Biographical Encyclopedia of Astronomers

Taylor, Geoffrey Ingram

Born Saint John's Wood, (London), England, 7 March 1886

Died Cambridge, England, 27 June 1975

Geoffrey Ingram Taylor is recognized within astronomy for the description of Taylor columns (rotating, rising fluid structures, of which the Great Red Spot on Jupiter may be an example) and for developing the theory of the Rayleigh-Taylor instability, in which a dense fluid, held up by the pressure of a less dense one underneath, rather suddenly exchanges positions with the less dense fluid, in a swirl of eddies and fingers. Supernova explosions and a range of other astronomical events and sources show evidence of the phenomenon. His work has also found applications in meteorology, oceanography, engineering, and aeronautics.

Taylor's father was Edward Ingram Taylor. His mother was Margaret (née Boole) Taylor, daughter of George Boole, the mathematician. Taylor grew up in an atmosphere conducive to an appreciation of science under the influence of his parents and the other Boole daughters, respected scientists in their own right. Indeed, at the age of 12, he and a friend constructed an X-ray generator, only two years after Röntgen had first discovered the ray's existence. Taylor's mechanical skills and ingenuity were also on display as a teenager, when he managed not only to build a sailboat in his bedroom, but also to get it out of his window and sail it on the Thames. Starting in 1905, Taylor attended Trinity College at Cambridge, studying mathematics and physics Upon graduation, he received a scholar-ship for postgraduate research and worked with J. J. Thomson on the interference of low-intensity beams of photons. This led to his first published paper in 1909. (The last appeared in 1973.) Taylor remained at Cambridge for most of his career, later as a fellow of Trinity College and a Royal Society Professor at the Cavendish Laboratory.

Taylor quickly shifted his interest from pure physics to fluid mechanics, and his second published paper, in 1910, studied the structure of shock waves and earned him a Smith's Prize at Cambridge. In 1911, he received a lectureship in dynamical meteorology and delved into an analysis of small-scale processes, including momentum and heat transfer in response to turbulent fluctuations. Taylor found that turbulent velocity distributions were isotopic except near the ground, in contrast to the prevailing theory of time. In response to the sinking of the Titanic, the British government sponsored a study of the distribution of icebergs in the North Atlantic in 1913, and Taylor was named meteorologist of the research ship, Scotia. This allowed him to study transfer properties on a much larger scale. His analysis of the results put forward the concept of a mixing length for turbulent diffusion

Taylor was also very interested in the stability of turbulent systems, including his famous work on steady flow between concentric circular cylinders. He investigated the motion of objects in a rotating liquid. He discovered that where Coriolis effects are dominant, Taylor columns form, of which the Red Spot of Jupiter is considered a potential example. Taylor subsequently

published several phenomenological papers on turbulence, culminating in the 1930s with an empirically testable understanding of the statistical properties of turbulence and a determination of the energy spectrum of turbulent motion

Taylor was always interested in practical problems and was active in war research during World War I and World War II. During the former, he studied shafts under torsion to build better airplane propeller shafts. In the latter, he worked on the Manhattan Project on shock waves and saw the first nuclear explosion at Alamogordo. Even after his retirement in 1951, and for the next 20 years, Taylor continued to investigate new problems in fluid mechanics, including how small organisms swim, electrohydrodynamics, and the dynamics of thin sheets of liquid. Several other important discoveries in the physics of fluids and solids bear his name, including the Taylor-Proudman theorem (one of whose consequences is that rotation of a fluid inhibits convection), Taylor-Couette instabilities, Taylor dislocations (in crystals, a topic he worked on intermittently from 1934 onward), and the Taylor dispersion relation (describing

the relationship between frequency and wavelength in unstable, incompressible flows). It might seem surprising that his work on the behavior of a fluid trapped between a solid cylinder and the inside of a cylindrical chamber is still commonly cited. It is because there remain surprisingly few exact results in the description of convective energy transport in fluids.

Taylor was famous both for his ability to find the important problems to work on and for his ingenuity in finding simple and elegant experiments to test his predictions. Among his honors were fellowships in the Royal Society, the United States National Academy of Sciences, and the American Philosophical Society, knighthood in 1944, and admission to the United Kingdom Order of Merit in 1969. George Batchelor and Sir Brian Pippard, both from Cambridge, were among Taylor's scientific heirs.

Michael Fosmire

Selected References

Batchelor, George K. (1996). *The Life and Legacy of G. I. Taylor*. London: Cambridge University Press. (This biography includes appendices on the honors he received and a complete bibliography of his published papers.)

Pippard, Sir Brian A. (1975). "Sir Geoffrey Taylor." *Physics Today* 28, no. 9: 67.

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