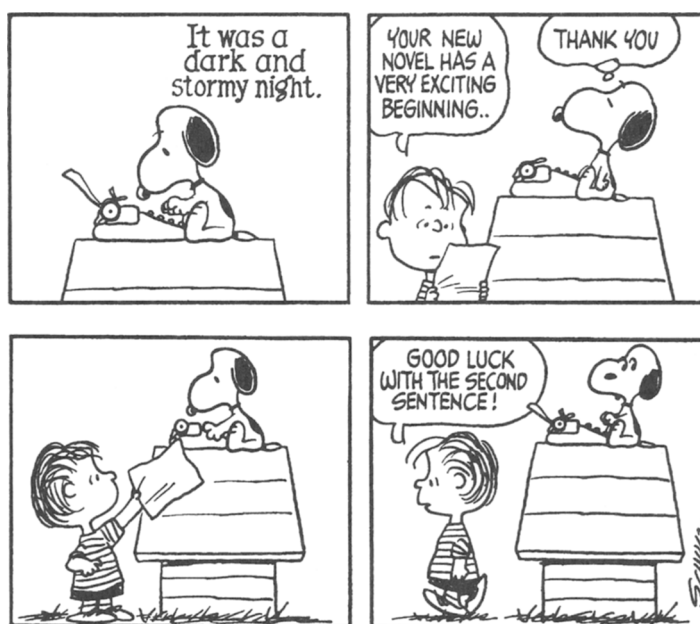


## Chapter 1

# General Principles



Peanuts reprinted by permission of United Feature Syndicate.

*Good writing . . . is clear thinking made visible.*

— AMBROSE BIERCE, *Write it Right: A Little Blacklist of Literary Faults* (1937)

*A writer needs three qualities: creativity, originality, clarity and a good short term memory.*

— DESMOND J. HIGHAM, *More Commandments of Good Writing* (1992)

*Writing helps you to learn.* Writing is not simply a task to be done once research or other preparation is completed—it can be an integral part of the work process. Baker explains it well [13]:

In writing, you clarify your own thoughts, and strengthen your conviction. Indeed, you probably grasp your thoughts for the first time. Writing is a way of thinking. Writing actually creates thought, and generates your ability to think: you discover thoughts you hardly knew you had, and come to know what you know. You learn as you write.

Writing brings out gaps in your understanding, by forcing you to focus on steps in your thinking that you might otherwise skip. (In this respect, writing is similar to explaining your ideas to a colleague.) Writing down partial research results as your work progresses can reveal structure and suggest further areas of development. Zinsser has written a delightful book that explores the idea of writing to learn [303].

*Good writing reflects clear thinking.* It is very hard for a woolly thinker to produce clear prose. Clear thinking leads to good organization, a vital ingredient of technical writing. A well-organized piece is much easier to write than a badly organized one. If you find a particular piece difficult to write it may be because you have not found the right structure to express your ideas.

*Writing is difficult!* Zinsser [304] says “It’s one of the hardest things that people do.” It is often difficult to get started. One solution, which works for some, is to force yourself to write something, however clumsy it may be, for it is often easier to modify something you have written previously than to compose from scratch.

The most fundamental tenet of technical writing is to keep your prose simple and direct. Much of written English is unnecessarily complicated. In writing up your research you are aiming at a relatively small audience, so it is important not to alienate part of it with long-winded or imprecise text. English may not be the first language of many of your readers—they, particularly, will appreciate plain writing. Aim for economy of words. Early drafts can usually be reduced in length substantially with consequent improvements in readability (see Chapter 7).

Probably the best way to improve your writing skills is to receive, and learn from, constructive criticism. Ask a colleague to read and comment on your writing. Another reader can often find errors and suggest improvements that you miss because of your familiarity with the work. Criticism can be difficult to take, but it should be welcomed; it is a privilege to have someone else take the time to comment on your writing.

Another way to improve your writing is to read as much as you can, always with a critical eye. In particular, I recommend perusal of some of the following mathematical books. They are by excellent writers, each of whom has his own distinctive style (this selection is inevitably biased towards my own area of research):

- ▷ Forman S. Acton (1970), *Numerical Methods That Work* [3].
- ▷ Albert H. Beiler (1966), *Recreations in the Theory of Numbers* [19].
- ▷ David M. Burton (1980), *Elementary Number Theory* [44].
- ▷ Gene H. Golub and Charles F. Van Loan (1996), *Matrix Computations* [108].
- ▷ Paul R. Halmos (1982), *A Hilbert Space Problem Book* [125].
- ▷ Donald E. Knuth (1973–1981), *The Art of Computer Programming* [157]. (Knuth was awarded the 1986 Leroy P. Steele Prize by the AMS for these three volumes.)
- ▷ Beresford N. Parlett (1998), *The Symmetric Eigenvalue Problem* [217].
- ▷ G. W. Stewart (1973), *Introduction to Matrix Computations* [261].
- ▷ Gilbert Strang (1986), *Introduction to Applied Mathematics* [262].

Also worth studying are papers or books that have won prizes for expository writing in mathematics. Appendix E lists winners of the Chauvenet Prize, the Lester R. Ford Award, the George Polya Award, the Carl B. Allendoerfer Award, the Beckenbach Book Prize and the Merten M. Hasse Prize.