INTRODUCTION

# INTO THE COSMIC (AGAIN)

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This book attempts to wrest the history of space exploration from its normative fetishization of machines, men, and manifest destiny. Our broader goal here is to enlarge the purview of what constitutes the history of space exploration, to foreground those narrative fragments normally consigned to the edges—environmental damage, Indigenous dispossession, infrastructural entanglements, failed pathways, and cultural registers of ambiguity and decline—to the center of space history, a field largely understood as a manifestation of Cold War tensions and subsequently, as a legacy of it. The chapters in this book suggest that those aspects of space history that are often seen as unencumbered by ambiguity and moral opprobrium, such as the landing of humans on the Moon or the use of space technologies to improve our daily lives, cannot be understood without appeal to ambiguous, extractive, and often violent phenomena.

A cursory consideration of the literature on the history of spaceflight shows a subfield concerned primarily with the fetishistic connection between nation and technology, manifest in several generations of scholarship on the Cold War "space race."[1] In part due to the centrality of the Apollo Moon landings in the history of technology (and undoubtedly shaped by the dominance of Thomas P. Hughes's heuristic notion of

"technological systems"), the result has been an array of overdetermined narratives about a massive federally funded program that successfully marshaled American science, technology, and capitalism to achieve a singular goal.[2] The Anglophone literature has been dominated by explaining the techno-triumphalism of Apollo while also acknowledging without question that technology was as much an ideational factor enabled by deep-rooted notions of "frontier" as it was a material representation of American exceptionalism.[3] In all these early accounts, space history was unable to elude the vast shadow of Apollo or indeed the frame of the "space race." Critiques of American exceptionalism, technofetishism, and the frontier analogy were even rarer, despite (or perhaps because of) their deep historiographical and cultural roots in settler colonialism.[4]

The isolation of space history from the history of science was particularly evident as historians of science and medicine produced a vast canon of literature on colonial (and then, postcolonial) science and medicine in the 1990s and beyond.[5] Space history, for the most part, worked in isolation. As late as 2019, a cultural history of the intellectual genealogy of American views of the space "frontier" avoided any mention that nineteenth century visions of the American West frontier were produced on the effacement of the bodies, lives, and presence of Indigenous peoples in North America.[6] In the past decade, some historians as well as science and technology studies scholars from history-cognate fields such as anthropology, sociology, and geography have enabled a fundamental shift by producing studies on such topics as the making of "place" in scientific discourses of outer space, the use of popular media in making outer space "familiar," and most important, the colonial-like inequalities engendered by space systems on the Earth.[7] While much of this work owes more to social science than to the *history* of science, it has collectively steered space history away from the parochial concerns of space "programs" (e.g., the Apollo program, the Chinese program, the Venus exploration program, etc.) toward a number of conceptual priorities within the history of science, including those related to the human body, waste, infrastructure, social movements, tacit knowledge systems, transnational knowledge networks, cultural representations, philosophical archetypes, and global histories.[8]

Some historians of science and technology have thus moved the discussion of space history beyond the United States, compelled to fill in the web of activity that circled American space activities, whether in Western Europe or the Soviet Union.[9] The considerable work on cosmic enthusiasm in the Soviet context tapped a particularly rich vein of topics, including populist science under socialism, the central role of mysticism

in cosmic thinking, and the paradoxes of Soviet science.[10] More recent cultural histories have provided rich insights on space activities, suggesting a kind of coproduction of imagination and engineering, often embodied in the biographies of important technoscientific figures during the Cold War.[11] Attempts to restore forgotten actors into the history of space have resulted in a number of popular works on women and people of color who have contributed to the work of NASA.[12] Now a critical mass of new scholarship seeks a fundamental repositioning of the history of spaceflight from its former mode.

## FRAGMENTS

In bringing together some of this new work, as well as introducing other contributions, this book seeks to destabilize the master narrative of space exploration. The organizing heuristic here consists of the "fragments" that result from our efforts to deconstruct and dismantle the received wisdom. Fragments operate in multiple registers in this book. First, these accounts function as fragments at the edges of the stories we have normally been told about spaceflight—forgotten, ignored, or invisible until now, but existing at edge-sites where the unitary narratives no longer apply. Their location at the periphery of the master narrative, however, does not make them unimportant; in fact, as many of the authors explicitly argue, the cosmic fragments presented here are not simply additions and embellishments to the history of space travel but, on the contrary, *central* to it. They reveal unstable, uncomfortable, and unseen processes that were fundamentally symptomatic of the spirit, ideology, and practice of space exploration in all its dimensions in the past half century.

The heuristic of fragments also functions as a referent for a form of modernity, with all its contradictory impulses, emblematic of space exploration. In thinking through the relationship between modernity and fragmentation, the art historian Linda Nochlin, in her book, *The Body in Pieces: The Fragment as a Metaphor for Modernity*, describes "that sense of social, psychological, even metaphysical fragmentation that so seems to mark modern experience—a loss of wholeness, a shattering of connection, a destruction of disintegration of permanent value that is so universally [first] felt in the nineteenth century as to be often identified with modernity itself."[13] Many consider the space program as one of the primary symbolic referents for twentieth-century modernity and its futurist imaginaries; if so, as with the modernist impulse, space exploration too can be characterized by loss of connection, destruction, and disintegration. In one way or another, all the chapters presented in this book sug-

gest this internal friction, between the utopian, upward moving, and positivist imperative of the cosmic imaginary, and the frisson manifested in more earthly dislocations and displacements, as if the optimistic parabolic arc of the rocket as it lifted into the heavens was pulled apart and distended by the stresses and pressures of earthly life. William Tronzo, writes in *Fragment* of "the contrasting modalities of the fragment" in the art historical tradition, but he might as well have been imagining how space exploration has imprinted itself onto the social order, as something that has been simultaneously "received and created, oppress[ed] and liberat[ed], past and future," with each of these registers possessing "the resonance of archetypes."[14]

These considerations, of the fragment as a symptom of modernity and its inherently "contrasting modalities," hover above all the chapters. The contradictions embedded in this most modernist human imperative of the late twentieth century—space exploration—are explored in this book through engagement with two broad historiographical traditions within the history of science and technology, one on the intersection between capitalism and knowledge production; and the other on science, technology, and the environment. These two traditions require some elaboration.

Although capitalism has fundamentally shaped the contours of much twentieth-century science and technology, especially after 1991, the links between science and capitalism remain woefully understudied.[15] While the converse—the relationship between science and socialism, particularly in the Soviet context—has been the subject of considerable work throughout and after the Cold War, in the West, science and technology have usually been understood as operating in a world without ideology—where the political economy is taken as a given rather than an externality (or a special case, as with socialism).[16] In other words, the universalist and normative position on science have often been conflated with mature forms of capitalism in the West, but without identifying any particular ideological foundation.[17] Yet, while state funding was the norm in both the Soviet Union and the United States in the early decades of the space era, Western space activities were very distinctly marked by capitalist relations, through public–private partnerships with a significant role played by large and small aerospace and defense contractors.[18] Long past the Apollo era now, and especially since the end of the Cold War, we find that capitalist modes leveraged on excess, exploitation, and extraction are poised to expand into the cosmos, perhaps in the same way that Lenin suggested that once capitalism had expended its markets at home, it would have to move outward as part of colonial and imperial projects.[19] As Peter Dickens notes, "Capitalism now has the cosmos in

its sights, an outside which can be privately or publicly owned, made into a commodity, an entity for which nations and private companies can compete."[20] Many of this book's authors suggest that fragments of the cosmos have already been subordinated to the vicissitudes of capital.

Recent work on the Anthropocene has drawn attention to the possible mapping between the Anthropocene and capitalism—Donna Haraway has coined the term "capitalocene" to denote this juxtaposition—which frames the second broader theme discussed here, of the historical relationship between space exploration and the environment.[21] In a literal sense, the environmental history of space has been concerned with fragments—both the fragments that constitute orbital debris around the Earth and the detritus left behind on the terrestrial landscape. But how do we conceptually relate this cosmic detritus to the technological systems supporting space travel? One of the most important contributions of recent scholarship in environmental history has been to problematize the supposedly discrete "boundaries of social, technological, and environmental things and processes."[22] Extending Hughes's notion of sociotechnical systems, we might think of "envirotechnical" systems, which, in the words of Carl Zimring and Sara Pritchard, "[seek] to capture the ways in which objects, artifacts, and systems are both natural and technological."[23] In furthering our thinking about this interweave between nature and technology in the Canadian North, Edward Jones-Imhotep introduces us to an understanding of the "geography of natural hostility" that causes technological breakdowns, while producing a mutual understanding of the limits of both nature and technology. In the hostile environments beyond our terrestrial atmosphere, we might also think of a similar correspondence between nature and technology where, in Jones-Imhotep's striking turn of phrase, we come to think of nature as "technology made fallible."[24]

The environment—and nature more broadly—is also brought into sharper relief through the sense of "place" that dreams of spaceflight have fostered. For example, scholars have now explored the ways in which images of the full Earth from outer space, in all its beautiful fragility, may have given fuel to the environmental movement in the 1970s and onward.[25] This link between the cosmic and the terrestrial operates in many registers: Valerie Olson, for example, has shown how our conceptions of outer space contribute to the creation of what constitutes the natural and social environments.[26] We also find the converse—that our conception of "place" in outer space has been fundamentally shaped by our experience on Earth. The Earth—and its social, institutional, and environmental settings—remains a persistent and indelible analogue, not simply in the artistic depictions of far-off planetary landscapes but

also in the kinds of questions planetary scientists ask about extraterrestrial objects such as exoplanets.[27]

## LANDSCAPE, EMPIRE, WASTE, AND DECLINE

Drawing from this literature to illuminate the fragments of the history of the Space Age, the chapters in this book are organized around four themes: landscape, empire, waste, and decline. Each section contains three full-length chapters followed by a single "Fragment"—a smaller text highlighting a discrete empirical example that informs the larger theme of that section. The first section of the proposed volume, "Landscape," introduces readers to three chapters on the relationship between landscape and infrastructure in the history of spaceflight. Each of these chapters invites us to consider the accommodations made—with Indigenous people, with the natural environment, with the local political economy—with the emplacement of advanced infrastructure to support space activities. Anna Reser explores the physical, legal, and symbolic processes of "emptying" the land on which the Kennedy Space Center was constructed in Florida. Through this process, she argues, NASA mobilized a flexible slate of meanings to denote "emptying," meanings that could be turned and tweaked to make the spaceport seem both inevitable and desirable, while simultaneously concealing the various displacements and disruptions necessary to create such a "space place." Her work foregrounds the notion of "tropicality" in the ground infrastructure of space exploration, whereby the natural environment at the Kennedy Space Center can be seen as echoing the visual registers of empire and colonialism. Christine E. Evans and Lars Lundgren explore the history of two rival global satellite networks, the US-led INTELSAT and the Soviet-led Intersputnik, the latter mainly positioned in socialist countries, to highlight how a satellite earth station in Nicaragua contributed to unanticipated and unsettling transnational connections and substantial resistance to its construction. The authors offer four "perspectives" for thinking about the Managua ground earth station—as "layered" infrastructure, as artists' renderings on postage stamps, as part of Soviet efforts to sell their technology in the 1980s, and as sites of espionage. They find it impossible to render such space infrastructure—often ignored as "banal and unworthy of attention"—through clean and linear narratives of national "progress" or international cooperation in space. Instead, we are left with cycles of "repetition and mimesis" and "conflict and erasure," when such technological sites appear and disappear and reappear in larger narratives on the global Cold War. Finally, in the chapter on the construction of the Sriharikota launch-site infrastruc-

ture in the Indian state of Andhra Pradesh, I introduce the concept of the "logic of location" to describe the ratiocination behind the siting of technoscientific infrastructure in "empty" landscapes. In the context of Indian modernization in the 1960s and 1970s, this logic of location was starkly defined in terms—mathematical, rigorous, and devoid of ambiguity—suggesting that any opposition to it was either irrational or antimodernist. I show that Indian elite scientists were able to mobilize powerful narratives of national development and the emancipatory power of spaceflight to obscure the terrestrial realities around Sriharikota. The result was the violent displacement of a large number of the Indigenous (Adivasi) population known as Yanadis from Sriharikota, to be replaced by the gleaming monumental architecture of the launchpads as markers of the modern state. In the fragment by Eleanor S. Armstrong that closes out this section, landscape appears in a different register, as a mode to render outer space legible to publics in interactive spaces such as museums. She shows how pastoral themes that invoke "the wilderness, the garden, and the farm," often used in science media to naturalize technoscientific concepts to the general public, are underpinned by "American colonialism and dominance over the environment." She argues that because they reify certain "gendered, racialized, sexualized, and metropolitan" assumptions about space travel, more inclusive "ecocritical" orientations are needed.

The second section, "Empire," consists of three chapters and one fragment that focus on notions of empire. Alice Gorman begins with a contemplation on the centrality of colonialism within discourses of space exploration, both in the past and for the future. Her chapter traverses a vast landscape, both terrestrial and extraterrestrial, from the Woomera range in Australia to other ground space sites in rural Alabama, New Mexico, French Guiana, and ultimately to the Moon. She finds that the "myth of the empty land"—a myth handed down from colonial times—was a sine qua non for progress-oriented narratives of space exploration. This persistent myth is now deployed to support capitalist and extractive economies for mining resources on the Moon, whereby "to exploit the Moon," she argues, "we have to make it strange and unfamiliar,"—that is, erase millennia of cultural associations of the Moon, "relegating them to the realm of superstition." Next, Haris A. Durrani recovers the story of the first geostationary satellite launched by NASA in the 1960s and its role in a web of legal practices (including lawsuits) over what constituted "free space." He shows how lawyers conceptualized the legal geography of the United States in and beyond Earth to assert the expanded boundaries of the American administrative state. This notion was underpinned by a new concept of American extraterritoriality that foregrounded

technological control as a basis for conceiving the United States as a new global empire. Ultimately, he argues for the inextricable relationship between empire and capital at the heart of the Space Age. Finally, Nelly Bekus, in her chapter on the afterlife of the Soviet Baikonur Cosmodrome, now in the independent nation-state of Kazakhstan, reminds us of a kind of internal colonization that marked the existence of the Soviet empire during most of the twentieth century. She introduces the concept of the "sacrifice zone" in thinking of Baikonur, where considerable damage to the environment (and thus, to the quality of life) was accepted as the cost of the futuristic Soviet (and later, Russian) space programs. In chronicling the work of anti-space activists in Kazakhstan in post-Soviet times, she finds the collapse of the utopian promise of space travel, now replaced by a deep ambivalence of the real costs of this project to Kazakhstan. In the fragment that closes out this section, Rebecca Charbonneau provides a brief schematic that situates the rhetoric and actors of the Cold War US and Soviet space programs as embodying expansionary and imperial ideologies, often rooted in past myths. She uses the example of the search for extraterrestrial intelligence (SETI) to foreground the ways in which these rhetorics of empire often translated from "abstract scientific theories" to actual practical ramifications, in terms of both the imperial frames that shape our expectations of possible extraterrestrial civilizations and the actual use of SETI equipment for military purposes during the Cold War.

In the third section, "Waste," the authors tackle not only waste but also how waste can be repurposed through reuse and repair. First, Julie Michelle Klinger, in her chapter on physical sites affected by space travel such as mines, launch sites, and asteroids, invites us to rethink how terms such as "wasteland" and the "frontier" are key concepts mobilized to reclassify remote places. As a result, these places are reconfigured as sites of imminent intervention and displacement by space activities underpinned by either profit or militarism. These sites are also rendered ahistorical, she argues, each without a past or an afterlife, existing only in the moment when they become legible to earthly extractive processes. She argues that "because future space travel takes off-Earth mining as a given, theorizing extractive practices on Earth can shed light on evolving engagements with outer space." Next, Réka Patrícia Gál explores the central role of reuse and repair in the history of space exploration, one whose received narrative has been largely obsessed with a fetishization of high technology and innovation. Revisiting an episode in the early history of human spaceflight—NASA's risky repair of the Skylab space station in 1973—she asks us to rethink the history of long-duration human spaceflight as emblematic of the "dual and constructive relationship of repair and in-

novation within the Anthropocene," where repair was both a resourceful act and a political position to negate the normative cycles of innovation and waste.[28] In the subsequent chapter, Subodhana Wijeyeratne finds a complicated story in postwar Japan, as the state sought to locate an appropriate site from which to launch rockets, abandoning some places and supporting others. In some areas, there was considerable local resistance to the siting of technoscientific infrastructure. In other launch places, such as Uchinoura and Tanegashima, there was "long-term decline of these areas in terms of both economy and population." Yet Wijeyeratne shows that at one abandoned launch station at Michikawa Beach, locals were able to repurpose the old site to function as a symbol of modern Japanese technical accomplishment. The suggestion here is that even in failure, the ruins of the Space Age have unexpected afterlives. In the concluding fragment, Lisa Ruth Rand writes about the ruins of the Space Age, the fragments of spent rockets on the ground, quiet satellites in orbit, and the assorted detritus of normal spacecraft operations on Earth, suggesting that, despite the prevailing reputation of space exploration as one of high-tech accomplishment and exploratory spirit, the Space Age, from the very moment of its arrival with the launch of the Soviet Sputnik satellite, can be equally understood as "moments of breaking," producing ruin and ruination.

In the final section, "Decline," all the chapters, in one way or another, find patterns of ambiguity and decline in episodes typically tied to triumphalism, jingoism, and the higher cause of space enthusiasm. Darina Volf explores the banner Soviet–American project at the height of détente, the Apollo–Soyuz Test Project from 1975, which has often been explored exclusively at the level of Cold War high politics. She recenters the story not on political leaders or astronauts but on the media, which, she argues, served as a central site for social negotiation over the importance of space exploration in both the US and the Soviet Union. Because the project was conceived entirely as a media spectacle—the emplacement of space into the theater of public opinion—when expectations were not met, both sides lost interest in similar future ventures. Apollo–Soyuz thus remained a kind of odd discontinuity in the Cold War rather than the first of many joint projects. In her essay on Hollywood space-themed cinema of the past quarter century, Esther Liberman Cuenca suggests that although the power of American exceptionalism retains a grip on cinema—especially through positivist narratives that valorize the exceptional technical acumen of NASA—recent movies have replaced the powerful nostalgia for the Apollo Moon landings with a certain feel-good liberal internationalism. From the late 1990s onward, she finds a reduced representation of Russia as a partner, which has been re-

placed by a growing coterie of other nations, such as China and Western Europe, in addition to an extremely heightened sense of the potential of global catastrophe due to the Anthropocene. Her chapter suggests that decentering the American experience masks a form of decline (regarding the reduced role of America) coupled with anxiety (about the increasingly apocalyptic outcomes resulting from human-caused climate change). On the other hand, Natalija Majsova explores the vibrant genre of Russian space films, which, in immediate post-Soviet times, confronted the material realities of a space program in decline with a form of deep irony and revelatory humor, thus highlighting both the inequalities that marked the Soviet space program and its normative collective memory. She shows that the resulting fragmentation of the master narrative of Soviet space exploration was then followed by a new generation of movies infused with neocolonial attempts to foreground uncritical mythmaking of a Great Russia. In the final fragment attached to this section, Alexander C. T. Geppert explores the multiple meanings of the term "space age"—its emergence, periodization, and residue—in late twentieth-century global culture. His careful exegesis of the concept reveals a fissure between the historical concept (often mobilized as an anticipatory metric) and its historiographical use (uncritically used to mark a discrete time period in the present and the past). In thinking about a possible "global" Space Age, Geppert juxtaposes multiple fragmented narratives from different spaces and times to advance a more useful concept of "planetization," which was originally offered in a different context after World War II by the French Jesuit thinker Pierre Teilhard de Chardin.

The book closes with a meditative epilogue by Edward Jones-Imhotep, in which he looks at the long history of space exploration not simply as a record of human endurance—a quest to imprint our histories with a form permanence—but also as an embodiment of entire economies that were expendable, used, and ultimately abandoned. In looking at the fragments of this history, he revisits some of the themes raised in the earlier chapters—emptiness and expendability, for example—and introduces some new ones, such as "estrangement" and "remains," to offer some final thoughts on the notion of that "the history of space activities is a history of things not meant to survive." This is not merely a disinterested academic judgment, he suggests, since "ruins are no more innocent than landscapes"—they have real-world consequences. In that sense, my hope is that future historians continue to reveal other cosmic fragments.