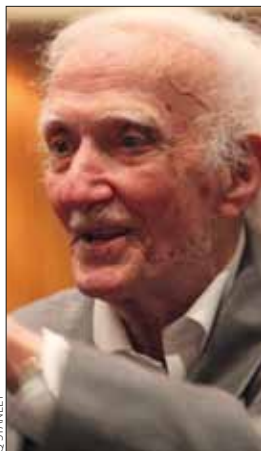


James Wynne Dungey 1923–2015



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A hugely influential theorist and RAS Gold Medallist, who in 1961 pioneered reconnection in the Sun–Earth system, remembered by **David Southwood**.

Jim Dungey was one of the last of the first solar–terrestrial physicists of the space age. Born in 1923, he finished school after the second world war had started. He did war work on radar at the BTH (British Thomson-Houston) plant in Rugby. Subsequently, at Cambridge, Fred Hoyle's lectures sparked his imagination and he registered for a PhD with Hoyle. He was surprised but not unhappy to receive a problem in solar–terrestrial physics – a problem that would follow him for his entire career. Hoyle turned on its side a proposal from Ron Giovanelli in Sydney that magnetic neutral sheets on the Sun could give rise to solar flares; he asked Jim to investigate whether the formation of a neutral sheet in the magnetic cavity on the nightside of Earth could give rise to the aurora. Jim concluded that a discharge could occur. Moreover, as he said, “My thesis in 1950 contained the essential of what I later called ‘reconnection’ and one major step in the application to what was later called the ‘magnetosphere’” (<http://bit.ly/1hj0zIV>). He did not publish the full implications, the reconnection model of the magnetosphere, until 1961, because he was awaiting an observational clue.

After his PhD he went to work with Giovanelli in Australia, followed by a year at Penn. State and then a return to Cambridge as an ICI fellow, during which time he produced his short monograph *Cosmic Electrodynamics* (published by CUP in 1958) by “writing down all I knew”. The book is long out of print but makes interesting reading. After stints at Kings College Newcastle (now Newcastle University) and the UK Atomic Weapons Research Establishment, in 1965 he accepted a chair at Imperial College, London.

Reconnection

Jim's two-page *Physical Review Letters* paper (Dungey 1961) now underpins our whole understanding of solar–terrestrial coupling. The observational clue was his realization that he could explain the SD storm time ionospheric current system. Nevertheless, community-wide acceptance that magnetic reconnection controlled solar wind–magnetospheric coupling was a long time coming. The reason for the delay is for historians to analyse. The field was riven by disputes in the 1940s and 50s between followers of two giants, Sydney Chapman and Hannes Alfvén. In hindsight, Jim's model resolved in one fell swoop the contradictions between these schools, revealing where both were wrong. That was not easy to accept for acolytes; high emotions were aroused. By 1966, Don Fairfield, one of Jim's students, had produced direct evidence of a southward magnetic field controlling ionospheric magnetic disturbances (Fairfield & Cahill 1966). In 1970, Aubry *et al.* showed magnetopause erosion uniquely predicted by Jim's model. Nonetheless, general acceptance came only with the results from the International Sun–Earth Explorer spacecraft later in the 1970s. Direct measurements

of plasma acceleration consistent with reconnection at the magnetopause (Paschmann *et al.* 1979) made doubt difficult, if not impossible.

The enormous influence of the 1961 paper draws attention from the many other seeds Jim sowed. He was a theorist, but he welcomed any kind of experimental data: ground-based, space-based or computational. Plasma physics itself was a new field when he began his career. Ideas such as frozen-in magnetic field and magnetohydrodynamic waves were opening up astrophysics as well as solar–terrestrial physics. At the same time it was becoming clear that plasmas, as perfect conductors, could lead to effects that were counter-intuitive to standard ideas.

New discoveries

Jim liked to shock and in part his fascination for collision-free plasmas lay in departures from expectations based on classical electromagnetism or the theory of gases. Stimulated VLF emission intrigued him immensely, as did auroral currents and acceleration and, always, collision-free reconnection. Asides

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or footnotes launched whole lines of research. In 1954, he proposed that the regular sinusoidal geomagnetic “micropulsations” were standing MHD waves in the (as yet unnamed and undiscovered) magnetosphere.

In 1955, he suggested that the interface between the solar and terrestrial environments (now known as the magnetopause) would be subject to Kelvin–Helmholtz instability. With US colleagues he showed that the radiation belts had an external origin. He saw early that whistlers could determine the equilibrium of the belts and that magnetospheric MHD waves could be excited by bounce-drift resonance.

In 1966, Jim proposed TOPS, the Tetrahedral Observatory Probe System, to the European Space Research Organisation, predecessor of the European Space Agency. Fruition came in 2000, when ESA launched the four Cluster spacecraft. Determination of the detailed structure of large-scale currents, Kelvin–Helmholtz boundary waves, the auroral acceleration region and the structure of the dayside and nightside reconnection regions and the bow shock became possible just as he had envisaged.

Jim did not receive as much recognition during his career as he was due. At the time of his retirement in 1984, he was happily aware that his open magnetospheric model by then ruled all. He received the Gold Medal of the RAS, the Fleming Medal of the American Geophysical Union and the highest European Geophysical Society award, honorary membership. Few people's reputation grows as much as Jim's has after retirement. In 2012, the RAS Council introduced an annual James Dungey Lecture in solar, planetary and solar–terrestrial physics. A special RAS meeting celebrated his 90 birthday in 2013; a Festschrift from that meeting is in the final stages of publication with Springer in the RAS Book series. ●

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