

Obituary

Clyde Tombaugh (1906–97)

Astronomer who discovered the Solar System's ninth planet

Clyde William Tombaugh died on 17 January at his home in New Mexico; he was 90. His major research achievement, discovering the planet Pluto, precipitated one of the most daunting puzzles of twentieth-century planetary science — a puzzle that Tombaugh fortunately lived to see largely resolved in the final years of his long life.

Tombaugh was born in 1906 in Streator, Illinois, to a family of wheat farmers. At that time, both Percival Lowell and William Pickering were undertaking the first searches for a planet suspected to exist beyond Neptune on the basis of perceived irregularities in the orbits of Uranus and Neptune. Five such attempts, carried out up to 1916 when Lowell died, were all unsuccessful.

Tombaugh developed an intense interest in astronomy during his adolescence, at first borrowing and later building several small telescopes. By the late 1920s he was regularly corresponding with astronomers at the Lowell Observatory in Flagstaff, Arizona — eventually earning himself a job at Lowell as an observing assistant for the renewed search for the suspected planet (dubbed 'X') to begin in 1929. When Tombaugh arrived in Flagstaff in January 1929, he was just 22 years old, had no formal training in astronomy, and only a high-school education.

The search technique for Planet X would use a new, wide-field, 13-inch telescope and camera, and was based on the fact that planets move against the background stars. Photographs of star fields would be made and compared using a special device called a blink comparator, which allowed the operator to distinguish between stationary and moving objects. The necessary equipment was ready in April. Within days of starting, the observatory's director, V. M. Slipher, left Tombaugh to his own devices to carry out the search.

Tombaugh adopted a schedule of sky photography during the period each month around the new Moon, when the sky was darkest; data analysis was undertaken when the Moon was more or less full. He contributed significantly to the search protocol by always obtaining a third sky plate of every field to help confirm or reject potential finds. He also realized that by searching the opposition point (the patch of sky opposite to the Sun), the amount of

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motion a moving object showed would be directly related to its distance. In this way, he was able to distinguish comparatively nearby (hence more rapidly moving) foreground objects, such as asteroids, from the hoped-for, distant, trans-neptunian planet.

The task was not easy. There are over 15 million stars in the sky brighter than Pluto. Each of the 170-plus plates Tombaugh obtained in his initial search contained between 50,000 and 900,000 stellar images, plus the tracks of many asteroids. Barely ten months into the search, however, Tombaugh found his prey. On the afternoon of 18 February 1930, while comparing plates of the constellation Gemini, his eye detected a faint pinpoint of light that jumped 3.5 millimetres — in accord with a planet moving two billion kilometres beyond Neptune. "That's it", he later recalled saying to himself, and confided that he briefly savoured the fact that he alone among humanity knew that a ninth planet indeed existed. He then proceeded to Slipher's office, where he calmly announced, "I have found your Planet X".

Following three more weeks of observations and checking by Lowell staff, the discovery was announced on 13 March 1930 — the 75th anniversary of Lowell's birth, and the 149th anniversary of Uranus' discovery by Herschel. Shortly, 'X' was named Pluto, after the Greek god of the underworld, and in honour of Percival Lowell (P. L.).

After the discovery, Tombaugh was awarded a scholarship and took astronomy degrees at the University of Kansas. He married in 1934, and continued to search for planets from Lowell during the 1930s and early 1940s. He found none, but his sky survey did reveal numerous new asteroids, a comet, a nova, a globular cluster, five open clusters, and the Andromeda–Perseus supercluster. During the Second World War, he taught navigation for the US Navy, and

afterwards became involved in early rocketry at White Sands Proving Grounds. In 1955, Tombaugh joined the faculty of New Mexico State University, where his research included a search for small satellites of Earth, studies of Mars that correctly concluded in 1950 that Mars would have impact craters, and studies of galaxy clustering. He retired in 1973, and remained an inveterate punster and a man of great energy. When the Smithsonian Institution recently asked him to contribute his 9-inch telescope to its collections, he responded, "They can't have it — I am still using it".

Ironically, by the 1970s, it was established that Pluto is too small to be the perturber of Uranus and Neptune that first set off the search. It later also emerged that those perturbations stemmed from inaccurate measurements, and were themselves fictitious. The search for X had been based on false premises.

Despite this, as more was learned about Pluto, its nature and context within the Solar System became increasingly puzzling. Its highly inclined (16°) and elliptical (25%) orbit is unlike that of any other planet. Although it crosses inside the orbit of Neptune for a brief portion of each 248-year orbit, the planet is protected from ejection by massive Neptune owing to a unique orbital geometry and a set of overlapping dynamical resonances with Neptune. The planet has a tiny mass (only a tenth that of the Moon), a diameter of just over 2,300 km, and a rotation axis inclined 120° to its orbit plane.

Pluto is also distinguished by a complex *mélange* of exotic surface ices and by its satellite, Charon — with a diameter half as large as Pluto. The pair are the only known example of a true double planet.

For decades, planetary astronomers were puzzled by the odd fact of a tiny, binary world lying on a strange orbit beyond the giant planets. Since 1992, however, a plethora of other, far fainter worlds have been discovered in the region where Pluto orbits. This discovery of the Edgeworth–Kuiper Belt provides a *double entendre* to a remark that Gerard Kuiper once made to Tombaugh, that "What you didn't find is more important than Pluto".

It is fitting that Tombaugh lived to see his discovery placed in its true context as the bright tip of a huge underlying population of remnant icebergs, planetesimals and small planets lying beyond the giant planets — in many respects reminiscent of the planetesimal disks discovered in recent years around other stars.

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