitiveness about science, scientists need to reconvince persons that public opinion about science actually matters. To do so, scientists need to establish a dialogue with non-scientists and should understand that the current attention focus on science literacy will be a wasted effort unless a dialogue is established.

Moreover, since a focus by scientists on science literacy will be unrequited by the American press, perhaps a new approach, which is better grounded in mass communication theory and common sense, is now merited.

References

Altimore, M. (1982) The Social Construction of a Scientific Controversy: Comments on Press Coverage of the Recombinant DNA Debate. *Science Technology and Human Values*, 7:24-31.

Altschull, J. H.(1984). *Agents of Power: The Role of the Mass Media in Human Affairs.* New York: Longman.

American Association for the Advancement of Science. (1989a). *Science for All Americans: Project 2061.*Washington, DC: American Association for the Advancement of Science.

American Association for the Advancement of Science.(1989b). *Biological and Health Sciences: Project 2061 Panel Report.* Washington, DC: American Association for the Advancement of Science.

Blakeslee, S. (Ed.) (1986). *Human Heart Replacement: A New Challenge for Physicians and Reporters.* Los Angeles: Foundation for American Communications.

Broder, D. (1987). *Behind The Front Page.* New York: Touchstone.

Broder, D. (1991). *A New Assignment for the Press.* Riverside: University of California Riverside Press-Enterprise Lecture No. 26.

Brown, T. Brown, C. and Rivers. W. (1978). *The Media and The People.* New York: Holt, Rinehart and Winston.

Burnham, J. (1987). *How Superstition Won and Science Lost: Popularizing Science and Health in the United States.* New Brunswick, NJ: Rutgers University Press.

Carey, J. (1989). *Communication as Culture: Essays on Media and Society.* Boston: Unwin Hyman.

Ciba Foundation Conference (1987). *Communicating Science to the Public.* New York: John Wiley.

Cohn, V. (1989a) Reporters as Gatekeepers. In M. Moore (Ed.) *Health Risks and the Press.* Washington, DC: The Media Institute.

Cohn, V. (1989b). *News and Numbers.* Ames, IA: Iowa State University Press.

Cohn, V. (1963). Are We Really Telling the Public about Science? *Science*, 148:750-753.

Council of Scientific Society Presidents (1991). *Bridging the Communication Gap: A Wingspread Conference on Strengthening the Between Scientists and Journalists.* Washington; Council of Scientific Society Presidents

Dewey, J. (1927). *The Public and Its Problems.* New York: Henry Holt and Company.

Dewey, J. (1916). *Democracy and Education.* New York: MacMillan.

Dunwoody, S. (1980). The Science Writing Inner Club: A Communication Link between Science and the Lay Public. *Science, Technology and Human Values*, 5:14-22

Dunwoody, S. and Ryan, M. (1985). Scientific Barriers to the Popularization of Science in the Mass Media. *Journal of Communication*, 35:26-42.

Ellul, J. (1964). *The Technological Society*. New York: Vintage Books.

Efron, E. (1985). *The Apocalyptics: How Environmental Politics Controls What We Know about Cancer*. New York: Simon & Schuster.

Fahnestock, J. (1986). Accommodating Science: The Rhetorical Life of Scientific Facts. *Written Communication*, 3:275-296.

Forer, L. (1987). *A Chilling Effect*. New York: W.W. Norton.

Franklin, J. (1986). *Writing for Story*. New York: New American Library.

Friedman, S., Dunwoody, S., and Rogers, C. (Eds). (1986). *Scientists and Journalists: Reporting Science as News*. New York: The Free Press.

Gans, H. (1979). *Deciding What's News*. New York: Pantheon

Goodell, R. (1977). *The Visible Scientists*. Boston: Little Brown.

Greenberg, D. (1974). Let's Hear it for Science. *Columbia Journalism Review*, 13:19-24.

Graham, L. (1981). *Between Science and Values*. New York: Columbia University Press.

Haff, G. (1976). Science Writing in American Mass Media. *Nieman Reports*, 30:18-24.

Hart, R. (1984). Shamans and Criers: Responsibilities in Science Reporting. *The Quill*, 72:24-28.

Habte, Amde-Michael (1983). The Mass Media Role in the Third World. In L. J.Martin and A. Chaudhary (Eds). *Comparative Mass Media Systems*. New York: Longman.

Hazen. R. M. and Trefil, J. (1991). *Science Matters: Achieving Scientific Literacy*. New York: Doubleday.

Innis, H.A. (1951). *The Bias of Communication*. Oxford: Oxford University Press.

Kolata, G. (1990). Wariness is Replacing the Trust Between Physician and Patient: Both Sides Talk of a Communication Breakdown. *The New York Times*, Feb. 20: 1, 9.

Kotulak, R. (1989). Sorting Through the Chaff. In M. Moore (Ed.) *Health Risks and the Press*. Washington, DC: The Media Institute.

Krieghbaum H. (1967). *Science and the Mass Media*. New York: New York University Press.

Kuhn. T. (1970). *The Structure of Scientific Revolutions*. Second Edition, Chicago: University of Chicago Press.

Laetsch,W. (1987). A Basis for Better Public Understanding of Science. In Ciba Foundation Conference, *Communicating Science to the Public*. New York: John Wiley.

Lasch, C. (1990). Journalism, Publicity and the Lost Art of Argument .*Gannett Center Journal*. 4:1-11.

Logan, R. (1991). Popularization and Secularization: Media Coverage of Health. In. Wilkins, L. and Patterson, P. (Eds). *Risky Business: Communicating Issues of Science, Risk and Public Policy*. New York: Greenwood Press.

Logan, R. (1989). The Unworkable Compromise: The Knowledge Tablet, Ethics and Public Policy for the Future. *Mass Comm Review* , 16:14-26.

Logan, R. (1985). Rationales for Investigative and Explanatory Trends in Science Reporting. *Newspaper Research Journal,* 7:53-58.

McCombs, M. and Shaw, D. (1972). The Agenda-Setting Function of the Mass Media. *Public Opinion Quarterly,* 36:176-187.

McQuail, D. (1987). *Mass Communication Theory: An Introduction.* Second Edition, Beverly Hills: Sage.

Merrill, J. (1974). *The Imperative of Freedom: A Philosphy of Journalistic Autonomy.* New York: Hastings House.

Miller, J. (1989). Scientific Literacy. Unpublished manuscript. Northern Illinois University. Presented to the American Association for the Advancement of Science, 1989 Annual Convention, San Francisco, CA.

Miller, J. (1987). Scientific Literacy in the United States. In Ciba Foundation Conference, *Communicating Science to the Public.* New York: John Wiley.

Miller, J. (1983). Scientific Literacy: A Conceptual and Empirical Review. *Daedalus,* 112:29-48.

Miller, J. (1986). Reaching the Attentive and Interested Publics for Science. In S. Friedman, S. Dunwoody, and C. Rogers. (Eds.) *Scientists and Journalists: Reporting Science as News.* New York: The Free Press.

Nelkin, D. (Ed.) and Task Force on Communication of Scientific Risk. (1984). *Science in the Streets.* New York: Priority Press.

Nelkin, D. (1987). *Selling Science: How the Press Covers Science and Technology.* New York: W.H. Freeman.

O'Keefe, M. (1970). The Mass Media as Sources of Medical Information for Doctors. *Journalism Quarterly*, 47:95-100.

O'Leary, D. (1986). Physicians and Reporters: Conflict, Commonalities and Collaboration. In S. Friedman, S. Dunwoody, and C. Rogers. (Eds.) *Scientists and Journalists: Reporting Science as News.* New York: The Free Press.

Pettegrew, L. and Logan, R. (1987). Health Communications, Review of Research and Theory. In C.R.Berger and S. H. Chaffee (Eds.) *Handbook of Communication Science.* Beverly Hills: Sage.

Perlman, D. (1974). Science and the Mass Media. *Daedalus,* 103:207-222.

Pfund, N. and Hofstadter, L. (1981). Biomedical Innovation and the Press. *Journal of Communication* , 31:138-154.

Prewitt, K. (1983). Scientific Illiteracy and Democratic Theory. *Daedalus,* 112:49-64.

Prewitt, K. (1982). The Public and Science Policy, *Science Technology and Human Values,* 36:5-14.

Rogers, E.M., and Shoemaker, F. (1971). *Communication of Innovations: A Cross Cultural Approach.* New York: The Free Press.

Rogers, E.M., and Kincaid, D.L. (1981). *Communication Network Analysis: A New Paradigm for Research.* New York: The Free Press.

Russell, C. (1986). The View from the National Beat. In S. Friedman, S. Dunwoody, and C. Rogers. (Eds.) *Scientists and Journalists: Reporting Science as News.* New York: The Free Press.

Schudson, M. (1978). *Discovering The News: A Social History of American Newspapers.* New York: Basic Books.

SIPIscope (1988). Who's Writing the Science Sections? 16:16, 24

SIPIscope (1986). Newspaper Science Sections Spreading Nationwide. 14:1-17.

Shepard, G.R. (1979). Science News of Controversy: The Case of Marijuana. Journalism Monographs, No. 62.

Shepard, G.R. (1981). Selectivity of Sources: Reporting the Marijuana Controversy. Journal of Communication, 31:129-137.

Shilts, R. (1987). *And the Band Played On: Politics, People and the AIDS Epidemic.* New York: St. Martins.

Simpkins, J., and Brenner, D. (1984). Mass Media Communication and Health. In M. Voight., and B. Dervin (Eds.) *Progress in Communications Sciences (Vol. 5).* Norwood, NJ: Ablex .

Sontag, S. (1989). *AIDS and Its Metaphors.* New York: Farrar, Strauss and Giroux.

Starr, P. (1982). *The Social Transformation of American Medicine.* New York: Basic Books.

Stephenson, W. (1973). *Lake Ozark Symposium on Science News.* Columbia,MO: National Science Foundation.

Stephenson, W. (1967).*The Play Theory of Mass Communication.* Chicago: University of Chicago Press.

Stoler, P. (1986). *The War Against the Press: Politics, Pressure and Intimidation in the 80s.* New York: Dodd, Mead.

Trachtman, L. (1981). The Public Understanding of Science Effort: A Critique. Science, *Technology and Human Values*, 36:10-15.

Tobey, R. (1971). *The American Ideology of Natural Science.* Pittsburgh: University of Pittsburgh Press.

Wilkins, L. (1987). *Shared Vulnerability: The Mass Media and American Perception of the Bhopal Disaster.* Westport, CN: Greenwood Press.

Wilkins, L. and Patterson, P. (1991). *Risky Business: Communicating Issues of Science, Risk and Public Policy.* New York: Greenwood Press.

Yankelovich, D. (1982). Changing Public Attitudes to Science and the Quality of Life. *Science, Technology and Human Values*, 39: 23-29.