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Worlds Beyond Earth: Martian Landscapes

Canyons, Volcanoes, and Polar Caps

Aira Astralis

Free sample: Introduction & Chapter 1

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

Introduction

This volume is a field guide to the surface of Mars, the most photographed landscape beyond Earth and the only other world whose every terrain a reader can tour from a desk. The subject enters as a pale dot with a confusing name and leaves as a planet of two faces, a canyon that would stretch across a continent, volcanoes that dwarf every mountain on Earth, riverbeds billions of years dry, ice that comes and goes with the seasons, and dust that occasionally swallows the entire globe. The whole terrain is walked here: the north-south split, the great wound, the volcano crown, the impact scars, the water's old work, the ice's slow work, the wind's endless work, the polar vaults, the strange ground, the robot witnesses, and the open questions.

The itinerary is posted before the first step: eleven stations, each read the way geologists read it, by shape, by mineral, by age, and by process. Every station keeps its own honest yardstick, numbers given as the standard reckonings, ages as the era names the field uses, and each unsolved puzzle admitted as unsolved.

The measuring conventions wait by the door. Elevations are given from the datum, the planet's agreed zero level, heights as the standard published values, and every claim about process is either observed, inferred, or openly modeled, the certainty stated beside the claim. Mars rewards honest units, and the volume keeps them.

Two kinds of traveler are seated together: the follower of the missions who wants the photos decoded without jargon, and the geology reader who wants the processes named and tested. A single plain voice serves both chairs from the first paragraph to the last.

The tone is fixed at the trailhead: Mars attracts both romantic exaggeration and reflexive dismissal, and neither is indulged here, because the actual land is stranger than both. The dry riverbeds are real, the dead volcanoes are real, and the planet is also really cold, really dry, and really hostile, and the account keeps all of it in one frame.

The walk's honest price tag: Mars is the one landscape humans may stand in within a generation or two, and every feature in this book is either a destination, a hazard, or a clue to where life might have lived. A reader who finishes the route will look at a Mars photo the way a geologist does, and the looking is the payoff.

One working rule rides along the whole trail: every figure carries its provenance plainly, measured, estimated, or argued, a discipline kept to the

final sentence.

A note on the guide's evidence discipline: every landform in these pages is dated by the crater count and read by more than one mission where possible, and the volume marks the difference between what the cameras saw, what the spectrometers measured, and what the models merely prefer, so that any account can tell the terrain from the argument about the terrain.

The guide's cast is largely robotic, and the introduction names them plainly: the orbiters that mapped, the rovers that walked, the landers that listened, the witnesses introduced properly in their own chapter but credited at each stop along the way, because a field guide to a planet no one has visited is a field guide to photographs taken by machines with names.

The neighboring shelves are signposted where they matter: the planet's whole story holds its own volume, the moons their own, Earth's oceans their own, and the crossings in these pages are marked at the trail forks. The walk begins at the planet's most obvious oddity, the line between its two faces.

A note on scale belongs at the door, because Mars punishes casual comparisons. Everything in this volume is bigger than the eye expects: the canyon would stretch across a continent on Earth; the volcano crown stands three times the height of the highest terrestrial range; the flood scars drained ground at discharge rates no terrestrial river approaches; and the polar vaults hold as much layered ice-and-dust record as whole terrestrial provinces hold rock. The planet is half Earth's width and keeps a full-sized planet's scenery, and the account will keep flagging the mismatch as it goes, because the mismatch is the point: a small world with giant landforms, built by gravity that is too weak to tear big things down quickly - the whole book, in one sentence, before the walk begins.

Chapter 01: The Two Faces

The planet's first strange fact is visible from orbit: Mars is split in two. The southern half stands high, several kilometers above the datum on average, and is old, cratered, and rough, while the northern half lies low, smooth, and much younger looking. Geologists name the line between them the crustal dichotomy, and it is the planet's most basic landscape boundary, wrapping most of the way around the globe like a seam.

The southern highlands are the ancient crust, the planet's original face, battered almost everywhere by craters four billion years old and older. The surface is broken into blocks and ridges, crossed by the old river valleys, and saturated with the clay minerals that form in water, the wet chemistry of the planet's earliest era written in its oldest ground. The highlands' roughness is age made visible, the unhealed record of a violent youth.

The northern lowlands are the opposite on every count. They sit kilometers lower, they are astonishingly flat over huge distances, and they hold comparatively few craters, the mark of a surface either made late or resurfaced. Their smoothness has invited the most famous and most argued speculation in Mars science, the idea that an ocean once stood over them, a hypothesis this volume reads with evidence on both sides in a later chapter.

The dichotomy's own origin is unsolved, the field's standing debate. One family of explanations is internal, a great overturning of the mantle that thinned and sank the northern crust early on, and another family is external, one or a few colossal impacts that scooped the lowlands out, and both families have evidence and dissenters. The volume reports the candidates and the honest verdict: the case remains open.

The line itself is worth a visit in every form. It crosses the planet as the highlands' edge drops, the transition marked by cliffs, mesas, and broken terrain, and in places the boundary is stark enough to see in a single image, ancient rough country ending at a scarp above a desert plain. The edge is dramatic country, the planet's own cliff between eras.

The boundary zone's local names earns a mention, the map's own vocabulary. The dichotomy's edge runs through terrains with their own catalogs, the fretted ground and the mesas of the transition belt, and the field's maps mark the boundary with a band rather than a line, the honest width of a feature this ancient and this argued. The seam is drawn softly because the evidence is soft-edged, and the account draws no harder line than the data.

The elevation reader gets its tool here, the volume's practical paragraph. The

heights in this book are read against the datum, the planet's agreed zero, and the map's colors, the reds of the highlands and the blues of the northern plains, are the datum's own scale, the same convention every published relief map uses. Anyone absorbing the datum's zero once reads every map of Mars for the rest of the volume, and the account hands over the key.

The dichotomy's buried half merits its closing note, the lowlands' hidden floor. Gravity mapping finds the northern crust thin, and the buried crust's structure beneath the smooth fill is itself mapped at depth, the lowlands' blank face hiding the planet's biggest unknowns, the basement's own story. The volume closes the chapter with the buried file noted, because the flat plains are read at two depths, surface and substructure, and both readings are still in progress.

The boundary itself warrants its paragraph: the scarp that divides the hemispheres is not a smooth line but a ragged shelf, hundreds of kilometers wide in places, buried under later volcanism and carved by later rivers, and its width is one of the argument's chips. A single giant impact should leave a rim that is at least recognizable in the crust's gravity, the impact camp says; the graders' camp points at exactly how eroded and buried that rim would be after four billion years, and the volume files the scarp as evidence read differently by both sides.

The ages sharpen the puzzle. The southern highlands carry the planet's oldest surviving surfaces, saturated with craters from the heavy bombardment, while the northern lowlands are younger and smoother, and the stark difference in crater density across the dichotomy boundary is the cleanest fact in the whole argument, the one thing every camp must explain.

The drowned ghost gets a card: under the northern plains, the gravity data hint at buried quasi-circular depressions, the faint outlines of ancient craters buried under lavas and sediments, a highlands-like crust hidden below the smooth face, suggesting the lowlands are an old surface wearing a young coat, which complicates any story in which the north was simply blasted into being.

The volume's own reading of the file: the dichotomy is the planet's oldest unsolved landform, the boundary's buried scarp and the lowlands' hidden craters entered as competing exhibits, and the guide carries the argument as a living question rather than a settled caption, the two faces the planet's own frontispiece and its own longest argument in one.

The chapter's honest summary: the two faces are one planet's biography in two halves, the old wet south and the low blank north, and every later landscape in this book sits on one side of the seam or the other. The

dichotomy is the map's first coordinate, and the walk now turns to the south's own crown jewel, the canyon.

The boundary between the faces has its own geography, and the tour owes it a stop. The line where the rough south meets the smooth north runs diagonally across the globe but is ragged, stepped, and embroidered with remnants - plateaus that sit stranded like islands in the northern lowlands, and channel-mouths where the southern drainage evidently poured onto the younger plain. Several candidate histories compete to explain the split: a single monster impact that peeled the north's ancient crust away, a ring of great basins from several impacts, or an internal story in which the north simply formed lower and cooled later. Each hypothesis has orbiters' gravity maps arguing for it, and the honest state of the question is that the biggest fact on Mars still lacks its one agreed sentence - the account marks the argument plainly and lets the crust speak for itself:

something enormous happened here, and the landscape keeps every version of the evidence.

The faces' relative ages needs a closing sentence of dating, because the whole planet's chronology hangs from it. The southern highlands carry the densest cratering on the planet - the oldest exposed surfaces known on Mars - while the northern plain carries so few craters that its final resurfacing came late, and the shoreline-hugging features in between record the boundary's complicated afterlife: lava flooding, sediment fill, and ice working the seam. The two-sided planet is therefore also a two-aged planet, and every tour after this one prices its stops against the split: the wound, the crown, the rivers, and the poles all belong to the younger north's story as much as the old south's, and the book's chronology - old crust below, new work above - is set at this first stop for the rest of the walk.

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.