

STRATEGIES

for Writing Effectively About Science and Technology

by David D. Herring

As science and technology increasingly affect our everyday lives, the lay public's need to understand science, and its applications, also increases. To function in today's society—to improve career options, to pursue higher education degrees, to make sound public policy decisions concerning the use and distribution of resources—lay people must grasp basic scientific and mathematical principles. But, according to critics, many scientists and science writers are not effectively communicating their messages. These critics, including best selling science fiction author Michael Crichton, complain that scientific writing often overwhelms readers with poor grammar, vague scientific jargon, cumbersome sentence structure, and unimaginative style. It's no wonder lay people balk at the thought of reading scientific journals or textbooks and, consequently, distance themselves from the subject.

Moreover, poor writing is an obstruction not only to lay readers, but to scientists in other fields. Over the last two centuries, the physical and medical sciences split into different disciplines and, increasingly, those disciplines divided into specialties. With each successive generation of scientists, specializations have grown even more remote from one another. Today, scientists tend to read journals related to their own fields and disregard publications in other fields because they are difficult to understand. Isaac Asimov recognized this trend and, in 1965, wrote:

The publications of scientists concerning their individual work have never been so copious—and so unreadable for anyone but their fellow specialists. This has been a great handicap to sci-

ence itself, for basic advances in scientific knowledge often spring from the cross fertilization of knowledge from different specialties.¹

It is important for scientists to be aware of what other scientists specializing in other areas are doing so that they may enhance their own work; and so that they do not repeat work that is already being, or has been, done. Concerning the abundance of poorly-written scientific text, Michael Crichton observes, "It is impossible to guess the cost here in wasted time, duplicated findings, and buried pearls."²

Poor scientific writing may be attributed partly to the fact that some scientists simply do not choose to make their writing more easily readable. These writers do not have their readers' needs or expectations in mind when they compose. Some critics argue that dense scientific text is not necessarily meant to educate; it is meant to impress the reader and to display the author's acumen. In "Jarring Jargon," a letter to the editor of *Scientific American*, K.A. Boriskin gives examples of scientists using terms to display their acumen. He writes, "I have yet to see definitions of such terms as modality, methodology, or dynamical that distinguish them in any significant way from mode, method or dynamic, respectively. These terms appear to be no more than the pitiful efforts of some scientists to sound more 'scientific!'"³

Other critics offer another perspective: Scientific writing is often weak because most scientists never receive formal training in writing. These scientists typically emulate older scientists' writing styles either because they learned from them, or because the older scientists are accomplished and respected in their

sentence—it carries the emotion and the image. The sentence's message is pulled along by the verb.⁵ Active verbs render text more dynamic and more interesting to read; therefore, science writers should use active verbs to capture readers' attention. Yet, scientists frequently use passive verbs in their writing to mask action and sidetrack readers' attention to objects rather than active agents.

Consider the following passages Lewis Thomas,¹⁰ cancer researcher and reknown populizer of science, wrote on the same topic—injecting papain (meat tenderizer) into rabbits' ears. The first appeared in a medical journal:

A substance has been demonstrated in solutions of crude papain which . . . results in complete collapse of both ears . . . It is concluded, tentatively, that the ear collapse phenomenon is not due to the crystalline papain protease [an enzyme that breaks down protein] or lysozyme [an enzyme-like substance].¹¹

The second article appeared in Thomas' professional autobiography:

We noted that the rabbits, for all their display of good health, looked different and funny. Their ears, instead of standing upright at either side, rabbit-style, gradually softened and within a few hours collapsed altogether, hanging down like the ears of spaniels. A day later, they were up again.¹⁰

The first passage is passive; an abstract object—"substance"—is its subject, and here the subject is receiving the action. The first passage is verbose and awkward; and, because it has no human character with whom the reader can identify, it is boring. The second passage is in the active voice; it is more concise and straightforward. Also, because it contains a human personality—Thomas tells us the rabbits' ears looked funny—it is more interesting.

Nominalizations

Turning a verb into a noun is called a nominalization. (The term "nominalization" itself is a nominalization.) We nominalize a verb (and adjectives) by adding "y", "tion", or other such constructs, so that "Discover" becomes "discovery," "investigate" becomes "investigation," "apply" becomes "application," and so on. Be judicious in their use because nominalizations both contribute to and are a symptom of the use of passive voice. In short, don't write that "a discovery was made when the investigation was conducted in which the application of chemical x onto substance y was found to cause symptom z." Instead, more clearly write that "John Doe investigated chemical x. He applied chemical x to substance y and discovered that it causes symptom z."

Poor sentence structure

A common criticism of scientific texts is that their sentences are hard to understand because they are too long. However, "too long" does not mean too many

words. A sentence is too long when its structure gets in the way of reader understanding. Scientists often compound the structural problems in their sentences by interrupting the subjects and verbs with lengthy modifiers. Readers expect subjects to be followed closely by verbs. Any phrases that come between subject and verb are regarded as an interruption and, therefore, as having less importance than the information in the stress position. Consequently, readers may miss the value of the interruptive modifier.

Michael Crichton points to the following introductory paragraph in an article published by the *New England Journal of Medicine* as an example of poor information flow caused by poor sentence structure:

Toluene is an aromatic hydrocarbon that has widespread industrial use as an organic solvent. Inhalation or "sniffing" of toluene-containing substances, including paint sprays, paint and lacquer thinners and household and model glues, has become increasingly frequent in recent years. In spite of extensive exposure to toluene by industrial workers and "solvent sniffers," remarkably little serious toluene toxicity has been reported among such workers. A possibly life-threatening complication of toluene sniffing—reversible renal tubular acidosis with serious electrolyte abnormalities—occurred in the two patients described below.²

At first, the passage appears to be about toluene. But then, as each sentence begins with a new subject or idea, the text jumps from topic to topic, leaving the reader unsure as to its specific point. Woe be unto the author particularly if the point of this passage is to teach the reader the physical symptoms of toluene inhalation! That information is contained in an interruptive modifier in the last sentence, and is therefore likely to be missed.

Scientific jargon

Each scientific and technical field has its own particular jargon. As these fields grow increasingly remote, as new discoveries are made, and new technology is developed, the language describing these events is modified or added to. Sometimes new terms are invented—frequently as noun strings that eventually become acronyms. Most likely, only a geologist or someone specializing in technology for burning coal to produce energy would know what a "stable equilibrium fracture failure formation" is. If it is necessary to include this term, writers should at least edit it to make it more understandable. If no background information is given, readers are forced to decide for themselves whether "stable" describes "equilibrium," "fracture," or "formation." Writers should use the following guidelines to render noun strings easier to read:

- Add hyphens to group words into grammatical units that best describe the technology;
- Re-order the noun string by adding one or more