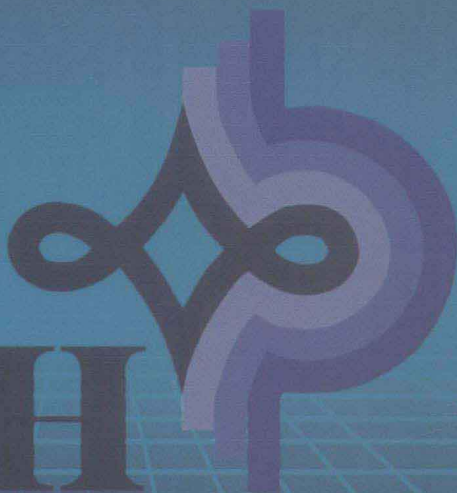


Ebel/Bliefert/Russey

# The Art of Scientific Writing

From Student Reports  
to Professional Publications  
in Chemistry and Related Fields

VCH



*Hans F. Ebel / Claus Bliefert / William E. Russey*

# The Art of Scientific Writing

*From Student Reports to Professional Publications  
in Chemistry and Related Fields*



Dr. Hans F. Ebel  
Editor-in-Chief  
VCH Verlagsgesellschaft mbH  
Postfach 1260/1280  
D-6940 Weinheim  
Federal Republic of Germany

Prof. Dr. Claus Bliefert  
Fachbereich Chemieingenieurwesen  
Fachhochschule Münster  
Stegerwaldstraße 39  
D-4430 Steinfurt  
Federal Republic of Germany

Dr. William E. Russey  
Professor of Chemistry  
Juniata College  
Huntingdon PA 16652  
USA

Production Manager: Heidi Lenz

Library of Congress Card Number 87-6165

Deutsche Bibliothek Cataloguing-in-Publication Data

Ebel, Hans F.:

The art of scientific writing: from student reports to professional publ. in chemistry and related fields / Hans F. Ebel; Claus Bliefert; William E. Russey. – Weinheim; New York: VCH, 1987.

ISBN 3-527-26677-1 (Weinheim) kart.;

ISBN 0-89573-645-4 (New York) kart.;

ISBN 3-527-26469-8 (Weinheim) geb.;

ISBN 0-89573-495-8 (New York) geb.

NE: Bliefert, Claus.; Russey, William E.:

© VCH Verlagsgesellschaft mbH, D-6940 Weinheim/Federal Republic of Germany, 1987

All rights reserved (including those of translation into other languages). No part of this book may be reproduced in any form—by photoprint, microfilm, or any other means—nor transmitted or translated into a machine language without written permission from the publishers. Registered names, trademarks, etc. used in this book, even when not specifically marked as such, are not to be considered unprotected by law.

Composition: Prof. Dr. Claus Bliefert, D-4437 Schöppingen

Printing: Zechnersche Buchdruckerei, D-6720 Speyer

Bookbinding: J. Schäffer oHG, D-6718 Grünstadt

Printed in the Federal Republic of Germany

*Ebel/Bliefert/Russey*

# The Art of Scientific Writing



*To Annie, Inge, Ruth, and Susan*

# Preface

This book is the product of an unusually close collaboration between three scientists from two countries. The three of us share varied backgrounds including teaching, research, and publishing in chemistry, but above all we share a deep interest in the role of the written word in science. Our book is especially dedicated to fellow chemists and aspiring chemists everywhere, but we hope it will be of service to others in the scientific community as well. Most of the examples in the book have been taken from chemistry, and some may be of interest only to chemists (such as the short excursion into chemical nomenclature in Chapter 6). Nevertheless, we have tried to present the basic ideas in such a way that they will be accessible to scientists in general. This is why our book has been given the title *The Art of Scientific Writing* and not "The Art of Chemical Writing" (which is not in any case an art in its own right).

Many books about writing already exist, particularly in English. However, we know of no book as broad in its coverage, as critical in its analysis of existing trends, and as international in its scope. Moreover, many of the books on the market do not supply the aspiring author with sufficient insight into the publishing process and the attitudes and expectations of referees, editors, and publishers. Nor are most books comprehensive enough to provide ready answers to the host of questions that inevitably arise during the communication process.

Our book is designed as both a reference manual and a basic text; a source of background information on causes and consequences of scientific writing, and a guide for the novice. We have therefore used an approach different from that of most other books on writing, an approach that is in itself scientific. Throughout the book we have tried to show the reader not only "how", but

also "why" certain procedures are recommended. We also examine the incentives underlying scientific writing and some of the reasons scientists write as they do. *The Art of Scientific Writing* is thus more than a book on "How to Write".

All stages of the publication process, of which writing is a part, have been considered. Our starting point is the writing required of a future scientist in college or graduate school.\* From there we proceed to more complicated material, in the end dealing with topics that may be of concern primarily to the mature author-scientist. In a way, the reader is led systematically from graduate student days to the heights of professional life. This idea is also expressed in the book's subtitle.

*The Art of Scientific Writing* consists of two parts. In Part I, basic types of scientific writing are discussed sequentially. Chapter 1 on reports is addressed primarily to science students, but also to those who write research reports and grant proposals in the academic world or industry. In it we describe what instructors and supervisors expect of an interim report, or even a properly maintained notebook. We hope that this chapter alone will substantially aid research directors in achieving their goals.

In Chapter 2 we accompany the graduate student through the horrifying maze of preparing a thesis, and the labor of achieving a degree. From here we move on to the more public types of writing, journal articles (Chapter 3). Finally, we offer the seasoned scientist advice applicable to the even more demanding—and far more rarely described—writing opportunities available later in a career: writing or editing a book (Chapter 4).

The technical problems entailed in scientific writing are almost independent of the kind of document to be produced. For this reason we felt it best to identify and isolate certain key subjects—the proper use of units and quantities and the preparation of figures and tables, for example—and treat them separately, one by one. The result is Part II of the book. Our objective here has been to share in a systematic way, and from a variety of perspectives, useful insights we have gained over the years. While primary attention has been directed to specific techniques that can lead to better scientific writing, there are also brief excursions into the aesthetic qualities of well-crafted

---

\* A forthcoming supplement by the same authors, entitled *Study Guide to The Art of Scientific Writing—Problems and Exercises*, will provide the student with additional guidance.

technical prose and the ethics implicit in scientific writing. We have also enjoyed the challenge of sketching the peculiar demands and problems posed by the "game" of scientific writing and publishing.

Some may see *The Art of Scientific Writing* as a textbook to be introduced at the college or university level. Others will, hopefully, keep it close at hand as a reference manual. For the latter purpose we have been careful to provide a wide variety of specific examples, an extensive set of internal cross-references, and an especially thorough index; in addition, a set of appendixes incorporates supplementary information. The book should also be useful to science instructors called upon to stimulate and criticize student writing, and to editors, copyeditors, and others in the publishing business.

A word about language is perhaps in order. English has clearly become the "lingua franca", the language employed by scientists all over the world as the chief medium of scientific communication. Today, if a French chemist visits the laboratory of a German colleague, the discussions that ensue are likely to be held in English. Likewise, a lecture by a European, North American, Australian or foreign scientist of any nationality to colleagues in the People's Republic of China will probably be in English. English now holds the position once claimed by Latin. For this reason our thoughts on scientific writing have been presented in English, even though our target audience is by no means limited to native speakers of English; it encompasses all scientists who want or need to write about science. The stature of our publisher—VCH, with offices in both Europe and the United States—has been of particular help in gaining such an international perspective.

We are indebted to a number of people who helped us complete this book. Several chapters have been read carefully, and improved, by Dr. Christina Dyllick-Brenzinger and by Dr. David I. Loewus, member of the staff of *Angewandte Chemie International Edition in English*. Valuable guidance and advice has been given by Dr. Gerald Reed, Milwaukee, and by Dr. Steve Yamamoto of the editorial staff of *Ullmann's Encyclopedia of Industrial Chemistry*; by Gerlinde Kruse, nomenclature expert of *Angewandte Chemie*, and Prof. Gerhard Wenske, member of several DIN committees, with respect to Chapters 6, 7 and 8; and by Dr. Peter Hass, Mannheim, with respect to Appendix C. Special thanks for linguistic and other improvements are due to Dr. R.E. Reed and S. Scott Munshower. Both contributed many hours reading the entire manuscript. Technical advice in preparing the master copy for the print was received not only from our publisher but also from Eckehard Stümpel, Münster, and Christophe Villain, Paris.



We enjoyed writing this book and gathering experience from these and other friends and colleagues. Comments and criticism will be greatly appreciated from the readers to whom we have devoted so much effort in an attempt to help them in their scientific lives.

Weinheim

H.F.E.

Steinfurt

C.B.

Huntingdon

W.E.R.

March 1987

# Contents

## *Part I Scientific Writing: Aims and Forms*

<i>1</i>	<i>Reports</i>	3
1.1	Writing and Science	3
1.2	The Purpose and Nature of a Report	5
1.2.1	A Matter of Definition	5
1.2.2	Some Characteristics of a "Typical" Report	7
1.3	The Laboratory Notebook	10
1.3.1	Is a Notebook Really That Important?	10
1.3.2	What Should a Notebook Contain?	12
	Introduction • Narrative	
1.3.3	Organizational Considerations	14
1.4	Transforming Notebook Entries into a Report	16
1.4.1	Describing an Experiment	16
1.4.2	Preparing the Report	19
1.5	Types of Reports	22
1.5.1	The College-Level Report	22
1.5.2	Research Reports	23
1.5.3	Grant Reports and Proposals	24
	Types of Grant-related Documents • Grant-writing Strategy	
<i>2</i>	<i>Theses</i>	29
2.1	The Nature of a Thesis	29
2.2	The Components of a Thesis	32
2.2.1	Overview	32
2.2.2	Title and Title Page	33
	Selecting a Title • Designing the Title Page	

2.2.3	Preface	35
2.2.4	Abstract	36
2.2.5	Table of Contents	37
	Purpose • Structure and Form • Creating Subdivisions	
2.2.6	Introduction	40
2.2.7	Results	41
2.2.8	Discussion	42
2.2.9	Conclusions	43
2.2.10	Experimental Section	43
2.2.11	Appendixes	45
2.2.12	Notes and Footnotes	45
2.2.13	References	46
2.2.14	Vita	46
2.3	Preparing the Thesis	47
2.3.1	From Outline to Final Draft	47
	The Need for an Outline • A Curse Turned Blessing • The Writing Itself	
2.3.2	The Finished Product	51
	Who Receives the Assignment? • What Problems Might Arise? • One Last Hurdle	
2.3.3	Thesis Documentation Services	54
3	<i>Papers (Journal Articles)</i>	57
3.1	The Nature of Scientific Journals	57
3.1.1	Publications and Publishing	57
	Journals • Authors • Publishers	
3.1.2	Types of Journals	60
	Primary Journals • Abstracting Journals • Terminological Confusion • Review Journals • The Limits of Classification • Media	
3.2	Basic Decisions for the Author	64
3.2.1	Why Publish?	64
3.2.2	When to Publish?	65
3.2.3	What to Publish?	66
3.2.4	With Whom to Publish?	67
3.2.5	In What Form to Publish?	68
	Types of Articles • Choice of Language	
3.2.6	Where to Publish?	70

- 3.3 The Parts of a Paper 72
  - 3.3.1 Title 72
  - 3.3.2 Authorship 74
  - 3.3.3 Abstract 75
  - 3.3.4 Body of the Article 77
- 3.4 Preparing and Assembling the Manuscript 79
  - 3.4.1 Text 79
  - 3.4.2 Formulas 80
    - Mathematical Equations • Chemical Formulas
  - 3.4.3 Figures 84
    - The Choice Between Figures and Tables • Preparation and Submission of Figures • Figure Numbers and Captions
  - 3.4.4 Tables 87
  - 3.4.5 Footnotes and Endnotes 87
  - 3.4.6 A Special Case: The Camera-ready Manuscript 88
- 3.5 From Manuscript to Print 90
  - 3.5.1 Journal Management and the Editorial Office 90
  - 3.5.2 Submitting the Manuscript 93
  - 3.5.3 Referees 95
  - 3.5.4 The Edited Manuscript 96
  - 3.5.5 The Typeset Contribution 99
  - 3.5.6 Proofreading 101
    - Learning to Be Critical • An Excursion into the Realm of Cryptic Symbols • A Few Details
- 4 *Books* 107
  - 4.1 Preliminary Thoughts 107
    - 4.1.1 What is a "Book"? 107
    - 4.1.2 When is Publishing a Book Justified? 108
    - 4.1.3 Authors and Publishers 109
  - 4.2 The Planning Stage 111
    - 4.2.1 Provisional Table of Contents and Tentative Preface 111
    - 4.2.2 Sample Chapter 112
    - 4.2.3 Sample Printing 114
    - 4.2.4 The Publishing Agreement 114
  - 4.3 Preparing the Manuscript 116
    - 4.3.1 Becoming Organized 116
    - 4.3.2 Collecting the Literature 117

- 4.3.3 Structuring the Argument 119  
Sorting Out One's Ideas • On the Length of Sections
- 4.3.4 Writing the Text 121  
The First Sentences • The First Draft
- 4.3.5 The Benefits of Computers 123
- 4.3.6 Revisions 125
- 4.3.7 The Final Copy 126  
How Clean is Clean? • New Demands and Promises •  
Choice of Type • Miscellaneous
- 4.4 The Typesetting Stage 133
- 4.4.1 Galley Proofs 133  
Copy Editing • Proofreading
- 4.4.2 Page Proofs 136
- 4.5 Completing the Book 138
- 4.5.1 Indexes 138
- 4.5.2 Preliminary Material 140  
General Observations; Half Title and Series Title Pages •  
Main Title Page • The Subject Title • Imprint Page •  
Preface, Contents • Miscellaneous
- 4.5.3 Cover, Dust Jacket, Promotional Material 145

*Part II Scientific Writing:  
Materials, Tools, and Methods*

- 5 *From Manuscript to Document* 151
- 5.1 Introduction 151
- 5.2 Typewriter or Word Processor? 152
- 5.2.1 Typewriters 152
- 5.2.2 Word Processors 153  
The Nature and Operation of a Word Processing Station • Basic  
Advantages • Choice of System • Hardware • Software • The  
Benefits of a "Magnetic Manuscript"
- 5.3 Format 161
- 5.3.1 Margins and Line Spacings 161
- 5.3.2 Headings, Paragraphs, and Lists 163
- 5.3.3 Notes 164
- 5.4 Proofreading and Correction 165
- 5.5 Duplication and Assembly 166

6	<i>Chemical Nomenclature</i>	169
6.1	Historical Perspective	169
6.2	IUPAC Rules for Inorganic Nomenclature	170
6.2.1	The Origin of the Rules	170
6.2.2	Writing Chemical Formulas	171
	Elements • Compounds • A Few Special Situations • Oxidation Numbers	
6.2.3	The Naming of Inorganic Compounds	179
	Binary Compounds and Other Simple Cases • More Complex Entities	
6.2.4	Additional "Systematic" Aspects of Inorganic Nomenclature	182
	Coordination Compounds • Species Containing Hydrogen • Double Salts and Polymorphs • Concluding Observations	
6.3	IUPAC Rules for Organic Nomenclature	186
6.3.1	Introduction	186
6.3.2	Classes of Compounds	188
	What is a "Class"? • Alkanes, Cycloalkanes, and Alkyl Radicals • Arenes • Heterocycles	
6.3.3	Substitutive Nomenclature	192
6.3.4	Other Types of Organic Nomenclature	194
6.3.5	Nomenclature in Areas Related to Organic Chemistry	196
6.4	CAS Registry Numbers	198
7	<i>Quantities, Units, and Numbers</i>	201
7.1	Quantities	201
7.1.1	The Meaning of the Term "Quantity"	201
7.1.2	Base Quantities and Derived Quantities	203
7.1.3	Symbols and Typography	207
7.2	Quantitative Expressions	209
7.2.1	General Remarks	209
7.2.2	Dual Notation	211
7.2.3	Expressing Quantities	212
7.3	Units	213
7.3.1	SI Units	213
7.3.2	Additional Units	216
7.3.3	Prefixes and Spacing	218
7.4	Quantities and Composition in Chemistry	220
7.4.1	The Mole	220

7.4.2	The Amount of Substance	221
7.4.3	Molar Quantities	222
7.5	Numbers	224
7.6	Troublesome Mathematical Symbols	227
8	<i>Equations and Formulas</i>	231
8.1	Mathematical Equations	231
8.1.1	Some General Rules	231
8.1.2	Placement and Spacing	233
8.1.3	Special Symbols	234
8.2	Chemical Formulas and Equations	238
8.2.1	Chemical Formulas	238
	General Considerations • Stereochemical Formulas	
8.2.2	Chemical Equations	243
9	<i>Figures</i>	247
9.1	Introduction	247
9.1.1	Types and General Characteristics of Figures	247
9.1.2	Figures for Typescripts	253
9.1.3	Figures for Publication	255
9.2	Line Drawings	258
9.2.1	Planning	258
9.2.2	Materials	260
9.2.3	The Drawing Process	263
	Basic Rules • Providing a Framework for a Graph • Drawing the Lines • Qualitative vs. Quantitative Graphs • Letters and Symbols • Patterns	
9.2.4	Column Charts, Bar Charts, and Pie Charts	273
9.3	Halftones and Color Illustrations	275
9.3.1	Photographs as Figures	275
9.3.2	Choice and Preparation of Photographic Copy	276
10	<i>Tables</i>	279
10.1	The Nature and Proper Function of a Table	279
10.2	The Preparation of a Table	281
10.2.1	Titles, Headings, and Footnotes	281
10.2.2	Presenting the Data	286
	The "Dimensions" of a Table • Units, Data Alignment	

- 10.2.3 Table Format 289
- 10.2.4 Miscellaneous Matters 290
- 10.3 Lists 291
- 11 Collecting and Citing the Literature 293*
  - 11.1 Introduction 293
  - 11.2 Organizing a Personal Collection of Sources 294
    - 11.2.1 The Master Card File 294
    - 11.2.2 Locating Pertinent Entries 296
    - 11.2.3 Taking Advantage of Computers 298
  - 11.3 Citation Techniques 301
    - 11.3.1 The Purpose and Nature of a Citation 301
    - 11.3.2 Numerical Citation Systems 304
    - 11.3.3 The Name-Date System 306
    - 11.3.4 Which System to Choose? 309
  - 11.4 Reference Format 310
    - 11.4.1 Introduction 310
      - Basic Requirements • Document Classification •  
Depth of Referencing
    - 11.4.2 References to Books 317
      - General • Names of Authors • Title • Publication Data •  
Chapters within Books • Series and Multi-volume Works
    - 11.4.3 References to Journals and Other Serials 324
    - 11.4.4 Patents 328
    - 11.4.5 Miscellaneous Sources 332

## *Appendixes*

- A Oral Presentations: Organization and Visual  
Materials 339*
  - A.1 Spoken and Written Presentation of Scientific Results 339
  - A.2 Preparing a Lecture 341
  - A.3 Slides and Transparencies 343
  - A.4 The Lecture Itself 347
  - A.5 Poster Sessions 350



<i>B</i>	<i>Aspects of Scientific English</i>	353
B.1	The Grace of English	353
B.2	A Few Useful Aids	355
B.3	Notes from a Short Course in Good Writing	359
B.3.1	Some Credos	359
B.3.2	Verbs and Nouns	360
B.3.3	Prepositions	362
B.3.4	Adjectives	364
B.3.5	Adverbs	364
B.3.6	The "Little Words"	366
B.3.7	On the Length and Structure of Sentences	367
<i>C</i>	<i>Authors and Their Rights</i>	369
C.1	The Essence of the Copyright	369
C.2	Copyright Law	370
C.3	Copyright Ownership and Transfer	372
C.4	Duration of Copyright	373
C.5	Integrity of the Work	374
C.6	Limits of Copyright Protection	375
C.7	The Publishing Agreement	377
C.8	Book Agreements: Form and Content	379
C.9	Contracts with Editors and Translators	380
C.10	The Work Contract	381
C.11	The Copyright Notice	382
<i>D</i>	<i>Using the Chemical Literature</i>	383
D.1	Acquiring an Overview	383
D.2	Keeping Current	389
D.3	Finding Answers to Specific Questions	392
<i>E</i>	<i>International Standard Serial Number and International Standard Book Number</i>	397
E.1	The ISSN	397
E.2	The ISBN	399
<i>F</i>	<i>Preparing an Index</i>	403
F.1	General Considerations	403
F.2	Index Card Files	405