Science criticism - what is it, and why do we need it? Panel report

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The point of departure for this panel was an essay by French physicist and science writer, JeanMarc Lévy-Leblond, published in French in 1996 and in English for the first time in an anthology, Public Communication of Science (Bucchi and Trench 2016). This essay, The Case for Science Criticism, was part of a wider project pursued by Lévy-Leblond to (re-)situate science in culture. As founder of the journal, Alliages, as author of L'Art et La Science / L'Art N'est Pas La Science (Hermann 2010), and as a contributor to popular science magazines in France, Lévy-Leblond returned frequently to the notion of "la mise-en-culture de la science". He saw science criticism – analogous to theatre, literary, food and art criticism – as an essential part of that placing of science into culture. The critic, in this view, plays an indispensable mediating role for science in society, providing interpretation and evaluation.

The notion of "the science critic" (and, therefore, science criticism) is not exclusively French, however. The British science policy commentator Maurice Goldsmith made the case for such in articles written in the 1970s, and in his book, The Science Critic – a critical analysis of the popular presentation of science (Routledge Kegan Paul 1986). The book's title is slightly misleading as most of the book is descriptive, and the case for the science critic is made in a short final chapter, but it is significant in linking criticism (or critique – the difference is important in this context) to a longer tradition in British science writing and science policy discussion, as represented, for example, in the founding in the late 1940s of the Association of British Science Writers (ABSW), and of the British Society for Social Responsibility in Science (BSSRS) in the 1970s.

Among more recent exponents of this strand of science writing is Bryan Appleyard, a regular contributor to the Sunday Times on science-related issues and author of Brave New Worlds – staying human in the genetic future (Harper Collins 1999). Appleyard has been a long-time critic of scientists over-reaching themselves, notably of Stephen Hawking, whom he cited in an account of the delusional grandeur of private-enterprise space-science (Sunday Times, 17 April 2016). Appleyard claims there that Hawking's support for sending mini-space ships to distant stars is expressed in terms that are more religious than scientific: "The limit that confronts us now is the great void between us and the stars. But now we can transcend it … Today we commit to this next great leap into the cosmos, because we are human, and our nature is to fly."

Another British science writer, Michael Brooks, examines critically the "myth of the rational, logical scientist who follows a clearly understood Scientific Method" in Free Radicals – the secret anarchy of science (Profile Press 2011). Brooks proposes that scientists are human too, and sometimes fearful: "Analyse the history of scientists speaking truth to power, and you will find the scientists strangely timid."

Science criticism may be practised by others than professional science writers, as, for example, by scientists who, from various perspectives, questioned the biological /genetic determinism that became prevalent in the life sciences from the 1970s onwards. Steven Rose in Britain and Richard Lewontin in the Unites States (It Ain't Necessarily So – the dream of the human genome and other illusions, Granta Books 2000) are examples of such scientist-science-critics. Historians too have contributed to science criticism, as in the case of John Waller with Fabulous Science – fact and fiction in the history of scientific discovery (Oxford UP 2005).

Projects like Retraction Watch and Annals of Improbable Research / IgNobel Awards offer examples of other modalities of science criticism, holding science to account to its own stated standards, but also deploying humour as a means of criticism.

Declan Fahy

The philosopher of science and technology Don Ihde (1997) argued that science critics faced particular difficulties that differentiated them from art or literary critics. Those who criticise science, he argued, are labeled as anti-scientific. But neither art critics nor literary critics are charged with being anti-art or anti-literature. Ihde pointed out that writers and artists are used to widespread judgement of their work, which is in any case aimed at segments of the public. Unlike writers or artists, however, scientists have traditionally shielded themselves from public scrutiny, preferring internal checks-and-balances through peer evaluation and replication (or not) of new empirical data. Yet some high-profile scientists have undertaken this critical evaluation of science and its relationship with wider society while working as practicing scientists, with the late Stephen Jay Gould a prominent and influential example (Fahy, 2015).

Ihde argued that a major problem for science critics is that they lack an institutional base. For him, science critics should be anchored within the philosophy of science. Philosophers could understand and criticise the philosophical assumptions and epistemological bases to scientific knowledge. But, he argued, that field has not produced science critics because its dominant current intellectual trends are influenced by positivist and analytic traditions, which often sought to justify and imitate science, rather than critique science. The rhetoric of science scholar Sarah Perrault (2013) included scientists, sociologists, historians, rhetoricians and communication scholars among those whose writings about science stood in contrast to the science boosterism that she argued continues to characterize much science writing.

Journalism has been an institutional home for some science critics. Yet science criticism has not been established in journalism in a similar way to the criticism of artistic areas such as film, music, and painting. Science journalism is a distinct area, but that journalistic specialism historically has been most closely associated with the translation of specialised information from scientists to non-specialists. As a consequence, science journalists have been subjected to a long-standing criticism for being more cheerleaders than critics of science. Even so, there are examples of journalists who illustrate in detail what this role might look like in practice. Both are journalists and science writers who have identified themselves as science critics.

One example is the American journalist and writer John Horgan. He studied English literature and then journalism before working as a staff reporter at *Scientific American,* where he profiled famous scientists including Francis Crick and wrote major features about the state of scientific fields, such as psychology. Through this and other work, he became interested in the limits of scientific knowledge. Characterizing his role in 2010, Horgan classified himself as a "critical debunker," who sought "exaggerated or erroneous scientific claims" he questions or interrogates. He said (Cited in Fahy and Nisbet, 2011, p.788): "I convinced myself that that was actually a good thing to do because science had become such an authority that there was a need for a scientific critic . . . I just enjoy that form of journalism myself. It's a paradox: it's using subjectivity to ultimately get a more

clear, objective picture of things." His approach can be seen in his books *The End of Science* (1996, but republished in 2015), *The Undiscovered Mind* (1999) and *Rational Mysticism* (2003). The institutional base for his work now is Stevens Institute of Technology in New Jersey, where he directs the Center for Science Writings.

Another example is British science writer Philip Ball, who trained as a chemist and physicist before becoming an editor at *Nature*. In 2011, he introduced a new column in *The Guardian,* declaring: "I'm going to try to be like an arts critic, but for science." At the end of that first column, Ball described how the job of theatre critics was to present an interpretation of a play. "Their job is not to deliver absolute verdicts -- at least, no one with any sense reads them that way -- but to offer perspectives. That's what this column will aim to do for science."

This view connects with more general writing about the nature of criticism. Daniel Mendelsohn (2012), writing in the literary and public affairs magazine *The New Yorker*, identified knowledge and taste as the two components of critical judgement. Knowledge, he argued, provided the foundation for judgement. "The second crucial component in the drama of criticism," wrote Mendelsohn (2012), "the reagent that got you from the knowledge to the judgment, was taste, or sensibility -- whatever it was in the critic's temperament or intellect or personality that the work in question worked on."

Journalism and popular science writing, as the examples of Horgan and Ball show, offer one mode of science criticism. But there are others -- and is here that science communication researchers have a role. Ihde argued that a science critic should come from an interdisciplinary position. The work of science communication researchers operates between fields. It also operates between the university and public life outside university walls. Science communication researchers can offer criticisms from outside science, anchored in knowledge and featuring an identifiable sensibility.

Alan Irwin

In his well-argued and provocative paper, Lévy-Leblond makes this central comparison: "Here is a key difference between art and science: the critical function exists and is recognized in the former, but is lacking or underdeveloped in the latter."

Bluntly put, his argument is that there are art critics but no science critics – I will revisit and refine that argument in my conclusion. In his paper, Lévy-Leblond explores this 'state of affairs' with reference to three aspects – or rather functions – of critical activity: the *productive* function (which is an 'internal' activity); a *mediating* function (linking the inside and the outside – concerned with dissemination but also how ideas from wider society come into science) and finally, and most briefly, a *political* function (essentially, concerned with the relationship between science and democracy).

The question I would ask with regard to Lévy-Leblond's paper could not be more simple: can this possibly be true? Certainly, a number of objections –or challenges - come to mind immediately. My suggestion here is that stating these challenges might get us closer to – or at least open up the discussion about - Lévy-Leblond's underlying conceptualization of science criticism.

The first challenge would be that criticism is actually central to science as an institution. One only needs to think of Karl Popper's highly influential notion of falsificationism or Lakatos and Musgrave's classic text (1970) on the philosophy of science, *Criticism and the Growth of Knowledge*. It would seem that, rather than lacking critics, science is the social institution *par excellence* within which criticism represents a central and constitutive activity – as anyone who has submitted a paper to a prominent scientific journal will testify. As I see it, this challenge relates to what Lévy-Leblond calls the productive function.

The second challenge concerns the mediating function as described by Lévy-Leblond. Actually, I find myself in agreement with much of what he writes here – including the argument that most dissemination of scientific knowledge is concerned with the latest discoveries rather than putting science in a larger historical perspective. However, his statement that 'there is no such creature as an amateur scientist' does need to be scrutinised, even if he later qualifies this: 'There are amateur naturalists, just as there are amateur astronomers, but you don't find any amateur molecular biologists or amateur physicists.' Of course, the rise of citizen science post-dates Lévy-Leblond's account – and it is still true that there are no 'citizen high energy physicists'. However, it is interesting to think about how citizen, garage or DIY science – or else biohacking – alter this basic assertion.

Perhaps the biggest challenge relates to Lévy-Leblond's third function, that of politics. As already noted, this is by far the shortest section – although a footnote does state that the political aspects of science criticism are dealt with in his other writings. On the one hand, I find myself agreeing with the general argument that "the impact of science and technology on the development of society is largely beyond our control". On the other, the account misses the active part played by (amongst others) feminist critiques of science, campaigns against the civil and military uses of nuclear power, arguments about GM food and local protests against environmental pollution. I would not argue that these have transformed the political function of science, although I certainly think they have had an impact upon it. My more basic case is that one risks downplaying or even omitting such significant movements when stating: "There are none who call themselves 'science critics'." Critics there certainly are. The challenge is how these diverse and sometimes discordant voices can be heard within the institutional and intellectual processes of science.

However, regarding at least the first and last of these challenges, I suspect that Lévy-Leblond intends something different for his notion of science critic. And it is at this point that our discussion should really begin. Here I think it is worth giving the last quotation – which actually comes rather early in Lévy-Leblond's paper - in full: "There exists today a class of people whose profession (or profession of faith) is 'art critic'. There are none who call themselves 'science critics'."

This for me says something both about the 'professional' nature of the science critic to whom Lévy-Leblond is directing our attention (albeit *in absentia*) but also about the character of the criticism itself. As I understand it, he may have a role closer to 'science connoisseur' in mind: namely, someone who can put science in wider cultural context, bring meaning to scientific achievements, and educate both scientists and larger publics about the history and epistemology of contemporary science. I can certainly see the general case for this - in certain ways more restrictive - form of criticism. Nevertheless, this should not cause us to forget, ignore or underplay other – perhaps more unruly but also democratically essential – critics of science. Instead, one key point for me precisely concerns the past, present and future relationships between the 'professional' and the 'political' criticisms of science.

Michelle Riedlinger

Environmentalists often act as such unruly critics of science and Yearley (2014) claims that environmentalists, more than any other kind of advocate working in public communication spaces today, act as science communicators and critics. Through their citizen science and advocacy efforts (or what Lévy-Leblond refers to as "mediating actions") environmentally-focused citizen groups attempt to redress science's lack of immersion in culture. Environmental groups align with other critics who argue that mainstream scientific institutions often fail to support or neglect particular kinds of scientific activity. Institutionalized science is criticized for aligning too closely with industrialised and neoliberalised agendas that often run counter to environmental conservation

efforts. These agendas lead to a lack of focus on particular areas of science that interest local communities or “undone science” (Hess, 2015, p. 141).

If left to chance, Lévy-Leblond argues, the underlying forces that guide institutionalized scientific activities are likely to be economic, and neglect “a plurality of potential options and the reversibility of choices” (p.166). However, since Lévy-Leblond’s critique of 20 years ago, recognized citizen science efforts aimed at filling gaps left by “undone science” and influencing policy agendas have been on the rise. Examples of these “lay expert” activities are drawn from a variety of scientific disciplines under an increasingly diverse set of labels: street science (Corburn, 2005), bucket brigades (Ottinger, 2010), research in the wild (Callon and Rabeharisoa, 2003; 2008), spontaneous public participation (Bucchi and Neresini, 2008), and extreme citizen science (Hacklay, 2013). These “non-professional” researchers are defined by their scientific citizenship capabilities (see Irwin 2015); they are able to interpret existing research on topics of interest and use their own perspectives to identify gaps in current institutionalized research efforts. Most importantly, they have a stake in the outcome of decisions that take scientific findings into account.

Environmental groups are taking on the more challenging mediating functions of science in areas where they have the social and cultural networks, and regional understandings to engage in dialogic communication and community relationship building. For example, after the Fukushima nuclear incident in Japan, environmental groups such as SafeCast created publicly-available maps of crowd-sourced regional radiation readings (Scientific American, 20 September, 2011). Jean-Christophe Plantin (2013), the neogeography researcher, reports that soon after the public SafeCast maps were released, the Japanese government produced their own maps of radiation levels and made them publicly available online. While Plantin acknowledges that the timing may have been a coincidence, publicly-available data was not provided by government researchers until the Safecast initiative was launched.

Yearley (2014) also reports on the case of the Friends of the Earth in Britain providing publicly-available online map-based information about local chemical pollutants that could be searched by postcode. The Environmental Agency responded by improving their own public information; Friends of the Earth withdrew their site soon afterwards. Many projects are focused on addressing species decline such as the campaign to change legislation affecting wild salmon in British Columbia (see, for example, Dean, 3 November, 2008 and CBC News, 7 May, 2015) and changing the research questions related to the global collapse of honeybees (Sangasari, 15 March, 2015).

There may be something heroic about non-professional researchers seeking to improve the quality of their community life in tangible and local terms. In fact, Irwin (2015) questions whether most citizen engagement in scientific activity has epistemic justice-seeking implications. However, not all data produced by extreme citizen scientists is considered good data; see, for example, Ottinger (2010) on the work of bucket brigades and Riedlinger and Rea (2015) on the proliferation of home-made Geiger counter videos on YouTube after the Fukushima nuclear incident.

Epistemic gaps will be filled because information-seeking communities consider “any data” better than “no data”. Internet-based communication, publicly-available environmental monitoring technologies, and “amateur scientists” such as neogeographers and open source advocates were not conceived of when Lévy-Leblond wrote his essay. But science communicators could usefully consider how new technologies provide opportunities for more productive public science engagement and criticism.

Irwin (2015) argues that the citizen science movement must take a more active role in supporting scientific citizenship, helping citizens to develop capabilities to critique and apply contextually-relevant scientific information. Science communicators can certainly find more ways to support environmentalists to hone their abilities as productive science critics and address areas of “undone

science". This makes a useful contribution to any discussion about what kind of science communication we need in the current context.

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