OBITUARY

Hermann Bondi (1919–2005)

Mathematician, cosmologist and public servant.

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Hermann Bondi, who died on 10 September aged 85, is perhaps best known as one of the original advocates of the steady-state theory of the Universe, advanced as an alternative to the now dominant Big Bang theory. But as an astrophysicist, mathematician and cosmologist, his interests were wide-ranging and his intellectual brilliance undoubted. As a scientific adviser to successive British governments, he also contributed immensely to the public life of his adopted country.

Bondi was born in Austria to Jewish parents. As a schoolboy in Vienna he showed precocious mathematical ability, and decided that he wanted to work with the renowned mathematician and astronomer Arthur Eddington at the University of Cambridge. Bondi arrived at the university's Trinity College in 1937. In March 1938, German troops entered Austria and *Anschluss* was proclaimed. Bondi's parents and sister followed his cabled advice to "drop everything and leave", settling eventually in New York; he himself, an anglophile, remained based in England for the rest of his life.

In the panic following the collapse of France in 1940, Bondi was interned on the Isle of Man and then in Canada. With typical resourcefulness, he helped set up a camp university at which he gave lectures on mathematics. In Canada, he met a fellow Viennese internee, Thomas Gold, who became his lifelong friend and collaborator. On their return to Britain in 1941, Bondi and Gold joined the Admiralty's radar research group, led by Fred Hoyle. It was this trio's off-duty discussions on astronomy that were to bear fruit when they returned to Cambridge at the end of the war.

This was a time of momentous advances in astrophysics. In the late 1930s, Hans Bethe and Carl-Friedrich von Weizsäcker had shown that, at the high temperatures inside stars, energy liberated from the nuclear fusion of hydrogen to form helium could supply stellar luminosity. This led Hoyle and Ray Lyttleton to a reappraisal of the physics and mathematics of stellar structure developed by Bondi's hero Eddington. Together with his wife Christine — one of Hoyle's doctoral students — Bondi transformed these equations, so simplifying the construction of stellar models, especially those of chemically inhomogeneous stars. Bondi's student, Roger Tayler, exploited their technique further in a thesis that foreshadowed the now established picture of stellar evolution through nuclear processing from the main sequence to the giant branch.

Bondi also applied his mathematical skill to various problems in cosmic gas dynamics. In particular, he wrote an elegant paper on the spherically symmetric, pressure-limited gravitational accretion of interstellar gas by a star at rest in a gas cloud. An earlier paper, written with Hoyle and Lyttleton, had argued that gravitational energy released by accreted gas heats the corona of the Sun to more than a million degrees. Although coronal heating is now known to come from the dissipation of energy propagating outwards from the Sun, the resulting coronal expansion — the 'solar wind' — is most simply described by changing the boundary conditions in Bondi's spherical accretion model to yield an analogous flow with opposite sign.

But Bondi is undoubtedly best known for his partnership with Hoyle and Gold in the advocacy and detailed study of steady-state cosmology. In this model, the expansion of the Universe — inferred by Edwin Hubble from the redshifted spectral lines of distant galaxies — is exactly compensated by the continuous creation of matter. According to this idea, the mean density of matter in the cosmos remains constant; the Universe has no beginning, no end and no age. Bondi's motivation came in part from observational difficulties then besetting the rival Big Bang cosmology (to use Hoyle's intentionally pejorative term), but also from his conviction that an acceptable cosmology must satisfy Mach's principle, which relates local inertial effects to the global properties of the cosmos.

His philosophy of science was strongly influenced by Karl Popper. He favoured steady-state cosmology because it was 'vulnerable' — it made precise predictions that were falsifiable, in Popper's sense of the word. This puritanical stance was tempered by his appreciation that incontrovertible observational facts were often hard to find. Thus he pointed out that the mass of Capella, used by Eddington to calibrate his stellar mass–luminosity relation, had since been revised. Equally, one 'fact' that cast doubt on evolutionary cosmology — the ages of the oldest stars apparently exceeded the estimated age of the Universe — disappeared in 1952 with Walter Baade's doubling of the cosmic distance scale.

Bondi remained true to Popper, and gave up the steady-state hypothesis in the face of increasing conflicting observational evidence, such as the discovery in 1965 of the cosmic microwave background radiation, which the steady-state hypothesis could not easily explain. He showed little interest in the subsequent revised versions proposed by Hoyle and his collaborators. Bondi's legacy in this area is his superbly written monograph *Cosmology*, and a series of papers on general relativity, especially on gravitational radiation. The list of concepts that bear his name shows his influence: the Bondi news function, the Bondi mass, Bondi waves, the Bondi–Metzner–Sachs group and the Tolman–Bondi universe.

From 1951, Bondi's academic career continued at King's College London, and culminated in his election in 1983 as master of Churchill College, Cambridge. But he also began a parallel life as a high-level public servant, becoming director-general of the forerunner of the European Space Agency, the Paris-based European Space Research Organization, in 1967. In a subsequent wide-ranging career in Britain that was testament to both his intellectual and his organizational abilities, he was successively chief scientific adviser to the Ministry of Defence, chief scientist to the Department of Energy, where he laid the groundwork for Britain's first long-term energy policy, and chairman of the Natural Environment Research Council. One of his greatest achievements was his report written after the 1953 floods that devastated parts of eastern England, which ultimately led to the construction of the Thames Barrier to protect London from storm surges.

Bondi believed strongly in the social responsibility of scientists, and so was active in the Pugwash movement and the scientific education of the public. From 1982 to 1999 he was president of the British Humanist Association. Although he could be ruthless when confronted with flawed arguments, whatever their source, he respected the intellectually honest opponent working from different axioms. He will be much missed, as both a public servant and a private man. ■

Leon Mestel
Leon Mestel is emeritus professor of astronomy at the University of Sussex, Falmer, Brighton, East Sussex BN1 9QH, UK.
e-mail: lmestel@sussex.ac.uk