George Herbig

(1920–2013)

Astronomer who pioneered studies of young stars.

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George Herbig's research, which spanned more than 70 years, built the foundation on which rests our present-day understanding of the birth of stars and of the properties of young stars. He had an uncanny ability to identify astronomical objects and research topics that would become key elements in the study of early stellar evolution.

Herbig, who died on 12 October, was an only child born in modest circumstances in Wheeling, West Virginia. His father, a tailor, had settled there after emigrating from Germany. Sometime after his father's early death, Herbig moved to Los Angeles, California, where as a teenager he built his first telescope. The nearby Mount Wilson Observatory, housing what was then the world's largest telescope, with a 2.5-metre mirror, fostered his growing interest in astronomy.

Through joining the Los Angeles Astronomical Society as a young man, Herbig met many of the great astronomers of the time, and had the opportunity to attend observations at Mount Wilson. He later spoke of the awe he had experienced when looking, using the spectrograph slit of the 2.5-metre telescope, at the giant star Mira — a luminous red spot, seemingly boiling as a result of its light passing through Earth's turbulent atmosphere. At the tender age of 20 he published his first brief scientific results, on the diameter of stars.

From observations spanning from the late 1930s to the early 1940s, Herbig's mentor, Alfred Joy, had discovered a peculiar class of variable stars named after the prototype star T Tauri. These objects are often associated with dark interstellar clouds, and it was initially speculated that their characteristic variable brightness could be attributed to the stars passing through the gas and dust of the interstellar medium.

T Tauri stars became the topic of Herbig's 1948 PhD thesis, *A Study of Variable Stars in Nebulosity*. His work supported the growing consensus that these stars are very young — with their luminosity arising not from nuclear burning, but from the release of energy as the stars contract under gravity. Following decades-long systematic studies of T Tauri stars, Herbig synthesized, in 1962, all that was known at the time about the class in a now-famous paper, 'The Properties and Problems of T Tauri Stars and Related Objects', which has become the foundation for the modern study of these young stars (G. H. Herbig *Adv. Astr. Astrophys.* **1,** 47–103; 1962).

As part of his investigation of T Tauri stars, Herbig studied a region of dark clouds in the Orion constellation, in which he noticed small nebulous objects with peculiar spectra. This class is now known as Herbig–Haro objects, after Herbig and astronomer Guillermo Haro, who had independently discovered them. Over several decades of study, Herbig and his collaborators established that Herbig–Haro objects move with supersonic velocities away from newborn stars, and are thus the signposts of recent star-formation events.

T Tauri stars are low-mass stars that eventually become similar to or smaller than the Sun. Herbig recognized that counterparts of these young stars, with masses several times that of the Sun, ought to exist as well. After exhaustive studies, he published in 1960 a landmark paper describing the discovery and characterization of the more-massive stars, now known as Herbig Ae and Be stars. Observations with telescopes, both ground-based and spaceborne, have revealed that disks of debris can surround these stars, and that in some cases these disks harbour newly formed planets and cometary bodies. As sites of planetary genesis, these Herbig stars have in recent years become the subject of intense study.

Herbig was fascinated by stars that are oddballs, recognizing that because stars live so much longer than humans, important evolutionary stages — if brief enough — may be seen only very rarely. In 1936, a faint variable star, FU Orionis, brightened 100-fold within six months, and has barely declined in luminosity since. Herbig studied this star and similar cases, and realized that such events represent important episodes in the early lives of some stars. Unafraid to take a stand against the prevailing wisdom, Herbig maintained that these 'FUor' events represent rapidly rotating young stars near the point of break-up. Most in the community believe that such events are the result of heating in a surrounding disk, which makes the disk self-luminous. But there are now signs that a hybrid model combining both these aspects might explain what is actually happening.

At an age when most people retire, Herbig embarked with his students on a series of observational studies of clusters of very young stars — groups of many hundreds or thousands of stars born together. He espoused the idea that star formation in clusters proceeds over several millions of years, with most low-mass stars forming first, until the birth of very energetic massive stars suddenly destroys the clouds of gas and dust from which stars are born and brings further star formation to a rapid halt.

Modest, mild-mannered and softly spoken, George exuded a quiet authority. He was an independent and private man, usually observing alone, and commonly processing and analysing the data himself. During his long career he saw major transformations in instrumentation and techniques — such as from photographic plates guided by eye to charge-coupled device cameras on telescopes controlled by computers.

We would sometimes joke that we had misspent our lives; we could have stayed at the pub while all the wonderful new hardware and software was being developed, and then have accomplished in a few years what had taken a lifetime. Of course, it is only in hindsight that there seems to be a shortcut in the winding path to knowledge and discovery. ■

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