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Peer review is not perfect but are the alternatives worse?

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The speaker spoke in a personal capacity, not as Associate Editor of *Journal of Chemical Information and Modeling* (*JCIM*): the views expressed in this talk do not reflect the opinions of ACS Publications. The talk concerned journal articles, not grant proposals, student assessment etc.

The functions of peer review are to improve good papers, filter bad papers, and detect abuse, plagiarism and fraud. In the past peer review was also used as a method of rationing space in print journals, but is this necessary in the Internet era? The mavericks and progressives say "no", but readers still like the concept of quality assurance. Peer review also gives authors feedback and gives them an incentive to write good manuscripts *before* submission. Publishers value the branding that peer review places on journals.

Peer review does not reduce "information overload" for readers because it does not really reduce the amount of information published. It should be seen as a "traffic policeman", not as a filter, since there is a "pecking order" of journals: if the paper is not published in the journal of first choice, it may then be passed down the line to a second, third, or even "lesser" journal (Cronin, B.; McKenzie, G. The Trajectory of Rejection. *J. Doc.* **1992**, *48*(3), 310-317). Nevertheless reviewers do save time for the rest of us by sorting material into an order of descending quality.

According to a recent survey (Sense about Science. Peer review survey 2009, preliminary findings. http://www.senseaboutscience.org.uk/index.php/site/project/395) researchers want to improve, not replace peer review: 84% believe that without peer review there would be no control in scientific communication and 91% say that their last paper was improved by peer review. Only 15% of respondents felt that formal peer review could be replaced by usage statistics. Reviewers want anonymity: 58% would be less likely to review if their signed report were to be published. Just over half of reviewers think receiving a payment in kind would make them more likely to review; 41% wanted payment for reviewing, but this drops to just 2.5% if the author had to cover the cost. Most reviewing (79%) is done by a core of active reviewers. The Sense about Science survey is an update on

one published in 2007 (Publishing Research Consortium (PRC)/Mark Ware Consulting. Peer review in scholarly journals. http://www.publishingresearch.net/documents/PeerReviewFullPRCReport-final.pdf).

Peer review inevitably causes delays in publication. Another issue is that of deciding who are the authors' peers, or from the editor's view point of view, how to choose reviewers fairly. Of course, the editor himself or herself cannot be truly objective. Peer review has been accused of subjectivity, bias, and discrimination against women, non-native English speakers, authors from the developing world or less prestigious organisations, and researchers with unconventional views. Studies have also shown a bias toward positive results in medicine. The current publishing system is subject to abuse by both reviewers (e.g., delaying publication, or stealing ideas) and authors ("salami slicing" research into multiple articles, duplicate publication, failure to give credit to other researchers, and so on).

Unethical practices such as falsification of results and plagiarism are seldom detected in the peer review process but the number of papers retracted each year is rising, according to *The Times Higher Education* supplement in 2009. CrossCheck (using iThenticate) is an initiative started by CrossRef to help its members prevent scholarly and professional plagiarism (http://www.crossref.org/crosscheck.html). The *JCIM* editorial office checks for duplicate papers. *JCIM* enforces the ACS Ethical Guidelines (http://pubs.acs.org/userimages/ContentEditor/1218054468605/ethics.pdf) and in doing so periodically crosses pharmaceutical industry researchers who are not allowed to publish their datasets.

The current peer review process raises a number of issues, one of which is cost. The Research Information Network (RIN) in the United Kingdom estimates that if full economic costs of peer review were to be made in cash, the costs to U.K. university libraries of subscriptions to learned journals would increase by about 45% (RIN. Peer review. A guide for researchers. http://www.rin.ac.uk/peer-review-guide). The cost of time spent by editors and reviewers of journal articles is over a quarter of the total cost of publishing and distributing journal articles.

Peer review is an increasing burden on reviewers. It also tends toward conservatism (the need to publish highly citable research in prestigious journals), and the emphasis on impact can limit innovative, blue-skies research. It can be unreliable in interdisciplinary research. The feasibility of the reactions in a recent publication describing a reactome array (Beloqui, A. *et al. Science* **2009**, *326*, 252-257) was questioned, and when a chemist, Ben Davis at Oxford on Faculty of 1000, asked for more scrutiny of the work it turned out that none of the reviewers was a chemist.

Last but not least, peer review is statistically dubious and reviewers frequently disagree; indeed it is not unusual for them to be diametrically opposed. Rothwell and Martin in an article in *Brain* in 2000 (cited by the PRC study) suggest that it is necessary to use six reviewers in order to get two who agree. Other estimates have suggested even higher numbers of reviewers might be needed for statistical reliability.

In order to reduce bias, current approaches usually involve reviewer anonymity ("single-blind" peer review) or anonymity for both reviewers and authors ("double-blind" peer review). Single-blind review predominates in the sciences; double-blind is more common in humanities and social sciences. ACS Publications uses single-blind peer review; the American Psychological Association practises double

blind peer review. In reality it is hard to conceal authors' identities: their linguistic style and research field may be easily recognisable and the references in the paper may also give clues.

A few journals or publishers advocate open peer review; *BMJ* (*British Medical Journal*) for example, has revealed names of reviewers to authors since 1999. It is claimed that this practice leads to fewer abusive reviews, prevents the stealing of authors' work, makes reviewers accountable, gives reviewers credit, and reduces the likelihood of bias. Most reviewers, however, prefer to be anonymous (Sense about Science peer review survey, preliminary results 2009. http://www.senseaboutscience.org.uk/index.php/site/project/395; Publishing Research Consortium/Mark Ware Consulting. Peer review in scholarly journals. http://www.publishingresearch.net/documents/PeerReviewFullPRCReport-final.pdf) and editors may find it harder to recruit "open" reviewers. It also seems likely that juniors will fear reviewing seniors' work and criticism may be inhibited.

Nature carried out an experiment in open peer review in 2006. The results are reported in an editorial in the December 21/28 issue: *Nature* **2006**, *444*, 971 and discussed in a blog (http://blogs.nature.com/peer-to-peer/). In total 1,369 papers were sent out for review during the trial period June 1 – September 30, 2006. The authors of 71 (or 5%) of these agreed to their papers being displayed for open comment. Of the displayed papers, 33 received no comments, while 38 (54%) received a total of 92 technical comments. Just eight papers received 49 of the 92 comments. The remaining 30 papers had comments evenly distributed. The most commented-on paper received 10 comments (an evolution paper about post-mating sexual selection). There was no obvious time bias: the papers receiving most comments were evenly spread throughout the trial, and recent papers did not show any waning of interest.

The editors concluded: "*Despite the significant interest in the trial, only a small proportion of authors opted to participate. There was a significant level of expressed interest in open peer review among those authors who opted to post their manuscripts openly and who responded after the event, in contrast to the views of the editors. A small majority of those authors who did participate received comments, but typically very few, despite significant Web traffic. Most comments were not technically substantive. Feedback suggests that there is a marked reluctance among researchers to offer open comments*".

So, is there some better method than traditional peer review? Electronic manuscript submission and review systems can speed publishing and widen the range of reviewers. Pre-review filtering, rejection without review by the editor(s) and fast-track review for certain categories can also increase efficiency. It has been suggested that some of the disadvantages of peer review can be overcome by training reviewers or using checklists and providing written guidelines, but a *BMJ* study showed that short training courses had little impact. All these adjustments to the system are akin to rearranging the deck chairs on the Titanic.

Several years ago Smith (Smith, J. W. T. The deconstructed journal, a new model for academic publishing. *Learned Publishing* 1999, *12*(2), 79–91) suggested the "deconstructed journal" where an article is accessed on a server, quality control is carried out by an evaluator organisation, and

dissemination is by subject-specific grouping of documents (a subject focal point). The server could be an institutional repository or a service such as JSTOR. Evaluator organisations could be learned societies and subject focal points would be subject gateways. One advantage would be that papers in cross-disciplinary fields could be published in multiple subject focal points ("journals"). An unsolved problem is who would pay for the deconstructed journal.

Preprint servers such as arXiv.org encourage discussion of a preliminary version of a manuscript, but the Chemistry Preprint Server on ChemWeb.com was not a success (Warr, W. A. Evaluation of an Experimental Chemistry Preprint Server. *J. Chem. Inf. Comput. Sci.* **2003**, *43*, 362-373). The significance of pre-existing practices in certain disciplines is obviously relevant, but above all, the present reward system in science inhibits scientists when it comes to experimenting with new models of science communication. Preprint servers serve a complementary function and do not substitute for peer-reviewed publication venues. Velden and Lagoze list the reasons why chemistry differs from other disciplines: focus on creation, long-tail science, longevity of literature and data, non-digital practices, diversity of research cultures, proprietary information, industry-academia balance, and ACS's global responsibility (Velden, T.; Lagoze, C. *Nature Chemistry* **2009**, *1*, 673-678).

Open, two-stage peer review as adopted by *Atmospheric Chemistry and Physics (*Pöschl, U. *Learned Publishing* **2004**, 17, 105) [discussed in the next paper in the meeting report by Wendy Warr & Associates]. Rustum Roy instituted so-called "super peer review" for *Materials Research Innovations* and *Journal of the Science of Healing Outcomes.* Roy points out that for years the *Proceedings of the Royal Society* and the *Proceedings of the National Academy of Sciences* did not need peer review but relied on the track record of the authors. In "super peer review" a paper is published if the author has already published widely (in 20-30 papers). The criteria for publication are track record and motivation. In short it is the authors themselves who are "reviewed". Members of the Editorial Advisory Board are, however, invited to comment.

Nowadays, article metrics are widely available. For example, the "most cited" and "most read" papers in *JCIM* are available on the ACS Web site. It should be noted, however, that article-level metrics are quality *assessment* whereas peer review is a quality *assurance* process. A number of journals and services use post-publication evaluation. In *PLoS ONE* reviewers check only for scientific rigour [paper also transcribed in the meeting report by Wendy Warr & Associates]. Naboj's dynamical peer review (http://www.naboj.com/) allows users to rate articles on arXiv and PubMed Central but it is little used. Faculty of 1000 (http://f1000.com/) is a paid-for service. The PRC survey found that post-publication review is a useful supplement to formal peer review rather than a replacement: 53% of scientists agreed.

One issue in the use of preprints and postprints is that of version control and determining which version is the "version of record". CrossRef is developing CrossMark (http://www.crossref.org/crossmark.html) to address this issue. Some publishers are using Web technologies to enable readers to add comments, notes and ratings post-publication. These too could be a supplement to peer review. One problem is that no one has the time to read all the poor material in order to select the good.

Social tagging and recommender systems with built-in trust metrics are not yet widely used in scholarly publishing but one "blogosphere" example in chemistry did occur recently. A 2009 paper reported the unlikely use of sodium hydride as an oxidising agent (Wang, X.; Zhang B.; Wang, D. Z. Reductive and Transition-Metal-Free: Oxidation of Secondary Alcohols by Sodium Hydride. *J. Am. Chem. Soc.*, **DOI:** 10.1021/ja904224y, published on the Web July 21, 2009, later withdrawn). Paul Docherty repeated the experiment and put the results on the *Totally Synthetic* blog. Five other chemists reported within 24 hours. This very quick discussion of results is typical of crowdsourcing and the blogosphere.

Caroline Arms suggests that "everything depends on a chain of reputation beginning with people we respect" (unpublished work reported in Arms, W. Y. What Are The Alternatives To Peer Review? Quality Control in Scholarly Publishing on the Web. *Journal of Electronic Publishing* **2002**, 8(1) DOI: http://dx.doi.org/10.3998/3336451.0008.103). Volunteer reviews provide a systematic way to extend the chain of reputation. The value of the review to the user depends on the reputation of the reviewer, where the review is published, and how well it is done (Arms, W. Y. What Are The Alternatives To Peer Review? Quality Control in Scholarly Publishing on the Web. *Journal of Electronic Publishing* **2002**, 8(1) DOI: http://dx.doi.org/10.3998/3336451.0008.103).

Services such as eopinions (http://www.epinions.com) and amazon.com (http://www.amazon.com) assign "reputation scores". Reviewers can be promoted to the status of "spotlight reviewer" at amazon.com. Every registered Chempedia user is assigned a reputation score (http://chempedia.com/about/peer-review). This score can be seen next to the name of any user who has submitted content. On a user's personal page the score appears underneath an image on the left. When other users vote up the contributions of an author, he or she is awarded reputation points. When other users vote down an author's contribution, points are subtracted from the author's reputation score. Authors actually get royalties on Sciyo (http://sciyo.com/).

Post-publication retraction is the most extreme manifestation of post-publication alteration. There have been a few prominent cases recently, e.g., Homme Hellinga's papers on protein design (Hayden, E. C. *Nature* Oct. 12, 2009) and 70 fraudulent structures from China in *Acta Crystallographica Section E*. Were supporting information supplied by the authors and checked by the reviewers, some cases of fraud might be detected, but reviewing of data is beyond the scope of this talk.

Scientists are generally agreed that publication of learned articles should not be a free-for-all, and that some form of quality control is necessary. On the other hand anyone who has studied peer review even cursorily has to admit that the traditional system is far from perfect. It succeeds as a compromise for the quality journals because of the way it is administered by journal editors. Peer review is not good at detecting "abuse". There are no *alternatives* but there *are* some useful complementary techniques.