Communicating on Climate Change:

An Essential Resource for Journalists, Scientists, and Educators

Bud Ward

Edited by Sunshine Menezes

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A publication of the
Metcalf Institute for Marine & Environmental Reporting
University of Rhode Island
Graduate School of Oceanography

www.metcalfinstitute.org

This material is based upon work supported by the National Science Foundation under Grant No. 0433415.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation, the University of Rhode Island, or the Metcalf Institute for Marine & Environmental Reporting.

ISBN 978-1-60725-447-8

Additional copies of this report are available from the

Metcalf Institute for Marine & Environmental Reporting
University of Rhode Island
Graduate School of Oceanography
218 South Ferry Road
Narragansett, RI 02882
(401) 874-6211
www.metcalfinstitute.org

Printed in the United States of America

Metcalf Institute for Marine & Environmental Reporting

National Science Foundation

University of Rhode Island

FOREWORD

The time has come for a sea change in the national approach to one of the world's most urgent scientific, public policy, environmental, and public health issues: anthropogenic climate change. This new approach will require more than political will, though; it will require a huge leap in the American public's understanding of climate change.

We have witnessed great advances in our understanding of the science of climate change over the past twenty years, but it is only recently that we have seen a shift toward more accessible and accurate public communication of this complex and sometimes overwhelming topic. The responsibility for this communication can be laid squarely upon the shoulders of two groups: scientists and journalists.

The Metcalf Institute for Marine and Environmental Reporting has published this report in an effort to help those most involved in explaining climate change improve their communication strategies – not only with the public, but also with each other.

The workshops described in the following chapters were a labor of love for everyone involved, but a few people deserve special credit for the project's success: Bud Ward and Tony Socci, the program managers for these workshops, for recognizing and acting upon the national imperative of an improved understanding between scientists and journalists about climate change, and David Verardo, Director of the National Science Foundation's Paleoclimate Program in the Division of Atmospheric Sciences, for acknowledging the importance of scientific communication and finding a way to support this project.

Metcalf Institute intends for this book to be used as a resource by all parties who are trying to more accurately and clearly relate the science of climate change and the myriad impacts of this global phenomenon. It is our hope that the following chapters will provide guidance for communicating on many other science and environmental issues, too.

As scientists and journalists become more knowledgeable about one another's professional cultures and standards, they will more effectively fulfill their respective roles as communicators of information that affects all of us. With that outcome, we all win.

Sunshine Menezes, Ph.D.
Executive Director
Metcalf Institute for Marine
and Environmental Reporting

About the Metcalf Institute

The Metcalf Institute for Marine and Environmental Reporting seeks to improve the clarity and accuracy of environmental reporting by providing science immersion opportunities for journalists. Based in the Office of Marine Programs at the world-renowned University of Rhode Island Graduate School of Oceanography, Metcalf Institute programs reach across the fields of journalism and science, bringing early to mid-career reporters and senior news executives together with expert scientists, environmental managers, and policy makers.

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PREFACE

This report is the product of a series of unprecedented workshops that brought the nation's top climate scientists and leading science and environmental journalists together to discuss media coverage and communication of climate change science.

The workshops were managed by the Metcalf Institute for Marine and Environmental Reporting, a nonprofit journalism organization based at the University of Rhode Island's Graduate School of Oceanography, in Narragansett, Rhode Island. The principal funder of the workshops project and of this report is the Paleoclimate Program, Division of Atmospheric Sciences, National Science Foundation. Initial financial support was also provided by grants from the U.S. Environmental Protection Agency's Office of Air Programs, and limited in-kind support was provided by the National Centers for Coastal and Ocean Science (NCCOS), the scientific research arm of the National Oceanic and Atmospheric Administration's National Ocean Service (NOAA/NOS), in the U.S. Department of Commerce; and by the National Aeronautics and Space Administration (NASA). David Verardo, Ph.D., of the National Science Foundation, is the person to whom the vast majority of the credit should go for supporting this unique science/journalism project.

Program oversight and implementation were the responsibilities of Bud Ward on behalf of the Metcalf Institute, from the journalism perspective, and of Anthony "Tony" Socci, Ph.D., of the American Meteorological Society, from the science perspective.

The program managers conceived these workshops to address climate scientists' and journalists' deep frustrations with how climate change science information was being communicated—or not communicated—to the general public, and over their concerns about public misunderstanding of climate change. By design, workshop managers and participants focused specifically on science issues related to climate change, and not on political or economic issues.

The goal was neither to create headlines nor to make news but to improve the communication of climate change science. The workshops accordingly sought to increase journalists' understanding of the modus operandi, mores and institutionalized culture of the science community while increasing climate scientists' understanding of journalism fundamentals and principles. A critical element in this approach involved an emphasis on respecting and preserving the essential independence and vigor both of independent journalism and of the science community.

The workshop series consisted initially of five two-day meetings, each involving a different set of invited scientists and journalists. Each successive workshop was designed to build on the rich discussions of those that preceded it. In a few cases, a journalist or scientist participated in more than one of the workshops. The first five workshops were held at and in cooperation with the following universities:

- University of Rhode Island;
- University of California, San Diego;
- University of Washington;
- Columbia University; and
- University of California, Berkeley.

The sixth workshop in the NSF-funded series—at the Woodrow Wilson International Center for Scholars in Washington, D.C.—broke from the format of the first five in that it was designed as a public meeting aimed at reporting on the lessons learned from the first five workshops. The Wilson Center workshop, held in August 2006, brought together

scientists and journalists who had participated in one or more of the earlier workshops, and it attracted a public audience of nearly 200 from across the science, journalism, and climate change policy communities.

In each of these six workshops, professional staff associated with the host institutions provided outstanding technical and logistical support critical to ensuring the success of the project.

The program managers invited individual scientists and journalists to participate in the workshops based on professional standing and reputation among their peers. They were chosen in part because they were generally acknowledged to be leaders both within and beyond their respective fields. The scientists were selected because of their firsthand experiences in dealing with the media, and the journalists because of their extensive reporting on climate science. Each workshop was conducted in an on-the-record but off-deadline setting designed to foster open and candid exchanges.

Metcalf Institute and the program managers were pleased with the outcome of these workshops. Not only did they attract some of the nation's, and indeed the international community's, most highly respected climate scientists and researchers, but they also attracted prominent and highly experienced journalists, many from among the nation's most widely respected news organizations.

In addition to the individual journalists and scientists specifically invited to participate in the workshops, other leading practitioners participated as key speakers and presenters: two-time Environmental Protection Agency Administrator William D. Ruckelshaus; Seattle Times publisher Frank Blethen; Columbia University Graduate School of Journalism Dean Nicholas Lemann; University of California, Berkeley Graduate School of Journalism Dean Orville Schell; and former NBC News President Richard Wald. Along with numerous National Academy of Sciences members and fellows of organizations such as the American Association for the Advancement of Sciences (AAAS), American Geophysical Union (AGU), and American Meteorological Society (AMS), two winners of the Nobel Prize for Chemistry—F. Sherwood Rowland of the University of California, Irvine, and Paul Crutzen, of the Scripps Institution of Oceanography—also participated in the workshop dialogues.

Some of those participating scientists and journalists contributed exclusive commentaries and analyses for inclusion in this book. But all of the participants contributed to the richness of the discussions.

This book reflects the soul-searching and enlightening discussions involving climate scientists and journalists during a time both felt their chosen professions needed to better inform the public about climate change issues. Their exchanges clearly led to an improved understanding of each other's potentials and constraints in communicating the science and impacts of climate change to a broad audience. They brought forth ideas that were often satisfactory to both disciplines for improving this communication, while protecting the independence of both scientists and the media.

From the first workshop in late 2003 to the final one in the summer of 2006, there was a significant increase in media reporting on climate change issues, and many of the participants have indicated that overall coverage generally had improved.

The vigorous discussions of the six workshops led to a series of important and substantive results. Participants identified specific strategies scientists and journalists, working individually and collectively, can take to improve climate science communication and reporting. They outlined many professional and institutional opportunities to help improve responsible journalism on climate change and responsible roles of scientists in sharing their work with the public to provide a broader public understanding of the issues. Workshop participants also identified actions that can be taken by established institutions

such as professional societies, universities, and funders to improve communication of this important topic.

Climate change is often described as a generational issue, given the decades over which it is expected to remain an imperative topic for society. In some ways, it is the perfect illustration of how the natural sciences and news media must each work effectively to help ensure a well-informed citizenry. At the same time, many of the examples drawn from the Science Communication and the News Media workshops that informed this report will prove relevant and instructive for other science issues in the public policy arena.

As program managers, Ward and Socci express their appreciation for the supportive efforts of the Metcalf Institute program staff at the University of Rhode Island, in particular Sara Hickox, the Principal Investigator under the NSF grant; Jackleen de la Harpe and her successor as Metcalf Institute Executive Director, Sunshine Menezes; and Metcalf Institute Program Coordinator Katharine McDuffie. They especially single out their appreciation for the roles of Menezes and editor Jean Plunkett for their invaluable contributions in editing and quality control. They express their appreciation also to the professional staff of the host universities and the Woodrow Wilson Center.

The project itself could not have proceeded—yet alone succeeded—without the creative and farsighted support of NSF Paleoclimate Program Director David Verardo. Many of the participating scientists, in particular, expressed their admiration and respect for what they saw as Verardo's courageous commitment to fund a program that went well beyond the conventional boundaries of basic science. Verardo provided the essential funding, then left the management and execution to program managers Ward and Socci, for which they are most thankful.

INVITED PARTICIPANTS

In planning the series of journalist/scientist workshops that form the basis of this report, project co-managers Tony Socci and Bud Ward recruited experienced individuals believed to be widely respected within their own fields and known to have had substantial direct professional experience with communication of climate science information to the general public.

The invited scientists and journalists, identified by name and affiliation in Appendix A, were invited to participate both as students and teachers—they came to share their own experiences and perspectives and also to learn from their professional colleagues, both those within their own sphere of science or journalism and from the other field: Scientists learning both from fellow scientists and from participating journalists, and journalists learning both from their fellow journalism peers and from the attending scientists.

While the hope and expectation on the part of Metcalf Institute and the project managers was clearly that all invitees would both teach and learn, there was a clear expectation that they could also prove to be effective teachers and mentors of the next generation's climate scientists and journalists, in part because of their widely recognized positions of respect and influence among their own peers.

Each of the workshops benefited from the perspectives of early career scientists and journalists—and science and journalism students—who brought their own valuable perspectives to the dialogues. But in the end, it is the breadth and depth of the professional science and science journalism experiences that the invitees brought to the table that most distinguished the workshop series and enriched the exchanges. We think these exchanges can serve as instructive experiences for others interested in the responsible communication of science and news media coverage of that information.

A WORD ABOUT WORDS

One of the essential challenges facing the news media and the science community in addressing the climate change/global warming issue is what to call it. Is it "climate change," the terminology apparently preferred by many in the science community because it is more all-encompassing than the somewhat more casual and colloquial "global warming"? Or is it instead "global warming," the term much of the public at large has come to accept and, to some extent at least, understand?

It's not just an academic discussion of semantics. Linguists and others agree that the words matter, and matter a lot.

Internet search engines demonstrate the predominant use of the term global warming versus the more technically accurate term, climate change.[1] Throughout the workshops there was also a sense that the general public expresses a higher level of awareness, interest, and concern when the subject is "global warming" than when they are asked their views on "climate change."

It is also common knowledge among the supporters of strong regulatory action and those who are deeply skeptical of either the underlying climate science or any related need for a strong societal response that the terminology carries great significance politically. Communication strategist Frank Luntz demonstrated this point in a leaked 2002 internal Republican communications memorandum in which he argued that the Bush administration should try to reframe the policy debate language from global warming to climate change. Luntz maintained that the latter term would be less alarming to the public.

Reporting on the Luntz memorandum, The New York Times' Jennifer 8. Lee wrote, "Mr. Luntz urges that the term 'climate change' be used instead of 'global warming,' because 'while global warming has catastrophic communications attached to it, climate change sounds [like] a more controllable and less emotional challenge.'"[2]

Perhaps not surprisingly, climate change activists prefer to stick with the global warming terminology. And those are by no means the only two sound-bite terminologies in play. Former Vice President and Nobel Peace Prize winner Al Gore prefers the term "climate crisis." Pointing to the broad scope of potential impacts, some scientists argue that "global climate disruption" or some variation is more fitting.

There is broad recognition among climate scientists, climate activists, and the news media that the challenges of precipitating meaningful behavioral changes among the public are only further complicated by the uncertainty over what to call the problem in the first place.

Unfortunately, the problem of semantics does not end there. The most responsible scientists and journalists take it as a matter of professional pride that they should be skeptical of claims, of new findings, of new evidence…of virtually all the information that comes across their desks in the course of their work. To these individuals, being called a "skeptic" is a badge of honor.

So what term do they then use in referring to that small but often vocal cadre of scientists and others who consistently rebut what many climate scientists have come to accept as settled scientific conclusions concerning the warming of the Earth and the factors contributing to that warming?

Many scientists refer to those who do not accept the scientific consensus on anthropogenic climate change as skeptics, but there is also a sense among the scientific community that the term has been misappropriated. To address this confusion, climate scientists have suggested a variety of different terms to describe this small group of people who reject the science of climate

change. These terms include "contrarians," "deniers," "denialists," and even "professional skeptics."

For the purposes of this report, the generally more accurate term "climate change" will be used to refer to the global impacts of human-caused shifts in climate. The term "contrarians" will be used here as an alternative to "skeptics," given the applicability of the former word to the scientific and journalistic communities alike.

On Attribution by Specific Names

Given the goal of these workshops, it was very important to record the professional perspective that informed a given participant's statement. Although not all quotes are identified by individuals, they are all identified by profession: whether the view being expressed was that of a journalist or a scientist, or a print versus broadcast or online journalist. Those professional distinctions have been made clear in the text.

In some cases, however, particularly in the earliest round of workshops, individuals indicated that they would be most comfortable knowing that their words would not be specifically attributed, feeling that approach would allow for a higher level of candor and honest discussion.

Those expectations have been respected herein, and quotes and paraphrases have therefore been attributed by discipline to scientists or journalists participating in the workshops. In some cases, the direct quotations are attributed to a specific journalist or scientist by name. In other cases, they are attributed not by name but rather by the speaker's professional identity as a journalist or a scientist. This approach protects individual workshop participants' legitimate interests while highlighting the professional perspectives that informed this book.

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EXECUTIVE SUMMARY

Frustration was the impetus behind the workshops that form the basis of this book.

The concerns about the communication of climate change science appeared widespread among many climate scientists and also among many journalists. In online exchanges, on their individual electronic mailing lists, and at major conferences sometimes bringing both scientists and journalists together, the frustrations were palpable, and increasing. Professional science societies, such as the American Association for the Advancement of Science, American Meteorological Society, and the Ecological Society of America were actively contemplating adding media-oriented panels to their annual meeting agendas.

Climate scientists were frustrated by what they saw as a failure of the general public to understand and appreciate the seriousness of the climate change issue. Many scientists said they were frustrated that the accumulated advances in understanding of climate change over more than two decades of research had not led to a better-informed public.

Some scientists acknowledged their own communication shortcomings and said they were frustrated with their own inadequacies in telling their research stories. But they also harbored great frustration with the news media, which they saw often reverting to a flawed approach that balanced expert scientific assessments against policy-motivated objections lacking in scientific gravitas. They said such reporting misrepresented the extent of scientific consensus about important—and basic—climate science issues.

Journalists—some of whom had been reporting on climate change for more than a decade—were also frustrated that the issue generally had not gained traction with editors or the general public. They emphasized that in an era of declining newsroom budgets and shrinking air time and print space available for such a complex and sometimes arcane issue, they often encountered obstacles to coverage within their own news organizations.

Reporters complained that their own newsrooms and editors often were not supportive of their efforts to report on climate change. They acknowledged too that important underlying changes in the very foundations of journalism—stemming in large part from competition from online sources, ownership consolidation, and shrinking of newsroom staffs and advertising revenues—were important factors.

In that context, the workshops focused not on climate change science itself but on the communication of science news and information. The workshops focused in particular on what scientists call "anthropogenic climate change"—that caused by human activities and not part of a natural cycle.

The newsroom tradition of providing audiences balanced coverage of competing viewpoints and perspectives on controversial issues was a major early focus of the workshops. Typically two sides are reported: the plaintiff versus the defendant; Democrat versus Republican; labor versus management; both (or all) sides of a political issue.

Scientists participating in the workshops generally faulted this traditional application of balance in reporting on science, arguing that peer-reviewed studies should not be weighed against expressions of opinion or policy arguments.

While defending a century of tradition in reporting on political or public policy news issues with a commitment to balance, many of the experienced reporters agreed

with the scientists' concerns, often faulting their own trade for misapplying the tradition in the coverage of climate science.

Former Washington Post and New York Times science reporter Boyce Rensberger, for instance, affirmed at the first workshop in November 2003 that accuracy trumps balance. While there may once have been a legitimate 50/50 split of viewpoints on some climate science questions, Rensberger argued, the preponderance of scientific evidence had since accumulated to a point where responsible reporters should give the scientific consensus on anthropogenic climate change much greater weight than dissenting claims challenging the mainstream scientific conclusions. The journalistic tenet of accuracy now demands that the established science be given total or near total prevalence in coverage of certain aspects of climate change science.

The scientists and journalists pointed to increasing levels of evidence reported over the years by the Intergovernmental Panel on Climate Change (IPCC) and various scientific agencies and organizations as supporting a shift away from what journalists call "he said/she said" news reporting on certain climate science issues.[1, 2]

Many participating reporters said they were having trouble convincing their editors of the virtues of reporting in an accurate and fair, rather than quantitatively balanced, fashion. Their reporting on new scientific findings often met with an editor's insistence that they also report the perspec-

Revisiting 'A Discernible Human Influence'
By Benjamin David Santer

Michael Crichton is a science fiction novelist. He draws you into a fictional world, suspends your disbelief, and sells a lot of books. A 2004 Crichton novel had the premise that human-caused climate change is a gigantic hoax, perpetrated by a sinister cabal of scientists and environmentalists. Despite a lack of any formal training in climate science, Crichton the following year was invited to testify before a Senate committee on climate-related issues. He appeared in televised debates with reputable climate scientists, and briefed President Bush on global warming.

In an age where appearance is often more important than substance, Crichton became an instant expert on climate science.

In the real world, not the one of the fictitious settings created by Crichton, I've worked for more than 20 years as a climate scientist. It is a remarkable job. Each day, I learn something about the nature and causes of climate change. In 1995, I served as Convening Lead Author on a key chapter of an IPCC scientific assessment of climate science. After several years of deliberation, involving hundreds of scientists worldwide, we reached the now historic conclusion that "the balance of evidence suggests a discernible human influence on global climate."

This cautious statement marked a paradigm shift. For the first time, a major international scientific assessment found that our penchant for burning fossil fuels has changed the chemical composition of Earth's atmosphere, and hence our climate. After millions of years of passively experiencing climate, *Homo sapiens* had become an active instrument of climate change.

Paradigm shifts rarely meet with universal approbation, particularly when they have significant implications for powerful economic interests. Back in 1995, many did not wish to hear the scientific community's "discernible human influence" message. It was far easier to shoot the messenger than to have a serious debate about potential economic and social impacts of human-caused climate change. Easier to spread disinformation, to question motives and integrity, to find "instant experts" who could cast doubt on the science, and act as purveyors of scientific certainty.

Those purveyors of scientific certainty for years exerted enormous influence on the media, out of all proportion to their contributions to climate science. They slept untroubled by the kind of scientific uncertainties that worry the rest of us. They confidently asserted that the atmosphere is not warming, sea level not rising, glaciers not melting. All of

tives of climate science contrarians who lack comparable scientific expertise and standing, as if covering a political campaign or a public policy dispute.

It is in this context that the National Science Foundation's Paleoclimate Program, in the Division of Atmospheric Sciences, stepped up to fund the series of workshops for climate researchers and journalists. The workshops brought the two groups together to share experiences, learn from each other, and identify obstacles to better informing the public about climate change science. The emphasis was solidly on communicating the science of climate change rather than political or policy issues surrounding it.

For both science and journalism participants, there was a substantial learning curve in understanding the forces driving each other's field. At the first workshop, a leading scientist interrupted the discussion early on to ask for a clarification of a term the journalists were using. Susan Avery, Ph.D., then at the University of Colorado, wanted to know what journalists meant by the term "peg."

The peg, also called the hook, of a story is that which makes it timely. It can be a significant anniversary of a widely reported event, the release of an important new study, a legislative hearing or consideration of a bill, in addition to the obvious breaking stories—devastating weather event, war news, elections—events happening in the present moment. Climate change, by contrast, is a continuing and long-term phe-

the 20th century warming, they maintained, originates from natural fluctuations in the ocean circulation.

They have made careers out of being wrong. And yet, throughout the 1990s and well into the current decade, they have been quoted extensively in the New York Times, The Wall Street Journal, and other reputable publications. They were interviewed on CNN and Larry King Live. In the name of journalistic "balance," they were consulted on almost any climate change story, including those related to something far removed from their area of expertise.

But in the prescient words of Bob Dylan, "The Times They Are a Changing". Science is dynamic, not static. Climate science has progressed. The evidence that we are responsible for a climatic version of "regime change" has accumulated as inexorably as the melting of the world's glaciers. And as the evidence has firmed up, we've moved far beyond the cautious "discernible human influence" conclusion of 1995. We have now quantified the size of the human "fingerprint" on climate, and shown that most of the warming in the second half of the 20th century is attributable to human-caused changes in greenhouse gases.

In evaluating how well a novel has been crafted, it's important to look at the consistency of the plot. Does the internal logic ring true? Are the individual storylines neatly woven together? We can ask a similar question about the climate system. Is it telling us an internally consistent story about the causes of recent climate changes?

The answer is a resounding "yes." We've identified human "fingerprints" not only in the temperature of the atmosphere and oceans, but also in rainfall, atmospheric moisture, and circulation patterns. The climate storylines mesh together tightly.

The climate change story is not a Michael Crichton novel. It is fact, not fiction. It is being told now, and it will unfold over generations. We ignore it at our peril. The ultimate ending is still unclear – but we know we can have some influence on the final outcome.

Scientists and journalists have a professional and ethical obligation to tell this story. Wise decisions on "what to do" about global warming will require an electorate and politicians with some basic understanding of climate science, and the potential risks and costs of different mitigation strategies. We can no longer afford to have the public's view of climate science shaped by the "instant experts," those with vested economic interests, or science fiction novelists.

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nomenon that occurs over time rather than as a specific event in a specific moment in time, and therefore, is somewhat outside the usual breaking-news approach of most newsrooms. As New York Times science reporter Andrew C. Revkin pointed out at several of the workshops, climate change "oozes but doesn't break," and is therefore the antithesis of breaking news.

The organizers of the workshops had had concerns initially that the highly specialized scientists, with their years of work in a given field, might have trouble explaining scientific complexities to journalists. Instead, it turned out the scientists were stumped by common media jargon, getting to one of the broad difficulties of communicating across disciplines.

The ensuing exchanges from the workshops—each involving a different set of invited scientists and journalists and each designed to build on the earlier workshop discussions—provided countless opportunities for the scientists to begin to understand reporters and editors, to gain insights into how decisions are made in the newsroom, to learn the different parts of a large and complex news organization, and to better understand how and why reporters cover the things they do.

Reporters attending the workshops got valuable insights into the workings of scientists and the scientific method in the world of climate research. They were exposed to the scientific process and the principles of uncertainty, relative risk, correlation, incrementalism, and dispute resolution within the scientific community. Reporters gained behind-the-scenes perspectives on the professional and institutional pressures scientists can face in deciding to immerse themselves in the public policy aspects of climate change, including criticisms from their science peers for appearing to seek publicity outside established channels of the scientific community. Some academic researchers, for instance, emphasized that scientists seldom earn tenure as a result of their outreach to the news media or their involvement in public policy controversies.

Over the duration of the workshops, participating scientists and journalists eventually came to recognize some common adversaries and allies. Reporters often expressed their frustrations with editors, whom they sometimes viewed as being removed from the rigors of their own specialized beats. When scientists learned that reporters for major news organizations don't write their own headlines—and in fact are often critical of those headlines—a common bond was formed. When reporters learned that scientists sometimes resented their own research institution's proclivity for promoting their research findings in the interest of more and bigger headlines and perhaps more grant support, another common bond developed.

Journalism and science professionals ought to be encouraged to pursue their work with increased appreciation of the mores, principles, and modus operandi essential to their own best work, it was agreed. Both should collaborate in the interest of a better-informed citizenry, but in a way that preserves and protects their essential independence, including their independence from each other. Journalists should not try to turn scientists into journalists when it comes to understanding what does and does not constitute news for a particular medium or audience. And scientists should not assume journalists can morph into specialized scientists in ferreting out on their own, on deadline, and without respected and impartial professional guidance, the scientific merit of each new research claim.

While recognizing the perspectives and skill sets that set journalists and scientists apart, many of the workshop participants in the end welcomed and sought to maintain those fundamental distinctions. Let journalists be journalists, was the prevailing view: aggressive, curious, open-minded, skeptical, and transparent in how they do their work.

And let scientists be scientists: curious, committed, specialized, and also open-minded and possessing a healthy skepticism.

A funny thing—rather a somewhat unexpected thing—occurred over the course of the workshops: Between the start of the first workshop at the University of Rhode Island in November 2003 and a related September 2007 workshop at Stanford University for news executives, the climate change issue gained some of the media traction and public interest judged to be missing at the outset of the workshop series.

By 2007, the media and the general public had begun to understand and more widely report on the ever-greater consensus of scientists that anthropogenic climate change is real and that global atmospheric temperatures are increasing. Many in the media, by mid-decade, had reached something of a collective, but independent, judgment to cease balancing every authoritative scientific report with a counterclaim judged to be of little or no scientific merit.

The trend toward increased media coverage of climate change was clear, from cover stories in weekly news magazines such as Time and Newsweek to increasing coverage on network nightly news programs, broadcast and cable television documentaries, the front pages of scores of even small and medium-size newspapers, and columns and op-eds from highly regarded journalists.

No one can know definitively how the change in public perception came about. In the United States the devastation wrought in New Orleans and along the Gulf Coast by Hurricane Katrina helped galvanize the public and media awareness of the potential devastating impacts of climate change, even though responsible scientists agree that specific catastrophic weather events cannot be directly related to climate change.[3] Just as such profound developments contributed to popular perceptions of climate change, they also helped steer and influence each succeeding workshop in this series. And those workshops in turn contributed to participating scientists' and journalists' attitudes toward reporting and communication on climate change.

The pages that follow describe the face-to-face discussions from these workshops, presenting the perspectives of both the media and the scientists. Those discussions brought to the surface ideas on how the continuing coverage of the science of climate change, as well as societal responses and reactions to climate change risk, can benefit from improved communications between climate scientists and members of the news media, and do so in ways consistent with each other's essential roles.

Workshop participants developed a long list of practical steps that scientists, journalists, and institutions can take to improve communication of climate change science.

In some cases, responsibility lies with reporters and editors and their news organizations and professional associations to help improve public understanding of climate change. In other cases, changes may best be implemented by journalism and science interests working cooperatively toward shared goals.

Journalists and scientists participating in the workshops—including those in the 2007 workshop for top-level editors—generally agreed that climate change, both as a broad societal challenge and as a news story, presents unprecedented social, economic, technical, political, and moral challenges and opportunities. They said they hoped the lessons from their experiences and their shared dialogues can inform not just future communications surrounding climate change science, but also other scientific endeavors, for which many of the same lessons will be relevant.

Climate scientists and journalists are but two components of those needing to accept the challenges posed by anthropogenic climate change.[4] But how the media and the climate science and research communities

measure up to those responsibilities over the coming months, years, and decades will play an important part in shaping global responses to the challenges posed by climate change.

Legendary New York Yankees coach Yogi Berra is said to have remarked before a game, "It gets late early out here." Members of the scientific community have begun to argue that it's getting late in terms of global efforts to formulate and implement an effective strategy to manage the adverse risks caused by manmade global warming.[5,6,7,8]

Whether it's in fact getting late or already too late may be an academic exercise. But few familiar with the scientific findings will argue that it's too early for the media and the science community—each dependent on the other—to get on with the job. It starts here.

2

BACKGROUND ON AND NATURE OF THE WORKSHOPS

Why These Workshops?

When journalists and climate scientists speak with each other—usually over the telephone concerning a specific story the reporter is working on, or at a professional conference—their discussions generally involve a particular research project or matters related directly to climate change and climate change science. Seldom do they discuss at any length issues related to the communication of climate change information—either that from the scientist to the media or from the media to the public.

The Metcalf Institute workshops were designed specifically to fill this communication void: Create a comfortable off-deadline atmosphere allowing journalists and scientists to share and better understand their own and each other's professional needs, interests, and frustrations in informing the broad public about important climate science issues.

The workshops were not designed to "make news," in that there was little or no expectation that the reporters would find the workshops themselves to be newsworthy. While the workshop participants came up with numerous worthwhile story ideas that individual reporters pursued independently from the workshops, they did not generate what daily newspaper reporters refer to as next-day stories.

The journalists and scientists invited to participate in the workshops—different individuals participated in each of the six workshops—were encouraged to attend both as teachers and students. The scientists attended so they could share their personal climate science communication experiences, their successes and their frustrations, with their science colleagues and with the media representatives, just as they came to learn from them. Likewise, the journalists came both as teachers and students, teaching and learning from not only their fellow media representatives, but also from the scientists.

The discussions dealt not with recent scientific studies, but rather with how information about this work is communicated with the public, and how that communication process might be improved.

Such in-depth consideration of communication and journalism issues is unusual both for the scientists and for media representatives. For reporters, the workshops offered a chance to step back from the frequent tight-deadline pressures increasingly common in today's 24-hour-a-day media markets. For scientists, the workshop dialogues provided opportunities to view their own work through a media lens, providing insights into the practical challenges of reporting on complex science news issues in today's fast-changing media landscape.

Why These Workshops at This Particular Time?

The workshops project, initially conceived by the project managers in 2002, had begun as a series of workshops for reporters in the Gulf Coast region and in the Pacific Northwest on scientific understanding of regional climate change impacts. The workshops in those regions were designed to address growing media interest in reporting responsibly on impacts in their own readership or viewership regions, notwithstanding the increased scientific uncertainty at local levels.

Those workshop dialogues also revealed deep-rooted concerns among both journalists and scientists about how issues related to climate change science were being communicated to the public, and about whether citizens understood the seriousness of climate change

issues. After holding reporting workshops at Loyola University in New Orleans and at The Seattle Post-Intelligencer, workshop organizers Ward and Socci refocused their efforts on broader climate science communications issues. These early workshops served as the backdrop for the Metcalf Institute workshop series described here.

Journalists at the time were finding fault among their own ranks concerning coverage of climate change science. They also expressed criticism that the scientific community was not doing more to help improve the situation. Scientists likewise were pointing to shortcomings within their own profession when it came to media outreach and education and communication activities generally. And they also expressed substantial concern about what they judged to be inadequate— and often inaccurate—coverage of climate change science.

> "There is no smoking gun for global warming. Instead, there is mounting evidence that when you put it together, it's hard for people to come up with another explanation."
>
> – Tony Broccoli, Ph.D.
> Rutgers University

These kinds of discussions appeared to be happening between scientists and, separately, between journalists, but not at any significant level among representatives of the two disciplines. The Metcalf Institute workshops sought to bridge that gap.

Much of the climate science community at the time was pointing to a growing body of peer-reviewed scientific literature concerning the global warming impacts of anthropogenic carbon dioxide emissions and emissions of other greenhouse gases.[1,2,3] They pointed to increasingly worrisome reports and assessments compiled by the Intergovernmental Panel on Climate Change, IPCC, and reports from organizations such as the National Academy of Sciences and professional scientific groups.[4,5]

A growing number of scientists expressed concern that the voice of the scientific community overall was being drowned out by what they considered to be a small number of climate science contrarians.[6,7] Those minority perspectives, the researchers argued, gained disproportionate media attention despite lacking a strong scientific foundation, leading to unnecessary confusion and uncertainty among the general public.

Reporters during this time were undergoing their own soul-searching, not only as it applied to their coverage of climate change science in particular, but also as it applied to traditional journalism. They expressed concerns about the unprecedented changes involving journalism as a result of increased competition from digital media. Along with the uncertainties posed by the new digital and Internet media, the news and information businesses overall were undergoing rapid consolidation of ownerships, loss of subscribers and viewers, and a decline in advertising and subscription revenues.[8] These changes rankled some and energized other journalists, but for most they posed uncertainties and unknowns about the future of their field, both short- and long-term.

With a sizeable segment of the climate change science community increasingly concerned about the seriousness of their research findings, and with the media feeling increasingly constrained in reporting in-depth on those findings, the first of the series of workshops took place at the University of Rhode Island, home of the Metcalf Institute.

Underlying Scientists' General Concerns

Professional scientific organizations—groups such as the American Association for the Advancement of Science, American Meteorological Society, and the American Geophysical Union—began to express growing concerns over how science and climate science in particular was being communicated to nonscientific audiences in the early 2000s.[9,10,11] Annual and regional meetings of such organizations increasingly were addressing these communications challenges as part of their formal agendas.

The scientists participating in the workshops brought with them their strong concerns about what they saw as the public's lack of understanding of science and, in particular, of

climate science. Among many respected climate scientists, such concerns about communication of climate science and the media's role in that communication had predated the start of the workshops in 2003. But the first and subsequent Metcalf Institute workshops provided a continuing forum for those concerns to be shared directly with reporters covering climate science issues.

There were several consistent concerns among scientists about communicating climate change research, and these themes came up repeatedly throughout the workshop series: the disproportionate media attention given to climate change contrarians; the public's unfamiliarity with basic scientific concepts (e.g., uncertainty, relative risk, the difference between a hypothesis and a theory, etc.); the lack of institutional support within the academic world for communicating with the press; the scientific community's practice of speaking with frequent and careful qualifiers; and their failure to capture the public's attention and/or concern about the potential impacts of anthropogenic, or man-made, climate change.

> "We live, we breathe, uncertainties, caveats. The thing that distinguishes us from our critics is that they have no error bars. They have certainty about the way the world works. That's the big difference."
>
> – Jeffrey Peck Severinghaus
> Scripps Institution of Oceanography

For reporters who were seeking clearer, more communicative scientists, these workshops presented a path toward better understanding of the norms and culture of academic researchers, while also identifying the major communication issues from a scientific perspective.

Underlying Journalists' General Concerns

Just as these workshops were informed by the frustrations of scientists about media coverage of climate change, so too did they evolve from the journalism community's frustrations at the response of the science community and media coverage of the issue.

Journalists who already bring vastly different levels of understanding of the scientific method, resolution of scientific disputes, and the peer review process to their craft were struggling under the additional weight of trying to get support from their editors for this type of coverage. Furthermore, reporters were finding it difficult to get scientists to express their passions and their emotions toward their work when discussing complex issues such as climate change.

As did the scientists, many journalists had a list of common concerns about how to effectively communicate the science of climate change to their audiences: the difficulty of getting space for climate change stories in the daily news when fighting against more flashy, breaking news stories; convincing editors that the traditional "balanced" approach toward reporting does not convey the climate change story accurately; and their struggles to get clear scientific analyses and personal perspectives from scientists.

From the very start of the workshops, a number of reporters expressed concerns that climate scientists working for federal agencies were becoming less accessible to the news media. Some scientists joined with the reporters in expressing concerns over what they said amounted to a politically motivated censoring or muzzling of climate scientists. They were buttressed in their perspectives by occasional major media headlines and broadcasts about prominent climate scientists (in particular NASA's James Hansen) having been forbidden by their employers—the Environmental Protection Agency, National Aeronautics and Space Administration, or National Oceanic and Atmospheric Administration—from taking reporters' interview phone calls, speaking out at public meetings, or addressing public forums on issues related to climate science.[12] A report by the Union of Concerned Scientists, an activist organization representing both scientists and environmentalists, captured headlines and prompted additional concerns about scientific "censorship" among both journalists and some scientists and policy makers.[13]

Another important issue of concern had arisen for journalists around this time. Just as they brought to the workshops their concerns with media coverage of climate change, the reporters also brought their growing concerns and uncertainties about the directions of journalism and mass communications generally. The shifts toward increased competition from digital media and declines in advertising and subscription revenues for traditional print media had begun before the start of the first workshop, and reporters feared that these trends could further affect their chances of improving coverage of climate change.

Not long after the first workshop, the respected Project for Excellence in Journalism published the first of its yearly "State of the News Media" reports.[14] That 2004 report detailed "epochal" changes under way in ownership and consolidation of news media, in the traditional news media business plan based on advertising and subscription revenues, and in trends toward delivery of news and information by digital and electronic media rather than by print and broadcast. These trends were leading to widespread reductions in newsroom staffs, paring-back of specialized newspaper beats, an increased emphasis on local news, and what many had characterized as a "dumbing down" of news content.

Those foundational changes in the nature of news dissemination and communication of information continue to fuel uncertainties about journalism's roles and capabilities for informing the public at large about complex issues such as climate change. With print and broadcast media's current uncertainties about whether the Internet is friend or foe, and many news organizations experiencing a still unresolved relationship between digital media and traditional news distribution, journalists pointed to both risks and opportunities for improved coverage of climate change and other complex science issues.

For scientists who were seeking more accurate media coverage of their research, the workshops would provide insights into the culture and professional norms of reporters, as well as an improved understanding of the major shifts being experienced by the journalism industry.

Changes in Coverage, and in Public Concern

While the above descriptions of scientists' and journalists' perspectives help describe the setting for the workshops, events wholly independent of the workshop discussions were leading to significant changes in media coverage of climate change and public interest in the issue.

By the time of the climate change roundtable for news executives at Stanford University in 2007, the quantity of media coverage of climate change had increased, and the overall tone of the coverage had changed substantially.

One can point anecdotally to several key factors as apparently influencing the change in quantity and quality of coverage and the change in public interest and concern, none of which on its own may sufficiently explain the changes:

- The devastating impacts of Hurricane Katrina on New Orleans and the Gulf Coast seem to have had a galvanizing effect on the public about the potential impact of severe storms in vulnerable areas. The public's overall perception of increased risk in the aftermath of this event seems to be partially attributable to a general sentiment that the federal agencies of jurisdiction planned inadequately and responded poorly to the Katrina disaster.[15,16] While no scientifically based cause and effect relationship can be drawn between Katrina and manmade climate change, the public and some media interests appear to think otherwise.
- The release and broad distribution of former Vice President Al Gore's high-visibility climate change documentary, "An Inconvenient Truth," which attracted substantial publicity to the issue and reached audiences previously only slightly familiar with it. The film's winning of an Oscar and Gore's subsequent nomination and selection for the 2007 Nobel Peace Prize brought continued publicity.

Science to Media: Catch-Up to, But Don't Get Ahead of, the Science

By Anthony Broccoli

When I began my career as a climate modeler more than 25 years ago, media coverage of climate change had a different character. Newspaper articles on the topic were uncommon. Stories would sometimes appear in popular science magazines, often presenting computer modeling of climate as an exciting and futuristic endeavor. These stories would sometimes discuss the implications for future climate, but the emphasis generally was on scientific discovery and the marvels of computer programs that could mimic the behavior of the climate system.

This would soon change as the climate modeling community became more confident in its conclusions and more concerned about the prospects of substantial changes in future climate. A major American heat wave in the summer of 1988 was described by some climate scientists as a harbinger of future changes, and the topic of climate change garnered more attention. Media coverage ramped up rapidly, and climate change became a question of not only science but also public policy.

The prevailing view among climate modelers that substantial changes in climate were in the offing was well-represented in media stories, and dissenting voices soon began to be heard more frequently and loudly. In their quest for "balance," journalists began to report on climate change as a controversy, with credentialed scientists on both sides, much as stories about the prospects for a recession might include differing perspectives from economists.

This "dueling experts" paradigm prevailed in media coverage of climate change through the early part of this decade, even as the comprehensive IPCC expert assessments became increasingly confident of a human impact on climate and the likelihood that larger changes in climate would lay ahead. Such coverage influenced public perceptions, and it didn't matter much if the contrarian arguments were scientifically sound: They had entered the public consciousness, and many of the questions from the audience focused on the perceived scientific controversy.

I became accustomed to explaining to the public, and sometimes to reporters, that the evidence was not so uncertain as they believed. Other climate scientists involved in public outreach had similar experiences.

But after almost 20 years of dueling experts, media coverage of climate change appears over the past few years to have taken a different direction. The focus on scientific controversy has diminished, and many news stories now accept the reality of global warming as a consequence of human activities. This is a welcome change, as it more accurately reflects the viewpoints of an overwhelming majority of climate experts. The release of new reports from the IPCC in 2007 seems to have further shifted the coverage of climate change away from an emphasis on scientific controversy.

Although welcome in most ways, the most recent evolution of media coverage of climate change is not without its unwelcome side effects. The increased acceptance of the reality of global climate change now has led some journalists to present genuinely controversial topics with less skepticism than is warranted. An example is the impact of climate change on tropical cyclones. Although it is likely that warming of the tropical oceans will increase the maximum intensity of tropical cyclones, the magnitude of this effect is far from settled. Yet too many stories implicitly, or explicitly, attribute the active Atlantic hurricane season of 2005, including the Hurricane Katrina disaster, to the effects of global warming.

To the extent that such stories are indicative of a new paradigm in the media coverage of climate change, climate scientists may experience a role reversal. Instead of convincing reporters and the public that the confidence of the scientific community is stronger than conveyed by the media, as we have had to do for much of the last 20 years, our proper role may shift to preventing the media coverage from getting ahead of the science.

This shift would require not only the communication of a more nuanced message, but also an attitude adjustment. After years of trying to get public perception to catch up to scientific understanding, it may feel very odd to hold up the Caution-Proceed Slowly sign.

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• The IPCC's progressively alarming and straightforward reports—each elevating the level of scientific confidence that Earth's climate is changing and that human activities play a significant role in that change—also were critical forces in shifting the tone of coverage by the popular media and in the public's awareness of the issue. Still, there was a sense that the general public had largely ignored these reports until 2006 and 2007.[17]

• The release of a series of updated global assessment reports throughout 2007 by the IPCC underscored a sense of growing concern and urgency among the international science community.[18,19] The November 2007 selection of the IPCC scientists as co-winners with Gore of the 2007 Nobel Peace Prize added additional luster and further increased publicity about and coverage of the issue.

• A growing interest among local and state governments to pursue regulatory strategies that would decrease greenhouse gas emissions.[20] Regional agreements in the Western and Northeastern United States indicated states' commitments to moving forward with climate change policy in the absence of a federal law.[21]

• The early-starting and long-running 2008 presidential primary campaigns resulted in leading candidates of both major political parties taking positions on climate change substantially different from that of the Bush administration. The support of the contending candidates for regulatory action on greenhouse gases likely contributed to a sense of greater public urgency about the issue.

The workshops were structured and conducted to focus on communication of climate change science issues, and not on related issues of climate change policy, energy policy, or related economic issues. This report highlights the lessons learned from the scientist/journalist dialogues, and provides insights into each profession's culture and communication strategies.

3

SCIENCE FOR JOURNALISTS

Journalists and scientists throughout the workshops discussed a number of ways in which their disciplines are similar: a mutual respect for independent verification and re-verification of data and information before accepting it as factual; an incremental but continuing approach to discovery of what they hope will be regarded as "truth" or certainty; a desire to be viewed as healthy skeptics of data and information they do not know to be accurate; a recognition of the value of transparency in how they conduct their research and reporting.

At the same time, however, the journalists and scientists acknowledged differences between their fields that help to explain why individuals seek out one field rather than the other. People usually pursue journalism careers because of a love of words, rather than a fondness for mathematics and statistical analysis, physics, chemistry, or even numbers. And those pursuing scientific careers usually do not do so because of a fascination with the arts and letters, public policy, or writing.

> "When you deal with very complex science that has undergone well established vetting, new studies don't change the big picture much. It's the equivalent of a minor veer in a big super tanker of information that is steering along. Nuances are new, but the basic ideas about the cause of climate change haven't changed in 40 years."
>
> —Stephen Schneider, at the University of California, Berkeley workshop

While insisting that the unique communication skills they bring to their field are a critical complement to scientists' technical competencies, most of the workshop reporters also acknowledged the value of journalists' having an adequate understanding of the scientific method and how scientists go about their research. For journalists whose most recent encounter with the scientific method may have been in a high school or college classroom, what better place to start?

The Scientific Method and Resolving Differences

The scientific method is best thought of as an overall process by which scientists come to better understand the natural world while removing their own personal biases. In part through the application of the scientific method and professional peer review, scientists have evolved elaborate checks and balances to minimize the influence of individuals' biases and to root out errors in methodology. They see the constant verification and re-verification process as moving inevitably toward consensus among their professional colleagues.

The application of scientific method varies between disciplines, but the ground rules of science tend to have a distinct character that differentiates scientific work from that of other professions.

Scientists develop hypotheses from observations of a phenomenon or group of phenomena. Hypotheses are then tested through observations and experiments in order to draw conclusions about their validity. No hypothesis is considered proven until it has undergone rigorous scientific review and testing, and other scientists must be able to replicate the tests or experiments and achieve the same results. This process for recognizing and weeding out errors can be time consuming, occurring over months, even years or decades, and it is inherently self-correcting. Scientists during the workshops emphasized to the reporters that the process is also inherently human: its path is far from straight, with many false starts and blind alleys along the way. The scientific method, they said, can never be perfect or without shortcomings.

Understanding and Differentiating Correlation and Causation

Both the scientists and the journalists attending the workshops were familiar with the Latin phrase "*Post hoc ergo propter hoc*," meaning "after this, therefore because of this." They had no trouble agreeing that journalists and the public cannot be beguiled into thinking an event is the result of a prior event simply based on the chronology of occurrence.

A similar, but different problem of assumption arises with correlated events or phenomena. It is not appropriate to assume a causative relationship between two events simply because they show a statistical relationship (or correlation). It is not sufficient, for example, to state that Hurricane Katrina occurred because of global warming. While one could show a correlation between these two events (e.g., warmer than average sea surface temperatures in the Gulf of Mexico and a stronger than average hurricane), that correlation does not mean that the warmer than average water was the causative agent for the stronger than average hurricane.

Correlations are, therefore, an early statistical step in determining the suite of factors that affect a certain variable, such as hurricane intensity. The mere demonstration of a relationship does not say anything about the strength of that relationship, or whether one variable causes another.

The scientists and journalists also discussed important semantics issues, involving terms such as theory, certainty, and correlation. For scientists, for instance, the term "theory" has a very precise meaning far different from how the term is used in everyday conversations. The general news media and the public overall may use the term theory to mean hunch or speculation. To scientists, however, a theory represents a hypothesis or group of hypotheses that have been confirmed through repeated experiments. After sufficient testing, hypotheses rise to the status of theories, which have come to be accepted by the scientific community. Theories about gravity, evolution, and relativity underpin our understanding of the universe, and help us to understand new phenomena.

Even so, theories cannot be proven unequivocally true no matter how rigorous the testing, and emerging scientific findings could someday overturn even the longest-lived theory. Overturning long-accepted scientific theories is considered unlikely in many cases, but not impossible, because there is always the prospect that new observations or data could prevail in the court of scientific review and assessment.

Scientists during the workshops emphasized to the media representatives the importance of recognizing that a single apparent contradiction does not necessarily disprove a well-established theory, even though it may raise new questions that need to be addressed. The scientists emphasized also that a single contradictory analysis is unlikely to overturn an entire body of established scientific theory about a particular subject. Several expressed concern that media headlines, in particular, sometimes lead the public to conclude that new research has undercut decades or established bodies of scientific research and theory.

Typically, only after repeated tests confirm that established theory cannot accommodate new data or phenomena do scientists question the underlying theory or consider modifying it.

It is obviously helpful for journalists to understand the basic workings of the scientific method, but one workshop participant, Philip Meyer, of the University of North Carolina, took the point further. Meyer told participating journalists that they could also apply aspects of the scientific method to their own reporting.

Meyer is the author of the 1973 University of Indiana Press book *Precision Journalism: A Reporter's Introduction to Social Science Methods*, long considered essential reading among many journalism educators and journalists. In the book, he encouraged journalists to take better advantage of methods used in the social and physical sciences, and he repeated many of those arguments at the workshop at the Lamont-Doherty Earth Observatory at Columbia University.

Meyer reiterated during that meeting some of the same points he had made in a September 23, 2004, column in USA Today.

"Scientific method is designed to let us ask questions of nature without being fooled by the answer," Meyer wrote in that column. *"Its objectivity is in its method, not in giving equal weight to all of the possible answers as journalists are wont to do."*

Expanding on points he had made earlier in the book, Meyer wrote:

> *Two key aspects of scientific method that journalists need to adopt are transparency and replication. A scientist tells how he or she arrived at a conclusion in enough detail so that another investigator can follow the same trail, examine the same data, and get the same answer.*
>
> *Investigative journalism that relies on paper trails and documented interviews can do that.*
>
> *Scientific method also drives you to play devil's advocate with your data and carefully look for explanations that aren't the ones you want to hear.*

Workshop reporters and scientists agreed that imprecise use of language can compound the public's confusion on science-based issues, and should be avoided.

The reporters and scientists had similar discussions on the semantics of the terms certainty and uncertainty. With the scientists generally convinced by their own and their colleagues' evidence that the globe is warming and that human-caused production of carbon dioxide emissions is a significant contributor to that warming, several expressed dismay when arguments against their position were posited, for instance, on the basis that "the science is uncertain." All science to some extent is forever uncertain, these scientists declared.

Nonetheless, a number of reporters throughout the workshops said their editors often seek certainty while their scientist sources often emphasize that certainty in the scientific context is unacceptable as an absolute and unequivocal term. In the context of climate change in particular, they said that some of the physical science conclusions amount to what they called "settled science," as determined by the consensus of experts.

New York Times science reporter Andrew C. Revkin quipped that in the context of many newsrooms, "uncertainty amounts to incrementalism," and he said incrementalism often leads editors to want to play down a story or not run it at all. "They bury it on page A-37," Revkin remarked.

Where Peer Review Fits In

Scientists explained to workshop journalists the value of using peer-reviewed research, a formalized system through which scientific papers and findings are subject to evaluation and testing by other scientists. But at the same time, the scientists emphasized that not all peer reviews carry equal weight, that some peer-review processes are more rigorous than others.

Generally, the reviews involve having unidentified qualified peers assess the scientific rigor and methodologies of a scientific manuscript prior to publication in a peer-reviewed journal. The authors have no control over the selection of those specific reviewers, and their precise identities remain unknown. In some peer-review processes, however, authors are given an opportunity to rule out specific individual researchers they judge, for instance, to be conflicted or otherwise inappropriate.

Once published, the researcher's work is open to confirmation and challenge by professionals in the field, who have access to the techniques, data, and methodologies used in the initial research and who may replicate it to see if they arrive at similar results.

The scientists told the journalists that an author's publication of a single peer-reviewed article is not by itself sufficient evidence of that author's level of expertise on that issue, or of the rigor of the science. Scientists suggested that journalists look for a history of peer-reviewed publications on a particular topic—in respected scientific journals—to assess a researcher's knowledge and how recently the researcher published on that topic.

It is also important to remember the inherently different time scales involved in scientific

publications versus the news, the workshop participants noted. Given the relatively slow pace of publication of peer-reviewed scientific manuscripts, contrasted with the immediacy of news media headlines and response to those research papers, the workshop scientists emphasized that science works incrementally and over a long time, only leading to general acceptance or rejection of a hypothesis after repeated testing.

By the time the scientific community's collective judgment is rendered on a specific study, journalists and scientists agreed, the public's initial impressions based on early publicity may be well entrenched and not easily reversed.

One scientist warned also about the growing number of unvetted publications being distributed through an expanding number of electronic and online outlets. Urging media to be cognizant of what some might consider insufficiently reviewed journal articles, he said, "An unstated part of peer review is that you can find a home for almost anything."

Those remarks prompted a discussion that an increasing number of "affirmative" scientific journals—those designed basically to reinforce the existing ideological positions of their intended audiences—now address issues related to climate research, energy, and the environment. The scientists said that publishing online through such efforts has become an increasingly popular way to circumvent more rigorous peer review altogether, and they said the public and the media need to be attuned to these trends and distinguish them from highly respected professional peer-reviewed journals.

Scientists as Communicators and Educators

Scientists pointed out that for most of their colleagues, the primary audience is not the public or the news media but their professional peers. They said that with the scientific method as a common denominator, scientists have fine-tuned their ability to communicate with each other and within their specialty fields on complex issues. Scientists voiced concerns that new challenges and unanticipated land mines often arise when they communicate beyond their established comfort zone. They cautioned, for instance, that the media and the public might see the give-and-take typical of scientific debate as a fundamental disagreement about the underlying foundations of evidence.

Journalists, for their part, have varying levels of understanding of fundamentals that underpin how scientists think and work and communicate. Many agreed that in pursuit of controversy as a key ingredient of many "good stories," the media sometimes inadvertently overstate the significance of the long process of scientific vetting on a given issue, sometimes portraying it as major uncertainty over underlying scientific principles, principles that may not be in question in the first place.

Scientists throughout the workshops also debated the extent to which they and their profession should engage in the sometimes heated and politically motivated public discourse over what they viewed as scientific "disinformation." Several agreed on the need to do so while noting that such engagement can be time consuming, emotionally draining, and at odds with their need and desire, and often their passion, to pursue their own scientific research. Several said that decisions on how actively, and how publicly, to engage in these sometimes emotional confrontations are best left to individual scientists, some of whom are more comfortable and capable in the heated and sometimes prolonged verbal exchanges that can arise. Scientists expressed the hope that reporters might respect individual scientists' decisions to engage or not engage in such exchanges, for instance, on the point-counterpoint television formats popular with many broadcast media. There was general agreement among the participants that in seeking a scientist's personal or policy positions, it is appropriate for the scientist to emphasize when he or she is speaking as a citizen rather than a scientist and important that the journalists make that distinction in the story.

Scientific Education of Climate Science Writers Through Pedagogical Use of Artful Sound Bites

By Jerry Mahlman

We climate scientists clearly are not in the habit of communicating the progress of our science in "hit and run interviews." That is far from our typical avenues of conveying new information.

Nonetheless, "Communication of Global Warming Science" has recently become a near-daily event in our professional lives. Climate scientists are thus forced to shift gears to communicate our science to a very broad group of science writers who work on deadlines far shorter than those scientists face. Journalists seem always in short-term deadline mode, while we scientists typically slog our new research manuscripts through arduous, lengthy, and painful review processes.

Yet we climate scientists and climate science writers have quietly, and perhaps unwittingly, succeeded in closing that gap far more successfully than any of us expected. In that process, it is clear that these two cultures in the future can be mutually helpful to each other's needs to get all of the stories right, not just the quickly exploding events that produce "man bites dog" stories.

These new realities are clearly out of the usual realm of the patient, slowly publishing, climate scientist.

Note initially that the cultures of science and journalism often are in a mismatch mode. The status quo: Reporters call us, and scientists seldom call reporters with our hot new research results. Perhaps it will always be so, but can't we increasingly call in our new information to the most appropriate science writer for that particular subject? What's stopping us? Dream on, Jerry?

A new infrastructure could help build trust and confidence between responsible climate scientists and the responsible science news media. No such infrastructure exists today to adequately help the media report on implications of new climate science research results. We need to do more to actually make it happen.

An interesting over-arching irony is the role of global warming contrarians. Even though their battle slogs on, they now have lost almost all visibility and credibility. Nonetheless, some are still vainly trying to make global warming disappear through increasingly bizarre arguments. Even sadder are scattered desperate efforts in the Senate and House to deny the scientific realities of climate change.

The science community still needs to remain vigilant in the presence of attempts across the nation's capital to manipulate scientific truths about the challenge of global warming. Manipulation of scientific truths is still alive, but not necessarily well, in Washington, D.C. Journalists need to remain the cop on the beat in regard to this problem.

I was deeply involved in the counterattack against government censorship of climate-science in February 2005. It was of special concern for me to witness NOAA, where I had worked for 30 years, fall prey to blatant censorship of climate science. About seven months afterward, Jim Hansen challenged NASA headquarters about its censorship of climate censorship problems. The bad news was that Jim came in very late; the good news is that NASA caved-in very quickly when he did. The final bad news is that the press came in very, very late. If they had followed NOAA's "backlash lead" carefully, the very late NASA backlash probably could have been avoided.

The divide between climate scientists and science writers has narrowed considerably in recent years, in part the result of the valuable workshops that have led to this report. The urgency of evolving climate-science information has led to a better dialogue between scientists and the media, lowering the barriers between climate scientists and journalists.

The challenges, of course, persist. Journalists need to communicate interesting and compelling new science stories, communicating scientists' insights to the lay public. Scientists need to understand how nature works and communicate their new knowledge to the world. Both provide an invaluable communication service to humankind, albeit one frequently unrecognized by the lay public.

In the end, the fact that climate scientists seldom take the initiative in communicating their new results directly to the popular media is as it should be. It's distressing to read "new news" about global warming topics that actually had been published a decade or two earlier. In covering climate science, journalists will do well to ask respected climate scientists to help assess the credibility or originality of the new work. Scientists through this service can help the media, and therefore the public and their political leaders, vet new claims well before they become part of the established, though perhaps flawed, perceived reality.

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Beware of new findings, studies, or claims that seem too good to be true or that purport to overturn well established scientific theory, scientists told the journalists. No single report can do that, they said.

In reporting charges and counter-charges involving the physical science of climate change, most of the reporters said they find it important to report to the public the sources of funding of a particular scientific research effort.

The scientists agreed that the public has a right to know and evaluate the financial supporters of important scientific research. That information is crucial, said the journalists, to judge potential conflicts of interest.

While agreeing in principle, some scientists said that scientific assessments ultimately must be judged on their own merits. They said they believe scientists are primarily responsible to their scientific peers and colleagues rather than to the media, their own funding sources, or even the broader public. Many scientists disagreed with the journalists who believed strongly that scientific research can be trusted or dismissed based on the impartiality and integrity of the funding source.

In the end, it is not important that the journalism and scientific communities agree on all aspects of communicating climate science to a lay audience, and seeking their agreement or consensus was in no way an objective of the workshops. Much more important is that active practitioners in the climate science and science journalism communities continue to communicate among themselves freely and openly on the challenges, opportunities, and imperatives they face in helping inform an interested but non-expert audience about climate change issues.

These NSF-funded workshops were an important start to that two-way communication, as is this report. The discussions between science communicators must be frequent if the public is to benefit from continued access to the most scientifically and journalistically rigorous information.

4

JOURNALISM FOR SCIENTISTS

Most of the climate scientists who participated in the Metcalf Institute Science Communication and the Media workshops had experience working with reporters covering climate issues.

While the scientists' experiences ranged from fully satisfying and rewarding to frustrating and depressing, the researchers acknowledged that they had little familiarity with the daily process of news reporting and editing.

The workshops filled that gap, providing climate scientists and journalists the chance to explore issues related to how the media cover climate change science and what scientists and journalists can do to strengthen public understanding of climate change issues.

Early anxieties that the scientists might talk in technical scientific jargon understandable to few beyond their own ranks were eased just 90 minutes into the initial workshop. One of the participating climate scientists—Susan Avery, then at the University of Colorado—signaled a time-out in the discussion to clarify the meaning of some of the journalists' own jargon.

With a single-syllable three-letter word, "peg," the journalists were using their own professional jargon, which was not understood by the scientists. They might just as well have used the newsroom synonym "hook" to refer to something—an anniversary date, an unusual weather event, the release of a major study or film—signaling an opportune time to report a story on a particular subject. For example, the annual April 22 recognition of Earth Day is a common peg for media to focus on environmental and pollution issues.

The point was clear from Avery's intervention: Journalists and scientists throughout the workshops would need to speak with each other and not merely talk at each other. Points that the reporters took as a given might need clarification or amplification for the scientists, few of whom, for instance, had ever stepped into a newsroom. Likewise, points well understood among the scientists might demand elaboration for the journalists.

A Theme Uniting Journalists and Scientists

Just as scientists underscored to reporters the essence of science as independent and fact-based, reporters described journalism similarly. They articulated the need that news gathering and reporting be free from external political, ideological, and economic forces. Some reporters also said they are worried about mounting pressures from each of those forces in a changing media environment.

Most major mainstream news organizations try to maintain strict division between news and business, news and advertising, and news and editorial writing staffs. Why? Editors and reporters pursuing a story, for example, on an airline or big retailer's carbon dioxide emissions should be free of interference from the advertising department whose job it is to pursue ads from those same entities. Reporters should not be influenced by their own newspaper's editorial page views of a particular policy or candidate.

That is the text-book version journalists learn as part of their studies. How things actually work in practice, of course, may vary substantially from one news organization to another.

Understanding Journalism Ground Rules

The journalistic counterpart to the scientific method may be a set of broadly understood, and sometimes only selectively imposed or enforced, ground rules by which reporters gather information.

Reporters and editors participating in the workshops urged scientists to understand that these ground rules are far from universally understood and practiced. Even among journalists, they said, there are widely varying understandings and interpretations of how various professional rules work in practice. Those points just underscore the importance of a scientist's confirming in advance any ground rules that may apply in dealing with an individual reporter.

Many journalists take the approach that information and news should be unfettered, an idea many of them first encounter as part of their journalism studies and then hear throughout their journalism careers. Their job is to responsibly share with their audiences the news they need to inform their lives and be constructive citizens.

Reporters said at the workshops that they expect information given to them by scientists to be on the record with proper attribution, either to an individual scientist or a spokesman for an organization. Anyone speaking to a reporter in a professional capacity should assume what they are saying is on the record. Only if a source specifically says he or she will not speak for attribution should that source assume that speaking freely will be kept private, and this point must be made prior to the interview or conversation.

That said, there is much disagreement in journalism today on the use of anonymous sources, and many reporters understand the value of only quoting sources by name, even though many mainstream news organizations have allowed anonymous sources in certain stories. Where the reporter and editor agree to a restrictive ground rule on attribution, they are increasingly explaining their rationale or justification as part of the news story.

Some examples from reporters throughout the workshops follow. This is not intended to be an exhaustive list of journalism ground rules but rather a summary of key points participating journalists thought scientists should know about the guidelines that journalists follow.

✓Ground rules must be set in advance of an interview, press conference, or speaking engagement rather than afterward. Information provided to a reporter cannot be retroactively retracted. Therefore, it is important that the scientist and the reporter understand and agree on the ground rules before they engage.

✓A reporter can agree in advance to a restrictive ground rule—for instance, not to reveal the name of an individual providing the information. However, absent that agreement, any information given to a reporter is fair game.

✓It may be that a reporter will agree to a qualified ground rule: for instance, attributing the information to "a scientist at a leading Midwest university," while agreeing not to name the scientist, if there is a specific reason not to.

✓The scientist or other source may request anonymity and may insist that he or she will not speak for attribution. The reporter may accept or deny that request, and the two may also have to come to terms on how specific to make the attribution ("a Midwest university," "a Midwest private university," "a large Midwest private Jesuit university," etc.).

✓The journalists noted that they are particularly reluctant to have any restrictions on information shared in an open session such as a press conference or public meeting, where journalists are often competing to break the story.

✓Information once shared with a reporter cannot subsequently be withdrawn or altered by the source of that information. A reporter might agree to a modification—correcting spelling or clarifying a point. But information once shared with a reporter is no longer subject to alteration at the whim of the source.

Scientists' Previewing Copy in Advance of Dissemination

It is a long-standing practice of the independent American press for reporters not to provide advance access to their news stories. Reporters take great care to avoid allowing any selective previewing of copy.

This tradition reflects the market sensitivities inherent in economic and financial reporting to some extent, where premature release of financial or other potentially proprietary information can provide an unfair advantage (akin to insider information) for some, and disadvantage for others. In a more general sense, journalists must be careful to not allow their stories to be slanted by interested parties.

The subject of previewing a reporter's copy in advance of publication arose in most of the workshops. Some journalists were adamant that allowing sources to preview copy is simply unacceptable. Some said it would be grounds for discharge at their news organizations.

Other journalists said they take a more nuanced approach to the subject, and a few said they routinely share select copy—perhaps a sentence or a few paragraphs—with outside experts to confirm the accuracy of their reporting. Some reporters who said their news organizations disallow such previewing said they find ways to do it anyway: for instance, seeking clarification on a point or two by reading back a direct quotation to make sure they've gotten it absolutely right.

It was clear to many of the reporters that complex issues may require some vetting from experts, including a source. They may do this in narrow ways, such as reading back portions of their stories for review on specific points to make sure that they have got it right. They said they would not, however, seek comments regarding the overall piece, tone, editing, or style.

Workshop journalists urged scientists to appreciate that journalists act on this issue on a case by case basis. Many of the most respected and experienced journalists, as a matter of principle, will not agree to have their copy previewed, while other equally respected and experienced journalists may agree to such a technical preview under the same circumstances. Some will take these approaches with the full approval and knowledge of their editors and employers, and others may do so with or without that approval.

In either case, the journalists participating in the workshops urged the scientists to respect an individual reporter's and news organization's own discretion on this especially sensitive issue.

Journalistic Application of Balance in News Stories

Perhaps the only subject that came up more frequently than previewing copy was the issue of balance in news stories.

But if the scientists thought they would find the balance conversations particularly divisive, they may have been surprised: The journalists generally agreed that the media had taken the balance approach too far when it comes to reporting on certain aspects of climate change science.

The reporters urged the scientists to appreciate that balance has an appropriate role in some news writing—including many unsettled climate science issues—but that it does not apply to editorials expressing an institutional stance on a subject or to individual opinion columns which are designed specifically to express viewpoints, as news pages are meant to be free of them.

Many of the scientists complained that the media for a long time had given disproportionate attention to perspectives inconsistent with the broad state of scientific understanding, in particular, the scientific determination that Earth's global temperature has increased in recent decades and that human activities have played a significant role in that warming. The more experienced science and environmental journalists at the workshops agreed that reporting on these issues no longer needs to be balanced against opposing minority claims lacking in scientific rigor.

The scientists said they were frustrated that the consensus judgments of groups such as the United Nations/World Meteorological Organization and the Intergovernmental Panel on Climate Change (IPCC) were often pitted against perspectives espousing minority and scientifically unsound viewpoints. These discussions, some pointed out, seemed to echo past out-of-balance writing about smoking and cancer, for example.

Even so, many of the reporters defended the general principle of providing news balance though they agreed that it can be misapplied. There is a long tradition in the American media of providing citizens full access to a broad spectrum of perspective and opinion as the basis for decision-making in a democratic society, they said.

Many described squabbles with their editors over an insistence on including the other side in cases when the reporters felt it was inappropriate to do so. Sometimes, they said, it frustrated them when an editor wanted them to qualify a scientific finding as something a scientist merely thinks or believes rather than a verifiable scientific conclusion.

The reporters agreed with the scientists that such nuances are often lacking in the cryptic wording of headlines. Headlines are the first thing read in a newspaper or online story and are designed to capture attention with certainty rather than with subtlety. But headlines are not

'Mediarology'—The Role of Climate Scientists in Debunking Climate Change Myths
By Stephen H. Schneider

In reporting political, legal, or other advocacy-dominated stories, fair and honest journalists only appropriately report both sides of an issue, but in science, it's radically different.

There are rarely just two polar-opposite sides, but rather a spectrum of potential outcomes, often accompanied by a history of scientific assessment of the relative credibility of each possibility. Climate scientists faced with a reporter who is locked into getting both sides risk getting their views stuffed into one of two boxed storylines: "We're worried" or "It will all be OK."

Sometimes, these two boxes are misrepresentative: a main-stream, well-established consensus may be "balanced" against the opposing views of a few extremists. To the uninformed, each position seems equally credible. Scientists must learn quickly how both the advocacy system and the media function.

Being stereotyped as the "pro" advocate versus the "con" advocate regarding action on climate change is not a quick ticket to a healthy scientific reputation as an objective interpreter of the science. In actuality, it encourages personal attacks and distortions—a problem I somewhat whimsically term "mediarology."

Expert witnesses spouting opposing views—in Congress, courtrooms, or on news and editorial pages—often obscure an issue for juries, congressional representatives or the general public. They often refuse to acknowledge that the issue is multifaceted, and they present their arguments while ignoring—or denigrating—opposing views. No big surprise, but it is shocking how often that strategy is deliberate. Stakeholders increasingly select information out of context to protect their interests (e.g., ideological or financial), and clear exposition and balanced assessment are low priorities.

The attitude that, "It's not my job to make my opponent's case!" arises not only in courtrooms, but in most policy debates and in much of media reporting. Let's call it courtroom epistemology.

Scientists claim to be disdainful of this behavior, often pretending to be above such polemics in their objective, detached, and dispassionate assessment of "the facts." It's not that reporters, politicians, lawyers, and others or their methods are wrong or that "impartial" scientists are morally superior; the issue is whether the techniques of advocacy-as-usual are suited for a subject such as climate change. Just as it is a breach of scientific ethics to elliptically spin facts, it is a breach of ethics for a professional advocate not to advance his or her client's interests, even if it means consciously picking and choosing from the full range of data available.

When a scientist merely acknowledges the credibility of some contentious information or endorses actions that affect stakeholders differentially, opposing advocates often see a spinning of information for some client's benefit. Even when the scientist points to a wide range of possibilities and refers to extensive peer-reviewed assessments the opposition accuses the expert of currying favor from some alleged funding agent. After all, isn't that what everybody else is doing?

The fundamental question related to climate change, then, is this: How can we encourage advocates to convey a balanced perspective when the judge and jury are Congress or public opinion, the "lawyers" are the media, and the polarized advocates get only 20-second sound bites on the evening news or five minutes in a Congres-

written by reporters. They are the province of copy editors who may lack scientific knowledge to inform their word choices.

Advice to Scientists: Do Not Let Errors Stand Unchallenged

Throughout the workshops, reporters expressed frustration when a scientist complained about inaccurate coverage, only to acknowledge that he or she never called the error to the attention of the reporter or the editor.

Accuracy in news reporting is the highest and most important standard for responsible journalists, they said. Competition to be the first to report an important story is fierce in a round-the-clock media culture, but there is no pride in being the first to get the story wrong. "Get it first, but first get it right" is a reporter's mantra.

sional hearing to summarize a topic that requires hours just to outline the range of possible outcomes, much less convey the relative credibility of each claim and rebuttal?

Is there a solution to this advocacy-truth conundrum? On the one hand, it is an expert's responsibility to honestly report the range of plausible possibilities (what might happen?) and their associated (usually at least partially) subjective probability distributions and confidence levels. (What are the odds?)

On the other hand, an expert may have a personal opinion on what society ought to do with a particular risk assessment. Can a scientist who expresses such value preferences about a controversial topic also provide an unbiased assessment of the factual components? This may be a feasible tightrope to walk, but even if one is scrupulously careful to separate factual from value-laden arguments, will advocates and advocacy institutions buy it as "objective"?

An active effort to make our biases conscious and explicit via outside review is likely to help keep our science-advocacy more objective. The more we discuss our initial assessments with colleagues of various backgrounds, the higher the likelihood of illuminating our unconscious biases, allowing us to better manage the "advocacy-truth" conundrum.

The best safeguard in science-based policy issues is to have the scientific community address risk assessment rather than leave it to advocates spouting brief sound bites or to a few charismatic individuals. Some will say an expert cannot maintain scientific objectivity in a value-laden public debate, but after 30 years of striving to do just that, I think that science-advocacy can be done honestly. Just because some people distort or misrepresent doesn't mean all do—and not to the same degree. No one is exempt from prejudices and value judgements, but those who know how to make their values and biases explicit are more likely to provide balanced assessments—and to be able to single out those who do not.

To more fully ensure their credibility, scientists must go one step beyond making explicit statements of their value preferences. Those who make public statements should also produce a hierarchy of backup products ranging from op-ed pieces to more in-depth popular articles, to full-length books, and these must meticulously distinguish the well understood aspects of an issue from those that are more speculative. Books should also provide an account of how one's views have changed as the scientific evidence has changed. Even if only a minute segment of the public (or media) wants this level of detail, having a hierarchy of articles and books in the popular and scientific literature satisfies those who want more and gives scientists credibility in the popularization process.

Responsible advocacy and popularization are not oxymoronic—but they take discipline to minimize trouble. Scientists who simplify to get heard will never succeed in pleasing everyone, especially not those colleagues who think scientists should stay out of the public arena whenever there is a call for simplification of the science. If we do avoid commenting entirely, then we abdicate the popularization of scientific issues to someone who is probably less knowledgeable or responsible. The bottom line is simply that staying out of the fray is not taking the "high ground"—it is just passing the buck.

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Scientists expressed surprise to hear reporters say they lose sleep over the possibility that they spelled a name incorrectly, botched a middle initial, or made some other mistake. The reporters said effective interactions with science news sources can help them avoid factual errors in the first place, but when they make an error, they want scientists to tell them so they don't make the mistake again. With the extended digital and online life of many news stories, errors or unfounded accusations left unchallenged take on a life of their own.

While the reporters encouraged scientists to let them know about factual mistakes in coverage, they also asked them not to overreact. Most said they want to hear personally from their sources rather than learning that they approached an editor with a complaint about inaccuracy. Dealing with factual errors ought to be distinguished from complaints about the slant or tone of an article.

The Peculiarities of Covering Climate Change News

Newsrooms of daily newspapers and local TV stations have defined news for decades in the context of important developments occurring in the present, in or around the community of readers and viewers, and having a major impact on the audience and its life and well-being.

On any given day, news organizations have more events to cover than they can reasonably get to. Reporters also compete with each other for the best placement of their work in a world of finite space and air time. Top editors make the final decisions on what to run and where, based on input they receive from reporters and on their own news judgment.

Andrew C. Revkin, who has covered climate change longer and in more depth than any other daily newspaper reporter, made the point in several of the workshops that climate science news in many ways is the antithesis of the traditional definition of news. Paraphrasing Revkin's points:

- The impact of climate change generally occurs over long periods of time and sometimes most dramatically at great physical distances from a given audience.
- As opposed to "breaking news," climate change news often "oozes." As a parallel, Revkin compared coverage of a major oil leak caused by the grounding of an oil tanker with the oil pollution caused by nonpoint discharges coming off the nation's paved roads that will have an effect for a longer period of time and may be more devastating.
- Climate change lacks a single highly visible and particularly responsible bad guy. The invisible and odorless carbon dioxide emissions keyed to warming are emitted by diverse human activities and not by a narrow set of polluters, in stark contrast to the recognizable and noxious air pollutants in soot and smog.
- The climate change science story is characterized by incrementalism. Reporters remarked that they never would see a headline pronouncing "Climate Change Arrived Yesterday at 1:38 p.m."

Other factors add to the challenge of covering climate change as a typical news story, too. A local audience is most likely to ask: How will climate change affect my family and me here in Toledo, or in Spokane? Yet scientific confidence about climate change impacts actually decreases with smaller spatial scales, due to increases in natural climate variability.[1,2] Predictions improve over larger (regional to global) spatial scales.

Scientists speak with careful qualifications, caveats, and uncertainties that can discourage news coverage. This uncertainty means that a story will often be buried in a newscast or newspaper, rather than receiving top billing. Yet the most widely quoted climate contrarians do not speak of uncertainties and caveats, several of the workshop scientists said. These contrarians speak incorrectly in terms of absolutes.

Scientists and climate-savvy science and environmental journalists agree that global climate change at different times and places will have differing impacts, some negative and others positive, depending on perspective. The experts in climate science project that impacts, even with the attendant uncertainties, will be more negative than positive when viewed global-

Hot Words
By Andrew C. Revkin

I was closing out our news story on the latest report from the IPCC, the report exploring measured and projected impacts of human-caused warming. Toward evening, on an otherwise slow news day, the story migrated up the list to be the lead of the paper. When this happens, there's far more scrutiny by layers of editors and a bit more eagerness, perhaps, to make sure the story justifies the placement. It was quite a momentous report, speaking of big transformations afoot in the climate system in coming decades with high confidence. But that didn't seem to be enough.

Fairly late in the evening, someone on the news desk proposed adding the phrase "possibly dire" to the first sentence. I immediately rejected the idea, saying that such a phrase was no different from saying "possibly benign," so why say it at all? In the end, I negotiated the language below. It was hardly great nonfiction literature, but serviceable:

BRUSSELS, April 6 — From the poles to the tropics, the earth's climate and ecosystems are already being shaped by the atmospheric buildup of greenhouse gases and face inevitable, possibly profound, alteration, the world's leading scientific panel on climate change said Friday.

Something in that exchange betrays the powerful forces in daily journalism that are always tugging at the heap of content a reporter accumulates while writing a story, always pressing to amplify the "front-page thought," that term of art for the angle or element that's most jarring, scary, counterintuitive, or otherwise, well, newsworthy.

IPCC reports expressly avoid characterizing the projections of future change, and the actual measured changes in climate and responses by ecosystems so far have hardly been what anyone would cast as "dire." In fact they were so mild that the sentence I wrote describing them didn't make the final cut:

"The fingerprints of human-caused warming on the earth and biology remain subtle for now, the report said, with the effects measured in such changes as the expansion and increased numbers of glacial lakes, thawing permafrost, increased and earlier runoff in streams fed by mountain snows, a shift toward the poles and up mountainsides of various plant and animal species limited to particular climates, pole-ward shifts in migrations by fish and birds and expanding high-latitude populations of algae and plankton in the oceans."

Asleep yet? Not exactly a disaster movie.

The report's projections for the future, if no one adapted, were indeed dire, including hundreds of millions of people in southern Africa and southern Asia facing scant water and some semi-arid regions getting even drier and more arid. But while the report said that the number of people facing flooding risks along coasts in 2080, for example, might be hundreds of millions if no one adjusted ahead of time, it said that number could fall to tens of millions if investments were made in cutting coastal risks at the same rate they are being made today. In other words, the future could be a catastrophe, or a gradual transition, depending on the biggest variable in the climate equatio —human behavior.

Depending on a journalist's loyalty to conveying what science has learned, can learn, and cannot learn about a pressing complicated issue, or loyalty to motivating readers to get scared or attentive, a few words can make a very big difference. As always, "hot content" counts more than cold data or statistics or error bars. To me, that means it has to be handled that much more carefully.

Some will read this and say I should have gone with "dire." I'm sure I was in the minority that day, judging by how many times I saw the words "apocalyptic," "disastrous," "catastrophic" and the like used to describe the findings. My sense, after covering human-caused climate change for 20 years, is that the truth is plenty powerful enough without gussying it up with terms that may, or may not, be correct in the end.

Andrew C. Revkin covers climate change and science for The New York Times.

ly, with some areas benefiting from warming or shifts in precipitation and most others adversely affected.[3] For reporters and editors, this mixture of beneficial and detrimental long-term impacts distinguishes coverage of climate change from coverage of other environmental issues.

Reporting on climate change also presents a special challenge because the costs of mitigating impacts or adapting to them must be borne in present time though it is future generations who will benefit from what is done now.

Despite the daunting challenges, reporters and scientists at the workshops gave many outstanding examples of excellent coverage of climate change. In these examples, the reporters wove together the scientific nuances with regional impacts and human stories in a way that conveyed the complexity of climate change without boring or gratuitously frightening the audience.

A Changing Face of Climate Change News—From Whether and Why to What to Do About It

An evolution in media and public attitudes toward climate change took place over the course of these workshops.

By 2007, a change in the overall tone of media coverage of climate change science was apparent. There was greater recognition of evidence that the world is warming and that humans make a significant contribution to it and considerably less coverage of a small group of climate contrarians challenging that evidence.

In many newsrooms, the focus of climate change coverage shifted from whether and why climate change is occurring to what impacts it will have, what steps can be taken to manage associated risks, what the relative costs and benefits will be, and what the implications will be, especially regarding energy. For climate scientists who had become accustomed to battling climate contrarians in the trenches of news coverage, the changes portended an increased media focus on climate change policy, economic impacts, and energy issues, and less focus on the basic physical science of climate change that had characterized news coverage throughout much of the past two decades.

This change in focus does not mean the media will ignore important climate change science issues, nor does it mean that unresolved climate science questions no longer exist. Still, scientists must recognize that the news business is in the midst of a major shift due to the digital revolution, and for the near future, the shrinking revenues of many news outlets will translate to shrinking newsroom resources and a smaller "news hole."[4]

As a result, workshop participants suggested, climatologists may well find that journalists will shift away from stories about the underlying science, and toward stories about climate change impacts. Coverage will probably feature more social science, politics, and economics. All will play a role in how the media report the climate change challenges facing society—and how, whether, and when the public at large comes to understand them.

5

WHAT JOURNALISTS CAN DO

Journalism and public awareness of climate change changed substantially over the course of the workshop series. Metropolitan newspaper newsrooms and their broadcast counterparts faced increasing pressure from digital and online information sources, which translated to increasing pressures on shrinking news staffs. This trend was documented by organizations such as the Project for Excellence in Journalism and other media groups.[1]

Even so, coverage of climate change and related news increased substantially during that period, as broadcast television networks, cable outlets, and weekly news magazines ranging from Newsweek and Time to Sports Illustrated and Business Week gave more coverage to what they described as a mounting scientific concern. Daily newspapers were also providing more coverage—and in the opinion of many media watchers, better coverage—than they had before.

Those changes, and the reporters' and scientists' perceptions of them, provided the setting for the following ideas aired during the workshops:

1. Engage the Public

"Engage." Reporters brought up the term repeatedly throughout the workshops. They must engage their audiences, capture their attention and interest, they said. Many factors make this particularly difficult on the subject of climate change:

✓Some of the most dramatic and iconic images of potential climate change effects—polar bears stranded on land, receding glaciers, and extinction of species—may be viewed as affecting only distant places far removed from one's own daily life experiences.

✓The most significant consequences in many cases are not expected to be visibly manifested for years and will primarily affect future generations while imposing costs on the current generation.

✓Long-term changes will vary substantially across the globe. Though most impacts are expected to be negative or are largely unpredictable, some regions may actually benefit from increased warming or other changes in regional climate.

Andrew C. Revkin has written about the challenges journalists face in addressing climate change:

> *News is almost always something that happened today. A war starts. An earthquake strikes. In contrast, most of the big environmental themes of this century concern phenomena that are complicated, diffuse, and poorly understood…*
>
> *Out of all environmental stories these days, none is both as important (to scientists at least) and as invisible as global warming. Many experts say it will be the defining ecological problem in a generation or two and actions must be taken now to avert a huge increase in heat-trapping emissions linked to warming. But it generally hides in plain sight. You will never see a headline in a major paper reading, 'Global Warming Strikes—Crops Wither, Coasts Flood, Species Vanish.' All of those things may happen in coming years, but they will not be news as we know it.*
>
> *Developments in environmental science are almost by nature incremental, contentious, and laden with statistical analyses including broad 'error bars.' In the newsrooms I know, the word 'incremental' is sure death for a story, yet it is the defining characteristic of most research.*[2]

Compounding the challenges inherent in reporting on climate change science as news, workshop reporters pointed to many scientists'

discomfort in speaking with reporters in the first place, and many scientists' highly qualified and carefully nuanced pronouncements that are more appropriate for their discussions with peers than for communicating with the public at large about an important issue. Throughout the workshops, there were repeated references to the fact that many scientists are reluctant to be perceived as taking an unqualified position.

Reporters debated how best to make the challenges posed by climate change real and relevant to audiences in their daily lives without overstepping what can be supported scientifically. They discussed ways to inform their audiences about actions that can be taken by individuals—such as through "What You Can Do..." sidebar pieces—without veering into the role of advocate.

> "We are all struggling for better metaphores to inform the public that the human fingerprint is discernible now"
>
> – Richard Somerville, Ph.D.
> Scripps Institution of Oceanography

As with other science news, coverage of climate change can be enhanced with vivid photographs, satellite imagery, personal accounts of people's lives being affected, firsthand testimonials by scientists engaged in the act of discovery, and stories about the impact on real people—where they live and work. Among suggestions from the workshop on engaging the audience:

✓Use explanatory journalism to both educate and inform, with articles relevant to readers or viewers.

✓Rather than simply cataloguing problems, include practical actions to give readers a sense they can make a difference.

✓Show the impact of collective measures such as car-pooling and energy conservation.

✓Use visuals and graphics to appeal to specific audiences, for instance those interested in fishing, hunting, travel, or culinary activities.

✓Report facts and findings and let interviewees and direct quotations deliver emotion.

✓Make the work more compelling by reporting about humans rather than just facts and figures.

✓Do not underestimate the public's receptiveness to new and profoundly important ideas, though questions remain about how much science the audience can absorb. It would be wrong to assume the public is not interested in science, and it is the job of the journalist to make the stories relevant and clear to those they are meant to reach.

✓When interviewing scientists, do not limit questions to asking what is new about the research but include why it is important and how it relates to the public at large.

✓Take every opportunity to work in the field and in laboratories with scientists. This can be much more productive than reporting by telephone or e-mail, and is particularly effective in climate science because many aspects of climate change research include field work.

✓Have background for some science stories at the ready, in order to quickly respond to teachable moments that provide good pegs. For example, profiles of prominent scientists who are going to be recognized for a newsworthy award or honor may be done in advance of publication or a review of a scientist's major accomplishments (perhaps prepared for inclusion in an eventual obituary), or a review of existing research findings on a subject in anticipation of peer-reviewed publication of new research findings.

✓Link climate stories to timely regional issues—a severe drought or flood or declining snow pack—in ways consistent with scientific understanding. Always be careful to avoid implying an unfounded cause and effect relationship between a specific storm event and climate change generally.

2. Master the Language

Humans try to make sense of the world through language. It is the most important tool of the journalist, and the terminology chosen to name something has much to do with how an idea is either embraced or rejected. One of the challenges to the public's understanding of climate

The Local Story on Climate Change Is a Critical One
By Bruce Lieberman

In the fall of 2007, wildfires driven by seasonal and fierce Santa Ana winds swept once again across Southern California. It was a terrifying reprise of October 2003, when fire consumed hundreds of thousands of acres of forests and brush lands, destroyed thousands of homes and darkened the sky with choking smoke and ash.

Could global warming be to blame? It may be tempting to draw a connection, but the science is unsettled. "The recent and tragic Southern California fires in chaparral-dominated landscapes cannot yet be unambiguously related to climate change," scientists at the University of California Merced and the University of Arizona said in a statement four days after the 2007 fires ignited.

The researchers cited a 2006 study that suggested a strong connection between global warming and the long-term increase in wildfires across the mid-elevation forests of Alaska, Canada, and the parts of the western United States. But for Southern California's coastal chaparral ecosystems, the fire record shows "no statistically significant trends," they said.

Meanwhile, some researchers suspect that global warming may be intensifying drought conditions across Southern California. Others have said that continued high rates of greenhouse emissions may increase the frequency of Santa Ana winds in November and December.

The wildfire story in Southern California is a telling one when it comes to reporting on the potential local impacts of a warming global climate. There are no clear answers, at least not yet.

Climate scientists have become increasingly confident about the global effects of warming temperatures, but there are still many uncertainties about how warming will play out in specific regions.

Nevertheless, people want to know how the world's rising thermostat might change everyday life for them. An acquaintance who is not a journalist or scientist once said to me: "I'd like to think I care about the penguins in Antarctica, but what's going to happen here?"

No credible scientists are going to say they can answer that question with precision. But researchers can help journalists understand how warming over the last half of the 20th century has left its fingerprints on regional environments. They can also help reporters understand the strengths and limitations of computer models as they attempt to predict regional changes associated with specific trajectories of rising carbon dioxide.

Think for a bit about the region you cover, and you'll find plenty of stories. In the western United States, for example, global warming is primarily a story of water. And there's probably no trend so worrisome as that of the declining mountain snow pack, a primary source of fresh water for California and many other arid states.

—*continued, p. 30*

change is the language chosen to characterize it. And consensus of the proper ones is elusive:

✓The 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report used the term climate change to refer to any change in climate over time, whether as a result of natural variability or of human activity.

✓In a widely reported 2002 memorandum on Republican Party strategy, however, Republican pollster and analyst Frank Luntz provided the following counsel:

> *'Climate change' is less frightening than 'global warming.' As one focus group participant noted, climate change 'sounds like you're going from Pittsburgh to Fort Lauderdale.' While global warming has catastrophic connotations attached to it, climate change suggests a more controllable and less emotional challenge.*[3]

In fact, the Bush administration by and large avoided the "global warming" terminology and referred instead to climate change or "natural climate variability," terminology generally less understandable to the general public and not well suited for headlines and sound bites.

✓On the other hand, to heighten public awareness of climate change, others prefer terms such as "global climate crisis," the term preferred by former Vice President Al Gore. Some simply call it: "climate crisis," including Democratic party activist and linguist George Lakoff, of the University of California at Berkeley. Speaking at the workshop in

Embedded in this story are numerous other ones:

As snow pack dwindles, will regional and state governments build more dams? Will desalination plants line the West Coast? What will water cost in coming decades? Will Southern California, naturally an arid landscape, look more and more in coming decades like Baja California, where the desert meets the sea?

Where wildfire and warming temperatures are strongly connected, how will frequent blazes change the ecology of entire landscapes? As constant companions in the summer and fall, how badly might wildfires degrade air quality and foul waterways?

All of these questions are starting points for local stories. They'll require that reporters and editors understand climate and environmental science, environmental policy, water management, and emergency preparedness.

There's also a need in climate coverage for old fashioned reporting – that is, checking up on what politicians say. In San Diego, for example, the mayor has joined hundreds of others around the nation in declaring that their cities will strive to meet the Kyoto Protocol. The target: cutting citywide greenhouse gas emissions to 7 percent below 1990 levels by 2012.

What exactly will it take to meet that goal, which will require massive and widespread reductions in greenhouse gas emissions throughout San Diego? My newspaper found that one "solution" would be to eliminate half the vehicles in San Diego. Another would be to stop all energy use by homes and industry.

Placed in a global context, analyzing one city's greenhouse gas emissions seems trivial. But global warming today is essentially the collective result of billions of decisions people make everyday. Reporting that focuses on consumption at all levels, and draws connections between what we consume and how much carbon dioxide individual actions are responsible for, should resonate with readers.

These kinds of stories can find a home throughout a newspaper -- in news, business, features, home, family, automotive and travel sections.

Sustaining coverage of the globe's warming climate takes a strong commitment from a newspaper's leadership. And these are tough times for the newspaper industry. As papers lose readers to the Internet, revenues are falling, news staffs are shrinking, and science reporting is falling by the wayside. Many news organizations have eliminated science reporting positions as they've recommitted their resources to what they see as higher priorities.

Still, the story of a warming climate can be a local one. It's important that it be told.

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Berkeley, Lakoff said he prefers that term because it connotes a need for immediate action.

A 2007 Newsweek feature story counted references in The New York Times to the two terms, climate change and global warming.[4] The magazine reported that The Times over the preceding three years had used the term global warming about twice as often as it used climate change.

3. Avoid the Temptation to Hype New Research Findings

Scientists and journalists alike acknowledged pressure to occasionally overstate or "hype" the importance of a finding or story. Scientists must attract funding. They may also feel pressure from their own public affairs offices to draw attention to their work.

Journalists feel constant pressure to compete with all other news for time on the air or space on the front page.

It may happen that reporters without proper skills to report knowledgeably on the process of science and scientific uncertainty may inadvertently exaggerate the importance of the incremental steps of science. One veteran journalist cautioned colleagues about relying on an institution's press releases regarding its own peer-reviewed publications.

4. Who Paid for the Research?

Discussions about the sources of funding for scientific research occurred at nearly all of the workshops. Journalism participants recognized the exhortation to "follow the money," a journalism aphorism that gained particular promi-

Why We Don't Get It

By Peter Dykstra

About ten years ago, I shot a story on the possible impacts of endocrine-disrupting chemicals on people, wildlife, and ecosystems. There was one little problem with producing this story: The respected, cutting-edge researcher on the topic did not think highly of TV journalists, and wanted no part of another TV interview.

We went back and forth on the phone for a while: The scientist related a few horror stories about what can happen when a TV station's Promos Department pumps a story about gender-bending alligators; I pressed on, making a case that my intentions were to produce a story that would leave science, journalism, honor, and virtue intact.

Then I made a good-faith effort to describe the challenge of passing science through the filter of TV news: "It's my job," I told the world-class researcher, "to take your life's work, and describe it in a single sentence."

The scientist agreed to be interviewed, and the story came out just fine. It's probably for the best that I never mentioned that there's a guy in the newsroom called a "Copy Editor," whose job is to make the life's-work sentence shorter.

When it comes to science stories, the 24-hour TV news world has its own Periodic Table. In our world, the most common elements have symbols like "OJ" and "BTK." (If you don't know what these stand for, clearly, you're not getting enough 24-hour TV news in your life.) Stories about things like the Origin of Humanity, or the Fate of the Planet, face an uphill battle in vying for attention with stories about the Origin and Fate of Anna Nicole Smith's baby.

It's particularly tough for "theoretical" stories like climate change. That has a lot to do with how the news business, and our society in general, make decisions.

Both journalists and the general public have a tendency to weigh the evidence for climate change by the same standards used for a criminal case. And while science doesn't live or die on the standard of reasonable doubt, that's the standard usually applied by newsrooms and policymakers.

There are at least three distinct constituencies seeking to cast reasonable doubt on the prevailing science: Scientists whose dissent with the prevailing view is genuine; scientists with more dubious credentials and funding sources whose dissent is seemingly reflexive – and in perfect harmony with their funding sources; and ideologues who view climate change as the opposite pole on a liberal/conservative axis.

Each of these groups contributes to the generation of reasonable doubt. And the most cynical among them view the generation of such doubt as an end, not a means. That's why many adhere to the direction most famously laid out in a memo from political consultant Frank Luntz:

"Should the public come to believe the scientific issues are settled, their views about global warming will change accordingly. Therefore, you need to continue to make the lack of scientific certainty a primary issue in the debate."

That goes a long way toward explaining why scientists and news executives can look at the same body of evidence, and the scientists see "consensus" where many news execs see "reasonable doubt." And as we've all learned in cable news, reasonable doubt means that global warming is acquitted, and is set free to seek the Real Killer. (See "OJ," above.) And more important, this is one of the reasons why the issue can be covered so badly, with a disproportionate amount of weight given to a tiny minority of scientists; or, as often happens, why the issue may not get reported at all.

I've urged my bosses to try and look at this, and other science issues, by the standard of a civil trial. "Preponderance of Evidence" is the order of the day in a civil court. A judge or jury is free to render a verdict if the evidence is overwhelming. This may be the fairest analogy to apply to policy and science issues such as climate change.

As more scientific evidence has poured in, and as some of the impacts of climate change make the transition from prediction to reality, the deadlock premised by media "balance" has given way. There is no doubt that the news media–television news in particular–need to stay in step with the scientific community in our understanding of an issue that could define the 21st century.

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nence in the early 1970s reporting on the Watergate controversy, and remains strong in many newsrooms today. Many journalists are taught to think those who pay the fiddler call the tunes. But to what extent should the media consider funding sources in weighing the credibility of scientific findings? Most reporters agreed that their audiences have a right to know who paid for the research, and to make their own decision about potential influence.

One scientist cautioned journalists not to focus excessively on the issue or on other personality or political characteristics of the scientist, saying that those issues can obfuscate rather than enlighten. Instead he said he would prefer to see reporters focus on the underlying scientific credentials and qualifications of their sources, such as an established record of publishing in respected peer-reviewed journals.

Some reporters responded that accurate reporting of scientists' financial, political, and institutional connections—for instance, their senior fellowships at public policy think tanks and interest groups—is part of a reporter's responsibility. The reporters agreed with several of the scientists that such reporting could nonetheless maintain a focus on the underlying scientific validity of the research.

5. Find Authoritative Sources on Climate Science

Workshop participants suggested that a Web site be established to help journalists and scientists find potential sources. The site could include biographical information on members of each profession and would allow journalists to vet scientists and find the ones most suitable in each area of expertise. Journalists also suggested that the scientists include additional information such as funding sources.

Science reporter Seth Borenstein, then at the Knight Ridder Washington, D.C., bureau and now at the Associated Press, told the Seattle workshop that he routinely uses an informal truth barometer to determine a scientist's trustworthiness and credibility.

Borenstein said he asks the scientist to identify other scientists who disagree with his or her findings, but whom he or she nonetheless believes to be reputable. "If you cannot think of anybody, you drop down on my list," Borenstein said. "There's always somebody you don't agree with wholly but who follows the rules."

Several reporters recommended the RealClimate Web site as a practical check and balance on complex climate science information.[5] RealClimate is maintained by professional climate scientists who want to clarify climate change for non-scientists. The Web site was described as a "rapid response mechanism" aimed at deflating scientific myths or rumors before they could be ingrained in the media and public consciousness. Journalists said the site is an example of new media's capability to distribute information and to challenge unsubstantiated claims to a large audience, independent of the timing and gatekeeper controls in the mainstream news media.

There is a growing trend of scientists using their own Web sites to trumpet their research findings. This approach is a reflection of the larger trend toward digital and online information dissemination and another form of competition for traditional news providers. Through such postings, the reporters and scientists agreed, individuals increasingly have an option to self-publish and distribute their own information, independent of the quality assurance, fact checking, and other benefits provided by independent editing through peer review or within a traditional newsroom setting, but also without the attendant constraints and limitations.

However, self-publication, workshop journalists and scientists agreed, imposes additional burdens on the public to do their own verification and analyses of trustworthiness. Because these postings bypass the scientific peer-review process, they can vary significantly in quality.

6. Ride the Wave of Public Interest in Climate Change

By the end of the workshop series in mid-2006, scientists and journalists agreed that there had been a significant transformation in reporting on climate change, and the public's receptivity to it. At the final National Science Foundation-funded workshop in Washington, D.C., and in the roundtable for news executives in September 2007, there was discussion about how the tone of coverage had shifted from questions about whether climate change was happening to what could be done about it.[6]

Given this shift in coverage, reporters were urged to:

✓Focus more on how climate change will affect people and less on contentious arguments about the more arcane points of climate science.

✓Report how various segments of society are addressing climate change and attempting to manage related risks.

✓Provide more coverage of climate change impacts on many aspects of daily life, such as tourism, sports/recreation, local government, health, business, agriculture, forestry, and education.

✓Report on climate change implications in business and financial sections of newspapers to better reach corporate and investment communities.

✓Make better use of year-end summary stories to characterize the changing nature of climate change science, policy, and of public opinion over a period of time.

✓Use sidebars to do more explanatory reporting.

✓Do more to help the public understand energy consumption patterns in our day-to-day lives and activities.

7. Convincing Editors— How to Get Past the Gatekeepers

Reporters at the workshops were clear on the need for senior editorial news managers to understand that climate change is a vitally important story to keep before the public. They spoke of the tension between reporters' desires to maintain the visibility of climate change stories and their unwillingness to miscast weather stories about specific meteorological events, for instance, as breaking news tied to climate change. They suggested a number of ways to persuade editors to publish or broadcast their climate change stories with appropriate prominence, while avoiding overstating the importance of the story.

✓Reporters need to make the case for increased coverage to their editors and news managers not solely on the basis of what they have uncovered that is new, but also on the implications, relevance, and importance to the audience.

✓Recognizing that editors are always in the market for good stories, reporters were urged to keep pitching ideas that editors can't resist, such as stories relating the daily rush-hour highway congestion to urban sprawl, energy consumption, air pollution, and climate change.

✓Workshop journalists suggested that freelance and independent reporters focus on climate change stories that the public might otherwise miss, rather than reporting on the latest scientific research routinely covered in-house by staff reporters. Given a trend in many newsrooms toward increased reliance on freelancers and smaller staffs, reporters said they see this approach meeting the interests both of freelancers and the news audience.

8. Back to Journalism Basics

Many of the suggestions included in the workshops were specific to reporting on climate change, but journalists also shared a number of recommendations for their colleagues that were reminders of the basic principles of good journalism, such as:

✓Achieve real objectivity as through the scientific method, using reporting that could be replicated by other reporters. Journalists should maintain a healthy skepticism and seek evidence, not merely opinion that contradicts specific findings.

Climate Scientists and Climate 'Skeptics': Deciding Whom to Trust
By Richard C. J. Somerville

As a climate scientist, not a policy expert, I think the most important function of climate science on an issue of broad interest like global warming is to help educate the public and to provide useful input into the policy process, but not to advocate policy. Governments and corporations and individuals should listen and learn from the science, then make their own decisions, just as intelligent people listen to their physicians when their health is in question.

Good science input can inform wise policymaking. I think the scientists' function is to communicate research results in an intelligible way that is policy-relevant but not policy-prescriptive.

We may contrast mainstream climate scientists and a smaller group of people often called climate skeptics. However, the language is misleading. All good scientists – like good journalists – are skeptical of received wisdom and want to have things proven for themselves to their own satisfaction. How do we distinguish the trustworthy scientists from the charlatans, or simply from the less competent scientists?

Climate science is complex and technical. There are many useful analogies with medicine. You cannot become a physician by spending a few weeks in the library, as some popularizers of climate change skepticism have tried to do.

The Intergovernmental Panel on Climate Change (IPCC) released its Fourth Assessment Report (AR4) in 2007. It is available for download at http://www.ipcc.ch. Two headline statements from the report of AR4 Working Group One (WG1) encapsulate the WG1 findings:

"Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." (IPCC, Paris, 2 February 2007)

"Most of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."
(IPCC, Paris, 2 February 2007)

Here 'very likely' is calibrated language denoting 90% or more certainty.

What exactly is the IPCC, and how does it work, and is it credible, and why? The IPCC is an international organization, established in 1988, specifically to provide an authoritative assessment of results from climate science

✓Reporters should be transparent about what they do and how they do it. They should be open about how they conducted their research, reporting, and interviewing, which source documents they used, and how they evaluated various sources' credibility on a subject. This could be accomplished through the use of journalists' blogs or even through editors' notes, as is done in some peer-reviewed journals. In effect, they should be open to sharing with their audiences the kinds of "how I did the story" accounts they often enjoy sharing with their colleagues.

✓Reporters should constantly hone their analytical skills on important issues to avoid deadline temptations to substitute an ostensible balance for more research and reporting and the in-depth analysis required.

✓Reporters need to recognize that traditional formats of news reporting sometimes are inadequate for doing justice to complex science stories. They should seek out longer formats to explain nuances, complexities, and consensus of opinion. They need to make use of all the media available in the digital age—video for the Web, expanded online versions of printed stories, responsible blogs, etc.

✓Reporters interviewing scientists might do well to go into the interview with a planned transcript of their questions, while understanding they will need to act spontaneously to fol-

as an input to policymakers. It doesn't do research. It just assesses the research that gets published in the peer-reviewed scientific literature.

The IPCC has a tiny budget and staff. Its main work is organizing large numbers of scientists to get these assessments done. People who favor or oppose particular policy outcomes, whether carbon taxes or nuclear power or emissions controls or encouraging energy conservation and efficiency, can have no quarrel with the IPCC. It does not take any policy positions, period. It just assesses science.

The strong reputation of IPCC derives mainly from the processes involved in drafting its reports. The IPCC is exceptionally open and transparent. According to established IPCC procedure, the Working Group I Fourth Assessment Report, which took three years to write, underwent several formal and fully documented expert and government review processes, where tens of thousands of comments were responded to (the responses to each comment are available).

The wide participation of the scientific community, the thorough nature of the assessment, and the absence of any policy prescription in the report are the characteristics that render the report so powerful. This is precisely why it serves a unique role in informing policymakers, as well as others such as industry and media and the general public.

Does the IPCC report provide absolutely certain "truth"? No, and one never gets that from science. But it is today's best summary assessment of what the science says, and it includes estimates of uncertainty. Its predecessors were endorsed by national academies of science and professional scientific societies worldwide. The new report will surely earn the same status.

Over the years, and at least until recently, the media in general have given far too much attention to the climate skeptics. Climate science is real science, and it has made great strides in recent decades. It doesn't hang from some slender theoretical or empirical thread that might easily be "refuted." It is certainly not going to be brought down by simplistic notions from non-scientists or from bystanders who don't do or publish climate research themselves.

The climate skeptics are typically people who can't or won't recognize that the science has passed them by. Their true motivations are more political than scientific. They have marginalized themselves by their unwillingness to confront forthrightly the totality of scientific evidence opposing them.

Through IPCC, climate science speaks to humanity as a wise planetary physician. Its message is simple. Ignore the charlatans. Listen to your trusted physician, then make your own decision.

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low up on specific points and, where necessary, trash their scripts entirely in pursuit of the story. They need a basic understanding of scientific concepts such as relative and absolute risk. And they need to understand the virtues and limitations of certainty and uncertainty and varying levels of statistical confidence.

✓Reporters must go beyond the press release-driven news story on a peer-reviewed article to understand and potentially explain the questions underlying the study, rather than just the conclusions.

✓Reporters need to avoid doing the same "day-one" story that all the other media are doing, and instead offer reporting that is unique and individual and no less valid scientifically. They should not over-rely on press releases or on executive summaries, and need instead to invest the necessary time to understand original documentation.

✓Reporters need to find effective and timely ways to fact check and verify their work in ways that go beyond what an on-deadline editor can be expected to do. They need to do so in ways consistent with their employers' policies on how and whether pre-publication or pre-broadcast material can be verified for factual accuracy, for instance by an individual being quoted, before publication or airing, and do so in a way consistent with responsible journalism.

9. Back to Science Basics

At some of the workshops, several scientists appeared surprised and pleased to hear journalists speak of their commitment to accuracy, a commitment that sometimes causes them to awaken during the night to worry about whether they got a date or the tricky spelling of a last name correct. For the journalists, accuracy and a commitment to it were raisons d'etre, and some expressed disappointment that the scientists would be surprised by that commitment.

Scientists said that they were afraid of being misquoted, or having their remarks taken out of context. They said that fear is one of the main reasons some resist taking reporters' phone calls. Several of the participating scientists said they hoped that having an opportunity to preview a reporter's copy could avoid their being misquoted, although this practice is anathema to responsible reporting. Some reporters, however, said there are acceptable and unacceptable means of having an outside expert help verify or validate reporting before it is aired or published. Some reporters said they work with scientists to confirm their quotations—for instance, reading back the exact wording or sending an e-mail with the exact language to be used in the piece. Few said they are willing to submit their intended questions in advance of an interview.

Journalists discussed a number of practices to improve reporting accuracy on scientific topics. These fell into the following categories:

A. Understanding Science and the Scientific Process

✓To judge the maturity of a scientific idea, consider the number of scientific papers published on the subject. Is the source among the authors of those peer-reviewed papers?
✓Review the references at the end of science journal articles for clues about other researchers who work on the topic. A person whose name appears in many of the articles cited is likely to be another good source.
✓Be careful in reacting to research findings simply because they are new. Have the discipline to step back and ask, "What do we really know today that we didn't previously?" Consider, and be prepared to question, possible non-science motivations of all involved—including oneself.
✓Clarify differences in scientific findings but avoid sensationalizing them.
✓Be leery of correlations that seem too good to be true—especially single factors used to explain complex phenomena. Seek more training in statistics and in how to interpret data.
✓Make multiple phone calls and make contacts that give confidence in the accuracy of the reporting.

B. Communicating with Scientists

✓Never hesitate to ask scientists to clarify what is not understood. Scientists often slip into jargon without realizing it. Ask them to explain the point in ways understandable to non scientists.
✓Insist that scientists disclose the evidence for their statements. How did they draw their conclusions?
✓Recognize that you can't rely on a single scientist for authoritative and comprehensive information about all aspects of scientific research in an issue as expansive as climate change. The complexity of climate change, for instance, requires the integration of atmospheric chemistry, oceanography, biology, hydrology, glaciology, biogeochemistry, paleoclimatology, and many, many more subdisciplines. Respect the specialized information in those fields—one wouldn't ask a scuba diver for detailed insights on spelunking.
✓As a truth barometer, have scientists identify experts in their field whose conclusions differ, but whom they nonetheless believe to be reputable scientists.
✓Seek out scientists who have no known partisan or policy agenda or affiliations—those who can serve as honest brokers of information on a given topic.
✓Question scientists about how they have determined that a particular phenomenon is the result of anthropogenic activities, such as the burning of fossil fuels, and not simply a natural effect. Hold them to high standards of proof and evidence.

✓Avoid asking scientists to delve into policy or political issues—or at least be careful about doing so. Allow scientists to address policy questions as individuals and as citizens if they are willing to do so and include that important distinction in the reporting. Some scientists may decline, in any event, to venture into policy issues, notwithstanding your assuring them that they can speak as a citizen and not as a scientist. It is always best to respect their preferences in these cases.

C. Assessing Uncertainty

✓Rigorously explore with scientists the levels of uncertainty in their work. Recognize that uncertainty is often a strength of the best science rather than a weakness, and that uncertainty can also make for more engaging science news. Those professing certainty in scientific issues may be more suspect than those readily acknowledging uncertainties.
✓Be cautious when the author or authors of a single study claim to have made a "break-through"—a word, by the way, that the best science writers vow to avoid—that refutes an established body of scientific research. The results of a single study rarely have such a profound effect on scientific consensus, and this claim is inconsistent with the iterative nature of the scientific process.
✓Help audiences understand and appreciate the role of uncertainty in science. Recognize that some scientific uncertainties will never be resolved.

D. Healthy Skepticism

✓Reporters need to think about the timing of the release of scientific findings—were they timed to influence policy activities or funding cycles? Why did this particular author or research institution choose this particular time to release this new finding?
✓Take care when reporting on uncertainty that appears to be intentionally generated for political reasons. Differentiate specious controversies from genuine scientific disagreement among qualified experts.
✓Understand the strengths and limitations of peer review. While critical, not all peer reviews are equal and some are more effective than others. Peer review in and of itself is not a guarantee of accuracy.
✓Be skeptical of climate scientists who speak in absolutes and without margins of error because the most responsible science is not without uncertainties and unknowns.

E. Newsroom Pressures

✓Avoid newsroom pressures to elevate incremental research findings to leading news when they are better suited to the inside pages. While it's nice to get the lead story, sometimes it is more responsible journalistically to acknowledge that the story deserves lesser play.
✓Resist editors' efforts to minimize uncertainty and help them understand why acknowledging uncertainty is important.

10. Truth, Fairness, and the Balance Issue

Reporters spent a good deal of time in the workshops on the issue of balance, recognizing that balance had become a particular focus of criticism among scientists. Ideas they discussed included:
✓When climate change contrarians challenge scientific findings as part of a policy campaign, refer to them only in the policy context unless their scientific qualifications and motivations fully warrant their being referred to in science stories.
✓Educate editors on the weight of the evidence, so that they don't determine the fairness of a story based on a balance of opinions rather than evidence. Don't let editors or outsiders determine the journalistic merits of reporting based on quantitative "balance" considerations, but rather on the basis of fairness and reporting evidence.
✓Support stories with well-documented facts—for instance historical temperatures, hard data showing that specific recent years were the hottest on record globally.
✓Focus on arguments and evidence and not on advocacy and opinion.

11. Make the Most of New Media

Journalists recognized that they need to take advantage of the emergence of new ways of communicating news and information. Some ideas they considered:

✓Take advantage of the Internet to tailor information for smaller and more targeted audiences and provide additional depth and context, including more extensive use of visuals, graphics, and charts.

✓Use the potential to tell stories in ways that are richer than in print and audio alone. In addition to offering more extensive graphics and visuals on Web sites and the printed page, provide electronic links to original source documents and background information, and address issues at more length than is feasible in the daily newspaper or in TV or radio news programs.

✓Seek out opportunities presented by the new digital media, and avoid focusing solely on the hurdles and challenges as the media transformation in the digital age proceeds.

✓Be prepared to fill a role not necessarily in breaking news, but rather in authenticating it, providing critical context and understanding.

✓Don't confuse technique with principle or means of distribution with substance. Basic principles of fair and responsible independent journalism need not be media-centric.

Good journalism—whether in "new" or traditional news media— keeps to the same guiding principles of accuracy, fairness, use of informed and authoritative sources, understanding of the issues, careful fact-checking and sound editing on the topic of climate change as any other science-based issue; indeed, every issue requires the same commitment to excellence.

6

WHAT SCIENTISTS CAN DO

Participants at the series of workshops developed an appreciation of the values shared by journalism and science, while acknowledging that their two disciplines employ different methods. Journalists and scientists must objectively verify facts and determine reliable sources of information. Both benefit from a story well told, factually accurate, and understandable to their target audience—what Gianna Savoie, an independent documentary producer at the time with WNET-TV and the public television program Nature, described as "saying something brilliant, simply."

Specific standards of ethics and conduct are applicable in both journalism and science. And the best journalists and the best scientists bring to their work a healthy skepticism and a persistent pursuit of evidence and "truth." Most participants came to see that the intellectual fruits of their labors in most cases lead to incremental steps toward full understanding.

Scientists and journalists by and large agreed that scientists need to learn to communicate more often and clearly with the media, and they must understand the basic tenets of journalism if issues such as climate change are to be understood by the American public.

Climatologist Stephen H. Schneider exhorted scientists to keep reaching out to reporters. Some disappointments are inevitable, he said, but the payoff over time will be improved coverage of science.

Many of the participating scientists spoke of their own naïveté and unfamiliarity with the fundamentals of sound journalism and confessed their lack of understanding of the principles that drive good journalists. Most scientists know little, they said, about newsrooms or about the forces driving today's media.

Both scientists and journalists at the workshops by and large agreed that scientists need to become better communicators, and must embrace the role of publicly countering misinformation.

Most scientists at the workshops recognized that some among them are inherently better suited than others to work with journalists and that not all scientists should play an active role with journalists. Scientists who are uncomfortable stepping out of the scientific community to communicate directly with the public may want to consider having another scientist stand in for them. Participating scientists from research institutions also posited that scientists ought to work closely with public information officers, as this communication resource is often overlooked.

However, the scientists understood that being an effective science communicator does not mean mastering what reporters dismiss as "spin." Quite the contrary, journalists emphasized, it is the absence of spin that they value in their dealings with scientists. The journalists advised the scientists to focus on explaining research clearly, with minimal scientific jargon. Scientists in the workshops said their teaching experiences in the classroom were the best preparation for explaining their work to journalists and non-scientists.

It was also suggested that scientists learn and, where possible, operate within the norms of journalism, and try to understand the business and the incentives driving media outlets. This understanding, participants agreed, could put scientists in a better position to know how to get their message across. Workshop participants had these recommendations for scientists:

1. Convey Research Clearly

Workshop participants suggested these tips for scientists to more clearly convey their messages to the news media:

✓Appreciate that information must be imparted many times and in many different ways before it is fully understood.
✓Learn to recognize and exploit moments that may provide valuable opportunities for teaching; e.g., a natural event such as a storm, or a manmade one such as the release of a relevant motion picture that can provide an opening to discuss climate change issues.
✓Be approachable.
✓Reveal passion for the work.
✓Attempt to convey research as both visual and dramatic and as relevant to the nonscientists.
✓Allow reporters to observe research progress before publication. Some workshop scientists, however, expressed concerns on this point, fearing open media access at scientific meetings, for example, could have a chilling effect on informal professional communications and reviews.
✓Avoid using arcane acronyms and jargon and recognize the potential limits of the audience's knowledge.
✓Streamline data for journalists to help them understand the research, why a study is important and how it is relevant to the general public.
✓Consider whether a peer-reviewed published paper ought to be the sole product of the work or if the practical applications of research findings are also a part of the mission.
✓Remember the audience. Rather than explaining research in the format appropriate for colleagues, focus on the people who will be reading a reporter's work or watching it on television.
✓Think of how to explain the research to family and friends at a family reunion, and use the same terms when translating for reporters.
✓Write concise, plain English synopses of research as a companion to official research papers—synopses that reporters can easily find on the Web and use to prepare themselves for interviews with the authors.
✓Don't obfuscate the crucial points of a paper by putting the most important points deep inside—what editors call "burying the lede." Reporters put major conclusions first in a story.
✓Become more skillful in communicating with journalists and non-technical audiences on basic scientific concepts and statistics, and do so in terms easily understood, using suitable metaphors and examples when possible.

2. Establish Professional Credibility

Suggestions for scientists to substantiate their professional credibility on a topic when speaking to reporters included:
✓Carefully describe the quality of evidence underlying conclusions and share the protocols on which research findings are based.
✓Describe work in the context of research that preceded and contributed to it. Acknowledge supporting work and scientifically rigorous, yet conflicting work by other researchers.
✓Provide reporters with the names of others in the same field who are willing to comment on the specific issue.
✓In interviews with the press, give responses specific to the science rather than offering personal judgments. When speaking out on an issue, be sure to make it clear to the reporter whether this is a personal or professional opinion.
✓Be careful to differentiate personal opinions from scientific assessments.

3. Reduce Factual Errors

In addition to putting their work in context for the media, scientists were urged to work to reduce the chance of factual errors:
✓Strive for accuracy rather than control over the journalist's article.
✓Ask the reporter for feedback on an interview to make sure that both understand each other. Sometimes emphasis is as much a concern as factual errors, and scientists can help the reporter cover these nuances accurately.
✓Ask the reporter what he or she has understood from the interview, but be careful to do so with tact and grace. Ask if he or she has a clear understanding of your work, striving for

constructive and courteous feedback. Scientists being interviewed should try to "play professor" at the end of the conversation, Stephen Schneider advised his colleagues: Ask, "Can you just play back for me what it is that you think you heard?" Or use another teaching technique. Ask, "Did you understand me on that critical point? Was I clear?" If the reporter (student) says, "Yes," ask him or her to explain the conclusions, and follow up with constructive and courteous feedback.

✓Seek out reporters who have proved reliable and accurate in the past.

✓At the conclusion of an interview, leave the door open for the reporter to come back to follow up or double-check his or her details or facts, even offering a follow-up interview or phone call for the sake of accuracy.

✓Be clear about the bounds of uncertainty in the research—what is known and what remains unknown, perhaps even unknowable. Uncertainty is a virtue of responsible science, and reporters should appreciate that those speaking with no acknowledgement of legitimate uncertainty may be driven by factors other than science.

✓Quickly inform a reporter if he has made a factual error in a story, but focus mostly on conceptual mistakes that need to be corrected. Don't permit a single negative experience to justify a general unwillingness to get involved in working to better inform the public.

✓Be frank with reporters if it seems they are going beyond the science to conclusions not borne out by current research.

4. Keep it Professional

✓Be open to reporters. Take their phone calls and do what can be done to help them report accurately.

✓Ask about the reporters' deadlines, and commit to helping them meet them. Consider providing a home or cell phone number to emphasize availability on an important story.

✓Understand the ground rules of an interview. If a researcher (or any interviewee, for that matter) is not willing to speak on the record and wants to be interviewed only for background, this ground rule must be made clear ahead of time. Without such clarity beforehand, reporters rightfully assume that all discussion is on the record and subject to coverage.

✓Wherever possible, scientists should talk with reporters during the research stage, and not simply when their findings are published in a journal. Sometimes the process of research is what can engage an audience.

✓Explain the relevance of the research to the reporter's audiences.

✓Help general assignment reporters understand the science. This takes time, and public information officers can be helpful.

✓Keep in mind that interviews between journalists and scientists are a two-way street—a conversation, with risks and potential benefits for both parties—and both the have strong incentives to get it right.

✓Hone communications skills and learn about the reporter and his or her target audience before the interview. Be prepared.

✓Learn to think more like journalists about points that should be made. Remember the basics of a story: the who, what, where, why, and when.

✓Help journalists understand the broader societal implications of the research. Be prepared to talk about who might benefit from the research and why.

✓Don't expect journalists to be surrogates in educating the public.

✓Remember that the ideal relationship between the scientist and the reporter is professional rather than personal, in which each respects the other and does his or her best to meet on that level.

5. Become a Trusted Source

Scientists at the workshops had advice to share with their colleagues:

✓Publicly support colleagues who follow responsible practices and speak out against unclear, obscure, or biased scientific claims

Airing Someone's Video? Probably Airing Their Soundbites Too? Not So Fast

By Jeff Burnside

We were about 3,000 feet below the surface of the ocean. It was pitch black. Suddenly, floodlights burst on, illuminating the bottom of the ocean. The cameras mounted on the scientific submersible began to roll, capturing otherworldly images of fish, sponges, other organisms - some were species never seen before. Scientists were looking for compounds that could cure disease.

When we returned to the surface, the news media coordinator for Harbor Branch Oceanographic Institute handed me the videotape of this unexplored ocean terrain to use in my television news report.

It's clearly not in our news budget to run subs to the bottom of the ocean to shoot our own video. So is it reasonable to use video supplied by others, even when they stand to gain from positive coverage? Yes, especially with environmental coverage where topics and locations tend to be remote. Defining when and how to use supplied video is the key.

Now that newspaper Web sites are using more and more video, the question of whether to use supplied video is one that print reporters and editors also face. It's essentially a complex twist on existing policies for printing still photos. Adding to the new policy twists: video from cell phone cameras, security cameras, cop car dashboards, Web site video, satellite feeds, and slick publicity-seeking video news releases (VNRs).

In the wake of the Bush administration's distribution of "video vignettes" featuring pretend reporters providing flattering coverage of health policies sent to television stations, news managers took a hard look at video supplied by outside sources.

These policies especially affect environmental journalism where provided video, like that from the bottom of the ocean, is essential.

The simplest policy is to put on-screen credits whenever supplied video is shown. Network viewers commonly see "Defense Dept." used over video provided by the military. But it can become complicated. As the pace of editing increases, some provided video goes by in only two or three seconds. In the fog of deadline editing, sometimes provided video airs in several different moments within the same report. It's not that easy to give live credit to each shot as it flies past. And it takes crucial extra time to permanently attach the credit to each shot during the editing process. Finally, provided video tends to live on in the archives, popping onto the air in future stories where less caution is used.

So it becomes equally important to raise simple journalistic questions:

- Is the group or person supplying the video trying to gain positive coverage?
- Is there reason to believe the video supplier may provide misleading footage in an attempt to inappropriately sway coverage?
- Is it video a news outlet could get, rather than taking the easy, quick source?
- Is the video supplier providing raw video, giving increased flexibility?
- If not, to what degree has the supplier condensed the video? For example, are they providing several minutes of long lasting shots? Or are they providing only brief clips of select shots?

The situation becomes more perilous in airing provided interviews or soundbites. Some stations don't use any provided interviews. For broadcasters considering using portions of supplied interviews, precautions are in order: Have they received the raw, unedited interview? Or did they only receive carefully crafted soundbites? Asking at least those questions can help TV news programs avoid warranted criticism.

Raw video of news conferences, for example, is common on network and regional television feeds. When it's not available, some confident, forward-thinking groups simply make raw video available from news conferences where journalists ask questions unfettered. Clearly, this creates less of a risk, but it still may not pass the appearance test.

I needed an interview with the people in Iceland handling Keiko the orca during his release from human captivity. We didn't have time—and certainly not the money—for me to fly there. So we arranged to have one of the Icelandic staff film Keiko using a home video camera. I asked the questions on the telephone. The staff person in Iceland had an earpiece plugged in his ear and attached to his cell phone so he could listen to my

questions. So it was my interview, though it was on their videotape. They express mailed it to me that day, using our station's account number. I used what I wanted. Keiko's handlers therefore had no influence other than crafting an interesting shot, which I would've done had I been present.

For the first time, we recently aired a story relying solely on video downloaded from a Web site. This approach was a sign of things to come: It was the only way to get the video, the technology was finally able to deliver video of broadcast quality, and yet it was clearly from an advocacy group trying to sway our story.

So we made the source and circumstances abundantly clear to our viewers and did our best to verify information. In this case, the whale protection group Sea Shepherd was promoting one of its interventions. Some of its members had planned to sideswipe a Japanese whaling ship in the Antarctic Ocean. What struck me was Sea Shepherd's expensive investment in satellites, high-resolution imaging, helicopter aerials, and excellent photography. This kind of high-quality, but misson-based video delivery means news outlets will need to make careful decisions.

It is already possible to do now, but emailing broadcast-quality video clips to reporters will soon become routine. That reality will dramatically expand the use of supplied video delivered immediately and precisely.

As the flood of video continues to expand in more aspects of our lives, airing video supplied by someone outside the newsroom is becoming increasingly complex. Policies need to be updated constantly. Stations will do best to start with simple questions.

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through letters to the editor of scientific journals and the popular press.

✓Talk with journalists to help them understand the current state of scientific knowledge.

✓Clarify for journalists why they are hearing conflicting statements and help them assess these statements.

✓Take time to educate journalists on the process of science so they can understand how scientists, through the scientific method, research, and peer review, come to an understanding of an issue.

✓Take part in keeping the public discourse honest by exposing false statements and correcting the record.

6. Make an Effort to Understand the News Media

Scientists were encouraged to:

✓Become more familiar with the components of news organizations, the differences, for example, between the newsroom and the editorial offices, as well as the editorial pages, columns, news and features, and specific sections.

✓Reach out to editorial boards of local newspapers to provide a scientist's opinion of how a particular outlet covers science issues and why this coverage is so important. Outreach to editorial boards is a common practice that has been long overlooked by the scientific community.

✓Appreciate the differences and needs of the full range of communications media and organizations, in particular the differences between print and broadcast media.

✓Target specialized media—aimed at specific audiences—to explain the significance of findings to different groups: outdoors and gardening enthusiasts, sportsmen, etc. In fact, the smaller outlets often serve as sources of story ideas or news to larger outlets. Specialized media can provide more in-depth coverage, for instance, on a narrow range of subjects (e.g. sports fishing, gourmet cooking, health and fitness) and their connection to climate science.

✓Use the distinct points of entry within a single news organization: reporters, editors and columnists, the business page, the financial section, the health and education beats, for example.

✓Get to know local editors, the gatekeepers who will ultimately decide if a story gets out, and in what form.

7. Make the Most of Accessible Technologies

Scientists have many more options today for getting their findings out beyond the peer-reviewed article.

In the digital age, scientists can post their findings on the Internet—on home pages and blogs—making them available worldwide. Unlike the newspaper op-ed, blogs have no gatekeeper deciding what gets out and what does not, although some in the news media are reluctant to accept this new, and as yet "unregulated," version of journalism. Scientists have used their Web postings to provide information and to counter misinformation about climate science. Internet links from newscasts are used more often and with them comes the opportunity to give smaller audiences greater depth and breadth of information. Many journalists look first at the Web site of a university or organization for information about a scientist and his or her work. In addition, many fields—and certainly climate science—are highly visual. Graphics and video are more likely to be picked up by journalists if they are made available online, although scientists should take care to specify any copyrights on these Web-based visuals.

Graphics, video, and various digital and online technologies can make research results more visually appealing and help scientists and news media capture the sights and sounds of laboratory and field work.

Some scientists at the workshops said they have successfully used hand-held digital cameras and video recorders to capture their work, later making those images available to reporters. Environmental reporter Jeff Burnside of the NBC television affiliate in Miami, Florida, said the immediacy of film taken on location can sometimes compensate for the absence of professional-quality video, although workshop reporters and scientists agreed that this practice does not extend to professionally developed video releases developed by partisan groups (see Burnside's sidebar on page 42).

Scientist and science educator Kim Kastens of Columbia University's Lamont- Doherty Earth Observatory said that the earth sciences often involve especially visual research, placing a premium on the use of effective graphics. She noted that emerging electronic and online media make better and more extensive use of color and graphics than does traditional news media.

Visual presentations help inform the public on climate and earth science issues, she said, adding that universities and research institutions can help by providing more information services such as training in the use of graphical arts software to scientists lacking the time and skills to master these technologies on their own.

Graduate school journalism students attending the workshop at Columbia University foretold the future of news with their enthusiasm for using digital technologies to teach about climate change. Several of them said the Internet is the first place they go to research topics, and research tools can reduce the need for multiple phone calls while trying to identify proper sources. Scientists who don't post their biographical information and media-friendly versions of their work on the Web are certainly at a disadvantage in dealing with early-career reporters.

8. Speak Out as a Citizen

There was considerable discussion at the workshops about the duty of scientists—moral, ethical, and civic—to speak out about what they know about important issues facing society. They were urged by the reporters to go directly to policy makers rather than expect the media to serve as advocates for them.

Not all scientists are comfortable dealing with the policy applications of their work, afraid their colleagues will criticize them for seeking the limelight. Blogging is a popular alternative that does not require a media gatekeeper. Speaking to citizens' groups and getting involved in community activities can also be effective ways to be heard.

Science in a Postoperative Newsroom

By Jeffery DelViscio

Heart transplantation is a tricky business.

Upon cutting through the armor of the sternum, a surgeon must expose the failing organ, which is cut from its seat vessel-by-vessel. The old heart is removed, the new donor heart connected. If the blood flow stops for any amount of time, the body dies. It is that simple.

After the operation, organ tissue rejection is a chronic concern. The immune system, not knowing the surgeon's intent, treats the transplant as an invader, attacking it as if it were the common cold.

What bearing could any of this have on journalism and more specifically, the coverage of science? Take a close look at print newspapers across the country and you will see that they look, very strangely, like a room full of heart transplant patients, many still on life support.

The New York Times, The Washington Post, The Wall Street Journal—these major papers have been hemorrhaging readers—and investment returns, according to Wall Street—for years. Since the mainstreaming of the Internet in the 1990s, they, along with many others, have all had to undergo major surgery.

The industry's form of blood flow, literally its circulation, has been drying up. Young readers are now more apt to click links than flip pages, and businesses see their brightest opportunities not in the Sunday section, but on liquid crystal displays.

As readers and ad dollars walk out on newsprint, so follow dollars for reporting. The vessels constrict and the whole newsroom culture strains under the added pressure. Staffs are cut, coverage narrowed. This reality often hits specialty beats, like science, first.

Much of the daily newspaper's current crisis can be understood as a vast circulatory malady—sped along by the reader-siphoning of the Internet. Unabated, it threatens to literally stop the presses. An aging newspaper industry has been headed for a heart attack, a fact that's been common knowledge to many in the industry for quite some time.

While speaking at Columbia University's school of journalism in 1999, Daniel Okrent, at the time an editor-at-large for Time Inc., famously announced "the death of print:" "Twenty, thirty, at the outside forty years from now, we will look back on the print media the way we look back on travel by horse and carriage," Okrent said, declaring his own medium "as relevant to our future as the carrier pigeon."

Fast forward to where I now sit, as an online producer at the Web newsroom of The New York Times. Okrent may not have envisioned such swift change. The Web newsroom, initially separated from its print analogue, now is "integrated," Web and print fully intermingled.

The Times is truly in the midst of its own open heart surgery. "Old" and "new" newsrooms recently have been connected as the "integrated" heart of The Times begins to pump from 620 Eighth Ave. Every phone line redirected, every meeting room replaced—the vessels have been cut and reconnected one-by-one.

But it's much larger than just a physical relocation. The ideological realignment—the paper now tries to craft reporting out of words, images and interactivity—is the real story. The Times, along with other papers, has very recently formed a symbiotic relationship with the Web, where only a parasitic Internet once was.

And print is no longer just print. Before, you might only read about the breakup of Arctic sea ice. Now you can read a story, listen to the tremendous din of shifting ice as it smashes and slides on a digital recording, or watch a field video from the reporter, all transmitted through the paper's Web site. Data too are no longer just the stuff of scientists' PowerPoints; interactive graphics on topics as diverse as climate change and workings of a biomechanical foot for amputees are now typical offerings on nytimes.com.

This transplant has not been without its complications, of course. As with any real transplant, rejection has been a real concern. Parts of the older journalistic body have, at times, treated its new digital tissue as a foreign invader.

Jim O'Shea, former editor of the Los Angeles Times, a paper in the midst of a similar reinvention, though generally praising his print reporters, has cautioned, "The newsroom can also be a cold, defensive, insular and conservative place, plagued by a bunker mentality that hides behind tradition and treats change as a threat."

It would be untrue to say that the same apprehension and aversion to change didn't exist at The Times, as

—continued, p. 46

no doubt at traditionally print-based outlets around the nation. There is likewise an equal and opposite hesitancy about traditional print media on the part of those younger members of the business, who, like me, grew up with the Internet first, and the newspaper second.

But the grand, unavoidable experiment is underway, and though the postoperative newsroom will require constant maintenance, it seems that the majority agree that a newspaper future without the Internet is probably not much of a future at all.

Why is it important for scientists to understand any of this? One of science's core purposes is to research, explain and ultimately obtain some degree of predictive capability when looking at social and natural phenomena. This is especially relevant in climate science, where the divination of climate cyclicity can help scientists predict, say, the effects of glacial meltwater surges on downwelling in the North Atlantic, or the effect of the El Niño/Southern Oscillation on drought patterns in the Sahara.

In the same way, understanding the internal dynamics of the global newspaper complex will increase the scientific community's grasp of how and why reporters cover not only climate, but science as a whole, and ready science to harness its research to the first journalistic flotillas shoving off into a digital sea.

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7

WHAT INSTITUTIONS CAN DO

Workshop participants discussed steps they can take as individuals to help improve public understanding of climate change. But they also discussed ways employers, universities, research institutions, and professional membership organizations and societies can join the effort.

The workshops benefited from strong support and hosting from some of the nation's most respected universities and think tanks. All of these organizations continue to show leadership in informing the public about the opportunities and challenges posed by anthropogenic climate change, and they have maintained a commitment to multidisciplinary training of journalists and scientists through formal course work, fellowships, in-service training, and other career enrichment programs.

Undergraduate and graduate journalism programs should improve training for future journalists who will cover various aspects of climate change, whether it is science, business, or policy, workshop participants concluded. Journalism academics nationwide consider the Columbia University and University of California, Berkeley, Graduate School journalism programs, for instance, as leaders in preparing students for the new realities of journalism in the digital age—what Philip Meyer has called the "media diaspora" facing today's working press and tomorrow's graduates.

A number of nonacademic organizations provide educational opportunities for journalists to expand and improve news coverage of climate change including the National Environmental Education Foundation, which is partoering with the American Meteorological Society and with the Cooperative Partnership for Operational Meteorology, Education & Training to meet the climate change education needs of broadcast meteorologists.[1,2,3] The Metcalf Institute for Marine and Environmental Reporting and the Society of Environmental Journalists (SEJ) will hold additional workshops for reporters and editors on covering climate change, with an emphasis on energy, economics, and solutions, as will the Yale Project on Climate Change.[4,5] In the Midwest, Ohio State University has held a one-day journalism workshop featuring its world-famous Byrd Polar Center and glaciologist and faculty member Lonnie Thompson, a participant in the Metcalf Institute workshops. The McCormick Foundation is planning training workshops for broadcast meteorologists on coverage of climate change. On the West Coast, the University of Oregon's Climate Leadership Initiative, part of the university's Institute for a Sustainable Environment, has hosted day-long training programs for media in the Pacific Northwest on coverage of climate change.[6]

1. University Opportunities for Reciprocal Education of Journalists and Scientists

Some of the recommendations from the workshops involved providing more opportunities for interdisciplinary training for scientists and journalists. Several leading university journalism graduate programs have announced a new emphasis on strengthening reporting on science and other complex and vital issues. Columbia University, for example, offers a dual master's program in journalism and earth sciences.

Some of the suggestions would require overcoming traditional campus aversion to cross-disciplinary work: making journalism and science courses and training more accessible to both communications and science majors; having science classes crafted jointly by journalism and science departments; and adding more summer enrichment programs that focus on journalism/science cross-training.

Workshop participants also called for more college level courses, fellowships, internships, and in-service education opportunities aimed at scientists to help them better understand the news media and expand their public outreach efforts. Programs such as the Stanford University/Woods Institute for the Environment Aldo Leopold Fellowships annually select outstanding mid-career scientists to receive communications training with the purpose of improving their science outreach to the public.[7] In addition, annual activities such as the National Science Foundation-funded Dissertations Initiative for the Advancement of Climate Change Research (DISCCRS) bring together recent doctoral degree recipients to expose them to issues spanning the natural and social sciences, including work with the news media.[8]

Journalists at the workshops said they were interested in exploring practical ways to provide scientists with insights about how

What are Children Being Taught in School about Anthropogenic Climate Change?
By Kim Kastens and Margaret Turrin

What sets the agenda for public discourse in America--the topics people talk about at the dinner table, the bus stop, the haircutter? The media and popular culture certainly play a key role. But the conversations of today and tomorrow also will be influenced by the ideas and questions that children bring home from school. With this in mind, we took a look at what teachers are being told regarding what children should learn about anthropogenic climate change.

Building on an earlier study of human-environment interactions in K-12 science education standards, we coded the standards for presence or absence of four aspects of anthropogenic climate change: causes of changes to weather or climate, the mechanism by which such changes may be caused, the impacts of such changes, and potential societal or personal actions that could mitigate the impacts of such changes (Table 1).[1]

Of the 49 states with state education standards, only 30 mention any aspect of anthropogenic climate change in their science education standards.

Looking at causes, we found that seven states mention or imply, at least once across their K-12 science standards, that burning of fossil fuels contributes to climate change. Five states mention land use changes such as deforestation in the context of changes to climate or atmosphere. Three additional states prescribe that students should learn about the causes of human impact on climate but do not articulate specific causes. In teaching journalism students to write clearly and unambiguously about the environment, the wording of many of these "causes" standards feels mealy-mouthed, for example: "The student will discuss the impact of the use of natural resources and other human activities on the earth's climate" (Minnesota, high school).

Seventeen states call for teaching something about the mechanism of climate change, mentioning greenhouse gases, greenhouse effect, carbon dioxide, or the carbon cycle in the context of climate change. The best of the standards distinguish clearly between natural and anthropogenic climate change, and cover both.

Far and away the most common emphasis is on impacts of climate change. All 30 states that deal with the topic at all discuss impacts. Among the specific impacts, rising air temperature and effects on living organisms are most common, followed by changes to the hydrologic cycle such as increased or decreased precipitation. Sea level rise is scarcely mentioned, and frequency of major storms is entirely absent. We also coded for ozone hole and acid rain, as students often confound these topics with the greenhouse effect.[2] The best of the "impacts" standards are clear and forthright, for example: "Since the Industrial Revolution, human activities have resulted in major pollution of air, water, and soil. Pollution has cumulative ecological effects such as acid rain, global warming, or ozone depletion" (New York, middle school).

Only eight states mentioned anything about how the effects of climate change could be prevented or mitigated. One state mentions alternative fuels. The rest are vague, calling for students to study the topic but not coming to grips with what mitigation might comprise, for example: "Research, evaluate and report on international efforts to protect the atmosphere" (Utah, high school).

Considering that science is supposed to be about causality and process, it is surprising that causes are so lightly covered, relative to impacts. Eleven states follow through on climate change science, from causes, to mechanism, to impacts. Three of these 11 continue on to mitigation strategies. The light coverage of mitigation and prevention strategies might result from some states covering this material in their social studies standards rather than in science standards. But the light coverage of causes makes us wonder if there may have been some compromise among conflicting constituencies on this topic.

Education standards are revised infrequently, and thus lag well behind media coverage. Acid rain and the ozone hole, which have faded in the media coverage, are still strong in the education standards, whereas sea level rise and frequency of major storms, which have been prominent in the media recently, are nearly absent from the standards.

Readers and listeners who habitually skip over or tune out news of science and the environment may be interested in their children's education. Environmental education (or lack of it) in your state or local schools offers an opportunity to connect to today's and tomorrow's audiences on a topic that concerns and interests them.

Table 1: Coverage of Climate Change in State Science Education Standards

State Science Education standards state or imply coverage of:	Number of States
Causes	
• Use of fossil fuels	7
• Land use changes, especially deforestation	5
• CFC's or aerosols	0
• Causes, not specific	3
Mechanism	17
Impacts	
• Sea level rise	3
• Changes to hydrologic cycle	5
• Frequency or intensity of large storms	0
• Warming of air	18
• Changes to atmosphere, not specific	15
• Changes to climate, not specific	13
• Acid rain	10
• Ozone depletion	13
Mitigation or prevention measures	8
Any of the above	30

Note: the dataset behind this table is available upon request from the authors.

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decisions are made in the newsroom, who the gatekeepers are, and differences among media types (broadcast, Web, print) and different aspects of journalism (news writing, feature writing, editorials, columns, and explanatory reporting).

Workshop participants recommended that academic institutions:

✓Provide forums in which experienced science journalists can educate and help mentor their counterparts in smaller markets.

✓Revise and expand curricula to broaden and improve access to and relevance of science courses available to journalism and other non-science undergraduate students.

✓Teach journalism students more fundamentals of the scientific method, statistical analysis, relative risk, and related issues.

✓Explore in the journalism curriculum ways reporters can check in with scientific sources on accuracy without compromising basic journalistic integrity.

✓Include communications training seminars in science graduate programs.

2. Universities as Safe Zones to Air Scientific Differences

It may be that universities, colleges, and junior colleges are the best venues for science and journalism interests to come together to work through complex problems.

"Remarkable things start happening," former Environmental Protection Agency Administrator William D. Ruckelshaus said at the University of Washington workshop, "when people put their interests, rather than their positions, on the table." Indeed, five of the six workshops in the series took place in university settings. The universities also allowed some students and interested faculty members to participate in the sessions, and the students brought to the discussion their youthful perspectives on the science/journalism relationship, a perspective that both reinforced and challenged the professional science and journalism participants.

Suggestions included developing science/journalism workshops modeled after this and other related series, and hosting regional workshops on science communication in general or on specific issues such as global climate change.

3. Universities' Public Outreach Role

Universities have the unique opportunity to encourage their faculty and students to provide scientific information in a format that can be broadly understood. Universities are also well suited to developing educational science programs that bring scientists and journalists together, in an off-deadline situation, such as the fellowships and science seminars offered by Metcalf Institute.

Workshop participants urged universities to:

✓Recognize that public outreach and education, including working with news outlets, are legitimate and essential roles for scientists, and provide incentives, rather than discouragements, for those activities. Make citizenship and public involvement a positive factor in science faculty tenure decisions and yearly performance evaluations, as is the case, for instance, at Duke University, according to workshop participant William Schlesinger, Ph.D., at the time Dean of Duke University's Nicholas School of the Environment and Earth Sciences.

✓Provide incentives for scientists to get involved with primary and secondary school education, for example, having them participate in the classroom and in teacher training activities, usually held in summer months; mentoring a grade school teacher or class; or getting involved in science literacy events.

✓Strengthen university public information officer programs to meet the professional needs of the media and of scientists without compromising the interests of either.

✓Provide information services and resources that scientists can use to improve their communications with diverse external audiences. Provide tools and expertise to help scientists and journalists more effectively incorporate graphics into their presentations.

✓Put scientists' work and their biographies on the external face of the organization, their Web site, and make it media friendly and accessible. Determine the most effective ways to make results available through popular search engines.
✓Devote more resources to working with news organizations—such as investing in science interpreters who know the science and understand the media and can act as go-betweens. Offer more academic positions and formalized programs to help scientists learn how to work with the press. Assist scientists in learning how to write and place op-ed articles and confer with local newspaper editorial boards.
✓Emphasize the value of public outreach by making this a separate budget line item for research institutions.
✓Encourage faculty to be more open and accessible in responding to reporters' inquiries.
✓Invite reporters to scientific meetings so they can can stay on top of the scientific work under way.
✓Establish spring/summer incubators at universities to re-invent and refine relationships between broadcast media and experts to help inform the public on critical science issues.
✓Sponsor public lectures and book signings on important environmental issues.
✓Provide more training for scientists on how to communicate uncertainty and relative risk to lay audiences.
✓Involve environmental and science writers groups such as regional or local chapters of the National Association of Science Writers or of the Society of Environmental Journalists in university-sponsored activities, via public lectures or workshops.
✓Include federal research organizations and laboratories in discussions of outreach plans. Identify opportunities for complementary science outreach efforts that highlight the integrated nature of scientific research, as exemplified by climate change impacts.
✓Include academics not just from the host institution but others in the region to expose journalists to a wide spectrum of expertise.

4. Media Outlets—Changing With the Times

Philip Meyer told the Columbia University workshop participants that the nation's metropolitan daily newspapers had focused too long on reducing costs—many by significantly reducing their reporting staff—rather than on improving the quality of their journalism.

Workshop participants aired a number of ideas on how media outlets can improve quality and make money doing it. These ideas included the creation of business models by which mainstream providers of news and what the digital world refers to as "content" can receive a reasonable rate of financial return on their investments. The new business model is especially important to mainstream media feeling their own product is being given away free by news aggregators such as Google and Yahoo!. Meyer, in his comments at the workshop, explored still-evolving thinking on how the traditional news media might best charge for their online versions, invest in staff development to improve basic science skills and develop specialized subject matter expertise, and increase ways to allow journalists to observe and report on scientists doing their work in the field or in their laboratories.

Journalists and scientists agreed that field observations are an important part of the story of science—particularly for climate change, where a good deal of the cutting-edge action is taking place in remote regions. At the same time, they acknowledged the principle that good journalism costs money, and they pointed to shrinking newsroom budgets and staffs as obstacles.

Some suggestions emerged for ways the news media can meet the current challenges in the world of journalism:

A. Cost-savings and Money Makers

✓Ask how certain media sectors—ethnic and alternative media outlets and public radio in particular—have grown even during times of contraction for other news outlets.
✓Examine those organizations' creative ideas

for journalism on a tight budget to see if some approaches—for instance sharing of reporting pools among smaller news outlets—provide attractive options.

✓Encourage drawing on resources from across multiple beats and news departments. Recognize that the widespread implications of climate change take the story well beyond the science and environmental desks. Encourage reporting staffs to look at climate change not just as a science or environment story.

B. Staff Development for Expertise in Specialized Subjects

✓Consider CD-ROM and Internet-based options for in-service training.

✓Improve subject matter expertise in the newsroom—either by cultivating sources or developing improved technical capabilities in-house. Given economic pressures facing many newsrooms and recent trends toward smaller editorial staffs, outsourcing or relying on freelancers may be options to consider in certain circumstances, though these options are controversial.

✓Provide opportunities for reporting staffs to remain current on important science issues through fellowship programs, for example, and attendance at conferences.

✓Conduct sessions for staff on use and abuse of data and statistics.

✓Identify local mentors on critical and complex science issues –sources newsrooms can rely on.

✓Improve science literacy at media outlets—from editors to reporters.

✓Breathe new life into science sections by featuring technological innovators and high-tech companies, in particular those focusing on emerging energy options.

C. Worthwhile Expenses that Yield a Broader, More Engaged Audience

✓Provide better resources to cover science stories, including for general assignment reporters.

✓Recognize the value of on-location stories of scientists doing their work and encourage journalists to get out into the field.

✓Make better use of Web sites to expand opportunities to educate the public—going beyond the traditional view that news and information is distinctly different from education. Workshop journalism participants noted that when The New York Times Company purchased About.com, many in journalism interpreted the move as a sign of the newspaper's taking more seriously its responsibility to educate, along with its traditional news and reporting responsibilities.

✓Develop news products that can be used as teaching tools for classrooms.

5. The Role of Professional Societies

As opposed to universities and news outlets, professional societies have the luxury of advocating for their respective professions. Participants at the Metcalf Institute workshops suggested that professional societies take advantage of their role in the following ways:

✓Bring to the attention of top editors the importance of better reporting of science. Journalism societies should consider enlisting scientists and scientific organizations in this task. Seek out the most respected and influential scientists and be specific in discussing concerns and suggestions with editors and editorial boards. Science societies, likewise, should enlist the assistance of skilled science communicators to help scientists understand the importance of clarity in their interactions with the press.

✓Use sessions at annual meetings of science and journalism professional societies to promote exchanges between scientists and journalists. Sessions could address general issues such as improving science communication (e.g., media panels at science societies' annual meetings), or focus on specific issues such as climate change.

✓Sponsor tutorials and other sessions at these meetings taught by scientists and journalists with proven track records in science communication.

✓Provide opportunities and incentives for scientists to mentor reporters and editors in smaller markets on the coverage of complex issues.

✓Explore various options for electronic ex-

changes between journalists and scientists—with the goal of reaching as many scientists and reporters as possible. This might include electronic mailing lists or blogs.

✓Do more to police members—identify individuals who violate professional standards of conduct. Help the public distinguish them from those doing responsible, independent work.

✓Encourage members to divulge the sources of their funding.

✓For journalism societies, consider credentialing or certification—not to be confused with licensing, which would conflict with the First Amendment principles of a free press.

✓For science societies, poll rank and file to determine what they know about a specific issue—e.g., climate change. Take formal positions on science issues and/or their implications for public policy, and advocate for what members believe are in the profession's and the public's best interest.

Credentialing for Reporters Covering Complex Issues?

By Jim Detjen

In the 1940s and 1950s when the first TV weather forecasts were aired, it was not uncommon for weathercasters to use puppets, animals, costumes, clowns and other gimmicks to tell viewers about the weather.

A cartoon character named Woolly Lamb sang about the weather on WNBT, a forerunner of WNBC, in New York City. The forecast was sponsored by Botany Wrinkle-Proof ties and the lamb sang, "It's hot. It's cold. It's rain. It's fair. It's all mixed up together. But I, as Botany's Woolly Lamb, predict tomorrow's weather."

Other TV forecasters wore slickers and carried umbrellas, if rain were predicted. They donned parkas and snowshoes, if snow was expected. And if warm weather were forecast, they brought out beach balls and bathing suits.

In an effort to improve the professionalism of TV weather forecasts, the American Meteorological Society (AMS) launched its first Seal of Approval program in 1957. It conferred this credential upon weather forecasters who met the society's guidelines for "completeness, clarity and professionalism."

"We think many TV weathermen make a caricature of what is essentially a serious and scientific occupation," wrote Francis Davis in TV Guide. These forecasters "help foster the notion that forecasters merely grab forecasts out of a fishbowl," he said.

The requirements for the first AMS seals were a written application and a film clip of one of the weathercaster's forecast. The applications were evaluated by an AMS committee and seals were given to qualified applicants.

By 1959 TV Guide noted that the seals of approval had already begun to have an impact. An editorial in the July 18, 1959, edition of TV Guide noted, "Television weathercasts have matured from off-the-cuff reading of the official weather bureau reports by announcers or pretty girls to serious interpretations by station meteorologists with official weather training."

TV weather forecasting has grown in sophistication during the past half century and today many forecasters have degrees in meteorology and substantial forecasting experience. Since 1957 more than 1,600 seals of approval have been granted and more than 770 are considered "active."

During the past 50 years the need for accurate and professional reporting about complex scientific issues – such as climate change – has steadily increased as the world has become more complicated.

Viewers are often confused by conflicting information they hear or see on radio and TV, in newspapers and magazines, and on the Internet. They know little about the reporters' backgrounds or the journalists' knowledge of the subject matter.

Beginning in 2005 the American Meteorological Society reorganized its seal of approval program to launch the Certified Broadcast Meteorologist (CBM) seal. In order to qualify, meteorologists must pass a 100-question closed-book exam. They must show proof of completing professional development programs every five years in order to keep the seal. Applicants must also have a degree in meteorology or a related scientific field.

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"The AMS seal of approval programs have had an incredible impact upon improving the quality of weather forecasting in TV newsrooms," said Stephanie Kenitzer, an AMS spokeswoman. "Weather forecasters today are typically the only [people] in a TV newsroom with a science degree."

I believe that similar credentialing efforts should be launched for journalists who report about complex environmental science issues, such as climate change. This effort should include journalists in all media—newspapers, magazines, radio, TV and the Internet.

Journalists who pass a certification test would obtain a Certified Environmental Journalist (CEJ) diploma. Qualifying tests would be developed by professional organizations (such as the Society of Environmental Journalists, National Association of Science Writers or AMS) in conjunction with academic experts at leading universities.

To keep their certification, journalists would have to periodically (perhaps every five years) complete a professional development program, to be offered at universities with a strong focus on environmental journalism (such as Michigan State University or Columbia University). These programs could be in the form of workshops, classes or online courses.

Journalists wouldn't be required to obtain a CEJ diploma to practice their craft. But because of the prestige associated with this designation, journalists would seek to obtain this seal as a badge of professional accomplishment. I believe this CEJ effort will do much to improve public understanding of complicated environmental issues —much as the AMS seal of approval program did 50 years ago.

Jim Detjen is a professor and Knight Chair in Environmental Journalism at the Michigan State University Journalism Department. Mr. Detjen is also co-founder and past president of the Society of Environmental Journalists.

6. Funding Organizations

Government agencies and philanthropic organizations will be essential to meeting the challenges posed by human-induced climate change.

Funders can encourage public outreach as part of the scientific research process. The National Science Foundation, for instance, requires that projects it finances identify the broader impact of the research through scientific outreach to students, the public and/or news media.

Among the possibilities for funding:

✓Fellowship programs for journalists such as the Metcalf Institute's Annual Science Immersion Workshop for Journalists that encourage more interaction at universities with local climate scientists.

✓Support for activities that make it easier for scientists to put their work in a format journalists can use (including writing, graphics, and formatting for the Web).

✓Mentoring that fosters improved understanding of science for journalists and improved understanding of journalism for scientists.

✓Research assistants dedicated to specific journalism projects.

✓Cross-media newsroom exchanges between TV, radio, newspaper, and magazine outlets to foster improved understanding across all the media.

7. Additional Recommendations

Some of the ideas discussed by workshop participants as potential next steps have no immediately apparent institutional home, so these might be seen as needs and opportunities for improved public understanding of anthropogenic climate change.

A. Expanded Resources

Journalism participants called for a variety of online resources to help them interact with the most expert scientists, both as direct sources of information and as independent arbiters of complex science issues. They recognized the dilemma of shrinking newsroom budgets and staffs and of reporters having to take on a wider range of responsibilities (as general assignment reporters) just as scientists appear to be getting more and more specialized.

Journalists discussed, for instance, how best to establish credible and trusted scientific mentors, perhaps local college faculty experts. They explored ways in which large metropolitan news organizations can help those serving smaller markets. Some experienced reporters pointed to their favorable experiences in the 1980s with the now-defunct Scientists Institute for Public Information Media Resource Service, which functioned as a referral service to trusted experts comfortable with working with the media.

Workshop participants identified a wish-list of resources to help journalists report more accurately on climate change. While some of the following suggestions may seem overly ambitious, others are already underway.

✓Listings of credible sources on a wide range of science issues, easily accessible electronically.

✓A comprehensive listing of organizations' biases, political or otherwise.

✓An online information source, perhaps analogous to Wikipedia, housing public domain information on scientific issues—an online library and primer wrapped into one, building on materials that have worked well in the past such as journalist guides and resources such as the Society of Environmental Journalists' Web page of climate change resources.[9]

✓Rapid scientific response through an online source to counter reporting of false and misleading scientific claims and to avoid error-prone media coverage, provide authoritative contacts, comment on exceptional coverage or analyze unfair or misleading coverage. Just such an effort was launched by a group of climate scientists during the course of the workshops: the Real Climate Website.[10] One of the lead scientists in the effort, Gavin Schmidt, Ph.D., of the National Aeronautics and Space Administration, discussed it as part of the LDEO/Columbia University workshop in June 2005, fairly soon after the site had been launched.

✓Several workshop participants explored the notion of creating a variation on a virtual dating service—a vehicle for journalists to explore the most newsworthy issues of the day with recognized experts, matching up journalists with scientists working in specific fields. This service might provide relevant biographical information on scientists and journalists and profiles of their organizational affiliations or news outlets.

✓Formation of a wire service specializing in coverage of climate change issues in the United States. One such wire service already exists at the international level, the environmental news portal of the United Nations Environment Program/GRID-Arendal, EarthwireClimate.[11] Broad environmentally themed variations on that kind of initiative currently exist in some parts of the nation, too. Some examples include:

The Environment Report (formerly the Great Lakes Radio Consortium), based at the University of Michigan, provides radio programming with a focus on regional environmental issues to over 160 public and commercial stations;[12]

The Natural Resources News Service is a program of The Public Education Center, whose reporting model brings investigative journalism to larger commercial outlets;[13]

Sightline Daily, formerly Tidepool, provides news and commentary focused on sustainability in the Pacific Northwest region.[14]

Some caveats: specialized information providers may be construed as existing mainly to provide job security for journalists rather than providing a legitimate source of information. Privately financed organizations such as the recommended climate wire service also may come with their own editorial biases, different from the approach a large daily newspaper might take.

But with environmental and science reporters facing newsroom buyouts and reductions, it is possible that a national climate change wire service—analogous to an Associated Press or Reuters and serving specifically as a news pipeline to other news organizations—could be successful. The diverse aspects of climate change—physical science, impacts, adaptation, economics, politics, and technology—provide a wealth of stories for such a wire service.

B. Informal Public Education

Workshop participants made the point early on that climate change is different from traditional pollution control issues that require a regulatory solution only after a problem becomes apparent.

They noted that the Intergovernmental Panel on Climate Change and NASA climate scientist James Hansen have cautioned that waiting until the damage from climate change is well under way could mean losing many options to respond effectively.[15,16] With the American public showing a growing awareness of the importance of climate change,[17] participants discussed the best ways to teach the implications and practical ways individuals and government may respond.

Television weather forecasts, zoos, and public aquariums have something in common: they provide opportunities to bring science to aver-

Shared Values of Science and Journalism: Opportunities for Improvement
By Anthony D. Socci

You don't have to look far to know that the way Americans receive information has changed in profound ways. According to the Project for Excellence in Journalism (PEJ), "the transformation facing journalism [today] is epochal, as momentous as the invention of television or the telegraph."

The more important issue is the potential erosion in standards and values that lie at the heart of journalism, rather than the changing preferences for various forms of media. This erosion would have vastly more profound—and more troubling—implications than changes in the forms of media.

Perhaps one way of strengthening and maintaining core journalistic standards is to draw from the array of standards and values that scientists and journalists have in common, most of which appear to derive from the shared goal of objectivity. In the words of Phil Meyer, "journalism and science come from the same intellectual roots," but while having these values and standards in common, the culture of science seems to have honed a more formally articulated and broadly adhered to version of these standards and values (e.g., objectivity in the form of the scientific method and peer review), possibly because of its longer history. As a result, science might serve as a template for journalism to better articulate and strengthen the application of its core standards and values.

For comparative purposes, a brief exploration of these shared standards and values (as summarized in Table 2 below), accompanied by a qualitative assessment of their journalistic and scientific rigor, might prove informative.

Objectivity The science community is well aware that each individual has his or her own peculiar biases that, if left entirely unchecked or unfiltered, could distort or undermine one's work, conclusions, and credibility. To help maintain an arguably minimal but effective degree of objectivity, scientists are strongly encouraged to submit their research for publication in reputable scientific journals. In so doing, scientists agree to subject their work to review at the hands of their expert peers or third parties. In other words, the process of un-biasing one's work is taken from the researcher and placed in the hands of third parties. Far from perfect, this practice nonetheless exerts a useful and effective form of quality control on the published product, generally leading to a more credible and unbiased product than would exist otherwise. The process also tends to be transparent.

While journalists similarly strive for objectivity, the realities of reporting complex science stories under deadline can often confound this goal. Ethical standards codified by various journalism organizations provide general guidance on journalistic objectivity, but the process that exists for science does not have an exact parallel in journalism. Of larger concern, though, is the misguided notion that journalistic objectivity should rest with the reporter, as opposed to being a process of stripping one's work of personal biases, a process that, of necessity, invokes third parties.

Balance Scientific conclusions result from the collection and analysis of data, testing, validation and replication of results by third parties. In theory, and largely in practice, methodological and other errors, as well as personal biases, should be rectified, minimized or removed in the peer review process. The idea of balance does not enter the picture in science as it does in journalism.

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age people in a way that informs and entertains. The science café model, popularized in Great Britain, is another way to encourage informal interactions between scientists and the public.

C. Research on Science Communication

Understanding how the general public perceives climate change, participants agreed, is essential to finding effective ways to communicate with them. To that end, public opinion surveys and polling provide important information for journalists and scientists.

A number of the climate scientists participating in the workshops said they believe special interest advocacy groups representing climate scientist contrarians often make more effective use of public relations and media relations activities than do those professional scientific orga-

Table 2
Values/Standards Scientists and Journalists Have in Common

Professional Norm	Scientists	Journalists
Objectivity	Generally conform to a broadly accepted minimal standard governing transparency, verification and the pursuit of truth/facts.	More difficult to define than in the sciences, but a process that is aspired to in the best journalism.
Balance	Must weigh competing results in reaching conclusions based on statistics, evidence, and existing literature.	Invoked often as a description of competing views—not in regard to weight of evidence, sometimes with unintended consequences.
Formal training/education	Required and specialized, but not necessarily at level of Ph.D.	Not necessary, but increasingly common.
Deadlines and space issues	Largely not a factor.	Critical drivers, especially at daily or 24/7 news operations.
Being first	Important and desirable but not critical; output must conform to scientific standards.	Critically important institutionally and personally, with attendant concern that need for speed should not come at expense of accuracy and detail.
Process of informing the target audience	Incremental and iterative in theory and practice.	Incremental nature of some stories at odds with the need to emphasize the "new" in news.
Independence—steering clear of conflict of interest	Independent to a large degree but conflicts of interest regarding funding sources can arise, especially with private funding.	Largely independent, although questions of media ownership have recently raised concerns.
Skepticism and critical thinking	Fundamental to successful research.	Fundamental to successful reporting.
Self-correcting	Self-correcting in the long run; context added to corrections.	Corrections often less prominent than the original error, and rarely in context.

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Over the past several years, there have been notable improvements in moving away from 'he said, she said' journalism, at least in the coverage of climate science and especially among science writers. However, science writers are only a small fraction of the army of reporters covering environmental science issues, especially given the compression of newsrooms. It remains to be seen whether this move away from reporting that presents two sides of the story as carrying equal weight (whether or not the two sides are actually weighted equally), is temporary, or represents a genuine transformation toward improved reporting.

Formal Training Careers in scientific research require formal training, typically involve graduate level training, and are nearly always highly specialized. While formal education and training has not historically been necessary for journalists, many of those entering the field now typically have at least an undergraduate degree in journalism, and many also have advanced degrees.

Some leading university journalism schools now offer journalism curricula that are tied to complex subject areas such as business, law, religion or Earth and environmental science. Unfortunately, cross-offerings among science, journalism and communication programs are still all too uncommon within most universities and colleges.

Science degree programs, by contrast, almost universally tend to offer no training in journalism or communication, or even instruction on how to teach for that matter. Outside of a few inspired programs that introduce scientists to the art and craft of communication (e.g., the Aldo Leopold Leadership Program, and Stanford climatologist Stephen Schneider's efforts in the name of communication), most scientists are unequipped for either effectively engaging the media and the public or for understanding communication or journalism.

Deadlines and Being First: The Unholy Coupling In science, the driving force behind the goal of being first seems more often personal rather than institutional. I would venture that it is perhaps more desirable for a scientist to have his or her work published in the most professionally demanding, noteworthy, and prestigious scientific journals than to be the first person to publish on a specific topic, although the latter is always attractive. This would perhaps be the equivalent in journalism circles to getting one's story on the front page of a nationally respected and influential newspaper or magazine.

By contrast, in most media venues (TV, print, radio), being the first to report a story or getting the exclusive is highly sought after and often institutionally driven, in part because of competition for audience ratings and advertising revenue. It seems that the phrase "You heard it here first!" has become a meaningless cliché. Getting a story right takes time; and journalistic research takes even more time.

Independence Scientists and scientific research have a long history of independence partly as a function of adherence to accepted scientific standards such as peer-review of research results prior to, and as a condition of, publication. Generally, but not always, scientific results are not considered to be compromised by the source of research funds, especially when projects are supported by government funding sources such as the National Science Foundation, NOAA, or NASA. That is not to say that there are no instances of real and alleged scientific fraud. The growth of private funding for scientific research has raised many questions about scientific independence.

The profession of journalism long has valued independence. But media business consolidation and the possible influence of advertising revenue and investor expectations have led to concerns as to whether the news is still truly independent. It seems to me that journalists are too often thrust between two very different and competing sets of values, those of the profession of journalism and those of the business of journalism - a situation in which 'bottom line' pressures can confound the expression of core journalistic values.

Process of informing the target audience Science is an incremental process that operates on a number of timescales. Conclusions and information, in general, are always in the process of being tested and refined, leading over time to greater confidence in the outcomes (e.g., Einstein's theory of relativity, plate tectonics, climate change, etc.). The process is one of constant refinement of knowledge that may take years or tens of years. A typical peer-reviewed science paper, for example, will often devote considerable time and space to setting the historic stage and context for the present work in question (i.e., How and why did this work come about?; How does the research relate historically to other research along the same or different lines?), which highlights the incremental nature of scientific research.

In journalism, the ideal of placing current events within the context of what has come before ("incrementalism") is not often achieved, because of pressures of limited time or space, tight deadlines and the need to focus on

what's new. In a recent commentary about news coverage of energy issues, Howell Raines, former executive editor of The New York Times, argued "The problem is that headlines...trump the revelations of yesterday's in-depth reporting. The digital-news era is good at letting us know what happens now. But it's lousy at reminding us of what's happening again."[1]

Skepticism and critical thinking These are both integral parts of the culture of science and application of the scientific method.

However, it is not enough in science merely to be skeptical. Skepticism alone does not constitute evidence or proof. Consequently, science places the burden of proof on those who challenge so-called "settled" scientific wisdom. Skeptics are expected to make the scientific case for their claims; otherwise, skepticism without evidence is just another opinion in a world of opinions. This is part of what helps make the scientific process largely effective.

Similarly, in the case of journalism, skepticism alone does not constitute good reporting. While journalists also cherish skepticism, they may lack the detailed knowledge or institutional framework that scientists have for sorting through competing scientific claims. Journalists work to maximize their research and critical thinking within a tightly constrained time frame, and the nature of their profession often forces them to become experts on a topic that they had previously known little about. History has shown that such pressures can often result in the invocation of false balance as a shortcut. Yet complex issues demand critical thinking and time to think and assemble one's thoughts. Perhaps the future of journalism will witness a greatly decreased emphasis on 'news' (the telling of what's new) and more emphasis on long-form journalism that genuinely informs.

Self-correction The process by which science is conducted is self-correcting on the scale of days to tens of years. Incrementalism goes hand-in-hand with the capacity and need to continually correct and, in the process, increase confidence in this acquired knowledge over time. As new research papers are published, some previous research is invariably overturned, some is altered, and some stands as is, at least for the moment. But in this process of refining information via self-correction, the historical context of these advances is typically recounted and preserved. Change is best understood when viewed in the context of what that change refers to and how it came about.

The news media strive for accuracy and have an ethical obligation to publish corrections to errors called to their attention, and they usually do so, but often without the same prominence as the original story that included the error. As summarized by Michael Schudson and Tony Doukopil, "PEJ's 2005 and 2006 'State of the News Media' reports find that cable TV news has 'all but abandoned what was once the primary element of television news, the written and edited story.' In its place is 'a journalism of assertion' where reporters perform 'off the cuff or from hasty notes' and where 'information is disseminated with only minimal attempts to check it out.'"[2]

The good news is that some media outlets and writers now place their corrections more prominently, and some even in context. The bad news is that the context for such corrections is still largely absent.

I hope to have left the reader with the impression that science, journalism and their respective educational institutions have much in common and much to offer one another.

Perhaps the time has come for relevant science and journalism educational institutions, and their respective professional societies, to better capitalize on these shared values and standards. This would be in the interest of improved communication on behalf of a new generation of journalists and scientists and, more broadly, in the interest of a more informed and democratic society.

That said, I am concerned that the current publicly-traded business model at the heart of many large media businesses—with its emphasis on ever-increasing quarterly earnings and little reinvestment of profits back into the news apparatus—operates at cross purposes with maintaining and nurturing many of the shared core values identified in Table 2. The primacy of upholding traditional journalistic standards and values must be returned to the forefront of journalism.

Perhaps the time has come to reconsider the publicly-traded media business model in favor of a societal trust-based model that places priority on upholding and nurturing journalistic standards and values. Nelson Poynter laid the philosophical foundation for building such vibrant institutions by setting forth a set of standards for ownership of journalism properties in 1947.[3] The first tenet states "Ownership or participation in ownership of a publication or broadcasting property is a sacred trust and a great privilege."

It is indeed a privilege—one to be exercised judiciously as a key component of our democratic society.

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Scientist **Anthony Socci** has long been interested in improving communication among scientists and journalists. He is a senior science and communication fellow at the American Meteorological Society.

1. Howell Raines, "Crude Reporting," *Portfolio Magazine*, July 16, 2008, http://www.portfolio.com/views/columns/media/2008/07/16/Criticism-of-Medias-Energy-Coverage#page1

2. The Project for Excellence in Journalism, "The State of the News Media 2005," and "The State of the News Media 2006," (The Project for Excellence in Journalism, 2005, 2006), http://www.stateofthenewsmedia.com, as reported by Michael Schudson and Tony Doukopil, "The Limits of Live," Columbia Journalism Review, January/February 2007, http://www.cjr.org/the_research_report/the_limits_of_live_1.php

3. Nelson Poynter, "The Standards of Ownership," August 6, 1947. Available at http://www.poynter.org/content/content_view.asp?id=87554

nizations representing the dominant scientific view on climate change.[18]

Participants suggested developing grant proposals seeking funding for social science research to fill information gaps such as: what the public knows about science; how people deal with, conceptualize, and respond to perceived risk; why public interest in science appears reasonably high but coverage in popular media appears generally on the decline; appetites for digesting and understanding science news; factors motivating changes needed to address climate change; and whether the media is meeting those needs.

D. Feedback To Media Executives on the Quality of Science Coverage

Many at the workshops said that without better science reporting, the public will not have the necessary facts to make informed decisions on vital public policy issues. Many participants, especially journalists, said they think individuals and institutions have a responsibility to speak out on coverage of science, that researchers need to speak up when coverage of their work is wrong or misleading. Without such feedback, change will not happen.

Program co-manager Tony Socci described his vision of an event in which the presidents of a dozen of the nation's foremost scientific organizations convene at the National Press Club, in Washington, D.C., for a day long exchange of views with a dozen top news executives. Socci dreamed that the scientists and journalists would exchange views and reach common ground on coverage of science as a critical element in a democratic society. He imagined that they would have a joint press conference, then move forward with what they had decided needed to be done. The challenges, after all, are big, he said, and can only be addressed by big picture approaches. He agreed that undertaking such an initiative at a state or regional level also makes lots of sense.

Another route suggested in the workshops was for citizens to go directly to top news editors and editorial boards to urge more coverage of science news. Participants said it is useful in such cases to keep actions local to be most effective—acting alone or as a coalition of citizens or scientists, with the backing of important local research and academic institutions. That same group might enlist the support of local colleges, universities, and public-minded corporations to stress the value and importance of outstanding science journalism to local media interests.

8

NEWS EXECUTIVES MEET WITH SCIENTISTS

A common recommendation at each of the Metcalf Institute's Science Communication and the Media workshops was that such a session should be held for top editors and scientists. Getting the people at the top involved emerged early as an important goal, and was an idea embraced by nearly everyone involved.

In September 2007, 18 news executives from some of America's leading daily newspapers and news outlets gathered for a day of roundtable discussions with nine of the nation's top climate scientists at Stanford University to discuss climate change.

The roundtable discussion was organized by the Metcalf Institute and the Society of Environmental Journalists, with support from the Woods Institute for the Environment, Stanford University, The Energy Foundation, the Heinz Family Philanthropies, and the Yale Project on Climate Change of Yale University.

The News Executives Roundtable: Covering Climate Change provided an overview of the physical science underpinning the current understanding of climate change, and several perspectives on projected economic impacts and technological approaches toward adaptation and mitigation. While some of the scientific findings discussed at the roundtable were new, the presentations were structured to provide an illuminating narrative about how the climate system works, how human activities have affected global climate, and the impacts of those climatic changes. This well-established physical science was supplemented with evidence of biological responses to climate change, and the economic and technological issues mentioned previously.

Participating editors responded very positively to the program, as indicated by their responses to an anonymous Internet-based survey distributed after the roundtable. The survey had a 78 percent response rate.

Editors' Evaluations

Perhaps the most obvious indication of the forum's impact on the editors came from Des Moines Register Executive Editor Carolyn Washburn, who moderated the Republican and Democratic nationally televised primary campaign debates in Iowa, less than three months after the Stanford meeting and before the state's January 2008 caucuses. Washburn used the GOP debate, the first of the 2008 presidential primary season, to raise the climate change issue. This was the first time climate change had been raised in such a high-visibility debate format. After the debate, Washburn noted in an email,

> *"I was pleased to ask the energy and climate change questions. The [roundtable] absolutely influenced my attention on that, raised my antennae so I was aware of the need. With so many related activities and our ongoing coverage of them—a major piece on ethanol, the Farm Bill, energy issues, and even the awarding of the Nobel Peace Prize to Al Gore—the [news executives roundtable] helped me connect the dots and better recognize the importance of climate change to all these issues"*

Some of the news executives' responses to specific questions are shown below.

Question: What were the most valuable insights you gained from the News Executives Roundtable: Covering Climate Change?

- "Listening to the speakers and the debate reinforced my belief that this is a topic that must be covered as a beat. We cannot start at 'ground zero' with every story and debate issues that science has largely settled. The day gave me more ammunition to take back to my producers and, most importantly, connected me with new sources."

• "The light bulb moment for me was understanding how interconnected climate change is to every aspect of life and public policy—public health decisions, economics, etc. I think about coverage of politics differently because I believe it will take bold political leadership to get us to make the changes that will make a difference."
• "The depth of empirical evidence available through databases, information that will give a stronger local voice to a global story."
• "The relative unanimity of view, the detail and expertise of the presentations, applicability to a more common understanding of the problem: (The problems in the tropical zones, the disappearing or moving fauna.)."
• "That the debate is 99.9 percent over in the scientific community, that climate change is a fact....that the scientific community takes offense at journalism's balanced approach to the subject in its coverage."
• "…it was extremely useful to hear from some of the most authoritative sources in the country. I was especially pleased that some of the speakers were able to make their presentations relevant—use of the progression of photos on the glaciers."

Question: Will the knowledge you gained change the way your news organization covers climate change?

	Response Percent	Response Count
Yes	57.1	8
No	7.1	1
Not Sure	35.7	5

Question: If you answered yes to the previous question, explain how this will change coverage of climate change in your news outlet.

• "I returned to press for more coverage of the subject. Fingers crossed."
• "First of all, the roundtable inspired me to write an editorial that very Sunday on the importance of addressing climate change. It's been a significant issue for us for a few years now…but I will very consciously make sure it's a component of our presidential coverage.
• "We will use database reporting to examine different layers of the onion, peeling the issue a layer at a time."
• "[It] may not change the way we cover it, but will definitely affect what we write about."
• "It confirmed for me the priority we've given this coverage and the ways we're doing it."
• "Now, there's just more awareness of key issues at top levels of newsroom."
• "Increased my interest and expertise in the subject. It allows me to be a better advocate and questioner in news meetings when stories are being selected. This definitely has gone up on my interest-index. I think it also will cause me to be a greater advocate for stories we'll do locally on ramifications of global warming in our corner of the world."
• "I came away from the meeting convinced we needed to give the subject more coverage."
• "…I am aware of how critical the issue is at this time in ways I had not thought of prior to the meeting. I have new story ideas and I have my enviro team working on a variety of new approaches."

In addition to the positive responses indicated above, the survey indicated that the attending editors left with many story ideas, and a unanimous opinion that they would strongly recommend similar workshops to their peers.

Getting the nation's leading news executives out of the newsroom and into a hands-on continuing education program on a single subject is difficult even in the best of journalism economies and is particularly problematic given the economic challenges that most journalism organizations are now facing. Nonetheless, efforts to work with organizations such as the Associated Press Managing Editors (APME) and business editors, broadcast meteorologists, and other top news executives are continuing, and few journalists or scientists likely see the end of the climate change story as a major newsmaker any time soon. With a new presidential administration and continued congressional interest in energy and climate change legislation, the nation's top news executives and those covering the stories day-to-day are likely to need continuing access to the most responsible climate science and policy resources and information.

AFTERWORD

Fingers were pointed…

… scientists' at the shortcomings of journalism and its reporters and editors, at their misapplication of journalistic "balance," their need to simplify and generalize, and their need for a snazzy headline and a "good story";

… and journalists' at the scientists and their equivocations, their "on the one hand, this…and on the other hand, that" qualifiers, and at their frequent aversion to dealing with the media in the first place.

As a result, the would-be conversation, the information sharing with the public at large and the hoped-for better public understanding of climate issues, was going nowhere. Who ought to shoulder the blame?

Scientists and journalists alike, along with academics and activists, pointed to the inability of the public to "connect" with climate change and climate science, or to appreciate the seriousness of the issue as it was understood by most of the world's leading scientists.

Scientists throughout the 1990s and the early years of this century fretted publicly that the processes and studies of groups such as the Intergovernmental Panel on Climate Change and the National Academy of Sciences were ignored or, worse yet, dismissed or discredited by a generally uninformed public. They felt that many in the news media were not meeting their professional responsibilities to inform and educate the public on an issue of overriding public policy importance.

The scientific community was not alone in that fear. Many of the reporters and editors attending the Metcalf Institute workshops, as well as the editors at the program for news executives, generally shared that perspective, though they did not place the blame solely on the media. They brought to the series of workshops their own concerns and frustrations, sometimes mirroring and sometimes differing from those of the scientists.

During a period of extraordinary transition for the "mainstream" media in their competition with new digital information resources, reporters often complained that they had trouble in their own newsrooms convincing editors of the importance of their climate change stories. In contrast to the local TV dictum, however hyperbolic, that "if it bleeds, it leads," science and environmental reporters emphasized that the climate change story oozes, and only very slowly and over periods or years, decades, even centuries.

They pointed out the contradictions in framing climate change science stories in the emerging around-the-clock breaking news mentality of many news organizations. They pointed to the long time scales involved with climate change, and also to the distant locations—often far removed from their immediate circulation and viewership communities—expected to first show adverse impacts of climate change.

Reporters blamed themselves, their editors, and their own profession in some cases. But they didn't spare the science community for its own communications shortcomings. They pointed to traditions and established practices within the professional science community, in which outreach to media often has been actively resisted. They complained that too many in the science community did not communicate effectively with nonscientists, frequently coming across as overly technical, isolated and removed from "real life" considerations, and too dependent on their own impenetrable jargon.

While critical of the media in many instances, scientists also acknowledged their own profession's frequent unwillingness to fully engage with the media and the public on a politically charged public policy issue. They spoke openly throughout the workshops of their own challenges in adequately explaining—and of the media's challenges in conveying and the public's

in understanding—concepts such as uncertainty, relative risk, correlation and causation.

There was a lot of talk from all involved about scientific literacy and the lack thereof, and about the respective roles of scientists and journalists in addressing the issue. But much of the discussion had been happening within professional peer groups, often conducted in the absence of the other discipline, somewhat like the proverbial ships passing in the night.

With an extraordinary network and decades of firsthand personal interactions with leading climate scientists from across the nation, Anthony D. Socci was able to attract to the workshops some of the most respected climatologists working on climate change issues. Those participants were matched by a comparably impressive group of science and environmental reporters and editors.

The workshop exchanges that constitute the substance of this report cannot be said to have united the journalism and science communities in their approach to dealing with climate change science. Nor was that the intention of the workshop managers from the start.

Instead, the exchanges were designed to improve each discipline's understanding of the principles, mores, and approaches of the other, with a goal of ultimately contributing to improved public understanding of important climate change issues.

With fierce independence a guiding principle of the best scientists and the best journalists, it is inevitable (and in the end perhaps even desirable) that they will at times be at odds with each other. The workshops opened communication channels not solely on matters of technical importance but also on the fundamental issues each profession must address regarding the way that scientific information is provided to the general public.

For a wide range of reasons detailed earlier in these pages, media interest in and coverage of climate change science and impacts increased significantly over the course of these workshops. In their professional electronic mailing lists, Web sites, and blogs, reporters and editors began expressing increasing confidence that certain climate science issues—especially the point that Earth indeed is warming and that human emissions contribute significantly to that warming—no longer need to be "balanced" against denials. Journalists began to speak increasingly among themselves about the need to weigh scientific evidence rather than just opinion and accusation in reporting on climate science issues.

It would be comforting, but pretentious, to suggest that these workshops played a major role in that evolution. In reality, it is more likely that they were one small cog in an elaborate wheel and series of events leading to increasing media and public interest in and understanding of climate change.

The program organizers and sponsors believe and hope that the lessons drawn from these workshop dialogues can be useful beyond their role in the continuing story of climate scientists' relationship with the news media. The most responsible and knowledgeable climate scientists and journalists understand that science in this area will never be fully settled, that uncertainty is a virtue and not a curse of responsible science, and that policy makers and the public will continue to depend on expert scientists and on journalists to communicate the story of climate change.

We hope to see the benefits from these workshops and this report carry over to other important areas of scientific endeavor, particularly those with a substantial public policy angle. In this respect, the scientific and the journalism communities will long remain active as teachers and as students of each other's needs and interests.

The climate change issue often, and accurately, is described as a generational issue. So too is the issue of how the scientific community and those charged with communicating to the public on science issues can best work together, consistent with the needs of each for independence and credibility. There is more than enough work to go around for scientists and journalists alike if the public and its leaders in coming months, years, and decades are to adequately appreciate and address the challenges of human-caused climate change.

Beyond the journalism and science establishment and professional societies, educational and continuing-education organizations ranging from secondary schools to colleges and universities have important roles to play in the effective communication of responsible climate change science and policy developments. As described throughout this book, the Metcalf Institute for Marine and Environmental Reporting and all of its critical project partners and affiliates stand committed to continuing the successes borne from these unique dialogues among leading journalists and climate scientists.

Bud Ward
Author, Workshop Co-Manager

Fall 2008

Appendix A: Workshop Participants

First Workshop, November 9–11, 2003
University of Rhode Island

Journalists

- Cornelia Dean, The New York Times
- Camille Rose Feanny, CNN Science & Technology Unit
- Richard Kerr, Science
- Peter Lord, The Providence Journal
- Boyce Rensberger, MIT-Knight Science Journalism Fellowships
- Andrew C. Revkin, The New York Times
- Randy Showstack, EOS, American Geophysical Union
- Sarah Webb, Ph.D. candidate, Indiana University, awarded a journalism workshop fellowship
- Dale Willman, Field Notes Productions

Scientists

- Susan Avery, Ph.D., Cooperative Institute for Research in Environmental Sciences, University of Colorado
- Judith L. Lean, Ph.D., Naval Research Laboratory
- Jerry D. Mahlman, Ph.D., National Center for Atmospheric Research
- Michael E. Mann, Ph.D., University of Virginia
- James J. McCarthy, Ph.D.,Harvard University
- Robert McDonald, graduate student, Duke University
- Ellen Prager, Earth2Ocean, Inc., University of Miami
- Roger Street, Environment Canada

Second Workshop, March 17–19, 2004
University of California, San Diego
Scripps Institution of Oceanography

Journalists

- Molly Bentley, BBC
- Jeff Burnside, WTVJ-TV, NBC News Eco-Watch
- Andrew Bridges, Associated Press
- Rex Dalton, Nature
- Peter Dykstra, CNN
- John Fialka, The Wall Street Journal
- Bruce Lieberman, San Diego Union-Tribune
- Madeleine Nash, Freelance
- Paul Raeburn, Freelance
- Andrew C. Revkin, The New York Times
- Robert Thomas, Ph.D., Loyola University
- Dale Willman, Field Notes Productions

Scientists

- Paul Crutzen, Ph.D., Scripps Institution of Oceanography
- Jeffrey Kiehl, Ph.D., University Consortium for Atmospheric Research
- Camille Parmesan, Ph.D., University of Texas
- Joyce Penner, Ph.D., University of Michigan
- V. (Ram) Ramanathan, Ph.D., Scripps Institution of Oceanography
- Sherwood Rowland, Ph.D., University of California, Irvine
- Ben Santer, Ph.D., Lawrence Livermore National Laboratory
- Steve Schneider, Ph.D., Stanford University
- Jeff Severinghaus, Ph.D., Scripps Institution of Oceanography
- Richard Somerville, Ph.D., Scripps Institution of Oceanography
- William Schlesinger, Ph.D., Duke University

Third Workshop, November 8–10, 2004
University of Washington

Journalists

- Frank Blethen, Seattle Times
- Seth Borenstein, Knight-Ridder
- John Carey, Business Week
- Jim Detjen, Michigan State University
- Sandi Doughton, Seattle Times
- Steve Krueger, KPLU-NPR
- Chris Mooney, freelance writer
- Jacques Rivard, Canadian Broadcasting
- Bari Scott, SoundVision Productions
- Pete Spotts, Christian Science Monitor
- Dale Willman, Field Notes Productions
- Aileo Weinmann, graduate student, Michigan State University

Scientists

- Maxwell Boykoff, Ph.D., University of California, Santa Cruz
- Anthony Broccoli, Ph.D., Rutgers University
- Richard Gammon, Ph.D., University of Washington
- Malcolm Hughes, Ph.D., University of Arizona
- Tom Karl, Ph.D., NOAA Climate Data Center
- Michael Mastrandrea, Post-Doc, Stanford University
- Hal Mooney, Ph.D., Stanford University
- Henry Pollock, Ph.D., University of Michigan
- John (Mike) Wallace, Ph.D., University of Washington
- Ed Sarachik, Ph.D., University of Washingon

Fourth Workshop, June 1–3, 2005
Columbia University
Lamont-Doherty Earth Observatory

Journalists

- David Appell, Ph.D., Freelance journalist
- Chris Bowman, The Sacramento Bee
- Beth Daley, The Boston Globe
- Daniel Grossman, Ph.D., freelance print journalist and radin producer
- Matt Hammill, WQAD-TV
- Bill Kovarik, Ph.D., Radford University
- Nicholas Lemann, Columbia University
- Philip Meyer, University of North Carolina
- Jon Palfreman, Ph.D., independent televi sion producer
- Andrew C. Revkin, The New York Times
- Don Wall, WFAA-TV
- Dale Willman, Field Notes Productions

Scientists

- Alan Betts, Ph.D., Atmospheric Research
- Anthony Broccoli, Ph.D., Rutgers University
- Kim Kastens, Ph.D., Columbia University Lamont-Doherty Earth Observatory
- Jerry D. Mahlman, Ph.D., National Center for Atmospheric Research
- Michael Mann, Ph.D., University of Virginia
- Maureen Raymo, Ph.D., Boston University
- Gavin Schmidt, Ph.D., NASA Goddard Institute for Space Studies
- Ronald J. Stouffer, NOAA Geophysical Fluid Dynamics Laboratory
- Lonnie G. Thompson, Ph.D., Ohio State University
- Stephen E. Zebiak, International Research Institute for Climate Prediction

Fifth Workshop, November 6–8, 2005
University of California, Berkeley

Journalists

- Chris Bowman, The Sacramentn Bee
- Brian Bull, Wisconsin Public Radio
- Dina Cappiello, Houston Chronicle
- Earle Holland, Ohio State University
- Charlie Petit, U.S. News & World Report
- Paul Rogers, San Jose Mercury News
- Tom Rosenstiel, Project for Excellence in Journalism
- Gianna Savoie, documentary film producer and writer
- Mark Trahant, Seattle Post-Intelligencer
- Dale Willman, Field Notes Productions
- Alexandra Witze, Nature

Scientists

- Newsha Ajami, Ph.D. candidate in Civil and Environmental Engineering, University of California, Irvine
- Tim Barnett, Ph.D., Scripps Institution of Oceanography
- Tom Crowley, Ph.D., Duke University
- Jerry Franklin, Ph.D., University of Washington
- Inez Fung, Ph.D., University of California, Berkeley
- Peter Gleick, Ph.D., Pacific Institute for Studies in Development, Environment, and Security
- Daniel M. Kammen, Ph.D., University of California, Berkeley
- David Karoly, Ph.D., Oklahoma University
- Naomi Oreskes, Ph.D., University of California, San Diego
- Ben Santer, Ph.D., Lawrence Livermore National Laboratory, University of California
- Stephen H. Schneider, Ph.D., Stanford University
- Barton "Buzz" Thompson, Jr., Stanford University

Sixth Workshop, July 25, 2006
Woodrow Wilson International Center for Scholars

Journalists

- Jim Detjen, Michigan State University
- Peter Dykstra, CNN
- Mark Jurkowitz, Project for Excellence in Journalism
- Bruce Lieberman, San Diego Union Tribune
- Andrew Revkin, The New York Times
- Dale Willman, Field Notes Productions

Scientists

- Anthony Broccoli, Ph.D., Rutgers University
- Jerry Mahlman, Ph.D., National Center for Atmospheric Research
- Naomi Oreskes, Ph.D., University of California, San Diego
- Benjamin Santer, Ph.D., Lawrence Livermore National Laboratory
- Richard Somerville, Ph.D., University of California, Scripps Institute of Oceanography

News Executives Roundtable:
Covering Climate Change, September 5, 2007
Stanford University

Journalists

- Caesar Andrews, The Detroit Free Press
- David Boardman, Seattle Times
- Jeanne Carstensen, Salon.com
- Bob Cohn, Wired
- John Diaz, San Franciscn Chronicle
- Leonard Downie, Jr., The Washington Post
- Susan Goldberg, The Plain Dealer
- Bennie L. Ivory, The Courier-Journal
- Martin Kaiser, Milwaukee Journal Sentinel
- Donald Kennedy, Science
- Glenn Kramon, The New York Times
- David Ledford, The News Journal
- Rick Rodriguez, The Sacramentn Bee
- Frank Scandale, The Record
- Anne Thompson, NBC News
- Carolyn Washburn, The Des Moines Register
- Len Wolinsky, Los Angeles Times
- David Zeeck, The News Tribune

Scientists

- Ken Caldeira, Ph.D., Stanford University
- Michael Greenstone, Ph.D., Massachusetts Institute of Technology
- Jon A. Krosnick, Ph.D., Stanford University
- Amory B. Lovins, Ph.D., Rocky Mountain Institute
- Benjamin Santer, Ph.D., Lawrence Livermore National Laboratory, University of California, Livermore
- Stephen Schneider, Ph.D., Stanford University
- James Sweeney, Ph.D., Stanford University
- Terry Root, Ph.D., Stanford University
- Lonnie Thompson, Ph.D., Ohio State University

NOTES

A Word About Words

1. A September 2008 search using the Google search engine's "trends" tool (www.google.com/trends) shows searches for the term "global warming" exceed those for the term "climate change" by more than a three-to-one ratio worldwide. In the U.S., the difference is even greater: Google searches for "global warming" exceed those for "climate change" by a ratio of more than six-to-one. http://www.google.com/trends?q=climate+change%2C+global+warming&ctab=0&geo=US&date=all&sort=1

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Chapter 7

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11. EarthwireClimate, United Nations Environment Program/GRID-Arendal, http://www.earthwire.org/climate/

12. The Environment Report, http://www.environmentreport.org/

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A Publication of Metcalf Institute
for Marine & Environmental Reporting
University of Rhode Island
Graduate School of Oceanography

Metcalf

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This report was made possible through
an award by the National Science Foundation.

National Science Foundation