



SCIENTISTS MUST WRITE

**A Guide to Better Writing for
Scientists, Engineers and Students**

ROBERT BARRASS

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*A guide to better writing
for scientists,
engineers and students*

Robert Barrass

*Principal Lecturer
at Sunderland Polytechnic*

London



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Scientists Must Write

To Ann

Acknowledgements

I write not as a grammarian but as a working scientist, knowing how difficult it is to write well and how important it is that scientists and engineers should try to do so.

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Preface

Some people say that young scientists and engineers should be taught to write so that they can be employed in management and administration. This is true, but they must also be able to write good English if they are to be effective as scientists and engineers. The requirements in scientific and technical writing are the same: clarity, completeness, accuracy, simplicity, etc. (see Chapter 4). In this book, therefore, the word *scientist* means scientist and technologist, and *scientific writing* means scientific and technical writing.

Writing is part of science but many scientists receive no formal training in the art of writing. There is a certain irony in our teaching scientists and engineers to use instruments and techniques, many of which they will never use in their working lives, and yet not teaching them to write. This is the one thing that they must do every day – as students, and as administrators, executives, scientists and engineers.

This book, by a scientist, is not a textbook of English grammar. Nor is it just one more book on how to write a technical report, or a thesis, or a paper for publication. It is about all the ways in which writing is important to students and working scientists and engineers in helping them to remember, to observe, to think, to plan, to organize, and to communicate.

Chapters 1, 2 and 3 are about all the ways in which writing is important to a scientist or technologist, and Chapter 4 is about the characteristics of scientific writing. I hope that this book will help anyone who has difficulty in putting their thoughts into words

(Chapter 5), and that it will cause them to consider the words they use (Chapter 6) and the way they use them (Chapters 7 and 8). In scientific writing, numbers (Chapter 9) and illustrations (Chapter 10) are important, and the preparation of illustrations is usually the first step in writing the results section of a report, thesis or scientific paper (Chapters 12 and 13). A chapter on reading is included (Chapter 11) and one on talking (Chapter 14).

Where appropriate, the advice given is consistent with American (ANSI), British (BS) and International (ISO) Standards (see p. 123) and with the *Guide for the preparation of scientific papers and abstracts for publication* (UNESCO, 1968).

This book may be read *either* as an alternative to a formal course on scientific and technical writing *or* to complement such a course. To help those who require guidance on a particular aspect of writing a detailed list of *Contents* is included and an *Index*. To help all readers and to reduce the number of cross-references, some essential points are repeated in different contexts.

Exercises are included in appropriate parts of the text (see *Exercises* in the *Index*). These are suitable for self instruction; and suggestions are included to help teachers of science, or of scientific writing, who wish to use these and similar exercises in their courses. Examples of unscientific writing and of poor English are accompanied by notes of faults or suggested improvements. Like Gowers (1973), I do not give the source of such extracts but they were written by people who speak English as their mother tongue; some by professors in universities and all by authors of books or contributors to journals.

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I

Scientists must write

When asked why we must write, most scientists and engineers think first of the need to communicate. Communication is so important that it is easy to overlook our other reasons for writing. We write as part of our day-to-day work: to help us to remember, to observe, to think, to plan and to organize, as well as to communicate (Table 1). Above all, writing helps us to think and to express our thoughts – and anyone who writes badly is handicapped both in private study and in dealing with others.

By writing we can communicate with people we know who can judge us by everything that they know about us – by our writing and by our conversation, appearance and behaviour. However, when we write to people whom we have never met, they must judge us in the only way they can – by our writing. The way in which a letter of application is written, for example, may be all that an employer needs to indicate that the applicant is not suitable for the job.

Students are judged by their course work (essays, records of experiments, project reports and theses) and by their performance in written examinations. Only by writing well can we give a good account of ourselves as students, as applicants for employment, and as employees (writing letters, instructions, progress reports, articles and reviews, and scientific papers for publication).

Some scientists and engineers recognize the importance of writing in their work. They take trouble with their writing. Others know that they write badly but they do not worry about this. They are mistaken if they believe that writing is not particularly important

in science. Still others, because they are satisfied with their writing, write without thinking about the possibility of improvement.

Many people may be encouraged in their belief that their writing is satisfactory by their success in school and college examinations. However, most students would get higher marks in course work and in examinations if they were better able to put their thoughts into words. Only teachers and examiners know how many marks are lost by students who do not show clearly whether or not they understand their work. In schools, many of the most able pupils fail to show their ability. For example, the following comments are from an examiners' report on a scholarship paper.

All answers included much irrelevant information. Even when a diagram was included, a full written description was also given. Looseness of expression indicated a lack of careful thought. The standard of explanation was disappointing . . . many candidates had the knowledge but were unable to express themselves. Very few answers were comprehensive. Marks were lost through omission. Even when they knew the answer many candidates had difficulty in bringing facts together in an effective order.

In the universities the students are bright and clever but are deprived because their teachers have neglected to instruct them in the elements of literary expression (Rivet, 1976). Professor Rivet marked 44 essays by arts and science students. All made spelling mistakes. Malapropisms were frequent. Confused syntax was common: dangling participles abounded, plural subjects were attached to singular verbs, 'thus' was used to introduce a new idea, and tenses were changed at random. In punctuation the commonest error was the interchange of full stops and commas (colons and semi-colons have disappeared), but some authors omitted commas entirely, whilst others sprinkled them on the text as though from a watering can, making it difficult to discover the meaning at first reading.

Many students are clever enough to understand their work and yet unable to communicate their knowledge and ideas effectively.

They need help with their writing more than further instruction in their chosen subject.

The need for improvement is also demonstrated in the writing of working scientists and technologists, who presumably do their best work when they are preparing papers for publication. Yet many authors need the help of an experienced editor:

The most important part of my editorial work consists of trying to help contributors to say clearly and concisely what they have to say.

... it is now the duty of every University to see that young people are trained better than ever before in expressing themselves lucidly, concisely, and with precision.

Cambridge University Reporter, C. F. A. Pantin (1959)

As I sit editing an article which may actually have something to say, beneath the ingrained verbiage, and as I try to put nouns back into verbs, passives into actives, and to remove 'isms' and 'isations' from nearly everything, I shudder to think of the amount of congested and unclear writing that the social sciences tolerate...

Only Disconnect, Bernard Crick (in McIntyre, 1975)

Despite the efforts of editors, many published papers include verbose and ambiguous sentences which indicate that many educated people either do not think sufficiently about what they wish to write, or they are unable to express their meaning clearly and concisely (see Tables 14 and 15, p. 90-3).

All scientists and technologists should accept that writing is part of their work, but the biggest difficulty facing anyone who wishes to improve the standard of scientific and technical writing is that most educated people are content with their writing:

We are with difficulty persuaded that we have much to learn about language, or that our understanding of it is defective.... The first condition for improvement in the adult's use of language must be to disturb this ludicrous piece of self-deception.

Practical Criticism, I. A. Richards (1929)

Many students of science and technology receive no formal instruction in the art of writing; and when they write badly their English may not be corrected. This is why many scientists do not appreciate how important writing is in science, and why they may remain unaware of their shortcomings.

It is not enough to teach scientists about science. We must also help them to be effective as scientists. And there is a certain irony in teaching students of science and engineering to use techniques and instruments, some of which they may never use in their working lives, and yet not teaching them to write – the one thing that they must do every day as students, and as administrators, executives, managers, scientists and engineers.

The requirements in technical writing are the same as in scientific writing: clarity, completeness, accuracy, simplicity, etc. (see Chapter 4).

There was once a time when Science was academic and useless and Technology was a practical art, but now they are so inter-fused that ... [most people] cannot tell them apart.

Public Knowledge, John Ziman (1968)

Scientific literature is probably no worse than any other kind but it should be better than it is. It is an amazing phenomenon that the scientist who, as a matter of course, conducts his laboratory research with the greatest refinement and highest precision of which science is capable, is so often willing to dash into print without making sure that his statements are clearly expressed. Surely the scientist, of all people, is under obligation to write not only so that he may be understood but so that he *cannot be misunderstood*.

E. H. McClelland (1943)

Science teachers should help in teaching English by telling young scientists why they need to write and how they should write. Children will not appreciate the importance of writing in all their school work if the teacher of English is the only one who corrects errors in grammar.

Young scientists should know, as early as possible in their

careers, that if they write well they will be better students and better scientists. 'All our education depends on the understanding and effective use of English – as does success in so many aspects of adult life' (HMSO, 1975). Drucker (1952) gave this advice on *how to be an employee*:

If you work on a machine your ability to express yourself will be of little importance. But the further away your job is from manual work, and the larger the organisation that you work for, the more important it is that you know how to convey your thoughts in writing and speaking. This ability to express yourself is perhaps the most important of all the skills that you can possess.

The power of rightly chosen words is great, whether these words are intended to inform, to entertain, or to move (Potter, 1969). There is, however, no short cut to better writing. We learn most by practising this art, by considering the comments of our teachers and colleagues or the advice of editors, and by example – by reading the best prose.