PUBLICATION PRACTICES IN PHYSICS

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I. Introduction

Publication of research results in scholarly journals plays an important role in the scientific community. These publications provide both a means for dissemination of new results and a means for evaluating the quality of scientific work and the scientists who perform it. This paper will examine motivations for publishing, ethical issues in publication, some relevant ethical codes, and some corrective measures that have been taken to shore up areas of ethical concern. Finally, the impact of new communications technologies on the future of publication will be considered.

Let us begin with some definitions. The term "publishing" in this paper will be restricted to the publishing of papers which appear in peer reviewed scholarly journals. Upon submission of a paper to such a journal, an editor selects one or more active researchers with expertise in the area of the submission to act as peer reviewers. These volunteer reviewers read through the submission and comment on both content and style, making an overall recommendation regarding the paper: publish as is, publish with modifications, or do not publish. Based on the recommendations of the reviewers, the editor decides whether or not to publish the paper.

Although the publication process is a time-consuming and drawn out affair, there are numerous motivations for publishing. Perhaps the most altruistic motivation is to provide a scientific record of your research so that others might benefit from it. Ideally, published results should provide new insights to others working in the same field and thus help avoid the problem of their having to "reinvent the wheel."

A second motivation for publishing is nearly as altruistic. Opening your research to the scrutiny of others provides a means of validation of your research results. Not only is your paper examined by one or more referees prior to publication, but also the paper will (one would hope) be read by numerous other individuals. When a significant problem is found with a paper, the authors often hear about it through direct communication, through discussions at scientific conferences, or through the "Comment" section in the journal. The more scrutiny your research can successfully withstand, the more confidence you have in the validity of any conclusions you have drawn.

These important scientific motivations for publishing notwithstanding, there are often job-related pressures to publish. A solid publication record is generally required to get and maintain in good standing an academic job at most universities. By publishing a paper, you can establish "priority" for a discovery, that is evidence that you observed a particular phenomenon first. Establishing priority in turn demonstrates your

contributions to the field, bolstering your application for academic promotion and tenure and for research grants. There may also be institutional (both academic and nonacademic) pressures applied to publish based on institutional desires to boast of a strong publication record and to establish priority in discoveries.

In summary, the publication process is used as a means of dissemination of results, validation of results, and measurement of scientific productivity. Thus ethical standards associated with the publication process ought to reflect these goals.

II. Ethical Concerns

Marcel LaFollette[1] describes a number of types of unethical conduct associated with scientific publishing. The following is taken verbatim from her Table 1 on page 42:

Types of Unethical Conduct or Misrepresentation in Scientific and Technical Publishing

By authors:

-Describing data or artifacts that do not exist.

-Describing documents or objects that have been forged.

-Misrepresenting real data, or deliberately distorting evidence or data.

-Presenting anotherís ideas or text without attribution (plagiarism), including deliberate violation of copyright.

-Misrepresenting authorship by omitting an author.

-Misrepresenting authorship by including a non-contributing author.

-Misrepresenting publication status.

By referees:

-Misrepresenting facts or lying in review.

-Unreasonably delaying review in order to achieve personal gain.

-Stealing ideas or text from a manuscript under review.

By editors or editorial advisors or staff:

-Forging or fabricating a referee's report.

-Lying to an author about the review process.

-Stealing ideas or text from a manuscript under review.

I would add to this list at least three other concerns. The first is submitting a paper to be published for the sole purpose of expanding your publication list. There are several ways to do this. A single paper can be split into two or more papers and published as a series. Another option is to publish essentially the same results with just minor modifications in a different journal. (Note that there may be legitimate reasons for doing this if, for instance, your motivation is to reach different audiences.) In any case, journal (and library) space is wasted, not to mention the time of those involved in reviewing the paper, all for the intent of creating a false picture of the extent and significance of your research.

A second concern is intentionally publishing incomplete papers for the purposes of obtaining or maintaining leadership in a field. This situation may arise in two ways. In the first case, a groundbreaking result may be rushed into print before all of the appropriate checks and confirmations have been made, with the intent of establishing priority for a discovery. In the second case, key steps in experimental procedure may be deliberately left out of a paper to make it more difficult for competing scientists to catch up.

A final area of concern is a referee disclosing to someone else an idea found in a paper under review. This is closely related to stealing an idea from a paper under review, but it broadens the concept beyond the personal use by the referee.

III. Ethical Standards

Having identified some areas of potential concern, we will now look at what the existing standards are (at least those which are in writing). The American Physical Society in 1991 adopted a code for professional responsibility. The complete text is available on the APS web site (aps.org). The relevant portions read as follows:

> Authorship should be limited to those who have made a significant contribution to the concept, design, execution and interpretation of the research study. All those who have made significant contributions should be offered the opportunity to be listed as authors. Other individuals who have contributed to the study should be acknowledged, but not be identified as authors. The sources of financial support for the project should be disclosed.
>
> Plagiarism constitutes unethical scientific behavior and is never acceptable. Proper acknowledgment of the work of others used in a research project must always be given. Further, it is the obligation of each author to provide prompt retractions or correction of errors in published works.

Peer Review

> Peer review provides advice concerning research proposals, the publication of research results and career advancement of colleagues. It is an essential component of the scientific process.
>
> Peer review can serve its intended function only if the members of the scientific community are prepared to provide thorough, fair and objective evaluations based on requisite expertise. Although peer review can be difficult and time-consuming, scientists have an obligation to participate in the process.
>
> Privileged information or ideas that are obtained through peer review must be kept confidential and not be used for competitive gain.
>
> Reviewers should disclose conflicts of interest resulting from direct competitive, collaborative, or other relationships with any of the authors, and avoid cases in which such conflicts preclude an objective evaluation.

There is additional information in the APS code regarding faking data, but that might be better classified under the heading of general research standards as opposed to standards specifically involving publication. Overall, the range of issues covered by the APS code and by LaFollette are fairly similar as far as authors are concerned. The APS code goes into somewhat more detail than LaFollette's table in the area of referees' responsibilities, including the statement that physicists have an obligation to participate in the process. Finally, the APS code is silent on issues associated with editors, perhaps because editors involve such a small portion of the physics community.

Included in the instructions to authors in Physical Review Letters (1996) is the following:

> The journal declines publication of papers which appear to parcel research results into fragments for multiple publication.

We hold the authors responsible for demonstrating adequate awareness of published prior research and for proper acknowledgment of colleagues. We invite the referees' comments on these issues, but we do not hold the referees responsible for deficiencies, nor does the journal accept responsibility for them.

Physical Review Letters, then, addresses the issue of padding a publication list by splitting papers. They also remind the authors that they, not the referees, are ultimately responsible for what appears in their paper, specifically regarding acknowledging related work.

IV. Areas of Concern

We now turn our attention to some problem areas related to publication. Of major concern to libraries and individuals who both pay for and store journals is the rapid rise in the volume of material published, resulting in higher subscription costs and greater shelf space requirements. This rise is reflected both in the increasing number of journals produced as well as larger size volumes of existing journals. To illustrate the latter, consider Physical Review Letters. Published weekly, in 1970 an average issue was about 60 pages long. By 1980, the average had risen to about 80 pages and in 1990 it was up to nearly 130 pages. In the second half of 1995, the average topped 180 pages per issue. This is an overwhelming amount of information, and it represents just the tip of the iceberg since Physical Review Letters is one of the most selective journals and it has a four-page limit for its articles.

With this explosion in information comes the problem of keeping up to date. A generally accepted requirement of publication is acknowledging those who have gone before you, people who have performed similar research. Searching the literature for related publications is becoming a larger task as the publication volume rises. Fortunately, the recent development of electronic databases has made searching somewhat easier, but it is not foolproof. A literature search based on certain key words and perhaps on some well-known authors in a given field may locate a large number of relevant references, but there is no guarantee that it will find all of the references. Thus while it is important to seek out and acknowledge the work of others in the field, it is not clear what constitutes an "honest effort" in searching for these contributions.

A related area of concern is erratum citation. If authors realize there is a significant error in a published paper, they may correct their paper by submitting a short correction notice called an "erratum" to the same journal. The erratum may follow the original paper by a few months or even a few years (in extreme cases). The problem arises when one reads a paper that is a year or more old and one does not realize that an erratum has been published. The original error, though corrected, may continue to propagate. A literature search geared for an erratum will easily turn it up, but it appears that such searches are not being made. For instance, a study of 14 papers in Physical Review Letters that were corrected with errata showed that when subsequent papers cited one of the original ones, the corresponding erratum was cited less than 40% of the time. Corrected Physical Review B papers fared even worse, with the erratum being cited less than 5% of the time[2]. Accuracy in the printed record is important, especially to those who are just beginning to build up from existing work done by someone else. Hence it is important that errors in the printed record be corrected as they are discovered. Those who make the effort by publishing an erratum should be applauded for their effort. However, it is less than satisfying to note how rarely these errata seem to be considered in conjunction with the original papers.

The errata considered in the previous studies were all associated with errors of significance, that is errors that had an impact upon one or more results or conclusions in the paper. Some of those errors resulted from "honest" mistakes, mistakes competent and diligent physicists make from time to time and embarrassingly happen to reach print.

Some of those mistakes, however, were likely better characterized as due to carelessness. These mistakes are the ones that should be caught by routine checks and reviews prior to publication. Distinguishing between these two is difficult at best and cannot always be done with any accuracy except by the originator of the mistake. Regardless of the source of the error, the error itself can have a measurable negative impact on the scientific community as it propagates or as time is lost by other parties needing to redo the research to correct the error. It may be argued then that one has an ethical obligation to avoid publishing work with careless errors. In proposing this as an ethical obligation, it should be noted that it is not necessarily enforceable since the line between a careless error and an honest mistake is not always clear. Enforceability, however, should not be a requirement for an ethical standard.

It would appear, based primarily on anecdotal evidence, that standards for publication lists have risen over the years. That is, to be a "competitive" scientist requires more publications now than used to be the case. Couple that with the tight job market for academic physicists and it is easy to understand the pressure to publish papers. One could ask whether this increased pressure to publish has led to more careless errors in literature. That careless errors exist is easy to demonstrate; however it is not clear if the problem is any worse now than it has been in the past.

Plagiarism, an issue addressed explicitly by the APS code, does exist in physics but blatant examples seem to be rare[3]. As with any discipline, one runs across the difficulty of deciding when the line has been crossed from using broadly accepted descriptions or ways of looking at things to stealing someone else's creative ideas.

Problems with referees seem to come up from time to time, but most of the evidence seems anecdotal. One hears stories, for instance, from people who are convinced that a referee has a grudge against them and for that reason is slowing up the review of their paper. Perhaps the best indirect evidence for problems with the refereeing system comes from the breakthrough in high temperature superconductivity. When Paul Chu and his coworkers submitted their breakthrough paper to Physical Review Letters[4] on high temperature superconductivity, the chemical formula for the new superconductor contained "Yb", the abbreviation for ytterbium. When the paper was published, the chemical formula had been corrected to replace "Yb" with "Y" (yttrium). While Chu denies that the use of Yb in the original manuscript was intentional, others speculate that he intentionally used an incorrect chemical formula out of concern over the possibility that details of the chemical formula might leak out during the refereeing process.[5] Regardless of whether or not Chu's action was intentional, some in the research community have said they would not blame Chu if he did intentionally alter the formula, indicating presumably that they too have concerns about confidentiality during the refereeing procedure.

Authorship in scientific papers has a different meaning than in other literature. One becomes an author of a scientific paper by, in principle, making a significant scientific contribution to the research reported. In a project involving a collaboration among several people, only one or two may be involved with the actual writing, with the remaining authors acting more like editors. "Honorary authorship", the practice of putting a senior lab member's name on a paper even if no scientific contribution was

involved, is probably less prevalent in physics than in other sciences. It is worth noting that honorary authorship can be risky -- if one has not followed the research closely enough, one does not know what the quality of work is to which one is lending one's name and reputation.

V. Corrective Measures

Among steps that have been taken to try to alleviate some of these problems is the effort by organizations such as the National Science Foundation to curb pressures for extensive publication lists. When submitting a grant application to NSF, individuals submit publication lists of at most ten papers (at most five directly related to the application and five not directly related). Some universities have gone to similar systems in evaluating candidates for vacancies or for tenure. This approach certainly reduces the incentive to extend one's publication list by subdividing papers or exchanging honorary authorships with lab members.

One of the problems in evaluating someone's publication record is that it is often difficult to assess the impact the published papers have had without being an expert in the field. This is why some evaluators have taken the easy way out by resorting to counting publications. Another numerical approach to assessing impact is by looking at the citation records. One asks the question: for a given paper, how many times has this paper been cited in other articles. The more citations then, presumably, the more impact the paper has had. Such a count is relatively easily done using a tool such as The Science Citation Index. However, it is not clear that this is really a genuine measure of the importance of a paper. It is also a system which rewards people for citing their own paper since excluding self-citations from a citation count is (presently) much more time-consuming.

One problem associated with the publication explosion is that libraries are running out of storage space for the journals. Paradoxically, some libraries are finding this problem resolved since journals are beginning to price themselves out of the market. As university libraries face subscription prices rising faster than their budgets, more subscriptions are being canceled.

David Mermin[6] has suggested that the journal explosion problem can be dealt with by boycotting some of the more obscure journals. Boycotting would entail refusing to submit papers to these journals, refusing to participate in the editing or refereeing process for the journals, and discouraging libraries from subscribing to them. The underlying assumption is that most of these obscure journals do not really add any new useful information outlets for the scientific community but rather just provide another mode for extending one's publication list. However, the criteria for deciding which journals deserve to be boycotted are not clear.

VI. The Electronic Future

The changing face of communications, in particular the move away from the printed word towards electronic communication, will surely have an impact on the publication process. Physical Review Letters is already distributed electronically (on-line and on CD ROM) as well as in traditional printed formats. There is the potential for a great savings of space and some savings in production costs as publishing moves in this direction. Furthermore, on-line versions of journals allow for Errata and Comments to be linked directly to the original article, making it easier for the reader to locate all the relevant information.

Mermin[7] has suggested that it might be worthwhile to move towards an entirely electronic publishing system, with most of the papers being unrefereed. This would eliminate most publication costs. Quality control, however, would be based on reputation and commentary attached to the papers.

Finally, it is worth noting that electronic databases of preprints have been in operation for several years. These databases make available via the internet papers which have been submitted but not yet accepted for publication. By doing so, they make available to all interested parties the most recent developments in their field, albeit in an unrefereed format. One can view this as a step towards a more democratic system as in the past such preprints were available primarily to a mailing list consisting typically of those people with whom the author has had previous contact.

VII. Conclusion

Some have suggested that the publication system in science is outdated and deserves to be scrapped. The argument goes that most of the up-to-date and important information is already adequately disseminated through conference talks and preprints of papers distributed prior to publication. However, until there is universal access to conferences and preprints, the printed record remains the most reliable way for someone breaking into a field or someone working at a smaller university to learn about existing work. The publication record also remains the best way to find out what has happened several years back, information which is no longer discussed at conferences or in preprints but may become relevant for newly discovered problems. Finally, the scrutiny at least some work receives pre- and post-publication can provide an effective means for screening and validating research. The nature of such a validation process is much less clear for preprints and preprint databases. For all of these reasons, the publication process, flawed as it may be, is worth preserving.

Notes:

1.LaFollette, Marcel C. Stealing Into Print: Fraud, Plagiarism, and Misconduct in Scientific Publishing. University of California Press (1992).

2. M. Thomsen and D. Resnik. "The Effectiveness of the Erratum in Avoiding Error Propagation in Physics." Science and Engineering Ethics 1 231 (1995).

3. For a reference to a documented case, see Phys Rev B 39 9614 (1989).

4. P. H. For, et. al. "Superconductivity at 93 K in a New Mixed-Phase Y-Ba-Cu-O Compound System at Ambient Pressure." Physical Review Letters 58 908 (1987).

5."Yb or Not Yb? That Is the Question" Science 236 663 (May 8, 1987).

6. Mermin, N. David. "What's Wrong With This Library?" in Boojums All the Way Through. Cambridge University Press 1990.

7. Mermin, N. David. "Publishing in Computopia". Physics Today 44 no. 5 p. 9 (1991).