

Biographical Encyclopedia of Astronomers

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Cowling, Thomas George

Born Walthamstow, (London), England, 17 June 1906

Died Leeds, England, 16 June 1990

English mathematician and theoretical astrophysicist Thomas Cowling gave his name to a model of stellar structure in which all of the energy is released very close to the center and to a theorem relevant to the generation and structure of the magnetic fields of the Earth and Sun. However, the part of his work that has the strongest resonance down to the present is the classification of vibrational modes in the Sun or other stars into p (where pressure is the restoring force) and g (where gravity is the restoring force) modes, separated by a fundamental radial oscillation, all of which have now been seen and which provide vital information on the deep interiors of the Sun and other stars

Cowling was the second of four sons of Edith and George Cowling, an engineer with the post office, who brought home a large horseshoe magnet that may well have contributed to his son's lifelong interest in magnetism. The family members were all lifelong active Baptists. Cowling married Dorris Marjorie Moffatt in 1935 and was survived by her and their three children

Cowling graduated from a county-supported grammar school in 1923 and won a scholarship to Brasenose College, Oxford, where he earned a first-class degree in mathematics in 1927 and a teaching diploma in 1928. This delayed his start in research toward his Ph.D. (1930) by one year, giving him the opportunity to become Edward Milne's first Oxford student. Milne had him work on the structure of stellar atmospheres. Among the results was the conclusion that work by Sydney Chapman, purporting to show that the Sun's magnetic field could not extend very far, was simply wrong. The Sun must have open-field lines extending very far out (far beyond the Earth's orbit). It is a tribute to Chapman that he reacted to this by offering Cowling his first job as a demonstrator in the mathematics department at Imperial College, London

Cowling spent his entire career in university mathematics departments: Swansea, 1933–1937; Dundee, 1937/1938; Manchester, 1938–1945; Bangor, 1945–1948; and Leeds, 1948–1970, the first three as lecturers, the last two as professors. He guided very few research students or fellows; only Eric Priest (a solar physicist) and Leon Mestel (a mathematically inclined astrophysicist particularly interested in magnetic fields) remained in astronomy.

A number of Cowling's calculations were of considerable importance at the time. These included a demonstration that magnetic field lines must be frozen into an ionized gas (1932). A more developed version of it was later published by Hannes Alfvén, whose relationship with Cowling was one of mutual respectful criticism

Cowling demonstrated in 1934 that an axisymmetric field cannot be maintained by dynamo action. This result gives rise to the name "Cowling antidynamo theorem" and prevents axisymmetric approaches to describe the magnetic field of the Earth and Sun.

Another Cowling demonstration showed that the lowered temperatures of sunspots must be maintained by magnetic fields connected with the solar interior (1935). In the Cowling model for stellar structure, energy generation is confined to the extreme center. A core with convective energy transport and an envelope with radiative energy transport are now known to describe

the conditions of hydrogen-burning stars of more than about 1.5 solar masses, which are powered by the CNO cycle

Cowling considered the possible runaway pulsational instability of stars with centrally concentrated energy generation (1935). He showed that convection would take over before the instability got out of hand except in very massive stars. Such stars are now known to display such instabilities as luminous blue variable or Hubble-Sandage variable stars, and he went on to classify less-violent pulsations that actually do occur in stars like the Sun (1941).

Cowling's close scientific association with Ludwig Biermann, and perhaps other Central European colleagues, led to his being considered unreliable during World War II. He remained in his department, although he realized afterward that some of the problems Chapman asked him to work on (gas diffusion theory, for instance) had been relevant to the atomic bomb project and others to the development of radar. Back problems from 1957 onward and a mild heart attack in 1960 gradually curtailed Cowling's activities. Although he had been a strong proponent of a national center of theoretical astrophysics, by the time such centers were established in Cambridge and Sussex in the late 1960s, he was not able to relocate.

Recognition of Cowling's work came in the form of a Gold Medal of the Royal Astronomical Society and the Bruce Medal of the Astronomical Society of the Pacific, election to the Royal Society (London), and award of its Hughes Medal, of which he never learned, dying just two days after the announcement. He served as president of the Royal Astronomical Society (1965–1967) and of the Commissions of the International Astronomical Union on stellar structure (1955–1958) and on magnetohydrodynamics (a field in which he was a pioneer) and physics of ionized gases (1964–1967). Cowling was both unusually tall and unusually (even for his generation) given to formal dress, so that an unsuspecting younger astronomer might well find himself being introduced, in effect, to Cowling's middle waistcoat button.

Emmanuel Dormy and Virginia Trimble

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