Reporting Research

A Biologist's Guide to Articles, Talks, and Posters

Want to learn how to present your research successfully? This practical guide for students and postdocs offers a unique step-by-step approach to help you avoid the worst, yet most common, mistakes in biology communication. Covering irritants such as sins of ambiguity, circumlocution, inconsistency, vagueness and verbosity, misuse of words and quantitative matters, it also provides guidance to design your next piece of work effectively. Learn how to write scientific articles and get them published, prepare posters and talks that will capture your audience and develop a critical attitude towards your own work as well as that of your colleagues. With numerous practical examples, comparisons among disciplines, valuable tips and real-life anecdotes, this must-read guide will be a valuable resource for both new graduate students and their supervisors.

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Preface

This book grew out of a repeated need, as graduate supervisor, referee (reviewer), and editor, to comment about irritants such as:

- the sins of ambiguity, circumlocution, confusion, inconsistency, vagueness and verbosity;
- misuse (or distractingly poor use) of words such as content, decimate, impact, level, light intensity, paradigm, parameter, and ratio;
- quantitative matters such as equations that didn't equate, ludicrous precision of numerical values, misleading bar charts, graphs with inaccurate axis labels, nonsensical 'log scales', and undefined error bars;
- statistics-related misuses such as the difference between standard deviation and standard error, statistical fishing expeditions, the meaning of a '*P*-value', and confusion among correlation, regression, and functional relations;
- incomprehensible talks and unattractive, or even repellent, posters.

What follows includes my gleanings during four decades as a university biologist: the things I wish now that I had known when I started out. It is mostly about broadcasting for the first time the results of original work in the biosciences (the inelegant umbrella term 'bioscience' embraces all the disciplines that work on living

things, including biochemistry, molecular biology, genetics, microbiology, biology, botany, zoology, anatomy, morphology, physiology, ecology, and applications in, for example, medicine, psychology, and soil science). This book is intended mainly for those beginning a career in bioscience research. If you are such an apprentice or journeyman then I hope that you learn from the mistakes I made at your age. Established bioscientists may also find things to interest them.

Some of what follows is elementary and you will know it already (but your colleagues may not). You will also find less familiar matter, some of it difficult to locate and some original. Knowledge about topics such as significant digits and the combination of errors is rare among bioscientists. The text contains sufficient detail for you to try to understand *why* these things are as they are. I also include more about the basis of simple statistics than you might expect because this is an area frequently criticised by editors and referees. Some of this will be of more help in designing your next bit of work than in reporting that already done. You will not find anything about grant applications, or how to seek approval from an ethics committee, or literature searching, or making a risk assessment, or journal clubs, or networking, or the need to keep wide interests, or any of the other activities that may contribute to a career in science.

Many of the examples come from the ecological end of the molecular-to-ecological range of the biosciences because that is where my research has been, but most of the principles they illustrate apply across the whole of the biological (and often other) sciences. Some examples are from fields outside bioscience in the hope that you may more easily concentrate on the principle they illustrate rather than the content. Yet others I have invented or modified from the original source.

In many places I have used a didactic (instructional) – or even imperative (commanding) – tone to save space and your time, and have assumed a 'typical' journal or scientific meeting. Yet many of the topics are more complex than I describe, or are contentious, or differ from subject to subject (biochemistry to ecology), journal to

journal, or meeting to meeting. Science publishing is in ferment, so some things may be out of date or irrelevant in your particular field, and many of the views are personal. You may well disagree with them. Good, for that is the high road to enlightenment. Presenting bioscience research is an art and, as with any art, you improve with practice, thought, and discussion. I hope to stimulate in you a critical attitude to the writing, speaking, and posters of other people as well as to your own.

A didactic approach may easily result in lists and a cookbook: '(1) Do this, then (2) do that.' This is the style of most instrument manuals and many books about scientific writing. My experience has been that one uses an instrument more effectively if one understands how it works, and why things should be done, and which of them must be done in order or with all possible care, and which are less critical. So in this book I have included explanations, discussion, and a good deal of background and parenthetic matter in the belief that the more you know and understand the better your own reporting will be.

I experiment with three unusual features. The first concerns parenthetic ▾ material.

▾ Footnotes are a nuisance; endnotes are worse (Chapter 5). I therefore use indented panels like this one to contain parenthetic material that is cued by superscript geometric shapes ▾, ●, ■, and so on in the *immediately preceding* paragraph. Solid geometric shapes are easier to return to than letters or special typographic symbols such as '§'.

Second, where a figure contains more than one independent graph the conventional order is from the top left as if reading text. But in this book the graphs are usually ordered from the lower left, across, then upper left and across. This puts the first part of the explanatory caption (below the figure) nearest to the graph that it concerns, and orders whole figures in the same way that one reads a single graph (start at the lower left corner).

And third, to shift your focus occasionally from reading to reflecting I have included a few questions in boxes (this one is borrowed from Lewis Carroll's 'The Walrus and the Carpenter'):

QUESTION:
Why is the sea boiling hot, and do pigs have wings?

IMPORTANT NOTE for those struggling to present their first few articles, talks, or posters, and anxious to know the basics. The book is in two parts (Figure P.1 below). *PART I: BASICS* contains four chapters. One of the first three ('1. Writing and publishing an article', '2. Speaking about your work', and '3. Presenting a poster') should be sufficient to help you to get started: one learns best by doing. Chapter 4 ('Scientific authorship') discusses the rewards and some of the hazards of authorship.

PART II: IMPROVING contains chapters that may help you to improve: '5. Writing style', '6. Misused words and concepts', '7. Quantitative matters', '8. Treating errors', '9. Data interrelations', '10. Tables and figures: the evidence', and '11. Citing and referencing'. A Bibliography, List of references, and an Index are at the end.

I recall with gratitude the late Cyril Mummery who set me on this road and the late Tony Fogg who encouraged me along it.

I thank, and so may you, those who have helped me: Brian Moss and Dick Webster for constructive criticism (and uncounted improvements) throughout the book; Alexandra George, Peter Grubb, Steve Ketteridge, Andrew Leitch, Richard Nichols, Håkan Rydin, and Tony Walsby for equally helpful improvements to one or more chapters; Alan Crowden for encouragement in finding a publisher; and at Cambridge University Press, Vania Cunha, Dominic Lewis, Ilia Tassistro, and especially Anna Hodson, for easing the book into print.

Finally, I thank all the individuals in that shadowy muttering crowd of those whose ideas or practices I have absorbed without remembering or even knowing the source. May they forgive me.

The defects that remain are, of course, my own. I welcome corrections and other amendments.

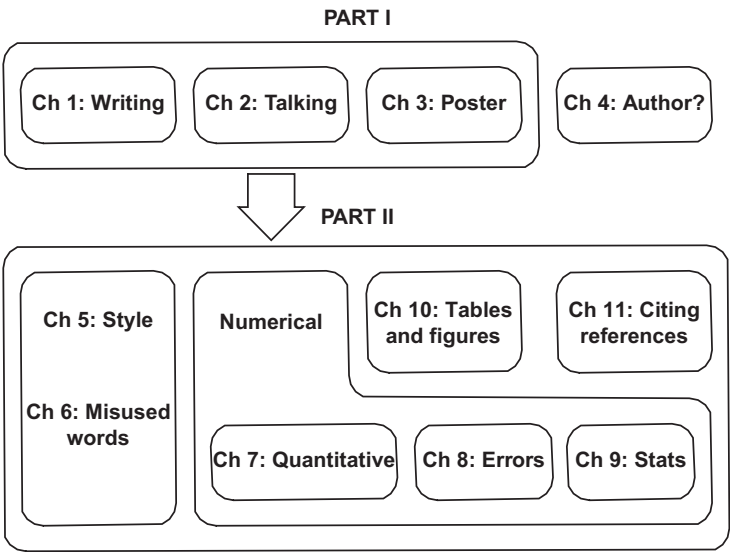

FIGURE P.1 Structure of this book. Chapters in Part II contain detail useful for the ones in Part I.