Donald Lynden-Bell

(1935–2018)

Astrophysicist who predicted that galaxies have black holes at their hearts.

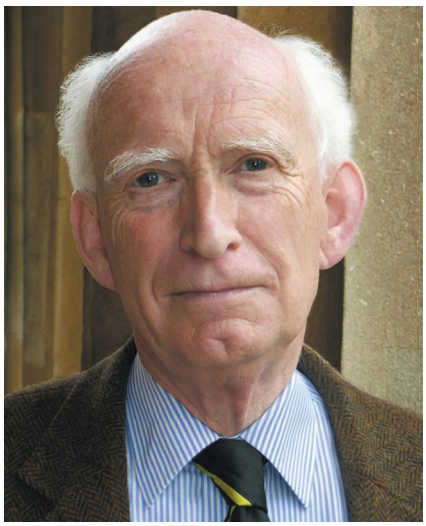
In 1969, Donald Lynden-Bell became the first astrophysicist to suggest that supermassive black holes in the cores of galaxies might generate the profuse energy put out by quasars — the astonishingly luminous distant bodies identified by astronomer Maarten Schmidt earlier that decade. Lynden-Bell proposed that quasars are powered by the release of gravitational energy as material falls into the deep potential well of the black hole, a process that is much more efficient than thermonuclear fusion (D. Lynden-Bell *Nature* **223,** 690–694; 1969).

Over the following decades, he was proved right. We now know that black holes are almost ubiquitous in galaxy cores and seem to have a central role in galaxy evolution. In the past 20 years, the motions of stars at the centre of the Milky Way have revealed a black hole that is four million times as massive as the Sun. And the Hubble Space Telescope has shown that black holes with masses of millions to billions times that of the Sun lie at the core of almost all massive galaxies. Lynden-Bell and Schmidt shared the first Kavli Prize for Astrophysics, in 2008, for their contributions to understanding quasars.

Lynden-Bell died on 6 February 2018. Born in 1935 in Dover, UK, he studied mathematics at the University of Cambridge, followed by a PhD there in theoretical astronomy with Leon Mestel.

In the early 1960s, he spent two formative years at the Carnegie Observatories in Pasadena, California. Using measurements of the composition and orbits of stars taken by Olin Eggen and Allan Sandage, the three developed a model for the formation of the Milky Way, based on the rapid collapse of a large spherical gas cloud (O. J. Eggen *et al. Astrophys. J.* **136,** 748; 1962). This was the standard picture for the formation of the Milky Way and other galaxies until the late 1980s, when it was overtaken by the hierarchical-assembly model used today. Lynden-Bell returned to Cambridge in 1962 and moved to the Royal Greenwich Observatory at Herstmonceux, Sussex, in 1965. By this time, he was an astronomer of international stature.

In 1972 he went again to Cambridge, as the first director of the Institute of Astronomy — an amalgamation of the Cambridge Observatories and the Institute of Theoretical Astronomy, which had been founded five years earlier by astronomer Fred Hoyle. The



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merger was not initially a happy one, and Donald did not relish his first years at the helm. But he threw himself into new projects, including a plan to build a telescope for the institute (sadly never realized).

He was generous with his ideas and time, and was always curious to know what students were up to, often quizzing them in the corridor. Although he was always supportive, his sharp mathematical insight and booming voice could sometimes be intimidating. He was renowned for taking on young scientists at squash. Student victories were rare.

In the early 1980s, he joined six collaborators in what, at the time, was a huge survey of more than 400 elliptical galaxies. The team — Sandra Faber, her former students Alan Dressler and David Burstein, together with Gary Wegner, Roberto Terlevich, Lynden-Bell and I — formulated a new method for determining the distances to galaxies. Combining this with measurements of how fast the galaxies were moving away, we traced their motions across the sky. It revealed a remarkably coherent flow — with a speed much greater than predicted — in the direction of the constellation Centaurus and close to the plane of the Milky Way, where dust obscures our view of the Universe beyond. Could the corrections used to account for this dust have given rise to a misleading result?

Lynden-Bell was tenacious in scrutinizing these data, and he formulated a test to ensure that the selection of galaxies had not introduced bias. The intense work generated friction among the team, some of which Lynden-Bell diffused by regaling us with funny stories. On one occasion, he gave a hilarious recitation of the Patrick Barrington rhyme that begins "I had a duck-billed platypus when I was up at Trinity…".

To account for the flow, we hypothesized that there should be many more galaxies behind and beyond the Galactic plane than had been assumed. Dressler nicknamed this concentration the Great Attractor. (Indeed, working with cosmologist Ofer Lahav at around the same time, Lynden-Bell identified a significant over-density of galaxies.) At meetings in 1986, theorists greeted the results with alarm, and observers were sceptical. At a workshop in Santa Cruz, California, astronomer Amos Yahil dubbed our team the 'seven samurai' as a nod to our disregard for conventional cosmology.

Lynden-Bell continued to publish influential work on many subjects. These ranged from accretion disks and jets, the violent relaxation of stellar systems, stellar dynamics and spiral structure to general relativity. His extensive studies of the Milky Way and its satellites will be tested in April 2018, when the next tranche of results emerges from the European Space Agency's Gaia satellite. He wrote several papers on statistical mechanics with his wife, Ruth Truscott, a professor of chemistry at Queen's University Belfast; they married in 1961 and raised two children, Marion and Edward.

Donald loved sharing the joy and excitement that a life in science had brought him. Fifty years after their first sojourn in California, he and three friends — astronomers Nick Woolf, Wal Sargent and Roger Griffin — returned to the western United States and relived some of the hikes and road trips of their youth. This expedition was made into a 2015 film, *Star Men*, by Alison Rose. Gentle and captivating, it explores comradeship and ageing. Donald travelled around the country to introduce the film and answer questions.

Donald Lynden-Bell was a towering, stimulating, analytical theorist of the sort that is increasingly rare in these days of high-performance computers. ■

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