House of Commons

Science and Technology Committee

Peer review in scientific publications

Eighth Report of Session 2010–12

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Eighth Report of Session 2010–12

Volume I: Report, together with formal minutes, oral and written evidence

Additional written evidence is contained in Volume II, available on the Committee website at www.parliament.uk/science

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The Reports of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in printed volume(s).

Additional written evidence may be published on the internet only.

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Summary

Peer review in scholarly publishing, in one form or another, has always been regarded as crucial to the reputation and reliability of scientific research. In recent years there have been an increasing number of reports and articles assessing the current state of peer review. In view of the importance of evidence-based scientific information to government, it seemed appropriate to undertake a detailed examination of the current peer-review system as used in scientific publications. Both to see whether it is operating effectively and to shine light on new and innovative approaches. We also explored some of the broader issues around research impact, publication ethics and research integrity.

We found that despite the many criticisms and the little solid evidence on the efficacy of pre-publication editorial peer review, it is considered by many as important and not something that can be dispensed with. There are, however, many ways in which current pre-publication peer-review practices can and should be improved and optimised, although we recognise that different types of peer review are suitable to different disciplines and research communities. Innovative approaches—such as the use of pre-print servers, open peer review, increased transparency and online repository-style journals—should be explored by publishers, in consultation with their journals and taking into account the requirements of their research communities. Some of these new approaches may help to reduce the necessary burden on researchers, and also help accelerate the pace of publication of research. We encourage greater recognition of the work carried out by reviewers, by both publishers and employers. All publishers need to have in place systems for recording and acknowledging the contribution of those involved in peer review.

Publishers also have a responsibility to ensure that the people involved in the peer-review process are adequately trained for the role that they play. Training for editors, authors and reviewers varies across the publishing sector and across different research institutions. We encourage publishers to work together to develop standards—which could be applied across the industry—to ensure that all editors, whether staff or academic, are fully equipped for the job that they do. Furthermore, we consider that all early-career researchers should be given the option for training in peer review; responsibility for this lies primarily with the funders of research.

Funders of research have an interest in ensuring that the work they fund is both scientifically sound and reproducible. We consider that it should be a fundamental aim of the peer-review process that all publications are scientifically sound. Reproducibility should be the gold standard that all peer reviewers and editors aim for when assessing whether a manuscript has supplied sufficient information to allow others to repeat and build on the experiments. As such, the presumption must be that, unless there is a strong reason otherwise, data should be fully disclosed and made publicly available. In line with this principle, data associated with all publicly funded research should, where possible, be made widely and freely available. The work of researchers who expend time and effort adding value to their data, to make it usable by others, should be acknowledged and encouraged.

While pre-publication peer review (the first records of which date back to the 17th century)

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continues to play an important role in ensuring that the scientific record is sound, the growth of post-publication peer review and commentary represents an enormous opportunity for experimentation with new media and social networking tools. Online communications allow the widespread sharing of links to articles, ensuring that interesting research is spread across the world, facilitating rapid commentary and review by the global audience. They also have a valuable role to play in alerting the community to potential deficiencies and problems with published work. We encourage the prudent use of online tools for post-publication review and commentary as a means of supplementing pre-publication review.

On the subject of impact, it was clear to us that the publication of peer-reviewed articles, particularly those that are published in journals with high Impact Factors, has a direct effect on the careers of researchers and the reputations of research institutions. Assessing the impact or perceived importance of research before it is published requires subjective judgement. We therefore have concerns about the use of journal Impact Factor as a proxy measure for the quality of individual articles. While we have been assured by research funders that they do not use this as a proxy measure for the quality of research or of individual articles, representatives of research institutions have suggested that publication in a high-impact journal is still an important consideration when assessing individuals for career progression. We consider that research institutions should be cautious about this approach as there is an element of chance in getting articles accepted in such journals. We have heard in the course of this inquiry that there is no substitute for reading the article itself in assessing the worth of a piece of research.

Finally, we found that the integrity of the peer-review process can only ever be as robust as the integrity of the people involved. Ethical and scientific misconduct—such as in the Wakefield case—damages peer review and science as a whole. Although it is not the role of peer review to police research integrity and identify fraud or misconduct, it does, on occasion, identify suspicious cases. While there is guidance in place for journal editors when ethical misconduct is suspected, we found the general oversight of research integrity in the UK to be unsatisfactory. We note that the UK Research Integrity Futures Working Group report recently made sensible recommendations about the way forward for research integrity in the UK, which have not been adopted. We recommend that the Government revisit the recommendation that the UK should have an oversight body for research integrity that provides "advice and support to research employers and assurance to research funders", across all disciplines. Furthermore, while employers must take responsibility for the integrity of their employees' research, we recommend that there be an external regulator overseeing research integrity. We also recommend that all UK research institutions have a specific member of staff leading on research integrity.

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1 Background

What is peer review?

1. Peer review is no more and no less than review by experts.[1] It is pervasive throughout all aspects of academic endeavour.[2] The principles of peer review are commonly applied to "the review of grant applications, and in nationwide resource allocation activities, such as the Research Assessment Exercise (RAE)".[3] Peer review is also used in scholarly publishing, in which it is described by the International Committee of Medical Journal Editors as "the critical assessment of manuscripts submitted to journals by experts who are not part of the editorial staff".[4] Those "experts" are commonly referred to as "reviewers" or "referees".

The importance of peer review in scientific publications

2. Scientific publications are the public face of science; they are the means by which researchers report and explain their findings to the wider world, including other scientists, practitioners, the public, and policy makers. Professor John Pethica of the Royal Society explained that the primary function of peer review in this context is "to improve the process and the coherence of scientific knowledge and its utility".[5] Peer review is used by publishers to help ensure that the scientific record is robust.

The importance of the scientific record to Government

3. The peer-reviewed literature represents an organised body of knowledge, reviewed by experts. Professor Sir John Beddington, Government Chief Scientific Adviser, summarised the importance of peer-reviewed literature to the Government: "scientific evidence is clearly fundamental to Government policy and peer review is a fundamental part of scientific evidence. […] it is absolutely clear that scientific evidence is essential for […] the evidence-based policy of the Government".[6]

Previous work

4. On 20 July 2004, the former Science and Technology Committee published the report, *Scientific publications: free for all?*, which aimed to examine the provision of scientific journals to the academic community and wider public and establish whether the market for scientific publications was working well.[7] On the issue of peer review, the former Committee concluded:

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1 Q 250 [Sir Mark Walport]

2 Q 225 [Professor Ian Walmsley]

3 Ev w20, para 6 [British Medical Association]

4 "Uniform Requirements for Manuscripts Submitted to Biomedical Journals", *International Committee of Medical Journal Editors*, www.ICMJE.org/

5 Q 2

6 Q 287

7 Science and Technology Committee, Tenth Report of Session 2003–04, *Scientific publications: free for all?*, HC 399–I, para 4

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> As is the case with any process, peer review is not an infallible system and to a large extent depends on the integrity and competence of the people involved and the degree of editorial oversight and quality assurance of the peer review process itself. Nonetheless we are satisfied that publishers are taking reasonable measures to [maintain] high standards of peer review. Peer review is an issue of considerable importance and complexity and the Committee plans to pursue it in more detail in a future inquiry.[8]

5. Shortly before the former Committee's report was published, the Sense About Science Working Party on peer review published the discussion paper, *Peer review and the acceptance of new scientific ideas*.[9] Since then, peer review has become a more mainstream concept outside of the scholarly community. In April 2005, Sense About Science carried out "a series of workshops with educational bodies, patient groups and information providers to produce a user-friendly short guide to the peer review process".[10] This guide, *I don't know what to believe… Making sense of science stories*, was published in November 2005 and "hundreds of thousands of copies have been downloaded".[11]

6. In recent years there have been an increasing number of reports and articles assessing the current state of peer review, in some cases questioning whether the peer-review system is "broken".[12] These reports have come at a time when there are big changes afoot in scientific publishing: the total number of peer-reviewed publications has grown by a third since the beginning of the 21st century;[13] the share of publications by countries which are not traditional scientific leaders, for example China and India, is rising;[14] Information Technology has transformed the administration of peer review through, for example, online submission tools and reviewer databases;[15] and the web (including tools such as Twitter) is providing new and immediate ways for rating and commenting on scholarly publications.[16] In this rapidly changing environment, and in view of the importance of evidence-based scientific information to Government, it seemed appropriate to undertake a detailed examination of the current peer-review system as used in scientific publications. Both to see whether it is operating effectively and to shine light on new and innovative approaches. As a consequence, this report examines the issues at length and we set out the bulk of our conclusions and recommendations towards the end of the report.

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8 Science and Technology Committee, Tenth Report of Session 2003–04, *Scientific publications: free for all?*, HC 399–I, para 207

9 Sense About Science, *Peer Review and the Acceptance of New Ideas*, May 2004

10 Ev 74, para 3

11 Ev 75, para 3

12 For example: "Nature's peer review debate", Nature Online, www.nature.com/nature/peerreview/debate; Mark Ware Consulting, *Peer Review in Scholarly Journals - perspective of the scholarly community: an international study*, January 2008; and, "Is peer review broken?", The Scientist Online, vol 20, Issue 2, February 2006, www.the-scientist.com

13 Royal Society, *Knowledge, networks and nations: Global scientific collaboration in the 21st century*, March 2011, p 16

14 *As above*

15 Ev w59, para 11 [Academy of Social Sciences]

16 Ev 73, paras 21–22 [BMJ Group]

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Our inquiry

7. We announced our inquiry into Peer Review on 27 January 2011 and issued a call for evidence based on the following terms of reference:

1. the strengths and weaknesses of peer review as a quality control mechanism for scientists, publishers and the public;
2. measures to strengthen peer review;
3. the value and use of peer-reviewed science on advancing and testing scientific knowledge;
4. the value and use of peer-reviewed science in informing public debate;
5. the extent to which peer review varies between scientific disciplines and between countries across the world;
6. the processes by which reviewers with the requisite skills and knowledge are identified, in particular as the volume of multi-disciplinary research increases;
7. the impact of IT and greater use of online resources on the peer-review process; and
8. possible alternatives to peer review.

8. We received 96 submissions in response to our call. We would like to thank all those who submitted written memoranda. We would also like to thanks Dr Irene Hames, the specialist adviser we appointed to this inquiry. Her expert advice was valuable and we are grateful for her contribution.[17]

9. In May and June 2011 we held four evidence sessions during which we took oral evidence from seven panels of witnesses, to whom we are grateful:

i. On 4 May 2011 we took evidence from: Dr Nicola Gulley, Editorial Director, Institute of Physics Publishing Ltd; Professor Ron Laskey, Vice President, Academy of Medical Sciences; Dr Robert Parker, Interim Chief Executive, Royal Society of Chemistry; and, Professor John Pethica, Physical Secretary and Vice President, Royal Society.

ii. On 11 May we took evidence from: Tracey Brown, Managing Director, Sense About Science; Dr Liz Wager, Chair, Committee on Publication Ethics and Board Member, UK Research Integrity Office Ltd; Mayur Amin, Senior Vice President, Research & Academic Relations, Elsevier; Dr Philip Campbell, Editor-in-Chief, *Nature* and Nature Publishing Group; Robert Campbell, Senior Publisher, Wiley-

[17] Relevant interests of the specialist adviser were made available to the Committee before the decision to appoint her on 23 March 2011. The Committee formally noted that Dr Hames declared an interest relevant to the Committee's work as a Council member, Director and Trustee, Committee on Publication Ethics (COPE); as a member of the Advisory Board, Sense About Science; as an author of Peer Review and Manuscript Management in Scientific Journals; and as offering advice to the Association of Learned and Professional Society Publishers. During the course of the inquiry as we took evidence Dr Hames declared further interests as an employee (until 31 October 2010) of Wiley-Blackwell; as a member, International Society of Managing and Technical Editors Industry Advisory Board; and as receiving fees for workshops from Roberts' funding for researcher training and career development.

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Blackwell; Dr Fiona Godlee, Editor-in-Chief, *BMJ* and BMJ Group; and, Dr Andrew Sugden, Deputy Editor & International Managing Editor, *Science*.

iii. On 23 May we took evidence from: Dr Rebecca Lawrence, Director, New Product Development, Faculty of 1000 Ltd; Dr Michaela Torkar, Editorial Director, BioMed Central; Dr Mark Patterson, Director of Publishing, Public Library of Science; Dr Malcolm Read OBE, Executive Secretary, Joint Information Systems Committee (JISC); Dr Janet Metcalfe, Chair, Vitae; Professor Teresa Rees CBE, Former Pro-Vice-Chancellor (Research), Cardiff University; and, Professor Ian Walmsley, Pro-Vice-Chancellor, University of Oxford.

iv. On 8 June we took evidence from: Professor Rick Rylance, Chair-elect, Research Councils UK; David Sweeney, Director for Research, Innovation and Skills, Higher Education Funding Council for England; Sir Mark Walport, Director, Wellcome Trust; Professor Sir John Beddington, Government Chief Scientific Adviser; and, Professor Sir Adrian Smith, Director General, Knowledge and Innovation, Department for Business, Innovation and Skills.

10. The report begins in chapter two with an overview of the peer-review process in publishing, including common criticisms and new innovations in publishing. Chapter three explores the roles of the editors, authors and reviewers. Chapter four examines the challenges involved in reviewing data associated with submitted work and storing it after publication. Chapter five looks at the growing area of review and commentary after publication. Finally, chapter six explores public debate and trust in science. It also assesses the role of peer review in preventing fraud and misconduct, as well as the broader ways in which research integrity is overseen in the UK.

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2 Peer review in publishing

11. Peer review, in the context of publishing, can take place before or after an article is published. The first records of journal pre-publication peer review date back to the 17th century, when the Royal Society's Secretary, Henry Oldenburg, adopted it as editor of the journal, *Philosophical Transactions of the Royal Society*.[18] The concept of peer review, however, may be even older. The Syrian physician, Ishaq bin Ali Al Rahwi (AD 854–931) is thought to have first described the concept in his book, *Ethics of the Physician*.[19] Al Rahwi apparently "encouraged doctors to keep contemporaneous notes on their patients, later to be reviewed by a jury of fellow physicians".[20]

12. The Association of Learned and Professional Society Publishers (ALPSP) explained that "peer review varies considerably between scientific disciplines; it is not a one-size-fits-all process. It has evolved to meet the needs of individual scientific communities".[21] Peer review originally evolved in a piecemeal and haphazard way and did not become standard practice in publishing until the middle of the 20th century.[22] As pointed out by numerous individuals and organisations, peer review is by no means a perfect system.[23] The Publishers Association described peer review as a system "based on human endeavour" which therefore "cannot be perfect or infallible".[24] Professor John Pethica, Physical Secretary and Vice President of the Royal Society, surmised: "Given that there is no perfect system, we have to devise a system which optimises the process".[25]

The traditional peer-review process

13. The key features in the peer-review process in scholarly publishing are summarised in the figure below:

18 Ev w4, para 3 [Richard Horton]; Ev 101, para 2 [Royal Society]

19 "The history of peer review", Elsevier, www.elsevier.com

20 Ev w4, para 3 [Richard Horton]

21 Ev w119, para 3

22 "The history of peer review", Elsevier, www.elsevier.com

23 For example: Ev w36, para 1 [Lawrence Souder]; Ev w72 [Political Studies Association]; Ev w77, para 3 [Royal Meteorological Society]; Ev w95, para 19 [British Antarctic Survey]; Ev w105, para 6 [Publishers Association]; Ev 82, para 2 [Wellcome Trust]; Ev 104, para 16 [Royal Society]; and Ev 115, para 7 [Elsevier]

24 Ev w105, para 6

25 Q 5

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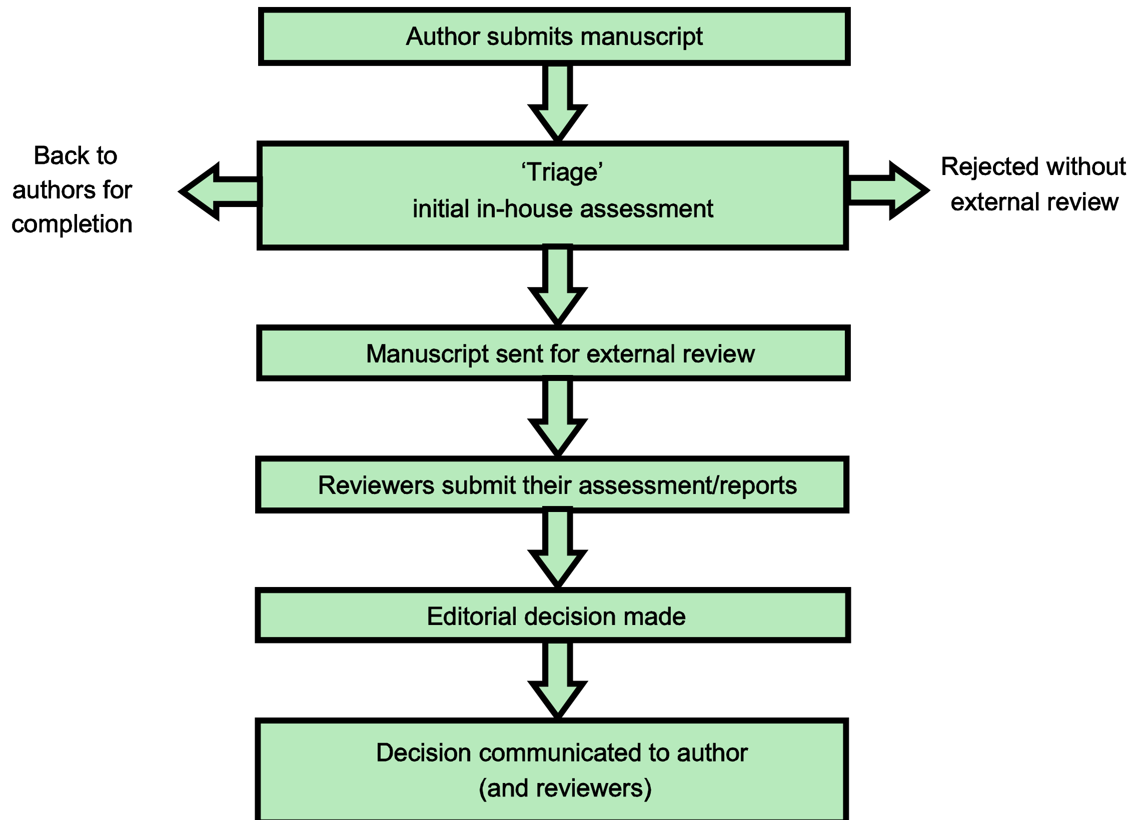

14. Authors submit a manuscript to their chosen journal, usually via a web-based system. It is not unusual for manuscripts to be sent to a few journals before being accepted for publication, although authors are only allowed—by convention—to send their manuscripts to one journal at a time. Initial in-house checks are carried out by part of the editorial team. These will include basic checks—for completeness and adherence to journal policies, as well as editorial checks—for scope, novelty, quality and interest to journal readership. At this stage, manuscripts may be returned to authors for completion and resubmission if the technical omissions are extensive; in minor cases, authors may just be asked to provide the missing items. Manuscripts can also be rejected at this stage on editorial grounds, without being sent out for external peer review. This decision is made by the journal editors. In some top journals, the rejection rate at this stage can be very high. For example, editors at *Nature* "reject 70–80% of submitted papers (the exact proportion varies with discipline) on purely editorial grounds".[26] Manuscripts that pass the initial checks are sent to external reviewers, usually two or more. The reviewers assess, and report back to the editors on issues such as:

- Study design and methodology;
- Soundness of work and results;
- Presentation and clarity of data;
- Interpretation of results;

[26] Ev 89, para 53 [Philip Campbell, *Nature*]

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- Whether research objectives have been met;
- Whether a study is incomplete or too preliminary;
- Novelty and significance;
- Ethical issues; and
- Other journal-specific issues.

The reviewers' role at this stage is to provide a critical appraisal, advise and make recommendations on the manuscript. Editors take the final decision as to whether or not to accept the manuscript for publication. The decision is then communicated to the author. This will generally be one of the following: accept; accept with revision (minor or major); reject but encourage resubmission; or reject.

Types of peer review

15. There are three main types of peer review in use. They are: "single-blind review", "double-blind review" and "open review". The Royal Society explained that:

> By far the commonest system in use is "single blind" peer review in which the author's name and institution is known to the reviewer, but the reviewer's name is not provided to the author.
>
> A number of journals instead choose to operate a "double blind" peer review system which is fully anonymised (i.e. the author(s) are unaware of the identity of the reviewer(s) and vice versa).
>
> Recently, there have been some experiments with a third type, "open" peer review, in which the authors' and reviewers' names are revealed to each other. […] Open peer review can be reasonably described as an experimental system at this stage and is far from common.[27]

16. During the course of this inquiry we heard that the Institute of Physics (IOP), the Royal Society and the Royal Society of Chemistry (RSC) use single-blind review.[28] The publisher, John Wiley & Sons, also primarily uses single-blind review.[29] It is the commonest system in scientific journals. In the social sciences, peer review "is almost invariably a double-blind process".[30] Some journals, such as the *BMJ*, choose to use open peer review.[31]

17. The BMJ Group explained that:

27 Ev 101, para 5

28 Q 7 [Dr Nicola Gulley, Dr Robert Parker and Professor John Pethica]

29 Ev 66, para 8.1

30 Ev w57, para 3 [Academy of Social Sciences]

31 Ev 72, para 16

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> Responses to a 2009 survey of more than 4000 science reviewers suggest, however, that reviewers prefer anonymity: 76% favoured the double blind system where only the editor knows who the reviewers and authors are.[32]
>
> This built on a 2007 survey of around 3000 academics and editors around the world (of whom about 10% worked in UK [Higher Education Institutions] and 18% were working in clinical medicine or nursing) which found relatively little support for open review as an alternative to single- or double-blinded review.[33]

18. It is sometimes suggested that bias in the peer-review process (see paragraphs 42-43) could be reduced by using the double-blind approach.[34] However, Dr Nicola Gulley, Editorial Director at IOP Publishing Ltd, explained that this is not always practical:

> Some of the research communities that I work with particularly are very small, so doing double-blind refereeing where neither the author nor the referee knows who each other is defeats the object because, generally, the referees will know who the author is from the subject area that they are working in or from the references and things like that. It varies very much between different subject areas.[35]

Others also acknowledged the problem of authors guessing the names of reviewers and vice versa in double-blind peer review.[36]

19. Dr Liz Wager, Chair of the Committee on Publication Ethics (COPE), told us that COPE does not recommend one system or another. The reason given was that:

> some editors have said to us, "We work in a very narrow field. Everybody knows everybody else. It just would not work to have this open peer review." There are different options. […] My opinion is that it depends on the discipline. With a discipline as big as medicine, where there are hundreds of thousands of people all around the world you can ask and they probably don't bump into each other the next day, open peer review seems to work. In much narrower and more specialised fields, it perhaps does not, and the traditional system of the blinded review is perhaps better.[37]

20. **We conclude that different types of peer review are suitable to different disciplines and research communities. We consider that publishers should ensure that the communities they serve are satisfied with their choice of peer-review methodology. Publishers should keep them updated on new developments and help them experiment with different systems they feel may be beneficial.**

---

32 Ev 72, para 15 and the original 2009 survey: "Peer Review Survey 2009: preliminary findings", Sense About Science, www.senseaboutscience.org.uk/index.php/site/project/395

33 Ev 72, para 15 and the original 2007 survey: Mark Ware Consulting, *Peer Review in Scholarly Journals - perspective of the scholarly community: an international study*, January 2008

34 Ev w95, para 21 [British Antarctic Survey]

35 Q 8

36 For example: Ev w47, para 10 [Professor R I Tricker]; Ev 72, para 14 [BMJ Group]; Ev w99, para 3 [International Bee Research Association]; and Ev w130, para 2.6 [Dr Thomas J Webb]

37 Q 88

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Assessing manuscripts

21. The core of the traditional peer-review process is the critical appraisal of the work and its reporting. The Public Library of Science (PLoS) explained that:

> It is helpful to divide [peer review's] functions into two broad areas: technical and impact assessment. Whereas technical assessment tends to be objective and provides greater confidence in (although cannot assure) the reliability of published findings, impact assessment is subjective and its role is less clear-cut.[38]

22. The value of the technical assessment is seldom questioned. Dr Michaela Torkar, Editorial Director at BioMed Central, was of the view that:

> It is fairly straightforward to think about scientific soundness because it should be the fundamental goal of the peer review process that we ensure all the publications are well controlled, that the conclusions are supported and that the study design is appropriate.[39]

We also heard from a number of witnesses that there is evidence that many authors feel that peer review improves the quality of the articles that they publish.[40]

23. Questions are, however, often raised about the impact assessment. The impact assessment can be thought of as the means by which an editorial decision is taken to publish or not publish a manuscript. It is based on various factors, for example, whether the subject of the manuscript will be of interest to the journal readership or whether the research is perceived to represent a ground-breaking discovery. Dr Nicola Gulley of the IOP explained that peer review in this respect acts as a "filter", helping scientists find the information that is of interest to them.[41] Dr Mark Patterson, Director of Publishing at the PLoS, explained the scale of the current situation:

> About 1.5 million [peer-reviewed] articles are published every year. Before any of them are published, they are sorted into 25,000 different journals. So the journals are like a massive filtering and sorting process that goes on before publication. The question we have been thinking about is whether that is the right way to organise research.[42]

24. Professor Teresa Rees CBE, former Pro-Vice-Chancellor at Cardiff University, added that:

> We have an expanding number of journals [...] and there is increasing pressure to publish. I think there is a question of whether academics can keep up with reading all the material in the growing number of journals. One might want to have a debate at

---

38 Ev 80, para 32

39 Q 162

40 Q 2 [Nicola Gulley]; Q 95 [Mayur Amin]; Ev w5, para 13 [Richard Horton]; and Goodman SN, Berlin J, Fletcher SW Fletcher RH, *Manuscript quality before and after peer review and editing at Annals of Internal Medicine*, Ann Intern Med, 1994, vol 121, pp 11–21

41 Q 2

42 Q 162

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> some stage about whether that is the most effective and efficient way of managing all the potential research that can be published.[43]

25. Published research is currently organised and sorted into thousands of journals. The impact or perceived importance of a published article is often judged by the "Impact Factor" of the journal in which it appears. A journal's Impact Factor is calculated annually by Thomson Reuters. It is "a measure of the frequency with which the 'average article' in a journal has been cited in a particular year or period".[44] It is, however, a measure of the journal and not of each individual article. It should also be noted that there are many peer-reviewed journals which are not indexed by Thomson Reuters and therefore do not have an Impact Factor; the Thomson Reuters 2010 *Journal Citation Reports* contains data for 10,196 journals.[45] Impact Factors and high-impact journals are covered in more detail in paragraph 59.

26. The question that arises when assessing the merits of the impact assessment made during the peer-review process is: how do journal editors or reviewers judge whether a particular piece of work is important? Professor Ian Walmsley, Pro-Vice-Chancellor at the University of Oxford, told us that this was "a very difficult thing to do".[46] He added that:

> In many ways [impact] is something best assessed *post facto*; that is, the impact of this work is: how many other people find it a fruitful thing on which to build? How many people find it a productive way to direct their research as a consequence?[47]

Dr Rebecca Lawrence, Director of New Product Development at Faculty of 1000 Ltd, agreed that:

> often it is not known immediately how important something is. In fact, it takes quite a while to understand its impact. Also, what is important to some people may not be to others. A small piece of research may be very important if you are working in that key area. Therefore, the impact side of it is very subjective.[48]

Dr Michaela Torkar of BioMed Central was also of the opinion that "the assessment of what is important can be quite subjective".[49]

27. Dr Mark Patterson, from PLoS, gave his view on the traditional process and how things may begin to change:

> Traditionally, technical assessment and impact assessment are wrapped up in a single process that happens before publication. We think there is an opportunity and, potentially, a lot to be gained from decoupling these two processes into processes best carried out before publication and those better left until after publication. […]

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43 Q 218

44 "The Thomson Reuters Impact Factor", Thomson Reuters, www.thomsonreuters.com

45 "The Thomson Reuters releases journal citation reports for 2010", Thomson Reuters Press Releases, www.thomsonreuters.com, 28 June 2011

46 Q 217

47 *As above*

48 Q 162

49 *As above*

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> There are benefits to focusing on just the technical assessment before publication and the impact assessment after publication. That becomes possible because of the medium that we have to use now. The 25,000 journal system is basically one that has evolved and adapted in a print medium. Online we have the opportunity to rethink, completely, how that works. Both [technical and impact assessment] are important, but we think that, potentially, they can be decoupled.[50]

28. Dr Malcolm Read OBE, Executive Secretary of the Joint Information Systems Committee (JISC), agreed that "separating the two is important because of the time scale over which you get your answer".[51]

29. **The importance of a pre-publication technical assessment is clear to us. It should be a fundamental aim of the peer-review process that all publications are scientifically sound. Assessing the impact or perceived importance of research before it is published will always require subjective judgement and mistakes will inevitably be made. We welcome new approaches that focus on carrying out a technical assessment prior to publication and making an assessment of impact after publication.**

Common criticisms

30. As explained in paragraph 12, peer review is by no means a perfect system. Professor Sir John Beddington, Government Chief Scientific Adviser, stated that:

> If you posed the question, "Is the peer review process fundamentally flawed?" I would say absolutely not. If you asked, "Are there flaws in the peer review process which can be appropriately drawn to the attention of the community?" the answer is yes.[52]

However, as pointed out by Dr Fiona Godlee, Editor-in-Chief of BMJ Group, "we have to acknowledge that there is a huge variety in the quality of peer review across the publishing sector".[53] Though there is variation in quality across the publishing sector, it is important to note that "peer review is independent of the business model applied to the journal".[54] In particular, we heard that "it is terribly important to put to bed the misconception that open access [see paragraph 79] somehow does not use peer review. If it is done properly, it uses peer review very well".[55] In this section we explore some of the common criticisms of the peer-review process.

Stifles innovation

31. A common criticism of peer review is that in some cases "there may be a tendency towards conservative judgements".[56] The UK Research Integrity Office Ltd (see paragraph

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50 Q 162

51 *As above*

52 Q 294

53 Q 97

54 Ev w107, para 16 [The Publishers Association]

55 Q 253 [Sir Mark Walport]

56 Ev w44, para 5 [Professor John Scott, University of Plymouth]

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254) went so far as to suggest that "there is a danger that the peer-review process can stifle innovation and perpetuate the status quo".[57] In response to this, Dr Malcolm Read, JISC, stated: "that sounds a bit overstated as peer review, in one form or another, has been an underpinning aspect of research—arguably, even before journals as we know them existed".[58]

32. Dr Gulley from IOP Publishing Ltd told us that "there is more conservatism in some research areas than there is in other areas".[59] Professor Ron Laskey, Vice President of the Academy of Medical Sciences, elaborated with an example:

> It can be more difficult to establish a novel and completely unexpected new branch of science if editors of journals are not alert to the fact that it is coming. There are one or two recent examples. One that springs to mind is a study in plant sciences which concerned resistance to viral infection in plants. That has given rise to a completely new area of understanding of a group of molecules that turn out to be important in all cells, not just in viral defence mechanisms against plants but because they change fundamentally in certain types of cancer. That was a small niche of advance that has suddenly become a front-line subject, but it would have been very difficult to publish that in a front-line journal at the time the work was being done.[60]

33. Dr Robert Parker, Interim Chief Executive of the Royal Society of Chemistry (RSC), added that "knowing the right people to ask about research that looks slightly different" was important in the peer review of unexpected or unusual research.[61] He added that the RSC "found, from doing studies on the articles that we reject, that most of them end up being published somewhere else. There are very few articles that we receive that are scientifically completely wrong. Usually, there is some merit in them".[62] Dr Malcolm Read, JISC, agreed, stating that this "cuts against the conservatism".[63]

34. Dr Philip Campbell, Editor-in-Chief of *Nature* and Nature Publishing Group, expressed the view that *Nature* was open to bold new research. He told us that *Nature* "would love to publish something that strongly made a provocative case [...] that is not because we want to be sensationalist but because [...] it needs to be out there and we would like to be the place to publish it".[64]

35. Robert Campbell, Senior Publisher at Wiley-Blackwell, agreed that it was not in a journal's best interest to be overly conservative. He stated that:

> If you have a very conservative editorial board, the journal will suffer. It is a market; the more proactive entrepreneurial editorial teams will win out and build better,

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57 Ev 124, para 1.4

58 Q 163; and Q 163 [Dr Mark Patterson]

59 Q 3

60 *As above*

61 *As above*

62 Q 6

63 Q 163

64 Q 98

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> more successful journals. It is a very dynamic market. A conservative editorial board wouldn't last long.[65]

36. Publishers are becoming increasingly more entrepreneurial and innovative. Authors now have the option of avoiding a conservative editorial judgement on provocative research by submitting their manuscript to one of an increasing number of online repository-type journals, such as *PLoS ONE*. These journals assess only the technical merit of the manuscript and are discussed in more detail in paragraphs 79-89.

37. However, it is not always simply an issue of the research being too "provocative". Dr Philip Campbell, *Nature*, explained that:

> sometimes [bold new claims] are too easily said and not backed up well enough. A journal, which also has a magazine role in *Nature*, has one of the most critical audiences in the world. They love to be stimulated but they also want to make damned sure that the evidence on which we base the stuff we publish is reasonably strong.[66]

As the Royal Society summarised, it seems that "in general, an extraordinary claim requires extraordinary evidence".[67] That is, a piece of research with potentially controversial impact would likely be more rigorously tested than research making a lesser claim.

38. Dr Philip Campbell, *Nature*, expanded on the need to rigorously assess research:

> Another use of the word "conservative" concerns robustness. For us, peer review helps us deliver robust publications. We, at *Nature*, if anything, are more conservative than other journals. We make researchers go the extra mile to demonstrate what they are saying. I also celebrate the fact that we do not want to be conservative with papers that go against the status quo. We want to encourage radical discoveries.[68]

39. Dr Godlee, BMJ Group, agreed that "conservatism is not a bad thing in science or medicine in terms of making sure that what we publish is robust, relevant and properly quality controlled".[69]

Biased

40. In addition to a perceived bias toward conservative judgements, Dr Liz Wager explained that "there are other kinds of biases as well, but a well set-up system and a good editor will minimise those biases".[70]

41. Professor Teresa Rees described the problem of gender bias in peer review:

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65 Q 96

66 Q 99

67 Ev 103, para 9

68 Q 97

69 *As above*

70 Q 64

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> Do people operate with a preconceived notion of quality? There is a whole series of studies about this. For example, evidence from the States suggests that if John Mackay or Jean Mackay submits an article it will be peer reviewed more favourably if it is by John Mackay. There is a whole series of papers to that effect. How do we deal with this? I add that this is discriminatory behaviour by both men and women. It seems to me that in the selection of reviewers to serve on research council boards, journals or promotion panels we need transparency so that people can apply and be assessed against merits to gain those positions, and we need turnover so it is not the same people doing that assessment for 20 or 30 years. We might want […] double-blind reviewing so you don't know the sex.[71]

The Committee on Publication Ethics (COPE) also acknowledged the problem of bias but added that "the evidence is not clear-cut and, in some cases, is contradictory".[72]

42. Professor Teresa Rees highlighted another similar problem: that of "unconscious bias against people with foreign-sounding names". She stated that:

> Brazil's science minister is very concerned about this and has encouraged academics there to co-author with people from the US or Europe who may have a surname that is more familiar to reviewers. Double-blind marking would deal with that unconscious bias that affects peer reviewers as it does any other member of the public.[73]

43. The BMJ Group added that studies have shown peer review to also be systematically biased against authors' ideas, reputations and locations.[74] The use of double-blind peer review is one way to minimise bias, but there are practical issues relating to its use, as described in paragraph 18. COPE explained that "it is probably impossible to eliminate all bias from peer review but good editors endeavour to minimize it".[75] The role of the editor is further explored in chapter 3.

Poor assessment of multidisciplinary work

44. It has also been suggested that peer review is biased against multidisciplinary research.[76] The Society for General Microbiology and the John Innes Centre expressed the concern that with the rise in multidisciplinary research it may sometimes be difficult to find reviewers with the right skills and expertise needed to assess multidisciplinary projects.[77]

45. Both PLoS and the UK Research Integrity Office Ltd (UKRIO) recommended that if the work is multidisciplinary, it may be necessary to seek the opinions of a larger number

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71 Q 247

72 Ev 67, para 3.0

73 Q 247

74 Ev 71, para 9; Merton R K. *The Matthew Effect in Science*. Science 1968, vol 159, pp 56–63; and Wenneras C, Wold A. *Nepotism and sexism in peer review*. Nature 1997, vol 387, pp 341–43

75 Ev 67, para 3.0

76 Ev w79 [Professor Grazia Ietto-Gillies]

77 Ev w91 and Ev w133, para 1.2.2

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of reviewers.[78] This is the approach taken by the Royal Society, as described by Professor John Pethica:

> The process in the [Royal] Society is, essentially, to increase greatly the number of referees and reviewers. Six or seven would be common, whereas two or three might be the number you would have within a well-defined subject, to try and ensure you get that coverage for a number of broad views. […] In general, one is obliged to do that simply because there may be a few people who have the vast and broad knowledge required, but in truly interdisciplinary areas, which really span gaps, you have to get a broad perspective and that means using more people, including from a variety of countries, environments and so forth.[79]

Expensive

46. Another common criticism of peer review is that it is expensive. In 2008, a Research Information Network report estimated that the unpaid non-cash costs of peer review, undertaken in the main by academics, is £1.9 billion globally each year .[80] In 2010, a report commissioned by JISC Collections brought together evidence from a number of studies.[81] It concluded that it costs UK Higher Education Institutions (HEIs), in terms of staff time, between £110 million and £165 million per year for peer review and up to £30 million per year for the work done by editors and editorial boards.[82] The BMJ Group pointed out that "peer reviewers are rarely paid by publishers, and their work is often done out of hours".[83] The financial and personal burden on reviewers is discussed below.

47. The cost of peer review does not, however, fall solely on reviewers and HEIs. Elsevier explained that "publishers have [also] made significant investments into the peer review system to improve [its] efficiency, speed, and quality".[84] We explored this in further detail with Mayur Amin, Senior Vice President of Research & Academic Relations at Elsevier, who told us that:

> Overall, one of the biggest investments for everyone in the publishing industry in the last decade or so has been migration to some of the electronic platforms. Across the industry, our estimate is that somewhere in the order of £2 billion of investment has been made. That includes the technologies at the back end to publish the materials as well. The technology has included submission systems, electronic editorial systems, peer review support systems, tracking systems and systems that enable editors to find reviewers.[85]

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78 Ev 78, para 13, and Ev 125, para 6

79 Qq 16–17

80 Research Information Network, *Activities, costs and funding flows in the scholarly communications system in the UK*, May 2008

81 JISC Collections, *The value of UK HEI's to the publishing process*, June 2010

82 JISC Collections, *The value of UK HEI's to the publishing process*, June 2010, Summary p 2

83 Ev 70, para 4

84 Ev 114, para 5

85 Q 103

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48. Elsevier later explained that the £2 billion estimate was based on a detailed review of Elsevier's own technology investments (£600 million between 2000 and 2010), which were then extrapolated to the entire industry.[86] The areas of investment are summarised in the table below:

Technology investment areas (2000-2010)	Industry estimate
Author submission & editorial systems	>£70m
e-journals and reference works back files	>£150m
Production Tracking Systems	>£50m
Electronic Warehousing	>£60m
Electronic Publishing Platforms, incl. search and discovery platforms	>£1500m
Other related back-office and cross-industry systems. e.g. digital preservation, Crossref for linking, CrossCheck for plagiarism detection, creation of special font sets, development of technical standards	>£300m

Data provided by Elsevier[87]

Burdensome

49. Related to cost issues is criticism of the perceived burden on academics involved in the peer-review process, particularly in the role of reviewer. Vitae, the UK organisation championing the personal, professional and career development of doctoral researchers and research staff, stated that:

> Most researchers will experience both authoring and reviewing papers during their careers and therefore have a vested interest in the system being as robust, ethical and equitable as possible. [...] There is an expectation that researchers will contribute to sustaining the peer review system by participating as reviewers. This is predominantly without financial or formal recognition, except for members of editorial boards (or grant review panels). [Peer review] is rarely acknowledged as part of the formal workload of an academic researcher. [...] Reviewing is often an 'out of normal hours' activity and therefore adds additional burdens on researchers [...] 'Good' reviewers are more likely to be invited to do more reviewing, thereby adding to their workloads.[88]

The "burden" on peer reviewers is discussed in more detail in chapter 3.

Lack of evidence of efficacy

50. Despite these criticisms, the disappearance of pre-publication peer review tomorrow would represent a "danger" to the scientific record.[89] Research Councils UK stated that "the strengths of peer review far outweigh the weaknesses".[90] Professor Ron Laskey of the Academy of Medical Sciences informed us that in the absence of peer review a "particular problem" in the biomedical sciences would be "sorting the wheat from the chaff and

[86] Ev 118

[87] *As above*

[88] Ev 146, paras 6–7

[89] Q 2 [Robert Parker, Royal Society of Chemistry]

[90] Ev 96, para 5

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knowing what information could be depended on".[91] Tracey Brown, Managing Director of Sense About Science, used the analogy of a "sea of material" that needs to be sorted, one way or another.[92] She added that:

> The important thing with a system that produces 1.3 million papers a year is that it is self-reflective. A lot of study goes on [...] looking at the fate of papers that aren't published and looking, just generally, at trends across the system. So long as that is going on and patterns of behaviour can be spotted, then the system can be self-correcting.[93]

51. Sir Mark Walport highlighted a recent study by the Wellcome Trust:

> We do conduct studies of peer review. The Wellcome Trust published a paper in *PLoS ONE* a couple of years ago in which we took a cohort of papers that had been published. We post-publication peer-reviewed them and then we watched to see how they behaved against the peer review in bibliometrics. There was a pretty good correlation, although there were differences. Experiments of one sort or another are always going on.[94]

David Sweeney, Director for Research, Innovation and Skills at the Higher Education Funding Council for England (HEFCE), added that:

> Through [HEFCE's] funding of JISC and [...] the Research Information Network, much work has been carried out [looking at peer review] and we remain interested in further work being carried out where the objectives are clear.[95]

52. The BMJ Group, however, was of the view that "little empirical evidence is available to support the use of editorial peer review".[96] The little evidence there is on editorial peer review is inconclusive.[97] Richard Horton, Editor-in-Chief of *The Lancet*, explained that Tom Jefferson and colleagues concluded in their review of the evidence that:

> "Editorial peer review, although widely used, is largely untested and its effects are uncertain". [Jefferson and colleagues] went on, "Given the widespread use of peer review and its importance, it is surprising that so little is known of its effects."[98]

53. In a recent article in the journal, *Breast Cancer Research*, Dr Richard Smith, former Editor of the *BMJ*, referred to a quote by Drummond Rennie, deputy editor of the Journal

91 Q 2

92 Q 63

93 Q 65

94 Q 251

95 *As above*

96 Ev 71, para 8

97 Ev w6, para 18 [Richard Horton] and Ev 66, para 1.0 [Committee on Publication Ethics]

98 Ev w6, para 18 [Richard Horton] and original quotes from: Jefferson T, Alderson P, Wager E, Davidoff F, *The effects of editorial peer review*, JAMA, 2002, vol 287, pp 2784–86

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of the American Medical Association, who once said "'If peer review was a drug it would never be allowed onto the market".[99] Dr Smith added:

> not only do scientists know little about the evidence on peer review but most continue to believe in peer review, thinking it essential for the progress of science. Ironically, a faith based rather than an evidence based process lies at the heart of science.[100]

54. COPE, however, noted that:

> lack of evidence of efficacy is not the same as saying there is evidence that it does not work. Peer review is difficult to study, partly because its functions have not always been clearly defined.[101]

55. Dr Godlee, BMJ Group, suggested a way forward:

> The overall level of evaluation of peer review is very poor [...] The UK could lead on [a programme of research]. Funding [for this] should come from [...] a combination of the journal publishing world, the grant-giving world, industry, but also public funding.[102]

56. Professor Rick Rylance told us that Research Councils UK "would be open to trying to think about how that might be researched".[103] However, when we asked Professor Sir Adrian Smith, Director General of Knowledge and Innovation in the Department for Business, Innovation and Skills (BIS), whether there was a need for a programme of research to test the evidence for justifying the use and optimisation of peer review in evaluating science, he responded:

> The short answer is no. [Peer review] is an essential part of the scientific process, the scientific sociology and scientific organisation that scientists judge each other's work. It is the way that science works. You produce ideas and you get them challenged by those who are capable of challenging them. You modify them and you go round in those kinds of circles. I don't see how you could step outside of the community itself and its expertise to do anything other.[104]

57. In summary, the peer-review process, as used by most traditional journals prior to publication, is not perfect. We have heard that there are a number of criticisms of it, including that: it has a tendency towards publishing conservative research (although this should not be confused with robustness); it does not adequately guard against bias; it is expensive; and it represents a huge burden on researchers. Despite these criticisms editorial peer review is viewed by many as important. However, there is little solid evidence on its efficacy.

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99 Richard Smith, *Classical peer review: an empty gun*, Breast Cancer Research, 2010, 12(Suppl 4): S13

100 *As above*

101 Ev 66, para 1.0

102 Q 105

103 Q 251

104 Q 290

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58. **We recommend that publishers, research funders and the users of research outputs (such as industry and Government) work together to identify how best to evaluate current peer-review practices so that they can be optimised and innovations introduced, and the impact of the common criticisms of peer review minimised. We consider that this would also help address any differences in the quality of peer review that exist. We encourage increased recognition that peer-review quality is independent of journal business model, for example, there is a "misconception that open access somehow does not use peer review".**

High-impact journals

59. Impact Factor was defined in paragraph 25 as "a measure of the frequency with which the "average article" in a journal has been cited in a particular year or period".[105] As we have noted, a journal's Impact Factor is calculated annually by Thomson Reuters and it often serves as a proxy measure for the impact or perceived importance of an article published in that journal. As such, publishing in a high-impact journal is traditionally perceived to represent a big achievement and is often used as a proxy measure for assessing both the work of researchers and research institutions. This is discussed in further detail in paragraphs 165-177.

60. Elsevier told us that approximately 3 million manuscripts are submitted to journals every year. Of these, around half are rejected. It explained that "rejection rates vary by journal, for example titles such as *Cell* and *The Lancet*, which have extremely high publication impact […] have rejection rates of 95%".[106] We questioned a group of publishers about why rejection rates are so high. Dr Andrew Sugden, Deputy Editor and International Managing Editor at *Science* (where more than 90% of the submissions are rejected),[107] explained that:

> Part of it is simply that they are weekly magazines with a print budget. We are publishing 20 papers […] a week, and a lot of people want to be published in them. We are receiving 10 times as many, roughly. […] We want to showcase the best across the range of fields in which we publish, so we have to be highly selective to do that.[108]

61. Dr Philip Campbell of *Nature* suggested that as journals increase their presence online and the prospect of the decline of print journals happens, the "pressure is lessened".[109] He added, however, that *Nature* would probably still publish the same number of papers.[110] Dr Fiona Godlee, BMJ Group, agreed that printing journals is no longer a constraint, but explained that editorial resource is.[111] She added that journals often find that "if they reduce

105 "The Thomson Reuters Impact Factor", Thomson Reuters, www.thomsonreuters.com

106 Ev 115, para 18

107 Ev 138, para 2

108 Q 116

109 *As above*

110 *As above*

111 Q 118

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the number of research papers they publish, their Impact Factor creeps up quicker. That is a commercial reputational issue".[112]

62. While high Impact Factors may be good for journals, the British Antarctic Survey told us that authors are known to complain that "for the very high profile journals with high Impact Factors, competition for space is fierce, and decisions about which papers are accepted can seem rather random".[113] It noted, however that:

> these decisions are often editorial ones based on topicality, and not on peer review; and […] papers rejected from such journals will generally be published elsewhere. If they are of sufficient importance this will usually be recognised by high citation numbers wherever they are published.[114]

The need to publish in high-impact journals and the effect this has on researchers and research careers is discussed in paragraphs 165-177.

63. Authors are faced with a vast range of journals in which to publish if they fail to get into a high-impact journal. We were told that peer review "has led to the development of a pecking order for journals".[115] Manuscripts that are rejected from a high-impact journal will often make their way down the pecking order until they find a home in a journal. This can be a time-consuming process; at each stage the manuscript is first assessed by editors who determine whether it fits the scope of the journal before potentially being sent out for external peer review. Dr Godlee explained that:

> increasingly people are going straight into one of the big open access journals, such as *PLoS ONE.* […] A lot of the publishers are beginning to open up so that people can get speedy publication if they haven't got into the journal of their choice. That is a good thing. That means we will see authors being able to move on to the next thing rather than spending a lot of their time adapting a paper for yet another journal which is going to reject it and then move on.[116]

64. The *PLoS ONE* journal model is discussed in further detail in paragraphs 79-89. Another method for reducing the burden of resubmitting rejected manuscripts to new journals, with fresh rounds of review, is the cascading system of review, which is covered in paragraphs 146-152.

Innovation in peer review

65. Deviations from the traditional peer-review process have been experimented with over recent years, some more successfully than others. In this section we discuss three well-known examples: pre-print servers; experiments in open peer review; and the move towards repository journals.

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112 Q 118

113 Ev w95, para 18

114 *As above*

115 Ev w99, para 7 [International Bee Research Association]

116 Q 118

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Pre-print servers

66. An innovative approach to peer review that has worked well for the physics community is the use of a pre-print server. Dr Nicola Gulley of IOP Publishing Ltd explained that the "arXiv" pre-print server was set up to allow authors to submit work that is "at a very preliminary stage".[117] The physics community is then able to access this work and comment on it. Dr Gulley explained that arXiv:

> originated from the high energy physics area where they had a need to be able to discuss the results across the international collaborations. A lot of the work that is posted, particularly from areas such as high energy physics, also goes through internal peer review within the research facilities as well before it is posted.[118]

67. Some of the benefits of the arXiv system were described by the Royal Society: it "allows the scientists to publish research quickly and get informal feedback and identify any weaknesses. This is then followed by formal peer review in a journal".[119] Dr Gulley explained that "a high percentage of articles that are pre-prints are eventually submitted to journals and get published in journals […] so there is still that requirement for the independent peer review".[120] She added that:

> We make it very easy for authors to be able to submit from the arXiv into our journals, for example, and this is common across many physics publishers, where the arXiv number can be used when submitting the article to a journal. Authors are encouraged to update their versions as well. From the publishing side, we encourage them to update the citations so that the link goes back to the final version of record once it has been peer reviewed and published.[121]

68. The IOP provided further details of how it makes this easy for authors:

> Within our online submission form there is an option for authors to enter their arXiv reference number when they submit the article to be considered for publication. This number enables us to locate the article in question and automatically upload the files from arXiv to our peer review system for processing.[122]

69. While physics publishers are clearly well linked into the arXiv server and it appears to be a system that works well for the physics community, it is not necessarily the best model for all disciplines. Dr Robert Parker of the RSC told us that this system was "not popular with chemistry because there is very often the possibility that an author will take out a patent on what they are producing. Putting your results out there in a pre-printed form is risking losing priority on them".[123] Professor Ron Laskey indicated that a pre-print server

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117 Q 11

118 *As above*

119 Ev 103, para 13

120 Q 11

121 *As above*

122 Ev 94, para 1

123 Q 8

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would also not be suitable for biomedical sciences.[124] He described two worries from the Academy of Medical Sciences submission to this inquiry:

> One is that biomedical sciences are more prone to inaccurate interpretations [...] There is a worry that, if you extended the pre-publication model to the biomedical sciences without any attempt to peer review, a lot of half-truths would creep into the literature.
>
> The second problem is the appetite of the media for some aspects of biomedical science. Without peer review we would get a storm, frankly, of incorrect headlines.[125]

70. Sir Mark Walport, from the Wellcome Trust, reinforced Professor Laskey's point:

> One of the issues in the biological sciences is that the volume of research is extremely high. An important issue in the medical sciences is that an ill-performed study can have harmful consequences for patients. Therefore, there need to be filtering mechanisms to make sure that things are not published that are, frankly, wrong, misconceived, the evidence is bad and conclusions are drawn which means that patients could be harmed. Different communities require slightly different models.[126]

71. Professor John Pethica of the Royal Society suggested that pure mathematics is a "good example of an area" which might benefit from the pre-print server model because "it can take a very long time for the assessment of theorems to become correct".[127] He added that this was in contrast with areas such as engineering, where there is an immediate technological impact.[128]

72. **We conclude that pre-print servers can be an effective way of allowing researchers to share and get early feedback on preliminary research. The system is well established in the physics community, and works particularly well, co-existing with more traditional publication in journals. We encourage exploration in other fields. We note, however, that pre-print servers may not work in fields where commercialisation and patentability are issues, or in the biomedical sciences, where publication of badly performed studies could have harmful consequences and could be open to misinterpretation.**

Open peer review

73. Open peer review has traditionally been defined as review in which the authors' and reviewers' names are revealed to each other. This system has been used successfully by the *BMJ* for more than a decade with no significant problems.[129] BMJ Group told us that:

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124 Q 15

125 *As above*

126 Q 254

127 Q 12

128 *As above*

129 Ev 72, para 16 [BMJ Group]

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> PLoS Medicine, however, tried and then discontinued this practice in late 2007 citing reviewers' reluctance to sign their reports—perhaps because at that time it was publishing a lot of laboratory-based research, which is arguably more competitive than clinical research.[130]

74. A more recent and much broader definition can also cover cases where: reviewers' names are publicly disclosed; the reviews are also published; and/or the community can take part or comment. Dr Philip Campbell explained the well-known *Nature* experiment in open peer review:

> In 2006, *Nature* ran an experiment in open peer review, in which over a period of four months, submitting authors were invited to post their papers on an open website for open assessment by peers. Their papers were also peer-reviewed in the usual way.
>
> […] In brief, the take-up by authors was low, as was the amount of open commenting. Furthermore it was judged by the editors that the comments added little to the assessment of the paper.
>
> It is my view, consistent with this outcome, that scientists are much better motivated to comment on an interesting paper when directly requested to do so by an editor.[131]

As a result, *Nature* chose not to adopt the widespread implementation of open peer review.[132]

75. Elsevier described the process operated by another journal, *Atmospheric Chemistry and Physics*, that uses an innovative type of open peer review:

> Following initial review by an editor to assess alignment with the title's coverage the manuscript is published online (usually two to eight weeks after submission). Comments and discussion by members of the public and select reviewers then take place for an eight-week period. The author responds to comments within four weeks, and then prepares a final revised article. The editor then decides whether to accept the paper. The original paper, comments, and final paper are all permanently archived and remain accessible. Other than comments from invited reviewers, spontaneous comments from members of the scientific community have been relatively low.[133]

76. The "transparent" approach, used by the *EMBO Journal*, which is published by the Nature Publishing Group, features "the online display of anonymized referees and

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130 Ev 72, para 16

131 Ev 88, paras 42–45

132 "Overview: Nature's peer review trial", Nature Online, www.nature.com/nature/peerreview/debate/nature05535.html

133 Ev 117, para 30(a)

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editors/authors' correspondence after publication, alongside the paper",[134] provided as a "Peer Review Process File".[135] However, Dr Philip Campbell informed us that:

> *Nature* and the Nature journals have so far not gone down this route. This reluctance is partly based on a precautionary fear that it might upset the relationship between editors and referees. Moreover, the documents reflect only a part of the process of discussions within the editorial team, between the editors and the referees, and between the editors and the authors. There is also a belief that few people will want to wade through this copious information.
>
> Nevertheless, transparency has its own virtues, and we are keeping this policy under review.[136]

The BioMed Central medical journals also provide this sort of "pre-publication history".[137] Dr Michaela Torkar, from BioMed Central, told us that this was "a very transparent way of seeing how the system works and the sort of records we keep".[138]

77. Others are now also seeing the virtues of transparency, particularly where issues have arisen relating to dissatisfaction with reviews. A recent example of this was the open letter by 14 leading stem cell researchers to senior editors of peer-reviewed journals publishing in their field:

> Peer review is the guardian of scientific legitimacy and should be both rigorous and constructive. Indeed most scientists spend considerable time and thought reviewing manuscripts. As authors we have all benefited from insightful referee reports that have improved our papers. We have also on occasion experienced unreasonable or obstructive reviews.
>
> We suggest a simple step that would greatly improve transparency, fairness and accountability; when a paper is published, the reviews, response to reviews and associated editorial correspondence could be provided as Supplementary Information, while preserving anonymity of the referees.[139]

The letter went on to urge adoption of the *EMBO Journal* model.

78. **The principles of openness and transparency in open peer review are attractive, and it is clear that there is an increasing range of possibilities. There are mixed results in terms of acceptance amongst researchers and publishers, although some researchers are keen to see greater transparency in their fields. We encourage publishers to experiment with the various models of open peer review and transparency and actively engage researchers in taking part.**

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134 Ev 89, para 49 [Philip Campbell, *Nature*]

135 "Editorial Process", The EMBO Journal, www.nature.com/emboj/about/process.html

136 Ev 89, paras 50–51

137 Q 192 [Dr Michaela Torkar]

138 Q 192

139 "Open letter to Senior Editors of peer-review journals publishing in the field of stem cell biology", EuroStemCell, www.eurostemcell.org, 10 July 2009

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Online repository journals

79. The constraints of print journals and the challenges associated with authors striving to publish in high-impact journals have been described in paragraphs 59-64. Authors are now able to submit their manuscripts to one of an increasing number of online repository-type journals. One such example is the journal, *PLoS ONE*, published by the "open access" publisher, the Public Library of Science (PLoS). "Open access" is defined as the removal of all barriers (for example, subscription costs) to access and reuse of the literature. To provide open access, PLoS journals use a business model in which expenses are recovered "in part by charging a publication fee to the authors or research sponsors for each article they publish".[140] This model is potentially open to abuse if the peer-review process is not robust and if publishers view it mostly as a revenue-generating venture.[141] However, in the case of *PLoS ONE*, the goal is to publish "all rigorous science",[142] placing an "emphasis on research validity over potential impact".[143] The Wellcome Trust stated that:

> The approach adopted by *PLoS ONE*—where the peer review process focuses solely on whether the findings and conclusions are justified by the results and methodology presented, rather than on assessment of the relative importance of the research or perceived level of interest it will generate—has both reduced the burden on the reviewer and the time it takes to get a paper published.[144]

80. Dr Mark Patterson, Director of Publishing at PLoS, explained that "*PLoS ONE* was launched in December 2006, [it] published about 4,000 articles in 2009 and 6,700 last year, so it became the biggest peer-reviewed journal in existence in four years".[145] The popularity of *PLoS ONE* has spurred the launch of a host of similar journals, as described by Dr Patterson:

> The American Institute of Physics and the American Physical Society have both launched physical science versions; Sage has launched a social science version; the BMJ group, who were actually the first, last year launched a clinical research version of *PLoS ONE*; *Nature* has launched a natural science version of *PLoS ONE*, and on it goes. The model is getting that level of endorsement from major publishers and I think, again, that is probably helping to make researchers very comfortable with the way in which *PLoS ONE* works.[146]

81. He added that:

> if another 10, 20 or 30 of these are launched over the next one to two years, which I think is quite likely […] that could make some fairly substantial changes in the way the pre-publication peer review process works. […] The benefit will be the

140 "About PLoS ONE", PLoS ONE, www.plosone.org

141 "Open Access Publisher Accepts Nonsense Manuscript for Dollars", *The Scholarly Kitchen*, 10 June 2009, http://scholarlykitchen.sspnet.org/2009/06/10/nonsense-for-dollars/

142 Q 171 [Dr Mark Patterson]

143 Ev 135, para 2 [Academy of Medical Sciences]

144 Ev 83, para 8

145 Q 170

146 Q 171

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> acceleration of research communication because you avoid bouncing from one journal to another until you eventually get published. That is a tremendous potential benefit.[147]

82. Professor Ron Laskey, from the Academy of Medical Sciences, explained that:

> initially, people envisaged *PLoS ONE* as a journal they would submit to only if their paper was having severe criticism from other higher impact journals. Now, important research has been submitted to get it on the record quickly before it is scooped by someone else who has a smoother path through the refereeing jungle.[148]

83. Dr Philip Campbell, of *Nature,* added that:

> there are people who are sick to death of editors and who value something like [*PLoS ONE*, or in Nature's case] *Scientific Reports*, which have […] no editorial threshold but do have a peer review process just for the validity aspect.[149]

84. Dr Patterson explained in further detail the way in which *PLoS ONE* achieved quicker publication times than traditional journals:

> the real benefit in *PLoS ONE,* which is relevant to speed, is that authors won't be asked to revise their manuscripts to raise them up a level or two. With a lot of journals, you get asked to do more experiments to raise it up to the standard that particular journal wants. That doesn't and shouldn't happen at *PLoS ONE.* As long as the work is judged to be rigorous, it is fine. The amount of revision can be quite a lot less because authors are asked to do it in that way and that can really reduce the overall time from submission to publication.
>
> There is another way in which I think *PLoS ONE* accelerates research communication generally. Often, articles are submitted to journal *A* and are rejected as not being up to standard. They go to journal *B* and then journal *C* and, eventually, are published. If you have a robust piece of work it will be published in *PLoS ONE* as long as it passes the criteria for publication. You will not have to fight with editors who are trying to argue for a certain standard. I think those two other things really have the potential to accelerate research communication broadly.[150]

85. The speed between submission, acceptance and publication has led to some commentators suggesting that the *PLoS ONE* peer-review process is "light".[151] Dr Patterson was asked whether he would describe it as "light touch" and replied "no, not at all", and then went on to describe the peer-review process at *PLoS ONE.*[152] The Wellcome Trust also defended the peer-review process used by *PLoS ONE*:

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147 Q 173

148 Q 6

149 Q 121

150 Q 166

151 For example: D. Butler, "PLoS stays afloat with bulk publishing", Nature, 2008, vol 454, p11

152 Q 176

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> *PLoS ONE* has very good peer review. Sometimes there is a confusion between open access publishing and peer review. Open access publishing uses peer review in exactly the same way as other journals. *PLoS ONE* is reviewed. They have a somewhat different set of criteria, so the *PLoS ONE* criteria are not, "Is this in the top 5% of research discoveries ever made?" but, "Is the work soundly done? Are the conclusions of the paper supported by the experimental evidence? Are the methods robust?" It is a well peer-reviewed journal but it does not limit its publication to those papers that are seen to be stunning advances in new knowledge.[153]

86. *PLoS ONE* publishes 69% of its submissions.[154] However, Dr Patterson explained that this does not necessarily mean that 31% are rejected.[155] He told us:

> Some of them are "lost" in the sense that they may be sent back for revision—maybe 5% to 10% are sent back for revision—and the others are rejected, as they should be, on the grounds that they don't satisfy technical requirements. […] We did some author research in the last couple of years and we have seen that, in both cases, according to the authors' responses, about 40% of rejected manuscripts have been accepted for publication in another journal.[156]

87. There has also been speculation about the level of copyediting that occurs at *PLoS ONE*. Richard Poynder, a journalist with an interest in publishing, wrote:

> *PLoS ONE* does not copyedit [this is the work that an editor does to improve the formatting, language and accuracy of text] the papers it publishes, only the abstracts. But it would appear that even this minimal service is not always provided. [...]When I contacted [Peter] Binfield [*PLoS ONE Publisher*] [...] he said: "Speaking for *PLoS ONE* we do not copyedit content (other than a very light clean up). We do a light (but real) copyedit on the abstract; and at time of submission one of our (many) Quality Control checks is on the quality of the English. However, as a general rule, if the language is intelligible, and passes QC and passes peer review etc., then it will be published as is".[157]

88. We put some of these concerns to Dr Patterson, who explained that:

> In our production process we focus on delivering really well structured files that will be computable, for example. We don't expend effort in changing the narrative. Scientific articles aren't works of literature. That is not to say it wouldn't be nice if, sometimes, a bit more attention was paid to that. It is also true that one of the criteria for *PLoS ONE* is that the work is in intelligible English. If an editor or reviewer thinks that something is just not good enough and they can't really see what is happening, it will be returned to the author.[158]

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153 Q 253

154 "PLoS ONE Editorial and Peer-Review Process", Public Library of Science, www.plosone.org

155 Q 164

156 *As above*

157 Richard Poynder, "PLoS ONE, Open Access, and the Future of Scholarly Publishing", 7 March 2011, http://richardpoynder.co.uk/PLoS_ONE.pdf, p 24

158 Q 167

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89. **We are impressed by the success of *PLoS ONE* and welcome the wider growth of quality online repository journals. These will accelerate the pace of research communication and ensure that all work that is scientifically sound is published, regardless of its perceived importance. However, we recognise that this is a relatively new and rapidly evolving model, and potentially open to abuse because publication fees are involved. It is important that a high quality of peer review is maintained across all repository-style journals.**

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3 Editors, authors and reviewers

90. At the heart of the peer-review process are the people involved: editors, authors and reviewers. Dr Robert Parker, Interim Chief Executive of the Royal Society of Chemistry (RSC) told us that "having professional people overseeing the peer review process is absolutely paramount".[159] We also heard that:

> Peer review or expert review is as good as the people who do it. That is the key challenge. It has to be used wisely. It is about how the judgment of experts is used. It is about balancing one expert opinion against another. The challenge is not whether peer review is an essential aspect of scholarship because there is no alternative to having experts look at things and make judgments.[160]

91. Peer review is regarded as an integral part of a researcher's professional activity; it helps them become part of the research community. The International Association of Scientific, Technical and Medical Publishers explained that "as every active researcher expects to publish and through peer review receive constructive critical comments on their work, so they too must expect to act as a peer reviewer for others".[161] It is a reciprocal activity; most researchers acknowledge this. Dr Nicola Gulley, Editorial Director at Institute of Physics (IOP) Publishing Ltd, further explained that "in a recent survey that was done by Sense About Science, about 86% of researchers said they enjoyed reviewing and there are benefits to it in that they get to see papers ahead of time and they get to keep up to date".[162] However, others have reported that "for many the review process is perceived as a 'chore and not a pleasure'. Reviewers feel this way because they are not rewarded or recognised for their work".[163]

The role of the editor

92. There are currently approximately 6,000 publishers around the world managing somewhere in the region of 25,000 peer-reviewed journals; publishers have become "stewards of the peer review process on behalf of research communities".[164] Broadly speaking, there are two types of journal editor: internal staff editors and external (academic) editors who are active researchers (see paragraph 101). The role of the editor is "central to the quality of the peer-review process".[165] The RSC explained that:

> It is the editor who will consider the information produced through the process and so ultimately decide what feedback is communicated to the author and which articles

159 Q 3

160 Q 252 [Sir Mark Walport]

161 Ev w126

162 Q 27

163 A Mulligan, *Is peer review in crisis?*, Oral Oncology, 2005, vol 41, pp 135–41

164 Ev 115, para 12 [Elsevier]

165 Ev 97, para 10 [Royal Society of Chemistry]

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> are published. The judgement applied by the editor to the information collected in the review process requires knowledge, skill, and care.[166]

93. The British Sociological Association also recognised the importance of the editor in safeguarding against problems in the peer-review process.[167] This could include monitoring and preventing bias, looking out for signs of research fraud or misconduct, and ensuring feedback and requests for further information from reviewers to authors are rational. The latter is becoming an "increasingly troublesome" problem.[168] Professor Ron Laskey of the Academy of Medical Sciences explained that in the biomedical sciences:

> a high proportion of time is spent fending off criticisms from reviewers that may not be on the main theme of the work. The reviews are beginning to dictate the agenda of the science in a way that is not fully productive. That can be frustrating, a waste of time and resource.[169]

94. Reviewer-suggested experiments were the subject of a recent *Nature* article, which suggested that "the problem is made more acute by the unwillingness of editors to express their opinions".[170] Dr Philip Campbell, Editor-in-Chief of *Nature* and Nature Publishing Group, told us that as a result of the remarks made in this article he had questioned his editors to find examples of "recent publications which had had to be revised, but where we had made a judgment that in this particular case this request for extra work was not required".[171] Dr Sugden, Deputy Editor & International Managing Editor at *Science*, explained that:

> Often you will get two or three referees' reports on a paper, but those referees may not agree with each other. It is the editor's job, if they consider the paper worth pursuing, to then make a recommendation as to which of those referees' revisions they should follow and which they should not. [172]

Mayur Amin, Senior Vice President of Research & Academic Relations at Elsevier, added that at Elsevier feedback was collected "from the researchers, authors, reviewers and the editors" so that as publishers they could "take that on board and present it to an editor or a journal and say, 'Look, a whole lot of authors are getting displeased about the way the process is working. We need to modify the process'".[173]

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166 Ev 97, para 10

167 Ev w112, para 7.7

168 Q 6 [Professor Ron Laskey]

169 Q 6

170 H Ploegh, *End the wasteful tyranny of reviewer experiments*, Nature, 2011, vol 472, p 391

171 Q 109

172 *As above*

173 *As above*

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Reviewer selection

95. One of the core decisions made by an editor during the peer-review process is who reviews the manuscript. Professor John Pethica, from the Royal Society, described how this decision is taken:

> One can keep a record of how effective various reviewers are, which is done by most journals. Some people are more effective than others and are used correspondingly. Also one uses the community to suggest future names of reviewers. It is very common, for example, if a senior scientist is asked to review something and they can't do for whatever reason, for them to suggest other names of people. This is a productive, rapid and efficient way of connecting the network of scientists. Since you have multiple reviewers in most cases, then of course you can test out the reviewers a little and build up a track record on them.[174]

Dr Parker, from the RSC, added that:

> Building up a knowledge of the community is very important. […] People do get to know a particular area and the interactions between certain authors and referees very well. You do get to know your community and you get a feel for whether there are any issues between particular people.[175]

96. For journals with staff editors, building and maintaining that relationship with the research community is achieved through attending conferences and seminars, as well as visiting universities and industry.[176] Dr Parker told us that RSC editors "regularly attend up to 200 conferences a year overall".[177] Dr Gulley, from IOP Publishing Ltd, indicated that their editors also attended a large number of conferences, in the region of 300–400 a year.[178]

97. Selecting the right reviewers for the job is a particularly important way of combating bias in peer review. Dr Gulley explained that "having a combination of the internal editors as well as the external editors helps with impartiality".[179] She added that there is also the option for authors to appeal if they disagree with the final editorial decision.[180] In addition to this, authors might also choose to take up their concerns in a public arena. A recent example of this is the open letter by 14 leading stem cell researchers to senior editors of peer-reviewed journals publishing in their field (see paragraph 77).

98. Bias in reviewer selection does not always work against authors. In the past, there have been accusations that top journals, such as *Science* and *Nature*, "are locked in such fierce competition for prestige and publicity that they may be cutting corners to get 'hot'

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174 Q 18

175 Q 16

176 Q 18 [Dr Robert Parker]

177 Q 18

178 *As above*

179 Q 21

180 *As above*

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papers".[181] The UK Research Integrity Office Ltd (UKRIO) drew our attention to the fact that "the Nobel Laureate, Robert Laughlin, commenting on a series of retractions from these eminent journals said 'in this case the editors are definitely culpable […] they chose reviewers they knew would be positive'".[182]

99. Dr Philip Campbell defended *Nature* against these accusations:

> That is completely wrong. I totally refute that statement [...] It is not in our interests to cut corners. […] we have one of the most critical audiences in the world, and any paper that makes a strong claim is going to be absolutely hammered in the form of testing in the laboratory or scrutinised in terms of discussions at journal clubs, within universities and so on. It is simply not in our interest, for our reputation in the long run, to publish papers that have any degree of cutting of corners in the assessment process.[183]

Dr Campbell added that after a "hot paper" is published, though there is "an immediate stream of interest", there is no "direct effect on sales".[184] He explained that "there is a big barrier of independence, institutionalised within the company, in fact, between the commercial side and the editorial side".[185]

100. **The role of the editor is at the heart of the peer-review process. The judgement applied by the editor to the information collected in the review process requires knowledge, skill, and care; particularly, in respect of identifying the right reviewers for the job and critically assessing the feedback from reviewers to authors.**

Training

Editors

101. Publishers use a variety of arrangements for editorial responsibility during the peer-review process. Broadly speaking, the two main approaches are to appoint staff editors as in-house professionals, or to use editorial boards consisting of active researchers. Regardless of whether journals opt for the use of staff editors, academic editors, or a combination of both, some form of editorial training is necessary—especially in the light of the central role of the editor (paragraph 92).

102. The RSC and the IOP use "a combination of in-house editors and external editors",[186] as does the journal, *Science*.[187] Dr Andrew Sugden told us that the initial filtering to identify "innovative" and "original" submissions at *Science* is carried out through consultation with a Board of Reviewing Editors.[188] This Board is appointed by the staff editors and consists of

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181 For example: "Science Fails When Cheaters Think They Won't Be Caught", Wall Street Journal, 27 September 2002

182 Ev 124, para 1.9

183 Q 134

184 Q 135

185 *As above*

186 Q 16 [Dr Nicola Gulley]

187 "Peer Review at Science Publications", Science, www.sciencemag.org

188 Ev 138, para 4

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mid-career active research scientists. "The responsibility for managing the peer review process and for making decisions on rejection/revision/acceptance of submissions for publication rests with the staff editors".[189] In contrast, Dr Philip Campbell, *Nature*, explained that:

> *Nature* and the Nature journals are untypical journals in that they do not have editorial boards of active researchers. All selection decisions are the responsibility of the fully independent and Chief Editors of each journal and their teams.[190]

103. During the course of this inquiry, we questioned a number of publishers about the type of training they provide to their editors, both in-house and external. On the whole, training for staff editors appears to be provided on the job.[191] Dr Philip Campbell explained the situation at *Nature*:

> The training that takes place [happens] by [staff editors] participating fully in the process of selecting papers. Every new editor sits within a small team with a team leader who will initially track their every thought and action in respect of every paper they handle.
>
> As months go by, this scrutiny gradually relaxes. We reckon that it takes about two years of handling papers and visiting many labs and conferences for our editors to gain the full experience of the various ways in which authors, editors and referees can interact and hence optimize the process. Also, over that time, an editor builds up extensive scientific and research-community knowledge and contacts.[192]

104. Training for academic editors and editorial boards—at those journals that use them—varies. The Public Library of Science (PLoS) told us that its:

> [academic editors] and their editorial boards are supported by PLoS staff, who provide initial training and ongoing support in the use of the journal management system. PLoS staff also send occasional communications on best practice to the editorial boards [...] The journals have an electronic discussion facility so that all submissions can be discussed with colleagues on the journal or with editors who work on other PLoS journals (on a confidential basis). The PLoS staff editors are occasionally brought in to discussions to provide support on specific content issues or matters pertaining to publishing ethics.[193]

105. A more structured approach is taken by Elsevier, which provides its new external editors with:

> a Welcome Pack which, in some 50 pages, introduces new Editors to Elsevier, its policies, procedures, the editorial and publishing teams which support the journal,

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189 Ev 138, para 3 [Dr Andrew Sugden]

190 Ev 86, para 7

191 Ev 81, para (i) [Public Library of Science]; and Ev 90, para 3 [Dr Philip Campbell]

192 Ev 90, paras 3-4 [Dr Philip Campbell]

193 Ev 82, para (ii) [Public Library of Science]

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> the peer review process including tools to find reviewers, ethical guidelines, as well as support tools.[194]

The journal, *PLoS ONE*, also provides newly recruited editorial board members with "a pack of information providing guidance about the editorial process and standards associated with *PLoS ONE*", as well as "videos explaining the operation of the journal management system". Additional support and ongoing advice are provided by *PLoS ONE* administrative staff.

106. **Broadly speaking, training for editors and members of editorial boards is provided on the job. We have heard that some publishers opt for a more structured approach, and include, for example, comprehensive welcome packs for new editors that cover peer-review processes, support tools and ethical guidelines. We encourage publishers to work together to develop standards—which could be applied across the industry—to ensure that all editors, whether staff or academic, are fully equipped for the central role that they play in peer review.**

Authors and reviewers

107. In addition to training their editors, some publishers also provide feedback or training for authors and reviewers. Dr Robert Parker, from the RSC, told us:

> We have a feedback loop where referees always get the feedback on the outcome of the articles that they have refereed so that they can learn whether their refereeing activity is generally in line with what is accepted and what is rejected.[195]

108. He acknowledged, however, that the RSC did not run a structured training programme and that the feedback was provided "ad-hoc".[196] Professor Ron Laskey, Vice President of the Academy of Medical Sciences, considered feedback to be very helpful. He told us:

> From a referee's point of view, something that I found extremely educational is to be sent back the referee reports of the other referees. There are several times when I have wanted to kick myself for missing something that the publisher spotted that I had not. Equally, it is not uncommon to find that you are in complete agreement.[197]

However, while feedback is common in some disciplines, it is by no means standard practice across all journals.[198]

109. Publishers are increasingly offering more training opportunities to reviewers, albeit in a sporadic way. Dr Janet Metcalfe, from Vitae, explained that bringing early-career researchers into the peer-review system was particularly important:

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194 Ev 120, para 3.2.2

195 Q 16

196 Qq 22–23

197 Q 23

198 Q 24 [Professor Ron Laskey]; and Q 25 [Professor John Pethica]

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> How do you get into that system? How do you become a reviewer? It is very often by recommendation. There are journals that have open calls for reviewers, but becoming a reviewer is usually part of the apprenticeship of being nurtured as a researcher by your principal investigator or senior academic. There are issues in terms of how we support those researchers to become involved and good at peer reviewing on both sides of the fence, but also how we recognise it by acknowledging the broadness of a researcher's activities.[199]

110. We heard examples of how publishers are addressing this challenge. Dr Nicola Gulley, from IOP Publishing Ltd, told us that:

> Recently, as a result of requests from some post-docs and graduates, we have given them some initial training on what peer review means. We are teaching them about what refereeing means and what we are expecting. There is a lot of literature as well that people are not always aware of so we have been trying to raise the visibility of that. Internally, we also try and match the interests of the referees to the papers as much as possible.[200]

111. Elsevier is also working with postdoctoral students on peer review. It has developed a "Reviewer Mentor Programme" whereby:

> experienced editors employed at two universities mentor postdoctoral researchers who have authored papers but not yet served as peer reviewers. Each mentor runs training workshops for the postdocs and then the postdocs review real articles under supervision. Each postdoc is marked, and upon successful completion receives a certificate. We are exploring ways to provide formal certification and a reviewer kite mark to scale up this successful pilot.[201]

112. Professor John Pethica, Physical Secretary and Vice President of the Royal Society, explained that "PhD students […] are trained, as part of their learning process, to understand how to criticise and to find out what is right and wrong with the scientific literature".[202] He added that it was "important that the training of researchers in general includes the understanding that they should participate in [peer review] as an expectation of being a good scientist".[203] Some concerns had, however, been raised about the lack of training in best practice for new reviewers, with suggestions that this should form part of post-graduate training.[204] We, therefore, questioned whether peer-review training should be a formal part of gaining a PhD. Sir Mark Walport, Director of the Wellcome Trust, told us:

> Part of the training of a scientist is peer review. For example, journal clubs, which are an almost ubiquitous part of the training of scientists, bring people together to criticise a piece of published work. That is a training in peer review. Can more be

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199 Q 224

200 Q 16

201 Ev 117, para 29e

202 Q 23

203 Q 26

204 For example, Ev w96, para 25 [British Antarctic Survey]

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> done to train peer reviewers? Yes, I think it probably can. PhD courses increasingly have a significant generic element to them. It is reasonable that peer review should be part of that.[205]

113. Professor Rick Rylance, Chair-elect of Research Councils UK (RCUK), was broadly in agreement with Sir Mark's comments. He added that "research is a collective enterprise and that anyone who wishes to enter that field either as an academic or in some other capacity needs to understand that".[206] Dr Janet Metcalfe, Chair of Vitae, provided more details about the current opportunities for new authors and reviewers in universities and research institutions:

> The tradition is very much an apprenticeship model. You learn the system by doing it in terms of writing papers, submitting them and maybe getting feedback from your principal investigator [PI]. Where that works it is absolutely fantastic […] But, because we are a collective in terms of the academic community, there is opportunity for that process not to be as well supported throughout the whole of the academic community as it could be.[207]

When we asked Dr Metcalfe whether she was in favour of more formal training, she responded:

> I think the opportunities to have training should be there. The process by which a researcher learns to become expert is very much up to their individual circumstances. If they are getting good individual nurturing and mentoring by their PI, that is great. But there should also be the opportunity, for those researchers who respond more to formal training, to have that available as well.[208]

114. Professor Ian Walmsley, from the University of Oxford, agreed that "a combination of both mentorship, which I think has a primary role, and some elements of non-mandated training would continue to be very helpful".[209]

115. Others were in favour of formalised training; for example, the British Medical Association (BMA) stated that:

> It is remarkable that there is no formal training process in place for such an important mechanism to ensure scientific quality. Guidance from a publisher alone, who may have parallel but different priorities, is not adequate. The BMA favours a system that provides proper peer review training as an option within postgraduate training.[210]

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205 Q 258

206 *As above*

207 Q 226

208 Q 227

209 Q 229

210 Ev w21, para 12

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116. Professor Sir Adrian Smith, Director General of Knowledge and Innovation in the Department for Business, Innovation and Skills (BIS), considered that it was not a "one size fits all" situation, he told us:

> We have to allow a lot of scope for particular research organisations or supervisors to decide on what is appropriate. Peer review training is already part of the Research Councils' postgraduate training. There is a formal expectation that students […] "obtain an understanding of the processes for funding and evaluating research." The terms and conditions of training grants actually put some of this in. If you think about it, if you are doing a PhD, you are having to read and access a lot of literature and synthesise that literature. […] It is an inherent part of the scientific process itself that you are constantly peer reviewing in a way. […] The amount of effort that has gone on in recent years on the part of the research councils to better codify their expectations of what research training should consist of and making that part of the conditions when they give out either doctoral training grants or research grants takes us most of the way. I do not think there is much that we could do in going further.[211]

117. Professor Sir John Beddington, the Government Chief Scientific Adviser, added that:

> a number of universities have exercises where PhD students and some academics examine individual papers. In that case, everybody goes away, reads a paper over the weekend and then they have a meeting and discuss and critically appraise that paper. That is part of the process. Obviously, that practice will differ between universities and subject areas.[212]

118. **A relatively straightforward way of educating reviewers about the quality of their reports and helping them improve their feedback to editors is to send them the reports of other reviewers, done confidentially when necessary. This should be standard practice across all journals. This would be a useful educational tool to improve the quality of future reports from reviewers.**

119. **Training for the next generation of authors and reviewers is also important. Many PhD students and post-doctoral researchers are fortunate to have the opportunity to discuss scientific literature in journal clubs and other informal settings. Some are mentored well by their principal investigator and thereby receive informal training in peer review. Others are not. Given the importance of peer review across the research spectrum, from grant applications to publications, we consider that all early-career researchers should be given the option for training in peer review.**

Funding for training

120. Training in peer review, whether ad-hoc or in a formalised setting is clearly desirable; we therefore examined where funding for this training would come from. Vitae, the UK organisation championing the personal, professional and career development of doctoral researchers and research staff, explained the current situation:

211 Q 301

212 *As above*

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> Until recently there were few opportunities for researchers to undertake formal training. The advent of Vitae and government funding through the UK Research Councils for implementing the recommendations of the Sir Gareth Roberts review[213] have significantly increased the opportunity for early career researchers to participate in professional development opportunities, including academic writing for publication and grant applications. These courses generally include experience of the peer review process. There are also examples of universities and other bodies providing structured development opportunities in being a peer reviewer, including encouraging early career researchers to set up and run journal clubs.[214] However, the numbers participating in these activities are fairly small and with the end of 'Roberts funding' in March 2011 even this level of provision may […] fall.[215]

121. Roberts funding of just under £150 million was provided to the Research Councils in the 2002 Spending Review to "increase stipends, length of doctoral programmes and provide training for their funded researchers".[216] We asked Professor Rick Rylance, from RCUK, how training in peer review would be funded in the absence of Roberts funding, he responded:

> The amount we are giving to universities for training and developing postgraduate research will increase, and it will include components which replace part of the Roberts funding. The issue we have to think about is that, on average, around only 25% of the UK postgraduate population are funded through agencies like the research councils. The rest of it is coming through other sorts of routes. How are universities going to provide a system for three quarters of the population who are not getting money from us? There has to be a joined-up conversation about how we develop that.[217]

122. Some of the other funders that Professor Rylance referred to are also providing the opportunity for training to be incorporated into the PhD programme, for example:

> The Wellcome Trust funds four-year PhD programmes, so we are providing funding for a longer period. […] the four-year model of the PhD is becoming well established and that gives universities the opportunity to provide that transferable skills training.[218]

We queried whether training in peer review was a part of this "transferable skills training", and were told that the Wellcome Trust was "not prescriptive in what universities teach" but that it would be "reasonable" for peer review to be a component of the training.[219]

123. Dr Janet Metcalfe, from Vitae, explained the need to share responsibility for the training of future generations of peer reviewers:

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213 G Roberts, *SET for Success: the supply of people with science, technology, engineering and mathematic skills*, 2001

214 D A Mackey, *Training peer reviewers*, Nature, 2006, vol 443, p 880

215 Ev 146, para 10

216 "Roberts Report", Vitae, www.vitae.ac.uk/policy-practice/1685/Roberts-recommendations.html

217 Q 260

218 Q 259 [Sir Mark Walport]

219 Q 260 [Sir Mark Walport]

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> Collectively, we all have a responsibility for [peer review] to work. I think journals have a responsibility to support and provide more information about what is required and to contribute to the training of their reviewers. I think institutions have a responsibility, as signatories to the Concordat for the Career Development of Researchers, to ensure that those opportunities are there. I think research and funding councils and Government have an obligation to provide enough funding within the entire system to make available that kind of training for our early career researchers.[220]

She added that it was also the responsibility of the individual researcher "to take advantage of [training] opportunities and ensure that they are developing their own expertise and understanding of the entire system".[221]

124. **Training for early-career researchers is important. We note that "Roberts Funding" is coming to an end and that the Research Councils will therefore be increasing the amount they give to universities "for training and developing postgraduate research". We invite the Research Councils to set out further details of how and where this money will be allocated and what proportion of it will be dedicated to training in peer review, including academic writing and publication ethics (discussed later in this report). We also ask for further details of how this will be "joined up" across different research funders.**

International challenges and opportunities

125. Earlier we highlighted that significant changes are taking place in scientific publishing, including the fact that the share of publications by countries which are not traditional scientific leaders, such as China and India, is rising (paragraph 6). Mayur Amin, from Elsevier, described the current situation:

> If you take somewhere like the USA, which produces about 20% of the output of papers, it conducts something like 32% of the reviews in the world, whereas China is producing something like 12% to 15% of the output of papers but is probably only conducting about 4% to 5% of the reviews. This is just a transitionary thing. China and India have grown very fast in the last few years; there are a lot of young researchers who will come up and take their place in peer review and start peer reviewing papers.[222]

126. This was widely recognised, for example, the Publishers Association told us that:

> There remain considerable geographical imbalances between those who benefit from peer review and those who contribute, most starkly between the US, the most prolific peer reviewer, and China, whose output of papers in certain disciplines has risen exponentially since 2000 but whose participation in peer review is increasing much less quickly. It is expected however that these imbalances will even out over time and within the UK there is more of a balance between publication output and

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220 Q 228

221 Q 232

222 Q 127

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> participation in peer review. Publishers active in India and China are appointing editors and establishing editorial offices from where they run workshops on peer review, journal publication practices, and publication ethics.[223]

127. Mayur Amin explained that:

> It is incumbent upon publishers to help out here, both in terms of technical infrastructure to help editors find a broader pool of reviewers, and also in terms of training needs, appointing editorial board members in those developing countries as well as running workshops and providing literature to help train new and young reviewers to come on to the system.[224]

128. We discussed these international activities with a range of publishers. Dr Robert Parker, from the RSC, and Dr Nicola Gulley, from IOP Publishing Ltd, explained that both organisations carry out face-to-face training in peer review, particularly in China and India.[225] Dr Parker told us:

> We do a lot of interaction with the Chinese academic market, as it is. We have two offices in China—one in Beijing and another in Shanghai. We have staff out in China. We do regular visits. We set up conferences in China now. We started off doing roadshows of the top chemistry departments in China. All of our roadshows include presentations on how to publish and how to referee. We have built up quite a significant connection with the Chinese academic market. We also involve them on our editorial boards. We get them involved as associate editors on our journals.[226]

129. Dr Gulley added that IOP Publishing had "been working with researchers in China for the past 11 years. We have a member of staff who visits universities and gives lectures on how to get published. We run workshops and we visit regularly".[227] Robert Campbell, Senior Publisher, Wiley-Blackwell informed us that they had "been carrying out a lot of training since 2005 in China, particularly in chemistry. We are increasing the percentage of peer reviewing from China now. It is still not parity but it is moving towards 20% of our papers".[228] Dr Fiona Godlee added that the BMJ Group was also "involved closely in training in Africa, China and India at the moment".[229]

130. **We welcome the fact that the publishers we have heard from are training authors and reviewers on an international level, particularly those from countries which are not traditional scientific leaders, and we encourage others to do the same. This should help alleviate the current imbalance between publication output and participation in peer review.**

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223 Ev w106, para 13

224 Q 127

225 Q 16

226 Q 51

227 *As above*

228 Q 149

229 *As above*

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Finding reviewers

131. In part as a result of the growth of scientific output, both at home and abroad, there have been expressions of concern about the state of the peer-review system, including claims that the peer-review system is in crisis.[230] In particular, claims that there is an increasing burden on reviewers and that "scientists face strong incentives to submit papers, but little incentive to review".[231] Professor Ron Laskey, of the Academy of Medical Sciences, stated that he "wouldn't say [peer review] is in crisis. I would say that the engine is misfiring rather than it has stalled completely".[232]

132. The Society for General Microbiology told us that "with the rise in research that is multidisciplinary and becoming increasingly specialized it is sometimes difficult to find reviewers with sufficient expertise".[233] Robert Campbell, Senior Publisher at Wiley-Blackwell, was of the opinion that there was "no quantitative evidence that [peer review] is in crisis".[234] He explained:

> I think the peer review system, as a whole, is more robust than ever. [...] in 2010 we had about 12% more submissions. There was no impact on publishing schedules and no added delays, although we only published 2% more articles, so the rate of rejection was higher. A study has been published in *Nature* by Tim Vines and colleagues where they did try to quantify this issue and tracked all the reviewers. They found that the population of reviewers is increasing with the 3% to 4% increase in the research community, as you would expect. Therefore the load on each reviewer is, if anything, slightly less than 10 years ago.[235]

133. The study by Dr Tim Vines, Managing Editor of the journal, *Molecular Ecology*, and colleagues analysed—at that journal—the number of requests required in 2001-10 to obtain a review; compared the number of submissions in 2001-07 with the number of unique reviewer names in each year; and calculated the mean number of reviews per reviewer in 2001-07.[236] They reported that it was slightly harder to recruit reviewers in 2010 than it was in 2001; editors had to send out more than two requests, on average, for every one acceptance, compared to 1.4 in 2001.[237] This increase, however, coincided with the journal's move from sending personal reviewer e-mail requests to an automated editorial system, leading to suggestions that requests might not be reaching their intended target because they were being tagged as spam.[238] They also found no increase in average reviewer workload over that period, because the reviewer pool had increased in parallel with

230 Ev w85, para 1 [Professor Jeremy Fox and Professor Owen Petchey]; and A Mulligan, *Is peer review in crisis?*, Oral Oncology 2005, vol 41, pp 135–41

231 Ev w85, para 1 [Professor Jeremy Fox and Professor Owen Petchey]; and Hochberg *et al*, *The tragedy of the reviewer commons*. Ecology Letters, 2009, vol 12, pp 2-4

232 Q 27

233 Ev w91

234 Q 125

235 *As above*

236 T Vines, L Rieseberg and H Smith, *No crisis in supply of peer reviewers*, Nature, vol 468, p 1041

237 T Vines, L Rieseberg and H Smith, *No crisis in supply of peer reviewers*, Nature, vol 468, p 1041; and "Trouble Recruiting Peer-Reviewers? Blame Spam!", The Scholarly Kitchen, http://scholarlykitchen.sspnet.org

238 *As above*

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submissions. The study concluded that there was "no crisis" in the supply of peer reviewers.[239]

134. **We are not convinced that there is a "crisis" in the supply of reviewers, especially as so little data are available. It appears that the current imbalance between publication output and participation in peer review may be a transitory phase. However, publishers should not be complacent and should continue actively to monitor the situation by collecting data.**

The burden on reviewers

135. While peer review may not be in crisis, we previously explained that reviewers were feeling the "burden" of peer review (see paragraph 49). The view of the Wellcome Trust was that it "imposes a significant burden on the research community".[240] The Medical Schools Council agreed that "the high volume of peer review requests that members are exposed to in addition to their other demanding roles, is a cause for concern. It is felt that the current system places excessive burden on reviewers".[241]

136. Dr Janet Metcalfe, from Vitae, explained her views on the burden of peer review as part of a wider problem in academia:

> I think many researchers would feel there is a personal cost in terms of the effort they put into peer review. They appreciate that it is a very important part of the system—it is partly about protecting academic discipline and contributing to the academic community—but there is an expectation, not just with peer review but other aspects of being an academic, that you have to put in very long hours and you are expected to work beyond your terms and conditions of employment to be successful. These are systemic issues within the academic community, and peer review falls very much within that. It is also rarely identified as a specific element in workload conversations or models within institutions, so we have no idea how much time is spent by the academic community on peer reviewing.[242]

137. Dr Malcolm Read, from the Joint Information Systems Committee (JISC), did not recognise academic working patterns as a big problem:

> I don't know that many researchers particularly feel they have a nine-to-five existence anyway. So I am not sure to what extent they would particularly resent [peer reviewing manuscripts in their own time]. I don't think there is a nine-to-five mentality in the research community.[243]

138. We were keen to find out whether the burden of reviewing falls disproportionately on one group of researchers over another. Professor Grazia Ietto-Gillies, from Birkbeck, University of London, told us that:

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239 T Vines, L Rieseberg and H Smith, *No crisis in supply of peer reviewers*, Nature, vol 468, p 1041

240 Ev 82, para 2

241 Ev w123, para 3.1

242 Q 219

243 Q 186

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> The reviewers' workload is not distributed evenly among academics. Academic stars are unlikely to be available for reviewing; hearsay suggests that sometimes professors ask their assistants or PhD students to do reviews which they sign! Academics low down in the pecking order may not be asked to review. Most reviews are done by academics in the middle range of reputation and specifically by those known to editors and who have a record of punctuality and rigour in their reviews: the willing and conscientious horses are asked over and over again by overworked and—sometimes desperate—editors.[244]

139. The Academy of Social Sciences agreed that "a minority of willing scholars find themselves increasingly burdened by requests and gradually withdraw their goodwill in order to protect their time" for other activities.[245] Once again, this highlights the "importance of employing professional and properly qualified scientific editors", in this instance to make sure "that no one reviewer is overburdened".[246] Electronic databases are making this easier for journal editors to achieve. The International Association of Scientific, Technical and Medical Publishers said that:

> in most cases now, each journal with the help of its publisher has developed an electronic database of experts with links to fields of interest. This usually includes details of all those who have reviewed for the journal before and can also be used as a management tool to ensure the same reviewer is not overburdened with requests. The identification of new reviewers for new fields has been significantly aided by the existence of abstracting and indexing databases that allow all those working in a field to be identified.[247]

140. Professor Ian Walmsley, from the University of Oxford, explained that it was necessary to look at the broader picture of how the burden of peer review falls on the research community:

> peer review is pervasive throughout all aspects of the academic endeavour, not just publishing. For example, one may distinguish that senior people will have more to do with evaluation of others through promotion, tenure, awards or what have you and perhaps at the editorial end in publishing, and that younger people will have more of the burden of evaluating individual articles or specific research grants.[248]

141. There is a sense of give and take about the burden of peer review. Professor Rick Rylance, from RCUK, described it as a "collective enterprise".[249] The IOP told us that "it is felt to be an integrated part of the role of a researcher [and there is] an expectation that by refereeing a peer's work you would in turn expect your work to be reviewed".[250] The IOP considered that there was "a case for revisiting this tradition, as other professions generally

244 Ev w80, para 2.4

245 Ev w58, para 5(b)

246 Ev w125, para 14 [Geological Society of London]

247 Ev w128, para 6

248 Q 225

249 Q 258

250 Ev 93, para 25

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do not proceed on this *pro bono* basis when offering a service" but acknowledged that the "majority of participants" supported the current arrangements.[251] Dr Malcolm Read, from JISC, explained that the situation would only become worrying if scientists had to spend more time on peer review proportionally to their scientific research.[252]

142. Professor Sir Adrian Smith did not:

> regard peer review as a burden which is somehow additional and keeping fabulous researchers away from their day job. Peer review is an integral part of the scientific and research process and is part of the day job.[253]

He added that like peer review, science itself is "time-consuming and labour-intensive" and that peer review of journals was an "incredibly efficient way of divvying up the labour".[254]

Reducing the burden

143. Dr Andrew Sugden, from *Science*, summarised his view of the current situation journal editors find themselves in when trying to find willing reviewers:

> It is usually [difficult to find reviewers] because they are over-committed. It is not usually because of an underlying unwillingness to review or about not having an incentive to review. It is simply because they are doing too many other things at the time. It may take us a week or two to find the three referees that we need for a paper sometimes. It is rare that it takes much longer than that.[255]

144. Journal publishers are working on managing and reducing the burden felt by reviewers, and thereby encouraging researchers to get involved. Two specific examples of this are discussed below.

Cutting out re-review

145. BioMed Central is experimenting with new processes in peer review to help reduce the burden on reviewers, and indeed authors. In a recent experimental policy at its journal, *BMC Biology*, authors are given "more responsibility for ensuring the validity of the paper" by being given the option to opt-out of further peer review once the initial comments come back from the reviewers.[256] Dr Michaela Torkar, Editorial Director at BioMed Central, explained how it works:

> Submissions are usually screened by the editorial team. There is quite a high rejection rate at that point. They will often consult with their editorial board to ask about the question of impact at that point. […] Of those manuscripts that go to peer reviewers about 60% are either rejected or require only minor revisions, so there

[251] Ev 93, para 25

[252] Q 185

[253] Q 303

[254] Q 304

[255] Q 126

[256] Ev 108 [BioMed Central]

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> wouldn't be a requirement for a re-review anyway. Of the remaining 40% of authors who are offered the option of [the experimental] peer review opt-out [policy], more than half will take it up. The editorial team will make a clear decision after the first round of peer review to make sure that they are very clear in their instructions to the authors about what needs to be done. They will then assess the revised manuscript when it comes back and they will usually go ahead with publication without re-review. I think there were only a couple of cases where that really wasn't possible for some reason. If the revisions aren't as extensive as they should be—say, some of the conclusions aren't put sufficiently into context to show there are some limitations to the study—they will commission a commentary which is published alongside the paper. That is written by an expert who will put it in context and point out those limitations just to make sure that non-expert readers understand that there might be some problems.[257]

BioMed Central told us that this policy "has the important effect of lessening the burden on expert reviewers, a scarce resource".[258]

The cascade system

146. The consensus that emerged at a recent workshop convened by the Wellcome Trust in partnership with the Howard Hughes Medical Institute and the Max Planck Society was that "the burden on researchers of reviewing papers is excessive, and we need to move away from the current system where the same paper is often reviewed multiple times by different journals".[259] One way around this is the "cascade" system, whereby if a manuscript is rejected by the author's journal of choice, it can be passed on to another journal, crucially, with the reviews from the first journal. This can occur in one of two ways: either, within one publishing organisation and between its "sister" journals; or, between journals from different publishers.

147. In our discussions with various publishing organisations, we learnt that publishers are, on the whole, happy to share reviews internally within their organisation, that is, between their own sister journals.[260] However, "some journals are a bit squeamish about the idea of acknowledging that the paper went somewhere else before it came on to them".[261] The internal cascading system is used extensively at BioMed Central and PLoS.[262] Dr Michaela Torkar told us that at BioMed Central:

> Sometimes the transfers will happen before the peer review and sometimes with the reviewers' reports. That does save time for authors and reduces the burden on the peer reviewers who don't have to re-review manuscripts for multiple journals.[263]

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257 Q 179

258 Ev 108

259 Ev 83, para 7 [Wellcome Trust]

260 Qq 129 [Dr Andrew Sugden, Dr Fiona Godlee, Mayur Amin] and 181 [Dr Michaela Torkar, Dr Mark Patterson]

261 Q 129 [Dr Fiona Godlee]

262 Q 181 [Dr Michaela Torkar, Dr Mark Patterson]

263 *As above*

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148. Dr Mark Patterson, from PLoS, added that "about 10% to 15% of submissions to *PLoS ONE* come from other PLoS journals. It is pretty clear that, internally, that works quite well".[264] He explained, however, that "the much more problematic issue is the sharing of reviews from one publisher to another".[265]

149. A well-known example of publisher to publisher cascading is the Neuroscience Peer Review Consortium, which is "an alliance of neuroscience journals that have agreed to accept manuscript reviews from other members of the Consortium".[266]

150. Dr Philip Campbell, from *Nature* and Nature Publishing Group, explained that the journal, *Nature Neuroscience*, participated in this consortium, he told us:

> We did it with some misgivings because [...] we invest a lot in getting editors out into the field and using referees whom we value because of the relationships that we have developed with them. To hand on, as it were, the outcome of that relationship to a competing publisher is something that hurts slightly. At the same time, you do have this competing interest of the research community to save people work. We found that the uptake of this facility, where authors can elect to have the referees' reports of the rejecting journal handed on to the next publisher, is not very great.[267]

151. Dr Patterson, PLoS, agreed that it "was not terribly popular with authors" but questioned "how much publishers were really behind" the experiment. He was "not convinced" that the "sense of ownership", as alluded to by Dr Campbell, was in the best interests of science.[268] Mayur Amin told us that Elsevier also participated in the consortium and also felt that authors were "somewhat reluctant" to engage.[269]

152. **Peer review is a burden on researchers but a necessary one, as it is an integral part of the scientific and research process and is part of the role of a researcher. However, we encourage publishers to work with their reviewers, to identify innovative new practices to minimise the burden.**

Recognition

153. Despite the importance with which it is viewed, peer review is rarely acknowledged as part of the formal workload of an academic researcher.[270] Dr Fiona Godlee, from BMJ Group, told us that:

> scientists are under a lot of pressure on a whole host of things, such as getting funding and the bureaucracy surrounding scientific research, and peer review is just

264 Q 181

265 As above

266 "Home", Neuroscience Peer Review Consortium, http://nprc.incf.org/

267 Q 129

268 Q 181

269 Q 129

270 Ev 146, paras 5–7 [Vitae]

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> one other thing. […] the more we can do to make it something that they gain proper recognition for, the better.[271]

154. Tracey Brown, Managing Director at Sense About Science, agreed that there were "very few incentives" to encourage peer review within the university system and that there was "no recognition" of it in a researcher's career.[272] This was particularly the case for reviewing manuscripts according to Dr Janet Metcalfe, from Vitae, who described peer review as an "invisible contribution to the academic community except when you get on to an editorial board or grant panel".[273]

155. Professor Rick Rylance, from RCUK, considered that "peer review should be part of professional development for researchers" and that it was "important that their employers recognise quite how much labour is put into it and how important it is in terms of not just their personal but their general benefit".[274] Indeed, the British Medical Association suggested some form of "professional recognition, accreditation or development of a reward system to encourage participation" in peer review.[275]

Rewards and accreditation

156. In the course of our inquiry we have questioned how carrying out peer review can be better recognised as a professional activity so that reviewers receive credit for their time and effort. Dr Gulley explained that some journals also give rewards "to their top referees".[276] Professor Ian Walmsley, University of Oxford, gave us an example:

> the American Physical Society has an outstanding referee award. Every year it makes a big deal of naming people who have provided consistent, high quality and useful reviews. […] It is not a direct financial compensation for time. However, I think most people would say this is a contribution to the community which reaps values in other ways.[277]

157. Another way in which journals show their appreciation to reviewers was described by Dr Robert Parker, from the RSC:

> Being a referee is often used as one of the criteria for tenure in the US. We deal with a lot of requests from US referees, young academics, wanting a letter of endorsement saying that they have acted as a referee for the RSC and that they have been reasonably good at it. It will help them to gain tenure.[278]

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271 Q 128

272 Q 90

273 Q 220

274 Q 263

275 Ev w20, Executive Summary

276 Q 28

277 Q 220

278 Q 26

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Dr Nicola Gulley told us that IOP Publishing also help with requests to "support younger researchers in their applications for green cards".[279]

158. It has also been suggested that payment could be used as an incentive for researchers to undertake the burden of peer review.[280] Dr Parker told us:

> Remuneration would be a difficult thing because, if you gave any realistic payment for the time that is involved, it would be a huge amount of money and it would have to be recovered from somewhere. It is just moving a financial burden around the whole system. The system relies on the benefits that people see from being involved in peer review. There is a quid pro quo as long as you are someone who publishes as well; you are an author as well as a referee, which is not always the case.[281]

There are also concerns that financial remuneration might reduce the impartiality of reviewers.[282] Some have suggested "payment in kind" (such as a free subscription) or a virtual payment system.[283]

159. Another form of recognition for reviewers is through accreditation. Dr Parker considered that this "might be" helpful to reviewers but "it would be quite difficult to do" because the RSC has about 33,000 referees all around the world that it uses routinely.[284] Dr Philip Campbell, from *Nature*, disagreed:

> In principle, I don't think it is [difficult to do]. A manuscript tracking system can be easily programmed. If what is needed is that the referees themselves get a proper statement of credit, that is fine. It is equally easy for a journal to decide to publish a list of everyone who has peer reviewed for them over a particular period.[285]

160. Professor Rick Rylance, from RCUK, considered that "there would have to be quite a complicated cost-benefit analysis" on whether peer review should be formally accredited.[286] His instinct was that it probably wouldn't be worth it.[287]

161. An easier and, currently, more commonly used approach is the annual publication by journals of a list of the reviewers they have used, or provision to reviewers of their reviewing service at the end of each year. Professor John Pethica explained that "at the Royal Society the referee is not paid, but we do publish a list of the referees at the end of the year to formally thank them for their input".[288] Dr Nicola Gulley told us that IOP Publishing also do this for some research communities.[289] The *Nature* journals are working

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279 Q 28

280 Ev w46, para 24 [Professor John Scott]

281 Q 28

282 For example, Ev w46, para 24 [Professor John Scott]

283 Ev w21, para 14 [British Medical Association]; and Ev w86, para 8 [Professors Jeremy Fox and Owen Petchey]

284 Q 29

285 Q 130

286 Q 263

287 *As above*

288 Q 28

289 *As above*

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on giving more credit privately to referees directly at the end of every year, letting them know what work they have done.[290] Dr Philip Campbell explained that "in a very competitive academic world, when you are going for tenure or for some other promotion, to be able to have something like that stated on the record is helpful".[291] Dr Malcolm Read, from JISC, suggested that "greater transparency in the peer review process" might improve the situation, ensuring that reviewers' work was known to their peers.[292] Dr Andrew Sugden, from *Science*, warned that there can be a "downside" to this approach, as some reviewers prefer to remain anonymous.[293]

162. In the future, Mayur Amin, from Elsevier, told us that it may become easier to set up accreditation systems in peer review:

> the advent of ORCID, which is [a] unique author identifier [system] may give us an opportunity also to be able to track with [a] unique identifier those people who have refereed and acted as referees. That may help to provide a stronger accreditation platform than is currently possible.[294]

163. Dr Mark Patterson, from PLoS, agreed that ORCID would "help to identify who has done what peer review".[295] Accurate identification of researchers and their work is not only useful in terms of tracking reviewer and author contribution, it is also increasingly important because of the problems of name ambiguity. Dr Parker, from the RSC, told us that this was "an issue, particularly in places like Korea, where there are only five or six really common surnames".[296] However, it was not only an international problem, for example, there were "two people with the same name both in the chemistry department at the University of Oxford".[297] The ORCID Initiative aims to establish an open, independent registry that is adopted by the publishing industry. Its goal is to resolve the systemic name ambiguity problem, by means of assigning unique identifiers linkable to an individual's research output.[298]

164. **In order to help research institutions recognise the work carried out by reviewers on peer review, publishers first need to have in place systems for recording and acknowledging it. A variety of approaches are in use, including rewards, awards and letters of endorsement and these should be encouraged. New initiatives for accurate author and reviewer identification may make it easier for publishers to track reviewer contribution to the peer-review process.**

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290 Q 101 [Dr Philip Campbell]

291 *As above*

292 Q 187

293 Q 130

294 *As above*

295 Q 190

296 Q 54

297 Q 54 [Dr Robert Parker]

298 "Open Researcher & Contribution ID", www.orcid.org

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Assessment

165. Professor John Pethica, from the Royal Society, told us that in addition to assessing manuscripts for the purposes of "generating a coherent scientific record", peer review is often "used for other proxy purposes and assessment" and that this "can, potentially, influence how it is carried out".[299] The proxy use that Professor Pethica refers to is the perceived importance of a piece of published research, as assessed during the peer-review process. When research is published in a high-impact journal—generally taken as one with a high Impact Factor (see paragraph 59)—that traditionally signals to the rest of the academic community that the research is perceived to be important. This has led to the suggestion that scientists have become "increasingly desperate to publish in a few top journals".[300] However, as we have noted, the Impact Factor relates to the journal as a whole rather than the individual published articles. Nonetheless, publication in a high-impact journal is frequently used as a proxy measure for assessing both the work of individual researchers and research institutions.

166. We questioned the logic of using the Impact Factor as a measure of quality. Professor Sir Adrian Smith, from BIS, told us that:

> It is a little circular, is it not, because why would a journal be designated as high impact? It will be related to the quality of the journal, which, in some sense, will be related to the selectivity of the journal, which will be related to the fact that it is sifting out, to some extent, the cream of the things that are submitted to it.[301]

167. Sir Mark Walport, from the Wellcome Trust, disagreed:

> Impact factors are a rather lazy surrogate. We all know that papers are published in the "very best" journals that are never cited by anyone ever again. Equally, papers are published in journals that are viewed as less prestigious, which have a very large impact. We would always argue that there is no substitute for reading the publication and finding out what it says, rather than either reading the title of the paper or the title of the journal.[302]

Professor Rick Rylance, from RCUK, added that "there is no absolute correlation between quality and place of publication in both directions".[303]

168. Below we discuss the use of Impact Factor as a measure of quality in relation to assessing excellence in research institutions as well as assessing researchers and the influence on research careers.

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299 Q 5

300 P. A. Lawrence, *The politics of publication*. Nature, 2003, vol 422, pp 259–61

301 Q 288

302 Q 255

303 *As above*

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Assessing research excellence

169. The Higher Education Funding Council for England (HEFCE) distributes public funds to higher education institutions (HEIs) in England for teaching, research, and related activities. There are similar funding councils in Northern Ireland, Scotland and Wales. HEFCE provides quality-related (QR) research funding, on the basis of periodic assessments of the performance of universities and institutions. The last was the Research Assessment Exercise (RAE) in 2008; the next will be the Research Excellence Framework (REF), scheduled for 2014. The criteria for assessment in the REF are currently being developed.

170. The Academy of Medical Sciences told us that "a strong publication record is a key determinant in the allocation of grant funding both to individual researchers and to their universities via processes such as the [REF]".[304] Professor Thomas Ward, Pro-Vice-Chancellor at the University of East Anglia added that:

> The Research Excellence Framework assessing UK Universities is seeking to apply metrics to some aspects of the periodic assessments of research quality. Some of these metrics depend on peer-reviewed publications and citation counting of the articles cited.[305]

171. Dr Parker, from the RSC, told us that:

> When it was the RAE before, [the panel members] always said that they would look at the quality of the papers themselves. They would read the papers themselves and wouldn't rely on the Impact Factors of the journals in which they had been published. […] How they are going to be used in REF, if it changes, I don't know.[306]

172. The proposed use of bibliometrics (that is, citation analysis, which includes counting how many times a particular piece of work has been cited by others), along with the inclusion of an impact measure, were the two major characteristics that were to differentiate the REF from the RAE. The International Association of Scientific, Technical and Medical Publishers told us that:

> Metrics-based assessments have been around since the 1960s […] The literature on these approaches is large but the majority of academics tend to critique these initiatives along the lines of Einstein's quote "not everything that can be counted counts, and not everything that counts can be counted".[307]

173. In April 2010, an article in the Times Higher Education Supplement suggested that HEFCE might not be using citation data in the REF process.[308] HEFCE confirmed to us that it had "ruled out the systematic use of citation data as a key indicator of research

304 Ev 133

305 Ev w98, para 23

306 Q 32

307 Ev w126

308 "Nervous Hefce 'edging out' of REF citations", Times Higher Education Online, 1 April 2010, www.timeshighereducation.co.uk

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quality at present".[309] David Sweeney, from HEFCE, also clarified the situation for the use of Impact Factors:

> With regard to our assessment of research previously through the Research Assessment Exercise and the Research Excellence Framework, we are very clear that we do not use our journal Impact Factors as a proxy measure for assessing quality. Our assessment panels are banned from so doing. That is not a contentious issue at all.[310]

He added that "the [REF] panels are meeting now to develop their detailed criteria, but it is an underpinning element in the exercise that journal Impact Factors will not be used".[311]

Influencing research careers

174. While, in the light of HEFCE's statement, the use of journal Impact Factors to assess research quality may prove not to be a contentious issue so far as the REF is concerned, the fact remains that researchers still feel under pressure to get their work published in the high-impact journals. When we asked Professor Ian Walmsley, from the University of Oxford, why this is the case, he responded that:

> Perhaps a simple answer to that from a parochial view of a university person is that that is the way one's career advances. […] a lot of very good work gets published in journals that do not have such high visibility, and I think that is quite crucial. None the less, having a highly cited paper in a journal that people would regard as high profile is considered important as a way to raise your visibility and develop your career. […]when a CV comes across the desk of a head of department for a faculty post, as a first pass through it makes a difference where those papers are published.[312]

175. However, as we previously noted, decisions about which papers are accepted by high-impact journals "can seem rather random", as a result of decisions that "are often editorial ones based on topicality".[313] We also questioned whether a researcher's contribution to peer review, as a reviewer, should be formally recognised as part of their work and whether this could be taken account of when evaluating them for promotion. Professor Walmsley told us that:

> in evaluating people for promotion one would look not only but primarily at the quality of the research undertaken and published but also at how they have contributed to the working of the community. […] One would normally expect to see, on a CV for evaluation, that somebody had undertaken reviewing for research councils or, in this sense, professional societies or other publishers for journals.
>
> As to the extent one wishes to quantify that to a greater degree, I would be cautious about that. One doesn't want to be prescriptive. One wants to see some threshold of

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309 Ev 85, para 9

310 Q 255

311 Q 256

312 Qq 216–17

313 Ev w95, para 18 [British Antarctic Survey]

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> evidence that people are playing a role without being quantitative about exactly how much they ought to be doing.[314]

176. Sir Mark Walport, from the Wellcome Trust, added that:

> I think this is one of those things where it is easy to say that you need to give people recognition for peer review. The reality is are you going to promote someone from a lectureship to a senior lectureship or from a senior lectureship to a readership on the basis of review? You are not going to do that. You are going to do it on the core scholarly activities which are education and the research itself. It is something that the community has to recognise. It is beneficial to do peer review. As I said before, it is part of your continuous professional development. It is about keeping up to date with the field.[315]

177. **We have concerns about the use of journal Impact Factor as a proxy measure for the quality of an individual article. We have been reassured by the research funders that they do not consider that publication in a high-impact journal should be used as a proxy measure for assessing either the work of individual researchers or research institutions. We agree that there is no substitute for reading the article itself in assessing the worth of a piece of research. We consider that there is an element of chance involved in whether researchers are able to get their articles published in high-impact journals, depending on topicality and other factors. Research institutions should be cautious not to attach too much weight to publication in high-impact journals when assessing individuals for career progression.**

314 Q 224

315 Q 263

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4 Data management

178. In paragraphs 21-22 we discussed the need for reviewers to assess manuscripts to ensure that they are technically sound. One of the questions that arose in the course of this inquiry was, how far should reviewers be expected to go to assess technical soundness? In this chapter we discuss the feasibility of reviewing the underlying data behind research and how those data should be managed.

The need to review data

179. Sense About Science told us that:

> The ultimate test of scientific data [...] comes through its independent replication by others; peer review is the system which allows publication of data so that it can be both criticised and replicated. It is a system which encourages people to ask questions about scientific data.[316]

180. Replication does not usually take place during the peer-review process, although, "in exceptional circumstances, referees will undertake considerable work on their own initiative to replicate an aspect of a paper".[317] Professor Sir Adrian Smith, Director General of Knowledge and Innovation in the Department for Business, Innovation and Skills (BIS), acknowledged that reviewing the underlying data is "rather difficult" where data have come out of laboratories or field studies.[318] He added, however, that replication of "somebody's derivation of a mathematical formula", for example, was possible.[319]

181. Replication of reported results is only possible if the submitted manuscript contains sufficient information to allow others to reproduce the experiments. Dr Mark Patterson, from the Public Library of Science (PLoS), told us that reproducibility is a "gold standard" that publishers should be aiming for.[320] Dr Philip Campbell, from *Nature*, explained that "it is part of the editor's and peer-reviewer's responsibilities to ensure that data and materials required for other researchers to replicate or otherwise verify and build on the work are subsequently available to those who need it".[321] Dr Rebecca Lawrence, from Faculty of 1000 Ltd, added that:

> within the kind of time frames of peer review, [...] you aren't going to be able to repeat the experiment yourself. All you can do is say that it seems okay; it looks like it makes sense; the analysis looks right; the way they have conducted it makes sense and the conclusions make sense. I think the issue of reproducibility must come after publication [...] That is when people say, "I couldn't reproduce it", or, "I could".[322]

316 Ev 75, para 11

317 Ev 87, para 13 [Philip Campbell]

318 Q 297

319 *As above*

320 Q 203 [Dr Mark Patterson]

321 Ev 87, para 16

322 Q 206

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Professor Sir John Beddington, the Government Chief Scientific Adviser, explained that this was indeed the way in which science progresses:

> We see all the time in the journals that are published this week that there will be people who have challenged peer-reviewed papers that were published some years ago and pointed out fundamental flaws in them or new evidence that undermines the conclusions of those papers.[323]

182. However, Dr Fiona Godlee, from BMJ Group, explained that there can be problems with inadequate reporting of data:

> We have to acknowledge that peer review is extremely limited in what it can do. We are sent an article, effectively, sometimes with datasheets attached. [...] A vast amount of data do not get through to journals. We know that there is under-reporting, misreporting and a whole host of problems, and journals are not adequate to the task that they are being given to deal with at the moment.[324]

183. Dr Mark Patterson explained what PLoS did when problems of under-reporting arose:

> in general, we have a requirement that, in the interests of reproducibility, you must make the data available. We have had cases where readers have reported to us a problem with getting hold of data from an author published in a PLoS journal. We follow that up. We talk to the author and ask what the issues are. In the majority of cases the author will deposit their data and it is a misunderstanding, almost, that they haven't deposited their data in the appropriate repository, or whatever it is that is done in that particular community.[325]

184. **We conclude that reproducibility should be the gold standard that all peer reviewers and editors aim for when assessing whether a manuscript has supplied sufficient information, about the underlying data and other materials, to allow others to repeat and build on the experiments.**

Depositing data during the peer-review process

185. The body of data reviewed can often be large and/or of a complex nature. An increasing challenge is how to make these large or complex datasets available for reviewers to assess confidentially.[326] Dr Andrew Sugden, from *Science*, told us that "currently no databases allow secure posting for the purposes of peer-review, and some authors are unwilling to release data prior to publication".[327]

186. PLoS explained that:

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323 Q 296

324 Q 106

325 Q 203

326 Ev 93, para 23; and Ev 141, para 27 [Dr Andrew Sugden, *Science*]

327 Ev 141, para 27

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> In some fields—for example, genetics and molecular biology—there are well-established curated databases where data can be deposited and linked to particular research articles. Examples of such databases include those available at the European Bioinformatics Institute in Hinxton, UK. The curators who run the databases perform critical quality control checks analogous to the technical assessment of research articles.[328]

These quality control checks are independent of the peer-review process involved in assessing the related research article.

187. The issue of quality control is an important one. Dr Andrew Sugden explained that reviewing data "that is many times the size of the submitted text is a burden to reviewers" and that "standards for reporting and presenting large data sets that allow common analysis tools could help greatly".[329] BioMed Central agreed, adding that:

> Capturing the vast amount of data that is continuously generated and ensuring consistent data deposition according to agreed formats and nomenclatures will be crucial to enabling smooth meta-analyses of datasets from different databases.[330]

188. The area of data deposition is evolving quickly. Dr Mark Patterson, from PLoS, highlighted a new project called Dryad.[331] This is an international repository of data underlying peer-reviewed articles in the basic and applied biosciences, governed by a consortium of journals.[332] Dr Patterson explained how Dryad works:

> The idea is that this is a place where you can deposit your data set [...] and where you can give privileged access to reviewers, for example, during the peer review process and then make the data available once the article is published.[333]

Editors and journals are aiming to "facilitate their authors' data archiving by setting up automatic notifications to Dryad of accepted manuscripts", and thereby streamlining the process for depositing data after publication.[334] Dr Patterson told us that Dryad "is developing a kind of generic database for data sets [...] particularly in the fields of ecology and evolution [...] but they are already talking of expanding into other areas".[335] There is also an ongoing project, DryadUK, funded by the Joint Information Systems Committee (JISC), to develop a mirror site in the UK.[336]

189. **If reviewers and editors are to assess whether authors of manuscripts are providing sufficient accompanying data, it is essential that they are given confidential access to relevant data associated with the work during the peer-review process. This can be**

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328 Ev 80, para 29

329 Ev 141, para 27

330 Ev 108

331 Q 206

332 "About Dryad", Dryad, http://datadryad.org/

333 Q 206

334 "About Dryad", Dryad, http://datadryad.org/

335 Q 206

336 "About Dryad", Dryad, http://datadryad.org/

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problematical in the case of the large and complex datasets which are becoming increasingly common. The Dryad project is an initiative seeking to address this. If it proves successful, funding should be sought to expand it to other disciplines. Alternatively, we recommend that funders of research and publishers work together to develop similar repositories for other disciplines.

Technical and economic challenges of data storage

190. Dr Malcolm Read, from JISC, cautioned that "there are technical and economic problems" associated with making data available in the long term.[337] He told us that "keeping [data] available, possibly in perpetuity, could end up as a cost that the sector simply could not afford",[338] and explained that different approaches would be required depending on the type of data:

> Keeping available all the outputs of the experiments on the Large Hadron Collider is just infeasible. Other data, such as environmental data, must be kept permanently available. I think that should be made more open. Of course, you can't repeat an earthquake and that data must never be lost. A lot of social data in terms of longitudinal studies make sense only if the entire length of the study is available. In some areas of science the data is produced by computers and programs. In that case, if the data is very large, an option might be simply to re-run the program.[339]

191. Sir Mark Walport, from the Wellcome Trust, agreed that there are "major costs" involved.[340] He added that the "costs of storing the data may in the future exceed the costs of generating it" and that this was an issue for research funders because they fund the research and so have to help with the storage.[341] He added that "our funding is a partnership between the charity sector and the Government and [data storage] is a shared expenditure".[342] Professor Sir Adrian Smith acknowledged that cost was "a real problem".[343] However, given how cheap data storage has become, we consider that this cost is a result of the sheer growth in quantities of data.[344]

192. Dr Philip Campbell, from *Nature*, provided an example of the potential costs involved in making data, software and codes available:

> I was talking to a researcher the other day and he had been asked to make his code accessible. He had had to go to the Department of Energy for a grant to make it so. He was asking for $300,000, which was the cost of making that code completely

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337 Q 208

338 *As above*

339 *As above*

340 Q 280

341 *As above*

342 *As above*

343 Q 300

344 For example, "Taking a Hard Look At Storage Costs", enterprisestorageforum.com, 8 August 2008

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> accessible and usable by others. In that particular case the grant was not given. It is a big challenge in computer software and we need to do better than we are doing.[345]

He added, however that this should not prevent others from validating the research by attempting to reproduce the work, for example, "you can allow people to come into your laboratory and use the computer system and test it".[346]

193. Dr Malcolm Read explained in more detail why making software code available can be difficult:

> if you are talking about stuff running on so-called super-computers, you have to know quite a lot about the machine and the environment it is running on. It is very difficult to run some of those top-end computer applications, even if, of course, they are prepared to make their code available.[347]

He added that the way to get around this problem was to ensure that authors "make clear the nature of the program they are running and the algorithms".[348] Dr Read explained that:

> A computer will not have any value beyond the way it is programmed. As long as they define the input conditions, as it were, and what the program is designed to do, you should be able to trust the outputs. That would be no different from any statistical test that is run on a data set, so long as you say what the test is. You then start to get down to the accuracy of the data itself, which is perhaps a more fundamental issue than the software or statistical test that is being run on it. I would say that the availability of the research data is a more important issue because then, of course, other researchers could run different types of algorithms on different types of computer on that data. I think access to the data is more fundamental.[349]

A culture of openness

194. Access to data is fundamental if researchers are to reproduce and thereby verify results that are reported in the literature. Professor John P. A. Ioannidis, from the University of Ioannina School of Medicine, stated in a recent *Scientific American* article that:

> The best way to ensure that test results are verified would be for scientists to register their detailed experimental protocols before starting their research and disclose full results and data when the research is done. At the moment, results are often selectively reported, emphasizing the most exciting among them, and outsiders frequently do not have access to what they need to replicate studies. Journals and funding agencies should strongly encourage full public availability of all data and analytical methods for each published paper.[350]

345 Q 136

346 Q 137

347 Q 202

348 Q 203

349 *As above*

350 J. P. A. Ioannidis, *An epidemic of false claims*, Scientific American, June 2011

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195. In response, Professor Rick Rylance, from Research Councils UK (RCUK), stated that:

> I endorse the broad principles of that. The one slight reservation I would have is that, quite often, research is a process of discovery and you don't quite know at the beginning what the protocols and procedures are that you are going to use, particularly in my domain. I would have a slight reservation about that, but the principles are right.[351]

196. Many of the individuals we heard from were broadly in favour of the principle of openness with regard to data availability post-publication.[352] We were told that:

> the principles of openness in science, of making data available and open, are something that the Wellcome Trust and other funders of biomedical research around the world are fully behind and completely supportive of.[353]

197. Professor Sir Adrian Smith, from BIS, explained the current situation and the Government's position on data availability:

> There is a great movement now and a recognition of openness and transparency, which has always been implicit as a fundamental element of the scientific process. But the more we collect large datasets, you have to give other people, as part of the challenge process, the ability to revisit that data and see what they make of it with openness and transparency. There is general support these days for the presumption that the research, the associated data and if you have written a computer code to assess it, should all be available and up for challenge and testing validation. In fact, explicitly the Research Councils encourage that, as Government Departments do. However, there can be complex and legitimate reasons for not necessarily, at least in the short term, being that transparent. An awful lot of policy in recent years has meant that we have been trying to lever more out of public investment by joint working with business and industry and levering additional funding. Once you get into that territory, you do have commercial and intellectual property constraints on a temporary basis at least, for openness and transparency. The presumption is that, unless there is a strong reason otherwise, everything should be out there and available.[354]

198. Sir Adrian added that "there will always be issues of personal data protection, commercial interests and intellectual property and national security, so the situation is quite complex".[355] Indeed, Dr Malcolm Read, from JISC, explained that "a blanket mandate on open data might not be feasible but the predisposition should be to make data openly

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351 Q 277

352 For example: Q 136 [Dr Philip Campbell]; Q 207 [Dr Mark Patterson]; and Q 278 [David Sweeney]

353 Q 277 [Sir Mark Walport]

354 Q 298

355 Q 299

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available".[356] David Sweeney, from HEFCE, agreed that consideration needed to be given to "the particular circumstances and the sensitivity".[357]

199. Sir Adrian explained that "different communities, different cultures and different forms of data pose different issues".[358] One example where making data available could be challenging is where confidential patient data are involved in biomedical research. The BMJ Group stated that:

> The Wellcome Trust and other major international funders have called for public health researchers to make studies' raw data available. *Annals of Internal Medicine*, the *BMJ*, *BMJ Open*, the PLoS journals and several BMC journals—among others—actively encourage authors to share data in online repositories with necessary safeguards to protect patient confidentiality.[359]

However, "if you are dealing with clinical material then the confidentiality of participants is paramount. You have to manage data so that they are appropriately anonymised and people cannot be revealed".[360] Dr Fiona Godlee did not see confidentiality as a problem:

> when one is talking about large datasets, confidentiality has already been dealt with, and we should not use that as an excuse for not looking at [data deposition]. There are no doubt practical issues, but […] nationally, we ought to have systems for data depositioning. The practical problems will be resolved, as with trial registration, which seemed impossible five or 10 years ago, and it is now routine.[361]

200. Dr Michaela Torkar explained in more detail the challenge faced by publishers and how these might be overcome:

> It is only if the standards are well established and agreed on by the community that you can really enforce [data deposition] and insist on it as a publisher. It becomes more difficult when, say, databases are not quite ready to accept all of the submissions or formats. That becomes a real barrier for authors. They cannot publish because the publisher insists on it. I think there is a lot of responsibility on the publishers to interact with different communities to establish the right databases and standards and where the limitations are and to make it mandatory in some cases and in others encourage submission and deposition, in particular. I think it depends very much on the communities.[362]

201. If mandatory data deposition is problematic, the question becomes how can we encourage rather than enforce it? Dr Mark Patterson, from PLoS, told us that:

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356 Q 208

357 Q 279

358 Q 300

359 Ev 73, para 19

360 Q 278 [Sir Mark Walport]

361 Q 157

362 Q 207

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> First, it would be really helpful for publishers to include some kind of statement about data availability so that it is clear. How do you get hold of this data? Are there any restrictions in terms of accessing it because of the size of the data in some fields or whatever? Secondly, there is an opportunity to incentivise the sharing of data by giving greater credit and finding mechanisms to reward researchers who do that to assess the impact of that sharing as well. Rather than focusing everything on what they have published in whatever journal, to start thinking about different kinds of outputs and their value.[363]

Dr Malcolm Read, from JISC, agreed that researchers "would deserve credit and recognition for that".[364]

202. We note that the Royal Society launched its *Science as a public enterprise* project in May 2011.[365] This will look at how scientific data should best be managed and may explore some of the issues highlighted in this chapter.

203. **Access to data is fundamental if researchers are to reproduce, verify and build on results that are reported in the literature. We welcome the Government's recognition of the importance of openness and transparency. The presumption must be that, unless there is a strong reason otherwise, data should be fully disclosed and made publicly available. In line with this principle, where possible, data associated with all publicly funded research should be made widely and freely available. Funders of research must coordinate with publishers to ensure that researchers disclose their data in a timely manner. The work of researchers who expend time and effort adding value to their data, to make it usable by others, should be acknowledged as a valuable part of their role. Research funders and publishers should explore how researchers could be encouraged to add this value.**

363 Q 208

364 *As above*

365 "Royal Society launches study on openness in science", Royal Society Press Notices, http://royalsociety.org, 13 May 2011

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5 Post-publication approaches

Post-publication review and commentary

204. In addition to the checks and balances carried out in pre-publication peer review, the "wider scientific scrutiny post-publication is as important […] indeed, this is a form of secondary peer review".[366] The British Sociological Association considered that:

> Peer review is in fact a layered process in which initial peer review of proposals leads into peer review of publications and thence into post-publication peer review (the latter is sometimes referred to as academic impact). The two are related and equally necessary processes.[367]

205. Review after publication can be carried out in a number of ways. Historically, where fellow researchers either agreed or disagreed with an author's findings, they would publish their own manuscripts or correspondence with the relevant journal in order to progress scientific understanding in their field. Professor John Pethica, Physical Secretary and Vice President of the Royal Society, told us that:

> [Post-publication review] is implicit in the fact that people publish subsequent papers saying, "X was right, Y was wrong, and we did this and produced that." That is implicit in the whole structure of scientific papers and there is a preamble about what has happened so far.[368]

206. In recent years, with the growth of online communication systems, publishers have started to introduce more formal processes for rapid responses to published articles. BMJ Group explained that:

> Many online journals encourage continuing discussion of their content. The BMJ's Rapid Responses or eletters, posted daily, provide a voluminous, lively, and often scholarly discourse and constitute an important source of ongoing peer review.[369]

207. While the BMJ Group reports "voluminous" commenting, others have been less successful with this approach. The Royal Society has an e-Letters system, which allows researchers to comment directly on a published article, the comment is then linked to the article for others to see.[370] This has not proven to be particularly popular as "remarkably few people choose to use it".[371] Other learned society publishers we consulted did not have any formal processes for post-publication review and commentary.[372]

[366] Ev w77, para 4 [Royal Meteorological Society]

[367] Ev w111, para 4

[368] Q 56

[369] Ev 73, para 21

[370] "eLetters", Philosophical Transactions of the Royal Society B, http://rstb.royalsocietypublishing.org

[371] Q 55 [Professor John Pethica]

[372] Q 55 [Dr Nicola Gulley and Dr Robert Parker]

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208. Other more informal approaches, such as the use of online blogs and social networking tools like Twitter, are becoming more widespread. Sir Mark Walport, Director of the Wellcome Trust, told us that:

> Web-based publishing brings new opportunities, because it brings the opportunity for post-publication peer review and for bloggers to comment. […] This is a fast-evolving space. As the new generation of scientists comes through who are more familiar with social networking tools, it is likely that Twitter may find more valuable uses in terms of, "Gosh, isn't this an interesting article?" All sorts of things are happening. It is quite difficult to predict the future. It can only be an enhancement to have the opportunity for post-publication peer review.[373]

209. The BMJ Group added that with Twitter, even though "their [character limit] allow only the briefest comment, tweets are facilitating rapid and widespread sharing of links to articles and other online content and can, it seems, quickly expose failings in peer review".[374] For example, in December 2010, "many scientists blogged immediate criticisms of [a] widely publicized paper […] heralding bacteria that the authors claimed use arsenic rather than phosphorus in their DNA backbone".[375] Many of the initial criticisms came from "the scientific blogosphere".[376] Since then, "*Science*, the journal that published the original paper, has published eight papers criticising it, as well as a response by the original researchers"; the debate continues.[377]

210. We questioned whether a potential growth in post-publication review and commentary would lead to declining expectation of pre-publication peer review by publishers. Dr Andrew Sugden, Deputy Editor & International Managing Editor at *Science*, did not believe this would happen.[378] Mayur Amin, Senior Vice President of Research & Academic Relations at Elsevier, agreed, adding that post-publication review and commentary would not "act as a substitute" for peer review.[379]

211. **Post-publication review in an era of new media and social networking tools, such as Twitter, is very powerful. The widespread sharing of links to articles ensures that research, both accurate and potentially misleading, is rapidly spread across the world. Failings in peer review can, rightly, be quickly exposed. However, there is no guarantee that false accusations of failings will not also be spread. Pre-publication peer review still has an important role to play, particularly in relation to assessing whether manuscripts are technically sound prior to publication. However, we encourage the prudent use of online tools for post-publication review and commentary as a means of supplementing pre-publication review.**

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373 Q 282

374 Ev 73, para 21

375 A. Mandavilli, *Peer review: Trial by Twitter*, Nature, 2011, vol 469, pp 286–87

376 "Arsenic-based bacteria: Fact or fiction?", New Scientist Online, 27 May 2011

377 *As above*

378 Q 159

379 Q 160

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Encouraging participation

212. One of the reasons that post-publication review and commenting is not yet considered to be a viable replacement for pre-publication peer review is that the numbers participating in it are low. The publishers, John Wiley & Sons, told us that:

> Evidence for the efficacy and usefulness of post-publication comment is not yet convincing, both in terms of the quantity and quality of such comments, although we expect to see links to blogs and other post-publication comments as standard practice, and our systems and processes will accommodate this if the academic and professional communities whom we serve want it. Post-publication comment is likely to be a supplement to pre-publication review rather than a substitute for it.[380]

213. Dr Philip Campbell, Editor-in-Chief of *Nature* and Nature Publishing Group, explained that the lack of commenting might be because "there is no prestige or credit attached [to it], there is the risk of alienating colleagues by public criticism, and everyone is busy".[381] Sir Mark agreed that academics do not like to "write critical comments of each other alongside the articles".[382] He added, however, that:

> There are some very interesting community issues here. In the humanities, there is a long tradition of writing book reviews where one academic is scathingly rude about another academic. [...] In the case of the scientific world, that tearing apart is done at conferences and at journal clubs. The scientific community does not have a culture of writing nasty things about each other.[383]

214. One of the main challenges is therefore to get post-publication commenting tools more widely used in order to "get the critical views across" and "encourage people to air their criticisms and put their names to them without fear of any repercussions".[384]

215. The issue is not just to get more researchers participating in public commentary; it is also essential that comments be fairly represented online. Dr Fiona Godlee, Editor-in-Chief of *BMJ* and BMJ Group, explained that:

> There are great variations [in journal practices]. Some journals exercise a liberal view, which is the *BMJ*'s view. Others have a much more editorially tight control over what gets written, post-publication. In some cases that I am aware of, critical comment about papers does not get out into the public domain. The other problem is that even when it does, the authors often don't respond. One is left with a situation that is far from perfect. There is a lot of progress with the Internet but it is still not perfect.[385]

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380 Ev 66, para 8.1

381 Ev 89, para 47

382 Q 282

383 Q 284

384 Q 212 [Dr Michaela Torkar]

385 Q 160

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216. However, the system could be considered to be "self-correcting" as "a scientist who wrote something that was particularly egregious would be subject to the peer review of their own community".[386]

Filtering content

217. While post-publication review and commentary can be used to further improve the technical assessment of published research, it can also be utilised to fulfil another one of the functions of peer review: to filter research publications and act as a guide for what readers might find interesting.

218. The extreme situation one could envisage would be that in which all research is published and then filtered, an approach advocated by Dr Richard Smith, former Editor of the *BMJ*.[387] However, we have already discussed why publishing research prior to reviewing it could be problematic, in particular for the biomedical sciences (see paragraphs 69-70). Mayur Amin, from Elsevier, explained the consequences of such an approach: "Where everything is published before it gets its first peer review filter, we may end up with a system where it is hard to differentiate between evidence-based conclusions and conclusion-based evidence."[388]

219. However, with the growth of online repository journals (see paragraph 80) and the development of more advanced tools for post-publication review and commentary, the role of the publisher in filtering research prior to publication is diminishing. Professor Ron Laskey, Vice President of the Academy of Medical Sciences, told us that "if there is a move towards publication in journals such as *PLoS ONE* and where impact is less important, then a subsequent impact assessment such as the Faculty of 1000 could become increasingly important".[389]

220. Faculty of 1000 Ltd (F1000) is an online service that collects the comments of selected experts on research articles that have already been published in biology and medical journals. F1000 told us that:

> Our Faculties of 10,000 experts across biology and medicine are asked to highlight those publications that they believe to be particularly important, irrespective of where they are published (the majority of our evaluations—86%—are *not* from what are often thought of as the top-tier journals, e.g. *Nature*, *Science*, *Cell*, *NEJM*, *JAMA*, *Lancet*, *BMJ*). Faculty Members are asked to provide a rating (recommended; must read; or exceptional) and then provide a short commentary ("evaluation") on why they believe the article to be so interesting and how it might impact their own research or specialty, and their names are listed against this. These evaluations are effectively short open referee reports and the service acts as a positive filtering service.

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386 Q 286 [Sir Mark Walport]

387 "Richard Smith: Scrap peer review and beware of "top journals"", BMJ Blogs Online, 22 March 2010, http://blogs.bmj.com

388 Q 95

389 Q 57

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> Multiple Faculty Members can evaluate the same article, providing a combined higher rating, or can write a dissent if they disagree with an existing evaluation. The authors of the article can write a comment in response to the evaluation, and registered users can also write comments.[390]

221. F1000 has policies to prevent bias in expert commentary; for example, the service is currently adding a specific declaration that Faculty Members will confirm for every evaluation they carry out. This declaration will state:

> This work has been selected for evaluation entirely on its scientific merit. Neither I nor my co-evaluators (where applicable) have collaborated with the authors in the past year or been influenced in the selection of this work directly or indirectly by the author/s or by any third party. This evaluation presents my opinions and those of any listed co-evaluators.[391]

222. Feedback on the usefulness of F1000 was limited. Professor Ron Laskey told us that "its use is patchy but it is recognised as providing a valuable service".[392] Dr Robert Parker, Interim Chief Executive of the Royal Society of Chemistry, added that it was generally a positive thing.[393] At present this service is limited to biology and medicine .

223. **While it is too early to make a judgement on post-publication filtering mechanisms, such as Faculty of 1000 Ltd, we recognise that such a system could offer a valuable service if widely used. It is likely that such services will become more important with the growth of repository-type journals.**

Measuring impact

224. The post-publication filtering of which articles might be of particular interest and subsequent commenting on those articles could be considered to be the foundation of a new model for measuring impact. Indeed, by assessing a specific article in this way, the status quo of using a journal's Impact Factor to assess impact may be threatened. The Public Library of Science (PLoS) told us that:

> a new paradigm is emerging and is being tested in several fields whereby articles are subject only to technical assessment (by peer review) before publication, and impact assessment takes place during the post-publication phase, which can broaden the assessment of the work (by peers) to a much wider constituency than can take place before publication.
>
> […] Rather than relying on the journal in which an article is published, it is now possible to focus on the merits of the article itself. An array of article-level metrics and indicators can be deployed to filter and assess content. Coupled with tools for post-publication commentary and addition of value, there are tremendous prospects for replacing the current impact assessment function of pre-publication peer review

390 Ev 143, paras 3–4

391 Ev 144 [Faculty of 1000 Ltd]

392 Q 58

393 Q 59

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with a post-publication system that has the potential to be more efficient and effective.[394]

225. Dr Mark Patterson, Director of Publishing at PLoS, explained that:

> It is not just about a blog comment […] There is a whole range of metrics and indicators, including resources like Faculty of 1000, which can be brought to bear on the question of research assessment. […] We want to provide an indication when [readers] come to [a] paper of how important [it] is and what impact it has had through usage data, citation information, blogosphere coverage and social bookmarking. There are so many possibilities.
>
> We have moved in that direction by providing those kinds of metrics and indicators on every article that we publish—we are not the only people doing this but we have probably taken it further than most—to try to move people away from thinking about the merits of an article on the basis of the journal it was published in to thinking about the merits of the work in and of itself. Indicators and metrics can help with that. They aren't the answer to the question but they will help. Ultimately, there is really no substitute for reading it and forming your own opinion.[395]

226. David Sweeney, Director for Research, Innovation and Skills at HEFCE, was not convinced that such "article level metrics […] necessarily captured the intrinsic metric" of a published article. He added:

> I remain of the view that there will be no magic number or even a set of numbers that does capture intrinsic merit, but one's judgment about the quality of the work, which may well be, […] in the eye of the beholder, may be informed by a range of metrics.[396]

Sir Mark Walport agreed with Dr Patterson's final point that "if you want to assess the value of an individual article, I am afraid that there is no substitute for holding it in front of your eyes and reading it".[397]

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394 Ev 80, paras 33–34

395 Q 209

396 Q 281

397 *As above*

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6 Publication ethics and research integrity

227. A US National Academies report explained that, for the individual researcher, integrity embodies a range of good research practice and conduct, including:

- intellectual honesty in proposing, performing, and reporting research;
- accuracy in representing contributions to research proposals and reports;
- fairness in peer review;
- collegiality in scientific interactions, including communications and sharing of resources;
- transparency in conflicts of interest or potential conflicts of interest;
- protection of human subjects in the conduct of research;
- humane care of animals in the conduct of research; and
- adherence to the mutual responsibilities between investigators and their research teams.[398]

The procedures for dealing with many of these areas are covered by publication ethics policies.

228. Peer review does not explicitly assess the integrity of research; nonetheless it has an important role to play. The UK Research Integrity Office Ltd (UKRIO) states in its Code of Practice that:

> Organisations and researchers should be aware that peer review is an important part of good practice in: the publication and dissemination of research and research findings; the assessment of applications for research grants; and in the ethics review of research projects.[399]

The publication and dissemination of research findings is the method by which scientific knowledge progresses. Furthermore, the accurate reporting of scientific results is important in informing public debate on scientific issues.

Public debate and trust in science

229. The London Mathematical Society stated that “public debate should be based on facts. Peer reviewed science is a source of facts”.[400] Dr Robert Parker, Interim Chief Executive of the Royal Society of Chemistry (RSC), doubted that the general public have much of a

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[398] National Research Council of the National Academies, *Integrity in Scientific Research: creating an environment that promotes responsible conduct*, 2002, pp 34–5

[399] UK Research Integrity Office, *UKRIO Code of Practice for Research: Promoting good practice and preventing misconduct*, September 2009, para 3.14.1

[400] Ev w101, para 4.1

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perception of peer review.[401] He explained that "they have a perception of science, that scientists do experiments and that they publish them. They probably don't really care that much about peer review".[402] The Institution of Engineering and Technology added that "the majority of the public does not ever access peer reviewed scientific papers".[403] However, John Wiley & Sons explained that:

> Sense About Science […] has shown the importance of public awareness of peer review, as has the Science Media Centre […] in briefing the media. Publishers like to see their peer reviewed articles quoted by the media and encourage this through press releases and agencies.[404]

These are generally the means by which peer-reviewed research findings are communicated to the general public.

230. Sense About Science told us that:

> people can get very worried and frustrated by conflicting claims and misleading information. It is not possible (nor desirable) to prevent people from encountering a wide range of information about science and health on the Internet and in the news media. […] "Is it peer reviewed?" is the first question anyone can ask to determine the status of the evidence, and one that can help the public weigh-up the claims they are presented with. Understanding the process through which scientific research starts to be scrutinised and evaluated can be a helpful tool for the public to sift information and understand its status.[405]

231. Sense About Science has carried out an enormous amount of work to improve the public understanding of peer review (see paragraph 5), including producing, as we have noted, a short public guide to the peer-review process, *I don't know what to believe… Making sense of science stories*, of which "hundreds of thousands of copies have been downloaded".[406] This encourages people to ask whether or not a piece of published research has been peer reviewed. Tracey Brown, Managing Director of Sense About Science, explained that this is beginning to "take off" as part of a "virtuous circle":

> If, in a Radio 2 programme in the afternoon, the interviewer is equipped to ask the scientist […] "Which of these claims has been published and peer reviewed? Do you have a study that backs this up?", the more that question gets asked, the more the listening audience expects that to be one of the interrogatory questions. The more that the listening audience expects that to be an interrogatory question, the more the radio interviewer feels that they, representing their listening public, must ask that question.[407]

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401 Q 40

402 *As above*

403 Ev w89, para 4.4

404 Ev 65, para 4.1

405 Ev 75, paras 9 and 12

406 Ev 74, para 3 [Sense About Science]

407 Q 86

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232. The Institute of Physics (IOP) was also of the view that the public should be encouraged to recognise that a peer-reviewed result was the "gold standard" in research and that it would "produce the most reliable information in the long term".[408] The Royal Society added that "peer review is valuable in informing the public about science as it acts as a 'kite mark' that a piece of research has been properly scrutinised and validated by scientists".[409]

233. In the absence of peer review, the Academy of Medical Sciences warned that:

> Work that is released in to the public domain without some level of quality assurance could potentially lead to situations where imperfect or incorrect science is used by the media and others. Ultimately this could be detrimental to the public's overall trust in research.[410]

234. The Association of Learned and Professional Society Publishers (ALPSP) indicated that this was particularly a problem in biomedical sciences.[411] The Society for General Microbiology considered that "the unreliability of other information published outside of the peer review system should be highlighted".[412]

Balancing the evidence

235. While information published without peer review may not be reliable or be based on opinion rather than facts, it is not necessarily the case that all information published with peer review is completely reliable. Professor John Pethica, Physical Secretary and Vice President of the Royal Society, considered that "it would be useful if the public becomes aware of the fact that mistakes happen".[413] The RSC stated that the "limitations" of peer-reviewed information is not often understood by the public:

> There is still currently a public preoccupation with scientific research providing "answers". A single piece of research rarely provides a definitive answer to a scientific problem. Rather a single piece of research must be viewed in the overall context of the field, as it contributes to the overall debate in a given area. Whilst this distinction is made by other researchers in the field, this is not often the case when a piece of research is examined in the public arena.[414]

ALPSP agreed that it was a "common misconception" that a "single published article provides the definitive answer to a scientific problem".[415] It is possible that within a particular field of research, different articles in the peer-reviewed literature may disagree with one another; there is often room for debate on the results themselves and on their

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408 Ev 93, para 20

409 Ev 103, para 11

410 Ev 133

411 Ev w121, para 31

412 Ev w92, para 4

413 Q 42

414 Ev 98, para 18

415 Ev w121, para 32

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interpretation.[416] In such cases, one needs to look at the balance of evidence; each published article must be considered in the wider context of the field.[417] In assessing the balance of evidence, it is necessary to be wary of, for example, the competing interests of different authors—the procedures for declaring these are governed by publication ethics.

Detecting ethical misconduct

236. Publication ethics covers a number of areas, including: authorship, plagiarism, fabrication, duplicate publication, competing financial interests and confidentiality.[418] Dr Michaela Torkar and Dr Mark Patterson explained that both BioMed Central and the Public Library of Science (PLoS) take publication ethics "very seriously".[419] It is common for publishers to set out guidelines to authors. Dr Parker, from the RSC, told us that the guidelines produced by the Committee on Publication Ethics (COPE) are "pretty much an industry standard now".[420] COPE is a UK registered charity that promotes integrity in research publication and advises journal editors how to handle cases of research and publication misconduct. It provides a forum for editors and publishers of peer-reviewed journals to discuss specific, anonymised cases. It also publishes a wide range of guidance material.[421]

237. The publication of fraudulent or incorrect papers "damages the public perception of science as a whole".[422] Tracey Brown, Managing Director of Sense About Science, agreed and added that "you cannot build a world that is immune to fraudsters. […] We have to accept that that is the case and hope that we have systems that detect [misconduct] as early as possible".[423] She explained that:

> It would be unreasonable to ask reviewers to spot fraud or plagiarism on a systematic basis, although, of course, there are cases where reviewers are quite well placed to notice such things. Their main consideration is whether the paper is valid, significant and original and whether it provides the basis on which others can understand what has taken place and, therefore, replicate or investigate those results.[424]

238. Critics of peer review claim that it does nothing to detect fraud and misconduct.[425] The RSC stressed that "it is not the role of peer review to scrutinise laboratory practice".[426] However, Dr Philip Campbell, Editor-in-Chief of *Nature* and Nature Publishing Group, considered that on rare occasions misconduct can be detected:

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416 Ev w101, para 4.2 [London Mathematical Society]

417 Ev w121, para 32 [Association of Learned and Professional Society Publishers]; and Ev 103, para 12 [Royal Society]

418 "Publication ethics", Nature, www.nature.com

419 Q 191

420 Q 36

421 Ev 66 [Committee on Publication Ethics]; and "About COPE", Committee on Publication Ethics, www.publicationethics.org

422 Q 40 [Professor Ron Laskey]

423 Q 83

424 Q 74

425 Ev w120, para 17 [Association of Learned and Professional Society Publishers]

426 Ev 97, para 11

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> Given that editors and peer-reviewers need to take everything that authors submit on trust, and do not seek to replicate the work, it is almost impossible for referees to detect misconduct. There have been occasions where a sharp-eyed referee has detected an inconsistency or other flaw in reported results that can only have arisen through inappropriate manipulation, but these are few and far between.[427]

239. Dr Parker agreed that the "peer review system relies on people being ethical".[428] He added that if misconduct is not picked up by the reviewer and the article is published, "it should be picked up by a reader and then it is usually dealt with either by the reader coming to the editor of the journal or the reader going directly to the author and dealing with the matter".[429]

240. Professor Ian Walmsley, from University of Oxford, added that co-authors need also take on some of the responsibility for detecting misconduct:

> As more and more papers are published with joint authors there is joint responsibility for doing that. That could lead in two directions: first, increased pressure to get it right because there are more people involved in the discussion; but, secondly, the chance that you will miss a trick or two because there are more people contributing.[430]

Indeed, Dr Philip Campbell told us that "in some of the most severe cases of misconduct, a problem has arisen because of insufficient critical scrutiny between co-authors".[431]

The role of technology

241. In addition to the vigilance of the people involved in the peer-review process, publishers are increasingly relying on technology to help identify certain types of misconduct.

242. Dr Liz Wager, Chair of COPE, told us that publishers are able to use tools such as CrossCheck, which is "very powerful text-matching software" that identifies duplication (with work already published).[432] Whether plagiarism (the use of someone else's writing or ideas without giving them credit for this, i.e. effectively, stealing) has occurred has, however, to be determined by a human being, and this is not always easy. Robert Campbell, Senior Publisher at Wiley-Blackwell, explained that:

> Duplication is also a problem where English is the second or third language. Authors are more inclined to copy text as it gets their message over much more easily than they can by re-writing it. […] publishers have set up a system called CrossCheck for picking up duplication. That is being taken up at a good speed. About 20,000 submissions a month are now being processed through CrossCheck. By the end of

[427] Ev 89, para 60

[428] Q 36

[429] *As above*

[430] Q 236

[431] Ev 90, para 61

[432] Q 73

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this year, about 10% of all submissions will be scrutinised through CrossCheck for duplication, which can mean plagiarism.[433]

243. Data or image manipulation is another area where technology is proving useful. Dr Wager pointed out that while "the software has […] made it easier to commit the fraud in the first place, it has also made it easier to detect it".[434] Professor Ron Laskey, Vice President of the Academy of Medical Sciences, told us that "in practice many journals now routinely examine the data files to see how the images were prepared".[435] He added that "you rarely hear about those [cases] because the journal simply declines to deal with that author in future".[436] One recent example that had been more widely publicised was the case of the American Society for Microbiology, which "retracted several papers by a Japanese researcher because of image manipulation and [then] issued a 10-year ban on the author from publishing in any of its journals".[437]

244. **The integrity of the peer-review process can only ever be as robust as the integrity of the people involved. Ethical misconduct damages peer review and science as a whole. Although peer review is not designed to identify systematically fraud or misconduct, it does, on occasion, identify suspicious cases. Where ethical misconduct is suspected, guidance for journal editors is in place, for example from the Committee on Publication Ethics, about how best to deal with it. In addition to relying on the vigilance of the people involved in the process, publishers must continue to invest in new technology that helps to identify wrongdoings.**

Frequency of misconduct

245. Richard Horton, Editor-in-Chief of the medical journal, *The Lancet*, told us that:

> editors have had to face an upsurge in the discovery of episodes of research misconduct (fabrication, falsification, and plagiarism). The increasing awareness of research fraud had led not only to greater vigilance […] among editors but also to the birth of institutional mechanisms to set standards and advise on research practice.[438]

246. COPE considered that "misconduct by reviewers and editors is probably rare but can have serious effects on those affected and is recognised as a form of academic misconduct".[439] Dr Wager, from COPE, added:

> I don't think there has been much research on the integrity of reviewers or editors. Much more research has focused on misconduct by authors. There have been some cases of reviewer misconduct. […] I have done a survey of journal editors to find out

433 Q 149

434 Q 73

435 Q 33

436 Q 47

437 Ev 116, para 23 [Elsevier]

438 Ev w5, para 15

439 Ev 67, para 4.0

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> how big a problem they thought reviewer misconduct was, and it came pretty low on their list.[440]

247. There is evidence of misconduct by researchers. A large survey of several thousand early and mid career scientists based in the USA and funded by the National Institutes of Health in 2002 revealed a broad range of serious and questionable research misbehaviours, including: falsifying research data, plagiarism, failing to disclose relevant commercial interests, and inappropriately assigning authorship credit. Around a third admitted they had engaged in at least one of the top ten misbehaviours (those seen as likely to be sanctionable at institutional or federal level) during the previous three years.[441] There are not to our knowledge any comprehensive published data on the incidence of research or publication misconduct in the UK.

The need for transparency

248. In cases of misconduct where the behaviour of the people involved in the peer-review process is called into question, it is essential that there is an accurate record of what was said and done at every step of the process. The availability of this "pre-publication history" to journals was considered to be essential by Dr Mark Patterson, from PLoS; he explained that:

> any reputable publisher has to have those kinds of records. These days there are standard systems which support the editorial process and provide the mechanisms you need to archive and keep all that correspondence.[442]

249. He clarified that the records were not publicly available, but were important for "internal record keeping":

> You need them if a dispute occurs two or three years later about some aspect of priority in terms of who discovered what and when or there are some shenanigans in the peer review process that people want to investigate. They are also a fabulous tool to help support the editorial process, in the sense that if you get a new manuscript in a certain area you can then go back, it reminds you of something and you can rediscover what went on. That can help you with the editorial process on a new manuscript.[443]

250. Dr Michaela Torkar added that in a series of BioMed Central's medical journals the pre-publication history was publicly available, allowing people to access "what the peer reviewer said and how the manuscript was revised".[444] Dr Patterson indicated that this was

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440 Q 74

441 B. C. Martinson and others., *Scientists behaving badly*, Nature, 2005, vol 435, pp 737-38

442 Q 192

443 Q 193

444 Q 192

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common amongst medical journals.[445] Dr Torkar explained that this was probably an historical decision.[446] She added that:

> we feel in the medical community there is more acceptance of a very transparent model like this. [...] It certainly has no negative impact on the peer review process and it makes it all quite transparent. It is not clear that the biology community would be quite as open to this model, but there are also experiments going on with different journals and different publishers to look at that.[447]

As noted in paragraph 97, other groups are encouraging the more widespread adoption of these transparent processes.

Taking action on mistakes, fraud and misconduct

251. When ethical misconduct takes place or mistakes are made there must be consequences. The IOP told us that:

> if/when incorrect results make it into the literature there are systematic mechanisms in place to correct errors and maintain a record of any corrections. In publishing this is done by the use of corrigenda, retractions or comments and replies, all of which can be linked back to the source article maintaining an updated record of changes.[448]

Robert Campbell, from Wiley-Blackwell, explained how new technology is helping to link retractions or corrections to published articles for a more robust scientific record:

> The [publishing] industry is developing [...] a new project called CrossMark. Every paper that has gone through the peer review process has the ongoing stewardship of the publisher picking up on retractions or corrections. By clicking on to the CrossMark logo, you can go to the metadata and find out if there have been any updates or even retractions. That is a technical solution which is being launched this year.[449]

252. Dr Wager, from COPE, explained that these are other potential consequences when misconduct is discovered:

> If the editor really steps out of line, they can lose their editorial position. Obviously, that would be quite public.
>
> In terms of reviewer misconduct, which is relatively rare but does occur, initially, they might well be sanctioned by their employer. [...] There could be an academic or employment case against them because that would be seen as professional misconduct.[450]

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445 Q 193

446 Q 195

447 *As above*

448 Ev 91, para 4

449 Q 143

450 Q 77

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253. Dr Fiona Godlee, from BMJ Group, told us that the consequences "depend on the ethical breach".[451] She stated that:

> If it was a plagiarism, then the paper might be retracted or there might be a statement of the offence. The institution would be informed. The author would be penalised via the institution. If it was a duplicate publication or a conflict of interests that was undeclared, all of these things have very straightforward remedies both through the journal and through the institution. The understanding of how to deal with what are now pretty standard ethical breaches is very well developed. More difficult is [the situation] where institutions or journals fail to pursue something adequately.[452]

Oversight of research integrity

254. Where there is doubt over the appropriate course of action following a breach in ethical conduct, advice is available from a number of sources. As we discussed in paragraph 236, COPE provides guidance and advice to journal editors. It was "established in 1997 by a small group of medical journal editors in the UK but now has over 6,000 members worldwide from all academic fields".[453] In 2006, another body—the UK Research Integrity Office (UKRIO)—was set up to "provide assistance to researchers, research organisations and members of the public" on issues relating to research integrity.[454]

255. Dr Wager, Chair of COPE, explained that though there are some overlaps between COPE and UKRIO, they have "subtly different audiences"; broadly speaking COPE advises journals and is looking at publication ethics, and UKRIO advises institutions and looks at all kinds of research misconduct.[455] While this distinction is clear, the oversight of research integrity appears to have become more complicated; Research Councils UK (RCUK) told us that Universities UK (UUK) are producing "a "Concordat" style document setting out principles on research integrity to which research funders can all sign up".[456] UUK will be "working closely with RCUK, the UK Funding Councils, the Wellcome Trust and the Department of Health" on this.[457]

256. It appeared to us that the oversight of research integrity in the UK is confused. We set out here our understanding of the existing arrangements. UKRIO was set up "primarily with a remit for the biomedical sciences".[458] A number of UK organisations with interests in research came together to set up, fund and support UKRIO, including:

> the four UK Departments of Health, the four UK Higher Education Funding Councils, the Academy of Medical Sciences, the Association of the British Pharmaceutical Industry, the Association of UK University Hospitals, the

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451 Q 141

452 *As above*

453 "About COPE", Committee on Publication Ethics, www.publicationethics.org

454 "About Us", UK Research Integrity Office Ltd, www.ukrio.org

455 Qq 66–68

456 Ev 96, para 2

457 Ev 96, para 4 [Research Councils UK]

458 Q 264 [Professor Rick Rylance]; also Qq 33–34 [Professor Ron Laskey] and Ev 126 [UK Research Integrity Office Ltd]

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> Biotechnology and Biological Sciences Research Council, the Committee on Publication Ethics, the Medical Research Council, the Medical Schools Council, the Medicines and Healthcare products Regulatory Agency, Research Councils UK, the Royal College of Physicians, the Royal College of Physicians of Edinburgh, the Royal Society, Universities UK and research charities including the Wellcome Trust.[459]

257. UKRIO had been "set up on a fixed-term basis".[460] In its initial pilot phase, 2006–10, it was hosted by UUK.[461] In late 2010, UKRIO transferred from UUK and became a company limited by guarantee, UK Research Integrity Office Ltd (which continued to be known as UKRIO).[462] Since then, UKRIO has continued to provide "independent and confidential advice to researchers, research organisations and the public".[463] UKRIO's original funding has lapsed but because it was run at a surplus in its first phase, these funds are currently sustaining the organisation as it evolves.[464]

258. In September 2010, RCUK and UUK published *The Report of the UK Research Integrity Futures Working Group*. The working group had been set up to consider the existing arrangements for research integrity in the UK and potential new arrangements from 2010 onwards.[465] The report recommended:

> The UK and its employers of researchers would benefit from a single body to provide guidance and advice across the many universal issues that are common to all research disciplines. This would be more efficient than current disparate approaches, and beneficial to organisations both in terms of management and representation. A clear repository for leadership, but not regulation, would also be more effective across the UK. This would not obviate the need for actions relevant only to certain disciplines, research designs or sectors.
>
> Such a national body would not have powers of regulation or investigation powers into poor practice or misconduct, but should be there to provide advice and support to research employers and assurance to research funders. This would be achieved through assistance with the promotion of training and good management systems, and providing expert advice where appropriate. A national body should, however, do this on behalf of all major research employers and with the active support of all research funders, to ensure consistency of approach and advice available.[466]

This recommendation has not been implemented.

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459 Ev 128, para 2.4 [UK Research Integrity Office Ltd]

460 Q 264 [Professor Rick Rylance]

461 Ev 126 [UK Research Integrity Office Ltd]

462 *As above*

463 Ev 128, para 2.7 [UK Research Integrity Office Ltd]

464 Ev 126 [UK Research Integrity Office Ltd]

465 Research Councils UK and Universities UK, *Report of the UK Research Integrity Futures Working Group*, September 2010, p2, www.rcuk.ac.uk/documents/documents/ReportUKResearchIntegrityFutures2010.pdf

466 Research Councils UK and Universities UK, *Report of the UK Research Integrity Futures Working Group*, September 2010, pp 3–4, www.rcuk.ac.uk/documents/documents/ReportUKResearchIntegrityFutures2010.pdf

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259. We asked Professor Rick Rylance, from RCUK, whether he was broadly supportive of this concept. He told us that RCUK wanted:

> a framework that is applicable in its different modes to different sorts of projects and disciplines. The situation in the old [UKRIO] was that it was only affecting a part of the community. Increasingly, there are cross-disciplinary projects which need attention across the piece. That is our anxiety.[467]

Indeed, we had heard reports that not all of UKRIO's original funders were happy with its remit being extended to other sciences.[468] However, UKRIO subsequently contacted us to inform us that in practice, since its inception it has "responded to enquiries on issues of research integrity across all subject areas and [its] published guidance is applicable to all disciplines".[469]

260. In addition to concerns about broadening the oversight of research integrity to all disciplines, Professor Rylance also expressed his concern about the need to "disentangle" various functions which were "caught up" in the original UKRIO.[470] He questioned whether one could be "both an assurer and an adviser" on issues of research integrity.[471] Professor Rylance added "if you are giving advice which then turns out to be wrong, you would then be policing your own mistake at some level".[472] However, UKRIO told us that it had not been created to deliver an "assurance mechanism".[473]

261. The Research Integrity Futures Working Group had not seen the separation of advice and assurance functions as an issue: it had recommended that the new national body "should be there to provide advice and support to research employers and assurance to research funders".[474] One body, covering all disciplines and providing advice to employers and assurance to funders, is an attractive and straightforward system for the oversight of research integrity. The current situation is highly unsatisfactory. Dr Fiona Godlee, from BMJ Group, told us that "the fact that we don't have a proper research integrity oversight body in the UK is a real scandal".[475] In other countries, there is even more stringent oversight of research integrity. For example, the Office of Research Integrity in the USA has a mandate to oversee institutional investigations of alleged misconduct in publicly funded research.[476] Dr Wager acknowledged that "there has certainly been criticism and people saying, 'We do need a body with more teeth, with some statutory powers'".[477] Professor Ron Laskey considered that the need for a body with statutory powers was "a

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[467] Q 269

[468] Q 33 [Professor Ron Laskey]

[469] Ev 132, para 2

[470] Q 264

[471] *As above*

[472] *As above*

[473] Ev 132

[474] Research Councils UK and Universities UK, *Report of the UK Research Integrity Futures Working Group*, September 2010, p3, www.rcuk.ac.uk/documents/documents/ReportUKResearchIntegrityFutures2010.pdf

[475] Q 141

[476] "About ORI", Office of Research Integrity, http://ori.dhhs.gov

[477] Q 72

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difficult matter" but that it was "something that does deserve to be looked at".[478] However, Professor Rylance considered that there was "no appetite" for a regulatory body.[479] Professor Sir Adrian Smith, from the Department of Business, Innovation and Skills (BIS), added that "if we can avoid getting into a heavy-handed regulatory framework, most of us would prefer to see if we could do it in another way."[480]

262. **Oversight of research integrity in the UK is in need of revision. The current situation is unsatisfactory. We are concerned that the UK does not seem to have an oversight body for research integrity that provides "advice and support to research employers and assurance to research funders", across all disciplines. The UK Research Integrity Futures Working Group report made sensible recommendations about the way forward for research integrity in the UK. Research Councils UK, Universities UK and the Government should revisit these recommendations and reassess how they can best be implemented.**

The role of the research institutions

263. Regardless of the system of oversight it is clear that, as employers of researchers, the research institutions have a part to play in dealing with research fraud or misconduct. The UK Research Integrity Futures Working Group concluded in its recent report:

> While there is an urgent need for a clear and joined-up approach at national level, the working group agreed that the primary responsibility in the UK, as in most other countries, must remain with employers of researchers. This does not only mean universities, but also includes industry and health service trusts/employers as well as national research organisations and institutes.[481]

264. Sir Mark Walport, from the Welcome Trust, agreed that "the integrity of the research is absolutely intrinsic to the good functioning of the university or the research institute. This is a responsibility that they must have".[482] He added that:

> Employers are responsible for the integrity of their employees in all sorts of aspects of life. They are responsible in business for making sure that they do not commit fraud and that the accounting is done well. […] as in health and safety, and all sorts of other aspects, such as the good behaviour of employers in respect of how they deal with students, this is an employer's responsibility. Increasingly, universities are taking [research integrity] very seriously. Of course, you can pick examples of where things go wrong.[483]

265. While we agree that it is the employer who must take responsibility for research integrity, we questioned who would oversee the employer and make sure that they were

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478 Q 34

479 Q 270

480 Q 308

481 Research Councils UK and Universities UK, *Report of the UK Research Integrity Futures Working Group*, September 2010, p3, www.rcuk.ac.uk/documents/documents/ReportUKResearchIntegrityFutures2010.pdf

482 Q 267

483 Q 273

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doing the right thing. We had already heard that there is "no appetite" for regulation (see paragraph 261). However, expanding on Sir Mark's analogy of employer responsibility for health and safety, we noted that there was an external regulator in this area: the Health and Safety Executive. We put this to Sir Mark and questioned again whether there was a need for regulatory oversight of research integrity. He responded that:

> The question is what those statutory powers should be. Ultimately, it is clear that a scientist who has committed some form of scientific fraud, if I can put it that way, should lose their job. Does that then fall under some other regulator? Is it something that the courts should deal with? Probably not very often. In the case of medical research, Andrew Wakefield eventually met his come-uppance at the General Medical Council.[484]

An article written by Andrew Wakefield and twelve co-authors, linking the MMR (measles, mumps and rubella) vaccine and autism, published in 1998, led to a drop in MMR vaccine uptake.[485] An investigative journalist, Brian Deer, exposed that the research was fraudulent after investigating the case over more than seven years.[486] Dr Wakefield was struck off the medical register for "unethical" research rather than scientific fraud, 12 years after the research was published.[487] In this case, Dr Wager, from COPE, explained that there was: "clear evidence that the institution [the Royal Free Hospital] did not fulfil its duty […] It should have done a proper investigation. […] It has now recognised that, and I believe it is looking into their processes".[488] COPE considered that an "important step would be for all UK institutions to appoint a research integrity officer who would act as a point of contact and coordinate investigations".[489]

266. Dr Wager explained that:

> Institutions don't like to proclaim when things go wrong. I would like to campaign for a change, so that rather than a misconduct finding against a university being a black mark, it is seen as a badge of honour. You should say, "Don't go to a university that hasn't had at least one person fired for misconduct, because it means they are not looking for it properly".[490]

267. While we did not conduct a detailed analysis of university views, of the two university Pro-Vice-Chancellors that appeared before us, neither had come across a case of someone being fired for research misconduct.[491] Despite not having come across a case of misconduct, both Professor Teresa Rees, from the University of Cardiff, and Professor Ian Walmsley, from the University of Oxford, implied that their respective universities had

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484 Q 274

485 "Health Drop in MMR jabs blamed on media scare", BBC News Online, http://news.bbc.co.uk, 26 June 1998; and "Exposed: Andrew Wakefield and the MMR-autism fraud", Brian Deer, www.briandeer.com

486 "Exposed: Andrew Wakefield and the MMR-autism fraud", Brian Deer, www.briandeer.com; and F Godlee, J Smith and H Marcovitch, *Wakefield's article linking MMR vaccine and autism was fraudulent*, BMJ, 5 January 2011

487 "Dr Andrew Wakefield struck off medical register", Times Online, www.timesonline.co.uk, 25 May 2010

488 Q 75

489 Ev 68, para 9.0

490 Q 75

491 Qq 236 [Professor Ian Walmsley] and 238 [Professor Teresa Rees]

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robust internal processes for dealing with such matters.[492] We queried how they could possibly know that their policies were robust, to which Professor Walmsley responded:

> I noted that we had not come across cases of fraud in respect of publications. There have certainly been other issues—I will not say it is fraud—associated with ethical conduct of research where we have processes that parallel those we might use for publication, and they have been shown to be effective. In respect of publication I would say that at least within my tenure they are untested, but I think there is good evidence that parallel processes for other issues work.[493]

268. Where fraud or misconduct has occurred and universities instigate some sort of investigation, another problem that journal editors face is the lack of transparency of proceedings. Dr Wager told us that:

> [Journal editors] will go to an institution with an allegation or a suspicion of misconduct and the institution will say, "Oh, we can't tell you. It's confidential." The journal editor may be put in a very difficult position, because if, for example, they have published something, they need to know whether to retract it or whether to publish an expression of concern. That is an area where transparency would be a great advantage. It would also help public confidence. [494]

269. Professor Walmsley explained the process in place at the University of Oxford for reporting proceedings to external organisations:

> The responsibility for investigating [misconduct] lies with the University's most senior officers (in the case of staff members, this is the Registrar; for students, this is the Proctors' Office).
>
> Although the details of such allegations or enquiries are not made publicly available, the University regularly reports externally on allegations and cases of research misconduct, for example to the UK Research Integrity Office, to the US Office of Research Integrity and to Research Councils UK. Where the research in question involves a third party, for example an external funder of research such as the Medical Research Council or the Wellcome Trust, the University is careful to ensure that the third party is kept closely informed of how the case is handled and the outcome of any investigation.[495]

270. Professor Rylance, from RCUK, added that:

> In the 18 months or so that I have been part of the AHRC I have had, perhaps, two or three occasions where relatively minor malpractice has been reported. The institutions involved have acted very readily. There is a working system between the funders and the institutions.[496]

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492 Q 240

493 Q 241

494 Q 76

495 Ev 107, para 2

496 Q 276

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271. **Employers must take responsibility for the integrity of their employees' research. However, we question who would oversee the employer and make sure that they are doing the right thing. In the same way that there is an external regulator overseeing health and safety, we consider that there should be an external regulator overseeing research integrity. We recommend that the Government set out proposals on the scope and powers of such a regulator and consult with the research community and other relevant parties to develop them.**

272. **We also recommend that all UK research institutions have a specific member of staff leading on research integrity. Such a person would be a first point of call in case of an ethical breach. Where an investigation subsequently takes place within a research institution, it is essential that the outcome be published.**

The role of the funders

273. In addition to the research institutions themselves taking responsibility, a degree of responsibility also lies with the funders of research. David Sweeney, Director for Research, Innovation and Skills at HEFCE, added that "in England, as the charities' regulator for most universities and as a regulator under the [Charities Act 2006], universities are required to report incidents to [HEFCE] and we monitor the way in which they handle incidents".[497]

274. Sir Mark Walport explained that funders play "a very serious role", adding that:

> We take research integrity very seriously as well. It is a grant condition that the work is done properly. From our perspective, in relation to an institution that failed to manage the research integrity properly, we would have to question whether that was an institution at which we could fund research.[498]

275. We questioned Professor Sir Adrian Smith, from BIS, whether any of the Research Councils had ever withdrawn funding because of fraud or allegations of fraud. We expected the number of incidents to be significant, given the evidence from researchers funded by the National Institutes of Health regarding the frequency of misconduct in the USA (see paragraph 247). However, BIS subsequently wrote to us explaining that there had been "no cases where funding has been withdrawn on the grounds of fraud/misconduct in research".[499] Three proven allegations of scientific misconduct during the last 10 years were highlighted, relating to work funded by the Medical Research Council (MRC):

> None of [these] cases has resulted in withdrawal of funding, but all have had sanctions imposed against the individuals concerned.
>
> 1. In 2001 an MRC-funded Clinical Fellow was reprimanded for serious professional misconduct and suspended for a year by the General Medical Council (GMC) for falsifying published data. The Fellow's supervisor was

497 Q 275

498 *As above*

499 Ev 148

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also severely reprimanded by the GMC for not having reacted adequately and promptly.

2. In 2010/11 there was a case related to manipulation of results and falsification of data (images) by a member of MRC staff.

3. In 2010/11 there was a case related to falsification of documentation relating to patient consent in a clinical trial supported by an MRC grant.

In the third case, where the allegation was against the Principal Investigator (PI), MRC temporarily transferred the supervision of the grant to another PI while the investigation was ongoing. This transfer was made permanent once the allegation was proven. This case was also reported to the GMC.

MRC decided to continue the funding the grant in the third case for a number of reasons:

- the recruitment of patients to the trial and collection of biological samples was already complete;
- there was no risk to patients;
- the misconduct did not affect the integrity of the data;
- publication of the results would be possible (having checked patient consent was valid); and
- the data from the trial would be important to inform clinical practice.

It would have been a waste of public money to terminate the grant as this would have prevented the results being analysed and published.[500]

276. Considering the evidence published on the frequency of research and publication misconduct amongst researchers in the USA, we would have expected a similar proportion of researchers to be engaged in these misbehaviours in the UK. We are therefore surprised that there have been no cases where funding has been withdrawn on the grounds of fraud or misconduct in research funded by Research Councils in the UK. **We recommend that the Research Councils, and other funders of research, reassess the robustness of their procedures for dealing with allegations of research fraud or misconduct, to ensure that they are not falling through the cracks.**

[500] Ev 148 [Department for Business, Innovation and Skills]

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7 Conclusions

277. **Peer review in scholarly publishing, in one form or another, is crucial to the reputation and reliability of scientific research. Pre-publication peer review has evolved in a piecemeal and haphazard way to meet the needs of individual scientific communities. The process, as used by most traditional journals prior to publication, is not perfect, and it is clear that considerable differences in quality exist. However, despite the many criticisms and the little solid evidence on its efficacy, editorial peer review is considered by many as important and not something that can be dispensed with.**

278. **In order for current peer-review practices to be optimised and innovative approaches introduced, publishers, research funders and the users of research outputs (such as industry and government) must work together. There is much that can be done to improve the quality of pre-publication peer review across the board and to better equip the key players to carry out their roles. We note that new innovations in pre-publication review are being introduced that have the potential to accelerate the pace of research communication and avoid duplication of effort by the research community, with the consequent drain on resources. Publishers can learn much from one another and should share best practice where possible—particularly in relation to the ways in which data are managed and in terms of promoting publication ethics and research integrity. It is clear that breaches in the latter damage both the scientific record and public confidence in science.**

279. **The publication of peer-reviewed articles is not only important in terms of maintaining a robust scientific record, it also has an impact on the careers of researchers and the reputations of research institutions. We have been assured by research funders that they do not use journal Impact Factor as a proxy measure for the quality of research or of individual articles. However, representatives of research institutions have suggested that publication in a high-impact journal is still an important consideration when assessing individuals for career progression. We consider that research institutions should be cautious about this approach, because as we have previously noted, there is no substitute for reading the article itself in assessing the worth of a piece of research.**

280. **While pre-publication peer review continues to play an important role, the growth of post-publication peer review and commentary represents an enormous opportunity for experimentation with new media and social networking tools. Online communications allow the widespread sharing of links to articles, ensuring that interesting research is spread across the world, facilitating rapid commentary and review by the global audience. They also have a valuable role to play in alerting the community to deficiencies and problems with published work. We encourage the prudent use of online tools for post-publication review and commentary as a means of supplementing pre-publication review.**

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Conclusions and recommendations

The peer-review process

1. **We conclude that different types of peer review are suitable to different disciplines and research communities. We consider that publishers should ensure that the communities they serve are satisfied with their choice of peer-review methodology. Publishers should keep them updated on new developments and help them experiment with different systems they feel may be beneficial.** (Paragraph 20)

2. **The importance of a pre-publication technical assessment is clear to us. It should be a fundamental aim of the peer-review process that all publications are scientifically sound. Assessing the impact or perceived importance of research before it is published will always require subjective judgement and mistakes will inevitably be made. We welcome new approaches that focus on carrying out a technical assessment prior to publication and making an assessment of impact after publication.** (Paragraph 29)

3. **We recommend that publishers, research funders and the users of research outputs (such as industry and Government) work together to identify how best to evaluate current peer-review practices so that they can be optimised and innovations introduced, and the impact of the common criticisms of peer review minimised. We consider that this would also help address any differences in the quality of peer review that exist. We encourage increased recognition that peer-review quality is independent of journal business model, for example, there is a "misconception that open access somehow does not use peer review".** (Paragraph 58)

Innovative approaches to peer review

4. **We conclude that pre-print servers can be an effective way of allowing researchers to share and get early feedback on preliminary research. The system is well established in the physics community, and works particularly well, co-existing with more traditional publication in journals. We encourage exploration in other fields. We note, however, that pre-print servers may not work in fields where commercialisation and patentability are issues, or in the biomedical sciences, where publication of badly performed studies could have harmful consequences and could be open to misinterpretation.** (Paragraph 72)

5. **The principles of openness and transparency in open peer review are attractive, and it is clear that there is an increasing range of possibilities. There are mixed results in terms of acceptance amongst researchers and publishers, although some researchers are keen to see greater transparency in their fields. We encourage publishers to experiment with the various models of open peer review and transparency and actively engage researchers in taking part.** (Paragraph 78)

6. **We are impressed by the success of *PLoS ONE* and welcome the wider growth of quality online repository journals. These will accelerate the pace of research communication and ensure that all work that is scientifically sound is published,**

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regardless of its perceived importance. However, we recognise that this is a relatively new and rapidly evolving model, and potentially open to abuse because publication fees are involved. It is important that a high quality of peer review is maintained across all repository-style journals. (Paragraph 89)

Editors, authors and reviewers

7. The role of the editor is at the heart of the peer-review process. The judgement applied by the editor to the information collected in the review process requires knowledge, skill, and care; particularly, in respect of identifying the right reviewers for the job and critically assessing the feedback from reviewers to authors. (Paragraph 100)

8. Broadly speaking, training for editors and members of editorial boards is provided on the job. We have heard that some publishers opt for a more structured approach, and include, for example, comprehensive welcome packs for new editors that cover peer-review processes, support tools and ethical guidelines. We encourage publishers to work together to develop standards—which could be applied across the industry—to ensure that all editors, whether staff or academic, are fully equipped for the central role that they play in peer review. (Paragraph 106)

9. A relatively straightforward way of educating reviewers about the quality of their reports and helping them improve their feedback to editors is to send them the reports of other reviewers, done confidentially when necessary. This should be standard practice across all journals. This would be a useful educational tool to improve the quality of future reports from reviewers. (Paragraph 118)

10. Training for the next generation of authors and reviewers is also important. Many PhD students and post-doctoral researchers are fortunate to have the opportunity to discuss scientific literature in journal clubs and other informal settings. Some are mentored well by their principal investigator and thereby receive informal training in peer review. Others are not. Given the importance of peer review across the research spectrum, from grant applications to publications, we consider that all early-career researchers should be given the option for training in peer review. (Paragraph 119)

11. Training for early-career researchers is important. We note that "Roberts Funding" is coming to an end and that the Research Councils will therefore be increasing the amount they give to universities "for training and developing postgraduate research". We invite the Research Councils to set out further details of how and where this money will be allocated and what proportion of it will be dedicated to training in peer review, including academic writing and publication ethics (discussed later in this report). We also ask for further details of how this will be "joined up" across different research funders. (Paragraph 124)

12. We welcome the fact that the publishers we have heard from are training authors and reviewers on an international level, particularly those from countries which are not traditional scientific leaders, and we encourage others to do the same. This should help alleviate the current imbalance between publication output and participation in peer review. (Paragraph 130)

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The burden of reviewing

13. We are not convinced that there is a "crisis" in the supply of reviewers, especially as so little data are available. It appears that the current imbalance between publication output and participation in peer review may be a transitory phase. However, publishers should not be complacent and should continue actively to monitor the situation by collecting data. (Paragraph 134)

14. Peer review is a burden on researchers but a necessary one, as it is an integral part of the scientific and research process and is part of the role of a researcher. However, we encourage publishers to work with their reviewers, to identify innovative new practices to minimise the burden. (Paragraph 152)

15. In order to help research institutions recognise the work carried out by reviewers on peer review, publishers first need to have in place systems for recording and acknowledging it. A variety of approaches are in use, including rewards, awards and letters of endorsement and these should be encouraged. New initiatives for accurate author and reviewer identification may make it easier for publishers to track reviewer contribution to the peer-review process. (Paragraph 164)

The assessment of researchers and institutions

16. We have concerns about the use of journal Impact Factor as a proxy measure for the quality of an individual article. We have been reassured by the research funders that they do not consider that publication in a high-impact journal should be used as a proxy measure for assessing either the work of individual researchers or research institutions. We agree that there is no substitute for reading the article itself in assessing the worth of a piece of research. We consider that there is an element of chance involved in whether researchers are able to get their articles published in high-impact journals, depending on topicality and other factors. Research institutions should be cautious not to attach too much weight to publication in high-impact journals when assessing individuals for career progression. (Paragraph 177)

Managing data

17. We conclude that reproducibility should be the gold standard that all peer reviewers and editors aim for when assessing whether a manuscript has supplied sufficient information, about the underlying data and other materials, to allow others to repeat and build on the experiments. (Paragraph 184)

18. If reviewers and editors are to assess whether authors of manuscripts are providing sufficient accompanying data, it is essential that they are given confidential access to relevant data associated with the work during the peer-review process. This can be problematical in the case of the large and complex datasets which are becoming increasingly common. The Dryad project is an initiative seeking to address this. If it proves successful, funding should be sought to expand it to other disciplines. Alternatively, we recommend that funders of research and publishers work together to develop similar repositories for other disciplines. (Paragraph 189)

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19. Access to data is fundamental if researchers are to reproduce, verify and build on results that are reported in the literature. We welcome the Government's recognition of the importance of openness and transparency. The presumption must be that, unless there is a strong reason otherwise, data should be fully disclosed and made publicly available. In line with this principle, where possible, data associated with all publicly funded research should be made widely and freely available. Funders of research must coordinate with publishers to ensure that researchers disclose their data in a timely manner. The work of researchers who expend time and effort adding value to their data, to make it usable by others, should be acknowledged as a valuable part of their role. Research funders and publishers should explore how researchers could be encouraged to add this value. (Paragraph 203)

Post-publication review and commentary

20. Post-publication review in an era of new media and social networking tools, such as Twitter, is very powerful. The widespread sharing of links to articles ensures that research, both accurate and potentially misleading, is rapidly spread across the world. Failings in peer review can, rightly, be quickly exposed. However, there is no guarantee that false accusations of failings will not also be spread. Pre-publication peer review still has an important role to play, particularly in relation to assessing whether manuscripts are technically sound prior to publication. However, we encourage the prudent use of online tools for post-publication review and commentary as a means of supplementing pre-publication review. (Paragraph 211)

21. While it is too early to make a judgement on post-publication filtering mechanisms, such as Faculty of 1000 Ltd, we recognise that such a system could offer a valuable service if widely used. It is likely that such services will become more important with the growth of repository-type journals. (Paragraph 223)

Publication ethics and research integrity

22. The integrity of the peer-review process can only ever be as robust as the integrity of the people involved. Ethical misconduct damages peer review and science as a whole. Although peer review is not designed to identify systematically fraud or misconduct, it does, on occasion, identify suspicious cases. Where ethical misconduct is suspected, guidance for journal editors is in place, for example from the Committee on Publication Ethics, about how best to deal with it. In addition to relying on the vigilance of the people involved in the process, publishers must continue to invest in new technology that helps to identify wrongdoings. (Paragraph 244)

23. Oversight of research integrity in the UK is in need of revision. The current situation is unsatisfactory. We are concerned that the UK does not seem to have an oversight body for research integrity that provides "advice and support to research employers and assurance to research funders", across all disciplines. The UK Research Integrity Futures Working Group report made sensible recommendations about the way forward for research integrity in the UK. Research Councils UK, Universities UK and the Government should revisit these recommendations and reassess how they can best be implemented. (Paragraph 262)

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24. Employers must take responsibility for the integrity of their employees' research. However, we question who would oversee the employer and make sure that they are doing the right thing. In the same way that there is an external regulator overseeing health and safety, we consider that there should be an external regulator overseeing research integrity. We recommend that the Government set out proposals on the scope and powers of such a regulator and consult with the research community and other relevant parties to develop them. (Paragraph 271)

25. We also recommend that all UK research institutions have a specific member of staff leading on research integrity. Such a person would be a first point of call in case of an ethical breach. Where an investigation subsequently takes place within a research institution, it is essential that the outcome be published. (Paragraph 272)

26. We recommend that the Research Councils, and other funders of research, reassess the robustness of their procedures for dealing with allegations of research fraud or misconduct, to ensure that they are not falling through the cracks. (Paragraph 276)

General conclusions

27. Peer review in scholarly publishing, in one form or another, is crucial to the reputation and reliability of scientific research. Pre-publication peer review has evolved in a piecemeal and haphazard way to meet the needs of individual scientific communities. The process, as used by most traditional journals prior to publication, is not perfect, and it is clear that considerable differences in quality exist. However, despite the many criticisms and the little solid evidence on its efficacy, editorial peer review is considered by many as important and not something that can be dispensed with. (Paragraph 277)

28. In order for current peer-review practices to be optimised and innovative approaches introduced, publishers, research funders and the users of research outputs (such as industry and government) must work together. There is much that can be done to improve the quality of pre-publication peer review across the board and to better equip the key players to carry out their roles. We note that new innovations in pre-publication review are being introduced that have the potential to accelerate the pace of research communication and avoid duplication of effort by the research community, with the consequent drain on resources. Publishers can learn much from one another and should share best practice where possible—particularly in relation to the ways in which data are managed and in terms of promoting publication ethics and research integrity. It is clear that breaches in the latter damage both the scientific record and public confidence in science. (Paragraph 278)

29. The publication of peer-reviewed articles is not only important in terms of maintaining a robust scientific record, it also has an impact on the careers of researchers and the reputations of research institutions. We have been assured by research funders that they do not use journal Impact Factor as a proxy measure for the quality of research or of individual articles. However, representatives of research institutions have suggested that publication in a high-impact journal is still an important consideration when assessing individuals for career progression. We consider that research institutions should be cautious about this approach, because

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as we have previously noted, there is no substitute for reading the article itself in assessing the worth of a piece of research. (Paragraph 279)

30. While pre-publication peer review continues to play an important role, the growth of post-publication peer review and commentary represents an enormous opportunity for experimentation with new media and social networking tools. Online communications allow the widespread sharing of links to articles, ensuring that interesting research is spread across the world, facilitating rapid commentary and review by the global audience. They also have a valuable role to play in alerting the community to deficiencies and problems with published work. We encourage the prudent use of online tools for post-publication review and commentary as a means of supplementing pre-publication review. (Paragraph 280)

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Annex: list of abbreviations

ALPSP	Association of Learned and Professional Society Publishers
BIS	Department for Business, Innovation and Skills
BMA	British Medical Association
COPE	Committee on Publication Ethics
F1000	Faculty of 1000 Ltd
GMC	General Medical Council
HEFCE	Higher Education Funding Council for England
HEIs	Higher Education Institutions
IOP	Institute of Physics
IT	Information Technology
JISC	Joint Information Systems Committee
MMR	Measles, mumps and rubella
MRC	Medical Research Council
PI	Principal Investigator
PLoS	Public Library of Science
QR	Quality-related
RAE	Research Assessment Exercise
RCUK	Research Councils UK
REF	Research Excellence Framework
RSC	Royal Society of Chemistry
UKRIO	UK Research Integrity Office (Ltd)
UUK	Universities UK

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Formal Minutes

Monday 18 July 2011

Members present:

Andrew Miller, in the Chair

Gavin Barwell
Stephen McPartland
Stephen Metcalfe
Stephen Mosley
Graham Stringer

1. Peer review in scientific publications

The Committee considered this matter.

Draft Report (*Peer review in scientific publications*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 280 read and agreed to.

Annex and Summary agreed to.

Resolved, That the Report be the Eighth Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for placing in the Library and Parliamentary Archives.

[Adjourned till Wednesday 7 September at 9.00 am

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Witnesses

Wednesday 4 May 2011

Page

Dr Nicola Gulley, Editorial Director, Institute of Physics Publishing Ltd, **Professor Ronald Laskey CBE FRS FMedSci**, Vice-President, Academy of Medical Sciences, **Dr Robert Parker**, Interim Chief Executive, Royal Society of Chemistry, and **Professor John Pethica FRS**, Physical Secretary and Vice President, Royal Society — Ev 1

Wednesday 11 May 2011

Tracey Brown, Managing Director, Sense About Science, and **Dr Elizabeth Wager**, Chair of the Committee on Publication Ethics and Board Member of the UK Research Integrity Office — Ev 13

Mayur Amin, Senior Vice President, Research and Academic Relations, Elsevier, **Dr Philip Campbell**, Editor-in-Chief, Nature Publishing Group, **Robert Campbell**, Senior Publisher, Wiley-Blackwell, **Dr Fiona Godlee**, Editor-in-Chief, BMJ Group, and **Dr Andrew Sugden**, Deputy Editor and International Managing Editor, Science — Ev 21

Monday 23 May 2011

Dr Rebecca Lawrence, Director, New Product Development, Faculty of 1000 Ltd, **Dr Michaela Torkar**, Editorial Director, BioMed Central, **Dr Mark Patterson**, Director of Publishing, Public Library of Science, and **Dr Malcolm Read OBE**, Executive Secretary, JISC — Ev 33

Dr Janet Metcalfe, Chair, Vitae, **Professor Ian Walmsley**, Pro Vice Chancellor, University of Oxford, and **Professor Teresa Rees CBE**, former Pro Vice Chancellor (Research), Cardiff University — Ev 42

Wednesday 8 June 2011

Professor Rick Rylance, Chair-elect, Research Councils UK, **David Sweeney**, Director for Research, Innovation and Skills, HEFCE, and **Sir Mark Walport**, Director, Wellcome Trust — Ev 49

Professor Sir John Beddington, Government Chief Scientific Adviser, and **Professor Sir Adrian Smith**, Director General, Knowledge and Innovation, Department for Business, Innovation and Skills — Ev 57

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List of printed written evidence

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2	Committee on Publication Ethics (COPE) (PR 34)	Ev 66
3	BMJ Group (PR 41)	Ev 70
4	Sense About Science (PR 51)	Ev 74
5	Public Library of Science (PLoS) (PR 54, 54a and 54b)	Ev 77, Ev 81
6	Wellcome Trust (PR 55)	Ev 82
7	Higher Education Funding Council for England (PR 57)	Ev 84
8	Philip Campbell (PR 60 and 60a)	Ev 86, Ev 90
9	Institute of Physics (PR 61 and 61a)	Ev 90, Ev 94
10	Research Councils UK (PR 67 and 67a)	Ev 95, Ev 96
11	Royal Society of Chemistry (PR 68 and 68a)	Ev 96, Ev 100
12	The Royal Society (PR 69 and 69a)	Ev 101, Ev 104
13	Professor Ian A Walmsley, Pro Vice Chancellor, (Research, Academic Services and University Collections), University of Oxford (PR 73 and 73a)	Ev 105, Ev 107
14	BioMed Central (PR 74 and 74a)	Ev 108, Ev 110
15	Joint Information Systems Committee, UCL, and the University of Salford (PR 77 and 77a)	Ev 110, Ev 113
16	Elsevier (PR 81 and 81a)	Ev 114, Ev 118
17	UK Research Integrity Office (PR 84, 84a and 84b)	Ev 123, Ev 126, Ev 132
18	The Academy of Medical Sciences (PR 89)	Ev 133
19	Dr Andrew Sugden, Deputy Editor and International Managing Editor, Science (PR 91 and 91a)	Ev 138, Ev 142
20	Faculty of 1000 Ltd (PR 94 and 94a)	Ev 143, Ev 144
21	Vitae (PR 95)	Ev 145
22	Department for Business, Innovation and Skills (PR 98)	Ev 148

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/science)

1	Dr P R Crompton (PR 01 and 01a)	Ev w1, Ev w3
2	Richard Horton (PR 02)	Ev w4
3	Brandon Lush (PR 03)	Ev w11
4	Professor Yasser Gaber Dessouky (PR 04)	Ev w11
5	Dr Edmund Lamb, Editor-in-Chief, Annals of Clinical Biochemistry (PR 05)	Ev w12
6	Professor Howard Elcock, AcSS (PR 06)	Ev w13
7	Neil McKenzie (PR 07)	Ev w14
8	Professor R N Franklin (PR 08)	Ev w15
9	Professor Michael J Kelly FRS FREng (PR 09 and 09a)	Ev w16, Ev w18
10	British Medical Association (PR 10)	Ev w20
11	Dr David Taylor (PR 11)	Ev w22

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12	Professor Annabelle Mark (PR 12)	Ev w25
13	Mary Nettle (PR 13)	Ev w27
14	Nikolaus Kriegeskorte (PR 14)	Ev w27
15	Mr N H Lewis (PR 15)	Ev w34
16	Lawrence Souder (PR 16)	Ev w36
17	Mark S Bretscher (PR 17)	Ev w39
18	Donald W Braben (PR 18)	Ev w41
19	Professor John Scott (PR 19)	Ev w44
20	Professor R I Tricker (PR 20)	Ev w46
21	Dr Julie Selwyn (PR 21)	Ev w47
22	Donald Gillies, Emeritus Professor, University College London (PR 22)	Ev w48
23	Professor Roger Jones (PR 23)	Ev w51
24	Sir John Ball (PR 24)	Ev w53
25	Professor James Hartley (PR 25 and 25a)	Ev w53, Ev w56
26	Academy of Social Sciences (PR 26)	Ev w57
27	Dr Ralph Kenna and Professor Bertrand Berche (PR 27)	Ev w59
28	John McLean, Professor Chris de Freitas, and Emeritus Professor Robert Carter (PR 28)	Ev w65
29	Political Studies Association (PR 29)	Ev w72
30	John Gorman (PR 30)	Ev w73
31	Royal Meteorological Society (PR 32)	Ev w77
32	Professor Grazia Ietto-Gillies (PR 33)	Ev w79
33	Medical Women's Federation (PR 35)	Ev w82
34	William Solesbury (PR 36)	Ev w84
35	Professor Jeremy Fox and Professor Owen Petchey (PR 37)	Ev w85
36	The Institution of Engineering and Technology (PR 38)	Ev w87
37	Society for General Microbiology (PR 39)	Ev w91
38	British Antarctic Survey (PR 40)	Ev w94
39	Professor Thomas Ward, Pro-Vice-Chancellor (Academic), University of East Anglia (PR 42)	Ev w96
40	International Bee Research Association (PR 43)	Ev w98
41	London Mathematical Society (PR 44)	Ev w100
42	Jonathan Cowie (PR 45)	Ev w102
43	The Publishers Association (PR 46)	Ev w105
44	Sir Iain Chalmers, James Lind Initiative (PR 47)	Ev w107
45	American Meteorological Society (PR 48)	Ev w109
46	British Sociological Association (BSA) (PR 49)	Ev w111
47	Dr E J P Marshall (PR 50)	Ev w112
48	UK Association for Heterodox Economics (PR 52)	Ev w115
49	The Association of Learned and Professional Society Publishers (ALPSP) (PR 53)	Ev w119
50	Medical Schools Council (PR 56)	Ev w123
51	Geological Society of London (PR 58)	Ev w124
52	International Association of Scientific, Technical and Medical Publishers (STM) (PR 59)	Ev w126
53	Dr Thomas J Webb (PR 62)	Ev w129

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54	Professor Mike Clarke (PR 63)	Ev w131
55	John Innes Centre (PR 64)	Ev w133
56	University Alliance (PR 65)	Ev w135
57	Faculty of Pharmaceutical Medicine (PR 66)	Ev w136
58	Adam Jacobs (PR 70)	Ev w136
59	Regional Studies Association (PR 71)	Ev w138
60	Martin Hill (PR 72)	Ev w139
61	Dr Alastair Gill and Professor Nigel Gilbert (PR 75)	Ev w141
62	Professor Daphne L McCulloch (PR 76)	Ev w145
63	Cancer Research UK (PR 78)	Ev w147
64	Society of Biology (PR 79)	Ev w148
65	Jonathan Sturgess (PR 80)	Ev w152
66	Daniel Mietchen (PR 82)	Ev w154
67	Thales UK (PR 83)	Ev w157
68	Professor George Bernard (PR 85)	Ev w159
69	UK Computing Research Committee (PR 86)	Ev w160
70	British Psychological Society (PR 87)	Ev w163
71	Diane Harley and Sophia Krzys Acord (PR 88)	Ev w164
72	The Association of Medical Research Charities (PR 90)	Ev w168
73	Kamal Mahawar (PR 92)	Ev w169
74	Veli Albert Kallio (PR 93)	Ev w173
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76	David Smith (PR 97)	Ev w177

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List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2010–12

First Special Report	The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10	HC 370
First Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails	HC 444 (HC 496)
Second Report	Technology and Innovation Centres	HC 618 (HC 1041)
Third Report	Scientific advice and evidence in emergencies	HC 498 (HC 1042 and HC 1139)
Second Special Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails: Government Response to the Committee's First Report of Session 2010–12	HC 496
Fourth Report	Astronomy and Particle Physics	HC 806 (HC 1425)
Fifth Report	Strategically important metals	HC 726
Third Special Report	Technology and Innovation Centres: Government Response to the Committee's Second Report of Session 2010–12	HC 1041
Fourth Special Report	Scientific advice and evidence in emergencies: Government Response to the Committee's Third Report of Session 2010–12	HC 1042
Sixth Report	UK Centre for Medical Research and Innovation (UKCMRI)	HC 727
Fifth Special Report	Bioengineering: Government Response to the Committee's Seventh Report of 2009–10	HC 1138
Sixth Special Report	Scientific advice and evidence in emergencies: Supplementary Government Response to the Committee's Third Report of Session 2010–12	HC 1139
Seventh Report	The Forensic Science Service	HC 855
Seventh Special Report	Astronomy and Particle Physics: Government and Science and Technology Facilities Council Responses to the Committee's Fourth Report of Session 2010–12	HC 1425