SAMPLE

Solar System Missions: Rosetta

Landing on a Comet

Aira Astralis

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

Introduction

A comet is a messenger from the cold storage of the solar system, and for most of human history the only way to read the message was to watch the messenger pass. Telescopes could track the head and tail; spectroscopes could name a few of the gases; spacecraft built for speed could streak past a nucleus and photograph it for a few frantic hours. What no one had ever done was go with a comet, to arrive as it approached the Sun, fall in beside it, and ride along while it thawed, erupted, and grew its tail, watching at leisure the whole cycle that a flyby sees for an instant. The European spacecraft named Rosetta did exactly that, and the two years it spent in company of comet 67P/Churyumov-Gerasimenko produced the most complete portrait any comet has ever been given.

The name was chosen with care. The Rosetta Stone was the slab whose bilingual inscription let scholars finally read Egyptian hieroglyphs, and the mission's builders hoped their spacecraft would do for the solar system's beginning what the stone did for a lost language: turn an unreadable record into a text. Comets are that record. Frozen at the system's birth, never melted or cooked, they hold the water, carbon, and dust from which the planets were assembled, and the craft designed to read one carried eleven instruments to taste its gases and dust, map its surface, probe its interior, and, in the mission's most celebrated act, drop a small lander named Philae onto the comet itself to sample the ground directly.

This book tells the story for the general reader: the comet hunters who found the target on a photographic plate in 1969, the twenty-year struggle to build and launch the mission, the ten-year voyage with its planetary slingshots and its long sleep, the dramatic landing that bounced, the two-year escort through the comet's summer, and the scientific harvest that followed, down to the discovery of glycine and the deliberate final descent onto the comet's surface in 2016. No equations appear, none are needed, and the human story, the engineers' decade of patience, the lander's sixty hours of life, the operators' grief at mission's end, is told alongside the science, because for this mission above all the two cannot be separated. What follows is the account of how humanity caught a comet, rode with it around the Sun, and learned to read one of the oldest texts there is.

How the account is arranged, briefly. The opening chapters carry the mission from concept to comet: the reasoning, the birth in committees, the decade of flying, and the strange double world found at arrival. The middle chapters hold the campaign itself: the lander's fall, the mapping of the surface, the interior's emptiness, the chemistry of the gases, and the comet's violent summer at

perihelion. The closing chapters follow the ending, the lander's discovery, the mission's ledger of findings, and the meaning of the whole. The chapters stand alone well enough, and the reader who wants the science first can jump to the middle, though the story of the two crafts, the patient mother ship and the bounced, brave, sixty-hour lander, reads best whole, as it was lived by the teams who flew them and as the comet, which outlasted them both, keeps them now.

Chapter 1: The Stone and the Message

The mission's logic begins with what comets are, and a paragraph spent on the objects themselves will pay for itself through every later chapter. Comets are ice-rich relics, formed in the outer reaches of the young solar system where the Sun's warmth never reached, and preserved ever since in deep freeze, the leftovers that never joined a planet. Unlike asteroids, which are mostly rock, comets carry the volatiles, water, carbon dioxide, carbon monoxide, and richer carbon chemistry, locked in ices and frosts; and unlike any other small bodies, they awaken, venting gas and dust whenever an orbit carries them near the Sun's heat. The venting is the tail. A comet seen from Earth is a small dark nucleus, typically kilometers across, wrapped in a vast temporary atmosphere of its own evaporating substance, and the object that makes the show is the least seen part of it: a black, dusty, frozen hill that only close spacecraft have ever resolved.

The reason scientists wanted a rendezvous, and not another flyby, is the awakening. A comet approaching the Sun does not simply warm up; it changes from season to season, its ices sublimating in different places as the Sun moves in its sky, its jets migrating, its surface restructuring, and its chemistry shifting as the deeper layers feel the heat for the first time. A flyby samples a single moment of that evolution; an escort, a spacecraft that stays, watches the whole transformation, spring turning to summer on a world where a year lasts almost six and a half Earth-years. The difference between a snapshot and a film is the difference between knowing what a comet is and knowing what a comet does, and the mission that eventually flew was built from the start to make the film.

The mission's European origin is part of its character. The comet-chasing concept was born in the 1980s, when the international fleet that visited Halley's Comet in 1986, led by the European craft that flew closest, proved that comets could be reached at all, and the follow-up ambition, hatched in the science community almost immediately, was to return with a lander. The European Space Agency adopted the mission in 1993 as a cornerstone of its science program: an orbiter to escort a comet to the Sun and a lander to ride down to its surface, a combination no other program has yet repeated. The name, drawn from the deciphering stone, was suggested to honor the hope that a comet's material might similarly unlock a lost script, in this case the solar system's own.

The target, too, has a story worth the opening chapter. Comet 67P was discovered in 1969, on photographic plates taken at the Soviet observatory at Alma-Ata by the astronomers Klim Churyumov and Svetlana Gerasimenko, one

of whom found it while examining plates for a different comet and initially read it as a fragment of that other visitor; the plate's small, fuzzy patch turned out to be a new comet of his own, later corrected and credited to both. The comet orbits the Sun every six and a half years, dipping between the orbit of Jupiter and just outside Earth's, one of the family of comets whose orbits were rearranged by Jupiter's gravity in the past, and it was chosen, as the next chapters tell, partly by accident and partly by fortune, a small, hardworking object that became the most closely studied comet in history.

The mission inherited a lineage, and the lineage had been building for thirty years. The international fleet that rendezvoused with Halley's Comet in 1986 gave humanity its first look at a comet's black heart, and the European contribution, flying through the coma to within six hundred kilometers of the nucleus, survived the encounter and proved the engineering. The flybys that followed, of other nuclei through the 1990s and 2000s, added portraits, each a few hours of images: a peanut, a bowling pin, a drumstick, each dark, each surprising, none studied for longer than a snapshot. The scientists who planned the escort knew all these portraits by heart, and their mission was designed to answer what the flybys kept raising and never settling, the questions of what lay beneath the black crusts, how the engines of the jets ran, and whether the chemistry of the ices matched the interstellar inheritance the models claimed, and the answers, as later chapters record, came from staying, not from passing.

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.