How the Internet changed science journalism

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It is difficult to over-state the pervasiveness of Internet communication in science. And it is plausible to claim that journalists have been more thoroughly affected by technological change in recent decades than any other occupational group. In the cross-connection of these processes science journalism is being redefined.

New opportunities, media, and genres for reporting science have emerged, that challenge established modes of science journalism. Producing and distributing 'science news' comprises part or all of the professional responsibilities or personal pastimes of an increasingly diverse range of social actors.

In this chapter, we shall review changes in the information-gathering and publishing practices of science journalism, which is situated at the boundaries of two sets of professional communities that have both been deeply affected by developments in information and communication technologies in general, and in the Internet in particular. We shall also consider how, in the context of proliferating and diversifying sources of scientific information, the functions and responsibilities of science journalism are altered. Some proposals will be offered as to how these altered responsibilities might better be fulfilled.

We distinguish ‘science reporting’ and ‘science news’, as representing various forms of journalist activity around science, from ‘science journalism’ as a specialist practice within professional journalism. We are not here entering a long-running debate about whether special qualifications, for example, a university education in science, are necessary in order to report science adequately. We are merely underlining that there are many more people producing science news than there are people who can justifiably define themselves as science journalists. This may be a source of disappointment, even an object of complaint, for some. But, in the context of Internet publishing in particular, it is an inescapable reality, and it has clear implications for the practice of science journalism.

This specialist practice is located at the boundaries of two professional communities, boundaries that are weakening progressively through developments on both sides, as it were. Not the least of these influences is the increasing use of Internet media in all spheres of science communication. Professional communication reaches external audiences, intentionally or not, and public communication connects discrete professional groups and interests. Science journalism, which has served as a boundary-minder and intermediary between internal scientific spheres of communication and external public spheres, risks being bypassed in both directions if it does not successfully adapt to the changed environment.

The web, which was developed for information-sharing among scientists, is increasingly used by research and educational institutions to recruit students, employees, and collaborators and to impress niche audiences in policy-making, scientific, and business sectors. These institutional websites frequently use mass media journalism formats, such as daily or weekly news updates. In this way, they make what may have been intended as peer communication

publicly accessible.

These, and other such paradoxes, demonstrate how, like other technologies, the Internet has escaped the (altruistic) intentions of its originators. In the interaction between social organisations and new technologies, unexpected things can happen.

The Internet for news or promotion

The plethora of Internet-based media that have developed for the dissemination of scientific information to wider publics include versions of services already provided via print and broadcast media, but also new media formats, such as portals, e-zines, forums and weblogs (blogs). Publishers of science information include higher education and research institutions, established scientific publishers and scientific societies, but also science centres and museums, public education initiatives, individual scientists, interest groups, hobbyists, lobbyists, and many more.

Open access scientific publishing has as its principal intention to facilitate sharing of knowledge between scholars. But it also means that members of non-specialist, but interested, publics have access to information prepared by professionals for professionals. Some sites maintained by scholarly societies and scientific journals require only that users register by name, and parts of such sites are freely open to any passers-by. Access to the web has opened up many aspects of scientific research previously hidden from the general public.

This creates a crowded, noisy space, where discerning valid and valuable information becomes ever harder. The difficulty is compounded by the way in which scientific societies, research institutions, funders, governmental bodies, and others use the web for marketing or other promotional purposes. Scientific institutions increasingly use directly employed (or, we might say, 'embedded') science writers or communicators to ensure rapid and controlled publication of results over the web, and by other means.

The formats these institutional sites use are often those of 'news', but the purpose is much less that of providing accessible information on matters of public relevance than it is of boosting the profile and reputation of the organisation. 'News' or 'Headlines' is often the hook used to attract visitors to the site, and to keep them coming back. A search for 'science news', or its equivalent in other languages, is as likely to take the Internet user to the site of a higher education or research institution as to that of a journalism-centred service.

Many publicity services have been developed on the web with journalist audiences in mind and some, like the European press release distributor, AlphaGalileo, restrict access to reporters and correspondents who specialise in science. However, much of the material available through that service is also available directly—perhaps after some delay—from the original institutional sources, and can be accessed by any web user. There are more such information distribution services that operate without restriction.

Journalists specialising in science often have a routine of checking in to institutional sites that cover areas of science in which they have a particular interest. But what they find there, other Internet users can find too. In space science, for example, the US agency, NASA, and its European counterpart, ESA, provide extensive resources for use by the media but these can be used, and are used, by many of the active amateurs who populate this territory.

Many sites of scientific organisations and societies offer e-mail alerts or bulletins that package information in easily accessible forms. These news services draw both on internal resources, in a form of direct publishing, but also—and in a further demonstration of the blurring of boundaries—on external services provided by established news organisations, such as news agencies, broadcasters, and newspapers.

As a consequence of this and other kinds of publishing activity, the Internet user may find on any substantial scientific topic working papers, personal home pages, research reports, university press releases, conference papers, news media reports, and formally published journal articles. In discussion groups and mailing lists, there may be commentaries and correspondence on any or all of these documents. The views of sceptics, dissidents and dogmatists may be accessible alongside each other.

In this communication environment, scientists cannot ensure that all scientific information reaching the public has been internally validated. Intensifying competition between sectors, institutions, and publishers, and the availability of means for much more rapid dissemination of new materials have greatly weakened the role of traditional peer review as a control on what information enters the public domain.

An Internet search for 'asthma cure' points the user to the websites of patient groups, and from there to papers published in medical journals, but also to those of asthmacure.com, of a company selling a salt pipe for respiratory problems, and to another proposing a nutritional programme. And all this is in the first page of results.

Looking for material on malaria vaccine, the Internet user finds information from news media, research organisations, activist groups, companies selling therapies, funders, and others.

A search for 'nanotechnology applications' brings up ads for reagents, enthusiastic promotions of the prospects for nanotechnology, a link to the US government's National Nanotechnology Initiative, and a link to an article on nanotechnology at wisegeek.com. Drilling down several layers to identify the author of this article, it transpires that he is, among other things, the director of the Immortality Institute for Infinite Lifespan.

How to mark out the 'professional site'

As the Internet user interested in science or simply curious about some recent development experiences it, the Internet is a noisy bazaar of traders bidding for attention. The distinctions between validated and non-validated information and between journalists and non- or near-journalists are harder to draw. This has clear implications for media practitioners working with scientific information. The increasing range and complexity of public science and the proliferation of science information sources mean that Internet users have special need of guidance on the reliability and trustworthiness of information about science, and of science information sources.

One important criterion for distinguishing professional journalists is adherence to ethical codes, and here, a question of professional, ethical responsibility arises very clearly. The challenges of independent science journalism lie more than ever in interpretation and contextualisation, or, as we might say, information about information. That was always a function of responsible journalism; in the changing circumstances, it assumes a central importance.

The case of biomedical information is especially sensitive, because this information can have 'end-user' value as diagnosis or remedy, and thus significance for a person's quality of life, or life itself. Databases of medical-scientific materials that are the primary information resource for medical professionals can be accessed online free of charge, but so too can health information from drugs companies, patient and awareness groups, complementary medicine practitioners, and mystics. There are several self-regulating initiatives among biomedical publishers to establish standards for websites that would allow users to discern professional, and therefore credible, sources. But search engines make no clear discernment between

information types and sources, and a majority of sites showing up in the kind of searches described above do not subscribe to publishing codes.

It is also around medical and health issues that we have some of the clearest demonstrations of the long-claimed Internet effects of consumer-becoming-producer, or everyone-becoming-publisher-or-journalist. Patient groups are active information providers, often as selective re-publishers of material already available on the Internet. Individuals with a particular interest in some medical condition are often also information providers, through personal home pages, weblogs, and other means. Some of the same patterns of publication and republication can be seen in other publicly debated and contested domains of science such as genetically modified foods, climate change, and stem cell research.

Indeed, it is a characteristic of much of the science that comes into the public domain that it is uncertain and contested, both from within and from outside science. The more sources there are on a given subject and the greater the diversity of those sources and of the information they provide, the greater the audience's sense of uncertainty is bound to be. Use of web hyperlinks, indicating a link between one page and another, can compound this uncertainty, rendering it mere confusion. Equally, however, hypertex-tuality can provide the means for open, public, and continuing negotiation of the uncertainties that surround us.

In a conventional view, still with wide currency, the function of journalists reporting science is to transmit in accessible form the results of scientific research. The job of the journalist is simplification without distortion, and therein lies the specific expertise of the science journalist. Given the journalist's imperative to be clear and concise, this simplification removes, or reduces, any equivocation or uncertainty in the results.

But the mere fact of operating in an environment of multiple information sources and source-types tends to limit the possibility of presenting any publicly significant information as certain and unambiguous. As more and more of the publics for science journalism have access to the Internet and as they seek information from 'balancing' or alternative perspectives, ambiguity and uncertainty are set to increase. With multiple routes through a narrative and multiple sources comes multiplicity of meanings. In these circumstances, science journalism can no longer credibly function as it was previously required or expected to do.

'Trust Management' to reduce uncertainty

The scientific institutions' embedded science communicators do at least part of the job of rapid transmission of scientific information. The challenges and responsibilities of independent science journalism lie much more in proposing meaning, or meanings, and in locating new information in relevant contexts. And the web, with its hyperlinks, looks like a medium chosen for providing the assistance to publics to make sense of so-called news. It facilitates approaches to publishing science news that can more fully meet users' needs, helping them to negotiate the complex information environment in which they find themselves. Practices to support users in this way include:

- Providing context for all 'news' by linking to any or all source material, source organisation, authors, previous reports on the same topic, current reports on related topics, and different points of view on the same topic;
- Providing information in multiple layers, allowing different groups of users to read the material in different ways, and at different levels;
- Using images of various kinds—photographs, diagrams, infographics—to

support explanation of science news.

Science news publishers can boost their relations of trust with users by making their information traceable to source, and improving transparency. Hyperlinking provides the means of adding this information about information. But merely linking to related materials says nothing about the character of the connection between two documents. Science news sites can offer fuller navigational assistance to users, for example with:

- Labels and signposts that indicate what lies behind such a link and an indication as to whether it might be worth making that link;
- Identification of linked documents by category, e.g., as peer-reviewed papers, self-published research reports, corporate press releases, or advocacy group statements;
- Relevance rating based on editorial judgement rather than user-popularity (as Google does, for example).

All of this requires professional editorial judgement and that is what independent, professional journalists can, or should, bring to the burgeoning field of science communication. How science journalism could perform this role, and how far most established practice is from doing this in any comprehensive manner, can be illustrated by an example from research into asthma, as also used earlier. At the BA (British Association) Festival of Science in September 2005, a biochemist at the host university, Trinity College Dublin, presented findings on an association between infestation with the parasite, schistosoma, and reduced incidence of asthma. On the basis of this association, television news programmes and daily newspapers in Britain and Ireland reported that a treatment might be developed for asthma based on the active ingredients of the worm. As a simple Internet search at that time revealed, the association between asthma resistance and parasites—including schistosoma—has been under investigation in Gabon, Brazil, Venezuela, and other tropical and sub-tropical countries in recent years. An editorial in the *American journal of Respiratory and Critical Care Medicine* two years earlier referred to the inconsistent findings of these studies but insisted that the associations were strong enough to merit further research. Also in 2003, the Netherlands Organisation for Scientific Research reported that research it funded demonstrated that lipids from schistosoma can inhibit human immune responses and were, therefore, the basis of a possible new treatment of asthma.

Of ten reports in leading Irish and British media over a relevant 24-hour period, many of them written by established science journalists, only the item in The Irish Times drew attention to this related research and defined the Trinity College team's achievement more specifically as being the demonstration of the immune effect in mice. Other reports presented the Dublin research as if it lay in the identification of a possible new treatment. Even a not especially attentive Internet user could have seen how partial this view was.

Situating scientific expert claims in relevant contexts such as these qualifies those claims and, from the point of view of both scientists and journalists, may take something from the 'news' character of the story. On the other hand, not providing such a context exposes both scientists and journalists to increasing critical scrutiny, on the basis that they may both be presenting information as new that does not merit that designation.

Web-based information sources

Constraints of time and space limit greatly how much context can be provided in 'old media' formats, but publishing on the web is not similarly constrained. However, only a small proportion of web-based information services have production strategies that realise this potential. My own observation is that there are both fewer science news sites offering significant web enhancement of their information, and that there is a lower level of such activity, even than was the case in the late 1990s, during the first flush of enthusiasm about the web. Some of the new Internet-native publications developed in that period and demonstrating good practice—for example, HMS Beagle, published as part of the BioMedNet site sponsored by publisher Elsevier—have ceased to exist. HMS Beagle closed in 2002, and BioMedNet followed it in 2004.

The web-based services of established science news media, such as the much-used online science news services of the British BBC or of the magazine *New Scientist,* provide external links with major stories that are generated mainly by automated means, linking the mention of a research centre in a story, for example, to the home page of that centre's website. The user may need to make substantial additional effort to drill down into the site to find the relevant report or statement. In other cases, such as links to journals that are mentioned in a news story, the user may meet a barrier that can only be crossed by those with a subscription to the journal or its online service. At the same time, there are many instances on sites such as these where the source information is, in fact, publicly available as a paper in an open access journal or as a press release, or as both, and the links are still not made to those documents.

The web's facilities for interactivity offer yet more possibilities for communicating science in richer, more textured ways than traditional dissemination or transmission models of science journalism can encompass. Through e-mail, forums, and weblogs, as well as other services, the Internet facilitates three-way communication—from producer to consumer, from consumer to producer, and from consumer to consumer. These facilities are widely used by scientist communities and by various social interest groups; for example, patient groups and environmental activists, as they seek to make sense of new developments in science. This corresponds to the dialogue model of science communication, so widely lauded as a replacement for the supposedly discredited (but still prevalent) deficit model. It also reflects the expectation of an increasing number of web users that they will be able to participate in public communication on topics of interest to them.

On websites whose publishers are committed to such approaches, the latest information appears with an invitation to comment alongside. As well as news pages, these sites have thematic dossiers, assembled over time from various perspectives and with fuller contexts, and linked to forums or to blogs. To present scientific information in these formats is to present it as hypotheses, open to examination from various perspectives, including sceptical and critical ones.

Professional science journalism, which often appears committed to strengthening its own authority as well as that of science, tends to be uncomfortable with such approaches, and offers few examples of experimentation in these formats. As journalist communities diversify, it is interesting to note that examples of web publishing of science news that realise a large part of the potential of this medium, are more likely to be found on the sites of science centres, such as Cité des Sciences et de l'Industrie in Paris or the Science Museum in London, than on those of scientific institutions or

established news media.

Scidev.net, a website on science and world development, is a relatively rare example of a journalist-driven service that demonstrates the power of the medium for rich communication. Through an agreement with the publishers of *Nature* and *Science,* Scidev.net can link a limited number of news reports each week directly to the papers in those journals to which they refer. The site examines large topics from various perspectives, and provides a platform for contending views about the applications and implications of science, though it orchestrates this debate carefully and has no facilities for open discussion.

News@Nature, the Internet news service associated with the scientific journal *Nature,* offers 'the best in science journalism', and provides lively, well-informed coverage of science and its institutions. This site's Specials correspond to the Dossiers on Scidev.net or Special Reports on *Guardian Unlimited,* but their external linking is superficial. The gesture in the direction of newer formats—blogs—is also superficial; the blogs are written by *Nature* journalists as diaries from assignments, without the characteristic blogosphere' features of references to other sources, or facilities for comment. *Scientific American's* website is more open in this regard; its journalists' blog entries on contested topics include links to external sites and a Trackback comment feature.

These examples represent a partial, and uneven, adoption of the features of the Internet that can support and enhance science reporting, and have it contribute more effectively to the public discussion of, and participation in, science that are widely regarded as essential for the democratic health of society. The Internet provides the means to present new scientific developments in ways that promote dialogue and conversation. Achieving this requires that those reporting science take different stances from those of established science journalism. But specialist science journalists have had a privileged position for some decades as the principal arbiters of what scientific information enters the public domain and how it does it. Their prevailing practices—including those applied on the Internet—indicate that they aim to maintain this privilege.

WEBSITES MENTIONED

AlphaGalileo
News@Nature
HMS Beagle (until 2002)
BioMedNet (until 2004)
Scidev.net

FURTHER READING

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