Cambridge University Press & Assessment
978-1-107-01506-7 — An Engineer's Alphabet
Henry Petroski
Excerpt
More Information

abbreviations. As frequently as engineers find themselves using the words *engineer* and *engineering*, they do not appear to have agreed on any single standard or official shorthand for the words. Among the abbreviations I have seen used are egr., eng., engr., eng'r., and engng. – none of which is especially mellifluous or, in isolation, unambiguous. Abbreviations are not meant to be pronounced as such, however, and as long as the context is clear there should be little need to worry about them being misunderstood. Even so, the arrangement of the letters in these abbreviations is not especially typographically graceful, and situations can arise where confusion might result, as in a university setting when a course number is designated Eng. 101. Is this Engineering 101 or English 101 or Energy 101? Engineers dislike ambiguity, and so the imprecision of an abbreviation for our own profession is annoying, to say the least.

It is apparently this aversion to ambiguity that has led engineers to introduce less-than-logical abbreviations for themselves. And it may well have been the potential confusion over what "eng." designates (engine, engineer, engineering, English, engrave, etc.) that led to the introduction of the unconventional, unpronounceable, and ungraceful abbreviation *egr*. for *engineer*, and sometimes its natural extension egrg. or egrng. for *engineering.* Although many common abbreviations have multiple meanings, the context can be expected to make clear which one is intended.

Unfortunately, the words engine, engineer, and engineering often occur in the very same context.

Although my dictionary shows me a full page of words beginning with *eng*, I find only a few words starting with *egr* – egregious, egress, egret. Such arrangements of letters may not themselves even look like full words; the latter may look as if they are truncated versions of regress and regret. In any case, they are not likely to need an abbreviation. While it may be specific, *egr.* is a clumsy abbreviation; I do not feel comfortable with it. Hence, I tend to use it only when I have to distinguish an engineering course from an English course at my university.

The lack of a single, straightforward, and dignified abbreviation for the engineering professional troubles me. Medical doctors invariably identify themselves by appending M.D. to their name, and lawyers have appropriated the courteous Esq. The registered professional engineer can use P.E., of course. However, because fewer than a third of all American engineers are registered, the majority of (unlicensed) engineers cannot legally use those letters. Medical doctors also are regularly addressed as "Doctor," prefixing their names with Dr., and lawyers are frequently referred to as "Counselor," at least in court. Although it has been proposed that engineers identify themselves as Egr. So-and-So, engineers have not yet gotten together, in America at least, on how they wish to identify themselves or how they wish to be addressed (*but see*, **prefixes for engineers' names**).

acronyms. Acronyms are not exactly the same as abbreviations, of course; however, the terms are often used as if they were synonymous. Strictly speaking, an acronym is a collection of initial letters or groups of letters of the words of a name or phrase that combine to form a new word, as "sonar" is formed from "sound navigation and ranging" and "radar" from "radio detecting and ranging." Although such acronyms might be said to be impure, in that they do not employ a consistent use of initial letters only, the latter is especially clever because the palindromic character of the word echoes the principle of the invention. The physical principle behind sonar is effectively the same as the one bats and dolphins use to navigate. Sonic devices were first developed by humans following the sinking of the *Titanic* and were used to detect icebergs. The technique was adopted for submarine navigation during World War I, but the word *sonar* was not coined until World War II, in imitation of the word *radar*.

In practice, the term “acronym” is frequently used more loosely to refer to any collection of letters that designates a (preferably) pronounceable title or phrase, as NASA stands for National Aeronautics and Space Administration although it is not, strictly speaking, a word in its own right. Nevertheless, this abbreviation is commonly and officially pronounced as if it were a word, “nasa,” and, inexplicably, sometimes (incorrectly) as if it were the city Nassau, the capital of the Bahama Islands and a county on New York’s Long Island. Some older staff members who were associated with NASA’s forerunner, the National Advisory Committee for Aeronautics (NACA), which was established in 1915, pronounce each letter (“N-A-S-A”) in keeping with the way to which “the N-A-C-A” was referred to by its distinct letters, as in “the N A C A Ames Aeronautical Laboratory near San Francisco.” The agency often appeared in print as N.A.C.A., with the periods signaling that the letters were to be pronounced individually. Some long-time NASA staff members at the Langley Research Center in Hampton, Virginia, recall that when the space agency succeeded the N.A.C.A. in 1958, it was common to see “N.A.S.A.” on highway signs in the vicinity of the center. Ironically, now many younger NASA workers refer to the NACA as “Nacca,” if they are not aware of its history, culture, and traditions. (These and other anecdotes, in the context of the Langley Aeronautical Laboratory – as the Center was previously known from 1917 to 1958 – are captured in the aptly titled *Engineer in Charge*, written by James R. Hansen and published in 1987 as part of the NASA History Series.)

How one pronounces NASA thus serves as a kind of shibboleth for identifying true old-timers in the organization. Many of those who recall when NASA was established also remember a joke that was current at the time. It was said that the C in NACA became the S in NASA to symbolize that the cents sign in the budget of the former became a dollar sign in that of the latter, an allusion to the enormous resources NASA enjoyed during the heyday of the space race. It is ironic that in the late 1990s, when money for space exploration was not so plentiful, NASA suffered repeated embarrassments attributed to its philosophy of "faster, better, cheaper."

Some so-called acronyms could never be confused with words. When the Liquid Metal Fast Breeder Reactor program was a highly visible part of the Department of Energy's effort to develop a fuel self-sustaining nuclear power program, engineers, managers, and environmentalists alike got comfortable reciting the vowel-less string of letters LMFBR as if it were the slogan for a brand of cigarettes, as was LSMFT, which stood for "Lucky Strike Means Fine Tobacco" and was emblazoned on the bottom of every pack of "Luckies." There was no pretension in either case, however, that the letters formed a word.

The advent of computer languages and large computer programs began a fad of naming them with clever acronyms, sometimes more forced than forceful. (Who would guess that BFX stands for "Bridge Fabrication error solution eXpert system"?) Some of the early efforts were rather successful and unforced, however, and this seems to have spurred later imitators into uncharted territory. Among early computer languages was COBOL, which stands for "COmmon Business-Oriented Language." The name of the scientific-oriented language FORTRAN nicely characterizes its "FORmula TRANslation" qualities. The example of BASIC, coined in 1964 to stand for "Beginner's All-purpose Symbolic Instruction Code," further illustrates how the rules of forming acronyms, even the best of them, are sometimes bent and often forced to fit the desired acronym.

Whether legitimate or not, whether clever or not, whether pronounceable or not, acronyms and engineers seem to go together. Engineers are notorious for sprinkling acronyms liberally throughout their writings and speeches. It is a fair criticism of many an engineering presentation that it is incomprehensible to the uninitiated. This is frequently acknowledged in books and written reports by the insertion of a much-needed list of acronyms and abbreviations in the front matter or as an appendix. However, reading such a report can be a two-handed exercise in flipping back and forth between the text and the list. It is unfortunate that this is so, but few engineers appear able to control themselves when it comes to the use of acronyms.

The alternative to a list of acronyms is the widespread habit of engineers to put the abbreviation or acronym in parentheses immediately following the first use of the term that is acronymized. (Engineers also like to coin verbs from nouns.) Thus, it is common to find strewn throughout engineering reports parentheses filled with strings of capital letters. This method works fine when one reads the report from beginning to end; however, there can be confusion and frustration when the reader dives into a later chapter of a report – beginning on, say, page 51 – and finds acronyms used there that may have been introduced anywhere in the previous fifty pages. (This kind of problem is not unique to engineering, of course, as is clear to anyone who has read an article published in an English or history journal and has found in the 201st footnote an abbreviated reference to a work that might be fully described in any one of the previous 200 notes. Neither scholarly articles nor technical reports tend to be typographically attractive or user friendly.)

Increasingly, engineers and others are beginning to be more sensitive to how their reports look, and they are being more circumspect about how they use acronyms and the parentheses that pack them into text. Indeed, it is increasingly the case that one finds abbreviations and acronyms used unobtrusively, with the meaning clear from the context. Thus, when an article first mentions an organization such as the National Society of Professional Engineers, there will be no parenthetical statement of the obvious: that its abbreviation is NSPE. Rather, the next time the organization is mentioned, which typically occurs in the next sentence or paragraph, the abbreviation NSPE is used without comment. This method makes for neater, cleaner, and more easily read reports.

"alphabet of the engineer." In his autobiography, James Nasmyth (1808–1890), the Scottish engineer and inventor of the steam hammer, wrote often of his learning to draw and of its importance for the practice of engineering. According to Nasmyth: "Mechanical drawing is the alphabet of the engineer. Without this the workman is merely 'a hand.' With it he indicates the possession of 'a head'." Using mechanical drawing figuratively as well as literally, Nasmyth allowed for it to represent the ability of the creative engineer to conceptualize and communicate ideas, and thereby lead technological innovations and enterprises. Engineers cannot easily be leaders beyond the technical sphere without also having a sense of their own profession's culture and traditions, and it is in this sense that Nasmyth's phrase has been adopted as the title of this book. *An Engineer's Alphabet* is meant to call attention to the importance of putting the quantitative engineer in touch with qualitative language and thought, emphasizing the importance of both sides of the brain to truly creative engineering. See *James Nasmyth, Engineer: An Autobiography*, new edition, Samuel Smiles, ed. (London: John Murray, 1885).

The alphabet metaphor was also used by Robert Fulton (1765–1815), who is perhaps best known for his work on the steamboat. Before devoting himself full time to engineering and inventing, Fulton worked as a portrait painter, first in Philadelphia and later in England. It was while he was abroad that he published *A Treatise on the Improvement of Canal Navigation* (London: I. and J. Taylor, 1796), on whose title page he is identified as "R. Fulton, civil engineer," the relatively new designation for the profession that distinguished its practitioners not from the yet-to-be-coined "mechanical engineer" but from the military engineers who had traditionally been responsible for large projects. In the preface to the book, Fulton reflected on the concepts of invention and improvement, observing that "the component parts of all new machines may be said to be old." It is in this context that he wrote that "the mechanic should sit down among levers, screws, wedges, wheels, &c. like a poet among the letters of the alphabet, considering them as the exhibition of his thoughts; in which a new arrangement transmits a new idea to the world." When that new arrangement produces a "new and desired effect" Fulton notes, its creator possesses that quality "which is usually dignified with the term Genius." The word *genius* is, of course, etymologically related to the word *engineer* through the Latin *gignere*, which means "to beget."

ancient engineering. In 1774, Benjamin Franklin wrote that "it has been of late too much the mode to slight the learning of the ancients." Indeed, his writing anticipated thinking in some circles today. Contrary to conventional wisdom, engineering is not a modern endeavor: It is as old as civilization. In fact, it can be argued that the beginnings of civilization and of engineering were coeval, and that civilization as we know it cannot exist without the practice of some form of engineering. The first engineer whose name we know is said to have been Imhotep, the royal architect-engineer to Pharaoh Zoser. Imhotep flourished in Memphis, Egypt around 2650 B.C. and is credited with building the Step Pyramid of Sakkara, the oldest Egyptian example of the genre, and thereby is said to be the inventor of pyramids generally. These ancient engineering achievements continue to awe and inspire.

The works of the Greek philosopher Aristotle (384–322 B.C.) have, of course, had a seminal influence on Western thinking. Of special interest to engineers should be the “minor work” attributed to Aristotle that has been translated into English as “Mechanical Problems.” In it, questions of scale and structure are discussed in ways fully meaningful to modern engineers, even though the arguments used may appear to have been primitive mechanically. Although the authorship of the work is sometimes disputed, it is still contained in Aristotle, *Minor Works*, translated by W. S. Hett (Cambridge, Mass.: Harvard University Press, 1980).

The oldest surviving written work on architecture and engineering is believed to be *De architectura*, which was written in the first century B.C. by master builder Marcus Vitruvius Pollio, now known to us simply as Vitruvius. His book summarizes the state of the art of building and describes related Greek and Roman technology so that the emperor, Caesar Augustus, could understand the quality of existing buildings and judge proposed construction projects. Vitruvius’s treatise was considered authoritative well into the Renaissance. The standard English translation of *De architectura* was made by Morris Hicky Morgan and was published posthumously in 1914 by Harvard

University Press under the title *The Ten Books on Architecture*, in which the term "book" refers to a subdivision of the entire work – what today we might call a chapter. In 1960 it became available in a paperback edition issued by Dover Publications. For more on ancient construction, see Rabun Taylor, *Roman Builders: A Study in Architectural Process* (Cambridge: Cambridge University Press, 2003).

Sextus Julius Frontinus was a Roman patrician who had a distinguished career as a military engineer and became governor of Britain and, later in the first century, *curator aquarum*, or superintendent of the water supply of Rome, what today might be called a water commissioner. After assuming this office, he inspected the system of aqueducts and their appurtenances and published (in 97 A.D.) a comprehensive report, *De aquae ductibus urbis Romae*, in which he described the nature of the water supply and its uses, including wasteful practices and misappropriation of water by the installation of unauthorized pipes. The book provides great insight into Roman civil engineering. Its manuscript was discovered by the American hydraulic engineer Clemens Herschel (1842–1930) in 1897 in the Monte Cassino Monastery, which is famous for being on a remote mountaintop in central Italy. Herschel was educated at the Lawrence Scientific School at Harvard and in Europe and has been described as a "brilliant linguist" as well as a talented engineer who invented the Venturi tube for measuring pipe flow. He translated the manuscript into English as *The Two Books on the Water-Supply of the City of Rome* and published it privately, distributing it among his friends. Some engineering societies also acquired copies of the book and for years used them as prizes for distinguished technical papers. Herschel's translation of Frontinus was later published in London by Longmans, Green (second edition, 1913), and was reprinted in 1973 by the New England Water Works Association.

Some secondary sources that provide insight into how engineering was practiced in ancient times are: L. Sprague de Camp, *The Ancient Engineers* (Garden City, N.Y.: Doubleday, 1963), a popular treatment of the subject; J. G. Landels, *Engineering in the Ancient World* (Berkeley: University of California Press, 1978); and the opening chapters of James Kip Finch, *The Story of Engineering* (Garden City, N.Y.: Anchor Books, 1960). See also Henry Hodges, *Technology in the Ancient World* (New York: Barnes & Noble, 1970) and the opening chapters of Richard Shelton Kirby et al., *Engineering in History* (New York: Dover, 1990).

applied science. Engineering is sometimes wrongly defined simply as "applied science," implying that it is little more than the application of scientific principles. This is a gross oversimplification of the nature of engineering, which in practice includes a considerable measure of art and judgment in design in addition to knowledge of scientific principles and application of the scientific method. A commonly cited counterexample to the notion that engineering is nothing more than applied science is the invention and development of the steam engine, which occurred over the course of a century and predated the science of thermodynamics. Indeed, thermodynamics was developed at least in part to explain the principles behind the working steam engines that in the eighteenth century had come into widespread use pumping water out of mines. For more examples, see *The Essential Engineer: Why Science Alone Will Not Solve Our Global Problems* (New York: Knopf, 2010).

architects vs. engineers. In ancient times, construction and other technical projects were under the direction of a master builder, who in Greek was known as an *architekton*, or arch technician, and in Latin as an *architectus*. It is from these classical words that the modern word "architect"