Biographical Encyclopedia of Astronomers

Milne, Edward Arthur

Born Hull, England, 14 February 1896

Dublin, Ireland, 21 September 1950 Died

British mathematician Edward Milne contributed many of the ideas that have made it possible to analyze the spectra of stars and determine the temperatures, densities, and chemical compositions of their atmospheres, some of those ideas bearing his name. However, he is perhaps more often remembered for a unique cosmological model in which gravitation and electromagnetism followed two different kinds of time.

Milne was the eldest of three sons (all eventually scientists) of a headmaster of a Church of England school, Sidney Milne, and a teacher, Edith Cockcroft. After completing his studies at Hymers College in Hull, Milne won a scholarship at Trinity College, apparently having achieved the highest score to date on the entrance examination. His eyesight made him ineligible for active duty in World War I, but a year and a half after beginning work (in 1914) at Cambridge, he withdrew to work on anti-aircraft ballistics research for the duration of the war Shortly after returning in 1919, Milne was elected a fellow of Trinity College (precluding the need for an advanced degree) and, in 1920, became assistant director of the Solar Physics Observatory under Hugh Frank Newall, the founder of astrophysics at Cambridge. Milne was appointed to the Beyer Professorship of Applied Mathematics at the University of Manchester in 1925 and, in 1929, became the first Rouse Ball Professor of Mathematics at Oxford University, where he and Harry Plaskett founded another school of astrophysics.

Milne's work of greatest lasting importance was done at Cambridge and Manchester. He showed that a star in which energy was transported by radiation could not rotate like a solid body, and that the pressure of radiation on atoms with very strong absorption lines (like the violet pair of ionized calcium) would be enough to lift atoms off the surface of a star into its chromosphere. Such "line driving" is now recognized as the cause of winds from cool, bright stars Working with Ralph Fowler, Milne showed that these strong lines are produced very high in the atmospheres of the Sun and stars, and used the Saha equation to calculate the temperature at which these lines would be strongest. This, in turn, led to a theoretical explanation of why some spectral features of ionized atoms appear stronger in giants than in dwarfs, providing the physical underpinning of stellar luminosity criteria, including an explanation of what the light coming from the Sun should look like. He pioneered the idea of detailed balance in stellar atmospheres (the idea that the number of transitions between a pair of levels going up and down must have a fixed ratio), leading to what were then called the Milne relations, and derived a form of the equation describing how radiation propagates through stellar gas that also bears his name. His approximation for the opacity of gas to that propagation is still used in calculations to show what the dominant effects must be in the appearance of stellar spectra. And the Milne-Eddington approximation describes absorption features and the stellar continuum as it is being formed together in all layers of the atmosphere.

At Oxford, Milne turned his attention to cosmology, as did many astronomically inclined British mathematicians, in light of Edwin Hubble's discovery of the redshift-distance relation and the increasing familiarity of Albert Einstein's general theory of relativity. Milne and William McCrea in 1934 published a set of Newtonian cosmological models that had many of the features of the relativistic ones, but were much easier for most people to understand and are still used as analogies in modern discussions of cosmology. But Milne felt that his most important contribution was what he called kinematic relativity. He started with homogeneity and isotropy (so that every fundamental observer would see not only the same physics but the same history of the Universe) as a basic assumption, not as an observation Milne believed that he could follow this assumption to a single-model universe that would be the only self-consistent possibility, requiring certain laws for gravitation and so forth. This was not published in final form until his 1948 book, Kinematic Relativity. By then, he had also incorporated different timescales for gravitational and electromagnetic time, the former a natural logarithm of the latter. Others have returned from time to time to these ideas, but so far without much impact on understanding either the structure of the Universe or the physics in it.

Also at about the time he went to Oxford University, Milne suggested that nova explosions might be caused by the collapse of a normal star to a white dwarf. They are in fact explosions on the surfaces of white dwarfs with close companions, but the suggestion meant that the idea of collapse as a source of rapid energy release was "in the air" when Walter Baade and Fritz Zwicky put forward the (correct) idea of powering supernovae with collapses to neutron stars

Milne was elected to the Royal Society (London) in 1926, and received medals from the Royal Astronomical Society (London), the Astronomical Society of the Pacific, and other scholarly organizations. He served as president of the London Maths Society (1937–1939) and suffered a fatal heart attack during a meeting of the Royal Astronomical Society, of which he had served as president from 1943 to 1945.

Douglas Scott

Selected References

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