CARL SAGAN'S GROOVY COSMOS: PUBLIC SCIENCE AND AMERICAN COUNTERCULTURE IN THE 1970S

By

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Abstract

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This thesis discusses the public science of Carl Sagan and its relationship with American counterculture in the 1970s. Historians have recently begun to rethink the seventies, emphasizing the lasting power of its turbulent politics. This is the decade in which Sagan published his most popular books and which he ended with *Cosmos*, his blockbuster documentary series. By infusing these pieces with a countercultural ethos, this thesis argues, Sagan helped create a demand for science that was socially accountable and intellectually democratic—a demand that helped bolster the resurgence of technocratic liberalism in the decades to come.

For most Americans, the 1970s were years of powerful cultural and material unease. In the gloomy economic climate, the money that the government had been pouring into scientific research since the end of World War II for the purported purpose of peace, security, and progress seemed wasteful and grotesque. Not coincidentally, the 1970s also saw a boom of literature on metaphysical transcendence and spiritual escape. For Sagan, the very scientific establishment

that had led to cultural enervation could also be a tool for personal fulfilment. Science could improve Americans' lives by giving them a "cosmic perspective" that would promote peace and unity.

This project is significant for three reasons. First, it reveals a productive interchange between science and American life by demonstrating how Sagan, an important and influential scientist, used science to promote the transcendent ideal of the “cosmic perspective.” Second, it shows how the fringe-scientific ideas that so fascinated Americans during this era—particularly the question of aliens—were brought into establishment circles by Sagan and others who grounded these ideas as part of a fundamentally scientific quest. Finally, following developments in recent American history writing, it helps us complicate the division between culture and counterculture and to better understand the productive intellectual space between the two by showing how Sagan, in reaching out to a countercultural audience, was arguing that their values could be reconciled with the kinds of science that he hoped would shape the future of intellectual inquiry.

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This thesis is dedicated to my family

and to my friends.

namque tu solebas

nugas esse aliquid meas putare

INTRODUCTION

> History is hard to know, because of all the hired bullshit, but even without being sure of "history" it seems entirely reasonable to think that every now and then the energy of a whole generation comes to a head in a long fine flash.
>
> —Hunter S. Thompson, from *Fear and Loathing in Las Vegas*, 1971.[1]

> I believe that the scientific perspective … provid[es] a sense of peaceful adventure, of the exhilaration of exploration… We see the Earth as it is, one planet among many, a world whose significance is only what we make it.
>
> —Carl Sagan, from *Mars and the Mind of Man*, 1973.[2]

Carl Sagan was one of the most widely-known, influential, and controversial American media figures of the 1970s. He was a prolific scientist, authoring or co-authoring scores of papers over the course of his career, and he was a popular personality, publishing dozens of best-selling books and penning countless editorials and newspaper columns. He was telegenic, well-spoken, and disarming. He had a wide, patient smile and a deliberate and friendly Brooklyn accent. He was a familiar guest of Johnny Carson on NBC's *Tonight Show* throughout the decade. In 1980, he co-wrote and starred in *Cosmos: A Personal Voyage*, a blockbuster science documentary series for Public Broadcasting that, in its original run, attracted almost 140 million viewers. He was a crossover success and perhaps the most effective science popularizer of the twentieth century.

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1. Hunter S. Thompson, *Fear and Loathing in Las Vegas: A Savage Journey to the Heart of the American Dream* (New York: Random House, 1971), 67.

2. Ray Bradbury, Arthur C. Clarke, Bruce Murray, Carl Sagan, and Walter Sullivan, *Mars and the Mind of Man* (New York: Harper & Row, 1973), 114-5.

Sagan's success had many causes. But one of if not the most important was his ability to tap into and redirect countercultural movements in a decade that was hungry for alternatives to the established order. This thesis argues that Sagan used transcendental ideas from the counterculture to present science as a practical tool to address personal anxieties in an anxious time. It also investigates Sagan's appeal and his audience, looking both at his impact on mainstream science and media culture and, where possible, at how his ideas were received by the American public at large.

For most Americans, the 1970s were years of powerful cultural and material unease. The industrial jobs that had been the foundation of material comfort were evaporating and the Democratic political coalition that had held progressive interest groups together with workers, factory owners, and academics since the days of the New Deal was disintegrating. Many economists and industrial planners had based their expectations on post-war wealth, and when prices rose and growth fell they could think of no obvious solutions. By the end of the decade, many Americans who had once optimistically organized for better wages and a better life felt lucky to be employed at all.[3]

In the gloomy economic climate, the money that the government had been pouring into scientific research since the beginning of the Space Age for the purported purpose of peace,

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3. Jefferson Cowie, *Stayin' Alive: The 1970s and the Last Days of the Working Class* (New York: New Press, 2010), 200-5, 331. See also Bruce J. Schulman, *The Seventies: The Great Shift in American Culture, Society, and Politics* (New York: Free Press, 2001) and Judith Stein, *Pivotal Decade: How the United States Traded Factories for Finance in the Seventies* (New Haven: Yale University Press, 2010).

security, and progress seemed wasteful and grotesque. Television shows like *All in the Family*, which ran from 1971 to '79 and films like 1975's *Dog Day Afternoon* and 1976's *Taxi Driver* skewered the old progressive social order and the middle-class, white, patriarchal families around which it had been organized. Science fiction pieces, meanwhile, like 1972's *Silent Running* and 1973's *Soylent Green*, depicted the future Earth as exhausted; stripped of its resources by an ignorant and single-minded establishment.

In 1973, the United States seemed particularly beset with disaster. The Paris Peace Accords, signed in January, officially ended American involvement in Vietnam but brought no apparent end to the violence. Over the summer, investigations by the *New York Times* and *Washington Post* uncovered President Richard Nixon's direct involvement in the cover-up of an illegal break-in at a Democratic campaign office at the Watergate Hotel in Washington, D. C. By November and December gasoline rationing spurred by a foreign policy crisis was contributing to a dismal economic forecast. Ski resorts in Colorado shuttered early and stopped maintaining their slopes. In Flordia, governor Reubin Askew warned businesses not to expect tourists, telling the *Times* that "we are all going to have to tighten our belts."[4] Three years later, newly-elected president Jimmy Carter acknowledged the mood in his inaugural address, saying that "we have learned that more is not necessarily better, that even our great nation has its recognized limits, and that we can neither answer all questions nor solve all problems."[5]

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4. Robin Resig, "The Gasoline Shortage is Giving the Travel Industry the Chills," *New York Times*, December 2, 1973.

5. Jimmy Carter, "Inaugural Address" (Speech, Washington, D. C., January 20, 1977), http://www.presidency.ucsb.edu/ws/?pid=6575. See also Schulman, *Seventies*, 23-52, 78-101.

Not coincidentally, the 1970s also saw a boom of literature on metaphysical transcendence and spiritual escape. New-age psychedelia and apocalyptic eschatology were popular alternatives to crumbling assumptions about order, progress, and rationality. Christian writer Hal Lindsey's 1970 book *The Late Great Planet Earth*—the best-selling non-fiction book of the decade—warned its readers that "man may be running out of time" and that "Jesus Christ is coming to take away all those who believe in him … without benefit of science, space suits, or interplanetary rockets."[6] Likewise, physicist and guru Fritjof Capra, in his 1975 book *The Tao of Physics*, wrote about a "beautiful experience" he had had while meditating on a beach that had shown him how "the principle theories and models of modern physics" coincided with "the views of Eastern mysticism."[7] This literature was heavily influenced by countercultural language and ideas. Lindsey, for instance, made explicit reference to the psychedelic experience of the popular counterculture drug lysergic acid diethylamide, or LSD, writing that when Christ returned it would be "the ultimate trip."[8]

Carl Sagan published his first solo piece of science popularization in 1973, and it too was influenced by countercultural themes. He explained the book's title, *The Cosmic Connection*, as a "reflection of an unspoken need to feel a significance… to believe that we are in some way

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6. Hal Lindsey, *The Late Great Planet Earth* (Grand Rapids: Zondervan, 1970), 2. See also Matthew Avery Sutton, *American Apocalypse: A History of Modern Evangelicalism* (Cambridge, MA: Harvard University Press, 2014), 345-53.

7. Fritjof Capra, *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism* (Boulder: Shambhala Publications, 1975), 11, 36. See also Peter Broks, *Understanding Popular Science* (Maidenhead: McGraw-Hill/Open University Press, 2006), 91-6.

8. Lindsey, *Late Great Planet Earth*, 144.

Figure 1: Carl Sagan at a press conference for NASA's Ames Research Center, 1973. Photograph by NASA. https://www.nasa.gov/centers/ames/news/releases/2001/01images/carlsagan/carlsagan.html.

hooked up to the universe." Literature "in a range of pseudoscientific or borderline scientific topics," he wrote, had identified the symptoms of cultural anxiety but not the cure. They were attempts, "overwhelmingly unsuccessful," in his view, to give their readers a "cosmic perspective"—a humbling sense of philosophical purpose. Only science, Sagan believed, could provide this perspective.[9]

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9. Carl Sagan, *The Cosmic Connection: An Extraterrestrial Perspective* (Garden City, NY: Doubleday/Anchor Books, 1973), 186.

The very scientific establishment that many Americans had accused of creating cultural enervation and that had built scores of terrifying Cold War weapons, Sagan argued, could yet be a tool for personal fulfilment. A scientific search for extraterrestrial intelligence, for instance, would improve Americans' lives by giving them an idea of their real place in nature and by promoting patience and unity. With public involvement, scientists could open their research to artists, thinkers, and "experiments in utopia."[10]

Sagan was a professional scientist, but he was peculiarly alert to critiques from the left that the scientific establishment was monolithic, undemocratic, and too-closely aligned with the interests of its military benefactors. Yet he believed that science was a universal, transcendental project, accessible not just to any thinking person but, potentially, to any thinking being whatever, regardless of species or home planet. There were many alternative transcendental paths, he acknowledged, but only science led to the real thing. By becoming personal, practical, and "groovy"—hip to social and political change—science could unite humanity (and, perhaps, its interstellar neighbors) in a harmonious and prosperous whole. That belief, expressed both through his best-selling popularization work and in his professional publications, would help to shape how Americans understood themselves and their relationship with the cosmos.

The first chapter of this thesis discusses the rise of the scientific establishment in the aftermath of the Second World War. The military had invested billions of dollars in science over the course of the conflict and with the looming threat of the Soviet Union it was prepared to invest billions more. Many scientists appreciated the sudden availability of grant money and the

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10. Ibid., 60.

opportunity to contribute to an apparently patriotic cause, while the storm of anticommunist politics silenced those who spoke out against the military's belligerent agenda and demands for secrecy. Public fears of technocratic power grew, and after the 1962 Cuban Missile Crisis, those fears began to coalesce around demands for a more democratic and more transparent scientific order—particularly within young, left-leaning circles on university campuses.

The second chapter introduces Carl Sagan in the context of the unidentified flying object, or UFO, crises of the Space Age. UFOs were a well-suited boogieman for a public that was both terrified of and fascinated by the power of science. Sagan, a young professional scientist who had grown up as a fan of science fiction and who came from a politically progressive family, felt that his colleagues were not doing enough to address the topic. So-called "UFO-ologists," or "saucerians," were, he felt, right to be paranoid about military influence in science even if they were wrong about the extraterrestrial origins of UFOs. He became an advocate for public involvement in science and science popularization, arguing that by being open about controversies and by challenging the silences of anticommunist politics, scientists could find a broader, more democratic foundation for their work.

Chapter three explores Sagan's attempts to build this foundation by helping to publicize the scientific search for extraterrestrial life. Sagan, together with Frank Drake and other members of the never-quite-secret "Order of the Dolphin," developed mathematical means to estimate the number of nearby alien civilizations and the technological means to search for them. But as these ideas grew in popularity they also became magnets for controversy. Some of Sagan's fellow scientists wondered at his growing fame and professional presumption while some in the press asked whether his quest might be foolhardy or even dangerous. Meanwhile, no evidence of life

beyond the Earth was forthcoming, and, for his part, Sagan worried that this was because of a fundamental trap at the heart of science—that building the means of interstellar communication also meant building terrible weapons and that the existence of such weapons might easily lead to self-annihilation.

The fourth and final chapter examines the 1977 *Voyager* record as the culmination of Sagan's thinking in this period and as an answer both to his critics and to his own fears. The record was at once countercultural and scientific, personal and universal, a hopeful message and a dire warning. Full of pictures, sounds, and music, the record, launched by a refitted missile and attached to a very expensive spacecraft, was a summary of human existence that nevertheless excluded images of war and violence. This contradiction, Sagan felt, represented a truth about humanity and about the universe at large that could only be revealed through his vision of transcendental science.

The History of Science

This thesis discusses Carl Sagan's cultural and scientific work within the context of what scholars have increasingly identified as the "long 1970s." It demonstrates Sagan's use of countercultural ideas within his science and it helps explain his attempts to bring science to the counterculture. It also contributes to and helps shape the category of "groovy science" as a historiographical tool by coming to terms with the role of one of its central actors. Eclectic, critical of the establishment, and willing to use his professional credibility to engage with social causes, Sagan was emblematic of what Americans came to expect from public science over the

course of the 1970s. His work during the seventies provides an ideal vehicle for linking recent successful developments in American history writing to the history of science.

For the most part, historians have offered little serious, scholarly work on Carl Sagan. There are two biographies of Sagan, both published in 1999—three years after his death—one by Keay Davidson and the other by William Poundstone. These books have some serious flaws, however—including a number of anecdotes that are, at best, of questionable provenance and that are, at worst, lurid fictions. They are also more narrowly focused on dissecting Sagan's personal life than on the broader issues of science within American society and politics that I hope to address here.[11] Steven J. Dick's book, *The Biological Universe*, does more of this. Dick has a broad command of evidence and some fascinating personal interviews with many of the same subjects I discuss, but his scope is both wider—looking at the history of thought about extraterrestrial life from ancient times to the present—and narrower—looking at science in more isolated, philosophical terms—than my own.[12]

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11. Keay Davidson, *Carl Sagan: A Life* (New York: John Wily & Sons, 1999); William Poundstone, *Carl Sagan: A Life in the Cosmos* (New York: Henry Holt, 1999). These issues are not worth exploring in detail here, but Sagan's widow, Ann Druyan, discusses them briefly in a letter to the *New Yorker*, published February 27, 2017.

12. Steven J. Dick, *The Biological Universe: The Twentieth-Century Extraterrestrial Debate and the Limits of Science* (New York: Cambridge University Press, 1996). Sagan merits brief mention in Peter J. Westwick, *Into the Black: JPL and the American Space Program, 1974-2004* (New Haven: Yale University Press, 2007), Erik M. Conway, *Atmospheric Science at NASA: A History* (Baltimore: Johns Hopkins University Press, 2008), and Sato Yasushi, "Astrobiology and Robotic Lunar/Planetary Exploration: A Tension between Space Science and Space Technology in the Cold War Era," *Quest* 15, no. 3 (2008), 6-13. Sagan appears more frequently in histories of science in the 1980s, when his work became more focused on the politics of nuclear weapons. See, for instance, Lawrence Badash, *A Nuclear Winters' Tale: Science and the Politics of the 1980s* (Cambridge, MA: Harvard University Press, 2009) and

Historians have tended to overlook or undervalue the seventies. In a review of recent American history writing, historian Rick Perlstein notes that most accounts portray those years as "dolorous, uneventful, derivative; hardly a historical moment at all."[13] For many historians, the 1960s have been more attractive. That decade, bright where the seventies were dark, provided stories of youth and rebellion, the flowering of dissent, and the mortal wounding of the old order—a general "dramatization of our humanity."[14] Within the last ten or fifteen years, however, historians have begun to rethink the seventies, countering the traditional "long 1960s" narrative with a "long 1970s" alternative and in the process complicating some long-accepted cultural and political borders.[15] My project is built on this "long 1970s" narrative.

My project also exists within a broader literature about science, technology, and the American left, including Thomas P. Hughes' *American Genesis* and Theodore Porter's *The Pursuit of Objectivity*. Both books emphasize the importance of "system" as directed by

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Matthias Dörries, "The Politics of Atmospheric Sciences: 'Nuclear Winter' and Global Climate Change," *Osiris* 26, no. 1 (2011), 198-223.

13. Rick Perlstein, "Books & the Arts: That Seventies Show," *The Nation*, November 8, 2010. See also Kathryn Jay, "Something Really Happened: Rethinking the Seventies," *Reviews in American History* 30, no. 2 (June 2002), 333-9 and Charles L. Ponce de Leon, "How Pivotal Were the Seventies?" *Reviews in American History* 40, no. 1 (March 2012), 128-38.

14. Maurice Isserman and Michael Kazin, *America Divided: The Civil War of the 1960s*, 4th ed. (Oxford: Oxford University Press, 2012), 5.

15. Besides Schulman, *Seventies*, Cowie, *Stayin' Alive*, and Stein, *Pivotal Decade*, see also Beth Bailey and David Farber, eds., *America in the Seventies* (Lawrence, KS: University Press of Kansas, 2004) and Sam Binkley, *Getting Loose: Lifestyle Consumption in the 1970s* (Durham: Duke University Press, 2007); compare to Peter Carroll, *It Seemed Like Nothing Happened: America in the 1970s* (New Brunswick: Rutgers University Press, 1982).

professional American scientists and technologists in the twentieth century.[16] Although the countercultural left of the 1970s rejected the "language of quantity" that Porter discusses, it did not entirely abandon the progressive project of using scientific systems to improve their lives and the world around them.[17]

Historians of science have been slow to recognize the seventies and its intriguing mix of scientific innovation and countercultural tumult. As David Kaiser and W. Patrick McCray argue, historical accounts often over-emphasize the disconnect between the left and the establishment, resorting to a "simplistic dichotomy, pitting counterculture against science." Kaiser and McCray attempt to correct this by providing historians with a new lens, that of "groovy science," which emphasizes science attuned to the "social exploration, experimentation, and eclecticism that were emblematic of the counterculture(s) during one of the most colorful periods of recent American history."[18] In bringing the history of science up to date with new thinking about the 1970s, this lens has enormous historiographical potential, and this thesis is in some ways built around it.

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16. Thomas P. Hughes, *American Genesis: A Century of Innovation and Technological Enthusiasm*, 2nd ed. (Chicago: Chicago University Press, 2004) and Theodore Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1996).

17. For the 1970s counterculture, see Christopher Gair, *The American Counterculture* (Edinburgh: Edinburgh University Press, 2007) and Peter Braunstein and Michael William Doyle, eds., *Imagine Nation: The American Counterculture of the 1960s and '70s* (New York: Routledge, 2002). To compare with the New Left, see Isserman and Kazin, *America Divided* and Van Gosse, *Rethinking the New Left: A Movement of Movements* (New York: Palgrave-Macmillan, 2005).

18. David Kaiser and W. Patrick McCray, eds., *Groovy Science: Knowledge, Innovation, and American Counterculture* (Chicago: University of Chicago Press, 2016), 3-7. Some further examples, predating the term, include Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, The Whole Earth Network, and the Rise of Digital Utopianism* (Chicago:

Science and Counterculture

This project is significant for three reasons. First, it reveals a productive interchange between science and American life by demonstrating how Sagan, an important and influential scientist, used science to promote the transcendent ideal of the cosmic perspective. Second, it shows how the fringe-scientific ideas that so fascinated Americans during this era—particularly the question of aliens—were brought into establishment circles by Sagan and others who grounded these ideas as part of a fundamentally scientific quest. Finally, following developments in recent American history writing, it helps us complicate the division between culture and counterculture and to better understand the productive intellectual space between the two by showing how Sagan, in reaching out to a countercultural audience, was arguing that their values could be reconciled with the kinds of science that he hoped would shape the future of intellectual inquiry.

Sagan's work helps us understand the meaning and purpose of science within the context of American history more broadly—that scientists and their ideas are central agents of, and, ultimately, subjects to historical change. Though Sagan was sometimes characterized as a "mere"

University of Chicago Press, 2006), Andrew Kirk, *Counterculture Green:* The Whole Earth Catalog *and American Environmentalism* (Lawrence: University Press of Kansas, 2007), David Kaiser, *How the Hippies Saved Physics: Science Counterculutre, and the Qunatum Revival* (New York: W. W. Norton, 2011), W. Patrick McCray, *The Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (Princeton, NJ: Princeton University Press, 2012), and Michael Gordin, *The Pseudo-Science Wars: Immanuel Velikovsky and the Birth of the Modern Fringe* (Chicago: University of Chicago Press, 2012). In an email to the author dated May 26, 2016, Kaiser writes, "Patrick [McCray] and I looked up a few years ago and realized that several of our friends and colleagues were working on related material, so we brought them all together… [*Groovy Science*] was a very fun project."

popularizer, he had built a solid reputation on the back of his professional expertise before he ever sat down in front of a television camera. Indeed, his willingness to engage with fringe elements helped define and fortify the boundaries of science at a time when it seemed to many as though they were under attack.[19]

Ultimately, one wonders what influence Sagan had on his later followers and how his work helped shape their politics. There is a fascinating contradiction at the heart of this relationship—between counterculture and science—that mirrors other conflicts between what might be called revolutionary ideology and liberal pragmatism. How did Sagan's embrace of a transcendent scientific identity square with the reality of technocratic state authority? What part did he play in the larger story of science in American history? What is his legacy in the first decades of the twenty-first century? These questions, and many others, flow through Sagan's work and through the turbulent politics of the 1970s. It is my hope that this thesis will help begin to answer them.

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19. Gordin, *Pseudoscience Wars*, 1-15.

CHAPTER ONE

In the American popular imagination, the atom bomb and its attendant mushroom cloud are likely the images most closely associated with the science of the 1950s and 1960s.[20] American policy makers in those decades held science as the country's most important strategic resource. After the victory in Europe, technologist and National Defense Research Council head Vannevar Bush told Congress that he believed the United States had led the Allies to victory in part because it had invested the most time and money into scientific research. Without that investment, he testified, "Nazi Germany would not now be prostrate."[21]

Over the course of the Second World War, the United States government had, to an unprecedented degree, committed itself wholly to supporting and controlling scientific research. Universities that had been mostly independent were showered with defense money in the expectation that they would contribute to the war effort. With that largesse came a new sense of responsibility, however, and as the American scientific establishment grew it also became less autonomous and less politically diverse. Military security measures meant that scientists had to be more secretive and less open with the public.

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20. See, for instance, Daniel Patrick Thurs, *Science Talk: Changing Notions of Science in American Popular Culture* (New Brunswick: Rutgers University Press, 2007) and Glen Scott Allen, *Master Mechanics and Wicked Wizards: Images of the American Scientist as Hero and Villain from Colonial Times to the Present* (Amherst: University of Massachusetts Press, 2009).

21. Francis Sill Wickware, "Manhattan Project," *Life*, August 20, 1945.

As the scientific establishment grew more tightly entwined with its military benefactors, however, Americans became wary of its apparently unchecked technocratic authority. President Dwight Eisenhower's eerie farewell warning about the "Military-Industrial Complex" reflected a growing sentiment that science—especially when handling matters as deadly serious as nuclear weapons—should be more democratic. In the face of political pushback, that sentiment drove resentment, especially among young people and college students, and especially after the 1962 Cuban Missile Crisis. By the end of the 1960s, that resentment had laid the groundwork for leftist protest movements and the rise of the counterculture, which rejected the establishment entirely. That counterculture, in turn, helped create a sea change in the American public's relationship with science in the 1970s and in the decades that followed.

The Basic Power of the Universe

The American project to build an atomic bomb began in the summer of 1939, when a small group of scientists persuaded Albert Einstein to write to president Franklin Roosevelt to warn him that emerging research into nuclear fission might soon lead to the creation of a singularly devastating weapon. The group, led by Italian physicist Enrico Fermi, were all émigrés from fascist countries in Europe. Fission, which released an enormous amount of energy from a very small amount of matter, had been predicted by Einstein's theoretical work and was a well-known scientific hypothesis. Fermi and his group argued that it was no less well-known in the institutions they had left behind and which were now part of the Axis war machine. With

conflict on the horizon, they insisted that the only hope for victory was to be the first to build the bomb.[22]

Code-named the "Manhattan Engineering District," the bomb project started small but grew quickly. Roosevelt initially agreed to set aside a $6,000 grant for fission research. After the Japanese attack on Pearl Harbor in December 1941, however, the government's investment expanded exponentially. By the end of 1942, it had reached $400 million. By January 1945, the bill had climbed to almost $2 billion.[23] By that time, the project was employing more people than the entire American automobile industry.[24] General Leslie Groves, who had been appointed as the project's military director, warned the scientists and engineers under his command that if they failed to produce a working weapon they could "look forward to a lifetime of testifying before congressional committees."[25]

The stakes were high. Under the advice of physicist J. Robert Oppenheimer, who had been selected as Groves' scientific liaison and as overall second-in command, the military set up a secret laboratory at a secluded ranch in Los Alamos, New Mexico. Groves demanded constant progress and set strict deadlines. Experiments with fissionable materials were often performed haphazardly, with little regard for safety. The mishandling of one plutonium "core" twice led to

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22. Daniel J. Kevles, *The Physicists: The History of a Scientific Community in Modern America*, rev. ed., (New York: Alfred A. Knopf, 1995), 324-48. See also Richard Rhodes, *The Making of the Atomic Bomb*, rev. ed., (New York: Simon & Schuster, 2012).

23. Kevles, *Physicists*, 324, 326-7.

24. John M. Findlay and Bruce W. Hevly, *Atomic Frontier Days: Hanford and the American West* (Seattle: University of Washington Press, 2011), 15.

25. Qtd. in Lansing Lamont, *Day of Trinity* (New York: Scribner & Sons, 1965), 76.

the deaths of prominent scientists.[26] Los Alamos physicist Richard Feynmann, aware that such experiments could quite easily lead to the obliteration of the entire site, referred to them as "tickling the Dragon's tail." Others wondered at the military's obsession with security. Their support was financially generous, but it also came with significant caveats. Everyone had been subjected to invasive background examinations with a special focus on their personal politics. Censors examined every piece of mail coming in or out. Feynmann eventually developed a complex private code so that he could more freely communicate with the outside world.[27]

Yet for most Manhattan Project scientists, the pressure was offset by the tremendous sense of exhilaration they had for their task. The Army brought scores of newly-minted Ph.Ds. to Los Alamos, where they lived and worked alongside as many as eight Nobel laureates at a time on a project that would not only blaze new trails in physics but would also contribute to the defeat of America's enemies. Some questioned the morality of the bomb, but the widespread loathing of Nazism in the camp quieted these objections. The project had been launched by refugees, after all, and it had since brought more on board. Many of the project's scientists were Jews who had relatives in occupied Europe, and they saw their work as a way to fight on their behalf.[28]

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26. Alex Wellerstein, "The Demon Core and the Strange Death of Louis Slotin," *The New Yorker*, May 21, 2016. See also Kevles, *The Physicists*, 329-34.

27. Richard Feynmann, "Los Alamos from Below: Reminiscences 1943-1945," ed. Lawrence Badash, (Lecture, University of California Santa Barbara, 1975), http://calteches.library.caltech.edu/34/3/FeynmanLosAlamos.htm.

28. Rhodes, *Making of the Atomic Bomb*, 443-85.

There were some dissenters. Physicist I. I. Rabi had turned down a position at Los Alamos, asking Oppenheimer in a letter whether he wanted "this" to be the "culmination of three centuries of physics?" By taking the military's money, he argued, "we become … servants of the 'munitions makers.'"[29] Ultimately, however, such voices were few and far between.

After Germany surrendered in May 1945, many of the project's scientists began to question the consequences of what they were doing. Some believed that with the Nazis defeated work on the bomb should be stopped altogether. Some agreed that it should not be used against the Japanese but proposed instead that it should be demonstrated to the world as a warning and as a call for peace. Others felt that it should be used on Japan but perhaps only to destroy some key military installation. As the work wrapped up, more had time to worry about what a post-war world would look like and how the atom bomb's tremendous capacity for violence would shape that world.[30]

The White House, meanwhile, now under president Harry Truman, developed a plan of its own. Los Alamos had assembled three working bombs. The Army detonated the first, nicknamed Gadget, at a bombing range in Alamogordo, New Mexico, near Los Alamos.

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29. I.I. Rabi to J. Robert Oppenheimer, February 26, 1943. Qtd. in Kevles, *Physicists*, 335.

30. Jessica Wang, *American Science in an Age of Anxiety: Scientists, Anticommunism, and the Cold War* (Chapel Hill: University of North Carolina Press, 1999), 10-43. See also Kai Bird and Martin J. Sherwin, *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* (New York: Alfred A. Knopf, 2005), 205-235.

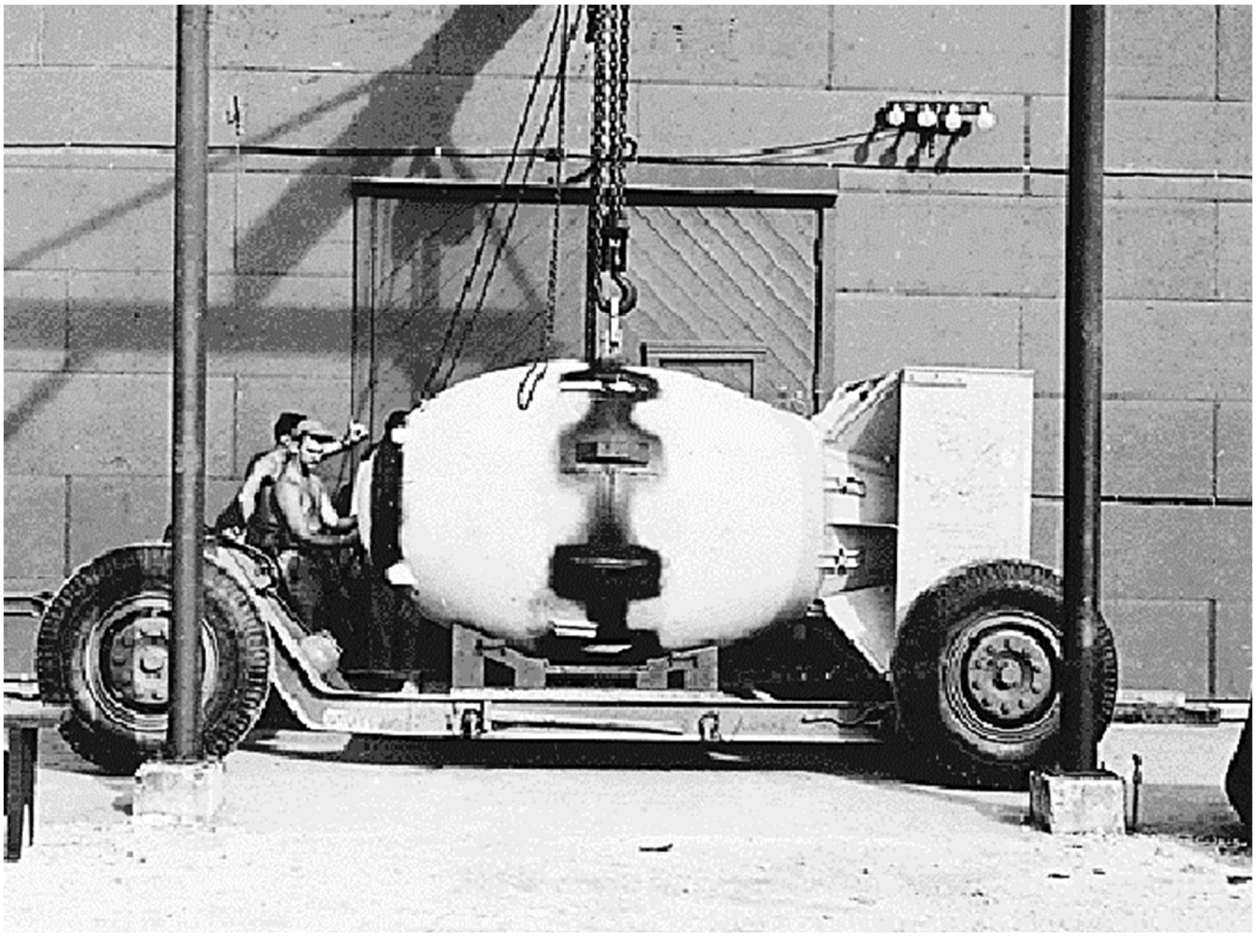

Figure 2: Fat Man at Tinian Island, August 1945. U. S. Department of Energy. https://www.osti.gov/opennet/manhattan-project-history/images/fat_man_image.htm.

They dropped the second, Little Boy, on the Japanese city of Hiroshima. The third, Fat Man, they dropped on Nagasaki. These cities were purely civilian targets, chosen by the Army and approved by Truman as a way to preempt an Allied invasion of the Japanese home islands and guarantee an unconditional end to the war before Soviet troops could reach the Pacific.

The results were shocking. Hiroshima and Nagasaki were destroyed. The bombs had been set to detonate about 2,000 feet before they hit the ground, and those who were exposed to the blast were vaporized—their shadows baked into the ground beneath them. Even some of those

who had been indoors had been burned or blinded by the flash of detonation. The crew of the *Enola Gay*, the plane that had dropped Little Boy over Hiroshima, reported looking back and being able to see the towering mushroom cloud from over four hundred miles away. The survivors faced not only the usual hardships of fire, sickness, and exposure, but also the strange new horrors of radiation poisoning. Americans both praised the attacks and denounced them as barbaric. Almost all celebrated the end of the war.[31]

For the military, the project had been a resounding success. Their investment, large though it had been, had paid off, leaving them with an apparently unanswerable superweapon. The White House announced that they had developed a bomb with "more power than 20,000 tons of TNT;" one that had been forged by American scientists from "the basic power of the universe."[32] Oppenheimer, perhaps still somewhat stunned, told a reporter that "if you ask: 'Can we make them more terrible?' the answer is yes. If you ask: 'Can we make a lot of them?' the answer is yes."[33]

For the scientists involved, the devastation of the bomb was overwhelming. Some shared Oppenheimer's tone: forlorn, withdrawn, and resigned to their place in history. Some hoped that the bomb would ultimately secure peace for the United States and the world. Most agreed that,

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31. Kevles, *Physicists,* 333 and *Rhodes*, *Making the Atomic Bomb*, 749-788. The debate over why these targets were chosen is outside the scope of this project, but is worth considering. See Tsuyoshi Hasegawa, *Stalin, Truman, and the Surrender of Japan* (Cambridge, MA: Harvard University Press, 2005).

32. "Press Release by the White House" (Washington, D. C., August 6, 1945), Ayers Papers, https://www.trumanlibrary.org/whistlestop/study_collections/bomb/large/documents/index.php?documentid=59.

33. "Science: Atomic Quickies," *Time*, October 29, 1945.

since the weapon was a product of scientific research, any sufficiently advanced nation could eventually produce them. Almost all felt that there would have to be international control and oversight of fission research and that this control would have to involve the Soviet Union. Anything less, they argued, would invite a catastrophic arms race.[34]

For a time, at least, this seemed like the best course to Soviet scientists as well. Their bomb project had gotten off to a slower start than that of the United States, but by 1945 it was well underway. Sympathetic leftists at Los Alamos had managed to leak some information about American progress to the Russian government, and, initially, some scientists, even those without strong political feelings, were hopeful that a joint research agreement could be negotiated. As the war wound down, however, with both sides now jockeying for position in Europe, that hope began to fade. After 1945, a handful of proposals for international oversight were put before the newly-formed United Nations, but the United States and the Soviet Union could agree on almost nothing. Stalin decided that the USSR would have to have a bomb of its own. By 1949, it did. The arms race that scientists had feared had begun.[35]

The Prisoners' Dilemma

The United States government responded to the Soviet bomb by redoubling its financial support of research. Demand for new and better weapons drove an unprecedented expansion of professional science. Universities began training legions of graduate students in physics and

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34. Wang, *Science in an Age of Anxiety*, 10-43.

35. Kate Brown, *Plutopia: Nuclear Families, Atomic Cities, and the Great Soviet and American Plutonium Disasters* (New York: Oxford University Press, 2015), 75-164.

engineering with the expectation that they would work on behalf of national defense. An array of new Defense Department grants, meanwhile, encouraged faculty to focus less on basic, speculative research and more on practical questions directly related to military needs.[36]

Some scientists resisted military encroachment, echoing Rabi's fear of becoming subservient to "munitions makers." Geneticist L. C. Dunn, for instance, worried about what he saw as growing "centralized private control for profit," while Morris Cooke, an engineer, wrote that science must work exclusively in the "public interest." They argued against elitism and isolation in science, for broader outreach, and for a more democratic distribution of grant money.[37] Few of these scientists had any connection to the radical left, but, together with their support for internationalism and Soviet rapprochement, their politics made them fellow travelers of convenience.

This correlation, however, also made these scientists exceptionally vulnerable to growing anticommunist sentiment. Some scientists who had initially agreed with Dunn, Cooke, and others like them felt that the resemblance was too close for comfort. Harold Urey, for instance, a former Los Alamos physicist now at the University of Chicago, had ended the war as a leftist but had eventually come to decide that any attempt to appease Stalin was naïve. Stalinism, he decided, was a threat to the democratic liberties necessary for scientific research and the United States was right to oppose it. Others, like Vannevar Bush, were and remained politically conservative and philosophically opposed to communism in general. Many who had perhaps been undecided

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36. Kevles, *Physicists*, 367-92.

37. L. C. Dunn, handwritten note, qtd. in Wang, *Science in an Age of Anxiety*, 33; qtd. in Layton, *Trinity*, 159.

or otherwise uninterested in politics simply fell in line rather than risk their position and access. By the late 1950s, internal resistance to military control of science had essentially evaporated. Those few who remained vocally opposed were refused grants and denied essential security clearance.[38]

This isolation stoked broader public fears about the meaning and authority of science. Fantasy films, novels, and comic books presented an image of the "mad" scientist, who wielded terrible powers and who answered only to his own twisted conscience.[39] They took as their inspiration organizations like the RAND Corporation, set up by the Air Force to formulate strategic policy by scientific means. Its analysts described the world as a series of grotesque mathematical games: the "Prisoners' Dilemma," for instance.[40]

In 1961, RAND analyst Herman Kahn published *On Thermonuclear War*, a variation on Carl von Clausewitz' 1832 book *On War* that he had been working on since the early 1950s. Clausewitz had famously argued that war was a "continuation of policy by other means," and likewise Kahn argued that atom bombs should be practical strategic weapons. Even after millions upon millions of casualties—indeed, Kahn coined the term "megadeath" to shorten some of his

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38. Wang, *Science in an Age of Anxiety*, 29-35. See also Kai & Sherwin, *American Prometheus*, 523-537.

39. Allen, *Master Mechanics and Wicked Wizards*, 92-113.

40. Paul Erickson, Judy L. Klein, Lorraine Daston, Rebecca Lemov, Thomas Sturm, and Michael D. Gordin, *How Reason Almost Lost Its Mind: The Strange Career of Cold War Rationality* (Chicago: University of Chicago Press, 2013), 133-158.

calculations—there would be multiple possible "tragic but distinguishable postwar states."[41] In other words, he argued, a third world war could be winnable. Kahn's book was widely read, and his apparently callous treatment of the human consequences of such shocking violence did nothing to improve the public image of science.[42]

Meanwhile, international tension rose as the United States and the Soviet Union fought proxy battles over influence in newly independent African and Asian nations.[43] That tension came to a head in October 1962, when the Soviet Union began installing medium-range missiles in Cuba. The United States responded by blockading the island. Russia seemed prepared to try and run the blockade. Each step of escalation seemed logical, obvious, and calculated, even while each step brought the two countries closer to the brink of total war—an inexorable product of RAND's rational strategic planning. By the end of the month, although the situation had been defused, many Americans' faith in an ordered, scientific world had been profoundly shaken.[44]

A Scientific Revolution

That crisis of confidence, together with growing anger about racial discrimination and prejudice in the Jim Crow South, led to a general call for protest, especially among students. In

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41. Herman Kahn, *On Thermonuclear War* (Princeton: Princeton University Press, 1961), 626.

42. Sharon Ghamari-Tabrizi, *The Worlds of Herman Kahn: The Intuitive Science of Thermonuclear War* (Cambridge, MA: Harvard University Press, 2005).

43. See, for instance, Raymond F. Betts, *Decolonization* (New York: Routledge, 1998).

44. Erickson, et al., *How Reason Almost Lost Its Mind*, 1-26.

1962, a group of protestors gathered in Port Huron, Michigan to form the Students for a Democratic Society, or SDS, which would go on to form the backbone of leftist student politics throughout the 1960s. "We may be the last generation," they explained in their organizing manifesto. To survive, humanity would have to find "a meaning in life that is personally authentic."[45] These students were aware of the presence of the military-scientific establishment on their college campuses, and that presence became the focus of their activism. Students highlighted their schools' affiliation with the military, rejecting what many called the "knowledge industry" formulation of education.[46] At Berkeley, students marched with IBM punch cards hung around their necks, demanding a more humanist curriculum.[47] The economy, meanwhile, was beginning to stagnate as the postwar surplus dried up. The army of graduate students that American universities had begun training in the 1950s could not find the jobs they had been promised. Without access to the jobs they had been trained for, the "practical" material they had been taught, they argued, was essentially useless.[48]

Yet the various protest groups could not agree on what that authenticity looked like. Some leaned more towards Marxism and traditional labor politics, encouraging leftists to get involved in democratic institutions and to change them from within. Others felt that this was

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45. Tom Hayden, "Port Huron Statement of the Students for a Democratic Society," Michigan State University, http://coursesa.matrix.msu.edu/~hst306/documents/huron.html.

46. See, for instance, Isserman and Kazin, *America Divided*, 158-178 and Gosse, *New Left*.

47. Turner, *Counterculture to Cyberculture*, 32-5.

48. Kaiser, *How the Hippies Saved Physics*, 1-23.

somehow trite. The system should be abandoned altogether, they argued, and a new society should be built in its place. This division, between what came to be known as the New Left and the counterculture, was partly a product of drug use. While the New Left had mixed opinions on drug use, counterculturists tended to see drugs—especially popular psychedelics like LSD and psilocybin—as a window to a more significant reality. The New Left, they felt, was ignorant to the larger truth of human community. Without access to that truth they could have no hope of achieving lasting change.[49]

That way of accessing truth by means of an internal, psychedelic sense of authenticity also came to define how counterculturists engaged with natural science. Many were particularly attracted to the work of Thomas Kuhn.[50] Kuhn had argued in an extended 1962 essay on *The Structure of Scientific Revolutions* that the history of science could be thought of as a series of shifting paradigms—sets of beliefs about nature that were internally coherent but mutually incommensurable. These paradigms, he wrote, changed over time for essentially cultural reasons. What made sense in one would be unintelligible in another.[51] As a historian, Kuhn was mostly interested in the European Renaissance, but his theory had a profound significance for counterculturists, who believed that it helped explain why they felt so intellectually isolated from other leftists.

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49. Isserman and Kazin, *America Divided*, 138-57.

50. Gordin, *Pseudoscience Wars*, 10.

51. Thomas S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), 43-51.

Some counterculturists went further, adopting the fringe-scientific ideas of Immanuel Velikovsky. A Russian Jew who had fled to the United States with his family at the onset of World War Two, Velikovsky was a psychoanalyst and Hebrew scholar, and he had a passion for biblical philology. In 1950, he published *Worlds in Collision*, in which he had proposed that the tribulations of the Israelites in *Genesis* had been caused by wild detours in the orbit of the planet Venus. His thesis was sensational and widely rejected, and the book had caused a minor stir after it was released by Macmillan in 1950 when a group of scientists had threatened to boycott the publisher's lucrative textbook imprint. *Worlds in Collision* found popularity again in the late 1960s among some counterculture-affiliated undergraduates and academics who saw the boycott as emblematic of the undemocratic and disconnected nature of the scientific establishment. By 1972, a pair of undergraduates had begun publishing *Pensée*, a Velikovskian journal, out of Lewis and Clark College in Portland, Oregon which, in short order, found over ten thousand subscribers. They were, they believed, the vanguards of a new scientific revolution that would make natural knowledge accountable to student protest.[52]

Conclusion

By the end of the decade, it seemed to some observers that a generation of Americans was poised to turn away from science altogether. The journalist Theodore Roszack, who had originally coined the term "counterculture," wrote that the students and activists he encountered

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52. Gordin, *Pseudoscience Wars*, 19-78; 135-162 and Michael D. Gordin, "The Unseasonable Grooviness of Immanuel Velikovsky," in Kaiser and McCray, eds., *Groovy Science*, 207-37.

were calling for a rejection of "our deep-seated commitment to the scientific world-view" and of "the securities and creature comforts of industrial affluence which science gives us." His characterization was widely cited by columnists and critics who feared that the left was descending into anti-intellectualism.[53]

But was the counterculture truly rejecting science? *Pensée*, despite its fringe ideas and revolutionary intentions, still attempted to abide by the common scientific standards of peer review and of publishing critiques of previous issues and articles. Meanwhile, some counterculturists had taken to the idea that their new society could be built in other spaces made accessible by science. Some, like the so-called "L5 Society," advocated for countercultural freedom through government-backed space colonization.[54] Others, like Stewart Brand and the subscribers to his *Whole Earth Catalog*, argued that the digital "cyberspace" of networked computers could serve this purpose, even if the computers themselves were produced by establishment military-scientific industries.[55] These groups could hardly be said to be anti-science.

Yet clearly something new was happening. The left wanted a science that was more personal, more humane, and more democratic. The Cuban Missile Crisis and the soaring arms race, books by Herman Kahn and the RAND corporation, and the lack of internal scientific

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53. Theodore Roszack, *The Makings of a Counter Culture: Reflections on the Technocratic Society and its Youthful Opposition* (Garden City, NY: Doubleday/Anchor Books, 1969), 9. See also Hughes, *American Genesis*, 443-72 and Broks, *Understanding Popular Science*, 84-6.

54. McCray, *Visioneers*, 73-112.

55. Turner, *Counterculture to Cyberculture*, 69-102.

protest all indicated to them that change was needed. Kuhn's ideas about scientific revolution seemed to provide one answer, but Velikovskianism, though popular, was not robust enough to completely fulfil that purpose. Rather, change began to come when scientists themselves—particularly young scientists and particularly those who were most engaged with students and the public, began to specifically shape their work to encompass these critiques. That movement was led in part by the popular planetary astronomer Carl Sagan, and it began over the controversy surrounding the sensational question of unidentified flying objects.

CHAPTER TWO

In the first decades of the Cold War, many Americans came to believe that the Earth was being visited by aliens, made evident, they argued, by reports of unidentified flying objects, or UFOs. These sightings tended to come in waves. The first came in 1947 after a Seattle-area pilot described seeing "saucerlike objects" while flying near Mount Rainier. They "came streaming over the Cascades at 1,200 miles per hour, in formation," he told reporters. "I don't believe it, but I saw it." The pilot offered no explanation, but many—including *Time* magazine—speculated that he might have seen extraterrestrial spacecraft.[56]

The so-called extraterrestrial hypothesis fit perfectly with the darkening American attitude toward science. The idea of spacecraft from other worlds was right out of the tropes of science fiction, but then so was the atomic bomb, which had first been predicted in *The World Set Free*, a novel by H. G. Wells.[57] The Air Force investigated the hypothesis and concluded it was false. Scientists, by and large, refused to comment, but after the enforced secrecy of the Manhattan Project this was not unusual. The extraterrestrial hypothesis came to include another hypothesis: that aliens had arrived on Earth and that the scientific establishment was actively

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56. "The Somethings," *Time*, July 14, 1947. On UFOs see David M. Jacobs, *The UFO Controversy in America* (Bloomington: Indiana University Press, 1975), Dick, *Biological Universe*, and Thurs, *Science Talk*, 123-58.

57. H. G. Wells, *The World Set Free: A Story of Mankind* (London: Macmillan, 1914).

covering it up. "All over the United States last week," reported *Time* after the 1947 sighting, "people turned curious or uneasy eyes to the skies."[58]

One such pair of eyes belonged to Carl Sagan. Sagan was precocious, prone to intellectual fixation, and fond of science fiction. He was also a life-long progressive who held a deep faith in the transformative power of science. He had inherited his politics from his parents. They were Russian Jews whose families had emigrated to New York City at the turn of the century to escape Imperial persecution. Both were engaged in the labor movement. His father held various jobs but eventually settled down at a union job in a clothing factory in Brooklyn. His mother was a housekeeper but was politically outspoken at home and in their working-class Bensonhurst community, where "FDR was second only to Moses."[59] By the 1932 election they had become loyal labor democrats, committed to the dream of uplift through technology and education.[60]

Born in 1934, Sagan was just old enough to remember the grief that the Second World War had brought to his parents, who still had connections in Russia. After the war, he read disquieting science fiction stories about the apocalyptic aftermath of nuclear conflict and associated them with the emerging story of technocratic slaughter in Europe. He kept a journal of

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58. "The Somethings," *Time*.

59. Interview with Linda Sagan, qtd. in Davidson, *Carl Sagan: A Life*, 16.

60. Davidson, *Carl Sagan: A Life*, 14-18.

his dreams. In one evocative entry, he saw himself wandering, lost and alone, in the ruins of a baseball stadium, wondering at the silence.[61]

But Sagan's favorite stories were more optimistic and more outward-looking. He loved reading about alien beings, about adventure among the stars, and about the limitless possibilities of space. He was particularly fond of Edgar Rice Burroughs' *John Carter* books, imagining himself, like their protagonist, travelling to other worlds inhabited by strange new civilizations and mingling with humanity's interstellar neighbors in bustling alien metropolises.[62]

Sagan saw science as representative of a historical choice facing the human species. Life or death—science could provide either, depending only on how it was used. "The gates of heaven and hell," he would later say in an episode of his documentary series, *Cosmos*, "are adjacent and unmarked."[63] But the transformative idea of an Earth united by science was so powerful, so tangible, and so very close at hand, he felt, that, despite the risk, it was at least worth trying the latches. Before he started high school, he had decided that he wanted to be an astronomer, and, after graduating early, at the age of sixteen, he left Brooklyn for the University of Chicago.[64]

Sagan's undergraduate education was shaped by the university's "Great Books" program, which confirmed his humanistic passion for liberalism and progress. He also continued thinking

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61. Carl Sagan, handwritten notebook (1952), Box 356, Folder 3, SMC.

62. Ibid., 16. See also Bradbury, et al., *Mars and the Mind of Man*.

63. *Cosmos: A Personal Voyage*, episode 4, "Heaven and Hell," directed by Adrian Malone, aired October 19, 1980, on PBS.

64. Davidson, *Carl Sagan: A Life*, 30-4.

about alien life. After receiving his bachelor's degree, he stayed on as a graduate student under Gerard Kuiper. He also worked with Harold Urey, who had since become a pioneer in planetary astronomy, studying the atmospheres of nearby planets, trying to determine if they could harbor any hidden living beings.[65]

By the time Sagan graduated in 1960, he had made a name for himself by promoting the search for aliens as a serious scientific subject. Though he had spoken at conferences about the possibility of life on Mars, the Moon, and perhaps even in the clouds of Jupiter, he had recently published a paper on the atmosphere of Venus which had caused some controversy by insisting that the planet was "hot, dry, sandy, windy, cloudy, and probably lifeless."[66] Venus had been thought of as being wet, and perhaps swampy, and, just possibly, full of strange amphibians—and Sagan's findings, confirmed in 1962 by the *Mariner 2* flyby, disabused those notions.[67]

But Sagan found the political limitations of the Cold War scientific establishment stifling. Public interest in UFOs, he argued, represented a broader desire for access to science. By refusing to engage with UFO enthusiasts, he believed that the scientific establishment was failing in its primary responsibility to answer to the public interest. More than that, however, he argued that the search for life itself had transcendent cultural significance, and it was the duty of scientists to make that significance known.

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65. Davidson, 65-9.

66. Carl Sagan, "The Planet Venus," *Science* 133, no. 3456 (March 24, 1961), 850. See also Carl Sagan, "Indigenous Organic Matter on the Moon," *Proceedings of the National Academy of Sciences of the United States of America* 46, no. 4 (April 15, 1960), 393-6.

67. Conway, *Atmospheric Sciences at NASA*, 96-8.

The Extraterrestrial Hypothesis

In 1948 the U.S. Air Force launched a secret investigation into the UFO phenomenon code-named Project Sign. Its report struck a measured tone, acknowledging the possible truth of the extraterrestrial hypothesis but ultimately concluding that the sightings were "inconsistent with the requirements for space travel." This was too ambiguous for the military, however, and in 1949 the Air Force launched a second investigation, Project Grudge, which conclusively reported that UFOs had been optical illusions, weather effects, RADAR ghosts, or simple hoaxes. [68]

But these reports, carried out behind closed doors and revealed to the press only reluctantly and with few substantiating details, were hardly reassuring. The Air Force, reeling from the recent aftermath of the first Soviet atomic bomb test, feared that details of the investigation could contain sensitive information about American technology. The scientists who had participated, meanwhile, already feared for their careers in the looming atmosphere of secrecy and anticommunism and did not want to be discredited by association with such an odd topic.[69]

Yet the idea of alien life was more popular in scientific circles than it had been in decades. Since the beginning of the twentieth century, astronomers had concluded that the universe was bigger and older than they had previously imagined. The Milky Way galaxy, they concluded, was just one among many others, which meant that there were an incomprehensible

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68. Carl Sagan and Thornton Page, eds., *UFO's: A Scientific Debate* (Ithaca, NY: Cornell University Press, 1972), 198. See Dick, *Biological Universe*, 267-320.

69. Thurs, *Science Talk*, 123-58.

multitude of stars, and, perhaps, many other Earth-like planets. Biologists, meanwhile, seemed to be on the verge of uncovering the molecular machinery of life, indicating, perhaps, that life was essentially a matter of chemistry. A popular 1940 book, *Life on Other Worlds*, suggested that, given these principles, "whenever in the Universe the proper conditions arise, life must inevitably come into existence."[70] In 1952, Urey, together with Stanley Miller, another of his students, attempted to prove the idea by mixing together various gasses thought to be present in the early atmosphere of the Earth and electrifying them—as though struck by lightning. They managed to produce complex organic compounds, which, though not actually alive, they argued, were a step in the right direction. Of their experiment, the biologist George Wald wrote in *Scientific American* that it had proved "life, as an orderly event" was "inevitable."[71]

Those Americans who were aware of these developments questioned why, if scientists were so willing to acknowledge the possibility of alien life in theory, they would be so quick to dismiss the possibility that UFOs were evidence of its existence. Some concluded that the confusion was deliberate misdirection and that the scientific establishment was hiding the truth. In 1950, journalist Donald Keyhoe published a widely-read article along these lines in *Truth* magazine titled "The Flying Saucers are Real," which he later expanded into a series of books.[72] Meanwhile, a piece appeared in *Life* that claimed, breathlessly, after "reviewing the available

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70. Harold Spencer Jones, *Life on Other Worlds* (London: English University Press, 1940), 57.

71. George Wald, "The Origin of Life," *Scientific American*, August 1954. See Dick, *Biological Universe* 59-221, 321-98.

72. Donald E. Keyhoe, "The Flying Saucers are Real," *True*, January 1950. See Jacobs, *UFO Controversy*, 57.

evidence," that UFOs could not "be explained by present science as natural phenomena – but solely as artificial devices, created and operated by a high intelligence" that "no power on Earth could account for."[73] Popular UFO-ology, or "saucerian," organizations began to sprout up all over the country.

After a brief frenzy of coverage during the 1952 wave, a handful of scientists decided that they were obligated to address the matter. Among them was Donald Menzel, an astronomer at Harvard and a science fiction aficionado who felt that his position was secure enough to risk the attention. Menzel published an article in *Look* magazine confirming the Air Force line—that these sightings had natural, earthly explanations—and arguing that the physics of interstellar spaceflight were extremely prohibitive and unlikely to result in such frequent, inconclusive visits. "Can you imagine," he asked, "travelling millions … of miles through space without making some attempt to communicate with what are obviously friendly people?"[74]

The Air Force also felt compelled to respond after 1952, launching a third investigation, code-named Project Blue Book. This time the project was spearheaded by the Air Force's public relations department and was handled more openly and with greater access for the press. J. Allen Hyneck, one of the project's lead scientists, tried to strike a cautionary tone with the hope of convincing skeptics. No one had yet come forward with conclusive evidence, he reported, but

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73. H. Bradford Darrach and Robert Ginna, "Have We Visitors from Space?" *Life*, April 7, 1952.

74. Donald H. Menzel, "The Truth About Flying Saucers," *Look*, June 17, 1952.

investigators would nevertheless "beware the ready explanation" and keep their minds open to all possibilities.[75]

As the space race intensified over the course of the coming decade, public fascination with outer space resulted in new waves of UFO reports. Some six hundred sightings were reported in the Fall of 1957 after the Soviet Union launched *Sputnik*, the first ever man-made satellite. Two hundred more were reported in the Summer of 1960 after the United States launched *Echo 1*, the first ever communications satellite. Such launches were reported on extensively, and most of the time, the vehicles themselves were visible from the ground at night, moving through the stars in unfamiliar ways.[76]

Friend, Foe, or Fantasy?

After a particularly well-reported wave of sightings in 1965 and 1966, the Air Force expanded Project Blue Book and, in 1967, brought a new panel of scientists on board. Hyneck invited Menzel to participate, and Menzel, in turn, invited Sagan.

By this time, Sagan was working with Menzel at Harvard, and his reputation for theorizing on extraterrestrial life had begun to spread beyond professional circles. In 1961, Sagan had gotten a taste of the power of public science after being asked to record a lecture on "Life Beyond the Earth" for *Voice of America*—a government-funded media outlet that was intended

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75. Qtd. in Sagan and Page, *UFO's: A Scientific Debate*, 137.

76. Dick, *Biological Universe*, 270. See also Howard E. McCurdy, *Space and the American Imagination*, 2nd ed. (Baltimore: Johns Hopkins Press, 2011) and Walter A. McDougall, *The Heavens and the Earth: A Political History of the Space Age* (New York: Basic Books, 1985).

to showcase American ideas and perspectives in Cold War battlegrounds—as part of their "Forum on Space Science." "To seek the beings of other worlds is a rare and poignant adventure," he intoned to his listeners, perhaps hoping to emphasize the power of science to transcend cultural borders. "Let us hope that all mankind will share the quest."[77] In 1966, he had co-authored a pair of colorful coffee-table books for *Life* and the Smithsonian on the state of planetary astronomy. In the text, Sagan repeated some of his earlier speculations, wondering about microbial plants on Mars, about huge floating whales in the atmosphere of Jupiter— "like jet engines with eyes"—and other possible alien curiosities. He particularly reflected on the problem of perspective, asking what the Earth might look like to a visiting probe with no foreknowledge of its inhabitants. "The information that today's scientists glean about the nature of the Earth's atmosphere, structure, and forms of life," he speculated, "will provide clues to what tomorrow's interplanetary explorers can expect when they venture into the universe."[78]

Sagan had also recently published a heavily revised translation of Soviet astronomer I. S. Shklovskii's popular Russian-language book on extraterrestrial life. Sagan, who did not know the language, had nevertheless heard of Shklovskii's work through mutual contacts and had written to him about the possibility of commissioning an English version. Shklovskii was amenable and

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77. "Life Beyond the Earth," *Voice of America Forum Series on Space Science* (Washington, D. C.: Voice of America, Spring 1962), Box 1002, Folder 1, SMC.

78. Carl Sagan and Jonathan Norton Leonard, *Planets*, Life Science Library (New York: Time-Life Books, 1966), 190, 44.

agreed to allow Sagan's publisher to translate it.[79] When Sagan read the manuscript, however, he felt that it was in some ways artless and overtechnical. He began to supplement and correct the text in the hope of making it more accessible and more in line with his ideas about the democratic duties of science. "I have felt obliged," he wrote to Shklovskii, "to introduce explanatory addenda, and to [make] your thoughts … more accessible."[80] He did more than this, in fact, adding cartoons, photographs, and anecdotes—filling the book with asides. By the time the book was published in 1966, as *Intelligent Life in the Universe*, it was more than twice as long as the original. Shklovskii, who ultimately never received any royalties for the book and who could not read English at the time, insisted Sagan take credit as co-author.

Buoyed by the wave of UFO sightings, perhaps, *Intelligent Life in the Universe* was a minor hit. A glowing review appeared in *Physics Today* which compared it favorably to other popular and professional books on the subject.[81] It also appeared in the countercultural *Whole Earth Catalog*. "Mathematically blow your mind," it advertised, "it's the best general astronomy book in years but that's nothing next to its impact on all the biggest questions we know."[82] An

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79. I. S. Shklovskii and Carl Sagan, *Intelligent Life in the Universe*, trans. Paula Fern (San Francisco: Holden-Day, 1966), vii-viii.

80. Carl Sagan to I. S. Shklovskii, October 8, 1963, Box 27, Folder 8, SMC.

81. Herbert Malamud, "Is Anybody Out There?" *Physics Today* 20, no. 6 (June 1967), 74-5.

82. Stewart Brand, Review of Sagan and Shklovskii, *Intelligent Life in the Universe*, *Whole Earth Catalog*, Spring 1969.

excerpt was printed in the *Saturday Review*—with Sagan given the sole by-line.[83]

Meanwhile, Sagan had also made his first television appearance. He was interviewed alongside University of Chicago astronomer Thornton Page as part of a 1966 CBS special titled "UFOs: Friend, Foe or Fantasy?" Sagan was a natural on television, projecting a cool skepticism but with a rebellious refusal to limit his imagination. Most importantly, he seemed authentic and approachable—hardly the image of the reclusive "mad" scientist. Of the saucers themselves, he cautioned, "there's not a single verified or checked out report which is at all compatible with the possibility of extraterrestrial life." Nevertheless, he insisted, there could very well still be "civilizations thousands or millions of years in advance of ourselves, capable of technological feats which we can hardly imagine."[84]

At the same time, Sagan began to push for the scientific community to repent its threatened 1950 boycott of Velikovsky's book and to demonstrate its commitment to transparency by holding a conference on Velikovskianism. By reaching out to *Pensée* and the countercultural groups it represented, Sagan hoped to "shape the flow" of the movement and lead it back to orthodoxy. He saw in his students "an enormous interest … in a range of pseudoscientific or borderline scientific topics … all of which represent an attempt," he argued, "to provide a cosmic perspective for mankind." If they had been led astray, he believed, it was not entirely their fault. Rather, they had left traditional scientific narratives behind because these

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83. Carl Sagan, "The Saucerian Cult: An Astronomer's Interpretation," *Saturday Review*, August 6, 1966.

84. "UFOs: Friend, Foe, or Fantasy?" *CBS Reports* (CBS, May 10, 1966).

narratives were not accessible and engaging in the ways that they should have been. They did not provide the same transcendental escape and they did not work hard enough to bring in new followers.

Sagan, along with some colleagues at the American Association for the Advancement of Science, organized a conference to discuss Velikovsky's ideas in the Summer of 1973. Ivan King, one of Sagan's fellow organizers, was straightforward about his motivation, writing to Stephen Talbott, the editor of *Pensée*, that "the presentation of this symposium does not in any way imply that Velikovsky's ideas are more acceptable to scientists than they have been in the past," but that they did "attract a large following" that needed to be acknowledged.[85]

Talbott and Velikovsky accepted. Five scientists were also on hand to present papers, including Sagan. They held the debate in San Francisco the following winter, in February 1974. The audience was packed, mostly with college students and counterculturists who were familiar with Velikovsky and wanted to see their intellectual heroes in action. They were not disappointed. Both Sagan and Velikovsky went over their allotted time, sniping at each other and dragging questions into long arguments against their opponent. Applause and laughter mingled with howls of derision. The meeting was expanded into two separate sessions to accommodate all the papers to be presented. Sagan, tenacious though he was, did not attend the second session.[86] Both sides claimed victory, though independent reviews were mixed. A reporter from

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85. Ivan King to Stephen Talbott, November 28, 1973, Box 802, Folder 3, SMC.

86. Donald Goldsmith, introduction to *Scientists Confront Velikovsky*, ed. Donald Goldsmith (Ithaca, NY: Cornell University Press, 1977), 19-28.

Time wrote to a friend of Sagan's that, although the proceedings had been entertaining, ultimately the "question" would be settled by "the facts," not by "polemic."[87]

Conclusion

In terms of his actual theories and professional publications, Sagan always remained firmly rooted within the scientific mainstream. As Sagan's public reputation grew, however, his academic reputation at Harvard began to sour. Though his pronouncements on UFOs were ultimately in line with scientific consensus, they had still managed to give him a slightly oddball reputation. Sagan did not contribute extensively to Blue Book, but when he returned later in 1967 he began thinking about finding another post. Sagan was up for tenure, but he was denied after a damning letter to the decision committee from Harold Urey, his former mentor, who now denounced him as "unserious." Sagan did not learn about Urey's letter until years later, but he had at least partially anticipated the committee's decision.[88]

Yet Sagan had hit upon a winning formula. By 1968 he had found a position at Cornell University in upstate New York, and although Cornell was smaller than Harvard and much less distinguished, Sagan brought the spotlight with him. To the mild annoyance of his colleagues and to the delight of the press and public, Sagan continued to engage with the fringe. He and Thornton Page even put together a conference on UFO-ology at Cornell through the American Association for the Advancement of Science. In his introduction to the published remarks, Sagan

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87. Frederic Golden to C. J. Ransom, August 19, 1974, Box 802, Folder 3, SMC.

88. Davidson, *Carl Sagan: A Life*, 200-1.

argued that "to talk of dignifying [UFOs] by discussing" them would have been self-defeating. They had already been "dignified in the sense of having widespread television and newspaper coverage." Counterculturists, he argued, and those "young people" willing to buy into fringe ideas were "finding science increasingly less attractive and less relevant to their problems."[89] Something had to be done, he felt, to make science work for them.

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89. Sagan and Page, *UFO's*, xiii.

CHAPTER THREE

By the end of the 1960s, the clear majority of scientists agreed that UFOs were not alien spacecraft, but few of them believed that this disproved the existence of intelligent life beyond the Earth. What, then, would constitute positive evidence of that existence? No other planet in the solar system seemed to be inhabited, and travel to even the nearest stars was impractical to the point of absurdity. The new science of radio astronomy seemed to provide the answer. Those who subscribed to this idea, Sagan among them, hoped to be able to find alien civilizations through evidence of their technology.[90]

The search, though limited, was never able to find this evidence. Something was wrong. Science predicted that life, even intelligent life, was commonplace, but if it was, it wasn't leaving any obvious signs. Sagan, reflecting on the centrality of the military to recent scientific development, began to worry that science was itself the culprit. Speculating on the cosmic significance of this fear, he generalized—perhaps once a given civilization had reached a certain level of development it was bound to destroy itself.

Humanity, Sagan began to believe, was facing down that danger. Sagan had promised that science would provide cultural salvation, but it had many competitors. "Fringe" sciences and new-age transcendentalism, he argued, were more than just wrong—they put the public at risk of

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90. See, for instance, Dick, *The Biological Universe*, 399-482 and David W. Swift, *SETI Pioneers: Scientists Talk About Their Search for Extraterrestrial Intelligence* (Tuscon: University of Arizona Press, 1990).

somnambulance. The onus was on scientists to be aware of this desire for transcendence and to act on it in productive ways. Scientists, Sagan felt, would have to rethink the ways they did science. Their work would have to be personal, relatable, and democratic. Only a fundamental synthesis of the scientific establishment with countercultural critiques, in other words, could save humanity from extinction, and to find that synthesis, Sagan argued, science would have to take its case to the public.

The Drake Equation

In 1959, a young radio astronomer named Frank Drake had a sudden idea about how it might be possible find proof of extraterrestrial civilizations. Drake had just started a postdoctoral position at the National Radio Astronomical Observatory in Green Bank, West Virginia. The NRAO was installing a new telescope that would be completed soon, and the astronomers were working out an observation schedule—trying to decide what to look at.[91]

Radio telescopes, derived from the RADAR technology of the Second World War, were designed to look at far-off cosmic objects whose light, its wavelength stretched by time and distance, had "red-shifted" out of the visible spectrum and into the realm of radio light. The issue with radio astronomy was that radio and television broadcasts tended to interfere with the signal, which is why it was necessary to set them up in out-of-the-way places like West Virginia.[92]

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91. Dick, *Biological Universe*, 402.

92. See, for instance, Douglas J. Mudgway, *Uplink-Downlink: A History of the Deep Space Network, 1957-1997*, NASA History Series (Washington, D. C.: NASA Office of External Relations, 2001).

Drake, who like Sagan was a fan of science fiction, wondered what would happen if such radio broadcasts were being made by aliens on a nearby planet. A quick calculation revealed to him that if that planet was putting out as much of a signal as the Earth was, Green Bank's new telescope could pick it out from up to ten light-years away. There were, he knew, at least two sun-like stars within that limit, and it seemed quite possible that they might have their own Earth-like planets.

Drake convinced the director of the observatory to let him have a look. The director agreed, if Drake kept reasonably quiet about it so as not to put the NRAO's funding at risk. Drake agreed, giving the plan the obscure name "Project Ozma," after the fictional land of Oz, and scheduling it for the Spring of 1960. When his turn came, Drake pointed the eighty-five-foot telescope at the first of the two stars and waited. He felt a rush of excitement as, immediately after turning on the equipment, "the chart recorder [started] banging off the scale." To his disappointment, however, he was quickly able to rule the signal out as being a broadcast reflected from the Earth. Despite over two-hundred additional hours of observation, Drake revealed no promising leads.[93]

Drake was not deterred. In 1961 he put together a conference at Green Bank to present his results and to discuss the possibility of a radio search with other interested scientists. He organized the conference by the expertise of its participants and by how that particular expertise might help systematize the search. How many civilizations could there be, he wondered, that a

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93. Frank D. Drake, "Project Ozma," in *Interstellar Communication: A Collection of Reprints and Original Contributions*, ed. A. G. W. Cameron (New York: W. A. Benjamin, Inc., 1963), 175-6 and Frank D. Drake, "How Can We Detect Radio Transmissions from Distant Planetary Systems?" ibid., 165-75. See also Dick, *Biological Universe*, 405-8.

radio telescope could find? He started with the total number of visible stars. Then he multiplied this by the fraction of those stars that had planets, the fraction of those planets that were inhabitable, the fraction of those that would see the genesis of living organisms, the fraction of those organisms that could be called intelligent, the fraction of those that would build radio equipment. Finally, he took that total and multiplied it by a number he called "L": the length of time that such an intelligent species would survive in a dangerous universe.[94]

Sagan only briefly attended the Green Bank conference, but he immediately embraced Drake's equation. By framing the quest for extraterrestrial life in straightforward mathematical terms, he believed, the equation leant it a distinct measure of scientific credibility. Sagan praised Drake's work in *Intelligent Life in the Universe* and in a piece on UFOs he wrote for the *Encyclopedia Americana*.[95] When he was invited to testify to Congress in 1967 as part of his work on Blue Book, he used Drake's work Green Bank as an example of what the scientific community could do to finally get at the truth of the extraterrestrial hypothesis. "Relatively

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94. Frank Drake, "The Drake Equation Revisited" (Lecture, Mountain View, September 29, 2003), http://www.astrobio.net/topic/deep-space/alien-life/the-drake-equation-revisited-part-i.html. There is a more precise summary in Carl Sagan, ed., *Communication with Extraterrestrial Intelligence* (Cambridge, MA: MIT University Press, 1973), 5. Different forms of the equation have been proposed and debated as different variables have been argued to be more or less important to the evolution of intelligent civilizations. Some scientists have argued that the number of relevant variables is impossibly large and that life is therefore rare. See Peter D. Ward and Donald Brownlee, *Rare Earth: Why Complex Life is Uncommon in the Universe* (Seattle, University of Washington Press, 2000). Others have argued that even if such civilizations do not now exist over time they are guaranteed to form. See A. Frank and W.T. Sullivan III, "A New Empirical Constraint on the Prevalence of Technological Species in the Universe," *Astrobiology* 16, no. 5 (May 2016), 359-62.

95. Shklovskii and Sagan, *Intelligent Life in the Universe*, 65; Carl Sagan, "Unidentified Flying Objects," *Encyclopedia Americana* (New York: Grolier, 1967).

modest programs," he told the panel, "could be organized, using largely existing instruments…, which would be ideal for this purpose."[96] By 1968, when Sagan arrived at Cornell, Drake had already been there some years, and the two began a close working relationship.

The Order of the Dolphin

After the Green Bank conference, some of the scientists who had attended, feeling as though they were a little exposed by association with what was still, after all, a fringe topic, agreed to quietly correspond with one another as members of the "Order of the Dolphin." The order, whose most active participants were Sagan and Drake, mostly existed for its members to amuse each other by sending linguistic puzzles back and forth—the sort that might be received via extraterrestrial radio transmission and which they would hope to decode.

The name was a reference to the work of member John C. Lily, a behavioral biologist who had made a name for himself investigating human-dolphin communication on behalf of the U.S. Navy.[97] With Sagan serving as its informal secretary and gatekeeper, the order grew over time, eventually including Shklovskii and a number of other prominent scientists.[98]

By the late 1960s, though, the subject of extraterrestrial life had acquired enough credibility that the order's half-hearted secrecy was no longer necessary. Indeed, in September

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96. Carl Sagan, *U.S. House Committee on Science and Astronautics Symposium on UFOs* (Washington, D. C.: U.S. Congress, 1968).

97. D. Graham Burnett, "Adult Swim: How John C. Lily Got Groovy (and Took the Dolphin with Him), 1958-1968," in Kaiser and McCray, eds., *Groovy Science*, 13-50.

98. Carl Sagan, et al., *Murmurs of the Earth: The Voyager Interstellar Record* (New York: Random House, 1978), 46-56.

Figure 3: Eight-five-foot telescope at Green Bank. Photograph by National Radio Astronomy Observatory. https://commons.wikimedia.org/wiki/File:85-3_Radio_Telescope_at_Green_Bank_NRAO.jpg

1971, with funding from both the American National Science Foundation and its Soviet counterpart, Sagan and Drake helped organize a widely-publicized international conference on extraterrestrial communication in Byurakan, Armenia. The Byurakan Conference was organized along the same lines as the original Green Bank Conference ten years earlier, with roughly one panel for each element of the Drake Equation. Aside from Drake, Sagan, and other order members, the attendees included Nobel-Prize winning biologist Francis Crick, along with dozens of other notable physicists, chemists, mathematicians, and astronomers. The participants

collectively resolved that science had at last made it possible to "shift some of the problems… from the realm of speculation to a new realm of experiment and observation." Sagan, who compiled and published the proceedings, felt that Byurakan would serve as "an aperture to future studies."[99]

Not everyone was convinced. Science writer Alfred Adler dismissed the conference in the *Atlantic* as "totally non-scientific and even meaningless," arguing that its "major substantive purpose" was "quite clearly a total fraud." As the face of the project, Adler singled Sagan out for criticism as "a gifted, highly trained, opportunistic, unimaginative ass."[100] Even some of the conference's attendees were skeptical. The University of Chicago historian William McNeill, famous for his single-volume world history *Rise of the West* and who knew Sagan from his time as an undergraduate, had been invited "to comment on the social perspective." Asked for his thoughts during the third and final session, McNeill offered that "our intelligence is very much a prisoner of words, a prisoner of language… I don't think you are justified in assuming that our mathematics is commensurate with their mathematics." He described the proceedings, only half in jest, as "the genesis of a new scientific faith," and said that he remained "agnostic, not only in traditional religion, but also in this new one."[101] In his diary, he complained that "the scientists'

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99. Sagan, *Communication with Extraterrestrial Intelligence*, xiii, 333-42.

100. Alfred Adler, "Behold the Stars," *Atlantic*, October 1974.

101. Sagan, *Communication with Extraterrestrial Intelligence*, 342-6.

casual assumption" that intelligent life was common was counter to his "abiding sense of historical contingency."[102]

One of the conference's overriding themes had been a general frustration with the search's lack of progress. At every stage of the equation, the numbers seemed more and more favorable to them. Stars were common, and planets were probably common also. If life was common, then surely intelligence was also. It was humanity's most distinguishing characteristic, the scientists agreed, and it had enabled our species to dominate the planet in an instant of geological time. There was a darker possibility that went almost undiscussed: what about "L," the length of time that a given civilization would, on average, survive? What if the scientific progress they were anticipating as inevitable was ultimately a dead end? McNeill had pointed out after one panel that "if communication should be opened up with a technologically superior civilization, [it] might choose to exploit the Earth rather than tell us fairy tales." In history, he argued, "those who had power used it." He was argued down by Crick, but for Sagan, at least, the point stuck out.[103]

Conclusion

Peace on Earth, Sagan believed, would begin with peace at home, and he continued his efforts to reach out to the disenchanted counterculture throughout the 1970s. He emphasized to

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102. William McNeill, "Journey from Common Sense: Notes on a Conference on Communication with Extraterrestrial Intelligence, Byurakan, Armenia, September, 1971," *The University of Chicago Magazine*, June 1972.

103. Sagan, *Communication with Extraterrestrial Intelligence*, 333.

them the "romance" of science and acknowledged "times of stunning change in social organization…, philosophical and religious perspectives, and human self-knowledge."[104] He scolded those who might dismiss or ignore new-age thinkers and pseudoscientists without letting them air their grievances. Their followers, Sagan argued, had "a kind of philosophical hunger" that establishment science, hijacked by the defense department, was failing to provide.[105] "Scientists," he wrote, "like other human beings, have their hopes and fears… and their strong emotions may sometimes interrupt the course of clear thinking and sound practice."[106]

Scientists, Sagan argued, had a responsibility to provide Americans with a holistic scientific worldview— "to convey its power and beauty."[107] They would have to reach out to those who had been disaffected by the military seclusion of the scientific establishment, and talking about UFOs, he believed, was a good first step. Yet Sagan did not stop here. Ultimately, he believed, the basic structure of science would have to change. Sagan agreed with Roszack's contention that the countercultural movements of the late 1960s and early 1970s were rejecting science. They were looking for a holistic, relatable view of the world—a "cosmic perspective"—and only science, he felt, could truly provide it.

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104. Carl Sagan, *Broca's Brain: Reflections on the Romance of Science* (New York: Random House, 1979), xi.

105. Sagan, *Cosmic Connection*, 59.

106. Carl Sagan, "An Analysis of Worlds in Collision," in *Scientists Confront Velikovsky*, ed. Donald Goldsmith, 44.

107. Ibid.

CHAPTER FOUR

The question of "L" gave Sagan a profound sense of urgency. How would humanity represent itself in a "cosmic discourse," Sagan wondered? Could humanity use science to justify its existence to the universe? If an alien civilization could be discovered, he argued, it would prove that a species could survive the development of science, and if humanity could unite around science, it would prove that intelligent life could survive in the universe. In his mind, then, the search was important because it would help humanity see itself "in cosmic perspective" by having them imagine the Earth from the outside-in. Scientific transcendence, in other words, was essential to long-term survival.

This belief led Sagan to one of the most well-known and controversial projects of his scientific career: the 1977 Golden Record. The record was a specially designed LP, bolted to the sides of the *Voyager 1* and *2* probes. It was a time capsule, a message for extraterrestrials, and ultimately a visionary personal statement on the universal truth of science—a statement that was, in turn, heavily influenced by countercultural ideas—as part of a tremendously expensive government spacecraft.

Glorious Adventures Among the Planets

Sagan had been involved with space science since its beginnings in the late 1950s. It was a field of science that perhaps best represented the contradictions at the heart of the military-funded scientific establishment. American media portrayed Astronauts as heroic pioneers, bound

for the distant frontier of outer space.[108] Before the launch of *Aurora 7*, for instance, in May 1962, *Life* magazine ran a glowing profile of the pilot, Scott Carpenter, as a man "ready… to make the rare and dangerous journey that awaits him." "Dedicated men," declared another issue, were making it all possible. The universe was "there for the reaching."[109]

But space travel was more like the Manhattan Project than a frontier expedition. In 1965, the White House budged $5.5 billion for the National Aeronautics and Space Administration—almost five percent of its total spending.[110] NASA's mighty rocket boosters, meanwhile, were essentially repurposed missiles. Werner von Braun, the lead designer of the Apollo program's Saturn V rocket, had also designed the V2 flying bomb for Nazi Germany. The Redstone missile he built for the U.S. Army was an improved version of the exact same design. In 1962, a refitted Redstone was used to launch *Aurora 7* into space.[111]

Many counterculturists and student activists had a poor view of the space program, seeing it as one more extension of the scientific establishment they were trying to dismantle. "I wish we could change the emphasis," said one protester to the *New York Times*, "towards the needs of the

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108. See McCurdy, *Space and the American Imagination*, 44-5, 181-5.

109. Loudon Wainright, "From a Mountain Boyhood of Roaming and Recklessness Comes a Quiet Man to Ride *Aurora 7*," *Life*, May 16, 1962; Paul Mandel, "Why All the Cost and Risk, Why Go?" *Life*, April 17, 1962.

110. "Federal Budget Receipts and Outlays: Coolidge to Obama," in *The American Presidency Project*, http://www.presidency.ucsb.edu/data/budget.php. See also McCurdy, *Space and the American Imagination*, 109.

111. McDougall, *Heavens and the Earth*, 41-6.

people."[112] The frontier image that had been used to promote space science, meanwhile, was being challenged. Protests at Alcatraz and Wounded Knee made it clear that, for many, the idea was no more than an offensive justification for imperial conquest. Science itself, wrote native activist Vine Deloria Jr., mocked "our perceptions of law and social reality… as superstitious fictions of savages."[113] In a piece about a 1977 conference in Los Angeles called "Space Day," meanwhile, at which Sagan had given a lecture, cartoonist R. Crumb warned his readers not to be "duped by foolish *Buck Rodgers* dreams of glorious adventures among the planets!!" He urged them instead to "wait until we've learned to get along with each other on Earth before we go barging into the cosmos!"[114]

To Let Others Know We Are Here

In their conversations about interstellar communication, Sagan and Drake had mostly operated on the assumption that a message would have to be short, simple, and transmissible by radio in binary code. In December 1971, however, after they had returned to New York from Byurakan, a curious opportunity presented itself. An upcoming NASA mission to launch a probe, *Pioneer 10*, to explore the planet Jupiter would, by chance, also be the first human spacecraft to escape the sun's gravity and leave the solar system. It would float in the darkness of interstellar

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112. Robert Reinhold, "Enthusiasm for Lunar Exploration is Found to be on Wane Around the Country: Few Pause to Observe Launching," *New York Times*, November 15, 1969.

113. Qtd. in Gordin, *Pseudoscience Wars*, 175. See Gosse, *New Left*, 85-110.

114. R. Crumb, "Space Day Symposium: Or What Ever The Hell It Was Called," *CoEvolution Quarterly* 15 (Fall 1977), 48-51.

space for millions of years, perfectly preserved, and in that time, they speculated, it was not totally impossible that some advanced civilization would notice it and pick it up.[115]

Sagan and Drake, both of whom had worked on the more data-oriented aspects of the mission, petitioned NASA to let them a message to the probe itself. NASA agreed, and together with artist and biologist Linda Salzman, then Sagan's wife, they designed a small plaque, engraved with a drawing of male and female human figures, a diagram of the solar system, and a map to the Earth based on the orientation of nearby pulsars—their unique rotation speeds encoded like fingerprints in a system of numbers based on the rate of quantum spin in hydrogen atoms. An extraterrestrial mind, they reasoned, would be able to decode this and the other parts of the plaque because they too would share the same essential scientific truths.[116] It was a countercultural assumption on the grandest possible scale: a truth so universal and so deeply buried in reality that even an entirely different species would have access to it.

As Sagan admitted, however, it was very unlikely that any alien, no matter how advanced, would ever find such a tiny probe in so vast an amount of space. Indeed, NASA's calculations, requested by Sagan, showed that *Pioneer 10* was unlikely to pass by any nearby stars.[117] Sagan was sure, however, that the plaque would be "meticulously studied—not by

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115. Sagan, *Cosmic Connection*, 17-20. See Richard O. Fimmel, James Van Allen, and Eric Burgess, *Pioneer: First to Jupiter, Saturn, and Beyond*, NASA SP-446 (Washington, D. C.: NASA Scientific & Technical Information Office, 1980).

116. Sagan, *Cosmic Connection*, 21-33.

117. Carl Sagan to Frank Drake, March 2, 1972, Box 417, Folder 6, SMC.

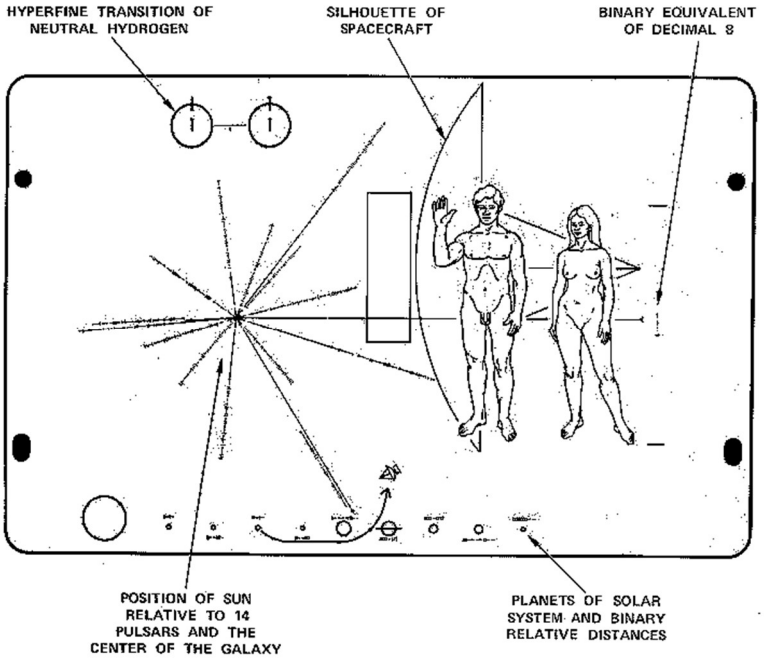

Figure 4: Diagram of the Pioneer *plaque. NASA. https://nssdc.gsfc.nasa.gov/nmc/spacecraftDisplay.do?id=1972-012A*

Figure 5: Pioneer 10 *on the launch pad, mounted to an Atlas missile. March 1973. Photograph by NASA. https://ails.arc.nasa.gov/ails/printPreview.php?rid=848*

extraterrestrials," he allowed, "but by terrestrials."[118] In a letter to Sagan, Drake predicted that "there will be at least one folk song and one rock-and-roll piece" about the probe; "a little bit of man on its way to Zubenelgenubi."[119]

Drake's prediction did not quite come true, but the plaque quickly became a sensational news item. *Pioneer 10* was launched on March 3, 1972, and in the week leading up to it, the plaque garnered more headline space than the probe's mission to Jupiter. The *Philadelphia Inquirer* exclaimed, "NASA Letter Asks: Is Anyone Out There?" The *New York Daily News* wrote, "Nudes and Map Tell About Earth to Other Worlds." In the *Los Angeles Times*, the headline was, "Hey, Out There! You in the Milky Way! A Message from Earth is Coming." The *Washington Post* reported that, "*Pioneer X* Carries a Message to Space Aliens"; the *Chicago Times* that, "Jupiter Probe Plaque to Tell Spacefolk, if Any, Who Sent It." Even the staid *New York Times* ran an editorial praising the effort, "To Let Others Know We Are Here."[120]

Again, however, the significance, practicality, and potential danger of the project were hotly debated. The *Daily Mail* lambasted the plaque's pretension, mockingly asking its intended extraterrestrial recipients, "Could We Have Our Spaceship Back, Please?" Some, echoing

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118. Sagan, *Cosmic Connection*, 22.

119. Frank Drake to Carl Sagan, February 10, 1972, Box 417, Folder 6, SMC.

120. Donald C. Drake, "NASA Letter Asks: Is Anyone Out There?," Philadelphia *Inquirer*, February 25, 1972; Edward Edelson, "Nudes & Map Tell About Earth to Other Worlds," *New York Daily News*, February 25, 1972; Marvin Miles, "Hey, Out There! You in the Milky Way! A Message from Earth is Coming," *Los Angeles Times*, February 25, 1972; Thomas O'Toole, "Pioneer X Carries a Hello to Space Aliens," *Washington Post*, February 25, 1972; "Jupiter Probe Plaque to Tell Spacefolk, if Any, Who Sent It," *Chicago Tribune*, February 25, 1972; Walter Sullivan, "To Let Others Know We Are Here," *New York Times*, February 25, 1972.

McNeill at the Byurakan conference, worried that the map would give too much away to potential invaders.[121]

For counterculturists, the plaque still represented the chauvinism of the scientific establishment. Salzman's loose, warm figures, originally intended to be Asian or African, had been altered by NASA's engravers, who made them stiff, white, and cold. The *Berkeley Bee* ran an illustration of the plaque with the caption, "Hello! We're from Orange County!" The figures' posture, meanwhile, with the man standing slightly in front of the woman, his hand extended in greeting, was interpreted by some as an antifeminist statement. One woman asked in a letter to the *New York Times* if "there truly [was] a group of intelligent people around who can blandly represent the human species to another civilization as 'Me Lead 'Em' Tarzan and 'Tell Them, Dear' Jane." In another letter to Sagan himself, the same woman asked, "a) Why is the man the only one who is communicating? … b) Why are the man's genitals detailed and the woman's not? … c) Why is the man's posture erect (alert) and the woman's posture slouched (inattentive)?"[122] Sagan, who believed that this audience was the most important one for him to reach, was determined to do better.

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121. "Excuse Me, But Could We Have Our Spaceship Back, Please?" Daily *Mail*, March 4, 1972, sec. Comment; Sagan, *Cosmic Connection*, 23.

122. Mary Waterbury to *New York Times*, "Male Chauvanism in Outer Space!" Letter to the Editor, March 1972; Mary Waterbury to Carl Sagan, June 1972, Box 417, Folder 6, SMC.

Information Other than Scientific

Sagan saw his chance in the upcoming *Voyager* missions. Originally called the Grand Tour, and, later, Mariner Jupiter-Saturn, *Voyager* was one of the few high-profile projects to survive NASA budget cuts after the end of the Apollo Program in 1972.[123] The general scheme came from Gary Flandro, an engineer at the NASA-affiliated Jet Propulsion Laboratory, who had argued in a 1965 paper that during the late 1970s and early 1980s the planets would be aligned in such a way that a small spacecraft, travelling past one, would be accelerated—snared by its gravity and pulled along by its orbital momentum—on to the next. Such a spacecraft could speed by most of the outer planets without having to lug along a lot of heavy and expensive fuel. Like *Pioneer 10*, it would also leave the solar system.[124] Sagan proposed attaching a similar message, and NASA, which had enjoyed the plaque's good press, agreed.

This time, Sagan felt, he would do justice to the thing. He not only reached out to Drake but to a dozen other scientists, including Menzel at Harvard. He also wrote to artists and musicians, asking them for input. He got in touch with science fiction authors, including Arthur C. Clarke, Isaac Asimov, and Robert Heinlein. Heinlein was particularly fascinated, writing a seven-page response full of suggestions. He was skeptical that a plaque would suit the purpose.

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123. McCurdy, *Space and the American Imagination*, 186. See also Charles Dunlap Benson and William David Compton, "Apollo Applications: 'Wednesday's Child'," in *Living and Working in Space: A History of Skylab*, SP-4208 (November 1981), http://history.nasa.gov/SP-4208/ch3.html.

124. Westick, *Into the Black*, 17-124, Jim Bell, *The Interstellar Age: The Story of the NASA Men and Women Who Flew the Forty-Year Voyager Mission* (New York: Dutton/Penguin, 2015), and David W. Swift, *Voyager Tales: Personal Views of the Grand Tour* (Reston, VA: American Institute of Aeronautics and Astronautics, 1997), 61-74.

After jokingly suggesting "a spacecraft the size of *Star Trek*'s *Enterprise*… loaded… with the British Museum," he wondered what else might work. "How many grams or kilograms," he asked, "are you allowed for this project?"[125]

NASA had not given Sagan much room for improvisation. Whatever the message was, it couldn't weigh much more than the original plaque and they would only agree to give him a $1,500 budget.[126] Yet more and more suggestions rolled in. Sagan, Salzman, and Drake had already decided that since the spacecraft itself would serve as a testament to Earthly engineering the message should contain "information other than scientific."[127] That meant, they felt, that it should include cultural artifacts—images, sounds, and music. A magnetic tape was out of the question since it would be too easily damaged by interstellar radiation. A chance conversation with a NASA-contracted video company in Boulder, Colorado that had recently developed a way to turn images into sound waves and back again led them to envision an anodized gold phonograph record made of the same durable materials as the plaque. It would be lightweight, requiring only the addition of a protective case and a small instrument to play it. With two sides at a slow playback speed, they calculated, it could be engraved with hours of sound and music and dozens of photographs.

Their medium chosen, Sagan brought on assistants and began the arduous task of selecting the contents of the record. It was an eclectic crew. Aside from Sagan, Salzman, and

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125. Robert Heinlein to Carl Sagan, December 20, 1976, Box 1246, Folder 8, SMC.

126. John R. Casani to Carl Sagan, et al., November 29, 1976, Box 1246, Folder 8, SMC.

127. Sagan, et al., *Murmurs of the Earth*, 11-19.

Figure 6: Engineers convert images to sound waves for encoding on the Voyager *record. Photograph by Colorado Video, reproduced with permission.*

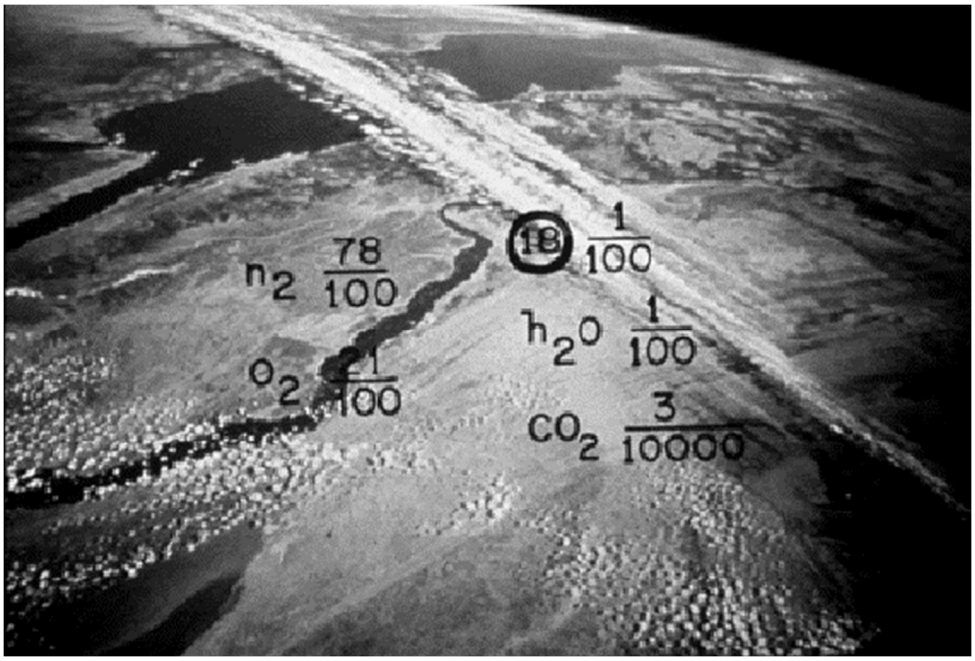

Figure 7: The Earth, with information about its atmosphere. From the Voyager *record. Photomontage by NASA. http://voyager.jpl.nasa.gov/imagesvideo/imagesbyvoyager.html.*

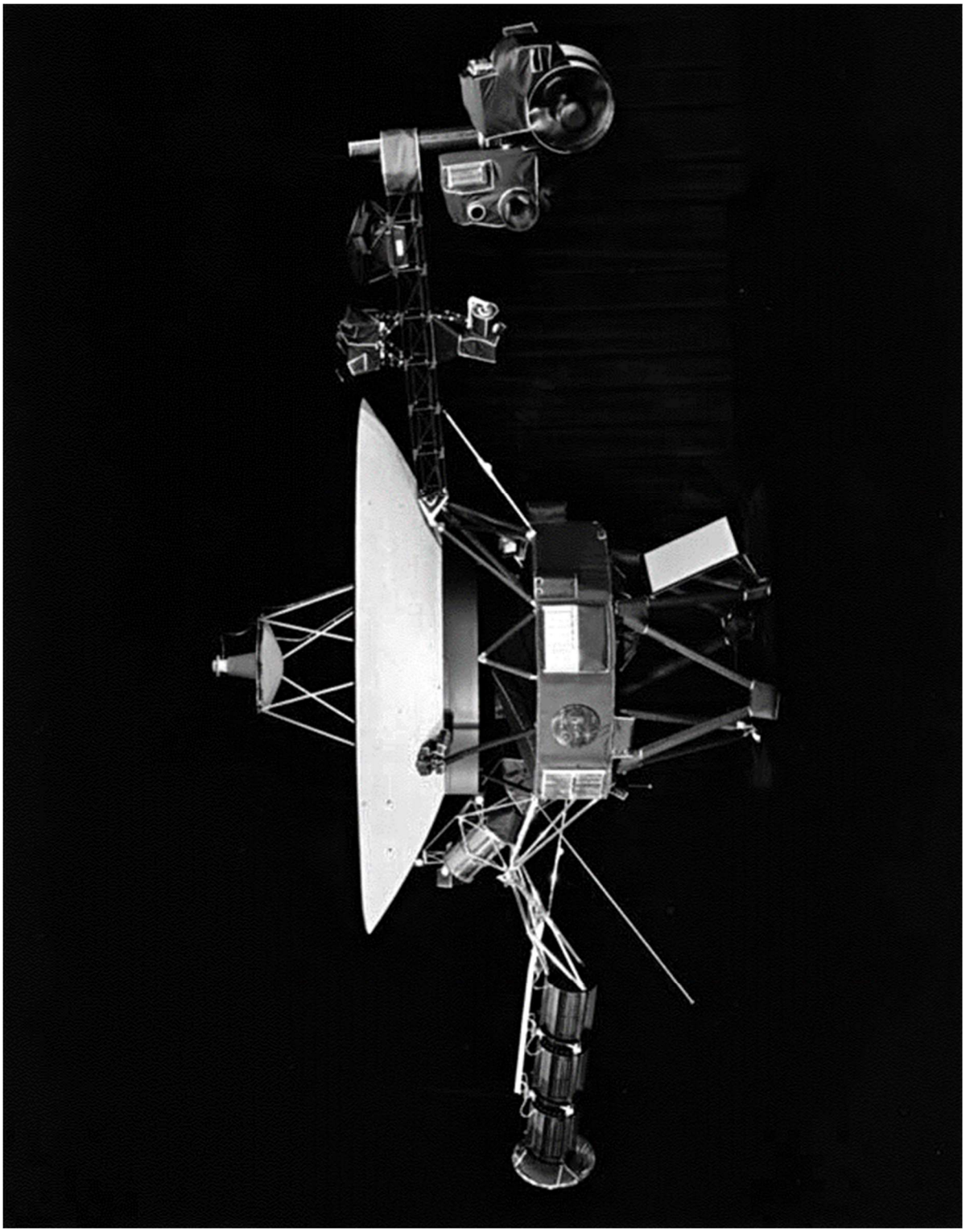

Figure 8: The Voyager *probe. The record cover can be seen at the center. Photograph by NASA. http://voyager.jpl.nasa.gov/*

Drake, there was Timothy Ferris, the *Rolling Stone* writer, his then-wife, the novelist Ann Druyan, the countercultural artist and LSD enthusiast Jon Lomberg, who had done many of the illustrations for Sagan's books, and Alan Lomax, an anthropologist and ethnomusologist. Others were called in for specific parts of the project—a friend who knew Jazz; someone who knew where to get a particularly hard-to-find album of Indian music. Someone from the band Jefferson Starship heard about the project and offered to contribute an original composition, though Sagan turned him down.

The project quickly blew past its $1,500 budget, but the crew agreed to work out of their own pockets. They combed sound and image libraries looking to assemble an audio-visual collage that they felt would reflect some essential truth about humanity. They included photographs of landscapes, portraits, and pieces of art from all over the world—birds in flight, a group of Peruvian children, a factory floor, and New York City at dusk. They debated what music to include, trying to reach "beyond the Western canon." Lomax contributed a "soaring Bulgarian shepardess' aria" that he had recorded on a research trip. As he played it for them, Sagan recalled, Druyan was "moved to spontaneous dance." Struck by the totality of the moment and of the project as a whole, Lomax spoke: "Do you hear that, honey? That's Europe."[128]

By the time the record was pressed it contained over a hundred photographs, over a hundred recorded greetings in as many languages, a "tone poem" of nineteen sounds, including a recording of Druyan's brain waves, a playlist of twenty-seven musical recordings, an array of scientific diagrams and interpretive legends, a message from President Carter and from the

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128. Ibid., 16.

Secretary General of the United Nations, and a list of names from congressional subcommittees that NASA hoped to impress. Under the headline, "Bach Music May Ring Out in the Stars," the Los Angeles *Times* reported that "there could be advanced civilizations that could detect and capture a foreign spacecraft. If a civilization has that capability, [Sagan] said, it certainly should be able to figure out how to operate a phonograph record."[129] Requests for a copy of the record poured in from all over the world—impossible, as it turned out, since Sagan had not been able to secure commercial rights to all the material.

Despite the depth of Sagan's efforts, several correspondents complained that the record did not truly represent humanity. The problem, they wrote, was that it was incomplete: there was no bloodshed, no war, and no hatred. Sagan pondered this, and replied that although these evils were part of the human experience, they did not reflect the universal truth of humankind—at least from the cosmic perspective. Lomberg, interviewed decades later, recalled that "there was a lot of political polarization" at the time, and that Sagan ultimately hoped that the record would be something that existed beyond that reality. "'Could we measure up to the *Voyager* record?' … I don't think any of us cherished a real hope that it would ever be found. So the only audience we [knew] about [was] the audience on Earth."[130]

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129. "Bach Music May Ring Out in Stars: Earth Sounds Recorded for Space Probes," *Los Angeles Times*, May 8, 1977.

130. Interview, qtd. in Bell, *The Interstellar Age*, 83.

Conclusion

The *Voyager* record was science, art, and countercultural statement all in one. It demonstrated the meaning that Sagan hoped the public could find in science and the sort of self-critique that science should be willing to restructure itself around. Space science remained particularly contradictory, and the record both heightened and undermined that contradiction. As with Scott Carpenter and all of America's other astronauts, Sagan's peaceful vision of humanity was lifted into the sky on the back of a specially-adapted missile that owed its original existence to the arms race.

Sagan saw space science as an example of how the scientific established should be altered to include the concerns of countercultural protests. Yet rather than toss out the military influence completely, Sagan argued, scientists should turn their relationship to the state on its head. Why not put the adventurous propaganda to good use and send more soldiers to the stars as agents of science? "The more of them engaged up there," after all, he wrote, "the less of them engaged down here."[131]

Science would lead the way, but history would be its guide. "The nations and epochs marked by the greatest flowering of exploration," Sagan wrote, "are also marked by the greatest cultural exuberance."[132] By selling out their interests to the Department of Defense in the years after World War Two, scientists had failed to make their interests relevant to people's personal needs. If they were anxious, maybe it was also because there were "no new places to go."

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131. Sagan, *Cosmic Connection*, 157, 65.

132. Ibid., 67.

Through a reformed scientific establishment, space could offer unique political opportunities. On Earth, Sagan argued, a stuffy sense of continuity reigned. In the *tabula rasa* of outer space, colonists could hold "experiments in utopia," and, after many such experiments, a new and better form of society would inevitably be discovered.[133] Like the counterculturists who had subscribed to Kuhn's theory of paradigms, Sagan believed these people would be the vanguard of an entirely new way of seeing the universe. Perhaps, he speculated, they would eventually be able to bring this new understanding back to Earth—though he suspected it would always be "an old-fashioned world."[134]

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133. Ibid., 153-6.

134. Ibid., 159.

CONCLUSION

Broadcast in the Fall of 1980, *Cosmos: A Personal Voyage* was Sagan's most extensive and comprehensive piece of science popularization. A thirteen-part television documentary produced for PBS, *Cosmos* summarized many of Sagan's ideas about the relationship between science and society. As with his 1973 book, *The Cosmic Connection*, Sagan had chosen his title carefully. It was, in the first place, personal. In *Cosmos*, Sagan made a direct appeal to those who were, he felt, mistakenly looking for spiritual peace in new-age or fringe ideas. Making their quest scientific would not only help them, he believed—it would also help science. In one episode, Sagan tells his version of the history of the renaissance astronomer Johannes Kepler's work with his cantankerous patron, Tycho Brahe. In their cooperation, Sagan saw the essential connection of the metaphysical—Kepler—with the practical—Brahe—that he believed was the key to transcendental science: the union of "skepticism and imagination both." The future, he counseled—our world—had "teetered on the precipice of their mutual distrust."[135]

Sagan's ideas, and his habit of explaining them in overwrought, grandiose terms, in some ways served as a smokescreen for the reality of technocratic state authority within the scientific establishment. He did not anticipate, for instance, the conservative political realignment of the 1980s and the new explosion of defense research that came with it. A frequent guest at the

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135. *Cosmos: A Personal Voyage*, episode 3, "Harmony of the Worlds," directed by Adrian Malone, aired October 12, 1980, on PBS. See also Thomas M. Lessl, "Science and the Sacred Cosmos: The Ideological Rhetoric of Carl Sagan," *Quarterly Journal of Speech* 71, no. 2 (May 1, 1985), 175-87.

Carter White House, Sagan could not bring himself to accept the handful of invitations he received from President Reagan. When Sagan later co-authored the controversial 1984 paper that predicted an apocalyptic "Nuclear Winter" in the aftermath of even a limited nuclear exchange, the Reagan administration accused him of using his scientific credibility as a political bludgeon. Among his colleagues, meanwhile, Sagan had never quite shaken the suspicion that he was fundamentally unserious. After 1984, many accused him of putting punditry ahead of his professional responsibilities. Sagan continued to publish throughout the 1980s, but he never again enjoyed the influence he had once maintained.[136] He died in 1996. His obituary in *Nature* stated that he "frequently entered the public policy arena" and that "he was often drawn into public debates." Of his science work, it focused mostly on Nuclear Winter, which, it observed, "remains controversial."[137]

Yet Sagan's work does indicate a profound shift over the course of the 1960s and 70s in the ways that Americans used and thought about science in their daily lives. Far-out proposals for space colonies and experimental societies never materialized, but countercultural interest in using establishment science to find personal transcendence did not disappear. Indeed, it has become central to the ways in which we work, play, and communicate with one another. Inspired by pieces like the *Voyager* record, in 1996 Electronic Frontier Foundation founder John Perry Barlow published "A Declaration of the Independence of Cyberspace." Composed on an Apple

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136. Peter V. Hobbs, "'Nuclear Winter' Calculations," Science 228, no. 4700 (May 10, 1985), 648. See Davidson, *Carl Sagan: A Life*, 375-6, Badash, *Nuclear Winter's Tale* and Dörries, "Politics of Atmospheric Sciences."

137. Joseph A. Burns, "Astronomer and Popularizer of Science," obituary of Carl Sagan, *Nature* 385 (January 30, 1997), 400.

computer, in software developed at Xerox and IBM—the very heart of Defense Department science—it opens: "Governments of the Industrial World, you weary giants of flesh and steel, I come from Cyberspace, the new home of Mind." Barlow goes on to declare that this home, sustained by an incomprehensibly massive computer network operated by the U.S. government, is nevertheless "naturally independent of the tyrannies you seek to impose on us."[138] These principles continue to inspire debate about the meaning and purpose of the World Wide Web, and they flow directly from the countercultural concerns that Sagan's work spoke to.

Cosmos, meanwhile, was recently remade by the astronomer Neil DeGrasse Tyson, Ann Druyan, and a group of Hollywood elites. It was produced for Fox, a commercial network, rather than for PBS, and Tyson's focus is slightly different. It is less of a paean to a better science and more of a guide for self-improvement. The viewer is encouraged to learn the facts that Tyson presents them with and to therefore become enlightened. If it is missing the essential countercultural ideas that Sagan presented in the original, perhaps that is because it expects its audience already to be comfortable with them.[139]

What to make of all this? Clearly the prospect of an isolated, secretive, and homogenous scientific community—especially here and now—is dangerous. But there is danger also in transcendentalism, which ultimately disconnects us from the larger global community that we inhabit. Space colonization seems as unlikely now as it has ever been, despite the press around

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138. John Perry Barlow, "A Declaration of the Independence of Cyberspace," Electronic Frontier Foundation (Davos, Switzerland: February 8, 1996), https://www.eff.org/cyberspace-independence. See Turner, *Counterculture to Cyberculture*.

139. *Cosmos: A Spacetime Odyssey*, directed by Brannon Braga and Bill Pope, aired March 9 to June 8, 2014, on Fox.

its privatization, and the vaunted new world of cyberspace has only managed to isolate us in self-sustaining bubbles of information. Perhaps the real significance of Sagan's work is his emphasis on the "cosmic perspective." Whether or not there are indeed alien beings scattered throughout the universe, it is still refreshing to consider what we might look to a stranger observing us from the outside-in. This is an old idea, but still a profound one, and Sagan's use of it is an important part of how we should understand the relationship between the American public and science, both today and in the first decades of the Cold War.

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