

Keynote Address From Vigorous Writing to Scientific Integrity

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I was told, when I was invited by your charming president to give this address, that as the annual meeting was to be in Philadelphia its theme would be "Documents that changed the course of history". The flattering implication was that, apart from the American Constitution, one such document was CBE's well-loved publication *Scientific Writing for Graduate Students*, which I helped bring into being way back in 1969 (1). Well, I hate to disappoint you, but the document I was referring to by my jovial title for the talk, "The Book that Launched a Thousand Snips", is not that major contribution to the scientific literature. No, it is another, much earlier one, which has been a major source of inspiration to me and countless others among you: *Elements of Style*, by William Strunk Jr and E B White.

Let me warn you at this point that I am going to drool about Strunk and White for quite some time. But bear with me, sit back, and enjoy the ride, even if you don't quite know where it's leading: I promise that I shall eventually arrive at a point where I point out the book's continuing relevance to scientific editors and to the CBE.

Strunk's Message on Brevity

Of course, what I had in mind in suggesting my title was that editors are often preoccupied with snipping out words, sentences, paragraphs, even sections from what they are editing—reducing unnecessary verbiage and excising mumbo jumbo. The popular image of editors is, as you are probably only too aware, that of someone with a harassed

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expression and a large pair of scissors.

But in rereading Strunk and White after all these years, I find that to write with brevity is not at all their main message! Strunk does not rant on, as do so many writers writing about writing, about conciseness. My memory must have been distorted by recollection of a vivid anecdote about Professor Strunk. It is said (I am sure, however, that this is apocryphal) that when he gave lectures at Cornell he had wrapped up what he had to say in so few words that to fill out the hour he had to lean forward after each succinct sentence—and repeat it, in exactly the same, exquisitely chosen words!

Strunk's Most Important Message

No, the main message of Professor Strunk (for E B White was only the medium through which we know of his existence) was not "Be brief." It was

Write with vigor.

"Vigor" is the word to cling to and the goal to aim at. Brevity might well make a contribution to vigorous writing, but it does not in itself suffice.

In more recent works on style, writers are often urged to be "transparent", so that the meaning can be perceived with ease through the limpid prose. Frankly, I much prefer Strunk's dictum that writing should be so vigorous that the meaning reaches the reader's brain with all the force of a well-aimed punch.

I warrant you, Strunk does bear revisiting. Take rule 10: "Use the active voice." My courses on scientific writing, and no doubt yours, always urged writers to prefer the active to the passive voice so as to avoid ambiguity, or clumsiness, or both. But Strunk is more concerned with a different aspect of the active voice, its punchiness. He says:

The active voice is usually more direct and vigorous than the passive.

Note the proper caution he exercises in using

the word "usually": Strunk is always direct, but never dogmatic. Some would-be scientific writers level this quite unfounded accusation at him. Furthermore, they claim that the necessity for a scientist to be impersonal precludes use of the active voice and that editors and their reviewers have become so used to the passive voice that they are inclined to condemn articles that use active constructions. That is nonsense. Editors are not so much used to as inured to passive, periphrastic phrases, and they are mightily refreshed if they encounter some clear, direct language. Moreover, the myth of the scientist as detached, impersonal observer is surely by now exploded: scientists who are worth their salt are deeply emotionally involved in what they are doing, and they pursue it with passion.

Strunk chooses his words with care: After a pair of examples, one in the active and one in the passive, he says that the passive construction "is less direct, less bold, and less concise." I love that strong word "bold" and its placement at the center of the triad. Notice too how the idea of conciseness comes last; it's really subsidiary to the idea of boldness, of strength. Strunk makes this crystal-clear in the last sentence of the passage on rule 10:

Note, in the examples above, that when a sentence is made stronger, it usually becomes shorter. Thus, brevity is a by-product of vigor.

So there we are: brevity may be the soul of wit, but vigor is at the heart of effective prose.

Second Important Message: Write Vividly

With vigor comes *vividness*. In rule 12, Strunk rightly attaches great importance to diction, the choice of words. And he enunciates criteria for the choice:

Use definite, specific, concrete language.

Perhaps his most famous example of

improvement in “communication skills” (a phrase he would have died rather than use!) is in the transformation of this sentence:

He showed satisfaction as he took possession of his well-earned reward.

into

He grinned as he pocketed the coin.

Later he quotes Orwell, saying “To show what happens when strong writing is deprived of its vigor, George Orwell once took a passage from the Bible and drained it of its blood.” (How’s that for a vivid turn of phrase?) Here’s Orwell’s translation:

Objective consideration of contemporary phenomena compels the conclusion that success or failure in competitive activities exhibits no tendency to be commensurate with innate capacity, but that a considerable element of the unpredictable must inevitably be taken into account.

I’m sure that most of you vaguely remember how the original verse from *Ecclesiastes* ran, but the force and vigor of the King James translation when you hear it again will surely make you gasp:

I returned, and saw under the sun, that the race is not to the swift, or the battle to the strong, neither yet bread to the wise, nor yet riches to men of understanding, nor yet favour to men of skill; but time and chance happeneth to them all.

How Does This Apply to Scientific Writing?

That’s all very well, you might say, but what’s it got to do with scientific writing? No one, surely no one, would claim that scientists are as free as creative writers to choose vigorous, winged words to express their pedestrian, mundane scientific thoughts.

Ladies and gentlemen, I am that no one. I do believe that we can, and should, express

our science vividly and with vigor. The fact is, there *are* no pedestrian thoughts in science—everything about this fantasy world of atoms and molecules we have never seen is exciting and imaginative. Just hold on to exhortations like those of Strunk’s—or just keep words like “bold” and “vigorous” at the back of your minds—and not only your writing and your e-mail correspondence will be transformed: your whole life will take an upward turn.

OK, let’s come down to earth a little and consider the Methods section of a journal article. Surely it is obligatory here to use definite, specific, concrete language. And won’t the same discipline, of being specific and concrete, also do wonders for the introduction? In that section, no new, cloudy concepts are being introduced; one is taking up where many before have labored. Let us pay them the tribute of respect and describe what they have concluded in good, clean prose.

Then, flushed with success, turn the spotlight of vigor and the discipline of being specific on to the discussion. And behold, the cloud of “perhapses” dissolves, the froth of prevarication subsides, your exegesis clears up like mist before the morning sun, your nebulous waves become definite particles . . . and your readers begin to love you.

Rule 13

Well then, vigor is our goal. With his next rule, Strunk springs conciseness on us, always remembering that it is but the handmaiden of vigor. The rule is: Omit needless words.

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.

So that’s what we should be after: con-

ciseness, yes; preciseness, so that every word should tell, yes; and brevity, but only as it’s in the service of vigor. That’s where the snips come in—but snip away at feebleness and woolliness, not just at wordiness.

Style Is Not Everything

Well, I hear you sighing, that all seems to be about writing style. Is it only style that matters in scientific publication, in scientific communication? No, of course not; but I fervently believe that a habit of vigorous writing engenders a habit of vigorous, and rigorous, thinking, which in turn leads to good science. That’s why I advocate the actual act of writing, of expressing thoughts in complete sentences—for oneself in the first instance—as a means of clarifying one’s thinking. For the act of writing, whether on paper or at a computer screen, requires to practice strict mental discipline, which bad for no one.

As a matter of fact, the 10-week course on writing a scientific journal article that is embedded in *Scientific Writing for Graduate Students* doesn’t touch the word “style” until week 6. What has been going on until then is a great deal of rigorous scientific thinking, including

- The critical appraisal of previous work in the field.
- The vital importance of sound experimental design.
- The selection of appropriate and sufficient controls.
- The adequacy of the statistical tools.
- The stringent assessment and analysis of results.

Only after all that do we come to the problems of comprehensible presentation, which by then will have been largely solved—a case of “sounder thinking through clearer writing” (2).

All that was inspired not by Strunk’s recommendations on style, but by the cast of his mind.

Trelease

Next to Strunk’s book I want to praise

another: Sam Trelease's prosaically titled *How to Write Scientific and Technical Papers*, first published in 1958 and after a reprinting in 1969 again out of print. It describes the ideal logical approach not just to writing a paper but to doing scientific research.

Trelease's book, almost as short as Strunk's, first discusses how to choose a research problem, how to search the literature, how to treat data in different ways, and how to assess the reliability and significance of measurements. Only then does he devote a section to structuring the paper; and finally he offers three sections on good form and usage.

That is the right order in which to take matters, I think; but in one respect I would differ from Trelease. After those sections on good form and usage, he has sections on tables and illustrations. I would put those before writing a single word of the paper, even before choosing the target journal or other publication medium.

For in scientific writing, new data are at the heart of the message and must be central to the thinking behind the writing. Preparing the tables and graphs and selecting the images—with all their surrounding labels, captions, and footnotes—is a powerful tool for analyzing just what advance the scientist has made, what is its magnitude, and what is its significance. Only then should the writer begin to think how to show off its points to best advantage, and to whom to direct the message.

This process of presenting the data to oneself and of making rock-solid the reasoning that links them together and leads to the final conclusions is central to the kind of course that appeals to scientists. I strongly advise those of you who are teaching a course, or guiding scientists in some other way, to focus exclusively at first on discussing your clients' data. This at once announces your intellectual orientation, establishes your credibility, and subtly relieves their minds of the dread that you are going to be preoccupied with grammar.

I found when I was teaching a course that graduate students, and more experi-

enced scientists too, were actually afraid of words and averse to handling them. They were, being scientists, much more interested in numbers and images, especially those they had produced themselves. So get them to say concrete things about why they had produced those particular values or pictures and what they must or could mean. Then they will be halfway to the goal of conveying the thoughts to others, and as a bonus you will be seen not as carping from the sidelines, but as playing on their team.

Scientific Writing for Graduate Students

Starting from the data is, I think, the chief merit of the CBE book and of the training course that it describes. I am currently engaged, at the request of CBE, in rewriting the book, but the principle of starting from the data will continue to be very much at the fore.

Many editors who set out to teach the reluctant neophyte how to write a scientific article or conference poster begin, in my opinion, at the wrong end: either from what I call the "paperclip end"—whether or not to put paperclips on the 3 or 4 copies that the editor demands; whether to number the pages in the printout, and if so whether at the top of the page or the bottom; how to cite and list the references—or from the "rhapsodical end": how to convince by dint of rhetorical devices and elegant diction. Of course, those matters concern, and greatly interest, us who are professional editors. But they are, don't you agree, monumentally insignificant beside the supreme endeavor of thinking logically and rigorously in doing purposeful scientific research and then publishing it by applying the same principles so that other scientists can build on it.

Clear, Rigorous Thinking for Benevolent Editors

What does this mean, then, for editors and for CBE? First, let's approach every scientific paper, every author, and every scientist who wants to learn to write well, from the standpoint of the perceived benefit to science. Second, let's coax the best we can out

of each scientist who comes our way.

I came across a lovely line in Sophocles' *Oedipus Rex* the other day, which struck me as particularly apt as a motto for scientific editors. When translated, it reads as follows:

For a man to help others, using such resources and skills as he may possess, is the noblest of tasks.

In this "noble work" of assisting scientists to achieve worthy publication, scientific editors will encounter one or more of several possible scenarios.

First scenario: You are lucky enough to encounter highly important work, well and clearly expressed. You should not only jump for joy, but find some mechanism of rewarding it—for instance, by speeding up its publication in whatever way you can, or if you are a journal editor, by highlighting the work by editorial comment.

Second scenario, unfortunately much more often encountered than the first: You are presented with work that is worthwhile but poorly expressed. If you are an author's editor, try to get the author to make it interesting through more vivid presentation, better design of illustrations, a livelier and more pointed introduction and discussion, and—throughout—the use of more precise, concrete, vigorous language. If you are a journal editor, you might be limited by time in the amount of help you can give in this way unless you are lucky enough, or have been farsighted enough, to have assistant or executive editors to help you (3). Failing that, you will have to content yourselves with stating that you think the work is important and encouraging the authors to seek help in improving its presentation.

Third scenario: You receive a paper that is muddled as well as slipshod, but with a golden nugget concealed within its tortured folds. You can do one of several things, depending on your role. As you well know, it is no good trying to patch up with honeyed words something that is hopelessly confused in its structure as well as its expression. If you are a journal editor, don't be too dismiss-

sive, although you must of course be firm; point to the gold among the dross, suggest a radical rethinking, and offer to consider a second submission at two-thirds the length. You might be surprised at this piece of advice, when I have just been maintaining that brevity is not the be-all and end-all of scientific writing; however, such an admonition coming from a journal editor often sharpens the author's mind wonderfully! If you are an author's editor, I suggest that you present, tactfully, your own sentence outline revealing what you think the paper needs to say and in what order, and omitting what it need not say, and ask the author to respond with a sentence outline that will improve on yours. After that exchange, you will have, with luck, the basis of a completely new paper, one on which you can work successfully.

Scientific Integrity

Fourth scenario: Finally, you are offered—rarely, I hope—a paper that smells, faintly or strongly, of cheating, fudging, or cutting scientific and ethical corners. Here you must, whatever your role, be ruthless: if you are the journal editor or reviewer, you must reject it; if you are the author's editor, you must require more and better scientific evidence before you will consent to work on it.

At the heart of scientific publishing, I have been insisting, is science. It must be good science. Everything we work for has to be underpinned by, and based on, scientific integrity—the *selfless* pursuit of truth for the common good. I know that since I was active at the bench 30 years ago there has been a vast increase in pressures on scientists to produce publishable, and if possible startling, results, and these pressures have in recent years produced some sorry cases of scientific fraud, which at least some people believe represent the tip of an iceberg. Whether that is so or not, it is editors who have the major role in guarding the moral and ethical frontiers when attempts are made to foist fraudulent findings on the scientific public.

A short time ago, a request from your central office came to me, as a past president of this organization, asking what I thought CBE should adopt as a major policy issue. Diffidently, because I have not been a journal editor for many years, I suggested a subject that would, I think, be appropriate: to consider how to guard and protect the scientific integrity of what you help to get into the public domain. I see in *CBE Views* for October-November 1996 (4) that your Editorial Policy Committee (which I was responsible for forming) has taken up the challenge—whether as a result of my suggestion, I have no idea—but I was disappointed to read also that of the four topics identified in this regard they have relegated that of scientific fraud to the Commission on Research Integrity. That's a pity, and I hope that they will reconsider, because I believe that editors should play a prominent nation-

al role in fighting this aberrant behavior. I am convinced that if this organization were to move into the front line with a statement on this topic, its reputation would soar to heights hitherto unknown. I beg you to do so, and I wish you well. ♪

References

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