Historical Perspective

The history of the peer-review process

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The peer-review process is a turf battle with the ultimate prize of the knowledge, science or doctrine being published. On the one side, we have the writers and originators of ideas, on the other, we have the editors and critics. But it was not always so.

Published online: 31 May 2002

The medical school on the island of Cos, Greece, contained the manuscripts of the medico-philosopher Hippocrates (460–377 BCE*) as they were written. Aristotle's (384–322 BCE) *Biology* describes and comments on the organisms that he and his colleagues found in their world. They observed and they wrote and these writings, unsullied by the meddling of others, have been passed on to us. Indeed, the ancient world is not renowned for seeking to improve on the messages of its small band of authors. But we do have evidence from the continual redaction of biblical texts, which occurred before they were canonized in ~CE 100, that these texts were 'worked on' by a form of 'copyist' review process. It is thought that one or other such worker (the use of the term 'peer' at this point could be strained) sought to 'improve' on the original.

Perhaps the first documented description of a peer-review process is in a book called *Ethics of the Physician* by Ishap bin Ali Al Rahwi (CE 854–931) of Al Raha, Syria. This work, and its later variants or manuals, states that it is the duty of a visiting physician to make duplicate notes of the condition of the patient on each visit. When the patient had been cured or had died, the notes of the physician were examined by a local council of physicians, who would adjudicate as to whether the physician had performed according to the standards that then prevailed. On the basis of their rulings, the practising physician could be sued for damages by a maltreated patient [1,2].

Entering the world of the printed document

After the fall of Constantinople in 1453 to the Muslim Turks, the situation changed. Guttenberg invented the printing press, and so what was printed could now be distributed and affect otherwise docile citizens or subjects. It therefore became important to regulate that which was set before the public. Copernicus was allowed his heliocentric revolutionary ideas, because he was a Canon of the Frombork Cathedral, Poland, and his work was published on the last day of his life in 1543. Nevertheless, it was later declared to be heretical by the Spanish Inquisition – a form of retroactive rejection. But others were not so fortunate. Servetus, a Spanish physician (1509–1553), was burned at the stake by John Calvin, a 16th Century theologian, in Geneva because he suggested that, in addition to other doctrinal differences, blood passed from the right side of the heart to the left through the lungs. The review process did not have the same consequences for Galileo (1564–1642). A year after the publication of his book *Dialogue Concerning the Two Chief World Systems* in 1632, he was confined to his home and required to withdraw his support for the Copernican view of the solar system. The Belgian anatomist Versalius (1514–1564) fared better. He challenged the orthodoxy of his day that was based on complete compliance with Galen (CE 129–210). However, his views were not expunged and so medicine was able to advance.

The scientific method defined

A universal method for the generation and assessment of new science was enunciated by Francis Bacon (1561–1626) in his *Novum Organum* of 1620. This powerful work inspired many English scholars, some of whom engaged in an informal pattern of meetings to discuss and debate their varied views and opinions on the unfolding science. In 1645, a group had formed that took the 'New Philosophy' seriously and on the 28 November 1660, they resolved to do as other countries had done and form an official society or academy. By 1662, they had a Royal Charter of Incorporation and, on the issuance of a second Royal Charter, this body became the Royal Society of London for improving Natural Knowledge. By 1665, the Society had it own journal, *Philosophical Transactions*, edited by Henry Oldenburg. At that time, what was published in the journal was largely a matter for the editor and those whose help he might, or might not have sought.

Seeking the help of peers

And so it was for the next ~100 years until, in 1752 the Society took over the editorial responsibility for the production of the *Philosophical Transactions*, at which time it adopted a review procedure that had been used previously by the Royal Society of Edinburgh as early as 1731. Materials sent to the Society for publication were now subject to inspection by a select group of members who were knowledgeable in such matters, and whose recommendation to the editor was influential in the future progress of that manuscript. This type of review is sometimes regarded as the beginning of the peer-review process, and many other societies, including the Literary and Philosophical Society of Manchester, adopted similar procedures whilst publishing a disclaimer as to the accuracy of the published material [3].

If there was to be a committee or group through which a manuscript had to travel, it was often prudent to first expose the contents of the communication to the Society through one of its established and respected members or fellows. Such a practice provided Charles Darwin with moments of acute embarrassment, such as when he was asked to present to the Linnean Society the manuscript by Alfred Russel Wallace that dealt with the concept of natural selection as a process that caused the evolution of species [4]. Otherwise it was common then, as it is now, to consult colleagues and friends informally for comments and criticism on the quality of a draft manuscript before it was sent to a society or a journal for publication.

From the mid-1800s, there was more journal space than there were articles to print. When a board of assistant editors was set up, their primary responsibility was to elicit articles and reviews to fill the pages of the publication. Peer-review for

*BCE, before common era; CE, common era.

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the next 100 years comprised the editor's opinion, fortified when necessary by special committees set up by societies to assess incoming manuscripts. Replicate manuscripts were tedious to create and it was not until the 1890s, when the typewriter became available, that carbon papers could be used to make replicate copies, 3–5 at the most. These could then be circulated to a committee for examination.

Peers from the scientific community

It was the increasing diversity and specialization of material presented to journal editors that made it necessary for them to seek assistance outside the group of knowledgeable reviewers who could be found in the sponsoring society. This happened at different times for different journals. *Science* and *The Journal of the American Medical Association* did not use outside reviewers until after 1940. *The American Practitioner* held did not use in-house peer-review until 1962 [5]. Once the Xerox photocopier became commercially available from 1959, the replication of manuscripts for the purposes of peer-review became facilitated. Around this time, the number of people working worldwide to generate new science increased considerably, so that the previous excess of space in the journals vanished and there was an increased need to be more discriminating as to what was published.

Now the possibilities were endless. For the majority of the peer-review processes since the 1750s, most authors did not know who the reviewers were and, in recent times, the practice of double-blind review has been used, where the reviewers know neither the names nor institutions of the authors. Such practices have been examined for their effects on the quality of the papers produced. In the 1990s, *The Journal of the American Medical Association* ran three symposia dedicated to the thorough examination of the peer-review process, with a fourth yet to be published [6–8]. There is also a publication of the papers presented at a symposium held under the auspices of the 162nd Annual Meeting of the American Association for the Advancement of Science in Baltimore in 1996 [9].

Peers of the net

With the advent of the computer and the Internet, the publication of science is in the midst of a new revolution. Some journals such as the *Internet Journal of Chemistry* and the *Internet Journal of Science* are published only on the Internet and the referees' reports might not be published with them. Other journals are available on the Internet in addition to a paper publication that has been peer-reviewed (http://www.sciencedirect.com). And most recently, a group called PubMed Central is offering peer-review for its web-based life-science papers [10].

Peer-review has come a long way in the defence of its turf. In a world where knowledge is being made available at a rate of millions of pages per day, it is comforting to know that some subset of that knowledge or science has been critically examined so that, were we to use it in our thinking or for our work, we would be less likely to have wasted our time.

References

1 Al Kawi, M.Z (1997) History of medical records and peer review. *Ann. Saudi. Med.* 17, 277–278
2 Ajlouni, K.M. and Al-Khalidi, U. (1997) Medical records, patient outcome, and peer review in eleventh-century Arab medicine. *Ann. Saudi Med.* 17, 326–327
3 Kronick, D.A. (1990) Peer review in 18th-century scientific journalism. *JAMA*, 263, 1321–1322
4 Spier, R.E., (2002) Beginnings. In *Ethics, Tools and the Engineer* (Spier, R., ed.) pp. 3–4 CRC Press
5 Burnham, J.C. (1990) The evolution of editorial peer review. *JAMA* 263, 1323–1329
6 Guarding the guardians: research on editorial peer review. Selected proceedings from the 1st International Congress in Peer Review in Biomedical Publication. (1989) *JAMA* 263, 1317–1441
7 The 2nd International Congress on Peer Review in Biomedical Publication. (1993) *JAMA* 272, 91–173
8 Peer Review Congress (1998) *JAMA* 280, 216–299
9 Stamps, A.E. ed. (1997) Advances in peer review research. *Sci. Eng. Ethics* 3, 3–102
10 Butler, D. (1999) Publishing group offers peer review on PubMed Central. *Nature* 402, 110

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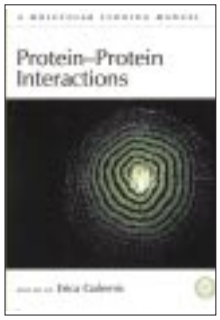
Book Review

Protein interactions contribute to protein function



Protein–Protein Interactions (A Molecular Cloning Manual)
edited by E. Golemis
Cold Spring Harbor Laboratory Press, 2001. £100.00 pbk (600 pages)
ISBN 0 879 69628 1

Proteins control and mediate many of the biological activities of cells. Hence, to gain an understanding of cellular function, the function of every protein must be understood, both in isolation and in the context of other interacting proteins. This view was established many years ago, but developments in genomics have led several scientists to invert this statement: if we knew most or all protein–protein interactions in a cell, the functions of most proteins would become clearer. Recently, we have seen the development of large-scale biological experiments that are technology-driven rather than hypothesis-driven. And, it has become evident that one can easily forget the main goal of biological achievement – understanding mechanisms of life – while concentrating on high-throughput technologies to populate biological databases. In this regard, protein–protein interactions are a special case: recent high-throughput technologies derived from a genetic assay in yeast, or from complex purification and mass spectrometric analyses have obscured the fact that protein associations have long been the focus of geneticists and biochemists. In the future, data raising from these various high-throughput technologies will be merged with knowledge extracted from the literature thanks to appropriate bioinformatics tools. Biologists will still perform hypothesis-driven science, but they will be building their hypothesis not only on their own expertise, but also by taking advantage of this incredible mass of data.

Protein–Protein Interactions, edited by E. Golemis, reconciles modern large-scale technological approaches with more