

A review of reviews

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The different senses of 'review' in the scientific literature are distinguished and their roles are sketched. Special attention is paid to critical reviews of scientific books and to the role of referees/reviewers of papers submitted to scientific journals. Some gaps in provision are pointed out. © 2006 Springer Science + Business Media, Inc.

1. Introduction

From its very first issue, just 40 years ago, the *Journal of Materials Science (JMS)* has carried review papers, covering a huge range of themes. As the first chairman of editors I judged this to be a crucial function of the new journal; in fact, the importance of this function can be judged from the fact that at an early stage review papers became the responsibility of a dedicated editor.

In this short essay, I aim to anatomise the wide variety of reviews in science in general, and in materials science and engineering more specifically.

To get an idea of just why reviews are so important, consider the following statistic. In a book [1] published in 1999, we are told that the longest index ever printed up to that time was the *Chemical Abstracts Twelfth Collective Index*, 1987–1991, which consists of 115 bound volumes with more than 200,000 pages containing over 35 million entries. Each of those entries refers to a published research paper. A conscientiously written chemical review paper can subsume, say, 200 of that 35 million in such a way that for most scientific purposes, the review can substitute for a trawl through those hundreds. . . or at the least, the reader of the review will know which few of those 200 publications he needs to study closely. This is obviously helpful, bearing in mind that most scientific papers are fated to vanish without trace and never to be cited.

Reviews save us from drowning in information.

2. Motives for consulting reviews; categories of reviews

A research scientist can have a number of quite distinct objectives in scanning or reading reviews:

(a) A specialist wishes to find out what is new in his specialism.

(b) A researcher who needs to use an experimental technique new to him, or an unfamiliar theoretical approach, requires a relatively elementary explanation to get started.

(c) An inquisitive scientist (probably young) browses, hoping to be mentally stimulated by learning about some recent development, presented very concisely.

(d) A researcher who feels the need for a more substantial treatment of a complex subject than he can get from a single paper, proposes to borrow or buy a book (a 'monograph') and needs a critical evaluation of those recently published in the field concerned.

(e) A scientist wishes to get a feel for a branch of science remote from his professional activities, and searches out a popular or semi-popular treatment.

To satisfy these very distinct requirements, the prospective reader has a choice between a number of categories of review. To be specific:

(1) A highly specialised book, or monograph.

(2) A textbook (devoted to a broad subject) which may be introductory or advanced. If it is a long multiauthor text, each chapter may be advanced enough to verge on the character of a monograph.

(3) A very thorough and detailed review paper, published in a journal exclusively dedicated to such reviews, which can include 'progress' serials or annual review serials (such as *Progress in Materials Science* or *Annual Reviews in Materials Science*).

(4) A somewhat less detailed review paper, published in a general archival journal (like *JMS*, or an 'overview' in *Acta Materialia*).

(5) An article in an encyclopedia, general or technical (like the recent *Encyclopedia of Materials: Science and Technology* [2]).

(6) An essay, typically around 1000 words in length, which concisely summarises a recent advance. This essay can appear in a newspaper (typically written by its science

editor), a popular science journal, or in a non-archival section of a broad-spectrum archival journal like *Nature*, *Science* or *Materials Today*.

(7) A critical review of a recently published textbook or monograph, normally found in a scientific journal. There are no critical reviews to be found of categories 3–6.

It will be clear that the word ‘review’ has several distinct meanings; in particular, a critical review of a book is something fundamentally different from a review of a scientific speciality. On top of that. . .

(8) an expert who is invited to adjudicate a paper submitted to a scientific journal is called a reviewer or a referee, as is an expert who is asked to provide his opinion of an application for research funds.

Like all the most important words, ‘review’ has many nuances.

3. The specialised review

As already indicated, these can appear in a variety of locations, and correspondingly the level and completeness of treatment varies extensively. Normally, the least comprehensive specialised overview will be found in an encyclopedia article. I will take just one topic, picked at random, to exemplify this. If a reader wants to learn about crystallographic texture, alternatively called preferred orientation, and its consequences, he can begin with an encyclopedia (e.g., [2]), and read concise treatments under the titles ‘Textures’ or ‘Microtextural Analysis’ (10 pages or less). If that is insufficient for his purpose, he can move on to a book chapter, such as my own 50-page chapter, ‘Measurement and Control of Textures’ in a multiauthor textbook [3]. If that in turn is not deep enough, the reader can finally turn to highly specialised review papers by someone like H.-J. Bunge or to an entire book (which in this instance will be over 40 years old and written in German). In each of these reviews, he will find plentiful references to the next, more advanced level of reading-matter. The starting-point, in an encyclopedia, can usually be quickly found by using the elaborate searching lists provided in such a book. Those who feel at ease with them use collections of abstracts to search for sources; nowadays, search-engines on the internet are undoubtedly more widely used.

Turning from the user to the provider, the topic of a specialised review varies a great deal. Typically, the title may denote a specific material, a family of materials, a physical, chemical or mechanical kind of property, an experimental technique, a processing strategy, a theoretical approach. My impression is that the topics reviewed in *JMS* are quite often unconventional, which enhances their overall level of usefulness. Listing all the review articles published in recent volumes, as done in *JMS*, enhances their usefulness. Reviews in category 3, above, published in journals that are exclusively dedicated to reviews, in some instances have to be commissioned by the editors (preferably, there are several of these), in other instances

can be submitted without prior invitation. Provided the editors are paragons of wide knowledge, there is something to be said for the invitation principle. That way, a good balance between topics is most readily ensured. However, no editor, however learned, can know about all topics worthy of being reviewed, or about all the new, young experts awaiting their opportunities. A mix of invited and unsolicited articles is probably best.

4. The essay

The essay that opens the browsing reader’s eye to a recent scientific development is in a time-honoured tradition, certainly going back to Victorian times. Such an essay can be the printed version of what was originally a public lecture, for instance a Friday-evening discourse at the Royal Institution in London, or it can be part of the broad cultural newspaper section which the press in mainland Europe is apt to call the ‘feuilleton’. All these are aimed at the general listener or reader, as distinct from the professional scientists. The essays that form part of the ‘News and Views’ (non-archival) section of *Nature* (a weekly), or else feature as ‘columns’ in a more sharply focused publication such as *Materials Today* (a monthly), are aimed at fellow-scientists.

I happen to have long experience of writing such essays, going back to an invitation in 1967 from the editor of *Nature* to become materials science correspondent to that journal. (No doubt my editorial involvement with *JMS*, then quite new, and dedicated to what was then a new field, led to this invitation). In the 38 years since then, I have written about 100 essays for *Nature* on a great variety of topics loosely included in materials science, pitched at a level to appeal to other scientists active in research. (I was specifically not writing for the general non-scientific public. . . their requirements are met in other publications). Just recently, I had the opportunity to do the same, in the form of 24 ‘Cahn’s Columns’, for *Materials Today*. The topics to be covered always came to my attention through a settled habit of browsing in a variety of sources and picking out topics that seemed to me genuinely important, or intriguing, or both. Occasionally, an unsolicited reprint received through the mail stimulated my interest sufficiently to generate an essay.

A collection of 100 such columns, not all from *Nature*, appeared in the form of a book [4]. In the preface, I remarked that a great variety of scientists – geologists, geophysicists, psychologists (as well as ‘straight’ physicists and chemists, not to mention materials scientists) had written to me to indicate what they had found of interest in some of these essays, and it was often some incidental aspect, the broad interest of which had never occurred to me. I also remarked that “one test of efficacy in getting an involved ‘story’ across to readers is whether some of them are deceived into believing that the writer is a specialist, one who is professionally centred on that week’s topic”.

One thing is certain: the habit of writing essays of this type fertilises the mind of the writer.

5. Book reviews

This is probably, today, the most neglected form of review. Books of broad popular appeal, accessible to non-scientists, do get reviewers' attention in journals of broad coverage, such as *Nature* or *Science*, or indeed in newspapers or magazines. The problem lies with specialised monographs: these are invariably expensive, often very much so, and it is crucial both that constricted library budgets should not be wasted on inferior books and that outstanding treatments are widely recognised for their merits and receive good sales... failing this, publishers are forced on to a trajectory of ever more outrageous pricing and ever more contracting sales, and eventually to the abandonment of monograph publishing altogether. Careful, expert and honest book reviews are essential to the health of scientific publishing.

A problem for journals such as *JMS* is that organising the commissioning and publication of book reviews is a demanding process and overburdened editors, especially the majority of editors who have other professional duties besides editing, simply keep clear. (When *JMS* began publication, a few book reviews were included at my urging, but my editorial colleagues soon put their foot down and the practice was discontinued). A few journals have recognised the importance for their readership of publishing reviews of books at different levels: one such journal with which I have been actively involved, *Contemporary Physics*, devoted primarily to specialised review articles in sense (3), above, also has a dedicated book reviews editor and about half of each issue is devoted to a very wide range of critical reviews of books about all aspects of physics (including physics of materials). This takes a lot of editorial time and care but the result is eminently worthwhile.

The house journals of many professional societies do recognise the importance of publishing book reviews but the number of pages devoted to this is usually very modest. Some journals at the borders of science and the humanities, such as *Isis*, have extensive book review sections, like *Contemporary Physics*, but usually few books of 'hard' science are covered here. I believe that there is no alternative to the inclusion of book reviews in the major archival journals, such as *JMS*. The publishers of such journals should subsidise the extra costs of undertaking this function, because after all in the long run this must necessarily benefit their book-publishing branches.

Most book reviewers are rewarded by being allowed to keep the book (though I have encountered a professional society which asked for the book back for incorporation in its library!). Payment is rare: only a journal with a very large circulation apparently can afford such a policy.

However, non-scientific periodicals (journals of opinion) seem to have no hesitation about paying their reviewers. I have noticed that people learned in the humanities are apt to list the book reviews they have written as part of their curriculum vitae, whereas very few scientists do this.

Some years ago, a publisher with whom I was involved discussed the tentative idea of starting a journal dedicated exclusively to critical reviews of scientific books (not, I hasten to add, restricted to books published by that firm), with elaborate provisions to keep possible corruption at bay, but in the end they decided that in commercial terms the project was too problematic. Perhaps it is time to think about this once more.

6. Referees/reviewers

I am referring here to the experts who are invited to report to a journal or book editor about the quality of a paper or chapter submitted for possible publication. In Britain, they are known as referees, in America they are more commonly (but by no means always) called reviewers. The American term may lead to confusion with other functions, but it does properly denote what an editor's adviser is supposed to do... namely, advise the editor, who decides. 'Referee' as a term is reminiscent of the man dressed in black who scurries around a football field and dominates it. A football referee decides... he does not advise.

It is generally accepted that the maintenance of quality in a journal, especially one that publishes the results of original research, is dependent on the input of referees/reviewers. This has gone so far that some scholars, in India particularly, divide their list of publications into those that were published in refereed journals and those published elsewhere. Some years ago, John Ziman (a physicist turned into a sociologist of science) remarked "An article in a reputable journal does not merely represent the opinion of its author; it bears the *imprimatur* of scientific authenticity, as given to it by the editor and the referees he may have consulted. The referee is the lynchpin about which the whole business of Science is pivoted" [5].

The end-result of the combined critique applied by the referee and the editor appears to be very dependent on the discipline. A study in 1971 by the renowned sociologist of science, Robert Merton, and his collaborator Harriet Zuckerman [6] revealed that whereas in a selection of physics and chemistry journals the average rejection rate of papers ran at 24 and 31% respectively, in sociology, language/literature and history it ran at 78, 86 and 90% respectively! Nobody has made such a study for materials science journals. In the same survey, we learn that in the *Physical Review*, 72% of references are to papers published within the preceding five years, whereas in journals devoted to history and art criticism, only 10–20% of ref-

ences are to such recent sources. Being a referee for a historical journal must be quite demanding: after all, one of a referee's explicit functions is to check whether appropriate reference has been made to earlier work.

The specific role of the referee/reviewer for a scientific journal has not received very extensive analysis, though from time to time an investigator will submit the same manuscript to several referees to find out what measure of agreement results. The result can be disconcerting. The most detailed general analysis that I know of is in the proceedings [7] (including very extensive discussion) of a symposium held at Vanderbilt University in Tennessee in 1992, under the title *Editing the Refereed Scientific Journal*. In that book, I have a personal paper about the proper role of referees, warning of the dangers of the notion that a referee should essentially have the last word in deciding whether or not a paper is acceptable. The usefulness of that symposium to a reader who is a materials scientist is however somewhat limited by the strong emphasis on the biomedical literature among the participants. That cluster of disciplines has its own very specific problems.

7. What next?

The reader will have noted by now that I support the exercise of expert critical judgment in the scientific literature, even though there are sociologists in plenty who have no use for judgment: 'opinion', in their view, is deeply suspect as a basis for decisions. There are indeed

areas of scientific publishing which are untouched by the exercise of judgment. In particular, this little paper apart, there are no such things as reviews of reviews, and more particularly, there are no comparative assessments of the merits of different surveys of (more or less) the same topic, taking monographs, book chapters, review papers and encyclopedia articles together. This lack requires attention from the community of editors and publishers: materials scientists may as well exercise leadership here.

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