

24: The future of peer review

RICHARD SMITH

Currently peer review is thought to be slow, expensive, profligate of academic time, highly subjective, prone to bias, easily abused, poor at detecting gross defects, and almost useless for detecting fraud. One cannot predict the future but at present there do not seem to be serious alternatives to peer review. Peer review has been structurally static since the nineteenth century mainly through lack of competition. However, advances such as electronic publishing and continuous quality improvement may help to improve the quality of peer review and evolve new systems.

Anybody who sits down to write about the future is a fool. You can only get it wrong. “Nothing in the world can one imagine beforehand, not the least thing,” said Rainer Maria Rilke: “Everything is made up of so many unique particulars that cannot be foreseen.” Somebody who sat down to write about the future of scientific publishing and peer review in 1990 might well not have mentioned the world wide web, and yet already it is changing everything, but to what is far from clear. “You can never plan the future by the past,” said Edmund Burke, and this is especially true as we crash from one age to another, from the industrial age to the information age. Yet we cannot avoid looking to the future. It is where we will spend the rest of our lives. And it doesn’t just arrive. We build it. So looking to the future is a useful activity, as long as it is tempered by generous helpings of humility.

Overestimating and underestimating future change

There is something distinctly odd about updating, for this second edition, a chapter on the future. If I had got it all right, then no updating would be needed. It might, however, be that I’d got it all wrong, in which case I’d need to start again and invent a new future – one that would probably be equally wrong. My main impression is that the future seems to be arriving painfully slowly. Most of my thoughts from four years ago are neither right nor wrong but still “work in progress”. It is an axiom of futurology, a dubious science, that we overestimate the impact of short term signals and underestimate the impact of long term change.

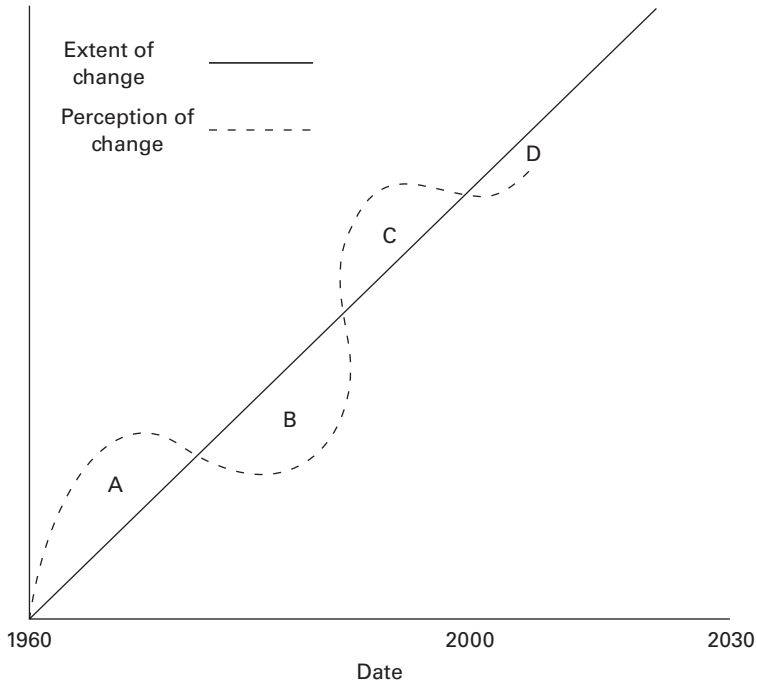


Figure 24.1 The relationship of perceptions of how much change will occur and how much is occurring. In the early days of computers people predicted the disappearance of paper (A). When it didn't happen people began to think that electronic publishing had been hyped and change would be minimal (B). Then came the dot.com revolution, with wild predictions of a new economy (C). Then came the dot.com bomb and again a feeling that the internet wouldn't change that much (D). In the meantime much has changed but it seems likely that much more is to come.

Figure 24.1 shows my analysis of how we have thought and are thinking about the electronic future of scientific publishing and peer review. We are somewhere in the middle of one of Thomas Kuhn's paradigm shifts.¹ The electronic information age might be said to have begun with the arrival of computers on the desks of some individuals in about 1960. Paradigms take around 70 years to change completely, which will take us to 2030. One characteristic of a paradigm shift is that those stuck in the old paradigm (that's you and me) cannot imagine the new paradigm. All we can be sure about is that things will be very different. (If this is true – and Kuhn makes his case convincingly – then my task in writing this chapter is hopeless.)

We began in the 1960s to talk about electronic publishing and the disappearance of paper journals. Some made wild predictions. But in

the mid-1980s it was common to hear people say: “We’ve been talking about electronic publishing for 20 years and almost nothing has happened. I suspect it never will”. Then at the end of the 1980s came the internet. Researchers began to have computers on their desks. Boom times began. Few journals had an electronic version in 1995, but by 2000 almost all of them did. In the late 1990s the dot.com revolution was in full swing, and wild predictions were again common. In 1997 internet enthusiasts were invited by the *BMJ* to predict the future of the scientific paper.² Their predictions were bold, but a review in 2002 showed that few had come to pass.³ At the beginning of the new millennium came the dot.com crash, and people began to complain that the impact of the internet revolution had been greatly exaggerated: the future wouldn’t be that different. Traditional journals using traditional methods of peer review would continue.

My thinking at the beginning of 2003 is that we are in a phase of underestimating the impact of long term change. I think it likely that by 2030 things will be very different from now – but in ways that it’s hard, perhaps impossible, for us to foresee.

Four scenarios of the future of scientific publication

Having been consistently wrong in their predictions, futurologists developed a new method of thinking about the future – scenario planning. With this method they develop not one future but several futures. These futures – or scenarios – should be plausible and not overlap too much, but at least one should be very different from now. Organisations can use scenario planning not to predict the future but to shape the organisation so that it might flourish in all of the possible futures.

Several of us from the BMJ Publishing Group used scenario planning to imagine four different futures for scientific and medical publishing.⁴ We named the four futures after characters from the Simpsons, an American cartoon about a family that has been shown across the world.

In the Lisa scenario – a world of global conversations – traditional scientific publishing has little importance. Instead, researchers and doctors gather their information from being part of a series of global communities on different subjects. These communities are largely electronic, using email, listserves, the world wide web, and mobile phones. If they want new information people find it either from colleagues whom they know to be connected to the relevant community or with sophisticated search engines. In this world peer review would not be an elaborate, written activity but rather a rapid group process. It might be something like the conversation that

occurs in the bar after an important presentation. A version of such a process can be seen now on bmj.com, the electronic version of the *BMJ*. Rapid responses, which are something like electronic letters, are posted in response to articles within 24 hours. Everything is posted – apart from those that are obscene, libellous, incomprehensible, or totally insubstantial.⁵ Dozens may accumulate within days of an article being published, sometimes demolishing studies that have passed traditional peer review.

Traditional publishing is also unimportant in the world of Bart, where information comes not from publishers but from large organisations who produce it as a spin off from their core businesses. These organisations might be pharmaceutical, insurance, or software companies, governments, or international organisations like the World Health Organization. There is no pretense about information being independent. Rather it supports the mission of the organisations, and the idea that information might be neutral is seen as naive and old fashioned. Peer review is run by the large organisations, and its main purpose is to see how much the new information advances the mission of the organisation.

The third world – that of Marge – is characterised by academic innovation. Original research is published not in traditional journals but rather on large, freely accessible websites funded by governments or organisations. Peer review might well be controlled, as now, by academics, but innovation and experimentation would be important. Academic credit in clinical medicine would come not from publishing in particular journals but from how much patient care was improved by new research. There would be sophisticated ways of tracking such improvements.

In only one of the worlds – Homer – do traditional journals survive. Original research is published in traditional journals and accessed mainly through large electronic databases supplied by the publishers. Peer review happens on line, but the processes are simply incremental developments of what happens now.

Oddly, it is this last world that seems most implausible to me. It will probably still exist in 2007, but surely things will look very different by 2015. Marge is the world that is appearing before our eyes, but both Lisa and Bart are here already in some form.

Does peer review have a future?

Perhaps peer review has no long term future. Perhaps it will be akin to communism or the phlogiston theory, aids to thinking and behaving that were of great importance in their time but are now only of historical interest. The speed with which communism is passing from a theory that dictated the lives of millions to the thinking of history illustrates how fast peer review might be gone.

Peer review might disappear because its defects are so much clearer than its benefits. It is slow, expensive, profligate of academic time, highly subjective, prone to bias, easily abused, poor at detecting gross defects, and almost useless for detecting fraud. All of these statements are well supported by evidence included in this book. We also have evidence that the majority of what appears in peer reviewed medical journals fails to meet minimum standards of scientific reliability and relevance.^{6,7} But where is the evidence that peer review is better than any other system at identifying which grants to fund and which papers to publish? It is lacking because we have no well conducted trials comparing peer review against another method. We do, however, have evidence that peer review can improve what is eventually published.^{8,9}

One major reason that we don't have good evidence comparing peer review with another method of deciding which grants to fund and which papers to publish is that no other method has the same credibility among researchers. Peer review has captured the scientific mind. Research monies might be allocated on the basis of previous performance rather than on peer review of proposed projects, and this does happen. Or money might be given as a prize to those who solve an important problem: how to measure longitude in the eighteenth century or how to "cure" schizophrenia today. But all of these methods include some sort of peer review, if we define it as peers making judgements on the value of other people's work.

Within journals, peer review (meaning now the use of outside experts to assess work) might be replaced by editors simply making up their own minds on what to publish and how it should be improved. An editor who took such a step would be bold indeed because peer review has almost religious importance within science: it is a cross to help us ward off the devil of poor quality science. But Stephen Lock, the immediate past editor of the *BMJ*, did try to make a comparison between his deciding alone which papers to publish, and the routine peer review system of the *BMJ*. His study, which allows only tentative conclusions, showed that he was as good as the routine system in deciding which to publish, but that the routine system did improve the papers more.¹⁰

So peer review in some form may have a future because it is hard to come up with an alternative method that has no element of peer review within it. Choices will always have to be made about which research to fund, and it is hard to see peer review being entirely absent from that process. Publication of scientific papers may, however, be different. Cyberspace is infinite, and potentially authors could post their papers on a website and reach readers directly. Readers could then make up their own minds on the validity and usefulness of papers, and journals, peer reviewers, and their arcane processes could become part of history.

Even the greatest enthusiasts for the world wide web have, however, retreated from the view that authors will go directly to readers without any intermediary. Readers, most of whom already feel overwhelmed by the amount of information supplied to them, could not cope. Perhaps, however, there might be some sort of electronic gopher that will endlessly scour the web on behalf of a reader searching out for him or her information that is directly relevant. Perhaps too the gopher might be programmed to judge the quality of that information. In other words, we could create an electronic peer reviewer. Can the processes of peer review be sufficiently defined to allow a computer to peer review? Could a computer, for instance, internalise the checklists for assessing studies produced by groups like that at McMaster University in Canada and apply them to papers posted on the web?

The increased structuring of scientific studies might eventually allow automation of peer review. We know that scientific studies often do not contain the information they should, making life difficult for those attempting systematic reviews. Standardised structures have thus been recommended for reports on randomised trials,¹¹ systematic reviews,¹² economic evaluations,¹³ and studies reporting the accuracy of diagnostic tests.¹⁴ More will surely follow for other sorts of studies. Increasing numbers of journals require studies submitted to them to conform to these structures. This process is likely to continue, particularly as we have evidence that use of the CONSORT structure for reporting randomised trials does lead to improved reporting.¹⁵

It is also likely that scientific studies will be broken down into an ever more granular structure,⁹ a process which again might make the eventual automation of peer review more possible. It can't be done now, and peer reviewers may flatter themselves that their processes are too complex and subtle to be taught to a computer. But they may be wrong.

Eprints rather than publication in traditional journals?

Although the arrival of the world wide web may not mean the end of peer review, it is sure to transform it, in ways that are far from clear. Craig Bingham summarises in Chapter 19 the experiments that are under way with peer review on the internet. The physics community has been leading the way with posting "eprints" (effectively drafts of papers) on an open website, inviting everybody to respond, and then later submitting the paper to a formal journal. Everybody thus has a chance to read a study long before it is published in paper form, and the publication of the paper becomes an academic ritual. But academic rituals are important, and the traditional physics journals

continue to flourish. They are, however, incorporating some of the methods developed by the electronic journals into their peer review processes.

The medical world has made much slower progress with eprints. Initially, medical journals resisted the idea, saying that they would not consider for publication material posted on an open website because that constituted publication.¹⁶ But some journals, including *The Lancet* and *BMJ*, not only changed their policy but also created eprint servers.¹⁷ These have not so far been a success. Despite many journals stating that they will be willing to consider for publication studies posted on eprint servers, very few studies have been posted. We don't know why medical researchers are reluctant to use eprint servers (and it would be a rich area for research), but one thing that clearly separates medicine from physics is responsibility to patients and therefore the public. There is anxiety that the mass media may catch on to medical eprints and publicise their results widely, possibly creating unnecessary public anxiety and forcing policy changes on the basis of inadequate information. It might also be that researchers hold peer review very dear and are reluctant to dispense with it. The *BMJ* held a debate on whether eprints should be introduced into medicine, and most respondents were against (despite being researchers and enthusiasts for the internet). The journal raised the possibility of "a middle way" (very popular at the end of the twentieth century when controlled economies seemed doomed and the free market seemed too red in tooth and claw).¹⁸ The middle way meant placing a warning on eprints about their status: "This research has not yet been accepted for publication by a peer reviewed journal: please do not quote". Many might argue, however, that it is the height of naivety to imagine that such a phrase would discourage journalists from disseminating a story of worldwide interest. Certainly eprints have not so far caught on.

Medicine has in some ways, however, tried to move ahead of physics. At the end of the 1990s the National Institutes for Health announced that they would create a website for medical research that would be available free to everybody. It was called PubMed Central, building on the worldwide acceptance of PubMed, a database of titles and abstracts from thousands of journals that has tens of millions of users.¹⁹ The research posted on PubMed Central has already been published in journals – and so peer reviewed. The original idea for PubMed Central included the possibility of posting directly, without prior publication in a journal, research that had been approved by two recognised authorities, perhaps people who had grants from the National Institutes of Health or similar organisations. In retrospect this was a bad idea: approval by recognised authorities – those "in the club" – is perhaps the worst kind of peer review. There was also talk of being able to post eprints on PubMed Central, but this has not happened.

A major problem for PubMed Central is that many publishers are unwilling to allow the research they publish to be posted, even after a delay. The publishers fear a collapse in their business. A new publishing venture, BioMed Central, has, however, appeared and allows the research it publishes to be posted directly on to PubMed Central.²⁰ BioMed Central helps researchers create new electronic journals and hopes to change the model of researchers publishing in traditional journals, many of which are highly profitable and most of which charge for access to their material. Another organisation, the Public Library of Science, has also just announced (at the end of 2002) that it will create two new online journals – one for biology and one for medicine – that will allow free access to the material it publishes.²¹ BioMed Central and the Public Library of Science charge researchers a fee for peer reviewing and publishing their material. So the traditional model of charging readers rather than authors is being turned on its head.

These innovations are constantly changing, and a new and stable form of publishing research has yet to emerge. It does seem likely, however, that something new will emerge. Most medical research is undertaken by academics and funded by public money, and the academic community resents the profits wrenched out of the system by publishers. They resent too that the research is not available for free.

Electrification of peer review

We must wait and see whether eprints become common in medicine, but undoubtedly traditional peer review is increasingly take place electronically, meaning that information is sent backwards and forwards electronically. Many journals now accept submissions only through the world wide web and have abandoned paper. This is a small step conceptually, but it may be that conducting the peer review process through the web will have surprisingly profound effects. One immediate consequence is that geography doesn't matter any more. If submission is through the web and if the journal has an online version it doesn't matter much whether it's an American, European, or Australasian journal. Similarly it makes no difference where reviewers are. In the paper days many editors were reluctant to use reviewers who were far away, particularly in the developing world, for fear of delay, but with the web it doesn't matter if the reviewer is in the next room or up the Orinoco. Journals and the processes of peer review are becoming much more global, and it's hard to see this globalisation stopping.

The electrification of peer review should also speed it up. This is partly because time is saved by avoiding postal delays but also because

the electronic systems allow authors to track where their studies are in the system. This puts pressure on editors to speed up their processes. The electronic systems also produce good data on decision making times, allowing instant feedback on whether innovations in the system are leading to improvements.

These electronic systems are expensive, although they do allow savings in postage and eventually staff, and they may prove another force – along with the costs of producing an online version – that will lead to a shake out in journals. Those journals that can't afford to become electronic may disappear. In contrast, BioMed Central shows how new, purely electronic journals can be started comparatively cheaply, presenting severe competition to journals who have to meet the large costs of paper, printing, and distribution.

Electronic postpublication peer review

Electronic postpublication peer review is arriving and is already used by the Cochrane Collaboration. It might be that comments can be placed side by side with published studies immediately, or, as mostly happens so far, editors may screen comments before posting them. These comments may be free form or may be structured in some way. Authors may want to revise their studies in the light of these comments or may be required to do so by editors. This is a crucial transition, turning the published version of the study from an archive into a living and evolving creation. Such a revolution is particularly important for systematic reviews, where the appearance of a new study and its incorporation into the review may change the overall conclusion.

Experience in the four years since I first wrote the preceding paragraph is that very slow progress is being made with turning dead papers into live ones.³ The process of updating is onerous, and most authors would prefer to move on to a new study rather than update old ones. Even with systematic reviews it has proved very hard to persuade authors to update them.

Journals or grant giving bodies are unlikely to resort to simply posting unpublished material on the web and asking reviewers to comment, for the simple reason that few people surf the web hoping to find something to spend two or three hours reviewing. The journals or grant giving bodies might instead nominate one or two reviewers to review an article or grant proposal on line and then invite either the whole world or a few observers to watch and comment. Those commenting might well include the authors, turning the process of peer review from what sometimes seems like a summary judgement into a discourse. Such a change might emphasise that peer review should be about improving the reports of studies and grant

proposals rather than simply about deciding which to publish and fund.

Open peer review

Most peer review by journals and grant giving bodies has been closed, meaning that the authors do not know the identity of the reviewers. The whole process has been compared with a black box: authors submit a paper or grant proposal, wait a long time, and then receive a yes or a no with little or no feedback. What happened within the box was obscure, and appeals were not tolerated. Peer review has begun to open up, in that journals and grant giving bodies now explain their process, provide feedback, and will consider appeals, but most have stopped short of identifying the reviewers.

In 1994 Alexandre Fabiato published in *Cardiovascular Research* a comprehensive analysis of the arguments for and against open peer review.²² His arguments are summarised in Box 24.1, but the main argument against it is the familiar “if it ain’t broke, don’t fix it”. Readers of this book, and particularly Chapter 22 by Chris Martyn, will not be impressed by this argument: it is broke. The second main argument against open review is that junior reviewers will be reluctant to review the work of their seniors. This is an argument that must be taken seriously. The livelihood and career prospects of junior researchers depend on senior researchers, and we have increasing evidence of abuse of junior researchers by senior ones, for example, in the area of authorship. A third argument against is that reviewers will hold back from strong criticism, although anybody who has ever listened to the criticism of papers at scientific meetings may doubt this argument.

The arguments for open peer review have been advanced strongly by Fiona Godlee,²³ and the main argument is an ethical one. Reviewers are making or helping to make judgements that are of great importance to authors. None of us would want to be judged for a serious offence by an anonymous unseen judge. Justice has to be done and be seen to be done. Peer reviewers should thus be identified, increasing their accountability. But as we increase their accountability so will we increase the credit that attaches to peer reviewing, particularly if the process is open not just to authors but to readers as well. By increasing the credit that attaches to peer review we may bring it out of the shadows and into the full academic sunlight, where, if we believe in it, it surely deserves to be.

The *BMJ* began to identify reviewers to authors in 1999, after the first edition of this book was published.²⁴ We did so after conducting a randomised trial that found that open review produced reviewers’ opinions of the same quality as closed review.²⁵ We then conducted

Box 24.1 Arguments for and against open peer review

Arguments for open reviewing:

- Open reviewing helps the reviewers maintain an appropriate balance between their judgemental role and their role in helping the authors
- The credentials of the reviewers will add credibility to their comments
- Open reviewing renders the reviewers more accountable
- Open reviewing should eliminate the intolerable abuses of the system
- Open reviewing may help resolve problems in controversial areas of research
- In a respectable scientific community there seems to be little justification for secrecy
- Open reviewing will render the reviewing process less disagreeable and more polite
- New technology may render open reviewing a necessity

Arguments against open reviewing:

- Junior reviewers' fear of reprisal by established authors
- Creation of an "old boy" network favouring established scientists
- Creation of resentment and animosity
- Open reviewing will cause a higher acceptance rate
- Open reviewing would cause more work and problems for the editors
- One should not change a system that generally works

Reproduced from *Cardiovascular Research*²²

(but have not yet published) a trial of the effects on the quality of reviewers' opinions of posting all peer review material, including the reviewers' opinions on the web for anybody to see. This too did not change the quality of the opinion, but the *BMJ* will probably move to posting peer review material routinely. We are currently trying to design an experiment to test the effects of conducting the whole peer review process in full public view.

The *BMJ*'s experience with open peer review might be summarised as "the earth didn't move". Most, but not all, reviewers are willing to review openly and no serious problems have arisen. We, the editors of the *BMJ*, have no sense of the quality of reviews deteriorating, but the classic pejorative review ("I'd stay clear of this paper. Everybody knows the author to be a fool".) has disappeared. Indeed, my impression is that the standard of reviews has improved, but I don't have strong evidence to support that impression. And even if it's true I don't know why. It might be caused by open review, but it might be because we use a bigger pool of reviewers, more reviewers being trained in epidemiology and statistics, or the electrification of the process.

Although it would be unthinkable for us at the *BMJ* to reverse our policy, few traditional journals have followed. Drummond Rennie,

deputy editor of *JAMA* and “prophet of peer review”, spoke dramatically in favour of open review at the closing of the Fourth Congress of Peer Review in Barcelona in 2001. “The ethical arguments against open peer review are disgraceful,” he said, “and yet hardly any journals have opened up their peer review process”.²⁶

It will be interesting to see if more journals do adopt open peer review. There does seem to be a trend towards increasing openness within science and most societies. Unsigned editorials have disappeared from most journals. Contributors to studies are increasingly expected to declare who did what. Everybody must declare conflicts of interest. Job references are increasingly open. Those who collect taxes must explain themselves. It is increasingly difficult for most governments to keep hidden the illnesses of leaders. We know the secrets of royal bedrooms. What is not open is assumed today to be biased, corrupt, or incompetent until proved otherwise. Like it or not, we are moving closer to Karl Popper’s open society, and peer review may have to follow to avoid looking anachronistic.

The internet also has an extremely open culture, and the electrification of peer review and its opening up are entangled. Open peer review may eventually mean that the whole process is laid bare for everybody to see. Nobody would contemplate publishing the whole peer review process on paper. Most readers are just not interested. But some are, particularly those researching in the same area, and they would be interested to see the whole debate on the web. Opening up the process would also be very useful for intensely controversial studies, and all editors know that the peer review process is often much more interesting than the final study. The opening up of peer review would also fit with science being a discourse not a series of tablets being brought down from the mountain.

An end to trust in peer review?

Peer review traditionally depends on trust. If somebody submits a study saying that it included 200 patients, 70 of whom were men, then editors and reviewers assume that to be true. Nobody asks to see the patients’ records or the raw data. If errors are found in a paper, then these are assumed to be “honest errors”. But is this enough? We have increasing accounts of fraud and misconduct within research, and many countries have developed institutions to respond to the problem and raise integrity in research.²⁷ Peer review in its present form will sometimes detect fraud, but more often it doesn’t. That something is peer reviewed is no guarantee that it is not fraudulent.

So should peer review change? Should it begin to operate more like a casino, where nobody is trusted and everything is checked,

rechecked, and videoed. To most of us the idea is abhorrent. We like to work in a climate of trust. How could editors start a relationship with authors by distrusting them? Plus we must wonder whether it would be workable to move away from trust. Would editors insist on seeing patient records, laboratory notebooks, and raw data? Would we do occasional random audits, as tax authorities often do? The costs of such methods would be high, and who would meet them?

Although editors may not like the idea of abandoning trust in peer review, they might be forced to – either by the public losing confidence in the integrity of research or by the editors being caught out once too often. I recently had the unpleasant task of pointing out to an editor in one phone call that two papers he had published were fraudulent. He was led to question whether, like it or not, editors would have to take on the role of “the research police”. I am currently involved in two cases where authors seem to have published dozens of fraudulent research papers in prominent journals and yet where nobody is taking responsibility to put the record straight.

The move towards evidence-based peer review

The idea that medical practice should be based on scientifically firm evidence and the realisation that much of it isn't have swept through medicine in the past five years. Evidence is replacing respected opinion as the primary currency within medicine. Some see this as simply the next stage in the long march from necromancy, others as a paradigm shift. Whatever it is, it has implications for peer review.

Although peer review is at the heart of science it was until recently a largely unexamined process. We had few data and almost no experimental studies. Editors of medical journals, who in their professional lives as, for example, cardiologists now expect high level evidence on whether to use thrombolysis to treat patients with heart attacks, have been content to change their peer review process without any evidence on whether either the old system worked or the new will be any better. Opinion and experience have ruled in the world of peer review to the extent that members of editorial boards have thought positively odd suggestions that new systems of peer review might be examined through randomised controlled trials. Nor are those who fund research much interested in such studies.

But increasingly we do have evidence on peer review, and nowhere is this better illustrated than by the growth and development of the international congresses on peer review. The first was held in Chicago in 1989 and the fourth in Barcelona in 2001. The first included much opinion from the grandees, whereas the third and fourth comprised mostly studies, many of them experimental intervention studies. The number of studies submitted and their quality has improved

dramatically, although there is a long way to go before the evidence presented at a congress on peer review approaches that at a congress on, say, hypertension.

Nevertheless, some publishing companies begin to have inhouse research departments doing not traditional market research but research into the processes of publishing, including peer review. They do this partly for business reasons, believing that evidence and innovation will in the long run increase profits.

There is considerable overlap among those interested in evidence-based medicine and those interested in peer review. This is not surprising, as evidence-based medicine focuses much attention on “the evidence”, the peer reviewed material that appears in medical journals, much of which is deficient. The challenge is not only to get more of medical practice to be based on evidence but also to find the best way to sort and improve the evidence that is available, the tasks of peer review.

It seems highly likely that peer review will continue to be studied and that changes and developments in peer review will come in response to evidence and be based on it.

Re-engineering peer review and continuously improving it

Perhaps because it has been largely unexamined and even unquestioned peer review seems to have been remarkably static over a long period. It is the lack of change rather than the rapidity of change that is striking, which is remarkable in a world where a predominant cliché is the rapidity and acceleration of change. The lack of change probably reflects the absence of severe competitive forces. Businesses change not because they want to change but because they will go bust if they do not. Many go bust even when they do. Peer review has until now been able to bumble along in a cosy amateur way. Editors are often not clear what they want from peer review. Reviewers are neither trained nor rewarded. They do it “on the side”, often poorly, slowly, and inefficiently. References are not examined, raw data not scrutinised, conflicts of interest not declared, explanations not given, and appeals not heard. In short, there seems to be great scope for doing peer review much better, and two business techniques, re-engineering and continuous improvement, are likely to be able to help.

Re-engineering a process means examining it closely and experimenting with doing it in a fundamentally different way. An example is the re-engineering of a menorrhagia clinic in Leicester Royal Infirmary. Women with heavy periods used to see a gynaecologist and then be referred sequentially for a series of tests, each of which needed a separate hospital visit. The women would

often wait two years for a diagnosis. Now everything is done on one day and women are rung in the evening with a diagnosis. It's a very radical change and was built around the experience of customers/patients. For the doctors the old system was fine. Similarly the amateurishness of much of peer review suits editors, but the authors are becoming impatient.

Peer review, like anything else, can be re-engineered. David Hearse, the editor of *Cardiovascular Research*, re-engineered, for instance, his journal's peer review system. In particular he reduced the time to make a decision from three months (and often longer) to three weeks. He did this by sending out the paper to three reviewers on the day it arrived, asking reviewers by fax in advance to agree to review the paper, rewarding the reviewers (with a music CD) if they responded within two weeks, and being prepared to make a decision on the basis of two reviewers' opinions. He also dramatically increased the number of reviewers on his database from 200 to 2000 and changed them from being 80% British to 80% from outside Britain; and he promised to publish accepted papers within three months (when the wait had been a year). The result was that he transformed a moribund journal that received perhaps 200 papers a year into a highly cited one that received over 2000 papers a year.

The point of this example is not to illustrate success or failure but to show how a familiar process can be changed radically, with only minimal technical development. It seems highly likely that new entrants to the process of peer review may find ways to re-engineer it in ways that the old timers may find hard to imagine.

Continuous improvement is another process that could transform peer review. The ideas behind continuous improvement were developed by American statisticians, implemented with great success in Japanese manufacturing industry, and then picked up by manufacturers worldwide. Now they are being adopted, with less conspicuous success, by service industries, including health services. In essence continuous improvement means defining your processes in detail, collecting data on how they function, reflecting on how they might be improved, making a change, collecting more data to see if the process is improved, and doing this continuously.²⁷ Importantly, the leaders of the organisation must create a climate in which deficiencies are "treasured" not hidden, where people are not afraid to criticise the status quo and suggest improvements, and where the customers (the authors) decide where quality is improved. If the operators of the system (the editors and the reader) think it is better, but the customers think it is worse, then it is worse.

Peer review is a multistage process that could easily benefit from the ideas of continuous improvement. Many journals and grant giving bodies have worked to improve their peer review process, but few have explicitly used the methods of continuous improvement. The

widespread adoption of these methods could lead eventually to substantial improvement, not only in processing times but also in the quality of decisions and the removal of bias.

Training reviewers and professionalising peer review

One way to improve peer review might be to train reviewers. This can hardly be a radical idea, but despite the antiquity of peer review there has been no formal training. Peer reviewers are expected to learn by doing, perhaps by asking seniors to help them – despite the process usually being closed and confidential. We know that reviewers trained in epidemiology and statistics produce better reviews, so might it be that training reviewers would improve peer review?

We have tried to answer this question with a randomised trial of training reviewers (so far unpublished). In a three arm trial reviewers received a day's face to face training plus a package of information, the package alone, or nothing. The outcome measure was the quality of review of three papers before and after training and the ability of reviewers to spot deliberate errors inserted into the papers. Generally training did not produce improvements, but the question remains whether more intensive (but expensive) training might.

It could be that peer review will be transformed from a largely amateur business – with untrained people doing it on the side for no reward – into a professional business. Instead of large numbers of amateurs “having a go” there may arise a class of professional reviewers. This has perhaps happened to some extent with the increasing involvement of statisticians in peer reviewing, the appearance of systematic reviewers, and increased training in critical appraisal.

Big business discovers peer review

Ironically, as the academic world grows tired and distrustful of peer review, big business is discovering it. BP, one of the world's largest companies and one that prides itself on being at the forefront of business thinking, has introduced peer review into the heart of its working.

BP has adopted peer review in two forms: peer assists and peer groups. With peer assist, one part of the business lends a member of its staff to another part to help it resolve a particular problem. Within the peer groups, members present proposed goals for the coming year and the other members critique the plan and offer information and suggestions on how to run operations more efficiently and set more ambitious targets. Peer review has been developed as part of

decentralising decision making and encouraging learning, and both the leaders of BP and the members of the groups are very enthusiastic about it. Members of the groups believe that they derive tremendous benefit from their peers' rigorous review of their plans. It is interesting to note that the emphases in this process are on improvement and discourse and that nothing is secret.

Conclusion

Despite its clear deficiencies, peer review probably does have a future. Indeed, its future may be more glorious than its past as it transfers to new worlds like big business. The appearance of the internet is likely to transform peer review just as it is likely to transform almost everything else as we move from the industrial to the information age. We are only beginning to see how peer review might work in the electronic age, but one consequence is that it is likely to become much more open. As peer review is adopted by business, so it might be radically improved by business processes such as re-engineering and continuous improvement.

In conclusion, after centuries of gradual change peer review may be about to embark on a period of radical change. Or then again, it may not be. The future is unknown and unknowable.

References

- 1 Kuhn TS. *The structure of scientific revolutions*. Chicago: University of Chicago Press, 1962.
- 2 The electronic future: what might an online scientific paper look like in five years' time? *BMJ* 1997;**315**:1692–6.
- 3 Delamothe T. Is that it? How online articles have changed over the past five years. *BMJ* 2002;**325**:1475–8.
- 4 Abbasi K, Butterfield M, Connor J, *et al*. Four futures for scientific and medical publishing. *BMJ* 2002;**325**:1472–5.
- 5 Delamothe T, Smith R. Twenty thousand conversations. *BMJ* 2002;**324**:1171–2.
- 6 Haynes RB. Where's the meat in clinical journals. *ACP Journal Club* 1993;**119**:A22–3.
- 7 DerSimonian R, Charette LJ, McPeck B, Mosteller F. Reporting on methods in clinical trials. *N Engl J Med* 1982;**306**:1332–7.
- 8 Pierie JPEN, Walwoort HC, Overbeke AJPM. Readers' evaluation of effect of peer review and editing on quality of articles in the *Nederlands Tijdschrift voor Geneeskunde*. *Lancet* 1996;**348**:1480–3.
- 9 Purcell GP, Donovan SL, Davidoff F. Changes to manuscripts during the editorial process: characterizing the evolution of a clinical paper. *JAMA*. 1998;**280**:227–8.
- 10 Lock SP. *A difficult balance: editorial peer review in medicine*. London: BMJ Publishing Group, 1991.
- 11 Moher D, Schulz KF, Altman DG. The CONSORT statement: revised recommendations for improving the quality of reports of parallel-group randomised trials. *Lancet* 2001;**357**:1191–4.
- 12 Moher D, Cook DJ, Eastwood S, Olkin I, Rennie D, Stroup DF. Improving the quality of reports of meta-analyses of randomised controlled trials: the

- QUOROMstatement. Quality of Reporting of Meta-analyses. *Lancet* 1999;**354**: 1896–900.
- 13 Drummond MF, Jefferson TO. Guidelines for authors and peer reviewers of economic submissions to the *BMJ*. The *BMJ* Economic Evaluation Working Party. *BMJ* 1996;**313**:275–83.
 - 14 Bossuyt PM, Reitsma B, Brns DE, *et al.* Towards complete and accurate reporting of studies of diagnostic accuracy: the STARD initiative. *BMJ* 2003;**326**:41–4.
 - 15 Moher D, Jones A, Lepage L. Use of the CONSORT statement and quality of reports of randomized trials: a comparative before-and-after evaluation. *JAMA* 2000;**285**:1992–5.
 - 16 Kassirer JP, Angell M. The internet and the journal. *N Engl J Med* 1995;**332**:1709–10.
 - 17 Delamothe T, Smith R, Keller MA, Sack J, Witscher B. Netprints: the next phase in the evolution of biomedical publishing *BMJ* 1999;**319**:1515–6.
 - 18 Delamothe T. Electronic preprints: what should the *BMJ* do? *BMJ* 1998;**316**:794–5.
 - 19 Delamothe T, Smith R. PubMed Central: creating an Aladdin's cave of ideas. *BMJ* 2001;**322**:1–2.
 - 20 <http://www.biomedcentral.com/info/>
 - 21 www.publiclibraryofscience.org
 - 22 Fabiato A. Anonymity of reviewers. *Cardiovasc Res* 1994;**28**:1134–9.
 - 23 Godlee F. Making reviewers visible: openness, accountability, and credit. *JAMA* 2002;**287**:2762–5.
 - 24 Smith R. Opening up *BMJ* peer review. *BMJ* 1999;**318**:4–5.
 - 25 van Rooyen S, Godlee F, Evans S, Black N, Smith R. Effect of open peer review on quality of reviews and on reviewers' recommendations: a randomised trial. *BMJ* 1999;**318**:23–7.
 - 26 Smith R. Medical editor lambasts journals and editors. *BMJ* 2001;**323**:651.
 - 27 Farthing M, Lock S, Wells F. *Fraud and misconduct in biomedical research*. London: BMJ Books, 2002.
 - 28 Berwick D. A primer on leading the improvement of systems. *BMJ* 1996;**312**: 619–22.