SAMPLE

Solar System Missions: Phoenix

Mars Polar Lander

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

In the summer of 2008, a spacecraft that had once been written off and shelved in a warehouse touched down on the frozen plains of northern Mars and did something no machine had ever done before: it reached out an arm, scooped up a shovelful of rust-colored soil, and found water ice sitting just beneath the surface, within reach of an astronaut's gloved hand. The mission was named Phoenix, and the name could not have been more fitting. The phoenix of Greek mythology was a bird that died in fire and rose again from its own ashes, and this spacecraft was the reborn remnant of a Mars lander that NASA had cancelled years earlier and stored, part by part, against the chance that it might one day fly.

That resurrection is only the first of the stories this book tells. The Phoenix Mars Lander, which arrived at 68 degrees north latitude on May 25, 2008, spent more than five months digging, sniffing, tasting, and photographing the Martian arctic. It was the first mission to land in the Martian polar region and survive, the first to touch water ice on another planet, and the first to run a wet chemistry laboratory on soil from another world. What it found there, in a landscape of polygon-cracked ground and shallow buried ice, reshaped how scientists think about the habitability of Mars and how future explorers, human and robotic, will use the planet's resources.

The chapters that follow trace the mission from its troubled origins to its frozen end. They describe the lander itself, an octagonal platform built largely from spare parts of a cancelled predecessor, and the seven instruments it carried, including the first lidar ever flown to Mars and the first microscope ever to peer at Martian soil. They walk through the landing, the digging, the sampling, and the moment of confirmation when a patch of white material dug from a trench simply disappeared over four Martian days, proving it was water ice and not salt. And they follow the science that came after: soils surprisingly friendly to life as we know it, a salty mineral called perchlorate that turned up where nobody expected it, snow falling from Martian clouds, and the slow victory of winter over a solar-powered machine that had already beaten every expectation set for it.

The Phoenix story is also a story about how space exploration learns from failure. The lander's direct ancestor, the Mars Polar Lander, was lost on descent in 1999, and the shock of that loss helped reshape NASA's Mars program. Phoenix was selected in 2003 as the first mission of the Mars Scout program, a line of lower-cost, competitively chosen missions in which a university, not a NASA center, led the science. The University of Arizona's Peter Smith led a team that proposed to raise the cancelled lander from the

dead, rebuild it, and send it to the place every earlier mission had avoided: the frozen north, where orbiters had seen ice, where polygons in the ground hinted at ice just below the surface, and where no lander had ever dared to set down.

This book follows the mission through all of that: the naming, the building, the nerve-racking descent, the daily grind of operating a laboratory on a planet hundreds of millions of kilometers away, the discoveries, the struggles with sticky soil and stubborn ovens, and the final silence as the Martian autumn closed in. The story of Phoenix is the story of a machine that got a second life and used it to answer one of the deepest questions ever asked about Mars: is there water, and could anything live where it lies? The answer it brought home changed the course of Mars exploration, and this book tells how it happened.

Chapter 1: The Discovery of Phoenix

The discovery of Phoenix did not begin with a launch or a landing. It began with a failure. On December 3, 1999, NASA's Mars Polar Lander fell silent during its descent to the planet's south polar region, and an investigation later traced the likely cause to a premature engine shutdown triggered when the lander's legs deployed and sent a false touchdown signal. The mission was lost, and with it went the confidence of a Mars program that had already lost an orbiter earlier that year. In the aftermath, NASA faced an uncomfortable question: what should it do with the lander that had been built to follow, the Mars Surveyor 2001 Lander, which was already partly assembled and had nowhere to go?

The agency's first answer was to cancel it. The 2001 lander was mothballed, its instruments stored, its half-built body sealed away in a clean room at Lockheed Martin in Denver, Colorado. At the time it looked like the quiet death of a project. In fact it was a long pause, because the hardware was good, and hardware that has already been built and tested is one of the most valuable things in spaceflight. Spacecraft are expensive not mainly because of their raw materials but because of the engineering, testing, and refinement folded into them. A cancelled lander is not scrap; it is a partially paid-for mission waiting for a purpose.

That purpose arrived through the Mars Scout program, a new NASA line of missions announced in the early

2000s. The idea behind Scout was simple and, for the agency, unusually humble: instead of NASA choosing its own centers to run each mission, it would hold an open competition and let the scientific community propose complete missions with fixed cost caps. The winning team would lead the science and manage the project. It was, in spirit, the same model that had produced the wildly successful Mars Pathfinder, and NASA hoped it could repeat the trick with a small, focused, lower-cost mission that could answer questions the big flagship missions could not.

In 2002, NASA asked for proposals for the first Mars Scout mission, and twenty-some teams answered. The field narrowed to four finalists, each with a different idea about Mars. Among them was a proposal led by Peter Smith, a University of Arizona planetary scientist and veteran of the Pathfinder camera team who had spent years thinking about what a lander could do at the Martian poles. Smith's team argued that a lander built largely from the mothballed Surveyor 2001 hardware could be sent to the northern polar plains, where it could dig into ground that orbiting spacecraft suggested was

loaded with water ice, and directly test whether the polar environment could ever have been habitable.

NASA's review panels weighed the four finalists, and in August 2003 the agency announced that Smith's lander had won. The name followed from the nature of the mission: a spacecraft reborn from the remains of a cancelled one, rising from the ashes of the Mars Surveyor 2001 project. Phoenix, the firebird of Greek mythology that burns itself at the end of its life and rises renewed from its own ashes, gave the mission both a name and a story, one the team embraced. The mission patch showed the legendary bird, wings spread against a red sky.

Naming a mission is more than marketing; it sets expectations the team must then live up to. In Phoenix's case the name did honest work. It told the world that the spacecraft was secondhand, and it told the team that their margin for error was thinner than a flagship's, since resurrected hardware carries the scars of its storage along with its savings. The team's early engineering reviews made that explicit: every inherited part had to be re-verified, and every unverified assumption from the original project was treated as a new risk. The name, in other words, was not only a myth but a management philosophy: remember where this machine came from, and what it owes.

The selection also settled a division of labor that shaped everything that followed. The University of Arizona would lead the science and run the mission's daily operations from its campus in Tucson, the first time a public university had been put in charge of a Mars mission. NASA's Jet Propulsion Laboratory in Pasadena would manage the project, provide the deep-space navigation, and handle the riskiest hour of all, the entry, descent, and landing. Lockheed Martin would complete and modify the stored spacecraft in Denver, raising the half-built lander from storage and turning it into a machine that could survive a polar touchdown. The Canadian Space Agency would build the mission's weather station, including a laser that would become the first lidar ever operated on another planet.

The team set itself a difficult goal from the start: land farther north than any mission had ever landed and survive. The northern plains of Mars hold the planet's water ice close to the surface, but they also hold a short growing season of sunlight, brutal cold, and a winter that no solar-powered lander could survive. Phoenix would arrive in the late northern spring, work through the summer, and die in the autumn, by design. Every decision in the mission, from its solar arrays to its science plan, was built around that deadline. The lander that had been granted a second life was going to spend it on a mission with an unavoidable end, which gave the whole project a strange, clear-eyed

intensity. The team knew exactly how much time it had: roughly ninety Martian days of planned operations, with luck a little more.

It was a gamble on inherited hardware, a fixed budget, and a landing site no one had ever dared. The next chapter describes the machine the team built to face 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.