

Hermann Bondi (1919–2005)

Travelling to Hyderabad with Fred Hoyle in the late 1980s, I once ran into Hermann Bondi and Lady Bondi at the Santacruz Airport, Mumbai. After exchanging greetings, I asked Bondi where he was off to. Hyderabad? Bangalore? No, he was heading for Vijayawada. Fred and I were surprised as we could not think of a scientific institution in physics or mathematical astronomy in Vijayawada that could attract him. Bondi explained that he was in India in connection with an international meet of humanists and was to visit the Atheist Centre in Vijayawada.

This episode brought home to me a new facet of Bondi, whom I had the pleasure of knowing from my student days in Cambridge. Apart from being an applied mathematician par excellence, and a physicist who was associated with astronomy and space sciences, including the early days of European Space Research Organization, Bondi was a philosopher and a rationalist. For a period he was the President of the British Humanist Association.

Born in a Jewish family in post-World War I Vienna in 1919, Bondi inherited his anti-religious belief from his parents. His father, while a non-believer himself, preferred to follow the rituals more as a way of sharing and sustaining social intercourse and as a part of the cultural ambience. His mother, however, was a rebel and disliked the orthodoxy and narrowness of religion. Not surprisingly, young Bondi grew in an environment of free thinking. This was to influence his scientific thinking and creativity.

A bright student at school, Bondi was greatly influenced by the personality and work of the Cambridge astronomer, Sir Arthur Eddington, Eddington had been to Vienna when Bondi was in his mid-teens and had encouraged the latter to try for a place in Trinity College, Cambridge. Trinity was a difficult college to get into, especially for foreign students with recommendations from seniors who were unknown to the Cambridge authorities. Nevertheless, Bondi succeeded in getting a place as a 'Commoner' (i.e. without a scholarship). His brilliant performance at the Mathematical Tripos, soon won him a scholarship and later the great honour of a College Fellowship.

However, while he was advancing on the academic front, Europe was in turmoil.

The Second World War had broken out and as Jews, the Bondi family wisely emigrated from Austria to the safer haven of England. Later, his family went to USA, while Bondi himself was interned as an alien coming from a hostile country. (Even in this state he organized a lecture course in mathematics.) All this was sorted out in due course and Bondi joined the war effort as a scientist at the Admiralty Signals Establishment. His work was on radars, but here he encountered Tommy Gold, another alien refugee scientist, who was to be a life-long friend and research collaborator. And even more importantly, he met Fred Hoyle, also from Cambridge, seconded to wartime research at the admiralty.



In the early post-war years the collaboration between Bondi, Gold and Hoyle, to which another Cambridge mathematical astronomer Raymond Lyttleton also contributed during a few occasions, turned out to be a fruitful one for astronomy. Classical mathematical astronomy from Newton's times had developed in the field of celestial mechanics. Eddington's work on stellar structure was to set a new dimension by showing how astronomical structures like stars could be understood with the help of mathematical models using laboratory physics. Hoyle and Lyttleton carried Eddington's baton further and the former was to make pioneering contributions to the fields of stellar structure, evolution and nucleosynthesis in the 1940s and 1950s.

Bondi, being inclined more towards applied mathematics than theoretical physics, opened a new chapter on stars. Stars are not in empty space, they are in a tenuous

medium containing gas and dust. Would not stars attract matter from the surroundings as they moved? Bondi's work on accretion, in collaboration with Hoyle and Lyttleton, was to set the trend which future generations of astrophysics would follow ... and are still following in many different contexts.

However, Bondi, Gold and Hoyle are perhaps best known for their contribution to cosmology, the subject dealing with the origin of the universe. In 1948, Bondi and Gold in a joint paper published in the *Monthly Notices of the Royal Astronomical Society*, propounded the perfect cosmological principle which laid down the rule that the universe, on a large scale, is not only homogeneous and isotropic at any given epoch (as most cosmologists liked to assume), but it is unchanging on long timescales. This assumption led them to the steady state theory of the universe. Bondi was motivated by the criterion laid down by the philosopher Karl Popper that a scientific hypothesis should be disprovable. That is, it should come out with clear-cut predictions that can be tested. The steady state theory of Bondi, Gold and Hoyle did make clear predictions.

Hoyle, on the other hand, also arrived at the same model of the universe from his belief that creation of matter in the universe is the most important phenomenon that a cosmologist has to explain. He used field theory, employing the notion of a negative energy scalar field, to generate matter. His paper was delayed, but appeared soon after the Bondi-Gold paper.

The big bang theory held the central stage and the steady state theory was treated as a serious rival, and the period 1950–65 saw many observational attempts to 'settle' the cosmological issue. There were several attacks on the steady state theory, with observations claiming to disprove it. Bondi vigorously defended it, as did Hoyle, until the 1965 discovery of the cosmic microwave background and the observations of light nuclear abundances. In the 1960s, these could not be explained by the steady state theory, which then lost the battle for survival. Bondi subsequently did not take an active interest in cosmology, including in the revival of the steady state theory in the form of quasi-steady state cosmology by Hoyle, Geoffrey Burbidge and Jayant Narlikar.

PERSONAL NEWS

In fact, he had moved away from cosmology towards the study of gravitational waves. In 1954 he joined King's College, London as Professor of Applied Mathematics and set up an active group on general relativity. With Felix Pirani and Clive Kilmister and with visitors like Ray Sachs and Roger Penrose, the King's relativity group acquired international reputation. Bondi himself regarded his 1962 paper in the 15-paper series on gravitational waves as his best intellectual achievement. Many would likewise consider his small book *Cosmology* as a classic that continues to be readable and relevant even today.

Bondi was a good teacher. His lectures were well reasoned out, clearly delivered and interactive with the audience. He enjoyed being an examiner too, setting new (unrepeated) questions. I had been at the receiving end when he was the examiner for the Dynamics paper in the Mathematical Tripos, Part II. I later discovered that one of the many tough questions was based on his accretion theory.

What was a loss to the academic world of mathematical astronomy and relativity but gain to science management and administration, were Bondi's subsequent

'avatars' as Director General of ESRO in Paris, Chief Scientific Advisor to the Ministry of Defence, Chief Scientist to the Department of Energy, Chairman and Chief Executive, Natural Environment Research Council and finally as Master of Churchill College, Cambridge. In each of these places he left his mark as a clear- and far-visioned administrator. He kept his cool and maintained an optimistic outlook in times of crises. As Hoyle once said, 'Hermann would laugh his way out of any difficulty'.

It was in Cambridge in 1947 that Bondi married Christine Stockman, a research student of Hoyle. Their five children are all doing well in their respective fields. Hermann and Christine wrote several scientific papers together. They travelled a lot and liked visiting India. Bondi enjoyed reading travel guides, including the ancient editions of Baedeker (which he preferred to the modern guides) and once confessed that he should perhaps have become a travel agent instead of a scientist!

As with many trained at the great Alma Mater, Cambridge, leaving it in 1954 had been a difficult decision. Bondi took it, as he felt that although he could continue doing exciting work at Cambridge, his

horizons there might be limited. This decision in retrospect was right for a person of such multifaceted talent. He did return to Cambridge some three decades later as Master of Churchill College, and after his retirement lived in a nearby village. In the concluding chapter of his autobiography *Science, Churchill & Me*, he expresses satisfaction at having enjoyed good health that permitted him to follow a strenuous routine, including long-distance jet-hopping. This biography was written in 1990. Ironically, a few years later, he was hit by Parkinson's disease. He continued his intellectual and physical activities despite its debilitating effects, but finally fell victim to it on 10 September 2005. He is survived by Christine. There were many (like this author) all over the world, who were inspired by his personality, his ideas, his work and his books and will miss him.

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MEETINGS/SYMPOSIA/SEMINARS

Sixth International Conference on Biodeterioration of Cultural Property

Date: 14–17 February 2006
Place: Chandigarh, India

Topics include: Biodiversity and biodeterioration; Causes and mechanism of biodeterioration of different materials; Case studies; Insect, bird and rodent attack; Environmental impact on biodeterioration; Impact of biodeterioration of materials on human health; Prevention and control, etc.

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Advanced Training Programme on Role of Mathematical Modeling in Groundwater Flow and Transport

Date: 23 January – 4 February 2006
Place: Visakhapatnam

The training course consists of lectures and practical hands-on exercises using software. The exercises include step-by-step model tutorials illustrating how to develop groundwater models with groundwater software.

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