SAMPLE

Earth's Sky: Noctilucent Clouds and Airglow

Earth's Highest Sky Lights

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

There are two lights in the night sky that belong to the Earth rather than to anything beyond it, and both are among the sky's best-kept secrets. The first is a ghost: in the summer twilight of the high latitudes, long after the ordinary clouds have gone dark, silver-blue filaments glow fifty miles overhead, rippling like the sky's own lantern-lace, shining by reflected sunlight from a height where no weather happens. These are the noctilucent clouds, the night-shining clouds of the upper atmosphere, the highest clouds on the planet, made of ice so thin and so cold that they should not exist at all, and their story, from the first recorded sighting after a famous volcanic eruption to the satellites that watch them flicker today, is one of this volume's two subjects.

The second light is even stranger because it never switches off. Step into a truly dark night, away from every lamp and every town, and let the eyes fully adapt, and the sky is not black: it glows, faintly, green and ruddy and dim, from the air itself, the atmosphere's own emission, an aurora's quiet cousin that runs every night of the year, at every latitude, without a single particle of the solar wind. This is the airglow, the sky's permanent luminescence, and it is the reason the night sky over a dark site has a floor of brightness that no darkness can pass below. Astronomers fight it, photographers paint with it, satellites map it, and almost no one outside those trades has heard its name.

This book is the biography of both lights, told as this series tells all its subjects, from discovery through physics to observing craft and open questions. The two subjects belong in one volume for a real reason, not a publisher's convenience: both are lights of the upper atmosphere, both live in the same neglected layer of the sky, the mesosphere and the thermosphere that sit between the weather below and the space above, and both are read by the same instruments and watched by the same small community of observers. The mesosphere, the least-studied layer of the atmosphere, meets the reader through its two most beautiful phenomena, and the tour of the one is a tour of the other.

A note on neighbors: this volume shares its shelf with the companion volumes of this series, and the courtesies are the usual ones. The aurora, the airglow's spectacular sibling, has its own chapters in the volume on atmospheric optics, and the present book touches it only as the comparison teaches; the observing crafts of the night sky generally, and the photography of the sky's faint lights specifically, are treated in their own volumes, and the practical chapters here stay with what is particular to these two. What follows is the story of the highest clouds and the quietest light, two of the sky's most delicate phenomena, and the reader who finishes it will never again see a summer

twilight or a dark night sky quite the same way.

A paragraph on how to read the volume, because a two-subject book benefits from its map. The chapters alternate the two lights deliberately, the clouds and the glow treated in parallel through discovery, understanding, characteristics, science, observation, features, context, modern work, research, discoveries, mysteries, future, trivia, and conclusion, and the reader who wants one subject alone can follow its thread; but the joint reading is the book's own recommendation, because the two lights explain each other, the clouds giving the glow's layer its most visible weather and the glow giving the clouds' layer its chemical context, and the boundary layer's science arriving whole only when both are in view. The chapters are also, as throughout this series, self-contained enough for the dipping reader, and the practical chapters, on the observing craft, are written to be used alone on a summer evening or a dark night.

Chapter 1: The Discovery of Noctilucent Clouds and Airglow

The discovery of the night-shining clouds has a date and a disaster attached. In the summer of 1883, the volcano on the Indonesian island of Krakatoa erupted with the loudest blast in recorded history, hurling dust and vapor around the planet; the world's skies were dyed with lurid twilights for months, and the watchers of the sky, professional and amateur, were out in force. Two summers later, in 1885, a German astronomer and a Hungarian observer independently reported the new sight the eruption era had trained eyes to catch: after twilight had drowned every ordinary cloud in darkness, wisps of cloud far above still shone, silver and strange, catching sunlight from beyond the horizon.

The association with the eruption was natural, a cloud of volcanic dust high in the sky, and the early explanations ran to volcanic steam, cosmic dust, and the lingering debris of the eruption itself; but the clouds refused to die, appearing every summer after the volcano's dust had long settled, and the observers of the high latitudes, mostly in Britain, Russia, and northern Europe, began the long patient record that continues tonight.

The understanding of what the clouds were came slowly and from the geometry first. The first observers' own measurements, timing when the clouds appeared relative to sunset, and how high they sat, fixed them at heights near fifty miles, five times higher than any weather cloud, and the height itself was the discovery's engine: no cloud could exist there by the ordinary rules, the air at that height is a thousandth of the surface density and ferociously cold in summer, and the very existence of the clouds became a standing puzzle, eventually solved by the strangest fact in cloud physics, that the summer pole's upper atmosphere is colder than the winter's, a fact the clouds themselves helped prove. The name settled into place, the night-shining clouds, and the census of their appearances became a small scientific institution, the record of the high-latitude twilight watchers running unbroken into the space age.

The airglow's discovery ran on the other schedule, the slow one of instruments and suspicions. The sky's permanent faint luminance had been glimpsed for centuries, the alpine darkness praised for its blackness was never quite black, but the serious pursuit began in the twentieth century: the astronomers' need to know the true darkness of the night sky led to photometry, the photometry found a floor that sunlight, starlight, and the galaxy's glow could not account for, and the postwar years, with photomultipliers and rockets and the first

satellites, settled the question. The atmosphere itself emits: oxygen's green line, identified in the laboratory spectrum and then found ruling the night sky's darkest layers; the sodium and hydroxyl emissions of the higher air, mapped by instruments carried on rockets; and the modern picture, built since, of a sky that glows in layers, each emission from its own altitude, each with its own chemistry and its own daily and seasonal rhythm. The airglow's history is the history of the upper atmosphere's exploration, because a glowing sky is a signpost, and the signposts guided the rockets.

The two discoveries close their chapter entwined, as they would remain. The space age found both lights from above, the satellites' cameras and photometers turning the phenomena from the ground's horizon-hugging twilight views into global maps, and the modern era opened with a neat symmetry: the clouds that were discovered from below are now watched mostly from above, and the glow that was measured from below is now mapped from orbit and harvested as a diagnostic, the upper atmosphere's health read in its own light. The discovery chapter's closing note is the standing one of this series' histories: both phenomena were found by people who looked carefully at what everyone else called darkness, and both still reward exactly that attention tonight.

A paragraph on the airglow's prehistory, the light before its name. The permanent luminance was reported in the centuries before its acceptance in terms each era understood: the alpine and desert travelers' descriptions of nights never fully dark, the sailors' and the polar explorers' notes of the sky's own faint sheen, and the astronomers' systematic complaints, the great observatories' dark-sky surveys finding a floor that no known source explained, the zodiacal light and the integrated starlight accounted for and something left over. The something was the atmosphere, but the proof needed the spectrum, the ability to ask the light its chemistry, and the prehistory's closing note is the instrument lesson this series meets repeatedly: the sky's secrets wait on the instruments that can ask the right question, and the airglow's right question, what is the darkness made of, needed a spectrograph and a war's worth of electronic eyes to answer.

A paragraph on the argument that followed the first sightings, because the clouds were noticed and then doubted. The mysterious silvery clouds logged in the summers after the great eruption were first suspected of being volcanic: dust from the disaster, some theorized, lingering aloft and shining in the twilight, a phantom of catastrophe rather than a natural thing; the debate took decades to settle, observations accumulating from enough places and enough years to show a recurring, seasonal, ordinary phenomenon rather than a volcanic relic, and the early papers read as a lesson in reserve, honest

scientists refusing to baptize a new species on one summer's evidence. The origin note for the file: the discovery's real work was the exclusion of the obvious explanation, the patient proving that the sky contained a permanent stranger, and the file's confidence in what the clouds are rests on that first generation's discipline in establishing what they were not.

A second origin note, on the glow nobody commissioned, the discovery that the dark is not dark. Astronomers measuring the night's true brightness, away from town and moon, kept finding a floor: a faint permanent luminescence across the whole sky, too even for starlight's scatter, too steady for aurora, a glow the upper atmosphere generates itself as its chemistry goes about its nighttime business; the light was eventually isolated, measured, and named, and the old assumption that a moonless country night is black retired. The origin's closing note: the discovery reframed the night sky from a dark backdrop to a dim lamp, the atmosphere itself being the faintest light source on Earth, and the file's two subjects, the icy mirror clouds and the chemical glow, are the twin discoveries that ended the idea of the sky as either empty or inert, both found by people measuring carefully enough to notice the obvious.

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.