Disconnect: The Gulf Between Scientists and Journalists

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In 1993, I attended a conference for journalists at the Smithsonian Institution in Washington. The topic was Earth's climate, in particular the possibility that human activity, chiefly the burning of fossil fuels, was vastly increasing the amount of heat-trapping "greenhouse" gases in the atmosphere, threatening potentially disastrous alterations to weather patterns around the world. The conference had been organized by eminent experts on climate. They hoped that once the journalists knew the facts, they would realize climate change was an important story they would have to cover closely.

But when the scientists were making their concluding remarks, one of the journalists, Ben Bradlee of *The Washington Post,* interrupted with a question. Come on, he said, in effect, are we really supposed to believe that this – he mimed spraying himself with an underarm deodorant – is really going to change the weather?

"Idiot!" the scientists muttered under their collective breath. How could Bradley be so stupid? Didn't he realize that chlorofluorocarbons, the propellants in sprays like deodorants, are factors in atmospheric ozone depletion, not climate change? Hadn't he listened to anything they had said?

The scientists were disgusted. Their work had been for nothing, another pointless exchange with stupid journalists.

But Bradlee was not stupid. As the newspaper's executive editor, he had presided as The Washington Post transformed itself from a more or less provincial daily into a newspaper of national importance. Reporters he led had uncovered the Watergate scandal and forced the resignation of a president. He was ignorant, though. He had obviously not been paying close attention either to efforts to preserve the ozone layer that insulates Earth from harmful ultraviolet radiation, or to the debate over what the burning of fossil fuels was doing to Earth's climate. In this, he was far from alone. Many people were confusing ozone depletion with climate change. (Many people still are.)

In fact, it was the scientists who were making the fundamental and more important error. Rather than dismissing Bradlee as a dunce, they should have been wondering how someone is such an influential position in the nation's news media could make such a mistake. Rather than complaining that he had failed to grasp their message, they should have been thinking about how they had failed to convey it.

In the years since, climate scientists have been increasingly frustrated by their inability to get their story onto the front pages of the nation's newspapers and into its evening news broadcasts. They grit their teeth as journalists glibly ascribe an unusually hot day to global warming – something it is not yet mathematically possible to do – and ignore the larger underlying issues society must address in order to avoid planetary disruption. In particular, they groan over the short shrift given to the Kyoto protocol which, whatever its faults, remains the major international avenue for addressing climate issues. In their frustration, we can read the entire story of what happens when things go wrong between scientists and journalists.

There was a time when this disconnect between science and journalism was not so important. But now it has big implications for the nation's public life. More and more questions of public importance have major science components. Must we take aggressive action to avoid global warming? Your answer may depend on how much faith you put in computerized climate models. Should we press ahead with the Strategic Defense Initiative and its missile defense shield? The answer hangs on the physics of ballistic missile detection. Should stem cell research be financed by federal taxpayers? Should it even be legal in the United States? Decision-makers – whether in government or in the voting booth – will want to know what price society will pay for shutting off this avenue of research. Is mammography worthwhile? If so, for whom? What about

prostate cancer screening? For many scientists these are open questions; few members of the public realize it.

But as science intrudes more and more into the nation's policy debates, "the gap between science and public life has grown ever larger and more dangerous, to an extent that now poses a serious threat to our future," the pollster Daniel Yankelovich wrote recently. [1]

"In today's public domain, scientists are highly respected but not nearly as influential as they should be. In the arena of public policy, their voices are mostly marginalized. They do not have the influence due to them by virtue of the importance and relevance of their work and of the promises and dangers it poses for our communal life."

Something must be done to improve this situation. One place to start is the news media, in particular the journalists who communicate news of science, and news *with* science, to the lay public. But, overall, scientists and journalists do not get along. At times each group seems to be almost contemptuous of the other. This paper will describe the reasons for this problem, what is being done to make things better and what else will have to happen for the situation to change.

A SOUR RELATIONSHIP

I joined the Science Department of The New York Times in 1986 and have worked as a science journalist for most of the time since. I believe it is fair to say that my colleagues in the Science Department are the best – and certainly the most lavishly supported – science news team of any lay language news organization in the world. We have far more time, money and space for our stories than our colleagues do at other news outlets. Senior editors at the newspaper support our work and do not shy away from science or medical stories, as is often the case elsewhere.

Yet we struggle to stay on top of a flood of possible stories, to decide what we must cover and what we can pass up, and to differentiate the genuine discovery from the flash-in-the-pan, the potentially interesting feature from the unimportant scientific byway. We are chronically disappointed by our inability to do things as well as we would like. And we are playing at the top of the game. Science journalists elsewhere, talented and diligent though they may be, work under far more difficult conditions.

So when I look to ways to improve the situation, I look not to journalists but to scientists. When I talk to them, my message is always the same: science journalism in general is not as good as it should be, and scientists are the ones who can make it better. This is a sermon I have preached at scientific meetings, panel discussions and conferences large and small around the country.

In October 2003, I was a panelist at a meeting of the Pew Marine Fellows, eminent fisheries and ocean scientists whose work is supported by the Pew Charitable Trusts. Nancy Baron, a zoologist and science writer who works with Pew, organized the panel as part of her longstanding effort to help scientists better communicate their work and its importance to the wider world. As researchers have in the past, scientists at this meeting told Baron they had a simple solution to their problems with reporters. “I don't take their phone calls," was a common refrain.[2]

That attitude is not mysterious. Far too often, talking to reporters is a no-win proposition for scientists. They communicate their findings in learned treatises published in peer-reviewed journals, not in lay-language news reports. They gain little by talking to journalists; decisions on whether they will be tenured, promoted or awarded research grants do not normally hang on what appears in the public prints. Viewed from this perspective, time spent with journalists is time wasted

If they are in the newspaper or on television or radio too much - and their colleagues may set that bar rather low - they become known as publicity hounds or polemicists who have abandoned the purity of the laboratory for a life of celebrity. Some scientists call this “the Carl Sagan effect,” after the Cornell University astronomer whose series for public television, “Cosmos,” was highly successful. But the more it was praised, it seemed, the more other scientists criticized him for the time he spent away from the lab. Some questioned some of his research findings as well, but had he not been such a television star, many scientists say, he would certainly have been elected to the National Academy of Sciences, the nation’s most eminent scientific organization. [3] According to the 2002 survey of the National Science Foundation, which regularly surveys public attitudes toward science and scientists’ thoughts about the public, forty-two percent of scientists admit they avoid talking to reporters for fear of the “Carl Sagan effect.”

Further, when scientists cooperate with journalists and take the time to describe their work, all too often they find themselves quoted in a report that is shoddy,

inaccurate or overhyped. Pushy, unprincipled, ignorant and shallow - those were some of the milder epithets the scientists at the Pew meeting applied to me and my fellow practitioners.

So it is no surprise that, according to the N.S.F., only eleven percent of scientists have a good deal of confidence in the news media. Almost all of them – ninety-one percent – agree that few in the media understand science and technology. Seventy-six percent describe the media as sensationalistic and only four percent say they speak regularly with reporters. Speaking as a journalist, I have to concede there is some truth in the scientists' indictment. Yes, we occasionally get things wrong. Even at The Times, we struggle to keep up with mushrooming developments in fields becoming ever more specialized. In large part, though, errors result because science journalists need scientists' help to get it right. Often we don't get it. Often scientists are unable or, worse, unwilling, to tell the story in words a lay audience can understand. Sometimes they cannot even tell the story in words their colleagues can understand. As my colleague James Glanz put it in a 1997 article for the journal *Science*, "the flood of unexplained acronyms, cryptic symbols, endless sentences, and nightmarish graphs has risen so high, say some leaders in the field, that physicists can no longer understand each other." [4]And Jim has a doctorate in physics!

"I wade through an enormous stack of technical journals every week, and it's a common observation that in recent years it is increasingly difficult to understand what anyone is talking about," said Robert Lee Hotz, a science writer for the *Los Angeles Times*. "The purpose, clearly, of scientific communication is not to communicate research results; it is to satisfy a kind of caste system of language and vocabulary." [5]

As a result, as Baron told the Pew fellows, journalists regard scientists as elitist, unable to talk except in jargon, obsessed with trivial details, isolated in ivory towers, and unwilling to take a stand on matters of public importance. It is sad that this is so. Journalists and scientists have much in common. Both groups are curious, analytical, skeptical, competitive, highly motivated, resistant of authority and self-centered. Also, both groups delight in learning things and then telling other people about them. But scientists and journalists view the world through vastly different prisms, and seek different kinds of information from the processes of science. And each group is vastly ignorant about how the other does its work.

DIFFERENT WORLDS

Scientists and journalists live in different worlds. Science approaches questions rationally, in orderly fashion and in accord with widely accepted natural laws and methods. The public arena, where journalists live, is ruled by emotion, prejudice, *post hoc ergo propter hoc* reasoning and other forms of un-reason.. "Public life is shot through and through with irrationality, discontinuity, and disorder," Yankelovich said in his report. [6]

Scientists and journalists tell stories differently. In a typical research paper, scientists describe the question they hoped to answer, the methods they used to gather data about it, the data themselves, and the conclusions they draw from them. Reporters tell this story almost in reverse, starting with the conclusion.

Scientists are used to counterintuitive findings, statistical anomalies and so on. They reason probabilistically. They understand that a fair coin flipped five times is as likely to come up HHHHH as it is HHTHT, the sequence which repeated tests show the general public thinks is the most "random."[7] Like the general public, journalists tend to hold to what is intuitively obvious even in the face of abundant evidence that it is actually wrong. (Eyewitness testimony, known to be least reliable, is the most believed.)

Scientists deal in probabilities; journalists seek certainties. They are not comfortable with odds ratios and error bars. Scientists are not comfortable without them. Everyone who has been a reporter had heard an editor bark, "Don't waste my time with something that MIGHT be true, tell me what IS true!" The scientist is mystified by this instruction.

"Working within the bounds of the accepted "scientific method" – observe, hypothesize, test, replicate – only the most foolhardy experimenters would make the kind of sweeping claims for their results that headline writers live for." [8]

In fact, their language is often so low key that to the journalist it seems almost deliberately obscurantist. Even Watson and Crick, who discovered the double-helix form of DNA, said in the paper describing their work that their finding might be of some interest."

On the other hand, scientists are not happy with anything less what they call statistical significance, the determination that test results, say, have only one in twenty odds of being due to chance. Journalists hate to have to watch as this finding or that

moves with agonizing slowness from supporting a theory to proving it. And they are unwilling to get out ahead of the scientists. For example, the consensus of the scientists at the 1993 Smithsonian meeting was that they could only say with seventy percent confidence that human activities were altering earth's climate – in other words, they could not say it. They wanted the journalists to believe it (one of the scientists, Stephen Schneider of Stanford, asked us, "If I told you there was a seventy percent chance there was botulism in your lunch, would you eat your lunch?"), but they could not say it. And the journalists could not report it without their say-so. This is another example of the way, as Yankelovich put it, the scientist's frame of reference "does not communicate well to the public." In fact, scientists' insistence on deliberate, steady progress toward statistical significance can render their work moot, in that by the time they are comfortable making pronouncements they may be bringing up the rear. Though the National Academy reported to the White House as early as1978 that global warming was a threat, it was another twenty years until it was confident enough to say it was happening.

Scientists explore things because they are interesting even if they have no immediate practical importance. Journalists need a news peg. They must answer the reader's question: "Why are you telling me this now?" When journalists must convince skeptical editors that a story is worth doing, the pressure can cause them to drift into hype. (Increasing commercialization pushes science toward the news peg – toward research with obvious commercial implications, but increasing commercialization of scientific research brings its own problems.)

Journalists and scientists operate in different time frames. Scientists think in "geological time" -- they are comfortable with the idea that they may spend their professional lives answering one or two questions. This is particularly the case with environmental scientists, who measure things that change slowly, and it is a particular problem for the journalists who cover them. "You'll never wake up to a headline "Global Warming Struck Yesterday," my Times colleague, the environment writer Andrew C. Revkin, told a conference on science communication convened by the Metcalf Institute in November 2003: "Journalism doesn't notice things that happen over a hundred years." [9]

Scientists subject their work to a process called peer review, in which a research report, say, is sent out to other experts for their comments and suggestions. Only after

these have been dealt with is a paper considered ready for publication. This system is highly fallible, but scientists put a certain amount of faith in it, and they do not understand why journalists do not adopt a similar approach. That is, they do not understand why journalists will not send them drafts of articles for their review before they are published.

Journalists may explain that it would be unwise, to say the least, to allow news sources to review or approve copy about them. Scientists reply that they are not ordinary news sources, they are seekers of truth, far too high minded to interfere with copy to advance their own ends. When journalists greet this claim with skepticism, scientists are offended. Many scientists believe journalists who specialize in science ought to advocate for science, and that critical news reports are an abdication of journalistic responsibility. (They may also say that the main purpose of science journalism is to educate the public about science. Some journalists sign on to this idea, but I do not. I believe the purpose of science journalism, like all journalism, is to give the news. If readers or viewers are educated in the process, fine, but that is not our mission.)

THE PROBLEM OF OBJECTIVITY

Perhaps the biggest hurdle journalists and scientists must overcome is the problem of objectivity. Reporters at conventional news outlets strive for objectivity – fair, balanced, accurate reports. In the service of objectivity, they look for "the other side of the story" and accommodate it in their work. For scientists confident in their own conclusions, the inclusion of alternate views looks like drumming up controversy for its own sake, rather than striving for fairness. "Objectivity is a personal gripe of mine," Dr. Anthony Socci, a project officer for the Environmental Protection Agency and one of the organizers of the Metcalf conference, told the group. "There's probably a reason to have balance, but as a scientist it's an alien concept."

For conventional journalists, the necessity of telling all sides is intuitively obvious. But in science writing it carries unusual risks. First, reporters who are unsure of their own ground, and often they are, may rely overmuch on official sources, like government agencies or even advocacy groups like the American Cancer Society, on the theory that their pronouncements have more weight and are therefore, somehow, more objective. But these groups may also have their own agendas and objectives. They may

have axes to grind. Also, reporters eager to avoid tendentiousness or editorializing — to give both sides voice — can wind up with he said/she said stories that simply shift the burden of analysis or interpretation to readers who are even less equipped for the job than the reporters are. Most important, though, reporters seeking objectivity may end up painting a picture of uncertainty or debate where none – or very little – exists. Often, what we describe as scientific debate is hardly debate at all; it is a contest between the collective weight of scientific opinion and a small group of dissenters. In this way, scientists complain, fringe opinions can achieve parity with mainstream opinions on newspaper pages or in television broadcasts. All too often, Yankelovich reported, experts "find themselves pitted in the media against some contrarian, crank or shill who is on hand to provide 'proper balance.'"

In cases like this, journalists' attempts to produce fair and balanced coverage can actually sow confusion on issues on which science is really more or less settled. I made this point in a commentary in *The New York Times* in November 2003, in a special issue marking the twenty-fifth anniversary of *Science Times*, its weekly section on science, medicine and health.[10] The piece drew a number of emails from scientists. "There really is no serious science debate today in areas such as the reality of global warming, the basic mechanisms of biological evolution, the age of the earth, the expansion of the universe, the supposed harmful effects of cell phones and other sources of microwave radiation, the claims for health benefits for magnets, or the proposition that alien interstellar microbes are raining down on the Earth," one of them wrote me after the commentary appeared. "Yet in every case it is possible to find someone who will be glad to espouse the losing side in return for being quoted in the press."[11] And, of course, someone glad to do the quoting. Another wrote in an email that when a respected news organization report pits members of NASA Mars Global Surveyor team against people who claim an artificial face has been constructed on the planet "one begins to lose all hope." "Quackulent quotations," a physicist called the phenomenon, in still another email.

The problem is, unless the journalist is an expert, and the journalist cannot possibly be an expert on everything she is called upon to cover, she has no way of knowing for sure whether a given scientific dispute has more than one side, or whose views must be heeded and who can safely be ignored. Anyway, the mainstream has been wrong often enough that journalists are right to be wary of assuming that

anything is true simply because a majority of scientists believe it. When something is known to science, it is not a matter of consensus it is a fact, like gravity or the orbit of Earth around the Sun. It is not necessary to talk of "consensus" on matters of accepted fact. But when we are writing about consensus, we cover ourselves by reporting "all sides."

In the case of climate, for example, mainstream scientists say we give too much coverage to scientists who doubt that human activity is contributing to potentially disastrous changes in the climate, or who argue that nothing is changing, or if it is that the changes will be beneficial, or that if they aren't, technological genius will engineer a fix. By now, dissidents are widely regarded as outliers whose opinions are notable more for the cover they give politicians than their scientific rigor. But there are plenty of responsible people who still argue their case. And as journalists we feel obliged to report their arguments, especially since one of them is the president of the United States.

Finally, scientists are not particularly good at announcing that this or that question has been settled. Probably because of the growing difficulties of obtaining and maintaining research grants, they emphasize what remains to be learned at the expense of what is known. So when President Bush proposed a large research agenda to find out whether global warming was likely to be a problem, scientists did not rush to the microphones to point out that the question had already been answered in the affirmative. They made plans to get some of the new research money.

WHAT HAS TO HAPPEN WITH JOURNALISM

The National Science Foundation periodically surveys attitudes toward science, and scientific knowledge. As everyone knows by now, the results of the latter test are never very encouraging. In her journalism training for scientists, Nancy Baron quotes Jay Leno: "According to the National Science Foundation, seventy percent of Americans do not understand science. Here's the sad part: thrity percent do not understand what seventy percent means." The real results are not much better. Scientists were cheered, for example, when the 2002 survey showed that a majority of Americans (though only a bare majority) believed in the theory of evolution. [12]

It would be nice if the teaching of science suddenly became so good that everyone who graduated from high school would have a basic working knowledge of

the scientific methods, statistics and probability, the working of the genes, and so on But it would be a mistake to count on this kind of change. Instead, we must look for improvement from journalists and scientists. When I worked at the *Providence Journal*, where I began my career, I had an editor who began any discussion about any proposed project by writing this message on the meeting room blackboard: "There is not enough time, there is not money, and there is not enough space in the newspaper." Then we would discuss how we would do what needed to be done, with the resources we had. But at that time the Providence Journal was relatively generously supplied with resources. Today, lack of resources is a major problem in science journalism, and it seems to be getting worse. The managers of media companies demand higher profit margins than businesses anywhere else are required to produce. Profits of fifteen to twenty percent of revenue are quite common. Some news organizations are required to produce profits of thirty or even forty percent, levels unheard of in the rest of American industry.

As a result, according to Tom Rosenstiel, director of the Project for Excellence in Journalism, working conditions for television journalists are bad and getting worse. [13] In 1988, he said, the average television reporter's workload was 1.3 stories per day. Today, he said, it was 1.8 stories per day. And stories are getting shorter. At one station in Phoenix, Rosenstiel said, the average story lasted just eleven seconds. According to Jeff Burnside, a reporter at the NBC affiliate in Miami and the originator of its prize-winning Eco-Watch series of environmental reports, after promos, commercials, weather reports and sports, the average half hour newscast contains only about eighteen minutes for everything else.[14] Even a good science story must fight hard for a place in that space. "Live, local and late-breaking is almost an addiction," Rosenstiel said. He said that when he and his colleagues do newsroom training for television journalists, and they ask them to create the rundown of a model newscast, "invariably the majority of people will pick the story with yellow police tape and will do it with a live lead-in" even if the event itself is hours old and there is no need for live coverage. "A lot of it has to do with branding," he said, "live, late-breaking. It's a safe way of doing it. It becomes a kind of refuge rather than something they know people want."

This resource starvation also exists at newspapers. Though there was a boom in newspaper science reporting in the 1980's, with freestanding science sections blossoming at papers from the *Boston Globe* to the *Los Angeles Times*, by now many of

them have died or been drastically pruned. When I worked at the *Providence Journal*, it had a medical writer, an environment writer and a science writer. Today the slot for the science writer is gone and the only full-time environment reporter is an intern whose salary is paid by the Metcalf Institute. Evidence is beginning to emerge that news organizations that devote relatively more resources to the quality of their reports do better in ways that impact positively on the bottom line. For example, when Rosenstiel, director of the Project for Excellence in Journalism, and his colleagues surveyed television news operations, they found that stations providing high quality local coverage – measured as thorough, significant, accurate, balanced, and authoritative – had better ratings, larger market share, and better demographics than stations that did not. "Quality sells and sells better than other strategies to a significant degree," he said. Does it have to bleed to lede? No.

Some newspapers are betting they can make money by spending money, by building reputations as reliable sources of thorough news reports in a world increasingly flooded with Internet garbage. That has been the philosophy at *The New York Times* for more than one hundred years. David Shribman, executive editor of the *Pittsburgh Post-Gazette,* says his newspaper also takes that approach. Americans' attention spans "is short and getting shorter," he said.[15] "The appetite for serious news is smaller than ever. *The Wall Street Journal* and *The New York Times* have an audience for serious news, but if you are in a setting where people don't actually know people on the ways and means committee the situation is different. Do we make a wager on the strong and put out a serious newspaper or do we cheapen ourselves and tell you everything you want to know about J-Lo's latest botched engagement?" He is betting that the newspaper will make money by spending money to gather news. Still, his paper covers science and medical news with a science editor and a handful of science and health writers. As Shribman put it, "information may want to be free but we have to pay the people who produce it.'

But even if they have adequate resources, as we generally do at *The New York Times*, journalists face other serious problems in covering science. For one thing, it is harder and harder to find sources we can rely on to deal fair and square with the facts and with reporters. Since the end of the cold war, the science infrastructure of the government – in agencies as diverse as the FBI, CIA and the EPA has shrunk. The presidential science advisor, who used to occupy offices in the Old Executive Office

Building next to the White House, is now in rented quarters on 18th Street – the political equivalent of Siberia. Moreover, in recent years government scientists have been arm-twisted into redacting their findings to fit the ideological framework of the administration. For example, researchers financed by the National Institutes of Health were instructed to avoid using words like "gay" or "homosexual" in their research proposals or reports, obviously a handicap for anyone attempting to research subjects like AIDS.[16] Whole sections of Environmental Protection Agency reports have been removed before they were made available to the public.

Meanwhile, the federal government's share of the nation's research spending has fallen. In 1960, according to Daniel Greenberg, originator of the newsletter Science and Government Report, the federal government's share of research spending was twice that of the private sector. Today the ratio is reversed and then some. Today, private sources – drug companies, high tech firms and the like – finance the majority of research efforts in the United States

> There is nothing inherently wrong with private spending on research, unless research grants to scientists come with strings attached, as is increasingly the case. More than that, once financial motives enter the equation, journalists must abandon any belief that the researchers they interview are free of conflict of interest. Or, as the authors of a paper in the *New England Journal of Medicine* put it in an article on the use of certain drugs in the treatment of cardiovascular disorders, there is "a strong association between authors' published positions on the safety of calcium-channel antagonists and their financial relationships with pharmaceutical manufacturers.[17]
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> The influence of money on science is now so profound that medical journals, the Food and Drug Administration, and other authorities no longer even attempt to ban conflict of interest. They just insist on disclosure, a requirement that is often honored in the breach. "Conflict of interest arising from [financial] ties is widespread," the *Journal of the American Medical Association* reported this year.[18] As a result, according to historian Christopher Lasch, much of the news media "has become a conduit for the equivalent of junk mail. Like the post office… it now delivers an abundance of useless, indigestible information that nobody wants."[19]

Without reliable, disinterested scientists to guide us, science journalists are at a loss. In this era of scientific specialization, even scientists cannot keep up with all the developments in their own disciplines. For journalists, the task is overwhelming and

impossible. Even if we do not display the ignorance Bradlee did at the Smithsonian conference, we will always approach our stories in some degree of ignorance. We can help ourselves by reading, by studying statistics or by spending time in the lab of one researcher or another, but no one can know enough science or medicine to cover the entire field without abundant help from the scientists involved.

WHAT HAS TO HAPPEN WITH SCIENCE

In her media training, Nancy Baron offers videotaped examples of the kinds of interactions scientists have had with reporters. Some of them describe their work in terms even the audience of scientists finds laughably obtuse. One described the good job he did interesting a reporter in his work, and the poor job he did explaining it. The result was a front-page story, above the fold, "with exactly the wrong message." Another described how, in a ten minute phone interview, he had transformed a reporter "from being really interested to mind-jarringly bored." In an ideal world, scientists would learn in graduate school how to tell ordinary people about their world. That will take time. Meanwhile, though, "it would be helpful for all concerned … if someone stopped training [scientists] *not* to communicate," says Hotz of the *Los Angeles Times*.[20] When they do talk, they often speak in scientific metaphors that confuse rather than enlighten, especially when they use ordinary words in ways that have nothing to do with their ordinary meaning. "String theory" has nothing to do with strings, in their ordinary sense; "charm," as a quality of quarks, has nothing to do with charm as we know it, and so on. Also science calls things "theories" that have long since passed into the realm of known scientific fact. Evolution may be a theory but it is a fact as well.

But metaphors and other figures of speech should not be abandoned. When they are used well, they are invaluable in explaining complicated subjects to a general audience. "I really do not want half-baked metaphors," says Alan Alda, who interviews scientists regularly on the public television program Scientific American Frontiers. "I want metaphors that help me understand the real thing. And if possible I would like them to get me to understand it the way they understand it in the language of science – math and science. "Like others who attempt to explain science to the lay public, though, Alda finds that explanations often come surrounded by useless detail. Scientists who are good at explaining "are able to let you know they are leaving something out and for now you can leave it out but if you probe deeper you will need

to know," he said.. All too often, though, they refused to do that, saying that they will be oversimplifying. But, as Alda put it, "Clarity is not the same thing as dumbing down." Alda, who commissioned and starred in a play about the physicist Richard Feynman, noted that Feynman used to say "if you can't explain it to a child you don't really understand it." But most scientists have to be trained to speak like that. "You have to be trained and any natural talent has to be sought out and if you don't have talent you have to learn the journeyman techniques," Alda said. "But I believe it can be systematically taught. The Stanislavsky method taught even untalented people to perform adequately."[21]

Scientists do not devote much energy to this kind of thing; indeed, many of them think it is something to avoid. Scientists believe their job is at the laboratory bench, not in the policy arena. They actively disdain their colleagues who put their training to work in the policy arena, as regulators, for example. For them, as one put it to me long ago, "regulation is the revenge of the C student." Even advising policy makers is something many scientists will not do. Once researchers start doing that, according to Jerry D. Mahlman, a researcher at the National Center for Atmospheric Research told the Metcalf conference, they are on "a bad downward spiral." Plus, researchers concerned about departmental budgets or grant money, which increasingly comes from private sources, fear speaking out on controversial topics. Young researchers, still working for tenure and promotion, may fear speaking out, particularly on controversial issues or in ways that challenge accepted thinking. Here is one recent example: Last winter, when I was at the Graduate School of Oceanography at the University of Rhode Island for a Metcalf board meeting, I heard about a young researcher who had attended a public meeting on one of the hottest issues in the state: whether a container port should be built at the site of a former Navy base at Quonset Point. There was a lot of debate about what the environmental effects of such an installation would be, and the young researcher had come to this meeting to contribute what he could to the debate.

The next day, after an account of the meeting had appeared in the local daily newspaper, a university official took the young researcher aside and said "Don't do that anymore, it's bad for the school." In other words, far from being encouraged, he was practically forbidden to take part in the public life of the community. [22] Science as an institution must figure out a way to solve this problem. Far from penalizing young

scientists who speak out on matters of public importance, the scientific establishment must reward them for it. Decisions on tenure or promotion must take this kind of activity into account – as a plus. Scientists must accept that they have an affirmative obligation to speak out. They must construct protections for those who do and they must stop sneering at them. (Electing Carl Sagan posthumously to the National Academy would help.) When asked for policy advice, they must give it, rather than once again mouthing their chronic response to any policy question, that more money is needed for more research. "Scientists must become agents of change," is how Baron puts it.

I made these points in my commentary on the 25th anniversary issue of *Science Times*. "It is disheartening to read that many scientists refuse to talk to the press," a researcher wrote me by email after it appeared. "If the good scientists retreat into their labs and lock the door, the vacuum will be filled by others perhaps less competent."

WHAT IS BEING DONE

A number of programs exist to train journalists in how scientists work and in particular fields of science. The Metcalf Institute, on whose board I sit, is one. Similar programs have long existed at the Marine Biological Laboratory at Woods Hole, Massachusetts, and elsewhere. The Knight Foundation sponsors year-long programs, notably at the Massachusetts Institute of Technology, to help journalists learn science. Also, journalism schools increasingly offer graduate programs in science journalism. One, at the University of California at Santa Cruz, recruits most of its students from science graduate programs. But as Boyce Rensberger, director of the Knight program at MIT put it at the Metcalf conference, "I don't see much coming from the scientists." And they are the ones who must be engaged. After all, Yankelovich wrote in his essay, they are the ones who know the importance of the scientific issues in the public arena. They know the harms and benefits science-based decisions can bring about. And they are the ones with the substantive knowledge about science itself.

Yankelovich, noting that scientists who are going to do ground-breaking work usually accomplish it by the time they are forty or so, suggests forming a cadre of older researchers and engage them in communicating information about their fields to the public. I don't like that idea. I think turning the responsibilities of citizenship over to a

subset of researchers, even eminent researchers, is a mistake. Among other things, it is too much like the kind of thing going on now, when a relatively few researchers, willing to speak and reasonably articulate, are quoted again and again. Besides, citizenship is an obligation we all share. Instead, we need is a change in the culture of science as an institution. Scientists must recognize that they have an affirmative obligation as citizens to speak out on the issues of the day in which science plays a part, whether the issue relates directly to their research or not.

In a speech in 1963 at Vanderbilt University, President Kennedy spoke of the responsibilities of citizenship[23] "They do not rest with equal weight upon the shoulders of us all," he told the Vanderbilt students. "You have responsibilities, in short, to use your talents for the benefit of the society which helped develop those talents." Among those responsibilities, he said, was an obligation "to serve the public," to be a participant, not just a spectator, in the public affairs. He was talking about government service rather than academic life, but what he said then is true of scientists today. "You will find the pressures greater than the pay," he said. "You may endure more pubic attacks than support. But you will have the unequaled satisfaction of knowing that your character and talent are contributing to the direction and success of this free society."

NOTES

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[1] Yankelovich, Daniel; "Winning Greater Influence for Science;" *Issues in Science and Technology*; (Summer, 2003).
[2] Annual meeting, Pew Fellows Program in Marine Conservation, Oct. 14-19, 2003, Blaine, WA.
[3] Hartz, Jim and Chappell, Rick; *Worlds Apart: How the Distance Between Science and Journalism Threatens America's Future*; First Amendment Center – Freedom Forum; (Nashville, TN; 1997), p. 41.
[4] Glanz, James; *Science*, vol. 277, No. 5328, (Aug. 15, 1997), p. 895.
[5] Hartz and Chappell; *op. cit.*; p. 40.
[6] Yankelovich, *op. cit*.
[7] Presentation by Josh Tenenbaum, associate professor of brain and cognitive science, Massachusetts Institute of Technology, Knight Foundation conference, Dec. 1, 2003. He also noted that if asked to pick a random number between 1 and 100 a plurality of people choose 37.
[8] Hartz and Chappell; *op.cit*.

[9] Science Communications/Media Workshop, Nov. 9-11, 2003, Metcalf Institute for Marine and Environmental Reporting, W. Alton Jones Campus, University of Rhode Island, Nov. 10, 2003. I am on the institute's board.
[10] Dean, Cornelia; "Rousing Science Out of the Lab and Into the Limelight;" *The New York Times*; (Nov. 11, 2003); p. F10.
[11] Morrison, David, NASA AMES Research Center, personal communication, Nov. 12, 2003)
[12] Hartz and Chappell, *op. cit*.
[13] Presentation at Shorenstein Center on the Press, Politics and Public Policy, Kennedy School of Government, Harvard University, Oct. 21, 2003.
[14] Interviewed at Pew conference.
[15] Presention, Shorenstein Center on the Press, Politics and Public Policy, Kennedy School of Government, Harvard University, Oct. 28, 2003.
[16] Goode, Erica; "Certain Words Can Trip Up AIDS Grants, Scientists Say;" *The New York Times*, (April 18, 2003), p. A10.
[17] Stelfox, Henry Thomas, et al.; "Conflict of Interest in the Debate Over Calcium-Channel Antagonists;" *New England Journal of Medicine*; Vol 383, No. 2, (Jan. 8, 1998), pp. 101-106.
[18]Bekelman, Justin E., et al.; "Scope and Impact of Financial Conflicts of Interest in Biomedical Research;" *Journal of the American Medical Association*; Vol. 289, No. 4, (January 22/29, 2003); pp 454-465.
[19] Lasch, Christopher, "The Lost Art of Argument," in *The Revolt of the Elites and the Betrayal of Democracy*, (New York, WW Norton & Co., 1995), 162-163.
[20] Reported in Hartz and Chappell, *op. cit*., p.40.
[21] Interview, New York City, May 27, 2003.
[22] This conversation was related to me by someone connected to the university, who spoke on condition of anonymity.
[23] Kennedy, John Fitzgerald; Remarks in Nashville, Tenn., at the 90th Anniversary Convocation of Vanderbilt University, May 18, 1963, Americanpresidency.org – The Public Papers of the Presidents.