Biographical Encyclopedia of Astronomers

Jeans, James Hopwood

Born Ormskirk, Lancashire, England, 22 September 1877

Died Dorking, Surrey, England, 16 September 1946

British mathematician and astronomer James Jeans formulated two astrophysical concepts: the Jeans mass or Jeans length for deciding whether a given mass of gas will collapse under its own gravitational force, and the Rayleigh-Jeans approximation to the long-wavelength part of blackbody radiation. For much of his life, he supported the Chamberlin-Moulton or tidal encounter hypothesis for the formation of the Solar System and favored a very long timescale, perhaps 10^{12} years, for the Universe as a whole

Jeans, whose mother was a Hopwood, was the son of William Tulloch Jeans, a parliamentary journalist. He was educated at Trinity College, Cambridge, in 1896. He tied for second place (second wrangler) in Part I of the mathematics *tripos* in 1898. Jeans took a first-class honors degree in Part II in 1900. He was awarded an Isaac Newton Studentship and the Smith's Prize in 1900, the latter for an essay on thermodynamics and statistical mechanics of gases

Jeans was elected a fellow of Trinity College in 1901 and appointed a lecturer in mathematics in 1904. Seeing no immediate opportunity for further advancement, he accepted a professorship in applied mathematics at Princeton University in 1905, returning to Cambridge as a Stokes Lecturer in 1910. While at Princeton, Jeans married Charlotte Mitchell of Vermont, who died in 1934, leaving one daughter. In 1935, he married Suzanne (Susi) Hock of Vienna, Austria, who survived him along with their three children.

Jeans experienced intermittent bouts of tuberculosis and heart problems through much of his adult life. He resigned the Cambridge lectureship in 1912, and held only more or less honorary positions thereafter (a Royal Institution professorship 1935–1946 and a research associateship at Mount Wilson Observatory 1923–1946).

Jeans's early work at Cambridge was carried out under George Darwin, who pioneered some of the mathematical methods that Jeans later applied to the behavior, first, of large assemblages of molecules, and, second, of large assemblages of stars. A few examples must suffice. His analysis of the stability of rotating fluid masses showed that if binary stars form from single rotating gas clouds, they must do so *via* violent fragmentation and not *via* quasi-static fission, because the more distorted configurations are more unstable. Starting in about 1900, Jeans reconsidered the question of radiation from gas in equilibrium at a given temperature, previously addressed by Lord Rayleigh, and concluded that the flux should increase monotonically to shorter wavelengths, no matter what the temperature of the gas. This is manifestly wrong, and the Rayleigh-Jeans law (though a good approximation to radio emission from ionized interstellar clouds) served to show that something was drastically wrong with classical considerations of gas and radiation The correct expression was put forward by Max Planck at about the same time and was an early example of energy quantization.

Jeans also examined the expected dynamical evolution of binary systems and of clusters and whole galaxies of stars. He concluded that to reach the current conditions (binaries with eccentric orbits and relaxed clusters and galaxies) would have required 10^{12} years, using the dynamical processes and initial conditions that he thought appropriate. Jeans was, therefore, driven to suppose that stars derive their energy from the annihilation of matter, so that they can live that long, rather than from the "subatomic processes" advocated by Arthur Eddington

His calculations for rotating fluids also persuaded Jeans that the Solar System could not have formed from a single, rotating gas cloud, or the Sun would be a very rapid rotator and have most of the angular momentum in the system. He therefore endorsed and provided a more detailed calculation of the tidal encounter (Chamberlin-Moulton) hypothesis, which said that the planets were made of material dragged out of the Sun by a close passage of another star. Such close approaches must be very rare (a calculation which he did correctly), and so planetary systems must be very rare. Jeans changed his mind on the age of the Universe and the likelihood of other planets only very near the end of his life

The book *Astronomy and Cosmogony* (one of more than half a dozen that he wrote primarily for the educated public) contains a suggestion that new matter is pouring into our Universe from some other dimension at the centers of spiral galaxies. Fred Hoyle credited him as the inventor of the idea of continuous creation in his own 1948 paper on steady-state cosmology

Jeans received a very large number of honorary doctorates, medals, and other honors from organizations in Britain, the United States, and India. He was knighted in 1928 and received the higher honor of the Order of Merit (both for his original scientific contributions and for his communicating science to the public) in 1937. Jeans was president of the Royal Astronomical Society from 1925 to 1927 and established its George Darwin Lectureship by providing the initial endowment. He was elected to the Royal Society in 1906 and served as one of its secretaries from 1919 to 1929, during which time he developed Part A (Mathematics and Physical Sciences) of its *Proceedings* into a leading scientific journal.

Jeans was an enthusiastic amateur musician. He was the author of a book on the physics of music who installed a large pipe organ in his retirement home, which he shared with his second wife; some of their playing was preserved in recordings archived by the Royal Astronomical Society.

David Jefferies

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