Africa Media Review, Volume 15, Numbers 1&2, 2007, pp. 68–88

(ISSN 0258-4913)

Deploying the Electronic Edge in the Peer Review of Scholarly Publications

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Abstract

This paper traces the origin and evolution of the traditional peer review system, and shows its strengths and weaknesses, which arise mainly due to the effects of human factors in the management of activities involved. An automated non-blinded open peer review system is recommended considering the versatility of the information and communication technologies and the modern openness culture in scholarly communication. This new system will improve the participation of developing countries' scholars in the review of scientific papers published in the mainstream journals, and thereby enhance their contribution in the international science scene.

Résumé

Cet article retrace l'origine et l'évolution du système traditionnel de révision par les pairs, et montre ses forces et ses faiblesses qui se posent principalement en raison des effets des facteurs humains dans la gestion des activités concernées. Un système informatisé un système de révision par les pairs qui est non sélectif et ouvert est recommandé compte tenu de la versatilité des technologies de l'information et de la communication, et la culture moderne d'ouverture dans la communication savante. Ce nouveau système améliorera la participation des chercheurs des pays en voie de développement à la révision des articles scientifiques publiés dans les grandes revues, et d'accroître ainsi leur contribution à la scène scientifique internationale.

Introduction

The twin debut of *Journal de Scavans* in France and *Philosophical Transactions* in Britain around the middle of the seventeenth century marked the beginning of the over 300 years regime of the paper journal as a format for science communication. The birth of the paper journal

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was heralded by the intersection of a number of social forces and technological advances, including the discovery of printing in Europe and the development and improvement of postal services (Eisenstein 1979; Cronin 2002) in addition to the attitudes in the scholarly community which were moving towards sharing established knowledge based on observations and experimentation (Kronick 1962). During these over 300 years, journals and other primary sources have ruled the science communication protocols, fulfilling, although not flawlessly, the expectation that scientists in different peer communities could be interconnected for mutual sharing of ideas and research results. With increasing stratification of knowledge and institutionalisation of science, the ability to contribute to knowledge through the journal media has become very significant in science, classifying scientists and their institutions as productive or non productive, being of high or low quality; in fact, epitomising human intellect. As a result, the number of journals globally has grown inestimably, with each community of scientists seeking to promote the chances that its members have their signatures appended on the tabloid.

From the angle of science communication, the aims of the journal are to:

- Encourage research;
- Aid the flow of information;
- Establish priority as quickly as possible; and
- Report separate parts of a research programme.

During the earliest stages of the modern paper journals, the journals fulfilled these expectations by receiving and publishing articles sent to them by authors, without any questions regarding whether the contents of the articles were authentic or had been published elsewhere. The scientific texts were accepted on their own merits within the prevailing notions of 'civility and gentlemanly conduct' (Foucault 1977). Hence, the same articles could be published in as many journals as the author wished, enabling the author to reach different audiences of his choice. What then brought about the institution of peer review?

The origin of peer review

There is a relative consensus that the institution of peer review was probably formally established in 1752 when the Royal Society of London formed a Committee of Papers, which was charged with the review of all articles submitted for publication in the *Philosophical Transactions. The major*

assignment of the Committee was to ensure that the articles contributed to knowledge (Zuckerman, et al. 1971; Burnham 1990). To effect this, the editor of the journal read the articles with the help of some editorial assistants. With increasing competition among journals and their publishers, some social, economic, political and other interests started to be introduced in the role of the journal as a publishing medium. Individual journal publishers started initiating policies to improve the postion of their journals among competitors. The journals started asserting undue control over the right of ownership of the published materials, although the copyright of the article remained with the author, thus introducing a dichotomy between ownership of the journal article and the copyright of the article. In 1969, Franz Ingelfinger the editor of *New England Journal of Medicine* (*NEJM*) made a policy that his journal would reject any paper that had been published – in whole or substance – in any other journal. Ingelfinger's policy began as an economic decision to improve the market rating of his journal. Thereafter, Arnold Relman, the next editor of *NEJM* introduced this factor as a responsibility of peer reviewers, so that articles published in *NEJM* would be confirmed not to have been published elsewhere (Altman 1996). Hence, peer review acquired a new purpose of being a strategy for sieving articles that had been published elsewhere, so that they do not feature in *NEJM*. With increasing use of the journals as communication media, coupled with increasing competition among scholars for tenure, the fear that wrong claims could feature in the prestigious *NEJM* motivated Relman to include a third point in the peer review responsibility, namely, to ascertain the authenticity of the articles sent to *NEJM* for publication. Peer review has since then been held to be the mechanism for ensuring the high quality, non-duplication and originality of publications.

According to El-Munshid (2000), there is a general consensus among scholars now that peer review, commonly involving the use of targeted and anonymous referees chosen by knowledgeable editors, is widely accepted within the scientific community at large because:

- It provides expert and impartial evaluation of manuscripts that would weed out flawed and fraudulent research, that is, it acts as a gatekeeper that ensures high standards for published scientific articles;
- It improves manuscripts through the constructive criticisms of the reviewers;
- It helps direct articles to the appropriate journals through some form of advice often communicated to the authors;

- Peer review is also to free publication from the domination of any particular individual's preferences, making it answerable to the peer community as a whole – within the discipline or specialty (Harnad 1985).

Constraints of peer review

Despite its advantages, peer review is a subjective process with clear fallibilities. Often, it is argued that peer review is subjective or biased as peer reviewers are essentially the author's competitors. Readings (1994) was very sharp in his observation regarding this, particularly as it affects younger scholars:

> Normally, those who review essays for inclusion in scholarly journals know what they are supposed to do. Their function is to take exciting, innovative, and challenging work by younger scholars and find reasons to reject it. The same goes for book manuscripts: one receives a hundred dollars for rejecting a manuscript, but if you suggest that it should be published, the check never seems to arrive (Altman 1994).

Peer review cannot ensure the validity of a study's data, and many journals do not even clearly describe their policies and practices. Articles can pass peer reviews, but might have been developed based on faulty and fraudulent data. Evidence to this can be cited from the many revelations of the international medical journal editors regarding the level of infelicity in primary research articles which passed through peer review oversight (Flanagin 1994). In a recent article, Hirschauer (2004) has even suggested that peer review is not a scientific measurement of the quality of publications, but a social institution for the calibration of reading time within a discipline.

Bias of peer reviewers may be based on gender, ethnicity or geographical location, research approach, and favour for one's discipline. There could also be some sujectivity in reviewers' bias when they show leniency towards renowned authors, otherwise known as the halo effect. This bias sometimes is expressed towards those with numerous previous publications or those who work in prestigious institutions. Another serious type of bias occurs when a hypothesis relating to the mainstream thinking is favoured in preference for those opposing what may be called conventional wisdom (Ernst 2000). Gender bias is expected because peer reviewers are predominantly male. A good case was documented in the *British Medical Journal* (Lock *et al*. 1990). Gilbert *et al*. (1994) have also done a comprehensive study of gender bias in the *JAMA* peer review process. To determine gender bias, Gilbert, Williams and Lundberg (1994) analysed information on the handling of 1851 research manuscripts submitted to *JAMA* in 1991 according to the gender of the corresponding author, as-

signed editor or the peer reviewers. They found that female editors were assigned manuscripts from female corresponding authors more than male editors; also male reviewers assisted the latter more than female editors. They concluded that gender differences exist in the peer review process.

Bias in peer review has also been related to institutional prestige. The study of Garfunkel *et al.* (1994) proved this aptly. They conducted a retrospective study at the *Journal of Paediatrics* in order to identify the extent to which institutional prestige affects peer review in the United States. They determined institutional prestige according to the monetary value of grants funded by the National Institutes of Health so that those that attracted higher grant volumes were ranked as more prestigious. Their results showed that for 147 brief reports, lower institutional rank was associated with lower rates of reviewer recommendation and selection for publication.

Further in this regard, Link (1998) investigated and showed that the source of a manuscript at the international level biases peer reviewers. Using 70 per cent of manuscripts submitted to *Gastroenterology,* reviewers' rankings of original manuscripts submitted to this journal in 1995 and 1996 were subjected to analysis based on the nationality of authors and reviewers with regards to whether the authors were from the US or not. The result showed that US reviewers when compared to-non-US reviewers, favoured US papers over-non-US papers and ranked US papers higher and assigned them a higher acceptance status. Thus, there was a clear preference by US reviewers for US papers.

A certain study examined whether there is peer reviewer bias against unconventional therapy (Resch et *al.* 2000). The study consisted of sending either of two invented versions of a short report on the treatment of obesity to 398 randomised reviewers of whom only 41.7 per cent replied. One version reported the results when using an orthodox drug while the second used a homeopathic remedy. The reviewers were requested to rate importance on a scale of 1 to 5 and to recommend either acceptance or rejection of the manuscript. There was a significant difference in favour of the orthodox version.

Peer review has also been argued to tend to stifle originality by blocking new ideas that are outside the mainstream or that seem to contradict established conventional wisdom. A number of commentators (Agger 1990; Readings 1994) argue that scholarly refereeing is inherently conservative. Those selected to be referees, at least for 'established' international periodicals, are generally 'recognised' scholars in their field who have already passed through the various publication hoops themselves. Original work,

which challenges orthodox views, while ostensibly encouraged, is in practice frequently impeded by academics that have a stake in keeping innovative critical scholarship out of respected journals. For if a contributor to a major journal runs against the grain of conventional scholarly wisdom in a given discipline, it is likely his or her submitted manuscript will have to pass through the hands of one or more academics who are prime representatives of prevailing opinion.

Peer review also provides opportunities for stealing ideas and plagiarism

Furthermore, peer review tends to render a certain proportion of scientists unnecessarily very powerful. In journal review, much depends on the goodwill of editors. Anecdotal tales of being 'set up' by editors abound in academic corridors. Such experiences where referees known to be especially 'vicious' in their criticisms, or to have strong prejudices against particular perspectives, are selected and can be devastating for beginning scholars setting out on the path to an academic career. Equally, of course, there is considerable satisfaction for authors when they encounter conscientious referees who submit their reports promptly, with balanced comments, fair criticisms, and constructive suggestions for improvement.

Indeed, on many occasions, referees perform an invaluable service in identifying faults the author may not have noticed — faults that if left unattended, could prove professionally embarrassing. Undertaking refereeing duties takes considerable time and effort to read scholarly papers and to respond to them thoughtfully. Agger (1990) maintains that, given the shortage of journal space and the abundance of manuscripts in most fields of study, the balance of power at present rests very much in the hands of those who edit, review for, and produce the journals. There is, his analysis suggests, simply not enough room for everybody – at least not in 'respected', international journals. Agger claims that much of the writing produced by academics is either never published or ends up in local, unrefereed sources. As a result, it remains – as far as the international scholarly community is concerned – largely 'invisible'. Agger observes:

> Academic reviewing becomes even nastier in an extremely competitive marketplace.... [I]t is no longer enough in many disciplines to have two strongly positive reviews and one lukewarm one; all three must be sterling given the rate at which writers submit papers for publication. In this climate, reviewers learn (and teach themselves, circularly) not to read generously but to target the smallest issues in their overall evaluation (Agger 1990).

Peer review also delays publication of research results. Some of the potential problems with peer review are intensified by the sluggishness of print and post systems. In the developing countries, these problems are more manifest. There are delays in sending and receiving of letters, and this can make it difficult for authors to quickly resolve problems with unresponsive editors and referees. In fact, the delays sometimes invalidate the result of a research when there is new knowledge or technique that cancels that contained in an article that is yet undergoing review.

But do we still need peer review?

Peer review is inevitable but we need a radical change

The problems associated with peer review notwithstanding, refereeing is inevitable. Without some sort of rigorous mechanism for judging academic work, the publication of scholarly articles and monographs can become somewhat an incestuous process. As a result, it is suggested that standard refereeing practices should remain an important mechanism for sieving the information that go to readers. Peer review is a critical component in the competition between rival journals because good refereeing and editing raise the perceived quality and increase reader appeal. With increased quality comes increased citation of published articles in scientific work. Highly cited journals attract more submissions, so that high quality is inevitably associated with a high rejection rate. It follows that quality journals spend more on the refereeing process, and that much of the investment appears to be wasted on rejected, and hence unremunerative, materials. However, the manual method seems to exacerbate the limitations of the peer review process. Harnad (1992; 1996), Stodolsky (1995), and others have suggested that there are other emerging systems that will minimise the human limitations that becloud the peer review process. Several factors have impacted upon, and transformed the way science is done today on the institution of peer review. For instance, the exponential growth of science has given way to a steady state, which results in tough competition for research funding and publication, and consequently a heavy strain on the process of peer review or even its corruption. The major external factor has been the advent of electronic publishing. The speed and convenience of the electronic medium has reduced the lag time between submission of a paper and its publication and increased the options for interactions between editors, authors and readers. It is appropriate to suggest a radical change in the peer review process harnessing the most modern and effective technology, namely, the WWW of the Internet.

The critical activities involved in the peer review process namely writing the article, and reading and assessing it for publication will remain a human function for a very long time to come. Except and until the electronic revolution becomes sufficiently sophisticated for the computer, for instance, to write or read an article, and also assess a scientific article, the human function will continue to exist. What then will be the role of electronic facilities in the peer review process? The critical role of electronic facilities in the process will consist of the management of those activities that cause delay and bias in the process.

Peer review functions fall within the category of activities that could be computerised. The process is repetitious and the volume of activities is very large. All the activities involved in peer-reviewing an article can, therefore, be computer-aided. A typical process of reviewing an article begins with a submission made by an author or authors. This usually follows a call made by the journal through various forms of advertisements both in the journal in question or other media. The journal has an Editor and, or an Editorial Board. With some journals, it is the Editor-in-Chief who in consultation with other members of the board, selects the referees, usually one or two per manuscript, and a third or more consulted to avoid a possible deadlock. The referees advise the Editor(s) by evaluating the manuscript and making recommendations about acceptance, or, rejection and or revision. The referees' reports are usually advisory rather than binding on the Editor, who makes the actual decision, although a good Editor often chooses his referees recommendation. The article is returned to the author if it requires some revision. Otherwise, the author is informed whether the article is accepted or not. This whole process takes a very long time and is very costly. Harnad (1996) has vividly described the benefits of the electronic alternative.

> But the Net does offer the possibility of distributing the burdens of peer review more equitably, selecting referees on a broader and more systematic basis (electronic surveys of the literature, citation analysis, even posting calls for reviewers to pertinent professional experts' bulletin boards and allowing those who happen to have the time to volunteer themselves). The speed with which a manuscript can be circulated electronically is also an advantage, as is the convenience that many are discovering in reading and commenting on manuscripts exclusively on-screen. All in all, implementing the traditional peer review system purely electronically is not only eminently possible, but is likely to turn out to be optimal, with even paper journal editors preferring to conduct refereeing in the electronic medium (Hanard 1996).

It is not clear whether we have realised the relative advantage of the Net where people are required to make decisions such as reviewing and editing, which still take time. Copyediting is much faster as the bulk of the formatting is done automatically. Database entry will be minimised as the authors and the software do the bulk of this work. No paid staff, or at most a minimum number, will be required to do any of the tasks. All correspondence will be conducted by email. Formatting, for both copyediting and publication, will be done by software. Printing, postage, telephone and other distribution costs will be completely eliminated, as the journal will be published only online. E-review will de-centralise the review process and enable platform independence. But how can we achieve peer review on the Net? Our approach here is rather radical.

Automated non-blinded open peer review

We suggest not only an electronic peer review system but also a completely open peer review type in which the identities of the authors and reviewers are not shielded from each other. This suggestion follows evidence that blinding peers is of no significant effect in the quality of the article, and the inherent openness of Internet activities.

Several studies have investigated the effects of blinding reviewers on the quality of reviews. The first significant study was a presentation by McNutt *et al.* (1983). They sent each of 123 manuscripts at the *Journal of General Internal Medicine* to two different reviewers: one blinded and the other non-blinded. The reviewers were allowed the choice of whether or not to sign their reports. Editors were blinded to the identities of both the authors and reviewers. They removed the identities of the authors, running headers and footers and any other clue in the text, and also the names of their institutions from the manuscript's title page. But self-citations were not removed. They concluded that blinding was 73 per cent successful, and that the causes of unblinding were recognition of authors from self-citations, knowledge of the authors' work, or an editorial error. The principal result was that editors graded the quality of blinded reviews significantly better than the unblinded reviews. Forty-three per cent of the reviewers chose to sign their reviews: editors graded signers as more constructive and courteous while authors graded signers as fairer. Apart from this study, three subsequent studies failed to confirm that blinding improved the quality of reviews in any way.

The study of Van Rooyen *et al.* (1998) is also significant in this regard. They randomised 527 consecutive manuscripts submitted to the *BMJ* and sent each to two reviewers, one blinded and the other unblinded to au-

thors' identities, with either masking or unmasking of a reviewers' identity to a co-reviewer. The authors concluded that blinding and unmasking made no editorially significant difference to review quality, reviewers' recommendations, or time taken to review. The experiment of Van Rooyen *et al.*. (1998) in which eight areas of weakness were introduced into a paper accepted for publication and sent to 420 reviewers randomised to blinding or unblinding, signing or not signing reports, plus a fifth group treated in the usual way, is also significant. They discovered that blinding reviewers to authors' identity and requiring them to sign their reports had no effect on the rate of detection of errors. Furthermore, Justice *et al.* (1998) used 118 manuscripts at five biomedical journals where the normal practice was non-blinding of reviewers, except for the *Annals of Emergency Medicine,* where reviewers are routinely blinded. The authors sent each manuscript to two reviewers, with the manuscripts randomly assigned either to normal practice, or to an intervention arm whereby the reviewer was either blinded or non-blinded. Their result showed that blinding was 90 per cent successful for the *Annals of Emergency Medicine* only. The average rate for the remaining four journals was 58 per cent, with blinding failure significantly occurring when the authors were well known. They concluded that that blinding of reviewers to the identities of authors' did not improve the quality of reviews even when the analysis was restricted to successfully blinded manuscripts. Essentially, the same group that performed the study of Justice *et al.* decided to evaluate differences in the success of blinding reviewers at seven biomedical journals. The percentage of reviewers successfully blinded was determined for three journals where blinding reviewers to authors' identities was a long-standing policy, and for four journals where there was no such policy (Cho *et al.* 1998). The success of blinding was not related to a journal's policy of blinding reviewers, but rather to the reviewers' research experience. But it is doubtful whether any journal would opt for less experienced reviewers to increase the success rate of a procedure which is largely ineffective.

In all the studies cited so far, it was only that of McNutt *et al.* (1983) that rated blinding high. What was the reason or reasons for the significant effect of blinding on the quality of reviews reported by them? El Munshid suggests that it could be because the authors and reviewers for the journal studied (*Journal of General Internal Medicine*) knew each other's research to a greater extent than for other journals, or the reason could be the way the review quality was assessed, and, in any case, the level of significance was not high ($P<0.02$). Subsequent studies, which

disproved the inevitability of blinding, incidentally involved more journals and larger samples and also employed somewhat different approaches.

On the other hand, many studies have shown that open peer review will work. Van Rooyen *et al.*. (1998) performed a trial at the *BMJ* aimed at examining the effect of revealing the identities of reviewers to the authors. They sent consecutive manuscripts to two reviewers randomised to be identified or anonymous, and the quality of the reviews was assessed by two editors and the corresponding author who were blinded to the intervention. The editors' evaluation was obtained for 113 out of 125 manuscripts and for 105 manuscripts in the case of the corresponding author. There were no significant differences between the anonymous reviews and those in which the reviewers' identities were revealed regarding quality, recommendation to publish, and the time taken to complete the review. However, the likelihood to decline was significantly higher when the reviewer was asked to consent to revealing his identity to authors. It was concluded that open peer review would be feasible at a large general medical journal.

Also, Walsh *et al.* (2000) conducted a study devoted to examining the feasibility of an open peer review system at the *British Journal of Psychiatry*. The study involved 245 reviewers constituting 76 per cent of those requested to participate, with consent to have their names revealed to the authors. A total of 408 submitted manuscripts were randomised to signed or unsigned reviewer groups. The quality of each review, its tone, recommendation to accept or reject and the time spent on it were assessed. Compared to unsigned reviews, those signed had higher quality, were more courteous, and took more time to complete; signers were also more likely to recommend publication. It was then concluded that open peer review would be feasible at a small specialised journal.

Thus, both studies agree on the feasibility of an open peer review system. Such a system would have the advantages of accountability, fairness and transparency. The quality of the reviews would not suffer and might rather be improved. On the other side of the argument is the probability that an open peer review system might lead to strained professional relationships, loss to the reviewer process of reviewers who decline to be identified, and increased number of manuscripts recommended for publication for the editors to consider.

The strong point in blinded review is the avoidance of bias often tied to the expectation that the author and the reviewers do not know themselves. But bias has been shown to always occur. Authors are very skilled persons, and have other caveats that could help unravel, to an extent, the

likely identity of the authors of articles they review. For instance, development in content analysis of textual data show that it is possible to establish the author of an anonymous article, and this is an activity that has been happening intuitively before a formal scientific procedure was developed to establish it. Even the content of the article, the materials and methods, the subject matter, among others are sufficient to point the reviewer to the likely identity of the author, his institutional and geographical origin, or even any other information about the author. When reviewers are biased, they hide under the cloak of blinded review process in which the author of a rejected article is lampooned to believe that his article has been given a fair chance, whereas it is not so. And so the author might put aside a good idea because he feels that the idea is not worth publishing. As a result, many good ideas would have been set aside or published in lower quality journals because they were originally assessed as unworthy of being published in high impact journals.

But open peer review will introduce some checks and balances. An author who feels that her article has not been given a fair chance could contest the report of a reviewer because the author and the reviewer might not be well disposed to each other. Furthermore, a reviewer knows that the author has his identity, and may therefore be wary of any assessments that are not based on objectivity. Moreover, open peer review will link the author with the reviewer. This is very important because the essence of an article is to share ideas and contribute to the stock of knowledge in an area. The author is not standing examination in which another author who, in his status as a reviewer, is the examiner. Every author is a reviewer, and every reviewer is an author. The credo of the publication and review process is to establish whether an article contributes to knowledge, and help the author organise her thoughts so that the content of the article can benefit members of the academic community.

Let us now stratify the scientific community somewhat and see how open peer review could obtain within and among the communities.

The options for electronic peer review

Thus far, we have dealt with issues relating to peer review, highlighting the limitations of the manual process, blinding and other quality control measures. Let us now examine the options for undertaking aspects of peer review activities on the Net. We shall stratify the scientific community broadly as consisting of specific community and universal community, and then suggest how this open peer review system could obtain within each community.

Option one: Community peer review

A 'community' means a group of people with some shared element. A scientific community is usually a loosely knit community of scientists and researchers working on the same subject. Sometimes the term *scientific community* is also used to describe the community of *all* scientists (http://encyclopedia.thefreedictionary.com). The community could be multidisciplinary, interdisciplinary or intradisciplinary. A multidisciplinary group consists of scientists from more than one discipline but their research strategy is usually the adoption of specific techniques and methodologies available in their various disciplines to solve problems. Typical examples could refer to the ubiquitous research groups that exist even in Africa. The Africa Technology Policy Studies (ATPS), for instance, would want to know what people outside engineering and related disciplines would contribute to the question of technology in Africa. On the other hand, interdisciplinary groups have implications for the adoption of a single methodological technique irrespective of the disciplines of the participating scientists, such as the activities of SIGMETRICS, focused on the application of informetric methods in the analysis of literature and related phenomena. Members are drawn from all disciplines but their interest is mainly in the application of informetric tools to analyse literature and other related activities in, preferably, the field of expertise of the scientist. Finally, intradisciplinary groups often consist of scientists from the same discipline who may then be focusing on problems adopting methods suited to their subject specialties. The various professional and disciplinary associations can typify intradisciplinary research groups. Typical examples are the Computer Society of Nigeria, Nigerian Library Association, etc.

Scientists naturally identify with relevant scientific communities. In this era of problem-solving focus of science, scientists are expected to be multidisciplinary, and, therefore, often belong to more than one scientific community. Members of each scientific community often 'know' themselves, and are expected to meet regularly to discuss progress in their disciplines and other issues of interest. In the modern times, this process has been eased by the existence of electronic *listservs,* which enable members of any scientific community to identify their members, their locations, and specific areas of specialisation, among other things.

Two methods of community open peer review can be suggested.

Restricted Community peer review

In this model, the peer review of any article is restricted to selected members of the community whose expertise are either the same with, or

is more closely related to, that of any scientist whose article is being assessed for publication. The articles sent to the journal are circulated to the selected members using the usual electronic medium. The scientists then review the article and return same to the journal editor, who in turn sends the reports to the author for possible revision or otherwise advise the author that the article was not accepted for publication. Except for the electronic intermediation, this procedure nearly mimics exactly the process adopted in manual peer review. Another major difference anyway is that, as expected, the peer review process is flexible, and the journal editor can therefore expand the number of persons to whom he sends a single article, thus increasing the spectrum of opinions that might improve the quality of articles a journal publishes. However, problems may arise when the number of reviewers is very large and the decision on publication of the article is tied to complete response from all the reviewers. A good practice, however, will be to define a threshold number of reviewers whose response is sufficient to decide on whether to publish or not.

Non-restrictive scientific community open peer review

Irrespective of the subject specialisation of scientists, members of the same academic community relatively share the same theoretical concepts and are therefore expected to be conversant with issues in each other's specialties. In a non-restrictive community of scientists, open peer review will refer to the inclusion of all members of a given community as peer reviewers. In this regard, every article sent to a journal for publication is distributed to all the members of the community for peer review. However, a threshold of the number of responses and the range of disciplines required suitable for taking decision on the article is defined. Although the size of this threshold is expected to be higher than the one in the previous model, the relative large size of the community would also be expected to cancel the chances of low reviewer response rates. Furthermore, there may be the fear that when scientists know that every member of the community is a reviewer of the same article, there may be some relaxation with respect to quick responses because 'another scientist will submit his or her own review'. But this limitation will not hamper the performance of this model because the compulsion to contribute one's opinion to a content that will be published in a journal is a pride to the scientist. Also, different scientists share wide varieties of opinions concerning even a single issue, and may want to use the opportunity to influence the content of the article. The advantages include the fact that the variety of reviewers' comments may

cut across various subject areas in the discipline, thus reflecting a true 'community' in the right sense of the word.

Option two: Universal community peer review

In a sense, the whole communities of scientists in the world also constitute a single scientific community. Several scientists have shared different variants of this view at different times. For instance, Cameron (1997) has called for a universal citation database and more that would link every work of science, and scientists together. This opinion is powered by the increasing consciousness that knowledge is just one single coin whose different faces are defined by factors associated with limitations of human beings and the need for specialisation, among other things. In this option, we can also identify two strategies.

Restrictive universal open peer review

In this format, journal houses are a little more transgressive in restricting the disciplinary affiliations of their reviewers. Reviewers are selected from any of the scientific communities that have relevance with the expertise of the article under review. Articles are deposited at a designated venue and distributed to relevant scientists irrespective of their disciplines.

Non-restricted universal open peer review

In this strategy, the opinion of every scientist has potential utility in assessing an article. Hence, the article is deposited in a venue where every scientist can reach, irrespective of discipline. But this strategy may look clumsy to many people and for several reasons. First, sooner or later, there may be an avalanche of articles that are queuing for review. Second, there may be reason to fear that the articles posted for review might not receive the attention of any scientist. Third, and very important, if the expected readers of the article see it in advance, what will be the essence of further publishing the article? These and probably more may border the conventional manual paper review adherent. But scientists are selective of what they read, being busy persons themselves. Also, the fact that every scientist is given an equal opportunity to contribute to an upcoming publication somehow levels the peer review playing ground already macadamised in favour of some very visible scientists, institutions, gender, and regions. Harnard (1996) has suggested allowing 'preprints' of articles to be available on the Internet prior to peer-reviewed publication. Physicists have followed this model for several years now, submitting articles to the e-print archive maintained by Paul Ginsparg at the Los Alamos National Laboratory, in advance of, or instead of, print journals (Taubes 1996). Moreover, if multidisciplinary

approach is considered a universal strategy, then it will improve the chances of reflecting the opinions of scientists of all backgrounds in an article in order to improve its utility. Furthermore, an article is written for information and education, and scientists know this too well. An article that is undergoing peer review is so designated, and the one that is published is also indicated to have undergone peer review. This process is common in communities where the distribution of preprints is a normal process in assessing the suitability of an article for publication.

Processing electronic peer review

We have indicated that the activities that go into the process of peer review can be computerised. There is a variety of software tools that enable the electronic management of peer review processes for elctronic scholarly journals. These tools promise to facilitate efficient and centralised control of the submission, assignment, tracking and publication of articles through the web, as well as enabling a central archive of various tasks performed. Some programmes keep all texts in online format throughout these processes, using multiple windows to allow reading, editing and online publication of articles, while others use automated files transfer protocol (FTP) and e-mail processes to exchange documents in standard formats.

A typical software programme would consist of an author screen which allows authors to submit articles electronically. This screen should provide templates/instructions to authors and other stakeholders for submission, conversion and uploading of content in any format. There should also be automated notification screens that generate e-mails to editors, reviewers and authors, notifying them of articles to be reviewed, as well as reviews or edited copies available online.There is also the editor screen which allows editors to identify, read and notify or assign submitted articles to potential reviewers except when the article could be assigned automatically to reviewers. There also exists a reviewer that should enable the reviewers to read or receive articles, and then post or send their comments and suggested revisions to the editor or author. Depending on the option operated by the journal, an article is assigned to reviewers and tracked. The event logging enables the retrieval of list of appropriate editors and reviewers and tracks those who choose or who are assigned to particular articles. This makes it easy to check the status of reviews. Very critically, the programme should automate the assignment of reviewers based on article categories. In other words, nomination of reviewers should be automated. In a typical open and non-blinded peer review process, the identities of the authors and the reviewers are not hidden. Com-

munication between the author and the reviewer is allowed, although tracked and logged. There should also be flexible authorisation in which articles or reviews in process are made available to different users. The reason is because the reviewer may need the opinion of other experts who were not originally considered relevant. All through the process, there is a quality/category tags which provide standard tags to enable the editors mark pre-print articles for quality and proper classification. The software should also provide screens for writing and saving or sending finished review to editor. Some split-screen allow devices can serve this purpose so that the reviewer can view an excerpt of an article while writing his report by the side.

It is also possible for authors to choose whether their articles should be reviewed blind/doubleblind or open. The software should contain enforcement nagging, which reminds the reviewer or even the author about deadlines for submission of reviews and also automatically sends e-mail reminders. Editors are also alerted about completed, pending or overdue reviews, the number of reviewers reports already received for a certain article, the characteristics and identities, results regarding whether to publish or not, among other things are logged for the editors to monitor. Finally, there should be automatic posting formats which publish articles that have received a proper number and quality of reviews. The software should also notify subscribers about the publication of a new article, contain summaries, abstracts, tips etc.

These suggestions may sound too radical. But they show the actual place where the Internet revolution has placed us today, and more importantly, hold a lot of promise for the participation of developing countries' scholars in mainstream science.

Opportunities for mainstreaming developing countries' scientists

Several studies have shown that the participation of developing countries scientists in mainstream science is low. The reasons for this are often tied to the low quality of science in such regions, among other factors. There is a very low proportion of published articles creditable to authors from low income countries in many research fields, including psychiatry, cardiovascular disease, and epidemiology and HIV/AIDS. This situation remains so even though the current global burden of infectious and parasitic diseases is heavily concentrated in the developing world. The large number of national and international initiatives that have been launched to improve research capacities in developing countries in the recent years is evident.

Crucial questions obviously arise. Why do scientists affiliated to countries with low or medium human development indices seem to play less dominant roles in the research and control of tropical diseases that affect them specifically? How then do they share their experiences and disseminate their findings in the peer reviewed international literature? What is the solution to the continued low representation of developing countries scientists in international indexes? Answers to these questions cannot be sufficiently provided here. But it is sufficient to state that research into the diseases that affect persons from countries with low human development indices cannot be complete without the input of scientists from such countries. Based on interviews with more than 100 scientists and journal editors, Gibbs (1995) concluded that the near invisibility of less developed countries in scientific information may reflect not just the actual quality of Third World research but also biases and economics of scientific publishing worldwide. More than economic, there is also the political angle to the low assessment of African and other developing region scholars. For instance, international citation indexes deliberately keep the number of developing countries sources they include in their indexes very low. The low level of indexing of sub-Saharan African health and biomedical journals in the world's leading bibliographic information sources, such as *MEDLINE* is a good reference.

According to Lippman, indexed articles related to Africa come from just over 1,160 different periodicals, of which only 14 (about 1.2 per cent) are from Africa, and of the 14, seven are from South Africa. He further elaborated that most African publications are not indexed anywhere, since the 1.2 per cent of indexed African literature does not include the wealth of research papers, reports by ministries and NGOs, theses and dissertations from African medical schools, and other fugitive literature that is often of primary importance. As a result, access to this information is inadequate. It is generally believed that 80 per cent of the world consists of developing countries which encompass 24.1 per cent of world's scientists and 5.3 per cent of its research expenditure; and that these countries only show a participation of 2 per cent in the indexed output of scientific information. Even within the region, there are scientists who have suggested that African science is published and more available elsewhere (Akhigbe 1990). The above positions cannot be altogether true. The simple fact is that African research outputs are not indexed locally as a basis for assessment of their science. The low state of science, the inward looking nature of publications in this region, and the expectation that scientists often address problems in their immediate environments, among oth-

ers, support the expectation that scientific outputs are mainly published locally, and in sources that do not meet the requirements of the indexing services of the West. In any case, and as a result, developing countries' input into mainstream science is rated low.

In recent times, a new dimension of the low participation of developing countries scientists has also been spotted. It relates to the fact that developing countries' scientists do not also participate in the review of those mainstream journals, which are the basis for their low assessment. Serious under-representation of developing countries' scholars in the editorial and advisory board membership has been documented recently. There are ubiquitous findings of imbalanced editorial and advisory boards of general medical and psychiatry journals to the literature on tropical medicine, for instance.

Electronic review will provide an unbiased platform. This platform will transform the process and structure of science so that researchers from developing countries can both respond and contribute to issues that relate to their local needs. It is also an opportunity for them to cancel erroneous opinions about them, share their research findings, and possibly struggle to mainstream with international scholars. This will definitely be a key factor in reducing the intolerable burden of infectious and parasitic diseases that continue to affect poor the people worldwide disproportionately and might consequently be an important strategy towards improving the participation of developing countries in international science.

Conclusion

No doubt, this paper might have raised more questions than answers. What about the publishers? Will journal articles not become so easy to write? Will the status of the author not be compromised? Will there not be a long list of reviewers' comments, which may delay the revision of an article, and also probably subsequently infringe on the advantage of the speed of the electronic process? Will there not be contrasting views concerning the content of the article, which may further confuse the author? What about journal ownership? How will the editor be remunerated? How will the users of the e- journal pay for the journal services? What will happen to the publisher, the copyright question, and so on? The fact is that a new era has dawned on us – the electronic era – and this era carries with it challenges for human beings to reorganise and restructure the way they live, think and do things. If the Guttenberg machine displaced the historical manual copyists, then who and what should be displaced by electronic peer review should not be a central focus.

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