first draft. Much contemporary science journalism, however, can be seen as a second, or even a third draft. Unlike reporters covering other fields of public life, science journalists don't get to witness earlier drafts of history-making because these are part of the peer-review process.

One way to tackle this would be to allow journalists access to (anonymous) referee comments alongside a final paper. This would have implications for how journals communicate their findings, and would need more discussion among the science community before being broadly implemented (some journals, such as *Biology Direct*, already publish reviewer's

comments alongside their final papers). On balance, I think it would be beneficial to science communication if this were the usual practice.

When we read a published scientific paper, it often feels like the last word, even though there is often a gripping story behind and ahead of it. Unless they are very experienced, journalists will have little sense of these stories, and that what they are reading has in fact been through an extensive review process of critique, comment, discussion, argument and refinement. Access to that process would help to make stories richer and more compelling for audiences. It is also likely to reduce the tendency — or should I say temptation — to report every

new finding as a 'breakthrough', something that happens all too often in the general media.

Greater public awareness of the peer-review process is something that we will all benefit from. It will help journalists do a more thorough job of reporting science; and it will aid the public understanding of science. ■

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See Editorial, page 1033, and online at <http://tinyurl.com/sciencejournalism>.

Science journalism: Too close for comfort

In the second of three essays, **Boyce Rensberger** tracks the progression of scientific correspondents from cheerleaders to watchdogs.

Science journalism has undergone profound changes since its origin more than a century ago, some more radical than most journalists of today are aware. Although there are legitimate complaints that some current reporters are too close to their sources, or otherwise unable to deliver a disinterested analysis of the field, it is salutary to reflect on how far the profession has come since its beginning.

In the 1890s, there seem to have been no full-time science journalists in either the United States or Britain, although there was one notable part-timer — H. G. Wells. When he wasn't writing science fiction, he penned newspaper articles on genuine scientific findings, arguing that there was a need for writers to translate scientists' jargon and use writing techniques to engage non-specialists. In an 1894 edition of *Nature*, Wells wrote of the need to employ what today is called narrative non-fiction: "The fundamental

principles of construction that underlie such stories as Poe's 'Murders in the Rue Morgue', or Conan Doyle's 'Sherlock Holmes' series, are precisely those that should guide a scientific writer." (See *Nature* 50, 300–301; 1894.)

In 1904 Adolph Ochs, founder of the modern *New York Times*, hired the legendary Carr Van Anda as his managing editor. Van Anda may have been the most scientifically astute news executive of the twentieth century. He had studied astronomy and physics at university, wrote science stories and encouraged his reporters to cover science. He stressed the need for accuracy: in an often-quoted anecdote, Van Anda corrected a mathematical error in a lecture of Albert Einstein's that *The New York Times* was about to print — after, of course, checking with Einstein.

Unlike now, the work of most science reporters in those days consisted largely of translating jargon and explaining the statements of scientists and medical leaders. More than that, according to Bruce Lewenstein, a historian of science journalism at Cornell University in Ithaca, New York, the handful of science journalists at US newspapers in the 1930s and 1940s believed that it was their job to persuade the public to accept science as the salvation of society (B. V. Lewenstein *Public Underst. Sci.* 1, 45–68; 1992). This was a vestige of the Progressive Era in American history that spanned the 1890s to the 1920s, in which intellectuals of all stripes believed that society was perfectible and that the wonders of science and technology would lead civilization towards this ideal.

To do this job, US science reporters decided that they needed scientists to take them more seriously and thus created the National Association of Science Writers (NASW) in 1934. They explicitly called themselves 'writers' rather than 'journalists' or 'reporters' because they felt it sounded more professional. NASW members, all 12 of them, told scientists that they could feel safe talking to members because they belonged to an elite society. Scientists were advised not to talk to non-members, because those reporters were not 'true science writers'. Thus began what I call the 'Gee-Whiz Age' of science reporting, in which the emphasis was on the wonders of science and respect for scientists, rather than on any analysis of the work being done or any anticipation of its effects on society.

In 1937, George W. Gray, who covered science for *Time* magazine, wrote that science journalism should serve to make "the scientific method an integral part of popular education and through it a universal element of

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civilized thinking". When Gray won an award in 1949 from the American Association for the Advancement of Science, he gushed: "What counts most is the recognition from scientists themselves."

Throughout much of this period science reporters encouraged the mythos, as Lewenstein puts it, "that the proper relationship between scientists and science writers was one of trust and respect." One of the best examples of such trust and respect can be seen in science reporter William Laurence's coverage of the Manhattan project to develop the first atomic bomb.

Laurence wrote for *The New York Times* and was well known for his desire that the public appreciate science — so much so that the Pentagon invited him to be the only reporter privy to the project and the atomic bombing of Japan. He was, in effect, one of the first science journalists to be embedded within the military. As it happens, Laurence was also on the US government's payroll, writing press releases about the bomb for President Harry S. Truman and the war department. Incredibly, Laurence's government job was not kept secret, nor did it seem to strike anyone as the massive conflict of interest that journalists today would see.

Friendly fire

After Hiroshima and Nagasaki, as rumours developed that people outside the blast area were becoming ill and dying, the war department held a press conference at the military base at Alamogordo in New Mexico. Laurence opened his resulting story this way: "This historic ground in New Mexico, scene of the first atomic explosion on earth and cradle of a new era in civilization, gave the most effective answer today to Japanese propaganda that radiations [sic] were responsible for deaths even after the day of the explosion." He wrote that the tour of Alamogordo would "give the lie to these claims". The journalism community felt that Laurence epitomized the best in science journalism: in 1946 he was awarded the Pulitzer Prize.

In the 1950s, science journalists wrote often of their belief that the facts of scientific discovery — the joy of science for its own sake — should be emphasized over the practical and social implications. NASW members would talk of how to make science journalism 'more effective', by which they meant making it result in the wider public appreciation of science, rather than making it a better watchdog of the field. It

was this attitude, I believe, that led many news executives in those days to begin to distrust their own science and medical writers. After all, in every other part of the newsroom, reporters are valued for their disinterested, even aggressive stance towards the people they cover.

Cracks soon began to appear in science journalism's 'Gee-Whiz' zeitgeist. In 1962, Rachel Carson published her book *Silent Spring*, highlighting the role of the pesticide DDT in weakening birds' eggshells and killing wildlife. But because pesticides had previously been reported as technological marvels, something the public should admire and accept, science journalists

William Laurence (left) wrote press releases for the US war department even while reporting on J. Robert Oppenheimer's (right) atomic bomb.

were conflicted. Some lambasted Carson's book as emotional and biased. Lawrence Lessing, who wrote for *Time* and *Fortune* magazines, attacked her and said that the best science writing was a result of cooperation with the American Chemical Society and with "enlightened industries encouraging a better discourse between working scientists and science writers, to the benefit of the public". Yet Carson's work — and her view that industry claims should not be taken uncritically — helped to launch not just the environmentalist movement, but also the field of environmental reporting. These reporters were more willing to be critical of the work of scientists, especially those funded by industry.

The 1970s offered increasing evidence of technology's potentially adverse effects, in part owing to controversies and crises such as the reactor meltdown at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania. By this time there was no way science journalists could ignore the social and political

implications of their topic. And so the next great age of science journalism began — the 'Watchdog Age' — as science reporters became much more like their colleagues in other parts of the newsroom.

Paper trail

The quantity of science journalism boomed too, starting with the birth of a science section in *The New York Times* in 1978. By the boom's peak in 1987, according to one count, some 147 newspapers had at least a weekly science page, and four new popular-science magazines had joined the venerable *Scientific American* and *Science News*. Sadly, this upturn was short-lived. By the late 1980s the magazine upsurge was over — all the new titles, none of which was ever profitable, died except for *Discover*, which still exists alongside the older titles. The number of newspaper science sections started to fall, eliminating all but the handful that survives today.

We are obviously now in the 'Digital Age', and the very definition of journalism is changing in uncertain directions. Science journalism has moved from working for the glory of the scientific establishment to taking back its independence and exercising a new responsibility to the public. Now, traditional news outlets are withering, leaving many journalists to self-publish online with total independence and a direct connection to the public. But scientists too can use the web,

bypassing journalists altogether and taking their science — and their agendas — directly to the public. It is becoming increasingly difficult for readers to tell which sources are disinterested and which have an axe to grind.

If science journalists are to regain relevance to society, not only must they master the new media, they must learn enough science to analyse and interpret the findings — including the motives of the funders. And, as if that were not enough, they must also anticipate the social impacts of potential new technologies while there is still time to make a difference. ■

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