SAMPLE

History of Astronomy: The Discovery of Pluto

Finding Planet X

Aira Astralis

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Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

On the eighteenth of February, 1930, a twenty-four-year-old Kansan named Clyde Tombaugh sat in a darkened room in Flagstaff, Arizona, staring into a machine that flipped photographic plates back and forth. He had been doing this for months, five nights of exposure and five days of scanning for every patch of sky, when a speck of light jumped on the pair of plates he was comparing. It moved. It was not a star, not an asteroid in the belt, and it was exactly the thing his employer had spent a fortune and his last years looking for: a new planet, the ninth, found at the edge of the solar system where sunlight was a thousand times weaker than at Earth.

The announcement, three weeks later, made headlines around the world and gave schoolchildren a ninth planet to memorize. This book is the history of that discovery, and of everything the discovery turned out to mean, from the prediction that led to it to the spacecraft that flew past it eighty-five years later.

The story runs on a peculiar engine: the planet was found by accident, in pursuit of a prediction that was wrong. Percival Lowell, the Boston aristocrat who built the Flagstaff observatory, believed that irregularities in the motion of Uranus pointed to an unseen planet beyond Neptune, and he calculated where it should be. Lowell died in 1916 without finding it. Tombaugh, hired in 1929 to resume the search, found Pluto in 1930 within a few degrees of one of Lowell's predicted positions, and for a generation the textbooks said the prediction had been vindicated. Then the measurements caught up. Pluto was far too small to have produced the irregularities Lowell had charted, and when the Voyager 2 probe fixed Neptune's true mass in 1989, the irregularities vanished altogether. They had been errors in the arithmetic of the age, not the gravity of a hidden world. Pluto, in other words, was a real planet found because of a mistake, a coincidence tidy enough that no novelist would dare invent it.

The second half of the story belongs to the slow demotion that followed the triumph. Mass estimates for Pluto shrank decade by decade, from something near Earth's size to a fraction of the Moon's. A large moon, Charon, appeared in 1978 and let the mass be pinned down for good. The Kuiper Belt, a ring of icy worlds beyond Neptune that Tombaugh had spent thirteen years failing to find, turned out to be full of Plutolike objects, and in 2005 one of them, Eris, was found larger than Pluto in the sky. The next year the International Astronomical Union wrote the first formal definition of the word planet, and Pluto failed the third clause of it.

A discovery that had entered the world as the ninth planet left the category it

had defined for children and teachers for three quarters of a century, becoming the type specimen of a new class, the dwarf planet. Few events in the history of science have been argued about with such feeling by people with no professional stake in the outcome.

And yet the third act of the story redeemed the loss of rank. In 2015, after nine and a half years of flight, the New Horizons spacecraft swept past Pluto and showed a world no one had predicted: nitrogen glaciers flowing across a heartshaped plain, mountains of water ice standing thousands of meters tall, a blue haze layered through a thin atmosphere, signs of a geology alive in the present. The small cold dot on Tombaugh's plates turned out to be one of the most interesting surfaces in the solar system. The chapters ahead tell the whole arc, the wrong prediction, the patient search, the naming, the shrinking, the reclassification, and the flyby, because the arc together is the story of how the modern era found, measured, and argued about the worlds at its own outskirts.

The account is built from the settled public record: the Lowell Observatory papers, the published orbit computations, the mission reports of New Horizons, and the proceedings of the union that did the reclassifying. Where the famous stories come in competing versions, the Venetia Burney naming among them, the versions are stated rather than settled by preference. Where an achievement was collective, it is credited that way, because the discovery of Pluto was the work of a wealthy dreamer, a hired farm boy with a talent for telescopes, and a great many patient observers after them, and it deserves the accuracy that celebration sometimes flattens.

A note on the two searches that had already been run, which the Flagstaff survey inherited and improved on. Lowell's own photographic campaign of 1905 through the discovery's decade had covered patches of the predicted regions with the observatory's earlier instruments, and a Harvard astronomer, William Pickering, had published independent predictions of a transNeptunian world and run his own plate searches from the southern stations, and both programs had come up empty. The 1929 survey's advantages were specific: the new 13-inch was built as a camera with a wide, flat field, the plate pairs were taken on a fixed schedule regardless of theory, and the scanning was assigned to a single trained watcher instead of being divided among senior staff with other duties. The empty searches of the 1900s and 1910s were not wasted either, since their plates entered the archive that later decades mined, but the contrast is the lesson: the survey that succeeded was the one designed as a survey, not as a hunt at a prediction.

Chapter 1: The Discovery of The Discovery of Pluto

The search began with Uranus misbehaving, or so the nineteenth century believed. Uranus had been found in 1781, and by the 1840s its observed positions drifted from the computed ones, and two mathematicians, one English and one French, had turned the drift into a prediction of an unseen planet. That planet was Neptune, picked up by the Berlin observatory in 1846 barely a degree from where the arithmetic said it should be, and the triumph was the most complete in the history of astronomy: a world found on paper before it was ever seen, by the force of gravity and the calculus of perturbations. The lesson everyone learned was that irregularities in a planet's motion meant an unseen companion, and the lesson waited forty years for its next application.

Percival Lowell applied it to the outer edge of the system. Uranus still showed small residuals even after Neptune was subtracted, and Neptune itself had barely completed a fraction of one orbit since its discovery, leaving its motion equally underdetermined. Lowell, a wealthy Bostonian with a mathematics training from Harvard and a passion for Mars that had made him famous and controversial, computed a planet from those residuals between 1905 and 1915, calling it Planet X, and estimated it at roughly seven times Earth's mass on an orbit reaching a hundred times farther out than our own planet's circle. He had founded an observatory at Flagstaff in 1894, high on Mars Hill, and he turned its 40-inch reflector and a growing agenda to the search. The plates from those years show a hard truth that was only discovered later: Pluto, faint and slow, had crossed some of the photographed fields, and it had gone uncaught, too dim for the exposures as they were taken.

Lowell died of a stroke in November 1916, aged sixty-one, with the planet unfound, and the search collapsed into litigation. His widow contested the will, which had left the observatory a substantial bequest, and for a decade the money to continue was frozen in the courts while the plates slept in the vault. The observatory survived on its other work, measuring the rotation speed of galaxies for the first time among other achievements, and the Planet X file gathered dust. When the estate was finally settled in the late 1920s, the observatory's director, Vesto Slipher, had a budget to renew the search, and he decided to renew it properly: a dedicated telescope, a systematic survey, and a new hire to do the scanning that the senior staff could not be spared for.

The new hire was the unlikeliest figure in the story. Clyde Tombaugh was a Kansas farm kid, born in 1906, too poor for college after a hailstorm wrecked

the family's wheat crop, and he had built his own telescopes out of farm machinery parts, old car parts, and handground mirrors, teaching himself to test optics by observing Jupiter and Mars. In 1928 he sent his drawings of Mars and Jupiter, made with his own 9-inch reflector, to the Flagstaff observatory asking for advice, and Slipher, instead of replying, offered him a job: three months of plate-taking and scanning for the planet search, at a salary that made no promises. Tombaugh arrived in January 1929 with his telescope and a suitcase, and never went home.

The instrument built for the search was a 13-inch photographic refractor, funded by Lowell's brother from the estate, and it was under construction through 1929. Tombaugh's first months were spent on trial plates with the older instruments, learning the exposure and measuring craft, and when the 13-inch came into service in April 1929 the survey began in earnest. The method was simple in principle and brutal in practice. Point at a field near the zodiac where the planet would be moving against the stars, expose a plate for about an hour, come back a few nights later, expose a second plate of the same field, then place the pair in a blink comparator, a viewer that flashed first one plate and then the other. Stars held still. Anything that had moved jumped, and the eye, hunting for a single jumping dot among hundreds of thousands of star images, was the only pattern detector that worked.

Tombaugh scanned the plates in the daytimes and took new ones at night, covering the whole zodiac strip in strips near the opposition point, where a transNeptunian planet moves fastest and shows the largest shift. Winter weather, plate flaws, satellites trails and airplane lights in the exposures, asteroids by the hundreds: each had to be checked and excluded. By January of 1930 the survey had worked through the regions that earlier searches had covered and into fresh sky near the Gemini twins. On the twentythird of January, he exposed a pair of plates on a field in Delta Geminorum, near the star cluster where the ecliptic crossed the winter Milky Way. Clouds delayed the companion plate until the twenty-ninth, and then Flagstaff weather held up the developing for a week, so the pair was not scanned until mid-February. On the eighteenth, Tombaugh sat down at the comparator with the plates from that field.

He had been at the machine for a stretch of hours, working down the plate, when at about four in the afternoon a dot jumped, a fifteenthmagnitude object a little above the middle of the plate. Then it jumped again when he blinked the plates, shifting by three and a half millimeters, exactly the shift expected of a planet beyond Neptune photographed six nights apart. He checked it against a third, fainter plate of the same field taken a couple of weeks earlier, and the object was there too, moved the right amount. The object sat close to

the ecliptic and about seven degrees from one of Lowell's two predicted positions for Planet X.

Tombaugh called Slipher in, and the senior men spent the evening measuring positions and suppressing the urge to shout. The planet, when found, had already been crossing the January plates for weeks while Flagstaff waited for the weather to clear. Discovery is a function of instruments, patience, and luck, and the luck in Flagstaff that winter ran both ways.

The announcement was held for a month of confirming measures. On the thirteenth of March, 1930, the observatory sent its telegram and released the news to the world, choosing the date deliberately: it would have been Percival Lowell's seventyfifth birthday, and it was also the hundred and forty-ninth anniversary of the discovery of Uranus, the first planet ever found with a telescope. Newspapers treated it as the biggest astronomy story in decades. The Lowell Observatory had found the transNeptunian world, the New York Times carried the story on its front page, and the world's observatories turned their telescopes to the new point of light to catch its motion. A planet had been added to the solar system for the first time in eightyfour years, and it had been found, by a fitting symmetry, within days of the anniversary week of the discovery of the planet that had started the whole chain of perturbation mathematics, Uranus itself.

A note on the word precovery belongs in the understanding, because the term's whole career began with this planet. Precovery is the practice of finding an object in archival images taken before anyone knew it was there, and Pluto's own record supplied the founding examples: the planet sits, a faint dot, on plates exposed at Flagstaff in 1915 and at other observatories across the 1920s, none of them examined for a moving point at the depth required. Once the orbit was known, the archive could be searched backward, and the earlier positions tightened the orbit solution by years of arc. The modern surveys industrialized the practice, and every near Earth object that gets a pre-discovery identification in someone's old frames is following the procedure that the Pluto search wrote, which is a second quiet way the discovery's method outlived its motive.

A word on the orbit's shape as the astronomers of the 1930s finally had it, because the numbers carry the strangeness well. The planet's path runs from its nearest point to the Sun, still a third farther out than Neptune's average distance, to a far point half again beyond that, and the crossing of the two orbits, Neptune inside Pluto for most of a century and the order reversed for the two decades around the perihelion passage of 1989, is the detail the public found hardest to picture. The tilt of seventeen degrees lifts the path out of the

flat of the planetary plane by a distance larger than the whole separation of the inner planets, so that the planet spends most of its slow round well north or south of the band where the others travel.

An orbit of that description belonged to no known planet, and the comet researchers of the era said so in print, describing the new object as a gigantic comet's kin, which was closer to the modern verdict than the astronomy of the day was ready to be.

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ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.