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Eponyms Matter: Diversity, Equity, and Inclusion for Quality in Engineering Sciences

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In engineering science there is a long tradition of naming equations, constants, and units after individuals. The idea of having a name that stands in the company of Isaac Newton, Georg Ohm and James Watt is even a motivation for some researchers. However, the historical restrictions in access to science communication mean that the names of constants and equations have rarely included underrepresented or non-European scientists or engineers. Remembering names of constants and equations is also unrelated to understanding engineering concepts. Recalling an eponym is also not a substitute for an understanding of the physics, it is at best a mnemonic device. As an alternative when the equation or constant can be described using words that reinforce the underlying math, physics, or chemistry these names should replace the eponym. Removing this unnecessary layer of abstraction can help reduce bias associated with the race, class, and geography of science that underlie the eponym.

Recent changes in engineering accreditation have been successful in raising the profile of Diversity, Equity, and Inclusion (DEI) initiatives in engineering (ABET, n.d.). Diversity, Equity, Inclusion, and Accessibility (DEI&A) initiatives have also encouraged support for well-established outreach and helped to motivate inclusion of sidebars in lectures and readings. In some cases, this approach can provide educational context and inclusivity. For example, efforts have been made to include text and lecture sidebars which provide examples of contributions to these disciplines by researchers from more diverse backgrounds, the hidden figures. The mathematician Katherine Johnson, climate scientist Eunice Foote, and the physicist Lise Meitner are all mentioned whenever their significant but unrecognized contributions are related to the topic. Some books go so far as including entire chapters to the foundations of many of the aspects of physics and math from origins of these disciplines in Egypt and Mesopotamian (Williams, James H., 1996). However, these efforts to highlight the contributions of more diverse historical figures are not part of the main narrative and remain as a sidebar rather than the central message associated with the technical content. Engineering is not alone in facing these historical issues. In biology, a problematic history is combined with a lack of broad representation (Guedes et al., 2023). In medicine, these names may also be related to experiments that do not meet modern ethical standards or are associated with atrocities (Whitworth & Woywodt, 2007). Like medicine some engineering subdisciplines also face a reckoning with not only the language but also with the practice of the discipline (Muller, 2018).

Engineering science remains closely tied to the history of science. Starting with simple concepts like Newton's laws and Ohm's law, the physics and introductory engineering classes build a foundation for the disciplines of mechanical and electrical engineering. Sir Isaac Newton and Georg Ohm are credited with these foundational ideas in classical mechanics and electricity. Unlike most current research, in the 17th and 18th centuries, the work was in some cases the result of the work of a typically highly privileged, single individual. However, the history of science is much more complex, and these researchers often made use of Roman, Greek or non-Western resources and understanding. The education of Ohm and Newton would have included a classical education while it is also quite likely that their work depended either directly or indirectly on less visible members of their community. Newton brilliantly articulated the concepts of inertia, momentum, and conservation of momentum. However, artisans and workers would have been familiar with the concepts well before Newton formalized the description. In contrast, Ohm's law concerning the proportionality of voltage and current is less likely to have been part of daily experience. However, Ohm still depended on prior work with galvanic cells and as a mathematician was responsible for formalizing ideas which were understood by experimental researchers. The fame of Newton and Ohm is safe since it is unnecessary to reconsider the names for units of force and resistance. However, the layer of abstraction created by referring to Ohm's law or Newton's laws instead of the proportionality of current and voltage and the conservation of momentum adds nothing to a student's understanding.

The elimination of unnecessary eponyms and resulting exclusion does not in any way minimize the value of including the history of science in the curriculum. Replacing eponyms with technically descriptive names simply removes a layer of obscurity and allows students to incorporate their understanding of the physical world into the naming conventions. In some other cases, using physical or mathematical descriptions can also enhance interdisciplinary communication by emphasizing the centrality of the mathematical, physical, or chemical commonality. For example, the calculus of variation is not usually included as part of undergraduate education. However, variational calculus forms a common thread in many theoretical formulations such as dynamics.

Dynamics can be one of the more difficult subjects for students with less experience with physical systems. The traditional undergraduate dynamics considers the relative motion of rigid bodies and often depends on the student to internalize the effect of the forces and the resulting relative motion using Newton's laws. While the field is mathematical, the math used is often conceptual rather than process oriented. One innovative textbook makes use of a sequential process which is both easier to teach and makes it easier to identify conceptual barriers that the students encounter

(Williams, James H., 1996). By substituting a Lagrangian formulation of the equations of motion for the more traditional Newtonian derivation the text allows an instructor to use a series of clearly defined steps. So, who was Lagrange and why does he get credit for this formulation of the equations of motion? In this case the eponym not only does not provide information about the method, but it also obscures a common mathematical thread.

Researchers in adjacent or related fields may share mathematical foundations which are less obvious when the math is replaced with a discipline specific eponym. If instead of Newton and Lagrange the two approaches were described as a momentum formulation versus a variational formulation the ideas would be more easily generalized. A larger audience and new learners would have no reason to try to remember whether it was 17th century European or 18th century European who took the derivatives of functions.

The naming and misnaming of mathematical or physical concepts is not limited to theory but also occurs in experimental applications. One example of an experimental test named after an individual is the Proctor test (Warrick, 2001). The Proctor test is used to determine the required moisture content for which a soil will be most effectively compacted. This is an important concept and standard test in construction where the underlying soil must be compacted to provide a solid foundation for the roadway or building (ASTM D698, 2012). Ralph Roscoe Proctor was primarily responsible for the systematic description and understanding and eventual improvement in compaction that was already used in practice. While a systematic description is important it is highly improbable that altering the moisture content to facilitate compaction was not already well understood by practitioners. More importantly, by separating the individual biography from the test the user is left with what can be simply called a bulk density test.

Deemphasizing naming and emphasizing processes and understanding for pedagogical purposes is not new. Richard Feynman is famous for his resistance to names as a tool of science not as science (Feynman, n.d.). Knowing the name of an object tells nothing about the object or concept. The elimination of eponyms has a unique standing by increasing the inclusiveness of engineering and science, enhancing understanding, and reducing ambiguity when working in cross-disciplinary fields and in international collaboration. Avoiding or eliminating eponyms also serves to make the study of the history of science a more deliberate act with the associated implications for inclusiveness. Rather than placing the hidden figures as a sidebar they can be discussed as a central part of the discussion of the history of development.

Some balanced thought in this area makes it clear that eponyms will remain in some areas, James Watt and Georg Ohm will remain for the foreseeable future. However, referring to the Proctor test as simply bulk density testing or replacing Newton and Lagrange with momentum formulation versus a variational formulation is straightforward. Perhaps most importantly being deliberate about the use of eponyms and calling them out when used is potentially an opening to a greater awareness of the process of inclusion in science and engineering. Given the association of many of the names in science and engineering with the period of European colonialism, this may truly be a case of decolonizing the engineering curriculum as a related movement proceeds in the physical sciences (Dessent et al., 2022).

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