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Solar System Missions: The Change Program

China's Lunar Exploration

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

Introduction

The Change Program of this book's title is China's Chang'e program, the Chinese Lunar Exploration Program, and it is one of the great exploration stories of the twenty-first century. Named for the goddess who, in Chinese legend, drank an elixir of immortality and flew to the Moon, the program has since 2007 sent orbiters, landers, rovers, and sample-return craft to the lunar surface, landed on the Moon's far side for the first time in human history, and brought back the first lunar soil collected since the Soviet Luna missions of the 1970s. This book tells the story of how a nation that had never sent anything beyond Earth orbit in the twentieth century built, in two decades, the world's most active lunar exploration enterprise.

The program's architecture has been unusually disciplined: three phases, each with a defined goal and a test to pass. The first phase orbited the Moon and mapped it; the second landed on it and roved across it; the third returned pieces of it to Earth. Along the way the program's engineers solved problems no one had solved before, most famously the far-side landing of Chang'e 4 in 2019, which required a relay satellite parked beyond the Moon to bridge a communications gap that had kept every previous landing on the Earth-facing side, and the far-side sample return of Chang'e 6 in 2024, a first so comprehensive that the samples it carried back are still being opened for study.

The chapters ahead trace the whole arc: the program's origins in the studies of the 1990s and its approval in 2004; the engineering of its spacecraft, rockets, and ground stations; the mission-by-mission story from Chang'e 1 through Chang'e 6; the science the missions have returned, from the Moon's unexpectedly young volcanism to the first mineral discovered on the Moon in half a century; the international context of cooperation, competition, and restriction; and the future the program is building toward, a crewed landing and a research station at the lunar south pole. The Chang'e program has returned the Moon to the center of space exploration, and this book tells how.

A note on names and dates before the story begins: the program's missions are numbered in the order of their approval rather than their flight, which is why Chang'e 4, the far-side lander, flew after Chang'e 3 and why the sample-return pair, 5 and 6, follow the landing pair; the dates in this book are launch and landing dates, the moments the public followed, and the reader who wants the engineering chronology can reconstruct it from the mission chapters that follow. The book keeps the record's own precision where it matters, the sample masses, the landing coordinates, the record durations, because the program's story is one of numbers honestly earned.

Chapter 1: The Discovery of The Change Program

The discovery story of the Chang'e program is the story of how China decided the Moon was worth reaching, a decision that took a decade of study and a moment of political will.

The program's intellectual origins lie in the 1990s, when Chinese space scientists, led by figures such as the engineer Ye Peijian and the academy's lunar advocates, began to study a lunar mission seriously. The early concepts carried the internal name Project Luan, the character for rabbit, an early nod to the mythology the program would later wear openly, and the studies ran through the decade: what a lunar orbiter would weigh, what rocket could launch it, what instruments it should carry, and what the mission would teach. The studies were deliberate, and the deliberateness itself was the discovery: China, which had flown its first crewed mission only in the planning stages of the decade, chose the Moon as its first destination beyond Earth orbit.

The decision point arrived in the early 2000s. In 2000 the government's first space policy white paper named lunar exploration as a coming activity, and in 2003 the State Council approved the program's fundamental design, the three-phase strategy that the program still follows: orbit, land, return. In January 2004 Premier Wen Jiabao approved the formal go-ahead for the Chinese Lunar Exploration Program, and the program received the name it carries, Chang'e, the goddess who flew to the Moon, a name chosen in a public solicitation that drew tens of thousands of suggestions and settled on the legend every Chinese schoolchild knows.

The launch of Chang'e 1 on 24 October 2007 was the program's proof of existence: a Long March 3A rising from Xichang, an eleven-day cruise to lunar orbit, and a spacecraft that mapped the whole Moon in its year and a half of service, returned China's first lunar data, and ended with a controlled impact in March 2009, a disposal rehearsed deliberately for the landing missions ahead. The discovery phase, from studies to a mapped Moon, took thirteen years from the rabbit studies to the first orbiter, and the discipline of the pacing, each phase entered only when the last was passed, has been the program's signature ever since.

The rest of this book follows the consequences of that discovery: the missions that landed, the far side that had never been visited, the samples that rewrote lunar chronology, and the station and the crewed landings that the program's first twenty years have positioned it to attempt.

The discovery story deserves its institutional credit line as well, because programs are people before they are missions: the program's early leadership, with the veteran chief designers Sun Jiadong and Ye Peijan guiding the engineering and Ouyang Ziyuan, the cosmochemist, supplying the scientific case, gave the lunar effort its unusual combination of engineering discipline and scientific purpose. Ouyang's advocacy, decades of papers and proposals arguing that China's future in space began with the Moon, is the program's intellectual foundation, and the pattern it set, a scientist's questions driving an engineer's staircase, still governs the missions the program flies.

The discovery phase also included a quiet international education: the program's planners studied every lunar mission ever flown, purchased and adapted where law allowed, and sent their engineers to learn the deep-space trade through the missions of others; the Chinese Mars mission that followed the lunar program's early success traces its lineage to the same study. The Chang'e program's discovery story is thus one of deliberate apprenticeship ended by design: the program's first launches were its graduation, and the far-side landing a decade later was the proof that the apprenticeship had produced a master.

The discovery chapter's close belongs to the moment the program became public, which the archive preserves: the January 2004 approval was announced with the program's name and its three phases stated plainly, and the world's space press noted a lunar program with a folklore name and a decade's homework behind it. The discovery, in the full sense, was not the orbit or the landing but the decision, made in an office, that the legend would get a budget, and every mission this book describes is the decision's working-out.

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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.