SAMPLE

Great Observatories: Hubble Space Telescope

Eyes Above the Sky

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

High above the atmosphere, five hundred kilometers up, a school-bus-sized telescope has been circling the Earth since 1990, and the astronomy it has done changed the science more than any instrument since Galileo's first tube. The Hubble Space Telescope, named for the man who proved the galaxies, has watched the deep universe assemble itself, weighed the cosmos's expansion, caught galaxies colliding, followed a comet's fragments into Jupiter, and put a face on the supermassive black hole. It has also been famously imperfect, famously repaired, and famously persistent, five astronaut servicing visits keeping a 1980s spacecraft alive and working into a second century.

This volume tells the whole story: the long argument for a telescope above the atmosphere, the decades of proposals and cancelled budgets, the 1990 launch, the mirror flaw that made the great observatory a national joke, the rescue mission of 1993 that made it a national treasure, the servicing era, and the science: the Hubble constant measured, the deep fields, the accelerating universe, the black holes, the planet-forming disks, the outer solar system's second crop of moons. The chapters run the series' usual route, the history first, then the machine's understanding, the numbers, the physics of the optics and orbit, the working observatory's record, the famous features, the sibling observatories, the science of the mature mission, the programs of research, the landmark discoveries, the failures and open questions, the future, the curiosities, and the closing significance.

What carries the story is a tension the Hubble wore openly: the telescope was sold as perfection and arrived flawed, and its greatness came after the failure, in the repair and in the three decades of work since. The Hubble's biography is thus the space program's own best lesson, that the first flight of a hard thing is not the verdict, and the chapters that follow make the lesson concrete: a machine built by committees, saved by astronauts, and immortalized by the pictures.

A word on the machine's name, because it carries a history of its own. The observatory was named for the American astronomer whose galaxy measurements a half-century earlier had shown the sky to be full of island universes and, soon after, to be expanding; the choice honored a debt the space age had come to collect, the orbiting telescope being built to measure the expansion's rate more sharply than any ground glass could; the reader will meet the name's full circle in the later chapters, the machine carrying the man's name outliving his own instruments by generations, and every constant it quotes, in a sense, signing the family name twice, once for the observer, once for the observatory.

The volume's frame deserves one more note: the machine as public object. Most instruments in this series worked in private, their output known to their users and their fame to historians; this one worked in the open, its schedule published, its images released, its crises covered by the evening news; the reader should expect the public dimension in every chapter, because the orbiting telescope is the first great instrument to live its whole life in the media's company, and the science's modern standing, funded by publics and justified to them, owes the arrangement to the precedent this machine set.

Chapter 1: The Discovery of The Hubble Space Telescope

The discovery of the Hubble Space Telescope is the story of an idea's fifty-year climb: proposed before anyone could build it, funded long after its proposers doubted it, and launched into a career no one fully predicted.

The idea belongs to the 1946 paper of Lyman Spitzer Jr., this series' Spitzer volume tells the fuller story, an astronomer's case for an observatory above the atmosphere: the atmosphere blurs and blocks, and a telescope in orbit would see sharply and deeply in wavelengths the ground cannot. The paper's fate was patient: the idea circulated for decades, the rocket era making it technically thinkable, the science's leaders, Spitzer among them, testifying and lobbying through the 1960s and 1970s while the budget agencies said no. The "Large Space Telescope" was studied, descoped, fought over, and finally approved in 1977, the Congress funding a telescope of 2.4 meters, the program finding its institutional shape, a NASA-led effort with the European Space Agency joining as a partner, and the astronomers' community organizing the telescope's scientific instruments through the institute that would run it.

The funding fight deserves the discovery's own paragraph, the near-death experience. The telescope's budget, grown from an early estimate by a factor of several, the congresses of the late 1970s' skepticism, the astronomers' decade reports, the lobbying and the testimony, Spitzer's own decades of it, are the program's political biography; the 1977 approval was narrow, the 1980s' budget crises repeatedly threatened cancellation, the congressional skeptics' mockery being the budget fights' standing tone, and the community's defense, the astronomers' campaigns and the scientific case's steady advocacy, carried the machine to the pad. The political biography's lesson is the space science's standing pattern: the big machines' costs, the cost growth, the "faster better cheaper" reaction's later debates, all began here, the Hubble's overruns writing the rules the next telescopes would inherit. The partnership deserves the discovery's note, the international share. The

European Space Agency joined the program in the 1970s, the agency's contribution, the solar arrays and one of the first instruments, the faint-object camera, plus the European astronomers' guaranteed access to fifteen percent of the observing time, buying the project its international character; the partnership's later history, the second solar arrays' delivery and the instrument's two-decade service, the European astronomers' participation in the famous programs, is the space science's multinational lesson, the Hubble

being the first great telescope run as a shared instrument, the model the Webb and the successors copied.

The building took the 1980s. The mirror, 2.4 meters of ultra-low-expansion glass, was ground and polished to a precision measured in nanometers by the contractor's opticians, the most famous mirror in astronomical history; the spacecraft was assembled around it, the instruments, the cameras and spectrographs of the first suite, built by teams across the country and across the Atlantic; and the launch was set for the mid-decade. The Challenger disaster of January 1986 changed the schedule, this series' astronaut-history volumes tell the shuttle story, the fleet grounded for two and a half years, and the finished telescope, its optics sealed, waited in a clean room while the program waited for the fleet's return.

The name deserves the discovery's own note, the founder's shadow. Edwin Hubble, the telescope's namesake, this series' Edwin-Hubble volume tells his own biography, proved the galaxies' island-universe nature and the expansion's signature in the 1920s, the science's founding measurements; the naming choice, made in the program's political decades, tied the machine to the science's most famous deed, and the telescope's central result, the expansion rate's measurement, is the namesake's constant, the founder's unfinished work carried to its conclusion by the machine wearing his name, the biography's neatest circle. The launch came April 24, 1990, the shuttle Discovery carrying the telescope aloft on the STS-31 mission, the deployment a day later, the telescope released into its orbit, the five-year effort of thousands of people floating free.

The deployment deserves the discovery's own paragraph, the first days in orbit. The telescope left the shuttle's bay on the mission's second day, the robot arm lifting the observatory free, the solar arrays unfurling, the aperture door opening after weeks; the checkout followed, the optics aligned, the instruments cooled and configured, the first commissioning targets observed. The shuttle crew's photograph of the telescope against the Earth's limb became the program's opening icon, the machine's working life beginning inside the frame of the planet it would spend decades escaping, one orbit at a time. The first light came in May, and the first images were, to the builders' relief, sharper than the ground's best.

Then came the diagnosis that made the discovery's story complete: the mirror, the program's proudest artifact, was flawed, ground to the wrong curve by a metering error at the contractor's plant, its edges a few wavelengths off, the images of everything but the brightest stars haloed. The flawed-mirror story, the "spherical aberration" that a commission traced to a testing null

assembled backward, is the discovery's dark chapter, and the repair, the 1993 astronauts' corrective optics, is the next chapter's opening, the telescope's whole biography pivoting between them.

The origins chapter should carry the congressional climb, because the idea's political decade is part of the discovery. The large space telescope was proposed, cut, scaled, cut again, and finally funded in the fiscal fights of the

1970s, its champions trading aperture for approval and partnering with the European agency to share the cost; the funding's price was a compromise the whole science would live with, a telescope smaller than the astronomers' first design, launched by the shuttle because the shuttle needed missions and the telescope needed a ride; the chapter's honest note is that the observatory began as an argument in a budget hearing, and the argument, like the mirror, needed correcting before it could see straight.

The origins account should name the shuttle's double bind, because the launch decision shaped the whole mission. The observatory was sized for the cargo bay and designed for return, the plan calling for regular round trips to the ground for servicing; the shuttle era's tragedy froze the flight rate and retired the return plan, and the mission re-planned itself around repair in orbit instead, a change the design's serviceability happened to permit; the history's honest note is that the machine's survival strategy was improvised twice over, first from the budget's compromises and then from the fleet's, and the improvidence paid, the telescope outlasting both of the constraints that had tried to shape it.

End of free sample. The full book is available at putrabooks.github.io

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.