WHY DO WE CALL IT A...

THIS IS THE SIXTEENTH IN A SERIES OF ARTICLES THAT INVESTIGATES THE HISTORY OF SCIENCE AND ENGINEERING.

One way in which this history has been preserved is in the names of the scientific units that we commonly use. Those units will serve as starting points for these articles as we explore "Why do we call it a...?"

By: ***Lyle D. Feisel****, Ph.D., P.E. (ret.), Iowa Alpha '61*

STOKES

In a past *Non Sequitur* comic strip, the mischievous heroine told the other little girl that Sir Isaac Newton was famous for "inventing gravity." Until Newton created that law, she said, everyone was just floating around. Of course, she also said that Sir Isaac invented the fig newton. The recipient of this valuable information was last seen running off to write her science report, which, we assume, did not receive an enviable grade.

This pair of protagonists might produce a similar scenario involving a Scottish mathematical physicist, Sir George Stokes, crediting him with "inventing viscosity." Viscosity can be thought of as a fluid's resistance to pouring, or, as I like to think of it, the opposite of runniness. Before viscosity was "invented," fluids, both liquids and gases, would have just sloshed around with no impediment to flow. With neither gravity nor viscosity, things would have been a colossal mess. Oh my.

While Stokes didn't really invent viscosity, he was responsible for developing the concept and establishing a mathematical model of the phenomenon. In honor of his many achievements, the centimeter-gram-second (CGS) unit of kinematic viscosity has been named the stokes (abbreviated St). Here is a brief look at the history of this brilliant scientist.

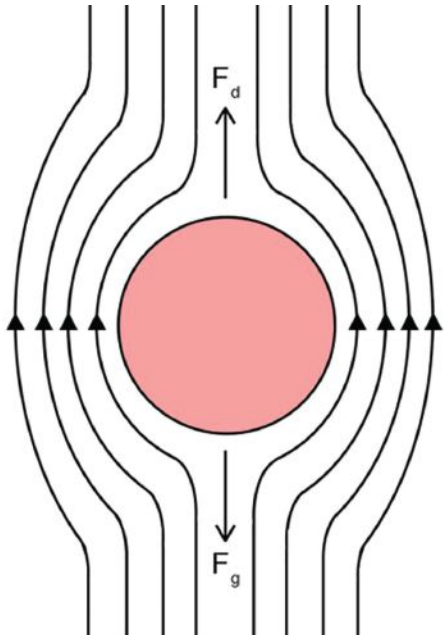
George Gabriel Stokes was born in County Sligo in Northwestern Ireland on 13 August 1819, the youngest son of a clergyman in the Church of Ireland. After receiving his elementary and secondary education in local schools, Stokes enrolled in Pembroke College of Cambridge University at the age of 18. He was an outstanding student, graduating with several honors including Senior Wrangler, a title awarded to the mathematics graduate with the highest score on an extremely competitive mathematics examination.

Why "Wrangler"? As nearly as I can determine, it's because these students wrangle or wrestle with difficult mathematical problems. Several famous scientists, including James Clerk Maxwell, Lord Kelvin, William Henry Bragg, and Bertrand Russel, were high-ranking wranglers. In 1890, the highest score on the exam was earned by a woman, Philippa Fawcett. She could

not be named Senior Wrangler or even be listed as a wrangler, however, because at that time women could not receive degrees at Cambridge. While the university began admitting women in 1869, they did not award degrees to women until 1948. But I digress.

Stokes spent his entire career at Pembroke College of Cambridge University. His academic achievement earned him immediate appointment as fellow of the college, one of a small group of scholars who are responsible for the college's governance. Interestingly, Stokes was required to resign the fellowship in 1857, when he got married. At that time, fellows of the college were required to be single. He was re-elected fellow in 1869, when the requirement was removed. Stokes was accorded the honor of being elected Master of Pembroke in 1902, shortly before his death.

Stokes' achievements were wide-ranging and contributed to several fields of science. As suggested above, he is probably best known for his work in fluid mechanics and viscosity, which he studied early in his career. He contributed to the understanding of the motion of fluids and the frictional forces that are involved in fluids in motion. While the concept of viscosity had been developed by Claude-Luis Navier some 30 years before, Stokes expanded understanding of the phenomenon. In 1851, he derived what is now known as Stokes' Law, which describes the motion of a spherical body through a viscous fluid. Specifically, the law says that the viscous force on a sphere moving through a fluid is proportional to the diameter of the sphere, its velocity relative to the fluid, and the viscosity of the fluid. It is the basis of the operation of the falling sphere viscometer, which determines the viscosity of a fluid by measuring the terminal velocity of a ball falling through the fluid.



Creeping flow past a falling sphere in a fluid: streamlines, drag force F_d and force by gravity F_g.

Stokes is also well-known for his studies of light. He published a number of papers early in his career investigating several optical phenomena including aberration - the apparent positional shift of a star due to the motion of the observer - diffraction of light in solids and liquids, and effects of polarization. He also studied the phenomenon of fluorescence wherein various materials exhibit the property of absorbing light of one frequency, such as ultraviolet, which is invisible to the human eye, and emitting another frequency that may be visible. This phenomenon has come to be known as the Stokes shift.

While Stokes' best-known work is in the basic sciences, he was also involved in more applied engineering activities. In May of 1847, the bridge over the Dee River in Chester, England collapsed, resulting in five deaths. In December 1879, a bridge over the Tay River in Scotland collapsed, killing everyone on board the train that was crossing the bridge at the time. In both cases (note they were some 30 years apart) Stokes was a member of the commissions that evaluated the accidents. The first commission's report resulted in the elimination of cast iron in railway bridges while the second established Stokes' method of calculating wind loading as standard practice in bridge design.

Sir George was also active in the non-technical world. Cambridge University elected - and still elects - one member of the British House of Commons; Stokes held that post from 1887-92 (Sir Isaac Newton had held it for two terms some 180 years earlier). Stokes was religiously devout and, interestingly, worked to defend Christian beliefs from challenges wrought by science, especially Darwin's theory.

Sir Stokes received many honors during his lifetime, including the Rumford Medal and the Copley Medal of the Royal Society. He was named an international member of the American Academy of Arts and Sciences and the American Philosophical Society. Probably more than any other scientist, Stokes has had his name applied as an adjective to various things, e.g., Stokes' Law, Stokes Vector, Stokes Operator, the Navier-Stokes equation, and many more. There is a Stokes Crater on the Moon and another on Mars.

Sir George Stokes died in 1903 at the age of 83. He made enormous contributions to science and engineering and received many honors and awards. His interests and capabilities were very broad, and he produced many scientific papers in such diverse fields as fluid mechanics, optics, ophthalmology and chemistry. He is best known, however, for his contributions to the understanding of viscosity. And that's why we call a stokes a stokes.