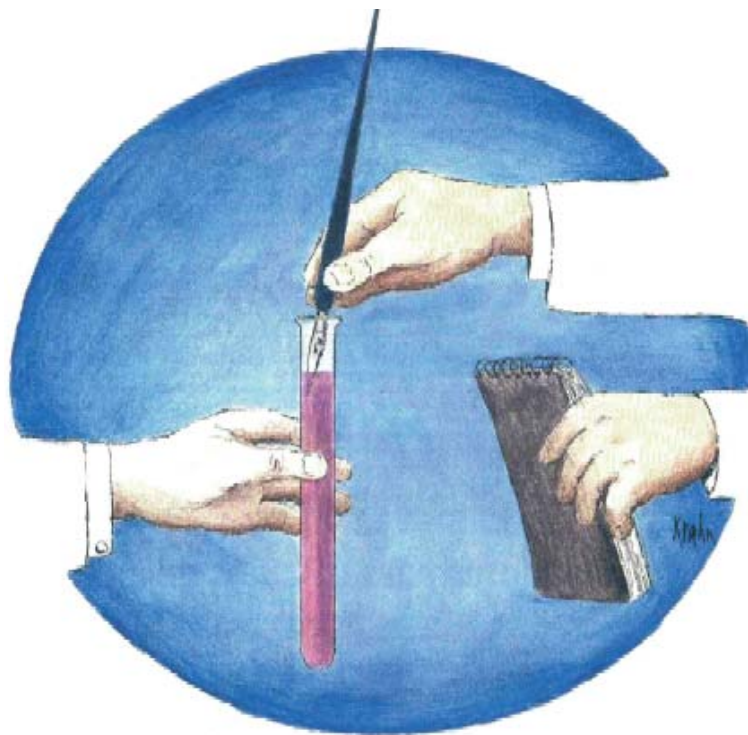


Science Communication in the 2.0 World

Vladimir de Semir
vladimir.semir@upf.edu

**Science Communication Observatory
Pompeu Fabra University (Barcelona, Spain)**



The world of news is experiencing a serious earthquake. The normal way in which people access information - basically: press, radio and television - is being pushed aside by new channels and media - websites, blogs, podcasts, google/news,... - and by a gradual change in the attitude of the public in terms of how to consume information and, in general, culture via internet.

Although the tremor may not be visible in the day to day for the general public, if we look carefully we see that it keeps producing a constant drip of problems and crisis which are gradually coming to the surface. At the start of May 2007, Hearst Co. the editorial company of the influential *San Francisco Chronicle* announced that a quarter of their editors would be laid off to overcome the newspaper's financial problems and this happened despite the fact that this daily newspaper is one of the best examples of adaptation to the new internet era. In fact, their website (SFGgate.com) is one of the 10 news sites with the highest traffic in the United States. However it doesn't generate enough advertising revenue to offset the process of change that is occurring in the way the public accesses news. Many other written and also audiovisual media have been reducing their services in recent times, closing sections – in particular many related to science and the environment.

Neil Henry, Professor of Journalism at the University of Berkeley (California), later wrote, on 29 May, in the *San Francisco Chronicle* itself, an article entitled “*The decline of news*” in which, amongst other things, he said:

“When journalists' jobs are eliminated, especially as many as *The Chronicle* intends, the product is inevitably less than it was. The fact is there will be nothing on YouTube, or in the blogosphere, or anywhere else on the Web to effectively replace the valuable work of those professionals. I see a world where the craft of reporting the news fairly and independently is very much endangered; and with it a society increasingly fractured, less informed by fact and more susceptible to political and marketing propaganda, cant and bias. I see a world in which the pursuit of truth in service of the public interest is declining as a cultural value in our society amid this technological tumult; a world where professional journalism, practiced according to widely accepted ethical values, is a rapidly diminishing feature in our expanding news and information systems, as we escape to the Web to experience the latest “new” thing. I see a world where corporations such as Google and Yahoo continue to enrich themselves with little returning to journalistic

enterprises, all this ultimately at the expense of legions of professional reporters across America, now out of work because their employers in "old" media could not afford to pay them."

Bypassing journalistic intermediation

In March 2009, "in response to the decline in journalistic coverage of sciences", a group of more of 40 prominent universities and research centres in the United States decided to create *Futurity*, a scientific news portal that provides information directly from those who produce it (the scientific, medical and environmental community) to the general public. *Futurity*, which has now extended to more organisations and also to institutions in Great Britain, is a clear alternative to what used to be the most common way of communicating on science: intermediation of journalists. In other words, a "bypass" has been created today that allows the world of science to skip the unavoidable collaboration or - for some - the obstacle represented by the media in their objective of circulating information to the general public, who also have the option of searching for information directly from the specialised sources.

This portal is a demonstration of the change being experienced by social communication of scientific, medical and environmental information. An approach that is becoming more and more widespread and which is characterised by the fact that producers of knowledge directly contact the public via the many channels now offered by the net, without requiring the media to act as intermediaries. The potential of these types of initiatives is probably very high given the high credibility of the scientific and medical community in the population (at least, in general terms) whilst the world of journalism has gradually seen the level of faith and authority the public instil in it decrease. The portal *Futurity* defends its existence and objectives as follows:

Why Futurity? Why now?

The way people share information is changing quickly and daily. Blogs and social media sites like YouTube, Twitter, and Facebook are just a taste of what's to come. It will be easier than ever to share content instantly with people around the globe, allowing universities to reach new audiences and engage a new generation in discovery.

Equally significant has been the recent decline in science and research coverage by traditional news outlets. For decades, universities have

partnered with journalists to communicate their work to the public, but that relationship is evolving. At the same time, research universities are among the most credible and trusted institutions in society and now have the ability to deliver their news and information directly to readers.

In an increasingly complex world, the public needs access to clear, reliable research news. *Futurity* does the work of gathering that news. Think of it as a snapshot of where the world is today and where it's headed tomorrow. Discover the future.

The case of *Futurity* illustrates a trend produced by the spread of the world of internet and serves to pose several questions:

1. If the public can access the information first-hand (and for free), why turn to the media?
2. Do the media have an added value for the user as information providers?
3. What reasons do scientists have for communicating their information to the public?
4. Is it worth this additional effort for the world of science?
5. Is traditional journalism partly to blame for this bypass spreading?
6. Can the quality of the information be affected in the new form in which it reaches the people?

The public can now access the direct source of the information they are interested in. Even the public can practice his own citizen journalism and be an individual source of news and opinion... However, people must also be prepared to learn the new rules of the game and, of course, be enough educated to be critical with the direct sources as it was, of course, with traditional media. The new “disintermediation” of scientific information can, therefore, be very positive, since it allows for more proximity between sources of information and society. But it can also have a negative side if the regulatory role that journalism should have in the search for the truth and as much objectivity as possible is being lost. We could ask ourselves, clearly, if the media have really played this rebalancing role in the recent past or are currently playing it or if, on the contrary, how they have acted

and their interests – which they also have – have contributed to a gradual social discredit and distancing of their normal users.

Scientists see bright side of working with media

Should scientists also be communicators or is it better that they hand this task over completely to communication professionals: journalists, publicists, press office managers...?

Jane Gregory and Steven Miller reflect in *Science in the Public: Communication, Culture, and Credibility* on the importance of openly recognising the motives that lead to a scientist to communicate to the public, and groups them in the following reasons or intentions : a) enthusiasm (the researcher feels passionate about the field they work in and wants to share it with others); b) improve the abilities of the recipients; c) improve the existing democratic processes or help to create new ones if none exist; d) prevent the alienation of specific sectors of society and e) serve the interests of the scientific community and the bodies that finance it.

Once upon a time in the world of science, sharing scientific work with the press was heresy. Journalists, according to the common wisdom, would get it wrong, your research would be distorted, and your colleagues would see you as little more than a shameless grandstander. Scientist popularizes such as the late Carl Sagan, a master of adroit science communication, were excoriated by many of their colleagues for the questionable practice of trying to make science accessible.

But a sea change is under way, it seems. In a report published in 2008 in the journal *Science*¹, an international team of researchers in science communication led by Hans Peter Peters from Forschungszentrum Jülich (Germany), reports that relationships between scientists and journalists are now more frequent and far smoother than the anecdotal horror stories scientists routinely share.

These are the key findings of the survey:

- Interactions between scientists and journalists occur more frequently and more smoothly than previously thought

- Previous research, as well as anecdotal evidence among researchers and journalists, has often led to the perception that a tension exists between science and journalism.
- Unexpectedly large percentage of researchers had interacted with the news media in the last three years and that the majority of these researchers were generally pleased with the experience.
- The most commonly cited motivation for communicating with journalists was to increase the public's appreciation of science.

There has therefore been progress in scientific awareness by communicating and diffusing knowledge and it is very significant that scientific communication is considered a functional requirement in the world context, given the democratic nature of the society of knowledge.

Scientists and journalists have to collaborate closely to ensure contextualised information reaches people that allows for the development of the indispensable critical spirit, both individually and collectively, to be able to understand and participate in the development of ideas and opportunities that will enable us to improve human and organisational abilities to be competent in an environment subjected to constant innovation, learning, creativity and change. The circulation of scientific culture has thereby transformed into the indispensable catalyst of the above-mentioned chain reaction that a cohesive society of knowledge must bring us.

Challenging the Future of Science and Society

Communication between science and society is crucially important: it informs the broader public about issues related to science and technology, it informs science about societal perceptions and expectations, it makes scientific expertise publicly available, it has an impact on policy-making and agenda-setting, it affects the legitimacy of research, and it plays a major role in the governance of science, technology and risk. But communication is also vulnerable to misunderstandings and misuses: over-simplified models and concepts about how science and society communicate, unrealistic expectations on both sides regarding the benefits of communication, and forms of communication that increase the distance between science and its extra-scientific audiences rather than 'engaging' them. Science communication may be able to help to establish a transparent and open form of communication in both directions that

contributes to defining the role of science in society, and to enabling society to make the best use of scientific knowledge.

In recent years, there have been many attempts to organize dialogue between the many actors involved in science communication. In this context, for example, science communication is often intended to attract children and young people, potential future scientists. The concern amongst scientists, science educators and policy makers is that science has lost its attraction, as young people choose other subjects and vocations. Part of the problem is that much science communication is initiated and conducted by scientists who cannot imagine that science as such is not interesting and attractive, and therefore present science in terms that are incomprehensible to non-scientists.

Nevertheless, as we can see in different studies about how the general public have access to scientific knowledge, the media are the principal way to disseminate science, with - of course - TV in a leading position till now. But at the same time, very few studies, quantitative or qualitative, are available regarding how the media transmit scientific issues to society. Nonetheless, there is an impression that the media trivialise scientific news. The “fast thinking” imposed on audiovisual media, independent of the degree of difficulty involved in presenting complex scientific knowledge, frequently reduces scientific news items to anecdotes and sound bites that may be accompanied by a certain degree of misinformation. Of course, science communication must simplify and this is not a problem at all if it is done in a sensible way. However the continuous impact of headlines in the news about astounding discoveries can lead to an anecdotal perception of what is really the progress of research and science if all this information is not properly contextualized; above all if we think about the complexity and uncertainty that is consubstantial to the scientific research.

Development of discourse analysis has involved approaches about the use of language and concepts precisely in the way in which scientific knowledge reaches the general public in the age of the information and communication. Scientific-academic use of language and concepts has been recognized as a specific register with his own norms, patterns and style, affecting not only terminology but ways of presentation and reasoning through particular discourse genres and procedures. No wonder, then, that the way of pieces of scientific knowledge is selected and transformed to be presented and explained to non-experts can be a very difficult task since it demands a rigorous recontextualization

conveyed through discourse and communication procedures. So discrimination between simplification and trivialization in science popularization is not an easy frontier.

“Serious marketing problem”

In this context, are scientific European institutions – research centers, universities, etc. – prepared to communicate science? Do they have good departments to interact not only with journalists but also with the general public? Which is the general level of implementation of Internet as an important tool to “open” the research centers and universities to the society? Are scientists aware of the strategic tool of communication? Do they have the skills to do it?

What is very clear in the Internet Age is that scientific community, scientific centers and universities must develop powerful communication skills and teams, using these new tools. Universities and research centers are the main social (even economical) force – in terms of quantity and in quality - in many European cities but their visibility in society is, in general, very poor.

This is the opinion of a relevant voice that has revolutionized the way of access to knowledge - Larry Page, the founding CEO of the Internet giant Google - in reference to the communicative context of science: “Scientists and engineers can change the world, but first they need to get over their serious marketing problem”.ⁱ

Larry Page stressed that they need to become more engaged in politics, business and the media if they are to "basically improve our lot in life by doing really great things. Harnessing the full potential of science and technology will require a better "sell" of science's possibilities to policymakers, business leaders and the public. Part of the problem lies in the lack of scientists in political leadership. Much of the time, science is watered down and robbed of its critical details by the time it moves through the layers of bureaucracy up to people in leadership positions. "I don't think it's generally a good thing, since it's the part where all the

ⁱ Speech in the Annual Meeting of the American Association for the Advancement of Science (San Francisco) - February 2007

economic growth is coming from, and all the changes in people's lives. I think you really want to have people in power who understand things."

Larry Page also encouraged scientists to make their findings more freely available, saying that "most of the work you guys have done is not represented" in Web searches because of publishing restrictions. Page threw out a few more ideas to raise science's profile, such as tying tenure and grant money to the media impact of research and having universities oversee science education in primary schools, which he admitted was a "radical proposal." He also praised programs such as AAAS's Science and Technology Fellowships and Mass Media Science and Engineering Fellowships as ways to increase scientists' involvement with Congress and the media.

A marriage of convenience

With their specific constraints and cultures, cooperation between the worlds of science and of the media is often reduced to a compromise. Yet despite this situation, researchers are highly regarded by the general public. The 2007 Eurobarometer survey *Scientific research in the media*, carried out by the Directorate- General for Research among approximately 27 000 people in the 27 Member States, found that scientists are the favored interlocutors. The survey also showed that most people are interested in scientific research and half of those interviewed consider that media coverage of research is sufficient and satisfactory. There are nevertheless some reservations: science information in the media is seen as reliable, objective, useful and varied but also difficult to understand, not very entertaining and unrelated to their concerns. The communication channels are therefore open, but the message received remains rather fuzzy.

These are the main conclusions of this survey:

- The majority of the EU population is interested in scientific research. Of all the research fields, medicine attracts the highest degree of public interest but the environment also enjoys high interest levels.
- European Union citizens have a positive view overall of the current presentation of scientific research in the media. However, in terms of ease of understanding there is a need for improvement as virtually a half of respondents say scientific news are difficult to understand.

- Television is the most important medium in all aspects covered by the survey: Europeans encounter information of scientific research most frequently via television. They prefer to receive scientific information via traditional and thematic TV channels and TV is the information source they trust the most.
- EU citizens consider scientific research to be a serious and important issue, since they would prefer programs on the topic – particularly documentaries – to be broadcasted during prime time on weekdays. In addition, the study reveals that Europeans would prefer scientists rather than journalists to present scientific information in the media as they consider this would be more trustworthy and more precise.

Building Public Engagement in Science

Over the past few years there have been signs of a major shift in how the scientific community views public engagement. Left behind is the assumption that simply informing an audience of the facts of science will meaningfully alter perceptions or decisions. Instead, one can detect a growing recognition that effective communication involves addressing an intended audience's values, interests, and worldviews.

Yet despite these new directions and initiatives, many communication efforts continue to be based on ad-hoc, intuition-driven approaches, paying little attention to interdisciplinary research on what makes for effective public engagement. Most notably, these initiatives start with the false premise that deficits in public knowledge are the central culprit driving societal conflict over science, when in fact, science literacy has only a limited role in shaping public perceptions and decisions.

Building public engagement efforts around these assumptions rather than false premises would be a major leap forward.

1. Research shows that science literacy has very little to do with public support, trust, perceptions, respect, or deference to scientific expertise.
2. Scientific organizations enjoy almost unrivaled respect, authority, and hold great communication capital but need to learn to use this communication capital wisely and effectively.

3. Specifically, when an area of science spills into the wider public eye, science organizations need to provide messages that emphasize shared common values and personal relevance rather than make it easy for people to re-interpret science in terms of false conflict, complexity or uncertainty. When science organizations fail to do this, they cede public communication to rival groups who seek to promote these interpretations.

4. Through public dialogue and consultation initiatives, science organizations need to empower citizens to participate in collective decisions but need to be prepared for citizen decisions to cut against the self-interests of science.

Evolution in Science Communication

During the past several decades, science has become more bureaucratic, problem-based, and dependent on private funding. Public surveys point to a high trust in scientists, especially those affiliated with universities, but the trust level decreases when it comes to scientists affiliated with corporations or industries. Factor in changes in the media landscape that have created audience fragmentation and ever fewer quality sources of science news, and it is clear changes in science communication are needed to better engage the public on science-related issues.

These changes in scientific research and the rapidly changing media landscape demand that eight specific steps be taken by science organizations and journalists in order to better engage the general public and to accurately report scientific research. The eight steps are outlined in “Science Communication Reconsidered,” an article published in the June 2009 issue of the journal *Nature Biotechnology*. It presents the collective recommendations made by 24 outstanding international experts in science, media, and policy at a science communication workshop in Washington, D.C. The workshop was organized by the University of Alberta.

The eight steps are as follows:

- 1. Scientists and science organizations should pursue a trust- and dialogue-based relationship with the public.** More forums, conferences, and other public dialogue initiatives should be held. The goal is not to persuade or sell the public on the importance of

science, but to “democratize” public input about scientific issues so that members of the public can meaningfully participate in science-related decision making.

- 2. Scientists and science organizations need to recognize the importance of framing science-related issues.** Science communication efforts need to be based on careful audience research. Different frames of reference that better communicate the nature and relevance of scientific issues across a diversity of audiences should be identified and tested. This research on framing can be used to structure dialogue and to move public discussion beyond polarized arguments and entrenched positions.

- 3. Graduate students at science institutions should be taught the social and political contexts of science and how to communicate with the media and numerous publics.** Graduate students are future spokespeople and decision makers. They need to understand the significance of research in the field of science communication. These programs should include specialized electives for doctoral students but also new interdisciplinary degree programs that combine scientific training with course work in communication, ethics, and policy.

- 4. Factors that facilitate media hype and errors should be recognized and addressed.** Researchers should resist the temptation to describe their studies using inflated metaphors and terminology, such as “groundbreaking,” and remain true to the significance of a study. Research funding and methodological details need to be included in media coverage so that the public may better assess credibility. Short-term gains in media credibility should not be valued above longer-term relationship building with journalists, decision makers, and the public.

- 5. Science communication initiatives should investigate new forms of digital media and film to move beyond traditional popular science outlets, such as science newspaper columns, science magazines, and television programs like PBS’s *NOVA*.** This

includes finding ways to create opportunities online for incidental exposure among key audiences not actively seeking news, information, and science-related content

6. **Scientific organizations need to track science-related media coverage (news, entertainment, etc.) to be aware of the numerous cultural contexts through which the public interprets science.** National newscasts, talk radio, blockbuster films, entertainment TV, and late night comedy provide broader audiences with alternative messages about science topics and can be important outlets for science communication.
7. **Journalism schools and news organizations should develop a science policy beat to address the gap between journalists covering science and those covering politics.** Developing such a beat and training journalists to understand both science and policy would provide important background for science policy debates.
8. **New models of journalism—whether foundation, university, or government supported—are needed.** The for-profit journalism business model is failing and specialty journalists, such as science journalists, are losing their jobs. In addition, new media formats offer another avenue for public participation, as user generated content can enhance professionally produced content.

The Internet Age

The entire media industry is facing unprecedented pressure from the Internet and the ongoing economic crisis, and science journalism is far from immune. *Nature* chronicles the ongoing pressures facing the industry as in its survey of 493 science journalists' shows that jobs are being lost in North America, and workloads are on the rise the world over. But as overstretched journalists struggle, new forces are rising. Scientists who blog are becoming increasingly influential, as are the press departments of scientific agencies and organizations. The Internet is allowing both of these groups to reach large public audiences on a daily basis. *Nature's* survey also shows that conventional journalists are increasingly relying on blogs and press releases for story ideas and what it

means for the public's understanding of, and access to, scientific information.

Blogs, home pages and open source publishing offer scientists more possibilities for distributing information to each other, and the wider public also has access to enormous amounts of information online. The problem is thus not how to increase an already large stock of information but how to increase people's ability to find useful information, to judge what is reliable and relevant for them at that moment, to make sense of the sometimes conflicting variety of information with which they are faced, and then to engage in communication and discussion when appropriate. Media literacy, across different media forms, demands enormous skills from both producers and users of information.

The internet is a pervasive research tool for science news and information. In some parts of the world, the internet is second only to television as a source of scientific information among the general population. A 2006 survey conducted by the Pew Internet & American Life Projectⁱⁱ in collaboration with the Exploratoriumⁱⁱⁱ of San Francisco benchmarked how the internet fits into people's habits for gathering news and information about science. The survey found that the majority of online users have used the internet as the primary source to look up the meaning of a scientific concept, answer a specific science question, learn more about a scientific breakthrough, and help complete a school assignment, check the accuracy of a scientific fact, downloaded scientific data, or compare different or opposing scientific theories. Such users also

ⁱⁱ The Pew Internet Project/Exploratorium report, made possible by the National Science Foundation, is based on a survey of 2,000 Americans conducted in January 2006. It has a margin of error of plus or minus three percentage points. The Pew Internet Project is a non-profit, non-partisan initiative of the Pew Research Center that produces reports exploring the impact of the internet on children, families, communities, the work place, schools, health care, and civic/political life. Support for the non-profit Pew Internet Project is provided by The Pew Charitable Trusts.

ⁱⁱⁱ Housed within the walls of San Francisco's landmark Palace of Fine Arts, the Exploratorium is a museum of science, art, and human perception filled with hundreds of interactive, hands-on exhibits. In addition to serving more than half a million people who visit the museum each year, the Exploratorium is also a leader in the movement to promote museums as informal education centers, providing professional development for science teachers and teacher-educators, and operating as a research and development center for the science museum field at large.

The Exploratorium's award-winning Web site, online since 1993, currently receives more than 20 million unique visits a year: www.exploratorium.edu

reported more positive attitudes about the role science plays in society and higher self-assessments of how well they understand science.

The internet has the potential to change dramatically the relationship between the providers of information and the general public bypassing gatekeepers in traditional media. The internet offers the possibility for scientists and science research centres to be in direct touch with the general public interested in science. Many think of the internet as a gigantic encyclopaedia on all subjects and this certainly applies to scientific information. However, the internet itself is a highly structured medium, and people need training to understand how and why some information is easier to find and how this can change over time and across different platforms.

When Tim Berners-Lee first started developing what we now call the World Wide Web in 1989, he saw it as a collaborative workspace for his fellow scientists at CERN, the European particle physics lab near Geneva. His creation far surpassed his early prediction that "the usefulness of the scheme would in turn encourage its increased use". Since the commercialisation of the Web in the mid-1990s, its use has grown far beyond its original user group of scientists. For most users, the web in its first decade was like a big online library, where they mainly searched for information. Today it is undergoing a subtle but profound shift, dubbed Web 2.0, to become more of a social web, not unlike Berners-Lee's original vision. Yet scientists are largely being left behind in this second revolution, as they are proving slow to adopt many of the latest technologies that could help them communicate online more rapidly and collaboratively than they do now.

There are fears, however, that scientists are now lagging behind, as they are proving slow to adopt many of the latest technologies that could help them communicate online more rapidly and collaboratively than they do now. The emerging web is largely being shaped by dynamic interactions between users in real time. But many researchers still see publications in the formal scientific literature as the primary means of scientific communication, not least because such publications are often the basis of individual career and wider institutional evaluations. Also, they perceive that traditional ways of publishing are ensuring the scientific memory, while the content of Internet is partially volatile. Although the traditional published paper is accepted as the undisputed information of record,

younger researchers, in particular, are concerned that scientists are missing out on new ways to communicate with each other and the public.

Supporters say these offer a forum for broader and timelier discussion, to complement the existing system of peer-reviewed journals. This could enhance science communication, both before publication, when generating ideas, and after publication, when discussing results. Blogs are just one example of new social technologies that are allowing more people to publish more easily and in more diverse ways on the web. By allowing reader feedback and syndication feeds, blogs create an instant online community. But for most scientists and academics, blogs and wikis remain unattractive distractions from their real work. Many consider them an online version of coffee-room chatter, background noise that goes against the very ethos of heavily filtered scholarly information.

The latest web tools enable scientists to communicate their ideas in new ways, and maybe to reach new publics. To enhance science communication, scientists could make more extensive use of collaborative technologies such as blogs, wikis and websites that any visitor can add to and edit both before publication, when generating ideas, and after publication, when discussing results. But for most scientists, blogs and wikis remain unattractive distractions from their real work. Many consider them an online version of coffee-room chatter, background noise that goes against the ethos of peer-reviewed scholarly information. Scientists who frequent the 'blogosphere' see it differently. The dynamic hierarchy of links and recommendations generated by blogs creates powerful collaborative filtering, they argue. Blogs may create noise, but they are also useful for keeping up with the most recent developments in the field.

Whatever opinion one may have about the blog world, the fact is that communication via blog is growing rapidly in the world. ScienceBlogs^{iv} data from April 2010 reports double-digit traffic growth:

- Visits for the quarter ending March 2010 grew by 41% year-over-year to approximately 13 million, and page views topped 25 million. Monthly unique visitors grew to 2.4 million worldwide and in the US surpassed 2 million for the first time this March.

^{iv} ScienceBlogs (www.scienceblog.com) is the leading social media site in the science category, with more than 130 acclaimed blogs, 11 content channels, a jobs platform, and a fast-growing audience of more than 2 million unique visitors a month. ScienceBlogs recently formed a strategic partnership with National Geographic spanning content and advertising sales.

- Total visits for 2009 grew by 55% year-over-year to 45 million and average monthly unique visitors climbed 49% to 1.9 million.
- ScienceBlogs.com has achieved high double-digit traffic growth (at least 50%) every year since its launch in 2006.

The network's robust growth is a positive sign when it comes to the transition of science communication from dead tree to the internet. We know that there's been a lot of stress on the part of science journalists as to the sustainability of their enterprise, though that is really just a domain-specific instantiation of the issues in journalism as a whole, but until that works itself out the growth and persistence of science blogging and science-related websites is a good thing. There is calm after the storm of creative-destruction, and the current science blogosphere is laying the seedbed for future renewal. The outcome may be sub-optimal from the viewpoint of labor, but the consumer will benefit.²

So, the World Wide Web offers the possibility of by-passing the traditional way of doing science communication without intermediary actors - and in a two sense interaction - but another problem arises: the need of critical capabilities of the public to know how to reach reliable and useful information, with the ability to identify trustfully sources.

On the one hand, it's clear that scientists and, of course, scientific organizations, must improve science communication of the work they do... The best success in communicating will happen for the work of scientists who can participate personally in the communication effort.

On the other hand, the future of science journalism will be online, in film, and/or multi-media, merging reporting with synthesis, analysis, personal narrative, and opinion. The goals will be to inform but also to persuade and to mobilize. However, the new forms, modes, style, and sponsors for science coverage will mean that we will have to rethink the standard orientations and definitions of objectivity and balance.

The future is already here, it's time to talk about what it all means!
