# What I learned on my summer vacation

KENNETH D. MAHRER, University of Denver Research Institute

**S**ome of you may recall that at the last SEG Annual Meeting in Dallas, I offered a Continuing Education course on technical writing and editing. You probably don't know that the course was canceled — a grand total of two people signed up! Needing a minimum of 15 enrollees to break even ... well, the rest is history. However, all was not lost. I used the preparations for that course to give a similar but somewhat longer course (in English) this past summer at Seoul National University, Korea.

Preparing a course is a wonderful learning experience. My wife, a past editor-in-chief for a magazine, who now earns a living writing books and articles, can attest that I spent my summer vacation devoting a great deal of time to those preparations. It was an effort that has now paid doubly, because it is the seed for this new *TLE* column.

My vacation reading was a series of books on technical writing and editing. Initially, I thought these books would be dry but necessary reading. To my surprise, I found these books particularly enlightening. Being an Associate Editor of GEOPHYSICS since the late 1980s, I thought I had a pretty good understanding of the microto-macro elements, characteristics, nuts and bolts, etc. of good technical writing and its cousins: reviewing and editing. I was awed by how much more there is to this craft, art, gift, ability ... My eyes were opened to the precept that, although I may have intuited, I never formally inventoried the elements and facets of technical writing.

The eye-opening issues, concepts, principles, insights, recommendations, etc., that struck me most are the essence of this inaugural column. All are important and each could be the subject of a lengthy discussion — some, in fact, may make up future columns. You will notice that I am not trying to wax literary and that I am using a pretty straightforward "list" style. Generally, I'll sacrifice style for the sake of clarity ... but that's a story for another day. I've grouped these pearls into the four elements-of-the-task: the document, the writing, the writer, and, yes, the reader, without whom there would be no point in *the writer writing the document*.

Read this list of thoughts — distilled from my notes and see if there is anything that catches your eye or that expresses what you may have pondered about your or others' writing, editing, and reviewing.

**Technical documents** — **the goal.** First and foremost, without publication, there is no science. Science done but not disseminated is the same as science not done. This is why technical papers must be written and why they must

be useful, usable, and used. If a technical report should *inform* managers, colleagues, and others about work in progress ... or if a journal article should have a *useful* life-after-publication ... *why are so many technical documents nei* - *ther useful, usable, nor used*?

But try we must to make them better. A publication may be the only permanent record of work. And good work deserves a valuable archive.

"... An acceptable primary scientific publication is the first disclosure containing clear and sufficient information to enable peers to (1) assess the findings, (2) repeat the work, and (3) evaluate the intellectual process," says Steven Day (*How to Write & Publish a Scientific Paper*, 4th edition, Oryx Press 1994). I find this is a solid base on which to begin to judge a technical document.

In this same vein, a successful technical document encompasses three dimensions:

- Information complete, clear, and useful
- Persuasion influences readers
- Ethics true and accurate

In reading technical documents, especially journal manuscripts, I find that persuasiveness is typically unrecognized, overlooked, or ignored. Most technical writers seem to believe "the science will sell itself." It doesn't! There are very few who, in my opinion, try to convince us of anything, and so they don't.

**Technical writing** — **tools of the trade.** Poor or weak writing hurts, delays, obscures, and can prevent good science — readers can only know what is written, not what is *intended* to be written. Poor or weak writing also hurts, delays, and can prevent publication.

So what makes a technical document poor or weak? That's a really tough question and, if it were easy to answer, we'd all be great writers! One plausible answer is that the document fails to harness all the fundamentals that can make a document strong:

- Content Is it worth reading?
- Organization Is the reader guided and are keypoints emphasized?
- Clarity Is it a *writer's* paper or a *reader's* paper?
- Style Is there an economy of words and is it easy to read?
- Visuals Do graphs, pictures, tables, etc., clarify concepts and relationships?
- Format Is it accessible and appealing?
- Supplementals Are appendices and references used wisely and do they broaden the appeal to include readers with varying needs and abilities?

Successful technical writing is more like journalistic than creative writing. The five eternal questions every newspaper hack vies to answer, scientific writers should make their own:

1) What was done?

BLOCK

<sup>(</sup>Editor's Note: The "Writer's Block" is a new bimonthly column on technical writing and editing issues by Ken Mahrer, a five-term Associate Editor for GEOPHYSICS. In the author's words: "Writing a column is new to me, so I will be feeling my way along. However, I don't intend this column to be an attempt to teach technical writing - I'm still wrestling with whether or not I believe that is possible. At this point, my intent is to (1) increase awareness of technical writing and editing issues, (2) encourage readers to consider or reconsider their approaches to technical writing and editing, and (3) give readers some tools to be more effective reviewers.")

2) Who "done" it?

- 3) Why was it done?
- 4) How was it done?
- 5) What was learned?

Even as these questions are answered, there is something else to remember. Technical writing is not simply writing about technical work. As I am trying to show, it has other characteristics and facets, perhaps the most important of which is reproducibility: *Technical work must be reported in sufficient detail to allow a reader to reproduce or verify that work.* 

At the core of a lot of weak writing is the mistaken belief on the scientist/author's part that writing a paper wraps up a project. "I'll be glad when this is over!" Not so! Each project really consists of two problems. The first is the project. The second is the reporting: finding the means to encapsulate the project effectively. Typically, the second problem is not recognized as such. It is seen as a necessary and final exercise, not as a specific problem demanding its own specific solution.

The writer — craft and creativity. Technical writing is an integral part of every technical professional's career; typically, we spend one-fifth or more of our time pushing pen, keys, or mouse. Ironically, most of us have never studied technical writing. From this, it would seem that, unlike our other professional skills, technical writing comes to us by magic or osmosis or is transferred with the handshake when we receive our degree(s). (I'm as guilty as everyone else!)

Although writing may come easily to some, most

authors in all fields face the dreaded "writer's block" (there, I worked it in!), struggle to add pizzazz to an otherwise bland or heavy subject, are dissatisfied with the outcome, and fall prey to endless rewrites. Conscientious technical writers have those worries and some additional ones. Technical writers can very easily *lose sight* of their effort and trip over common pitfalls:

- 1) Not matching the writer's objectives with readers' needs and interests
- 2) Including more information than is needed
- 3) Adding irrelevant and uninterpreted information
- 4) Implementing a confusing organization
- 5) Using jargon and vague technical expressions
- 6) Being wordy
- 7) Using poor visuals

However the work is handled and published, the fact remains, *if the reader is confused, the writer has failed!* No one but the writer is accountable for this failure. Still, frustrated writers who reply to questions or comments by saying, "Read my paper more carefully" aren't rare.

An example comes to mind involving a long, multiplechapter technical report I edited some years ago. After spending more than 10 days editing, I went to the author and explained that I had spent so much time on his report because it was hard to read. Among its many flaws it particularly lacked flow, continuity, or logical development. For example, key, new topics were cavalierly used in the early chapters but were not referenced or explained until later chapters. The author's reply surprised me. He calmly said, "That's the readers' problem, not mine. The information is there. Let 'em figure it out!"

To this I can only say: *The burden of proof is on the writer, not the reader*!

Successful writers have a good conceptional understanding of their readers' profiles. They don't de facto direct their writing to one famous expert. Instead, they recognize that:

- 1) The reader is not a captive audience.
- 2) All readers are not the same.
- 3) All readers are not like the writer.

**The reader** — **our target.** Here are some insightful notes I jotted during my summer reading.

- 1) Understanding is a complex process combining a reader's knowledge, attitude, and reading behavior.
- 2) A reader extracts new information and tries to associate it with some given or previously known information (Haviland and Clark, "What's new? Acquiring new information as a process in comprehension," J. Ver bal Learning & Verbal Behavior, 1974).
- 3) "Readers do not simply read, they interpret," (Gopen and Swan, "The Science of Scientific Writing," *Am. Scientist*, 1990).

Readers have needs. Part of a successful document is meeting these needs. From a document, the reader should gather:

- 1) What information is important
- 2) Where to focus attention
- 3) What to be thinking about
- 4) What to remember

5) What "it" looks like

- 6) How "it" is organized or related
- 7) How the work was done
- 8) What the work means

Readers also have interests. Successful documents explicitly address these interests, just as they handle the readers' needs. Particularly compelling is the question in every reader's mind: How will this work or information help me?

Furthermore, readers have expectations. They expect an efficient document that sorts, organizes, and interprets information suiting their needs, interests, and abilities. Writers who don't recognize this don't get read!

Our electronic world of Internet, databases, faxes, etc., has greatly expanded readership beyond a few select specialists within the discipline of the author. Successful writers recognize this expanded market for their work and write with it in mind.

A *user-friendly* document is built by recognizing how hard a reader must or will work to "get the message." A user-friendly document stays within the reader's limits for:

- Orientation and efficiency quick, clear, concise, and unambiguous
- Accuracy objective, bias-free, ethical
- Comprehensiveness complete, self-contained, accessible, verifiable
- Interest useful and applicable
- Correctness grammar, syntax, punctuation, word usage

Now you know what I did and learned on my vacation. I hope you gained something from reading it. I also hope that the next time you read a strong or weak article or document, you recognize the items and elements that make it strong or weak. This is especially true when either I or one of my co-Associate Editors asks you to review a manuscript for GEOPHYSICS. Thanks for your interest. I hope I can continue to deserve it.



Kenneth D. Mahrer, when not musing over manuscripts (he's been an Associate Editor for GEOPHYSICS since 1989) or sweating over being a new columnist, maintains a flexible, eclectic professional career — i.e., a résumé way of saying repeated unemployment has led to diversification. He willingly admits his proclivity to do "just about anything for a buck!" Presently, he is a senior research sci entist at the Denver Research Institute, working on geophysics and — proving his

versatility — law enforcement projects. He is also an associate research professor in the Engineering Department, where he teaches whenever asked, and an active adjunct professor in the Physics Department, both at the University of Denver. Prior to this stop, Ken worked on a variety of projects including electromagnetic detection of near-surface anomalies and containments, characterization and longevity predictions for the DOE High-Level Nuclear Waste Repos itory at Yucca Mt., Nevada; the development of an impulsive bore – hole seismic monitoring of hydraulic fracturing. After receiving bachelor's and master's degrees in physics, Mahrer received his PhD in geophysics "shortly after the plates began to move" (i.e., when plate tectonics research was first getting big at universities and dinosaurs no longer ruled Earth).

# Golf swings, tennis serves, and technical writing — things we can upgrade

KENNETH D. MAHRER, University of Denver Research Institute

*T* he objective of the proposed research was to test the hypothesis that male courtship feeding, and sexual cannibalism in particular, are maintained through a post-copulatory female mating preference of males capable of supplying females with the highest material ... This excerpt from a published research report: English? Yes. Good technical writing? Not even close!

In my last column, I facetiously noted that most professionals seem to acquire technical writing skills either magically, osmotically, or through the handshake that accompanies a degree. Learning technical writing skills is not something to which we devote a reasonable amount of time. And it is certainly not something we typically update or upgrade. Ironically, as professionals we spend 20% or more of our time writing.

Perhaps we feel that we learn technical writing through a practice-makes-perfect approach. I suggest that the practice-makes-perfect approach, in truth, is more like the bad-golf-swing or weak-tennis-serve approach: Continually repeating something that is incorrect does not correct it, it just ingrains it! Somehow we have to break the routine. For both golf and tennis, we can easily recognize our shortcomings and seek professional help or advice to improve. For technical writing, we rarely recognize our shortcomings and even more rarely seek professional help or advice.

Maybe the answer is that in golf or tennis we keep score as we play. This keeps us posted on our progress toward the goal: Winning. However, in technical writing, there are no running scores; there is only a final score (e.g., getting a manuscript accepted for publication). No strokes or points are tallied during the writing, editing, or reviewing processes. Can you imagine if there were? "Woow, I lost two strokes for poor syntax." Or, "Sorry, but that weak abstract will cost you a penalty point, love-15." Absurd? Sure, but I go back to my original question. If we are willing to study golf or tennis to improve performance, why won't we study technical writing?

I think the common answer to that question is: "I am too busy. I know I should work on my skills, but I have other things ahead on my to-do list." I know that's what we say, but is that really true? I am a firm believer in the old adage: *If you want something done, ask a busy person.* Time certainly could be found. And there are resources to match that time: Books, articles, seminars, the Web, night classes, weekend classes, even an SEG short course remember the one that was planned for the weekend before the November 1997 meeting but was canceled because only two people registered? No, I don't think it's time; it is really something else. In my opinion, the no-time-too-busys are a subterfuge. What I really think is most of us feel we write OK. Maybe not great, but OK. Right? I would be jingling loudly if I had a shekel for every time I've heard, "I'm not a great writer, but I am a good writer. I can do the job." Maybe. But if that is the case, there must be a lot of good writers. And with all these good writers, the review-and-editing process is probably unnecessary. Right? We could save lots of time and money and simply publish originally submitted manuscripts! Right? Wrong! All of us at GEOPHYSICS know this would not work. Nearly all the manuscripts submitted to GEOPHYSICS need editing.

At the risk of offending but following the example of the little boy who proclaimed, "The king has no clothes!" I believe there are a lot of well-intentioned but weak writers and relatively few really strong writers. And, like the king hearing the little boy, I'd like to think that this column, both this month and in general, is a wake-up call. In my opinion, most if not all weak writers have the ability to become much stronger writers. Taking a lesson from tennis or golf, swallowing some humble pie, admitting that one may not be a good writer, and then doing something about it can dramatically improve writing skills.

The first step, recognizing and admitting one's own weakness, is probably the most difficult. However, as the following example taken from a recent issue of a national oil journal shows, it's only the first step. A second step, doing something about it, must follow.

This is my final issue as Engineering Editor of [Journal X]. Nearly five years of editorial experience has been an extremely valuable tool for me. As a petroleum engineer with time served in the field, working for a major international oil and gas magazine has greatly enhanced my oral and written skills, which are critical assets to engineers today. Which is why I encourage every engineer (or any other technical professional) that reads this column to write and present and/or publish at least one paper in their career. It's a humbling experience at first (trust me, it helps to have an English or journalism major with good editing skills handy), but also a very rewarding one. It could help your career out in ways you cannot imagine.

As you can see in this example, the author has openly admitted his initial technical writing weakness. As you can also see, he seems to have fallen just a bit short in curing his problem with grammar.

My point here is not nailing this author. He recognized his shortcoming and tried to do something about it. My point is this. Who needs to study, review, or update technical writing skills? Answer: We all do, from the novice to the oft-published writer. We all can gain from periodically evaluating our skills. Technical writing is not osmotic or magic; it's not a learn-once-have-always tool; and it's certainly not a practice-and-you'll-get-perfect skill. Truthfully, it's a learn-once-maintain-and-upgrade-periodically

Editor's Note: The "Writer's Block" is a new bimonthly column on technical writing and editing issues by Ken Mahrer, a five-term Associate Editor for GEOPHYSICS. The inaugural column appeared in the March 1998 issue of TLE. The author can be reached at kmahrer@ du.edu.

skill. If you don't believe me, consider your golf swing or tennis serve!

[Note: To aid in my campaign to get our readers to selfevaluate and upgrade technical writing skills, my next column will be a review of means and methods for upgrading technical writing skills. My campaign (i.e., harangue) is not purely altruistic. Well-written documents are much easier to read. Also, good technical writers make better technical reviewers, and we at GEOPHYSICS are always looking for good technical reviewers.]

**A**t this point I'd like to change directions a bit and discuss a recent experience that goes to the etiology of weak writing skills.

A few days before I began writing this column, I had the not-very-joyous task of grading undergraduate research project reports. The project was the laboratory part of a general survey class on energy. The project asked students to log their personal energy consumption for two weeks. At the end of the two weeks, the students formed into groups of four or five and combined their energy logs to calculate average energy consumption. They were then asked to find ways to reduce realistically the average total energy consumption by 20% of its total dollar value and then to assess the implications of this reduction. Finally, they were told to compile their results and write a final report, one report per group. You can just imagine what I received!

Despite spending most of a two-hour class discussing the organization/preparation/writing/proofreading/etc. of a technical report, I was utterly amazed at what I received. I had specifically warned about the pitfalls of eleventh-hour work; in some cases what I received must have been eleventh-hour-fifty-ninth-minute work.

From the macro- down to microscale, most of the reports were substandard. Poor grammar was the rule, not the exception. One group had a section titled "Percussions." (I think they meant *repercussions*, but it passed the spellchecker so it must be correct!) Most graphs were very colorful (the joy of color printers) but lacked captions, names of axes, or explanations of symbols. Data tables were also en vogue, but unfortunately they were typically 7  $\frac{1}{2} \times 10$  inches of columns of numbers without explanations, units, column heads, etc.

Consider these special examples:

In total, there were about 20 groups of students. Four groups decided to reduce overall energy consumption 20% by having each member of their four-member group reduce energy by 5%. Given this approach, reducing energy consumption 20% was "a piece of cake," as one group wrote. I later asked the class en masse, "To reduce 20% you used 4 people each reducing 5%. Using that same logic, if you had had 100 members in your group and each reduced energy consumption by 1%, would that have caused a 100% reduction or no energy left?" Most just looked at me. Some bowed their heads in disbelief.

Another group wrote: "The average American has more percentage of body fat than any other country on the planet." What can you say to something like that?

The students had been told to begin each report with a one-page summary. I had told them this was common in reports and that they should put specific information into the summary. Here is one, not atypical, example. "The purpose of this experiment is to take a detailed twoweek sample of an individual's energy intake. Our goal was to reduce energy consumption by 20%. Through formulas and conversions, a uniform standard provided a common ground to compare the results. In the experiment, we obtained each member's information and analyzed the areas yielding excessive waste. From this analysis, we formed opinions as to where the consumption reduction could be achieved. Each member chose a specific area to achieve a reduction in consumption. Through combined efforts, we successfully achieved a 20% reduction in the overall picture of waste and consumption." Does this sound like any abstracts that you have read? Sound and fury signifying nothing?

I could go on, but I think I have made my point on etiology. Here, also, is an irony. Yes, these reports are by students and, yes, students are here to learn. The exercise was designed for them to learn, but, unfortunately, they won't learn about writing. I marked up the reports, but for most of them, those marks were not recognized for their value — a learning tool. Few came to pick up their reports. Of those who did pick up their reports, they opened them, looked at the grade, glanced at the marks, and left my office. I can only imagine the names they bestowed upon me for the grade I gave them (not the grade they earned). In general, there was minimal recognition of the feedback loop regarding the writing. And that's the irony. They should be learning about writing, in addition to the project. But, they won't, because the course is not a writing course. Instead, they will simply keep repeating their golf swing or tennis serve and wonder why curmudgeons like me hassle them. It seems to parallel what happens with some of the manuscripts I edit for GEOPHYSICS.

# WRITER'S

# Do I need a tune-up and where to get one if I do

KENNETH D. MAHRER, University of Denver Research Institute

BLOCK

Wishful thinking on my part, but you may recall that in my last column I asked: Who needs to study, review, or update technical writing skills? You may also recall my answer: We all do, from the novice to the oft-published writer. Paraphrasing the great American baseball player and master of the malapropism, Yogi Berra: Technical writing is 90% perspiration, and the other half is inspiration. Let s work on the perspiration.

If in my previous columns I failed to inspire you to examine your writing, recognize your pitfalls, and want to do something about them, then take a moment right now and answer these questions instinctively. Better yet, ask a friend or colleague who knows your writing to answer these questions about your writing.

Is your writing clear? Do you discuss all the needed topics completely? Do you write with a well-defined plan or simply sit down and write ? (One way to assess this is to weigh your discussions: Are they heavy, that is, extensive, when discussing recent work and light for work done in the past, despite the complexity of the material?)

Are your explanations quantitative, accurate, unbiased, and straightforward? (Or, do you indulge in qualitative discussions and sweeping generalities, such as unsubstantiated claims about the universality of your method.)

Do you write with the reader in mind? (Are you paying careful attention to logic, sequence, and usefulness?)

Do you begin documents by clearly defining the problem to which you direct your work and your writing? (Or is your writing a progress report in which you leave it up to the reader to identify that which you are pursuing?)

Arc your English language skills acceptable?

If the honest answers arc positive, you re excused and can go read another article. If you are not sure or bravely admit some shortcomings, you should consider a tune-up.

[Aside: Before any further discussion of ways to tuneup your technical writing, I would like to briefly address the delicate subject of authors to whom English is not their first language. Beyond the suggestions I offer in my columns, writing in a language other than one s own presents obvious additional challenges, especially a language with the oddities and nuances of English. I have thought about this a lot and have discussed it with many people. There is no easy answer, but there is a simple solution: Seek help from a native English-speaker, preferably one who is familiar with your work. Too often, as an associate editor for GEOPHYSICS, I have seen manuscripts in which the syntax and grammar had been adequately reworked, perhaps by an English teacher who, in the process, massacred the concepts. If reliable help is unavailable, then I suggest contacting the prospective journal, describing the situation, and asking for guidance. With the increase in international authorship, I would like to believe that journals are considering ways to assist non-English-speaking authors. One suggestion is to try to enlist the expertise of retired members.]

Because you have read this far, I assume that either

you ve read the rest of this issue and the plane hasn t landed yet or perhaps you do indeed recognize that your writing skills could be tuned up. I cannot offer you a repair manual or quick tips that will have you writing like Faulkner. Let me remind you, 90% is sweat. So what can you do?

One option is to have your company call in an expert to conduct an in-house short course. I endorse this wholeheartedly and not just because I m available. Consider also that some professional societies, such as the SEG, offer short courses at their annual meetings (perhaps this column will spark renewed interest in the SEG s short course, which you recall has been canceling due to insufficient enrollment). Another option is to take a scheduled writing course at a local college or institution. Writing courses have become a popular offering for night schools, although caveat emptor. Those that are labeled technical usually concentrate on how to produce computer and software manuals, engineering reports, technical product advertising, and other topics of limited application for you and me. If a scheduled writing class is your choice, then I suggest contacting the Society of Technical Communication (home page: http: //stc.org) or the Association of Writers National Science (http://www.nasw.org) to get their recommendations.

However, my cynical side all six of them, according to my wife tells me that while you may be all fired up now, you may not actually enroll or complete a course on writing. Let us, therefore, move on to Plan B, the more-convenient-not-too-disruptive-of-work-and-personalschedule-and-easily-resumed-when-you-must-stop plan. As I see it, that leaves two resources: the Internet and books.

Ah, the (ubiquitous) Internet: The information superhighway, the supermarket of frequently poor, often atrocious, rarely edited writing a topic that I just may have to discuss in a future column. Actually I should say, Ah! The Internet: That invaluable resource for the writer looking for help, including the resources for finding someone who will examine your manuscript and give you an honest and unbiased opinion.

Because space prevents me from going into detail, I will leave it to you and your favorite search engine to cruise the Net. However, here is a short list of sites that I garnered from a wonderful book, *Writer s Internet Sourcebook*, by Michael Levin (No Starch Press):

The Craft of Scientific Writing (http://darkstar.engr. wisc.edu/alley/). A multitude of resources including a selfstudy course. Levin describes it as A superlative site. I agree.

Internet Resources for Technical Communicators (http://www.interlog.com/~soltys/techcomm.html). Ample resources including online help and lists of newsgroups and discussion groups (may be a good place for the non-English-speaking author to find help).

*Technical Writing* Page (http: //techwriting.miningco. com). An outstanding introduction to technical writing, many links to technical and scientific Web sites for technical writers, a resource list that includes help systems, tutorials, advice, etc. Also recommended by Levin.

Other sites that belong in your Bookmarks include:

http://www.columbia.edu/acis/bartleby/bartlet for *Bartlett s Familiar Quotations;* gopher://odie.niaid. nih.gov/77/.thesaurus/index for *Roget s Thesaurus,* and http://www.theslot.com/contents.html#start, which is a little-known gem created and regularly updated by Bill Walsh, not a technical writer but a pretty sharp editor. This barely skims the surface of what the Internet offers.

**Call me old-fashioned**, but my personal choice is still books: Convenient, inexpensive, without power requirements, portable, pleasant to the touch, and they never, ever crash. Some models are still working after 500 years in use. And you can take them to the reading room (try taking your computer to the reading room and see the looks you get!). I like books for self-teaching because they allow easy access to their full volume. Once read, a book is forever a resource.

For all my high praise, finding the right books may not be the easiest option. I recently strolled into a local branch of a large national bookstore chain to check out books on technical writing. I was surprised to find a paucity of choices; there were, however, a gazzilion texts on writing software manuals.

Later that day I tried the Internet, specifically Amazon.com (http://www.amazon.com), a de facto search engine for texts. Doing searches on technical writing, scientific writing, and scientificediting produced more than 700 texts. This was wonderful except that I don t buy before I try.

I like to spot read, examine the index and table of contents, etc. Internet purchasing precludes that, so if you are also a try-before-you-buy person, let me save you some trouble and recommend the following favorites from my book shelf.

At the punctuation, grammatical, and syntactical levels

of writing, I have three texts. First is *The Elements of Style*, by W. Strunk Jr. and E. B. White (Macmillan); it s renowned as simply The Classic. The New York Times calls Strunk and White as timeless as a book can be in our age of volubility. Enough said! My other two books for these levels are *The Well-Tempered Sentence A Punctuation Handbook for the Innocent, the Eager, and the Doomed* and *The Transitive Vampire* 

A Handbook of Grammar for the Innocent, the Eager, and the Doomed. Both are by K. E. Gorden. All three books are wonderful references for those lie-or-lay, comma-no-comma, What is a gerund, anyway? questions.

At the planning-organizing-writing level, I refer to four texts. All are quite complete, dealing with the full range of topics in technical writing (e.g., text, tables, and graphics). Despite some individual weaknesses, I highly recommend them all.

First on my list is *How to Write & Publish a Scientific Paper* by R. S. Day (Oryx Press). Professor Day teaches technical and scientific writing at the University of Delaware. This book has been around for a long time (first edition is 1979). I like this book because the chapters are short and direct to their point. Next is From Research to Printout: Creating Effective Technical Documents, by J. H. White (The American Society of Mechanical Engineers Press). This text is the most complete of my books spanning, as the title indicates, information generation to final product. It is also the most up-to-date, including many discussions on computer software options and utilizations to aid the writer. This text also offers many illustrative examples. Number three is Technical Writing, by J. M. Lannon (Addison Wesley Longman). Like White s text, this book is ripe with examples. I like this book because its style of writing seems directed toward maintaining writing awareness in the writer. This is exemplified by the 44-item Checklist for Revising the Document given within the front

cover. My last text is *The Craft of Scientific Writing*, by M. Alley (Springer-Verlag). Of all these texts, this is the most readable; I particularly enjoy the pithy quotation on writing that opens each chapter. Of all four, this text is the best airplane reading.

Finally, I recommend two more texts: Guide to Technical Editing Discussion, Dictionary & Exercise, by A. Eisenberg (Oxford University Press), and Rewrite Right! How to Revise Your Way to Better Writing, by J. Venolia (Ten Speed Press/Periwinkle Press). In my opinion, the real cornerstone of good writing is good self-editing-again, a possible topic for a later column. Writing gets the information on the paper or in the computer, but editing makes the document readable. These texts point out ways, means, and pitfalls of editing your document.

Well, this ends my three-article harangue on self-evaluation and self-help. In the next columns we will change directions. My feedback indicates the first two installments have been favorably received. If you have any topics that you would like me to address in future columns, contact me, and I will see what I can do. ■

# If you write it well, they will read it

KENNETH D. MAHRER, University of Denver

**S**ome of you may recall that wonderful line from the movie, *Field of Dreams*, in which a Kansas farmer standing in his cornfield hears a spiritual voice, "*If you build it, he will come.*" The farmer builds *it*. Then *he* comes, as do many more. Even if you're not familiar with that movie, the resonance of the line goes beyond that cornfield. If I were that spiritual voice and you were sitting at your desk late one night, writing a paper, I would say, "*If you write it well, they will read it.*" Or, if I had had spicy food for dinner, I might say, "*If you write it poorly, they will complain.*"

And, complain they do! As a fifth-term associate editor for GEOPHYSICS, I have read, heard, and sometimes, contributed complaints about articles. In the last few years the complaints about GEOPHYSICS articles seem to center more on topic and less on writing quality. For example, I have heard discussions pointing to too many theoretical articles and not enough case studies. The official response to these discussions has to be something like: We can only pick from what is submitted. Unofficially, I consider what is really being said. Are these complaints about topic or are they really about quality, specifically *readability v. unreadability*?

To support the topical side of this question, consider the demographics. Many data analysts feel that theoretical and modeling papers don't fall within their spheres of interest and, hence, rarely give these articles a second glance. Similarly, many theorists feel the same about case studies. And, who besides modelers ever reads a modeling paper. Each camp likes to point a finger at the other's articles. The conflict is probably as old as technical publication and, probably, will never be resolved. This finger pointing seems to signal that the complaints are topical. Personally, I believe that the finger pointing is only a vehicle and that the root of the complaints is quality. Here's my reasoning.

A good scientist or engineer recognizes that science and technology are supported by a balanced tripartite: theory, data, and modeling. A complete study needs each. Each is necessary to support the other two. If any one of the three is weak, they all are weakened! Theory encapsulates our understanding and allows us to generalize, predict, and, most of all, communicate. Data (i.e., case, lab, or field studies) are the ground truth, our measurements. Modeling, whatever type, quantifies theory, creating synthetic data sets, and linking theory to measurement.

As I said, good science and technology need the tripartite in balance. Similarly, we, as scientists and engineers, need a balance of the three in our technical publications. Surely, we need to read or, at least, scan the articles in each of these areas to stay knowledgeable. Based on this, I believe that good scientists and engineers want to read a sampling of the full breadth of articles in their expertise, but are frustrated by the poor quality of the articles. Or, put slightly differently, the complaints are really about the quality of the writing, not the topics.

Consider now the recurring theme found in manuals or books on technical writing: Too many writers write for themselves and not for their readers. These writers neglect elements that readers need to appreciate, understand,



Figure 1.



#### Figure 2.

and use the information described within their papers. To show this, I made an ad hoc study using recent issues of GEOPHYSICS. Before I present the study and the findings, let me digress for the next three paragraphs and discuss some elements of technical writing that will help put my data in perspective.

Books and manuals on technical writing consistently define the function(s) of each section of a well-written technical paper. The successful functioning of each section is necessary for meeting the needs of the reader. For example, the introduction identifies and presents the problem. It also gives the background and defines terms needed by the reader to understand and verify the work (i.e., the solution to the problem) discussed in the paper. For continuity with the remaining article, the introduction should foreshadow or summarizes the new material in the article. It must successfully perform all of these functions so that the reader is prepared for the main body of the text.

Similarly, the conclusion, or its equivalent last section in the article, has its own well-defined, reader-needed functions. The conclusion summarizes the results (i.e., data or new information), persuades the reader as to the value of these results, builds relationships and correlations, and discusses what has been learned. It also tells the reader what the writer expects the reader to do, as a result of having read the article. In general, the conclusion should close out the paper on a positive note, persuading the reader as to the value of having read this paper!

Both the conclusion and the introduction must perform their functions for the paper to be a valuable, readable document. This means that each must comprise a necessary and sufficient percentage of the total length of the article to perform its functions. The relative lengths of the introduction and conclusion are the basis of my ad hoc study.

Returning to my study, I used the introduction and conclusion sections as correlations to the quality of the writing. Since quality of writing in my opinion is not readily quantifiable, I used the lengths of these sections as barometers for gauging the author's understanding and appreciation of the needs of the reader (i.e., the readability of the paper). The hypothesis of the study was that the relative lengths of these sections reflect the relative value that a writer overtly places on readability. I chose the introduction and conclusion because, unlike the main body of the paper, which reflect the writer's ability to report the work, the introduction and conclusion more strongly reflect an author's writing skill. In other words, once the science has been completed, the main body practically "writes itself." In contrast, the introduction and conclusion must be created and written as specifically functioning units.

**The study.** In the study, I took two issues of GEOPHYSICS published in 1997. From these issues, I randomly chose 20 technical articles (10 from each issue), excluding short notes. Then, using a standard ruler, I measured the total column length of each article and the column lengths of its conclusion and its introduction. (Note a single text column of GEOPHYSICs is about 23 cm long.) Figures, appendices, acknowledgements, references, etc. were not included in the measurements. I only measured the length of technical text. The results of the study are shown in the two figures.

Figure 1 shows the percentage of column length of the conclusion (i.e., {Conclusion length divided by full article length}x100%). For these 20 articles, the full article lengths ranged from 100 cm to nearly 500 cm, while the conclusion percentages range from about 3% to an anomalously high 19%. The interesting characteristics in these data are the two trends. About half the articles show an upward trend with increasing article length: the longer the article, the increased emphasis on the conclusion. The remaining articles seem to show a flat, or possibly decreasing, trend: a 3% to 7% conclusion, independent of the article length.

It seems to me that, as an article becomes longer, the percent dedicated to the conclusion should increase to some reasonable maximum. If articles maintained a fixed percentage for the conclusion instead of increasing with increasing length, then each increment of main body text would correspond to one unit of conclusion length. Hence, increasing the main body length gives a comparable linear increase in conclusion, keeping the percentage of conclusion fixed. This precludes the possibility that different increments in the main text can correlate and therefore add a nonlinear component (i.e., additional information) to the length of the conclusion. If this were not the case, then the length of the article would not be justified; too much is discussed in the main text compared to what can be concluded or learned (i.e., a poorly-written article).

Figure 2 complements the findings of Figure 1. Figure 2 shows column length of the conclusion versus the column length of the introduction for the same 20 articles. Note again the dual distribution. For about half of the articles, these lengths are proportional. For the remaining articles, the conclusion length seems independent of the introduction length. Interestingly, the introduction for these articles seems fixed at about 10 cm. These articles show a very common characteristic of weak articles: a single-paragraph conclusion. I invite you to do your own ad hoc study and see how many 10-cm conclusions you find in an issue.

I interpret the two trends in Figure 2 to show two general classes of writers. One class is those who recognize that as the background, perspective, and problem-definition section grows in length, equivalently so must the benefit section. The other class of writers, those whose conclusions are ~10 cm, seems to be writers who are "out of breath" or, to use a pun, "are out of breadth" and simply shut the door on the writing exercise. One can only surmise that as the reader progresses through this type of article, the article reads more and more tired!

Early in this column I stated that there was discontent voiced by some readers of GEOPHYSICS and that the discontentedness would appear to be topical. I have tried to show that it is not topical, but is a lament on the quality of writing of too many of the articles. Reviewers and editors can only do so much; in the end the responsibility for the quality of the writing rests firmly on the author(s).

So, what's all this to mean. Am I simply stating the obvious? Perhaps, or perhaps I'm trumpeting yet another wakeup call! Many writers need to drop the attitude that, since they have been successful at getting articles through the system (i.e., published), they are good or, at least, capable writers! If that were the case why do we hear complaints? As I see it, publication success is not necessarily a statement of writing success, but a weakness in the system—a system that fails to require good writing. But that's a column for another time. E

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WRITER'S

# An open letter to authors whose native language is not English

#### KENNETH D. MAHRER, University of Denver

Author's note: Since starting this department, I have been regularly asked to dedicate a column to authors who are struggling primarily because their native language is not English. This is my reply. My help and advice are "fixes" for common weaknesses that I have encountered in manuscripts submitted to GEOPHYSICS and other technical journals. I am not implying that all nonnative-English-speaking authors are inferior writers. This certainly is not the situation. Many have a superior command of English and are capable, accomplished technical and nontechnical writers.

#### Dear friends and colleagues:

Thank you for your many inquiries on preparing manuscripts for publication in English. I greatly admire your effort. English is not an easy language. As a youth, I was not very successful at foreign languages. As an adult I was totally unsuccessful, so I strongly empathize with your struggles.

Let's begin with some basics so that we're starting at the same point. A credible scientific or engineering study follows the scientific method point by point. "The steps in the scientific method are (1) statement of the problem; (2) hypotheses as to the cause of the problem; (3) experiments designed to test each hypothesis; (4) predicted results of the experiments; (5) observed results; and (6) conclusions from the results of the experiments" (Zen and the Art of Motorcycle Maintenance by Pirzig, Morrow, 1974). Similarly, a technical paper uses the scientific method as its foundation and backbone. Within the paper, each of the six items must be addressed clearly, concisely, and completely. If each is not properly discussed, the manuscript fails and will be rejected. This means that you must design your manuscript to include all six items. Note that to be effective, designing should be done before you write, not, like some authors do, while you write!

Elizabeth Whalen, discussing these matters in "Editors and the scientific method" (*The Editorial Eye*, September 1998), wrote: "Those of us who edit scientific writing soon learn that our responsibilities go beyond working with words. Scientists—especially university researchers—need and want to be published, but 'poor scientific design' is one of the most common reasons given for rejection of articles by peer-reviewed journals. If the findings don't prove anything scientifically, it really doesn't matter that the grammar and usage are perfect."

I concur with Whalen and find that the most common design flaw and the major reason manuscripts are rejected is item (1): failure to state the problem. Many authors write as if the problem is obvious and doesn't need stating. This is simply not true. Successful papers identify and explicitly state the problem. Unsuccessful ones don't. A paper may not completely solve the problem and may only give insight, but the value of the paper (i.e., the reason for doing the work) is an outgrowth of the problem addressed, not the effort extended. Without a statement of the problem, the remaining manuscript has been built on an incomplete foundation and easily becomes a series of empty statements, lacking purpose and value to the reader. Although it may be obvious to you, be sure you define your problem for your readers. If you cannot clearly define and state the problem, then reexamine the reason for your work and reconsider publishing.

Let's now assume that you have begun designing your manuscript. Designing can be expedited by creating an outline. Many word processors have an outlining feature. If you don't already use the feature, consider learning it. Despite its great utility, many authors look down at outlining (but that's a topic for another column). Personally, I think that shunning outlining is a mistake and one reason why many authors write weak papers.

Whether you outline or not, make your design as detailed as possible . . . but don't begin writing. At this point your only task is to create a very detailed design. If you're concerned as to whether to include some aspect of your work, include it! You can always remove extraneous information later; now you need to include all your information. It is very common for authors to write a lot about work done recently, since it is fresh in the mind, and to be very sketchy and incomplete about work done in the past. This often causes problems for the reader (i.e., lack of needed information) and can bring into question two necessary features of (publishable) manuscripts: reproducibility and verifiability. Readers intending to use your findings must be able to reproduce and verify your work. Hence, you must give enough information to enable replication.

Now you have a design. I assume that you have worked and reworked your design to ensure that all the pieces are there and that your manuscript will flow logically and clearly. Good! Are you now ready to write? No! You still lack one more ingredient.

Sociologists tell us that perception or how we view things is in part based on language. Since your native language is not English, I assume that your perception of technical material may differ from scientists who speak English natively. I assume that this is especially true for languages that are very different than English. Because you are trying to publish in English, I strongly recommend a lesson in perception and technical writing in English. Said a bit differently, "If the reader is to grasp what the writer means, the writer must understand what the reader needs." This statement is from "The science of scientific writing" by Gopen and Swan (American Scientist, November-December 1990). This isn't as painful as it sounds, but it is a really necessary step. Many unsuccessful authors write weak or insufficient manuscripts because they fail to include what readers need from a manuscript, not because of poor science.

To further my point, consider another quotation from Gopen and Swan. "As critical scientific readers, we would like to concentrate our energy on whether the experiments prove the hypotheses. We cannot begin to do so if we are left in doubt as to what those hypotheses might be—and if we are using most of our energy to discern the structure of the prose rather than its substance... In real and important ways, the structure of the prose becomes the structure of the scientific argument. Improving either one will improve the other." To give yourself a perception injection, get and read Gopen and Swan's article. I am not alone in saying that it is one of the best articles on technical writing ever written! If you can't get a copy, keep trying until you do! It is *must* reading. A warning, though—it is not short, and it is not simple. But it is extremely worthwhile! If after reading it once, you are confused, please read it again. Still confused? Read it a third, fourth, fifth . . . time, if necessary. Still confused? Get someone to help you with it. The effort is well worth it! If you read and absorb what Gopen and Swan are saying, you will be a greatly improved writer! This paper will give you a new perception and perspective on technical writing in English. If not, go read it again!

Are you *now* ready to write? Hopefully, yes. But, before you begin writing, let's discuss a few more issues, specifically, common pitfalls and their solutions.

In English, the order in which words and phrases appear within a sentence is critical. This ordering is called syntax. Poor or incorrect syntax is not a small flaw; it is a major problem that can totally obscure meaning. Remember the quotation from Gopen and Swan, "the structure of the prose becomes the structure of the scientific argument." To readers poor syntax = poor science. Poor syntax can cause a manuscript to be rejected. If the reviewers cannot understand what the author is trying to say, they are obligated to reject the manuscript.

One way to reduce problems with syntax is to keep sentences short. Shorter sentences have few words so the chances of misorder are reduced! Try to keep sentences to a maximum of 10-15 words. When sentences become long, word order becomes very important, and syntax can be a problem. Also try to avoid using sentences with many prepositional phrases. Recall that prepositions are those little words like *on*, *in*, *to*, *over*, *above*, *upon*, *behind*, *near*, *through*, *under*, *between*, etc. You certainly cannot avoid using prepositions completely, but using three to four or more in a sentence can create a complicated sentence, which is especially susceptible to syntax errors.

Another common pitfall is writing poor introductions. Many authors seem to feel that noting and discussing each of the 30-40 articles they read is necessary. It's not. With regard to the scientific method, the introduction is where you state the problem and give some background directly applicable to both the problem and your solution. It is not the platform upon which you discuss any and every study, no matter how remotely related. As you will learn from reading the Gopen and Swan article, give readers only the information needed to guide them directly from the problem to your solution. Don't give information that can misdirect your readers. If you want to write about the many articles related to your work, write a review article.

Another, and similar, problem for many authors is their failure to write an adequate conclusion. I have read many manuscripts that document six or more months of very hard work. Yet the conclusion is one short paragraph! How can that be? If you spent months working, you certainly learned more than one paragraph. If not, is there value in your effort? Spend the time and mental energy needed to write a complete and useful conclusion. Remember, the conclusion tells the value of your work and is the last section read. If you want your work remembered, write a useful, valuable conclusion.

OK, now that you have completed your (draft) manuscript, what should you do? Send it in for publication? No! Now you must edit! First, ask people who are very competent in English to read and critique your manuscript. Ask them to be direct and honest and not to worry about damaging your friendship (i.e., don't let your friendship be damageable based on their comments). I recommend that you ask both scientists and nonscientists. Scientists can help with the scientific elements and its presentation. Nonscientists can help with the overall presentation. If in discussing comments with nonscientists you find yourself saying that they would understand something if they were a scientist, consider the following: The burden of creating an understandable manuscript is not the reader's, but the writer's. A reader's lack of understanding is a flag that your writing is below standard. It does not matter if the reader is a scientist or not. The proper response is to go back and rework the sections in question.

Well, that's about it. In a nutshell: (1) Prepare completely before you write; (2) write carefully watching out for pitfalls; and (3) ask good reviewers for help. I hope that my letter is an aid to you. I further hope that you continue to strive to improve your English technical writing.

P.S. In a previous column I listed some Web sites that may be useful to both native and nonnative-English-speaking authors. Here are a few more: *http://www. writing-edu.com* (this site was designed for young writers and home educators. It has some additional useful links); *http://www.editpros.com/ggquiz.html* (this site has a grammar quiz, which could be helpful to those who don't trust their grammar); and *www.cc.columbia.edu:80/acis/bartleby/strunk* (this site offers a copy of the classic text on writing by Strunk and White, *The Elements of Style*). **RITER'S** 

# Ten common qualities of uncommonly effective writers

KENNETH D. MAHRER, University of Denver, Colorado, U.S.

If rarity impacts value, then good writers are worth their weight in gold. Their works are happily received by editors and enthusiastically read by audiences. Technical writers have a knee up on more mainstream writers; they come to the table with heads full of knowledge. Their task is not to conjure plots but to vend information in a concise, precise, and readable manner. And yet the fraternity of truly good technical writers is thin because too many scientists are unschooled in what it takes to be in the inner circle. Good technical writers realize that both editors and readers have rights and expectations. They live up to both. Although they write with individual styles and about different subjects, they share common qualities that make them uncommonly successful.

- Successful technical writers are, first and foremost, successful scientists or engineers. Unlike journalists, who may write about subjects of which they have only secondhand knowledge gleaned through interviews, technical writers are the experts. They write about what they do and know. Strong technical writers wrap their pens around strong information that is well researched and well documented—in other words, scientifically sound.
- 2) Good technical writers are proficient in laying out both an argument and a manuscript in a manner that makes sense to the consumer. The development is clear and logical. Each piece of information is linked to that which precedes and that which follows. There are no gaps in information, argument, or presentation, and the material is well supported. Weak writers create arguments only they can follow. Strong writers create arguments even those less familiar with the discipline can follow.
- 3) Linguistics being the brick and mortar of all communication, successful technical writers understand and use the basics of grammar and the rules governing sentence structure. They possess strong vocabularies and are comfortable using them. Good writers understand that well-chosen and well-placed verbs are a bet-

ter option than strings of modifiers and prepositional phrases. They also know when to elaborate and when fewer words say more.

- 4 ) Personal honesty is another characteristic found in outstanding technical writers. They understand that not all technical work is suitable for publication. That which is invariably states and solves a real problem or question of interest to the audience. They would not submit unqualified work in the hope of padding their publication lists. If more writers were personally honest, journals would be smaller and more valuable.
- 5) Successful writers are humble they try to keep ego out of their writing. Their published papers are testimonials to the science rather than to the scientist. Work submitted by these professionals lacks the whistle-tooting of writers with less hubris. Their manuscripts detour around inconsequentialities that bulk up the look of a manuscript but add little to the content. They give the facts that are pertinent and necessary and leave out the fluff.
- The authors of papers shoulder a 6) huge responsibility in producing quality material, but they are merely among the people needed to bring that project to the public. Professional colleagues, reviewers, and editors are important links of the publishing chain. Uncommon writers recognize this chain and realize that each link offers expertise that improves the presentation and readability of the finished product. Strong technical writers respect the importance of critical feedback. They approach suggested revisions without defensiveness and give respectful consideration to constructive comments.
- 7) Successful writers are sensitive to the needs of their readers. They write to be read. Talented technical writers know that if a reader cannot understand the material, then the writer has not done a sufficient job. They also seek to make reading painless.
- 8) Patience is a virtue that applies to writing. Those who cultivate this quality are more likely to produce

successful articles which are well researched, well supported, and well presented. Without a compulsion to rush the paper to press, the writer can allow a new manuscript to rest before editing it. While the article is set aside, the author can change mantles from writer to reader. Subsequent revisions are made with less emotional attachment and more perspective.

- 9) Uncommonly competent writers are permanent students. Their ongoing quest for growth crosses over the boundaries of their discipline. These professionals are interested in the world around them. Despite the academic letters that follow their names and the accolades they have received, they have not yet arrived. On the contrary, they are in the middle of a journey for knowledge that has no end.
- 10) Finally, well-received writers understand the art of persuasion. Unlike unsuccessful writers, who write believing the science will automatically sell itself simply because it is science, uncommon writers recognize that the value of their work is in its acceptance. These writers know that ideas may be met with skepticism and that readers must be persuaded. They create documents designed specifically to work through the reticence of readers. They anticipate and meet objections with explanations and turn a skeptical audience into believers.

Most writers have known the puzzlement or pain of having a manuscript rejected. They have suffered the blow-to-the-belly feeling when holding their wounded work and scouring it for answers to the questions: Why was it returned, and why should I try again? Uncommonly good writers know the answer: It was rejected because it wasn't strong enough. And they try again, because they are. **E** 

If you have any topics that you would like me to address in future columns, contact me and I will see what I can do.

Breaking the cycle can only be done only by mandating change. It cannot be done by simply paying lip service to the need for change.

Ironically, I wrote this column while visiting Seoul National University (SNU) in Korea. I was visiting the campus to give a short course (four days, four hours per day) on technical writing for publication to engineering and science graduate students. This is my second time giving this course. In my first Writer's Block (March 1998), I described what I learned when preparing my lecture notes for my first course. Well, I went back again. It is quite a task to lecture in English (I don't know Korean) about publishing in English to students and faculty whose mother tongue is not English. It is also interesting to note that this course is totally optional, and each participant paid about US\$25 to attend. Two years ago I lectured to about 85 students; this time it was about 200. Why the increase? I'd like to believe I was brilliant and was returning for an encore performance. However, I'd probably be inflating the facts. SNU has instituted a requirement that each graduate student must publish in an international journal in order to get a master's or Ph.D. However, like many curricula in the United States, SNU's engineering and science curricula do not require or offer any courses on technical writing. Ergo, this special course and its high enrollment.

The English language proficiency of these students was, in general, wonderful. Although often slow and somewhat deliberate when speaking (I assume because they were translating from Korean to English in their heads), their comprehension was wonderful. I say this because they laughed at my jokes (most of the time), and catching the subtleties of humor in a foreign language is not easy. However, based on samples (I gave them a writing assignment during the course), their writing skills were much weaker than oral language skills. Fortunately, the professors and administration at SNU who invited me recognized this weakness and are trying to break the poor-writing cycle.

So what should we do about the uninformed-student-becomes-weak-writer? Change university curricula? This would certainly help, especially if taught by someone qualified in technical writing (and NOT by English majors professing technical writing skills based on a history of studying Shakespeare, Chaucer, Dickens, Hemingway, etc.—a topic for another day). However, in my opinion this is not going to happen from within academe. Based on my experience at more than one university, changing curricula from within a department mandates an act of Congress but can be done given a few years. Changing curricula to include subjects viewed to be peripheral to the main emphasis of a department requires divine intervention of the first kind! Getting faculty members to agree on the change and finding the available block in which to insert the new courses is not a simple task or one not easily accomplished in a single lifetime.

What then? How do we break the cycle? We need to do a number of things. First, we need to tell academe that it's turning out students poorly prepared for the technical writing demands beyond the ivy-covered walls. Poor writing in school means a poor grade, poor writing in a profession can have greater consequences, including lost revenue. Next we need to apply pressure ... especially by those groups and/or individuals who finance academic programs, projects, etc. The pull of the purse strings is very persuasive, particularly within universities.

We also need to focus beyond academe. We need to do something about weak writing within the profession. We need to improve our short courses and make-not encourage-students and new, young, and seasoned professionals take them. Short courses can open eyes, blow away dust, and re-polish tarnishing skills. However, one has to be careful not to assume that short courses are the total answer. They are good but not the whole answer. Short courses can teach concepts but do not have enough time to provide practical feedback, evaluation, and rewrites of the students' work. You can lecture people until the Chicago Cubs win the World Series—a feat usually described by "Wait till next year!"-but the real test comes when they write. If not, we would all be Rembrandts after listening to lectures on painting. Short courses are a partial fix.

The full fix will come only when we finally stop accepting substandard work. Within organizations this may require time-consuming rewrites. That's expensive, but in the long run, it should pay dividends. Within the publication world, it means not accepting and pushing through substandard manuscripts. Editors and reviewers have to accept the stewardship of their professions, even if it means controversy or stepping on some toes. In general, it means we must accept that all dispersed material, whether within an organization or within the professional community, is an example of technical writing quality that subsequent writers may follow. We must immerse readers in a sea of top quality not a sea of overwhelming quantity or the cycle of poor writing will continue. **E** 

# Why manuscripts fail, according to 12 experts

KENNETH D. MAHRER, University of Denver

Since this column began, only my views, opinions, harangues, and suggestions on technical writing have been emphasized. As wonderful as they are, this month I've broadened the scope to include the opinions and harangues of a gaggle of experts. Recently, I emailed two questions to the Associate Editors of GEOPHYSICS: (1) What are the most common errors, shortcomings, or pitfalls you find in your reviewing and editing? (2) What are the most difficult or most profound errors, shortcomings, or pitfalls you find in your reviewing and editing? I received 12 replies. I think you'll find the variations in answers very enlightening. I certainly did.

*Expert 1.* (1) English. Maybe more papers are being written by non-English speakers than in other fields, but I can barely read more than half of the papers I get to review. (2) The most profound shortcomings are lack of enough information to be able to reproduce the results or algorithms. This is often not apparent during the editorial process but only shows up when I try to use what is published. I can list at least four examples in the last two years where I have tried to program an algorithm from a published paper only to find that critical details were missing or contradictory. Somehow, we should have a criteria like "could a working algorithm be generated from the information in this paper?"

*Expert 2.* (1) Incorrect English and incoherent organization are common problems; this is not necessarily limited to those who are not native English speakers. The language and sometimes the style require additional work—in addition to passing on the merits of the science—by editors and referees; if the scientific content deserves it, I consider that a part of the reviewing process. For worthwhile contributions from scientists whose native language is not English, it is not always easy to find somebody with language proficiency who can help polish the manuscript. I believe it ... inexcusable when something deficient comes from a native English speaker at a professional level. (2) No answer.

Expert 3. (1) Grammar. (2) Grammar.

*Expert 4.* (1) The world is mostly too complicated to model directly, so we used simplified models based upon a lot of assumptions. Most authors do not explain the assumptions that they've made, justify them, discuss the limitations they impose on the model, or discuss the consequences, if they're violated. The latter is especially needed to warn people about lifting a model from the literature that was developed for a particular purpose, and then using it for another purpose. (2) People misusing data and models. The most egregious examples are people who chain together a series of models with different sets of assumptions. They're usually not consistent in the assumptions between the models and may be contradictory.

*Expert 5.* (1) Poor abstracts, introductions and/or summaries. (2) Boring presentations ... they are technically correct ... but their presentation is a real burden to the reader.

*Expert 6.* (1) It's hard to attribute poor writing to any one cause. But I think GEOPHYSICS authors commonly write for themselves and not for the audience. I often find myself urging authors to have an English-fluent nonspe-

cialist read their revisions. Of course, this almost never happens; I can always tell when it does. (2) See my response to (1).

*Expert 7.* (1) Inappropriate abstracts. It took me a long time to understand what an abstract was supposed to be, and even now I don't write them as well as I would like. My experience is that most authors are even worse. (2) Authors not making clear the principal point(s)—why the reader should care about this paper—in combination with the inclusion of marginally relevant material. This is particularly important when the paper is very mathematical.

*Expert 8.* (1) Too much detailed math or algorithms. I tend to agree with (Frank) Levin's commentary. Math is often essential but put only the salient results in the body of the paper and carefully discuss their meaning. How often have you read a long section of technospeak and wondered how it relates to the paper? There is often insufficient bridging and motivating material. I think any subsection of a paper should begin with a short summary of what is to be discussed and why. Another common shortcoming is failure to concisely summarize a paper's most important points. (2) Usually, I have the most trouble with disorganized or grammatically confused writing. Such stuff can be so far from acceptable that the best editing seems to be a complete rewrite.

*Expert 9.* (1) Papers are sent in too fast after the first draft is written. Authors should learn to avoid the temptation to send it in immediately. They should put the paper away for at least a week, come back to it later, and see if it still seems well written, logical, etc. I recommend giving the paper to a knowledgeable friend to find the obvious problems and fix them before wasting the reviewers' time. (2) Is there enough good, original material in this paper to occupy a place in GEOPHYSICS; i.e., are other geophysicists going to be glad they read the paper or was the paper written to boost the author's number of publications, self-image, or boss's image of the author? Could the material in this paper to make a more substantial and worthwhile publication?

*Expert 10.* (1) I am most annoyed by authors assuming that everybody is familiar with their earlier work or with the background literature. In my opinion, "it can be shown" is an inadmissible statement; either "show" (perhaps in an appendix) or give a reference, page number included (e.g., what good does it do to refer to a tome like Morse and Feshbach, if the poor reader must sift through two thick volumes to find what the author meant to say?) (2) Careless derivations, leaving too much to the readers' imagination. It is completely inadmissible to use lines like "this work is proprietary, and thus I cannot disclose the details." Authors who cannot disclose in full detail should not be allowed to publish.

*Expert 11.* (1) Bad English; papers that are poorly organized or don't maintain a coherent thought stream. (2) Revised papers that really don't take into account the reviewer's comments or state that something is important so they left the paper as is. Also, papers that have a lot to offer but are impossible to read [or edit] because the author is such a poor communicator.

*Expert 12.* (1) Vague or broad reference, especially using the word "it." For example: "Our method uses only the interval velocity, and it doesn't …" Writing like this means you have to get to the end of the sentence (or sometimes a few sentences later) to realize to what "it doesn't" refers—the authors' method or the interval velocity. I get this very frequently and in a variety of forms. (2) Authors who don't know what their papers are about, so they do a memory-dump presenting readers with a grab bag of loosely related material. Such papers could easily be titled "A potpourri of … methods" instead of a more descriptive title. Beyond this, I think the error I encounter most often is lack of clarity from lengthy sentences.

Adding my experience, Expert 13. (1) Failure to explicitly define the problem to be solved; failure to write with any element of persuasion; failure to understand the needs, interests, and reading expectations of readers; failure to discuss the benefits of the work; assuming a captive audience. (2) Lack of understanding or adherence to the principles and guidelines of sound technical writing from micro- through macroscale; irrecoverably incorrect grammar and syntax; disjointed or disconnected structure; camouflaged organization and flow; and self-inflated value.

It is very interesting to note that poor English is the most common complaint, but not the only complaint. Many failings can be traced simply to poor writing, which is not a function of the writer's native language. This is very important and very significant to prospective authors whose native language is not English. It is very easy for an author who is not a native English speaker to hide behind the excuse of writing manuscripts doubly difficult. But, as substantiated by the experts, unfamiliarity with English is not the only reason for failed manuscripts. Many manuscripts, from native English speakers and from nonnative English speakers, are simply poorly written.

# To make a silk purse: The contract between reviewers/editors and authors

KENNETH D. MAHRER, University of Denver, Colorado, U.S.

As professionals we are sometimes asked to examine a report, a letter. ... A lucky few have even been tapped to review and edit a manuscript for GEOPHYSICS. Those tempted to think that this requires simple scanning should think again. This is a journal, an archival record; to get a manuscript ready for publication is the equivalent of cutting and polishing a gem ... or refinishing an old masterpiece ... or working with precious woods. ... It is all about eliminating imperfections while enhancing natural attributes without altering the nature and essence of the piece.

John Rennie, the editor in chief of *Scientific American*, satirized, in the April 1998 issue, the editing process at SA. Granted that SA's *raison d'etre* is different than GEO-PHYSICS', they do receive manuscripts from the scientific community and transform them into articles for consumption. What I'm trying to illustrate through his humor is that, even before the actual editing starts and sometimes after it is done, the process is anything but smooth or easy. Wrote Rennie:

Upon arriving at our offices, the envelope is promptly opened. ... The administrative staff collects the ... contents and passes them to the editor in chief (that is, me), who immediately reaches for his large bottle of aspirin. A string attached to the aspirin bottle opens a valve on the coffeemaker, pouring a gallon of hazelnut Colombian directly into the waiting mouth of the article editor. Twitching with caffeine, that editor is now ready to begin her work.

Editing is a highly complex process and quite impossible without a lot of heavy machinery. First, we feed the manuscript through the Dejargonizing Passive Phrase Reallocator. Operating on quantum-mechanical principles of wave-particle equivalence, it changes sentences such as "Samples obtained from Site 46 were subjected to analysis by multiple investigators and subsequently reintroduced to the environment from which they had been collected" to "We examined the specimens, then put them back." The *Implicity Inflection Remodulator* makes sure that sentences carry some form of punctuation at least every 200 words, whether they need it or not. Most awe-inspiring is the Randomizing Optimum Structural Facilitizer, a cross between a paper shredder, a house fan and a sewing machine, which takes apart a manuscript at the subatomic level and reorganizes it. It's roughly at this point in our work that the brilliant scientist contacts us, informing us that the manuscript we are working on was sent by mistake and that the real one is on its way. Also, he would like his vacation photographs back. I then reach for my aspirin again, and the editing begins anew." (Scientific American, April, 1998, p. 6)

Rennie's point is simple. Editing and (I include) reviewing are demanding, taxing, complicated and, usually, thankless tasks. They are also supremely important! There is probably no better real-life example of the adage "to make a silk purse from a sow's ear."

Although all authors believe their first-cut manuscripts are ready for publication, this is rarely the case. As a rule, new manuscripts need one or more rounds of tough reviewing and severe editing by honest, dedicated professionals—both volunteer professional scientists or engineers and paid professional editors. Reviewers and editors must tell authors the truth, and authors must be willing to hear it. To reach the goal of a crafted, useful paper, all parties involved enter a balanced cooperative—a de facto contract. If one were to draw such a contract, it might look something like the example I made (facing page).

My wife suggested that under "Authors' Acceptance" I add: "I will send the editor/reviewer expensive gifts, especially at holiday time—a little blue VW bug here, a trip to the Bahamas there." Clearly, my wife travels in some fast circles in her editing and reviewing—and all I got was this T-shirt!

**Blockettes.** From time to time interesting, amusing, or insightful snippets come to my attention. I'd like to pass these on to you in a subcategory of this column I'll call *Blockettes*. Here is one dedicated to those who, before submitting a paper, run it through the spell-checker instead of carefully proofreading it one more time.

## My New Spell Checker

Eye halve a spelling chequer It came with my pea sea It plainly marcs four my revue Miss steaks eye kin knot sea. Eye strike a key and type a word And weight four it two say Weather eye am wrong oar write It shows me strait a weigh. As soon as a mist ache is maid It nose bee fore two long And eye can put the error rite Its rare lea ever wrong. Eye have run this poem threw it I am shore your pleased two no Its letter perfect awl the weigh My chequer tolled me sew.

—Sauce unknown

Author's note: This column is dedicated to my favorite professional reviewers/editors: my wife and Dolores Proubasta, the Associate Editor of TLE—two classy ladies who make silk purse texts out of sow's ear manuscripts.

## **Contract Between Editors/Reviewers and Authors**

This contract is divided into two parts. Part I addresses the Editors/Reviewers' responsibilities. Part II addresses the Authors' responsibilities.

### I. EDITOR/REVIEWER

### I.A ACCEPTANCE

In agreeing to review, evaluate, and make editorial suggestions to the manuscript:

- 1) I will stand by my review as complete, honest, and fair.
- 2) I will review based on both scientific and textual content.
- 3) I will provide a complete review, including helpful suggestions, in a reasonable time frame.
- 4) I will be direct, concise, and constructive throughout the review.
- 5) I will remain objective and avoid undue negativism and personalized comments and/or suggestions.
- 6) I will remove myself from the task if at any point I can no longer act by the above criteria.

#### I.B GUIDELINES

I am willing to base my reviewing/editing on the following guidelines:

Strengths—What are the strengths of this manuscript?

*Value*—Is the subject of interest, worthwhile, novel, timely, unique? Is sufficient content or progress noted to justify publication? Does it present the value of the work to the reader or is that left as an exercise for the reader?

*Content*—Can the abstract stand alone (e.g., within a database)? Is the reader properly oriented by the introduction? Are the basic concepts presented clearly? Can only an expert follow this manuscript?

- Is the background adequately presented? Too little? Too much?
- Is sufficient detail given to allow duplication, checking, or extending of results?
- Are sufficient data given? Are the data presented clearly?
- Are methods adequate and accurate to yield trustworthy results?
- Are vagaries or limitations exposed, discussed, and put into perspective?
- Do the results have error bounds (literally and/or figuratively)?
- Is there a valuable conclusion and are conclusions substantiated by the text?

*Balance*—Is the length of each section proportional to its importance? Is proper space devoted to interpretation and discussion?

Language—Are syntax and grammar acceptable?

*Emphasis*—Are significant results and important points emphasized?

*Presentation*—Has the author included only necessary figures and mathematics? Are more/fewer figures needed? Are figures clear and concise?

Acknowledgments—Is appropriate credit given to others who contributed to this work?

References—Are cited references (reasonably) available to readers?

Figures—Are figures used wisely or simply stuffed into the manuscript?

*Craft*—Does the manuscript meet the format of the journal?

Suggestions—What are the weaknesses of this manuscript and how can they be improved?

## II. <u>AUTHOR</u>

### II.A ASSUMPTIONS

In preparing and submitting this manuscript for reviewing and editing, I have attempted to report on useful, original, and valuable work in a clear and concise manner. Further, I have attempted to present a finished, complete document meeting the guidelines and format of the journal. I agree not to use the reviewing and editing process for finishing document preparation, stimulating new ideas, or avoiding my own editing responsibilities.

### II.B ACCEPTANCE

In agreeing to allow my manuscripts to be reviewed and edited:

- 1) I will consider all the comments, criticisms, and suggestions of the reviewers and editors. I will not preemptively dismiss these comments, criticisms, and suggestions, but will address each in my written reply to the journal, if I choose to continue the process toward publication.
- 2) I will respond to the comments, criticisms, and suggestions of the reviewers and editors in a timely manner, as set forth by the journal.
- 3) I will maintain a professional attitude and demeanor in all interactions with the journal, the editors, and the reviewers.

# Bugged by bad writing? Help break the cycle

KENNETH D. MAHRER, University of Denver, U.S.

**K**eviewer: I read your abstract and, frankly, it really didn't tell me anything about your manuscript. It has some real problems. When I removed the fluff but kept your original words, it distilled down to three simple sentences: A study was done. Results were found. Conclusions were drawn. It gave me nothing specific about the content of your manuscript.

*Author:* So? Do you have a problem with that?

*R*: (speechless with quizzical look)

*A*: That's the way abstracts read. Isn't that correct? Isn't that the way to write mimic what's worked for others; use published works as examples? That's what my thesis advisor told me.

I wish I had a dime for every time I had that conversation. My pockets would jingle loudly.

Have you ever wondered why so many technical articles talk a lot but say little? Why so many are simply chronologies, or de facto diaries, of what the authors did and seem to ignore what you, the reader, need? Why so many lack purpose (beyond fulfilling the author's professional requirement or personal need to publish)? Or, why so many are solutions looking for problems, i.e., they describe (often prodigious) effort but fail to espouse value or utility. Ever wondered why people write like this? Well, I have, and here are some possibilities. It might be genetic. Maybe there's a

poor-writing gene? An interesting idea, but not too likely. Maybe it's a poor-writing bug or, in the cant, a viral or bacteriological agent. That's a cute idea. It certainly could explain a lot: Why it's so pervasive (pandemic?) and why it continues to propagate through the literature (contagious?). Yes, I rather like the concept of the poor-writing bug. Unfortunately, to the best of my knowledge, no such beastie has yet been found.

So what's the cause? Truthfully, I don't know, but I have some ideas. Some books on technical writing call it "writer's ego"—writers becoming so enamored with their own work, they lose the ability to present it to readers. Personally, I think it's less ego and more writer's "innocence" or "ignorance." I think we are victims of a system that talks about good writing but does little to instill the skills. Most writers are products of a system that seems to have lost selectivity and now rewards nearly all writing, good or bad, with publication.

Because poor writing is not part of the human genetic heritage, it's probably safe to say good writing is also not built into humans. Good writing is a taught skill. Ironically, as a subspecies, we scientoids fall short in teaching our offspring (i.e., protégés) correct writing ... possibly because we never correctly learned. Although technical professionals typically spend 20-50% of their time writing, our formal academic training or working environments do not

**Blockettes.** Recent email from Scott Phillips, a geoscientist at Los Alamos National Laboratory in New Mexico, contained some keen insights about editing manuscripts from authors whose mother tongues are not English. Some excerpts as written by Scott:

The point I'd like to make, and perhaps interest you enough to follow up, is that 'poor' writing from nonnative English speakers has a large cultural component.

I spent six months as a researcher in Japan and edited papers for English on almost a daily basis. I got very frustrated with, to my eyes, the convoluted logic and organization in addition to the poor English that I faced in nearly every case.

After one particularly tough bout, I suggested that the author write the paper in Japanese and translate it directly to English. (I can handle bad English, but not bad organization). He replied, "That's what I did."

In another case, I tried to distill a paper's main conclusion into a succinct, final statement. The conclusions had been scattered throughout the body of the paper. The author (a well-respected scientist) replied, "I am embarrassed to make such a strong statement."

Advancing one's opinion is a cultural faux pas in that part of the world. Scientists must be deft to get their work and ideas published without offending others. Western culture requires simple, concise, and strongly worded presentations. The conflict could not be greater.

I try to keep these experiences in mind when I review manuscripts by nonnative English speakers and perhaps I'm more lenient than most. But leniency is not the answer. The question is: If the problem is cultural, how do outsiders learn to present findings in Western media? Can we help the learning process? Consider the difficulty we would have publishing in the East!

> allot enough time to teach or develop technical writing skills. We teach the technical and presume the writing. We presume that, by giving a writing assignment in a class or at work, the assignee will write a successful document. If not, so what, we give the student another assignment and maybe he or she will do better. Or, we simply whisper this person cannot write but continue to give assignments anyway. We don't seem able to take the initiative to break the cycle. Hence, we continue to turn out students untrained in basic technical writing skills, and we continue to accept output from colleagues who write poorly. We need to break this trend!

> Ironically, since this trend remains unbroken, we are de facto expecting students, young professionals, and even seasoned professionals will learn or improve technical writing skills by emulating the published works they read. This is completely illogical. How can we expect them to learn if they mimic articles that have a good chance of being poorly written. Even if they do read a well-written article, they probably don't have the tools for understanding why it is well written. It sounds like another vicious circle: untrained student becomes professional, writes weak manuscripts that are published, read, and mimicked by uninformed student who becomes uninformed professional, etc. Again, I say, we need to break the cycle.

Breaking the cycle can only be done only by mandating change. It cannot be done by simply paying lip service to the need for change.

Ironically, I wrote this column while visiting Seoul National University (SNU) in Korea. I was visiting the campus to give a short course (four days, four hours per day) on technical writing for publication to engineering and science graduate students. This is my second time giving this course. In my first Writer's Block (March 1998), I described what I learned when preparing my lecture notes for my first course. Well, I went back again. It is quite a task to lecture in English (I don't know Korean) about publishing in English to students and faculty whose mother tongue is not English. It is also interesting to note that this course is totally optional, and each participant paid about US\$25 to attend. Two years ago I lectured to about 85 students; this time it was about 200. Why the increase? I'd like to believe I was brilliant and was returning for an encore performance. However, I'd probably be inflating the facts. SNU has instituted a requirement that each graduate student must publish in an international journal in order to get a master's or Ph.D. However, like many curricula in the United States, SNU's engineering and science curricula do not require or offer any courses on technical writing. Ergo, this special course and its high enrollment.

The English language proficiency of these students was, in general, wonderful. Although often slow and somewhat deliberate when speaking (I assume because they were translating from Korean to English in their heads), their comprehension was wonderful. I say this because they laughed at my jokes (most of the time), and catching the subtleties of humor in a foreign language is not easy. However, based on samples (I gave them a writing assignment during the course), their writing skills were much weaker than oral language skills. Fortunately, the professors and administration at SNU who invited me recognized this weakness and are trying to break the poor-writing cycle.

So what should we do about the uninformed-student-becomes-weak-writer? Change university curricula? This would certainly help, especially if taught by someone qualified in technical writing (and NOT by English majors professing technical writing skills based on a history of studying Shakespeare, Chaucer, Dickens, Hemingway, etc.—a topic for another day). However, in my opinion this is not going to happen from within academe. Based on my experience at more than one university, changing curricula from within a department mandates an act of Congress but can be done given a few years. Changing curricula to include subjects viewed to be peripheral to the main emphasis of a department requires divine intervention of the first kind! Getting faculty members to agree on the change and finding the available block in which to insert the new courses is not a simple task or one not easily accomplished in a single lifetime.

What then? How do we break the cycle? We need to do a number of things. First, we need to tell academe that it's turning out students poorly prepared for the technical writing demands beyond the ivy-covered walls. Poor writing in school means a poor grade, poor writing in a profession can have greater consequences, including lost revenue. Next we need to apply pressure ... especially by those groups and/or individuals who finance academic programs, projects, etc. The pull of the purse strings is very persuasive, particularly within universities.

We also need to focus beyond academe. We need to do something about weak writing within the profession. We need to improve our short courses and make-not encourage-students and new, young, and seasoned professionals take them. Short courses can open eyes, blow away dust, and re-polish tarnishing skills. However, one has to be careful not to assume that short courses are the total answer. They are good but not the whole answer. Short courses can teach concepts but do not have enough time to provide practical feedback, evaluation, and rewrites of the students' work. You can lecture people until the Chicago Cubs win the World Series—a feat usually described by "Wait till next year!"-but the real test comes when they write. If not, we would all be Rembrandts after listening to lectures on painting. Short courses are a partial fix.

The full fix will come only when we finally stop accepting substandard work. Within organizations this may require time-consuming rewrites. That's expensive, but in the long run, it should pay dividends. Within the publication world, it means not accepting and pushing through substandard manuscripts. Editors and reviewers have to accept the stewardship of their professions, even if it means controversy or stepping on some toes. In general, it means we must accept that all dispersed material, whether within an organization or within the professional community, is an example of technical writing quality that subsequent writers may follow. We must immerse readers in a sea of top quality not a sea of overwhelming quantity or the cycle of poor writing will continue. **E** 

# The DSB method-Persuasive writing made simpler

KENNETH D. MAHRER, University of Denver

 ${f A}$ s I have discussed in previous columns, successful technical documents possess critical qualities. One of these and the one most commonly missing in weak documents is persuasiveness. Simply, persuasiveness is demonstrated value or utility to the reader. Weak writers assume value if they highlight the hoops through which they jumped in completing their work. This is not the case. Effort is not value; value is value, and it has to be shown.

It's easy to misconstrue persuasion or selling the value with a vision of a scientist or engineer as a stereotypical used-car salesperson with a gaudy sports coat and a slap on the back. That is not the case. By selling or persuading, I mean overtly and unquestionably demonstrating value, utility, and benefits and not placing the burden of finding value on the reader. Most readers won't go looking for value, and the document will fall into the abyss of the eminently forgettable. No authors want that.

So we agree that persuasion is an important quality. Then, why is it so often overlooked or ignored and how can writers increase the persuasiveness of their documents? The answer to the first question comes from the traditional structure of technical writing. This structure is IMRaD, an acronym for Introduction, Means/Methods, Results, and Discussion.

IMRaD is pervasive. It's pervasive because it's easy; it's easy because it simply follows the work chronology. As discussed below, that's also its weakness. Before we discuss that weakness, let's analyze the parallel between IMRaD and work chronology.

The first thing the researcher does or has done is background reading. The first element of IMRaD, the Introduction, is typically a boatload of summaries of papers, books, reports, abstracts, theses, etc. Some authors attempt to focus the summaries on their work. More often the Introduction reads like a random walk through a literature survey. Rarely does it explicitly define a problem and the importance of that problem. Hence, from the beginning, the value of the work (e.g., solving a problem) is left for the reader to find.

Next, the authors typically do their research. Similarly, the document usually has the Means/Methods section immediately after the Introduction. Although it may be called something besides Means/Methods, it reports the tasks leading to the results. Typically, this section is built upon a combination of two templates. One is development that mimics the work order. The other is a verbiage weighting inversely proportional to hiatus since the task was done (i.e., tasks done long ago are discussed briefly; tasks done recently are discussed in detail). Value or utility does not enter these templates.

A compilation of findings follows the actual research. Similarly, the document usually follows Means/Methods with the Results section. Results sections typically fall into one of two types: too short probably because the thinking of the writers was in their work and not its benefits (i.e., "a problem looking for a solution") or much too long because everything that was examined is reported. The toolong sections could use some very heavy culling, based on

Blockette. My middle-school daughter gave me the following Dr. Seuss-like poem on English. It's by the famous author Anonymous.

Why is English Hard

We'll begin with a box, and the plural is boxes. But the plural of ox should be oxen, not oxes. Then one fowl is goose, but two are called geese. Yet the plural of moose should never be meeses.

You may find a lone mouse or a whole lot of mice.

But the plural of house is houses, not hise. If the plural of man is always called men.

Why shouldn't the plural of pan be called pen? The cow in the plural may be cows or kine.

But the plural of vow is vows, not vine. And I speak of foot and you of feet.

But I give you a boot ... would a pair be called beet?

If one is a tooth and the whole set are teeth, Why shouldn't the plural of booth be called beeth?

If the singular is this and the plural is these, Should the plural of kiss be nicknamed kese?

Then one may be that, and three may be those, Yet the plural of hat would never be hose.

We speak of a brother, and also of brethren, But though you say mother, we never say methren.

The masculine pronouns are he, his, and him. But imagine the feminine she, shis, and shim!

So our English, I think you will all agree, Is the trickiest language you ever did see!

value or expected utility of the work to the reader. Instead, the template here is simply a catharsis of everything found.

The parallel between work chronology and reporting continues into the final or Discussion/Conclusion section. In research, once results are compiled, conclusions are drawn-maybe. It's obvious that for some work, conclusions are not drawn and the Conclusion section becomes a minisummary of the work (see Writer's Block, October 1998). In other efforts, the writers draw and report conclusions. Hence my original statement: IMRaD parallels the work chronology.

As stated, IMRaD is easy, but, unless one is a talented, aware writer, IMRaD is also an easy path to a poor document. IMRaD is a blueprint for a writer's paper-one that only the writer (and those few engaged in the same work) appreciates. Most readers are confused, misdirected, or hard-pressed to find value or utility in writer's papers.

Said a bit differently, writer's papers are predisposed from IMRaD. This is because each component is an "I/we" section. The Introduction is a manifestation of "Here is what I/we read." Means/Methods manifests "Here is what and how I/we did." The Results is "Here is what I/we found, derived, modeled, or measured." And, the Discussion is sometimes "Here is what I/we like and disliked about my/our work," but more often it's "Here is a one-paragraph summary of what I/we did." Nowhere is the reader specifically included in the IMRaD structure and

nowhere is the reader explicitly shown the value of the work. Instead the document is a smorgasbord of the writers' work, thoughts, etc. that is laid out in front of the reader and which the reader is invited to sample. Unlike food, which many of us could benefit by indulging a bit less, a smorgasbord paper is tasted and then left on the table.

So, if IMRaD is a path to writing a weak, nonpersuasive document, what is an alternative? Or, as posed above, how can writers write persuasive documents? Simply, write a "reader's paper." Write a document that brings readers into the document via strong, explicit reasons to value the work and for spending the time reading it carefully. Easy to say, but easy to do? Actually it's not that difficult, but a writer must be willing to use an upgrading of IMRaD.

This is done by using DSB—Definition, Solution, and Benefits. DSB's structure shares many qualities with IMRaD but, in addition, it forces the writer to explicitly bring the reader into the document. It's less smorgasbord and more maître d's (i.e., an insider's) recommendations.

The Definition is a reformulated Introduction. Instead of a clump of one or two-sentence summaries and citations, the Definition focuses the reader's attention by identifying and explicitly stating the problem that is being solved. The problem is not implied but specifically stated. In many documents this is not easy, but it is necessary because it immediately "hooks" the reader: It says, "Here is a specific problem that I/we have solved or to which I/we have found fresh new insight and which is important to you." This immediately persuades readers that they will receive value and utility.

Here's an example. Assume the authors have developed a new algorithm. Such a paper typically begins by presenting existing literature on similar work. It then derives the new algorithm, followed by some examples of output. If the algorithm is faster or more accurate than existing algorithms, the speed difference or accuracy is usually mentioned in a sentence or two buried within the depths of the Results or Conclusion section. The paper can be a real struggle to readers, unless they're doing similar work. This is a classic writer's paper.

Instead, at the beginning the writers should state explicitly that there is a problem with the slowness or inaccuracy (i.e., inadequacy) of the existing algorithms otherwise why was this work done? In addition, to enhance value, details of the inadequacy should be given. Here is where the background reading summaries come in. All this helps define the problem, add value, and bring readers "into" the paper. The algorithm can now be developed, because the reader is hooked.

Defining the problem, the specific problem, may not be as easy and as obvious as in this example. It may require a lot of brain activity by the authors. For one thing, it may require authors to justify their work, something they may not have done before. Too often justification is equated with different and novel, perceived values, as opposed to real value. Nevertheless, the exercise of defining the problem is well worth the effort. Readers who see a definitive problem and the statement that a solution follows can relate to the work and its need.

Within the Definition section (of course, it does not have to be called that in the paper), there is room for some but certainly not all the background reading cited in the (old) IMRaD Introduction. Perspective, background, and other ingredients of the IMRaD Introduction can be included, but the key point of the Definition section is an explicit statement of the problem. This section must say to the reader, "Here is an important problem to consider" not simply "Look what I read and studied."

Following the Definition, the readers expect a solution. Successful writers meet these expectations. Hence, the Solution section follows. It has many of the qualities as Means/Methods and the Results sections of IMRaD. However, these sections should be directed toward giving the steps that lead to the solution of or findings concerning the defined problem.

After the Solution section, the writers need to bring home the impact of this work. This is the function of the Benefits section. Instead of being the old Conclusion/ Discussion, the Benefits section must be designed to "close the deal." It must tell readers that their time has been well invested because this work can enhance productivity, increase understanding and decision-making confidence, or some other specific benefit(s). In other words, the authors must relate the value of their work to the reader's work. Like the problem in the Definition section, this must be done explicitly, and it must be done with authority and not with wild speculation. This section has to say to the reader, "This solution is important and useful to you because..."

That's the DSB structure. It's not a radical departure from IMRaD, a structure with which most of us are comfortable. Rather it's an enhancement of IMRaD and designed to make documents much more persuasive and more acceptable to readers, especially those pesky journal reviewers and editors. ■

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# Sages of the ages

KENNETH D. MAHRER, University of Denver, Colorado, U.S.

**D**ince starting this tech-writing thing (vernacular gratis my teenage daughters), I have read, been sent (thanks!), and heard a gaggle of insightful, inspirational, and funny quotations on writing, editing and review, and related topics. If you find one or two particularly suitable, hang it or them on your wall.

## **On Writing**

"Without publication, science is dead."

—Gerard Piel, scholar

"Grasp the subject, the words will follow." —MARCUS PORCIUS CATO, THE ELDER, ancient Roman

scholar

"For there are plenty of mistakes made by writers out of ignorance, and which any man finds it difficult to avoid. But if we knowingly write what is false ... what difference is there between us and hack writers?"

—POLYBIUS, ancient Roman scholar

"A bad beginning makes a bad ending."

—Euripides, ancient Greek playwright

"If you would not be forgotten, as soon as you are dead and rotten, either write things of worth, or do things worth the writing."

*—BENJAMIN FRANKLIN, statesman, author, inventor, etc.* 

"You write with ease to show your breeding, but easy writing's curst hard reading."

-RICHARD BRINSLEY SHERIDAN, playwright

"To find out the true state of facts, to report them with fidelity, to apply to them strict and fixed principles ... to inform as far as possible ... appear to me to be the first duties of those who write."

-HENRY REEVE, author and editor for the Times of London

"A moment's thinking is an hour in words." —*THOMAS HOOD, poet and humorist* 

"There are no dull subjects. There are only dull writers." —H. L. MENCKEN, author

"Your manuscript is both good and original, but the part that is good is not original, and the part that is original is not good."

—SAMUEL JOHNSON, poet, scholar, and lexicographer

"In our experience, the misplacement of old and new information turns out to be the No. 1 problem in American professional writing."

-GEORGE GOPEN and JUDY SWAN, writing specialists

"What is wrong with most writing today is its flaccidity, its lack of pleasure in the manipulation of sounds and phrases. The written word is becoming inert."

—ANTHONY BURGESS, scholar

"Words, when well chosen, have so great a force in them that a description often gives us more lively ideas than the sight of things themselves."

—DANIEL O'NEAL JR., scholar

"The wastepaper basket is a writer's best friend." —ISAAC BASHEVIS SINGER, author

"... word processors can be responsible for producing a good deal of flabby writing. The words come out of you like toothpaste sometimes."

—GARRISON KEILLOR, author and humorist

"Wood carpentry is like any other kind of carpentry: You must join sentences smoothly."

—ANATOLE FRANCE, scholar

"Writing, like life itself, is a voyage of discovery." —HENRY MILLER, author

"Too many scientists and engineers see technical writing as a legacy of technical courses. It's not. It's a voyage of a different course."

-ANONYMOUS

"Having published is neither necessary or sufficient to being a good writer. It may simply indicate an imperfect system."

—Anonymous

"When ideas fail, words come in very handy." —JOHANN GOETHE, poet, novelist, and dramatist

"Good writing is a function of two things: What you say and what you don't say."

-ANONYMOUS

"Each researcher has two problems to solve. The first is the research; the second is reporting it."

-ANONYMOUS

"Don't underrate the ability of words to shape man's thinking, polarize his attitude, mold his character, and dictate his actions."

-H. MICHAELSON, technical writing author

"Clutter is the disease of American writing. We are a society strangling in unnecessary words, circular constructions, pompous frills and meaningless jargon."

—WILLIAM ZINSSER, author

"Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines, and a machine no unnecessary parts. This requires not that the writer make all his sentences short, or that he avoid all detail and treat his subjects only in outline, but that every word tell."

-WILLIAM STRUNK JR., author and grammarian

Block

"Writing is among the greatest inventions in human history, perhaps THE greatest invention, since it made history possible."

-A. ROBINSON, author

"Good writing is good manners. You can both please and help your public only when you learn how to be the first victim of your writing, how to anticipate a reader's difficulties, and to hear yourself as others hear you."

-RITCHIE R. WARD, scholar

"I have rewritten—often several times—every word I have ever published."

—VLADIMIR NABOKOV, author

"No one can write decently who is distrustful of the reader's intelligence or whose attitude is patronizing." —E. B. WHITE, author

"Trouble in writing clearly ... reflects troubled thinking, usually an incomplete grasp of the facts or their meaning." —BARBARA TUCHMAN, American historian and author

# **On Editing and Reviewing**

"Nature fits all her children with something to do, he who would write and can't write, can surely review."

—JAMES RUSSELL LOWELL, poet, essayist, and diplomat

"Editing is like sculpting ... The editor and the sculpture both take a basic form, add elements that are needed to strengthen lines or create interest, and remove elements that distract from a harmonious whole. Each step builds on what has been done before."

—JAN VANOLIA, technical writing author

"Proofread carefully to see if you any words out." —*ANONYMOUS* 

"As your experience grows, you will find that revising is pleasurable, even though its purpose is the discovery of your own failings."

—JACQUES BARZUN, scholar

"My writing is a process that does not converge: I cannot read a page of my own prose without wanting to improve it."

-N. DAVID MERMIN, physicist

"No passion in the world is equal to the passion to alter someone else's draft."

-H. G. WELLS, novelist and historian

"Editing your own writing, on the other hand, challenges your ability to be objective. To develop distance from your writing, take a break before beginning to revise ... several days ... let it cool off over night ... As a minimum, walk away for a few moments ... whatever is necessary to change your perspectives from those of writer to those of reader. Try to see the document from fresh eyes."

—Jan Vanolia

"A draconian task."

—JON AKE, geophysicist

"... everything you do you have to do again, and your

capacity for rewriting is the only thing that separates you from people who do things in a hurry."

–JOHN IRVING, author

### On the Rest

"One does not speak of a Euclidean, an Archimedean. When truth is evident, it is impossible for parties and factions to arise. There never has been a dispute as to whether there is daylight at noon."

-VOLTAIRE (FRANCOIS MARIE AROUET), French philosopher

"Anyone who isn't confused really doesn't understand the situation."

—EDWARD R. MURROW, radio and TV newscaster

"... (he) seems to not realize how the appearance of great complexity can be mimicked by noise."

-ANONYMOUS

Finally, since I am quoting others, I'd like to end with a short essay from Vanolia's book *Rewrite Right! How to Revise Your Way to Better Writing* (Ten Speed Press/Periwinkle Press, 1987). I find this essay particularly insightful.

Because the essay was written in the 1980s and because the electronic era has changed technical writing, I have taken the liberty of updating it a bit.

#### Is Good Writing Obsolete?

Who cares about good writing those days? Has the need for good writing disappeared as paper and pencil have been replaced by screen and keyboard, Internet, and Web pages, desktop publishing, etc.? Not at all. In fact, when asked recently what subjects students should study to prepare for business, top executives answered in one voice: Learn to write better. Editors, who must sift through mailbags full of ineptly written manuscripts, would say 'Amen.'

Many skilled individuals falter when it comes to writing. They may be experts at their science or technology, but tell them to write it up and they turn into wimps. They mask their insecurity by relying on the worn-out expressions and stilled prose they perceive as being authoritative. For writing models they look to their colleagues, most of whom write poorly.

Such mediocre writing can have unwelcome effects. Muddled instructions create confusion. Costly research is replicated because the results are buried in an obscure, two-pound report. Boring writing is tossed aside unread, a waste of the investment made in producing it. Slipshod writing breeds distrust, prompting readers to wonder if language is the writer's only area of incompetence.

At the other end of the spectrum, good writing can get things done right. Its crisp, clear style requires less of the reader's time. Good writing is cost-effective; it lowers administrative expenses and lightens workloads. Polished writing has a professional tone that reflects well on the general competence of the writer, suggesting that attention is paid to other areas as well.

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# A boring test

KENNETH D. MAHRER, University of Denver, Colorado, U.S.

**D**o you write boring papers? Of course not. Your papers are interesting. Right? Not right? Well, maybe once in a while a manuscript escapes that's a bit less than interesting, but it's certainly not boring. Right? How could your papers be boring? Your work's not boring, so your writing must not be boring. You read and reread your manuscripts, and each is interesting, concise, valuable, maybe even exciting. (Wow! Let's not get carried away.) In addition, your colleagues always say, "Interesting paper!" So, tell me, if your writing isn't boring, what is the font of boring papers? Other people, you say.

Consider other-people-not-me write boring papers. I have researched it. I've asked and been given the same answer: other people. Confused, I searched for the "other people" and have yet to find any. This means the density of "other people" is sparse and seemingly below the threshold for producing the existing density of boring papers. Hence, the other-people-not-me explanation fails.

So, we come back to same question: Who produces the boring papers? After further research, the only answers are: (a) a new property of the ether, that undetectable, all-pervasive "stuff" that 19th century scientists originally manifested to explain the confusing behavior of electromagnetism; or (b) there are those among us who are not aware of the condition of their papers! We can safely eliminate the former—just think of the authorship and copyright problems it would cause. Would you trust a paper written by undetectable stuff? Unfortunately, that leaves only the latter.

Are you wondering whether you are a member of that club? Perhaps it would help if you took a membership or qualification test. Funny thing, I just happen to have a boring test. However, first, let's make sure we're all on the same page. What makes something boring? Eric Haseltine writes ("The beauty of boredom" in the March 2000 issue of *Discover*): "The answer lies buried deep in our nerve cells, which automatically damp down their initial excited response to stimuli every subsequent time a stimulus occurs. Those neurons also enhance response to things that change—especially that which changes quickly. We probably evolved this way because our ancestors got more survival value, for example, from attending to what moved in a tree (such as a panther) than to the tree itself. Boredom, as a reaction to a static environment, turns down the level of neural excitation so that a new stimulus (such as that panther) stands out more. It's the neural equivalent of extinguishing a porch light to see the fireflies."

Haseltine seems to be saying that writers drive readers to boredom by being monotonous, predictable, repetitious, circuitous, or long-winded. With this in mind, take this boring test. You're safe—there's no score. Judge your own answers and draw your own conclusion(s). I have parenthetically included some points to ponder when considering your answers.

Your general philosophy. Do you assume that your work must be as interesting to all as it is to you? (This falls under the umbrella of "writer's folly"—i.e., my work is supremely important and will make everyone do things differently in the future. Reality check! Unless your name is Newton or Einstein or you've found a cure for cancer, world hunger, global warming, or a comparable issue, chances are your work is, like that of most, a small but valuable piece of humanity's knowledge.)

Do you recognize that persuasion is part of successful technical writing? (Many writers follow the philosophy the science sells itself, and fail to hook, attract, and persuade their readers. Readers become bored and move to something else. Successful writers recognize that they are salespersons of their work and present solid arguments for its value, utility, and benefits in addition to the science.)

Do you stop writing because you are done or because you're out of interest, time, or steam? (If writing about this material bores you, what do readers find?)

**Your abstract.** Do you compose a concise, stand-alone, and terse summary of the new information in your paper

or do you just slap something together? (A boring abstract clues the reader that the rest of the paper won't be much better.)

Is writing your abstract hated labor? (If so, readers will know this and assume, again, that the rest of your writing is the same.)

Does your abstract droll on? (Unless your article is a tome, your abstract should be about 4-6 exacting, information-intensive sentences.)

Do you stubbornly cling to the belief that abstracts must be in passive voice? (Passive voice easily falls prey to long, indirect sentences that say very little, while appearing to say a lot. Typically, abstracts in passive voice are a boring information void.)

**Your introduction.** Do you copy your abstract and use it as the first paragraph in the introduction? (*Boring!*)

Do you feel the success of an introduction is based on the number of references cited, the more the better? Or, said a bit differently, do you feel that numerous single-sentence descriptions of work by other people make



good introductions? (Readers want concise writing. Beating your chest by citing everything you've read does not add value to your work, it only bores readers.)

Are your introductions page after page of somewhat related material without focus? (Telling everything you know about a subject is not the path to a successful introduction.)

#### Your means and methods sections.

Do you overwhelm with unnecessary details? (Verifiability and repeatability are critical to correct science or engineering, but excessive detail bores. Use appendices for the dry but necessary details.)

Do you choke readers with equation after equation? (Readers are looking for value; endless equations show effort not value. Again, use appendices for dry details and keep the reader's focus with value and benefit.)

Your results section. Do you inundate readers with a flood of figures that document every second of your effort? (Figures are critical to technical writing but unless your figures are equivalent to tables—i.e., specific data can be extracted from each—choose only representative figures.)

Similar to the previous question, do you fail to focus your work and therefore assume that overwhelming readers with (repetitive) figures expands its value?

Your conclusion. When you start to write your conclusion, do you find that you've run out of gas? (One-paragraph conclusions that are real or de facto copies of the abstract don't work. Also, conclusions are not summaries. Why do readers need a summary? They just read the article. The conclusion makes the final sale; it cements the values, benefits, utility, etc. of your work. You should not sell your work short.)

Are you guilty of unrealistically overvaluing your work, assuming that everything you write must be the next paradigm? (I suspect industry is not going to change because of one paper, but some may benefit from your work ... if you show them why.)

**General style.** Do you like long sentences? (Long sentences are almost always tedious. In packs, they are boring and lack impact. Impact comes from shorter sentences, each with an obvious focus.)

Do you choose concise verbs or write in a stream-of-consciousness flow? (Weak verbs give rise to word patching—i.e., adding more and more words to clarify meaning—and long, unfocused, and boring sentences.)

Do you cut-and-paste the same passage(s) throughout the document? (If yes, you must be joking. Do you really think you can keep the reader's attention by saying the same thing?)

Well, there's my boring test. If you passed, congratulations! If it brought you some thought and awareness, great! We all benefit from better writing. If my test did nothing but bore you, we have two possibilities. Either I failed the test or you need to go back, take it again, and find the hidden meanings. Remember, readers are interested in your writing if it has value, benefit, utility to them, not just your sweat input. They are not interested in all the necessary, yet tedious, details through which you struggled to bring forth those values, benefits, and utilities. Remember what Hazeltine said: You drive a reader to boredom. E

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# Too many chefs—an allegory

KENNETH D. MAHRER, University of Denver

**I** he following allegory on multiple-authored reports is based on personal experience.

Some months back a friend from a local oil and gas service company phoned. He and a task force of coworkers were finishing an 18-month project and were about to write the final report. My friend was very concerned that they would write a weak report, upsetting his client and losing the follow-up work. He was calling for help. We set up a lunch meeting (if I didn't get a contract, at least I'd get a meal).

After hanging up, the old adage "too many chefs spoil the broth" kept passing though my head. Over the years, I have read many large final reports, most of which were poor and nearly useless to anyone except the writers. Too many end up gathering dust on shelves. To get this contract I'd have to show how this could be prevented.

A few days later, we met. I began, "The key to your success is thorough planning. So let's begin with some questions to bring me up to speed. First, how many chefs?" A confused look flew across the table. I'd forgotten that we were in a restaurant. "I mean, how many authors and how many contributors for this report? Actually, before you answer that, how have you written reports in the past?"

answer that, how have you written reports in the past?" My friend answered, "It's been pretty simple. We do the work and just sort of write the final. Company policy dictates an internal review before sending it, so a colleague reads it. He or she usually has two or three comments, a few changes are made, and the report is sent. It seemed to work. We're still in business. However, recently I've reread some old reports and, frankly, they are poor! That's why I called you. For one thing, our reports seem to lack organization. They read as if we are saying to the reader, 'Here is what we did, now you figure it out.' Some of it is my writing. I want this one to be different. It represents a lot of work, a lot of money spent, and even more money in the future."

"OK," I replied. "Let's go back. How many authors and contributors?"

"Thirteen, sort of, but what's the difference between authors and contributors?"

"Authors write and are directly responsible for the product; contributors give graphs, pictures, data tables, etc., and can walk away. The number of each represents the amount and variety of management that the head person must do."

"Head person?"

"We'll get to that in a moment; continue with the manpower loading."

"Well, actually it's a bit complicated. For writers, there are six of us here in Denver, five in Texas, and two, who are the client's engineers, living overseas. For contributors, I'm not sure."

"Since your authors are spread out, your preparations will be different than if everyone is on the same floor in the same building. OK, next. What is the focus of this report?"

"Focus? I haven't thought focus. Can you clarify?"

"OK. What value do you want this report to bring to your client? If you want to impress your client—that is, get additional work—you have to walk in his shoes and bring your work to his needs. You have to focus this document to his problems, how you've solved them, and the benefits he will derive. Benefits usually mean money. You can't just report your work and expect your client to dig out the value and benefits. Focus is something you will have to think out and make sure all your authors understand. Now, staying in this general thought, what is the expected utility of this report?"

"What do you mean?" He put down his fork, took out a pad, and began taking notes.

"I mean action. After reading this report, what do you expect your reader to do? Smile and nod introspectively, run out and close a bunch of valves, or change completion strategies on all future drilling? Meaning, think about things and probably do nothing, make immediate changes, or change future operations. A successful report should point out or point the way to financially beneficial action or actions."

"Ahhhh, I hadn't thought about any of this. This stuff is really good."

At this point I began to feel like a tent-revival preacher bringin' the light. "Good. Next. Who is the targeted audience? Meaning, the money guys, the decision makers, the field engineers, etc.?"

"Well, all of them. But does that make a difference?"

"Targeting your audience makes a big difference. The audience's expertise defines how you write. Since you anticipate a broad-based audience, not just technically competent engineers and scientists, you have to write at a level they all will understand, at least for some parts of the report. For example, a report covering this much work should begin with a two or three page executive summary. It's written to reach the money guys, meaning, it should be void of jargon and overtly stress the problems, solutions, values, but mainly benefits of this project and your work. It should not stress methods, even though 95% of your time was on methods. That's for the main body.

"Since the summary is what the money guys read, it's your marketing and sales section. It should market what you did through its benefits, cost-effectiveness, how much work remains, and how clever you would be in attacking those problems. That's a tall order for two or three pages and that's what makes it the hardest section to write. But this is probably the only section that the money guys and decision makers will read, and this is your only chance to impress them. ... I see a furrow in your brow. Recognize that most scientists and engineers are poor at marketing their work. They assume that the quality of their work sells itself. It doesn't. The people you need to impress don't read between the lines; they read the bottom line. OK, next question. Do you have any background information already prepared, meaning, outlines, notes, figures, graphs, etc.?"

"Well ... we have monthly progress reports; that's about it."

"OK, they'll be really helpful if they are thorough. I'll talk about this a little later. Next, how long do you want this report to be?"

"Again, that's something I had not thought about. Is it important? In the past we just wrote until ... ahhhhh ... we were done."

"As I said earlier, planning is critical. Having a target

length, which can be modified, is part of planning. Otherwise, people don't write until they're done, they write until they run out of steam, get bored, or are pulled from the project. That means the text can be long-winded and boring or terse and confusing. Imagine how your readers feel, assuming they stay around, reading this quality of writing. Remember what happened when you read your old reports?

'Yes, I couldn't read my own writing."

"Hmmmmmm," I thought. Forget the tent revivalist. Now I felt like a cartoon hero arriving just in time to save the day. Jokingly, I said, "That's OK, your thesis adviser said the same thing, but he passed you anyway." We laughedsituation defused. "You do understand that part of what I am doing here is expanding your thoughts on preparation. Sweating during the planning will make the writing go much easier. Because we're starting to run a little bit long, let me add a few more questions for your notes and then give you the next few steps in your strategy. You can call me later with any questions. What are the estimated resources that you will devote to this project? Specifically, man-hours, and are they really adequate to do this task? Make sure you have the necessary time and people committed. In that same vein, are there any drop-dead deadlines? For example, is this report supposed to be on the client's desk by a certain day or you will start paying late fines? What software will you be using? This is not a problem if everyone is using the same products and the same versions. It can be a problem if different products are used. Despite their promoters, software products are not 100% compatible. When it comes to technical word processing with figures, tables, equations, Greek letters, symbols, etc., it will save hours of hassle if you make sure all your authors use the same software. The same is true for text, tables, figures, etc. You must choose one format style that all authors will use. Otherwise, when compiling the report, someone will have to reformat each contribution, a long and tedious job. Here are my suggestions:

"Put one person in charge. This head person (HP) has to have final authority over everything. That includes organization, deadlines, assigned writers, final wordings, etc., everything. It will make preparing this document much easier and much smoother if you use a benevolent despot approach rather than a democracy, oligarchy, or anarchy.

Unfortunately, whoever is HP will have a lot of work, so make sure you throw a party for him or her after this work is done.

"Once the HP has been tapped, he or she must have a meeting or teleconference with all the writers and discuss the topics I have mentioned. This includes focus, utility, etc., of the report. This meeting serves a few purposes. It gets everyone on the same page and primes them for the tasks ahead. It also makes sure that the HP has all the people lined up.

"Next, the HP must write a realistic schedule.

"Next, the HP makes an outline. Here is where those monthly reports are critical. Giving the proper weight and emphasis to each topic is the mark of a good outline. No matter

what you feel about outlines, they are necessary in multiauthor reports. I won't waste your time giving you all the reasons. At this point, the outline should have only two levels of details, chapter titles, and section titles. In addition, the outline should include who writes what. Writing assignments are the HP's choice and are not a topic of dispute. The outline should then be distributed to each assigned writer. The writers can then make suggestions for changes, modifications, improvements, etc., to the outline but not the assignments. In addition every writer will add one more level of detail (in other words, content) to every section assigned. Also, if a writer needs something from a contributor or contributors, this is the time to line up contributors. The writers will then return the annotated outlines to the HP, who will update/upgrade the outline, weighing the suggestions and including the added level of detail.

"Assuming that I am part of your editing team, the leader will forward the outline to me and any other editors for comments, suggestions, etc. At this point editors are most like your client. They have not lived one-on-one with this project for the past 18 months. Editors can give an objective view of the outline and see if the outline really captures the values and benefits of this project. After examining the outline, the editors will return it to you and we will schedule another meeting to discuss editorial comments. I recommend that we have a short, one-hour course on persuasive report writing before your people start writing.

"After this meeting, the HP will revise the schedule and send it and the final outline to all the writers. Now the writing must begin. Remember, you're always a marketer for your work."

Our luncheon meeting was now over.

**Epilogue: I got the contract.** My friend and his coworkers wrote their report. I helped with the outlining, the editing, the revising, and gave a two-hour short course on persuasive writing. My friend later told me the client was overwhelmingly pleased with the report, especially the quality of the presentation. The client hired my friend's group for the follow-on work. Maybe we should change the adage to "well-organized chefs make great meals."



# Clearer sentences—Part 1

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On the recommendation of George Gopen, coauthor of "The Science of Writing Science" (*American Scientist*, 1990), my favorite article on technical writing, I picked up a short text called *STYLE—Toward Clarity and Grace* by Joseph M. Williams. What a find! In his preface Williams writes, "Do not take what we offer here as draconian rules of composition, but rather as diagnostic principles of interpretation. We offer these principles as the basis for questions that allow a writer or editor to anticipate how readers are likely to respond to a piece of prose, a species of knowledge usually unavailable to writers when they unreflectively reread their own writing." This and future columns are rooted in Williams' vade mecum. I have taken many examples directly from Williams.

How would you describe these sentences?

- 1) Our lack of knowledge about local geology precluded determination of the planner's effectiveness in resource allocation to those areas of investigation with greatest potential.
- 2) Because we knew nothing about local geology, we could not determine how effectively the planners had allocated resources to investigate areas of greatest potential.

Most would call sentence 2 clearer and more concise. This is because sentence 1 makes us sort out and then reassemble its actions through abstract nouns—*knowledge, determination,* etc. The rearranging distorts the sequence of actions and obscures who does what. In 2, we have converted the abstract nouns into verbs, we've made the actors the subjects of these verbs, and we have rearranged the events into a logical sequence. This is the essence of writing clear sentences.

The storytelling model. From childhood through adulthood we use stories to amuse, to warn, to excite, to inform, to explain, and to persuade. In written form, stories can communicate large amounts of information clearly, quickly, and persuasively—a goal of all technical writing. The success of storytelling is rooted in characters and their actions. To be clear, both stories and technical writing must follow the model: subjects = characters and verbs = their actions.

Consider sentences 1 and 2 according to our model. No characters are visible in 1—the subject of the sentence is *lack*. The action of the sentence is expressed by abstract nouns and the verb is *precluded*. Sentence 1 does not conform to the model, and it is confusing. In sentence 2, the characters of the main sentence and the subordinate clauses are *we* and *planners* which are also the subjects of the sentence and clauses. The actions of the characters are *knew*, *determine*, and *allocated* which, similarly, are the verbs of the sentence and the clauses. Sentence 2 follows the model and is much clearer.

The difference between 1 and 2 is how the writer tells the story, and where Williams locates his First Two Principles of Clear Writing: "Readers are likely to feel that text is clear and direct when (1) the subjects of sentences name the cast of characters of the text, and (2) the verbs that go with those subjects name the crucial actions of which those characters are part."

These two simple principles give visible guidelines for evaluating your writing. When it feels abstract, complex, con-

fusing, inflated, or pompous, you should locate the cast of characters and the actions they perform (or are the objects of). If you find that those characters are not subjects and their actions are not verbs, rewrite so that they are. Be careful not to assume that the subjects of the sentences are de facto the cast of characters. Determining the cast and actions may require some mental energy, but when you invoke Williams' two principles, there are positive consequences.

**Concreteness.** When verbs become nouns, thus deleting the characters, sentences become abstract: "There has been an affirmative decision for program termination." Compare with: "The director decided to terminate the program," which is a concrete sentence.

Fewer prepositional phases. Consider the offending words in: "An evaluation of the effectiveness of the software by us will allow determination if it offers an improvement in efficiency to our coworkers." Consider instead: "We will evaluate the software's effectiveness to determine if it can improve our coworkers' efficiency," which eliminates most of the prepositional phrases.

**Logical order.** Turning verbs into nouns and stringing them through prepositions can confuse the sequence of events: "The closure of the branch and the transfer of its business and nonunionized employees constituted an unfair labor practice because the purpose of obtaining an economic benefit by means of discouraging unionization motivated the closure and transfer." Following subjects = characters and verbs = their actions, you are more likely to match syntax to the logic of your text. To implement this you may have to invoke the main character, which was left out: "The company committed an unfair labor practice when it closed the branch and transferred its business and nonunionized employees in order to discourage unionization and thereby obtain an economic benefit." The previous sentences exemplify the curse that haunts reviewers and editors—a poorly written sentence that does not have enough information for good revision.

**Logical relationships.** See if you can connect the dots in: "The more effective presentation of needs by other departments resulted in our failure to acquire funding, despite intensive lobbying efforts on our part." When turning nouns into verbs, you need logical operators such as *because, although,* and *if* to link sequences of clauses: "Although we lobbied intensively, we could not acquire funding because other departments presented their needs more effectively."

**Shorter sentences.** I will dispense with an example because, ironically, all of Williams's examples are too long. Suffice to say that when subjects and verbs match characters and actions, fewer words are used and sentences are more readable. When longer sentences are required, this allows the information to flow more effectively.

I end Part 1 with a direct quotation from Williams that thoroughly captures the essence of this column. "As we read a sentence, we have to integrate two levels of its structure: one is its predictable grammatical sequence: subject + verb + complement. The other level is its story, a level of meaning whose parts have no fixed order: characters + actions. To a significant degree, we judge a style to be clear or unclear according to how consistently a writer aligns these two levels. We usually feel we are reading texts that are clear, direct, and readable when writers consistently express the crucial actions of their stories in verbs and their central characters (real or abstract) in their subjects. We usually feel that we are reading texts that are gummy, abstract, confusing, and difficult when writers unnecessarily dislocate actions from verbs and (almost by necessity) locate their characters away from subjects or delete them entirely. There are details about these principles worth examining." Part 2 will examine these details.

Blockette. Recently, I presented these concepts as part of a technical writing short course at an oil and gas company. Although the participants agreed about the increased clarity, they were reluctant to adopt the principles. One said they certainly cleaned up the writing and made it easier to understand. "But it did not sound ... ah, well, ah ... pompous ... ah ... or regal enough." He and many of the participants associated scientific or technical value with bombastic style. However, by the end of the course, all were staunch proponents of subjects = characters and verbs = their actions and related concepts to be discussed in the next column. What really convinced them was the clarity that emerged when I revised their writings using these principles. Suddenly they could understand what their coworkers had written!

# BLOCK

# Clearer sentences—Part 2

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**M**y last column began a two-part series on clearer sentences based on Joseph M. Williams' vade mecum *STYLE Toward Clarity and Grace*. Part 1 introduced and developed Williams' first two principles of clear writing: subjects=characters and verbs=their actions. In clear sentences, the subjects and verbs overlay the characters and actions.

**Subject and characters.** There are many types of characters. The most important and clearest are direct agents, the obvious source of the action: *We initiated this project ...* 

Sometimes the subjects name a means by which an unstated character performs an action: *Studies of fault traps show that* ... which really means: People who study fault traps, find that ...

("Studies" takes the role of a character and that's clear enough). In poor sentences, however, characters are typically not explicit, and a review is required to bring them to light. In extreme cases, the characters may be so deeply buried below the surface that only the authors can revise and extract them from obscurity. The reconstruction of these sentences is the bane of all reviewers and editors.

**Verbs and action.** "Action" means more than physical movement; it includes mental processes, feeling, relationships, etc. The following four-sentence progression becomes clearer as the verbs become more specific. Note also the improved clarity when the subject aligns with the character.

*There has been effective member information dissemination control on the part of the consortium.* 

*The consortium has exercised effective member information dissemination control.* 

The consortium has effectively controlled member information dissemination.

The consortium has effectively controlled how members disseminate information.

The crucial actions were not *been* or *exercised*, the verbs unnecessarily introduced in the first two sentences, but *controlled* and *disseminate*.

Weak sentences use verbs not to express action, but to state that an action occurred. Consider *We conducted an investigation into the causes* versus *We investigated the causes*. The first sentence exemplifies a common cause of unclear sentences: nominalization, whereby the action is expressed by a verb in noun form; e.g., *discovery* instead of *to discover*, *movement* for *to move*, etc.

Too many writers use nominalization to make their text sound scholarly. In reality, all it does is obscure the action, disconnecting it from the character. Therefore, whenever possible, use verbs to express actions for clearer sentences.

**Good and bad nominalization.** Williams gives guidelines for finding useless nominalizations and revising them.

1) When the nominalization follows a verb with little specific meaning, change the nominalization to a verb that replaces the empty verb:

Our group conducted a study of the region.

Our group studied the region.

2) When the nominalization follows "there is" or "there are," change the nominalization to a verb and find a subject:

*There is a need for further investigation of the region. The geophysics staff must investigate the region.* 

3) When the nominalization is the subject of an empty verb, change the nominalization to a verb and find a new subject:

*The intention of the proposal is to study the region. The geophysics staff proposes to study the region.* 

4) When you find consecutive nominalizations, turn the first into a verb and either leave the second or turn it into a verb in a clause beginning with how or why:

There was first a review of the investigation of the region. First, the geophysics staff reviewed the investigation of the region.

5) When a nominalization in a subject is linked to a second nominalization in a predicate by a verb or phrase that logically connects them, revise extensively, including finding subjects:

*The cessation of the investigation was caused by a funding loss.* 

*The geophysics staff ceased investigating because they lost funding.* 

To be fair, not all nominalizations create poor or abstract sentences. Some useful instances are:

1) The nominalization is a subject referring to a previous sentence:

The investigation showed that ...

2) The nominalization names what would be the object of its verb:

We do not understand either his assumptions or his conclusions.... which is more compact than saying... either what he assumed or what he concluded.

3) A succinct nominalization can replace an awkward "The fact that":

*The fact that we reject what he found is ... Our rejection of his findings is ...* 

**Passives and agents.** Avoid the passive voice whenever possible. In passive sentences the subject expresses the goal of an action, and the agent of the action may be expressed by a phrase beginning with *by*; e.g., *An investigation of the region was done by the geophysics group.* An

active version would read: *The geophysics group investigated the region.* 

Active sentences encourage you to name the agent of an action and avoid extra words. Because the passive voice reverses the order of agent-action-goal, it can cripple the flow of a dynamic style. Compare the following passages:

It was found that data concerning allocated energy resources to the states were not obtained. This action is needed so that a determination of redirection is permitted on a timely basis when weather conditions change.

We found that DOE had not obtained data about energy resources that Federal offices allocated to the states. DOE needs these data so that it can determine how to redirect these resources when weather conditions change.

The passive voice is vague, while the active voice is straightforward and gives specific information.

There is, of course, a place and time for choosing passive over active, and this will be the topic of a future column. However, as a general rule, when we combine unnecessary passives with nominalizations, we end up with those ponderous passages so typical of legalese and techno-babble. It is definitely much easier to violate Williams' principles for clearer sentences using passive.

**Your goal until next time.** To check for clarity in your writing try the following. Go through one of your texts sentence by sentence, identify subjects and their verbs, then identify the characters and their actions. Are the characters and actions easy to identify? (Would they be as easy to identify for your readers?) Once identified, do subjects = characters and verbs = actions? If they do, you are probably writing clear sentences. If not, rewrite the sentences accordingly.

Next look for nominalizations (i.e., mainly words ending in "-tion"). Are they necessary or can they be replaced with verbs? This exercise will save a lot of time and red ink if someone else edits your copy. Finally, avoid trying to "sound" important; just tell your story in simple and clear terms. **E** 

# Cohesive paragraphs, Part 1

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"The two capital secrets in the art of prose composition are these: first the philosophy of transition and connection; or the art by which one step in an evolution of thought is made to arise out of another: all fluent and effective composition depends on the connections; secondly, the way in which sentences are made to modify each other; for the most powerful effects in written eloquence arise out of this reverberation, as it were, from each other in a rapid succession of sentences."

> —Thomas De Quincey (1785-1859, English essayist)

"Teachers, students, and the museum public have shown continuous interest in the Wiggle Monitoring Project. The functioning of the different ground motion monitoring stations in the first years of activity and the analysis of the first data recorded testify to the good quality of the data and the huge potential of this project for social and educational purposes. Scientists and researchers held discussions with teachers, students, and the public about the themes of research and the requirements for improved protection of the environment as well as disaster preparedness and mitigation. Finally, the constant support of local institutions helped us achieve the prototype monitoring network, while a number of national governments provided limited funds for meetings of teachers involved in the project on 1999 and 2000."

The preceding paragraph, adapted from a publication, is not complicated, but it is hard to understand. Individually each sentence is clear and follows the model developed in my last two columns: Characters and actions should match subjects and verbs. However, there is more to readable writing than sentence length or local clarity; cohesion is the next level up from local clarity. The struggle we all face is how to keep local clarity while casting sentences that fit their context and reflect the intent that first motivated us to write.

**Information flow.** In modern technical writing, we advise writers to use the direct, active voice and avoid the weak and indirect, passive voice. The following two sentences are (1) active and (2) passive:

- 1) Fluid injections in deep wells in which the downhole fluid pressure sufficiently reduces the effective frictional stress across a plane of weakness induce microseismicity.
- 2) Microseismicity is induced by fluid injections in deep wells when the injected fluid pressure sufficiently reduces the effective frictional stress across a plane of weakness.

Some authorities would automatically advise using the active voice. But what if the sentence were used in the following context? Geophysicists are finding some astonishing new results about fracture and joint growth by studying microseismicity. [*insert sentence* (1) or (2)] By reducing the frictional stress below the in situ shear stress, we generate a local slip or dislocation that grows into a microseismic event.

Coherence dictates using (2), not (1)! This is because in the last part of the first sentence we introduce an important new character, microseismicity. If we use the activevoice sentence, microseismicity is not mentioned again until the end of the second sentence. This extensive distance between introducing and discussing microseismicity makes the passage choppy and disjoint—i.e., incoherent. This example illustrates two important issues.

First, the challenge of technical writing in English is that with every sentence, we must find the best balance between the principles of clarity, as discussed in the last two columns, and the principles of coherence that bond sentences into a full discourse. In that balance, "we must give priority to those features of style that make our discourse seem cohesive, those features that help the reader organize separate sentences into a single, unified whole" (Williams, *Style: Toward Clarity and Grace*, 1995).

Second, the example illustrates Williams' two complementary principles of cohesion: (1) Put at the beginning of a sentence those ideas that you have already mentioned, referred to, or implied, or concepts with which you can reasonably assume your reader is already familiar and will readily recognize. (2) Put at the end of your sentence the newest, the most surprising, the most significant information that you want to stress—perhaps the information that you will expand on in your next sentence.

These principles mean that as you begin a sentence, you must prepare your readers for new and important information. You do this by providing a familiar context out of which you build the unfamiliar, "from the known to the unknown" (Williams, 1995).

The beginning. The key to invoking these two principles is how you begin your sentences. It is harder to begin a sentence well than to end it well. To end a sentence you must decide only which idea, concept, etc., is the newest and probably the most complex, and imagine it at the end. The problem is to get there successfully. This means starting the sentence successfully.

The most important features of the beginning of the sentence are (a) transitioning or connecting it with that which preceded and (b) announcing the sentence topic i.e., what you intend to discuss. I defer discussing transitioning and will discuss topic.

tioning and will discuss topic. Williams (1995) states, "The topic of a sentence is its *psychological* subject. The psychological subject of a sentence is that idea we announce in the first few words of a sentence. It is almost always a noun phrase of some kind that the rest of the sentence characterizes, comments on, or says something about. In most English sentences, psychological subjects, that is the topics, are also grammatical subjects":

(Continued on p. 867)

Editor's note: This column is the third in a series of tutorials adapted from Joseph M. Williams' book Style: Toward Clarity and Grace. The first two tutorials discussed writing clear sentences.

Microseismicity is induced by fluid injections in deep wells. ...

The sentence announces the grammatical subject, i.e., topic, microseismicity, and readers assume that the writer is going to discuss microseismicity.

Note that the sentence subject may not be the grammatical subject:

Regarding microseismicity, we can mitigate the potential danger by keeping the injection pressure below a critical level.

Here the grammatical subject, *we*, is not the psychological subject, but microseismicity, which is the sentence's topic.