

STAR SETTLERS

THE BILLIONAIRES, GENIUSES, AND CRAZED
VISIONARIES OUT TO CONQUER THE UNIVERSE

FRED NADIS



PEGASUS BOOKS
NEW YORK LONDON

ENDNOTES

PREFACE

- 1 David Ketterer, *New World for Old: The Apocalyptic Imagination, Science Fiction, and American Literature* (New York: Anchor Press, 1974).
- 2 Richard J. Gott, "Longevity of the Human Spaceflight Program," in Edward Belbruno, ed., *New Trends in Astrodynamics and Applications III, American Institute of Physics Conference Proceedings, Volume 886*, (Melville, NY: AIP, 2007).
- 3 Tom Wolfe, "One Giant Leap to Nowhere," *New York Times*, July 18, 2009, <https://www.nytimes.com/2009/07/19/opinion/19wolfe.html>.
- 4 Howard Bloom, "The Big Burp and the Multiplanetary Mandate," in Steven J. Dick and Mark L. Lupisella, eds., *Cosmos and Culture: Cultural Evolution in a Cosmic Context* (Washington, DC: NASA, 2009), 145.

CHAPTER ONE—MARS MANIA 1.0

- 1 William Sheehan, *The Planet Mars: A History of Observation & Discovery* (Tucson: University of Arizona Press, 1996), 79.
- 2 Camille Flammarion, translated by Brian Stableford, *Lumen* (Middletown, CT: Wesleyan University Press, 2002), 56.
- 3 Bernadette Bensaude-Vincent and Liz Libbrecht, "A Public for Science. The Rapid Growth of Popularization in Nineteenth Century France," *Réseaux, The French Journal of Communication* 3, no. 1 (1995): 75.
- 4 Bensaude-Vincent and Libbrecht, "A Public for Science," 87.
- 5 Robert Markley, *Dying Planet: Mars in Science and the Imagination* (Durham, NC: Duke University Press, 2005), 50.
- 6 David Strauss, *Percival Lowell: The Culture and Science of a Boston Brahmin* (Cambridge: Harvard University Press, 2001), 178.
- 7 Markley, *Dying Planet*, 64.
- 8 Robert Crossley, *Imagining Mars: A Literary History* (Middletown, CT: Wesleyan University Press, 2011), 76.
- 9 *Publications of the Astronomical Society of the Pacific* 6, no. 37 (1894): 214–218.

- 10 J. E. Evans and E. W. Maunder, "Experiments as to the Actuality of the 'Canals' Observed on Mars," *Monthly Notices of the Royal Astronomical Society* 63 (1903): 499.
- 11 Crossley, *Imagining Mars*, 75.
- 12 Kristina Maria Doyle Lane, *Geographies of Mars: Seeing and Knowing the Red Planet* (University of Chicago Press, 2011).
- 13 Crossley, *Imagining Mars*, 94.
- 14 John R. Hammond, *A Preface to H. G. Wells* (New York: Routledge, 2014), 24.
- 15 David C. Smith, ed., *Correspondence of H. G. Wells, Vol. 1* (London: Pickering and Chatto, 1998), 261.
- 16 John Taliaferro, *Tarzan Forever: The Life of Edgar Rice Burroughs the Creator of Tarzan* (New York: Scribner, 1999), 15.
- 17 Crossley, *Imagining Mars*, 237.
- 18 Markley, *Dying Planet*, 217.
- 19 Conrad Duncan, "Life on Mars Could Be Found Within Two Years but World Is 'Not Prepared,' Nasa's Chief Scientist Says," *The Guardian*, September 29, 2019, <https://www.independent.co.uk/news/science/nasa-mars-life-discovery-space-exomars-rover-chief-scientist-jim-green-a9125076.html>.

CHAPTER TWO—ROCKETEERS

- 1 James T. Andrews, *Red Cosmos: K. E. Tsiolkovskii, Grandfather of Soviet Rocketry* (College Station: Texas A & M Press, 2009), 16.
- 2 Tom D. Crouch, *Aiming for the Stars: The Dreamers and Doers of the Space Age* (Washington, D.C.: Smithsonian Press, 1999), 24.
- 3 Chris Gainor, *To a Distant Day: The Rocket Pioneers* (Lincoln: University of Nebraska Press, 2008), 21.
- 4 George M. Young, *The Russian Cosmists: The Esoteric Futurism of Nikolai Federov and His Followers* (New York: Oxford University Press, 2012), 51–70.
- 5 Nikolai F. Fyodorov, "Karazin: Meteorologist or Meteorurge?" in Yvonne Howell, ed. *Red Star Tales: A Century of Russian and Soviet Science Fiction* (Montpelier, VT: Russian Information Services, 2015), 35.
- 6 Young, *Russian Cosmists*, 45–48.
- 7 Asif A. Siddiqi, "Imagining the Cosmos: Utopians, Mystics, and the Popular Culture of Spaceflight in Revolutionary Russia," *Osiris* 23 (2005): 266.
- 8 Young, *Russian Cosmists*, 79.
- 9 Siddiqi, "Imagining the Cosmos," 266.
- 10 Young, *Russian Cosmists*, 148.
- 11 Crouch, *Aiming*, 26.
- 12 Andrews, *Red Cosmos*, 77.
- 13 A. A. Blagonravov, ed., *Collected Works of K E. Tsiolkovskiy, Volume II*—"Reactive Flying Machines," 62–63, <https://spacemedicineassociation.org/.../Tsiolkovsky%20Oberth%20Goddard.pdf>.
- 14 *Works of K. E. Tsiolkovskiy, Volume II*, 67.
- 15 *Works of K. E. Tsiolkovskiy, Volume II*, 79.

- 16 Konstantin Tsiolkovsky, "On the Moon," in Yvonne Howell, ed., *Red Star Tales*, 54.
- 17 Andrews, *Red Cosmos*, 69.
- 18 Siddiqi, "Imagining the Cosmos," 268.
- 19 Robert H. Goddard, "Material for an Autobiography," in Esther C. Goddard and G. Edward Pendray, eds., *The Papers of Robert H. Goddard, Volume One* (New York: McGraw Hill Book Company, 1970), 7–9.
- 20 The Tom Swift book series began in 1910, but it had many predecessors, including *The Steam Man of the Prairies*, a dime novel first published in 1868, which featured a boy inventor and his marvelous Steam Man.
- 21 Goddard, "Materials for an Autobiography," 10.
- 22 Goddard, "Materials for an Autobiography," 13.
- 23 Goddard, "Materials for an Autobiography," 14.
- 24 *Papers of Robert H. Goddard*, 95.
- 25 "R. H. Goddard to Army Chief of Ordnance," August 20, 1917, *Papers of Robert Goddard*, 199.
- 26 "R. H. Goddard to Secretary, Smithsonian Institution," August 8, 1918, *Papers of Robert Goddard*, 253.
- 27 Clarence Nichols Hickman, an oral history conducted in 1973 by Julian Tebo and Frank Polkinghorn, IEEE History Center, Hoboken, NJ, https://ethw.org/Oral-History:Clarence_Nichols_Hickman#About_Clarence_Nichols_Hickman.
- 28 R. H. Goddard "Diary," August 4, 1918, in *Papers of Robert Goddard*, 250.
- 29 "First Volunteer for Leap to Mars," *New York Times*, February 5, 2020, 1.
- 30 "Report to Smithsonian Institution Concerning Further Developments of the Rocket Method of Investigating Space," *Papers of Robert Goddard*, 313–30.
- 31 Cited in William Sims Bainbridge, *The Spaceflight Revolution: A Sociological Study* (New York: John Wiley and Sons, 1976), 32.
- 32 "Goddard to Secretary, Smithsonian Institution," August 1, 1923, *Papers of Robert Goddard*, 498.
- 33 Michael J. Neufeld, "Weimar Culture and Futuristic Technology: The Rocketry and Spaceflight Fad in Germany, 1923–1933," *Technology and Culture* 31, no. 4 (1990): 729.
- 34 Jonathon Keats, "Out of this World: Four Decades before Sputnik, Soviet Avant-Garde Artists Envisioned the Conquest of Space," *Art & Antiques*, February 2016, <http://www.artandantiquesmag.com/2016/02/soviet-avant-garde-art/>.
- 35 Siddiqi, "Imagining the Cosmos," 269.
- 36 Siddiqi, "Imagining the Cosmos," 272.
- 37 Siddiqi, "Imagining the Cosmos," 277.
- 38 T. O'Connor Sloane, "Space Travel," *Amazing Stories*, March, 1935, 11.
- 39 T. O'Connor Sloane, "Discussions," *Amazing Stories*, April 1938, 141.
- 40 David Clary, *Rocket Man: Robert H. Goddard and the Birth of the Space Age* (New York: Hyperion, 2003), 144–181.
- 41 Eric Leif Davin, *Pioneers of Wonder* (Amherst, NY: Parthenon Books, 1999), 53.

- 42 De Witt Douglas Kilgore, *Astrofuturism: Science, Race, and Visions of Utopia in Space* (Philadelphia: University of Pennsylvania Press, 2003), 35.
- 43 “The ARS Early Years (1930–1944).” American Institute of Aeronautics and Astronautics, <https://web.archive.org/web/20150923144229/https://www.aiaa.org/SecondaryTwoColumn.aspx?id=1906>.
- 44 Kilgore, *Astrofuturism*, 31.

CHAPTER THREE—VON BRAUN

- 1 Michael J. Neufeld, *Von Braun: Dreamer of Space, Engineer of War* (New York: Knopf, 2008), 24.
- 2 Bainbridge, *The Spaceflight Revolution*, 49.
- 3 Wernher von Braun, “Reminiscences of German Rocketry,” *Journal of the British Interplanetary Society* vol. 15, no. 3, May–June, 1956, 128.
- 4 Daniel Lang, “A Romantic Urge,” *New Yorker*, April 21, 1951, 83.
- 5 “Here to Show Us How to Use Mail Rockets,” *Brooklyn Daily Eagle*, February 21, 1935, <http://affictor.com/2016/05/25/old-print-article-willy-ley-encourages-america-to-use-mail-rockets-brooklyn-daily-eagle-1935/>.
- 6 Neufeld, *Von Braun*, 55.
- 7 Michael J. Neufeld, “Creating a Memory of the German Rocket Program for the Cold War,” in Stephen J. Dick, ed., *Remembering the Space Age* (NASA, 2008), 74.
- 8 Von Braun, “Reminiscences,” 130.
- 9 Neufeld, *Von Braun*, 64.
- 10 Neufeld, *Von Braun*, 144.
- 11 Neufeld, *Von Braun*, 96–7.
- 12 Von Braun, “Reminiscences,” 143.
- 13 Bob Ward, *Dr. Space: The Life of Wernher von Braun* (Annapolis, MD: Naval Institute Press, 2005), 40.
- 14 Neufeld, *Von Braun*, 128.
- 15 Ward, *Dr. Space*, 50.
- 16 Ward, *Dr. Space*, 42.
- 17 G. W. Trichel, Colonel, Ordnance Department, to Colonel Horace Quinn, May 23, 1945, Archives Department, National Air and Space Museum (NASM), Smithsonian Institution, Washington, DC, Richard Porter Papers, Box 5, Folder 15.
- 18 Seymour Nagan, “Top Secret—Nazis at Work,” *New Republic*, August 11, 1947, 24–26.
- 19 Alfred Africano, “Nazis Vs. U.S. Scientists,” *New York Herald Tribune*, February 11, 1947. Library of Congress, Wernher von Braun Papers, Box 53, scrapbooks.
- 20 These editorials were collected by von Braun. Library of Congress, Wernher von Braun Papers, Box 53, scrapbooks.
- 21 “Fort Bliss, das Amerikanische Peenemünde” [“Fort Bliss the American Peenemünde”], *Kieler Nachrichten*, April 3, 1948. Wernher von Braun Papers. Box 53, Scrapbooks. Translated for the author by Maxximilian Seijo.

- 22 A Simpleton, "Jetzt Schlagt's Zwolf," ["Enough is Enough!"] *Berlin am Mittag*, July 4, 1947. Wernher von Braun Papers, Box 53. Translated by Maxximilian Seijo.
- 23 "Blitz—Entnazung im Raketentempo!" [Flash—Denazified at Rocket Pace], *Leipziger Volkszeitung*, December 12, 1946, Wernher von Braun Papers, Box 53. Translated for the author by Maxximilian Seijo.
- 24 Chesley Bonstell to Wernher von Braun, November 30, 1951, Wernher von Braun Papers, Box 42, Folder: Colliers Correspondence and Related Matters.
- 25 Wernher von Braun to Seth Moseley, March 26, 1952, Wernher von Braun Papers, Box 42, Folder: Congress and Space, Colliers.
- 26 Von Braun to Martin Caider, June 8, 1955, Wernher von Braun Papers, Box 1, Folder: 1954 M–Z.
- 27 "Journey Into Space," *Time*, December 8, 1952, 70.
- 28 Cited in Ward, *Dr. Space*, 89.
- 29 Von Braun to John Leonard, October 9, 1953, Wernher von Braun Papers, Box 1, Folder: 1953 A–H.
- 30 Wernher von Braun, "We Need a Coordinated Space Program," Fourth Congress of the International Astronautic Federation, Zurich, August 1953, Wernher von Braun Papers, Box 46, Folder: 1951–55.
- 31 Wernher von Braun, "Crossing the Last Frontier," *Collier's*, March 22, 1952, 25.
- 32 Wernher von Braun, "Space Superiority as a Means for Achieving World Peace," December 1952. Wernher von Braun Papers, Box 46 "Speeches," Folder: 1951–1955.
- 33 Wernher von Braun, "The Importance of Satellite Vehicles in Interplanetary Flight," Second International Congress on Astronautics, London, September 3–8, 1951, Wernher von Braun Papers, Box 46 "Speeches," Folder: 1951–1955.
- 34 Wernher von Braun, "We Need a Coordinated Space Program."
- 35 J. P. Telotte, "Disney in Science Fiction Land," *Journal of Popular Film and Television* 33, no. 1 (2005), 12–20.
- 36 "Shooting Script, Prod. 5559 'Rockets & Space,'" Smithsonian Institution, NASM Archives Department, Willy Ley Papers, Box 33, Folder 7.
- 37 Flyer from CIA FOIA files online, CIA-RDP80B01676R003800020019-1, <https://www.cia.gov/library/readingroom/document/cia-rdp80b01676r003800020019-1>.
- 38 Donald Robinson, manuscript of Army article prepared after Explorer launch, n.d., circa 1958, Wernher von Braun Papers, Box 46, Folder Jan–April 1958.
- 39 Wernher von Braun speech, March 18, 1958, Wernher von Braun Papers, Box 46, Folder: Jan–April 1958.
- 40 Neufeld, "Creating a Memory," 83.
- 41 "Remarks by von Braun Before Employees of Marshall Center," July 5, 1961, Wernher von Braun Papers, Box 47, Folder: July–August 1961.
- 42 Michael Chabon, *Moonglow* (New York: HarperCollins, 2016), 395–401.
- 43 Von Braun to Richard Porter, August 24, 1969, NASM, SI, Archives Department, Richard Porter Papers, Box 3, Folder: Correspondence with von Braun.

CHAPTER FOUR—MODERN CONQUERORS OF MARS

- 1 Arthur C. Clarke, "What Will We Do with the Moon?" *Popular Science*, April, 1952, 166.
- 2 Otto O. Binder, "Mars Colony," *Space World* 1, no. 8, (1961): 31.
- 3 *Mars Terraforming not Possible Using Present-Day Technology*, NASA, July 20, 2018, <https://www.nasa.gov/press-release/goddard/2018/mars-terraforming>.
- 4 Jim Zimbelman, of the Smithsonian Institution, calculated that the feet of Wilt Chamberlain, who had the highest vertical jump in basketball, could have cleared the basketball rim by about five inches on Mars. Zimbelman, email to author, March 23, 2020.
- 5 Markley, *Dying Planet*, 221.
- 6 Carl Sagan, "Planetary Engineering," *Icarus* vol. 20, issue 4, December 1973, 513–14.
- 7 M. M. Averner and Macelroy, "On the Habitability of Mars: An Approach to Planetary Ecosynthesis," Washington, DC: NASA technical report, January 1, 1976.
- 8 Christopher McKay, et al., "Making Mars Habitable," *Nature*, August 8, 1991, 489–496.
- 9 Wernher von Braun, "The Importance of Satellite Vehicles in Interplanetary Travel," Second International Congress on Astronautics, September 3–8, 1951. Wernher von Braun Papers.
- 10 Robert Zubrin, *The Case for Mars: The Plan to Settle the Red Planet and Why We Must* (New York: Free Press, 1996, 2011), 267.
- 11 John Wenz, "There's not enough CO2 to Terraform Mars," *Astronomy*, July 31, 2018, <http://www.astronomy.com/news/2018/07/terraforming-mars-is-a-no-go>.
- 12 Andrew Coates, "Sorry Elon . . .," *Independent*, August 6, 2018, <https://www.independent.co.uk/voices/elon-musk-mars-colony-space-tesla-terraforming-a8479156.html>.
- 13 Adam Rogers, "Sorry Nerds: Terraforming Might Not Work on Mars," *Wired.com*, July 30, 2018, <https://www.wired.com/story/co2-terraforming-mars/>.
- 14 Leah Crane, "Terraforming Mars might be impossible due to a lack of carbon dioxide," *New Scientist*, July 30, 2018, <https://www.newscientist.com/article/2175414-terraforming-mars-might-be-impossible-due-to-a-lack-of-carbon-dioxide/>.
- 15 Ashlee Vance, *Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future* (New York: HarperCollins, 2015), 24.
- 16 Vance, 37.
- 17 With no specific budget lines, NASA has always been quite vague about the schedule for manned missions to Mars. As of 2018, there still was no timetable but the idea that by the 2040s the manned mission would take place.
- 18 Vance, 4.
- 19 Musk receiving 2012 Mars Pioneer Award at Mars Society Conference, Accessed August 1, 2018, <https://www.youtube.com/watch?v=PK0kTcJFnVk>.
- 20 A few months after the conference, Tesla reported a profit for its third quarter in 2018, suggesting its economic woes were on the wane and the Model-3 was selling well.

- 21 Palmer Luckey, “Because He Is a Superhero,” from “In Defense of Elon Musk,” *Popular Mechanics*, October 16, 2018, <https://www.popularmechanics.com/space/rockets/a23508636/defense-of-elon-musk/>.
- 22 Zubrin interview in Poland, September 17, 2018, <https://www.rmf24.pl/nauka/news-pewnogodnia-mars-bedzie-bardzo-ekscytujacym-miejscem-do-zyc,mId,2632545>.
- 23 Wernher von Braun, *Project Mars: A Technical Tale* (Burlington, Canada: Apogee Books, 2004 [1949]), 177.
- 24 “Mission,” Mars One, <https://www.mars-one.com/mission> (Accessed August 15, 2018).
- 25 Jonathan O’Callaghan, “It’s Not Going to Be Big Brother on Mars,” *Daily Mail*, February 20, 2015, <https://www.dailymail.co.uk/sciencetech/article-2961743/It-s-not-going-Big-Brother-Mars-exciting-story-time-Mars-One-founder-remains-convinced-going-red-planet.html>.
- 26 Jennifer Chu, “Mars One (And Done?)” October 14, 2014, <http://news.mit.edu/2014/technical-feasibility-mars-one-1014>.
- 27 Anna Holligan, “Can the Dutch Do Reality TV in Space?” BBC News, June 20, 2012, <https://www.bbc.com/news/world-europe-18506033>.
- 28 Andrew Smith, “Can Mars One Colonize the Red Planet?” *The Guardian*, May 30, 2015, <https://www.theguardian.com/science/2015/may/30/can-mars-one-colonise-red-planet>.
- 29 Gwendolyn Smith, “Mars One Mission: ‘My Boyfriend Is Cool with Me Going to Mars on a One-Way Trip,’” *The Telegraph*, November 13, 2015, <https://www.telegraph.co.uk/women/life/mars-one-mission-my-boyfriend-is-cool-with-me-going-to-mars-on-a-one-way-trip/>.
- 30 Interview with Dianne McGrath, on podcast, “Future Martians: Interviews with the Mars 100, Episode 10,” <https://plus.google.com/+Mars-one/posts/chJE9pLQ7dn> (Accessed September 10, 2018).
- 31 Interview with Dianne McGrath.
- 32 Karl Tate, “Space Radiation Threat to Astronauts Explained,” *Space.com*, May 30, 2018, <https://www.space.com/21353-space-radiation-mars-mission-threat.html>.
- 33 Kim Stanley Robinson, email to author, March 13, 2019.
- 34 Robert Zubrin, email to author, March 16, 2019.
- 35 J. R. Skok, phone interview with author, October 2, 2018.

CHAPTER FIVE—SPACE COLONIES

- 1 Patrick McCray, *Visioneers: How a Group of Elite Scientists Pursued Space Colonies, Nanotechnologies, and a Limitless Future* (Princeton University Press, 2017).
- 2 Tasha O’Neill, phone interview with author, September 25, 2019.
- 3 Al Reinart, “Gerry’s World,” *Air & Space*, April/May 1989, 30.
- 4 Gerard O’Neill to Walker Bleakney, July 20, 1967, Archives Department, NASM, SI, Washington, DC, Gerard K. O’Neill Collection Box 5, Folder 9.
- 5 George Pimentel to Gerard K. O’Neill, July 9, 1967, Archives Department, SASM, SI, Gerard K. O’Neill Collection, Box 5, Folder 9.

- 6 Gerard O'Neill, *The High Frontier* (New York: William Morrow and Company, 1977), 236.
- 7 "Public Trust in Government: 1958–2019," Pew Research Center, April 11, 2019, <https://www.people-press.org/2019/04/11/public-trust-in-government-1958-2019/>.
- 8 Cary Fun and Brian Kennedy, "Public Confidence in scientists has remained stable for Decades," Pew Research Center, March 22, 2019, <https://www.pewresearch.org/fact-tank/2019/03/22/public-confidence-in-scientists-has-remained-stable-for-decades/>.
- 9 Donnela H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, *Limits to Growth* (New York: Universe Books, 1972), 25.
- 10 Meadows, et al., *Limits to Growth*, 127–8.
- 11 Herb Bernstein, email to author, August 21, 2019.
- 12 *High Frontier*, 248.
- 13 T. A. Heppenheimer, *Colonies in Space* (Harrisburg, PA: Stackpole Books, 1976), 34–49.
- 14 Tasha O'Neill, phone interview, September 25, 2019.
- 15 O'Neill, *High Frontier*, 43.
- 16 Stewart Brand, ed., *Space Colonies* (New York: Penguin Books, 1977), 23.
- 17 Arthur C. Clarke, "Rocket to the Renaissance," in *Greetings, Carbon-Based Biped! Collected Essays, 1934–1988* (New York: St. Martin's Press, 1999), 214.
- 18 Brian O'Leary, *The Fertile Stars* (New York: Everest House, 1981), 93–94.
- 19 O'Neill, *High Frontier*, 170.
- 20 George Koopman, "We're Going," *L5 News*, September 1977, 2–3.
- 21 Robert Crumb, email to author, September 9, 2019.
- 22 "Inner Space and Outer Space: Carl Sagan's Letters to Timothy Leary," Timothy Leary Archives.org, <http://www.timothylearyarchives.org/carl-sagans-letters-to-timothy-leary-1974/>.
- 23 *L5-News*, October 1976, 11.
- 24 *L5-News*, December 1976.
- 25 Brand, *Space Colonies*, 72.
- 26 De Witt Douglas Kilgore, *Astrofuturism: Science, Race, and Visions of Utopia in Space* (Philadelphia: UPenn Press, 2003), 169.
- 27 Kilgore, *Astrofuturism*, 52.
- 28 McCray, *Visioneers*, 107.
- 29 Brand, *Space Colonies*, 45
- 30 Brand, *Space Colonies*, 44.
- 31 Brand, *Space Colonies*, 40.
- 32 Brand, *Space Colonies*, 44.
- 33 "The Gee Whiz Society," Space Studies Institute, December 18, 2019, <http://ssi.org/gee-whiz-society/>.
- 34 Gerard K. O'Neill Collection, SASM, SI, Box 55, Folder 16.
- 35 O'Neill's lecture notes, "2081," n.d., likely presented in 1981, NASM, SI, Gerard K. O'Neill Collection, Box 53, Folder 1.

- 36 Tasha O'Neill, phone interview, September 25, 2019.
- 37 O'Neill to Robert Hofstadter, August 25, 1983, NASM, SI, Gerard K. O'Neill Collection, Box 51, folder 9.
- 38 T. A. Heppenheimer, "Astrolling the Astroturf," *L-5 News*, January 1976.
- 39 *L-5 News*, October 1977, 8.
- 40 Bruce Friedman, "L-5 and the Jewish Community," *L-5 News*, October 1977, 14.
- 41 Jackie Knowles, "Paradise in Heavens Sought by Space Club," *Pasadena Star-News*, December 11, 1977, 1.
- 42 Daren Nigsarian, email to author, August 19, 2019.
- 43 Taylor Dark, email to author, July 20, 2018.
- 44 "Ten Years of Perspective on Space Colonization," in Charles H. Holbrow, Allen M. Russell, Gordon F. Sutton, eds., *Space Colonization: Technology and the Liberal Arts* (New York: American Institute of Physics, 1986), 142.
- 45 "Ten Years of Perspective on Space Colonization," 143.
- 46 "Ten Years of Perspective on Space Colonization," 147; 150–52.
- 47 "Ten Years of Perspective on Space Colonization," 153.
- 48 Carolyn Meinel, email to author, September 26, 2019.
- 49 Alan Boyle, "Jeff Bezos: 'We will have to leave this planet . . . and it's going to make this planet better,'" *Geekwire*, May 29, 2019, <https://www.geekwire.com/2018/jeff-bezos-isdsc-space-vision/>.
- 50 Mark Hopkins, "A \$178 Million Infusion for Space Solar Power," *ad Astra* 1 (2019): 13.
- 51 Taylor Dark, email to author, April 9, 2019.
- 52 Carolyn Meinel, email to author, September 26, 2019.
- 53 "Ten Years of Perspective on Space Colonization," 145.
- 54 "Ten Years of Perspective on Space Colonization," 146.

CHAPTER SIX—BIOSPHERE 2

- 1 John Allen, *Me and the Biospheres: A Memoir by the Inventor of Biosphere 2* (Santa Fe: Synergetic Press, 2009), vii.
- 2 Allen, *Me and the Biospheres*.
- 3 Allen, *Me and the Biospheres*, 1.
- 4 Allen, *Me and the Biospheres*, 9.
- 5 Rebecca Reider, *Dreaming the Biosphere: The Theater of All Possibilities* (University of New Mexico Press, 2009), 32.
- 6 Jane Poynter, *The Human Experiment: Two Years and Twenty Minutes Inside Biosphere 2* (New York: Thunder's Mouth Press, 2006), 18, 21.
- 7 Poynter, *The Human Experiment*, 39.
- 8 Reider, *Dreaming the Biosphere*, 23.
- 9 Reider, *Dreaming the Biosphere*, 30–31.
- 10 Dan Burton and David Grandy, *Magic, Mystery, and Science: The Occult in Western Civilization* (Bloomington: Indiana University Press, 2004), 318.
- 11 See Reider, *Dreaming the Biosphere*, 115–6.
- 12 Laurence Veysey, *The Communal Experience: Anarchist and Mystical Counter-Cultures in America* (New York: Harper and Row, 1973), 279.

- 13 Allen, *Me and the Biospheres*, 46.
- 14 Reider, *Dreaming the Biosphere*, 271.
- 15 Poynter, *The Human Experiment*, 19–20.
- 16 William J. Broad, “As Biosphere Is Sealed, Its Patron Reflects on Life,” *New York Times*, September 24, 1991.
- 17 Joel Achenbach, “Bogus New World,” *Washington Post*, January 8, 1992.
- 18 Confirmed by the Smithsonian Institution’s Jim Zimbelman and other planetary science staff via email, September 18, 2019.
- 19 John Allen and Mark Nelson, *Space Biospheres* (Oracle, AZ: Synergetic Press, 1989), 1.
- 20 Allen and Nelson, *Space Biospheres*, 82.
- 21 Young, *The Russian Cosmists*, 157.
- 22 Allen and Nelson, *Space Biospheres*, 53.
- 23 Allen, *Me and the Biospheres*, 93.
- 24 I. I. Gitelson, I. A. Terskov, et al., “Long Term Experiments on Man’s Stay in Biological Life-Support System,” in *Controlled Ecological Life Support System: Natural and Artificial Ecosystems*, NASA Conference Publication 10040, 63.
- 25 D. Obenhuber and C. Folsome, “Carbon Recycling in Materially Closed Ecological Life Support Systems,” *Bio Systems* no. 21, 1988, 165–73, https://www.researchgate.net/scientific-contributions/4883299_Clair_E_Folsomee.
- 26 Lynn Margulis and Dorion Sagan, *What Is Life?* (Berkeley: University of California Press, 2000), 235.
- 27 Allen, *Me and the Biospheres*, 180.
- 28 Jeremy Walker and Celine Granjou, “MELiSSA the Minimal Biosphere: Human Life, Waste and Refuge in Deep Space,” *Futures*, May 2017, https://www.researchgate.net/publication/311825298_MELiSSA_the_minimal_biosphere_Human_life_waste_and_refuge_in_deep_space.
- 29 Reider, *Dreaming the Biosphere*, 71.
- 30 Allen, *Me and the Biospheres*, 127.
- 31 Mark Nelson, *Pushing Our Limits: Insights from Biosphere 2* (Tucson: University of Arizona Press, 2018), xiv.
- 32 Reider, *Dreaming the Biosphere*, 90.
- 33 Veysey, *The Communal Experience*, 293.
- 34 Veysey, *The Communal Experience*, 294.
- 35 Marc Cooper, “Take This Terrarium and Shove It,” *Village Voice*, April 2, 1991, 25.
- 36 Cooper, “Take This Terrarium and Shove It,” 29.
- 37 Seth Mydans, “8 Sealed in a World beneath Glass for Two Years,” *New York Times*, September 27, 1991.
- 38 Carlyle C. Douglas, “A Voyage of Discovery that Doesn’t Move,” *New York Times*, September 20, 1991, E7.
- 39 Reider, *Dreaming the Biosphere*, 138.
- 40 Poynter, *The Human Experiment*, 130.
- 41 “8 Scientists Locked into Biosphere for 2-Year Test,” *Los Angeles Times*, September 27, 1991, A35.

- 42 Poynter, *The Human Experiment*, 5.
- 43 Achenbach, “Bogus New World.”
- 44 Poynter, *The Human Experiment*, 24.
- 45 Reider, *Dreaming the Biosphere*, 189.
- 46 E. K. Erik Gunderson, *Mental Health Problems in Antarctica, Report No. 67-14*, Bureau of Medicine and Surgery Department of the Navy, Reprinted from the Archives of Mental Health, October 1968, vol. 17.
- 47 Robert Reinhold, “Strife and Despair at South Pole Illuminate Psychology of Isolation,” *New York Times*, January 12, 1982, <https://www.nytimes.com/1982/01/12/science/strife-and-despair-at-south-pole-illuminate-psychology-of-isolation.html>.
- 48 Reider, *Dreaming the Biosphere*, 190.
- 49 Seth Mydans, “8 Bid Farewell to ‘Future’: Stale Air, Roaches and Ants,” *New York Times*, September 27, 1993, A1, 13.
- 50 Tony Burgess, “Refuge Notebook: Species Packing into Biosphere 2,” *Peninsula Clarion*, November 18, 2018, <https://www.peninsulaclarion.com/sports/refuge-notebook-species-packing-into-biosphere-2/>.
- 51 George de Lama, “Biosphere Has Coming out Party,” *Chicago Tribune*, September 27, 1993, D1, 3.
- 52 Robert Lee Hotz, “Biosphere Crew to End a Two Year Stay in a World of Their Own,” *Los Angeles Times*, September 25, 1993, A1, 22–3.
- 53 George de Lama, “Biosphere Has Coming out Party,” 8.
- 54 Reider, *Dreaming the Biosphere*, 210.
- 55 “Some Very This Worldly Trouble,” *The Chicago Tribune*, 6 April 1994, N14.
- 56 Dave Mosher, “Life in a Bubble: How We Can Fight Hunger, Loneliness, and Radiation on Mars,” *Business Insider*, April 12, 2018, <https://www.businessinsider.com/mars-colonization-human-survival-radiation-food-biosphere-2018-4>.

CHAPTER SEVEN — MAKING SPACE FUN AGAIN

- 1 Rachel Arthur, “Fashion’s Space Race: Why the Spacesuit Is a Huge Future Branding Opportunity for Designers,” *Forbes*, August 27, 2017, <https://www.forbes.com/sites/rachelarthur/2017/08/27/fashions-space-race/#557e88417dff>.
- 2 John Spencer, phone interview with author, May 6, 2019.
- 3 “Las Vegas Visitor Profile Survey,” Las Vegas Convention and Visitors Authority, 2018, 29, <https://www.lvcva.com/stats-and-facts/visitor-profiles/>.
- 4 John Spencer, Mensa presentation, 2016, <https://www.youtube.com/watch?v=OCxvANETd6w>.
- 5 Helene Cooper, R. Blumenthal, and L. Kean, “Glowing Auras and Black Money: Then Pentagon’s Mysterious UFO Program,” *New York Times*, December 16, 2017, <https://www.nytimes.com/2017/12/16/us/politics/pentagon-program-ufo-harry-reid.html>.
- 6 Lara Logan, “Bigelow Aerospace Founder Says Commercial World Will Lead in Space,” *Sixty Minutes*, May 28, 2017, <https://www.cbsnews.com/news/bigelow-aerospace-founder-says-commercial-world-will-lead-in-space/>.

- 7 “FAQ on Space Tourism and Exploration,” Spaceport Associates website, <http://www.spaceportassociates.com/faq.html>.
- 8 David B. Yaden, Jonathan Iwry, et. al, “The Overview Effect: Awe and Self-Transcendent Experience in Space Flight,” *Psychology of Consciousness: Theory, Research, and Practice* vol. 3, no.1, 2016, 1.
- 9 Yaden, Iwry, et. al, “The Overview Effect, 6.
- 10 “Declaration of Vision and Principles,” The Overview Institute, <https://overviewinstitute.org/about-us/declaration-of-vision-and-principles/>.
- 11 Maureen O’Hare, “Look inside the first luxury space hotel,” CNN, January 21, 2019, <https://www.cnn.com/travel/article/aurora-station-luxury-space-hotel/index.html>.
- 12 Samantha Masunaga, “Now Boarding Space Tourists—for a Price,” *Los Angeles Times*, June 8, 2019, C1, 5.
- 13 “Space Exploration: Can Sex, Drugs and Rock’n’Roll Replace Flag Planting?” *San Jose Mercury News*, July 24, 2009, <http://www.parabolicarc.com/2009/07/24/space-exploration-sex-drugs-rocknroll-replace-flag-planting/#more-7253>.
- 14 David Kushner, “Going to Space? First Stop: Eight Months of Grueling Training in Russia’s Star City,” *Wired*, August 18, 2008, <https://www.wired.com/2008/08/ff-starcity/>.
- 15 Alex Layendecker, phone interview with author, May 25, 2019.
- 16 Alexander Layendecker and S. Pandya, “Logistics of Reproduction in Space,” in E. Seedhouse and D. J. Shayler, eds., *Handbook of Life Support Systems for Spacecraft and Extraterrestrial Habitats* (Basel: Springer Nature, 2019), https://doi.org/10.1007/978-3-319-09575-2_211-1.
- 17 Layendecker, *Sex In Outer Space and the Advent of Astrosexology* (PhD dissertation), Institute for Advanced Study of Human Sexuality, May 1, 2016, 80.
- 18 Rick Hampson, “NASA Told to Make Room for Sex in Space,” AP News, June 25, 1985, <https://www.apnews.com/0b6a54cedbf96659356945815d3d431e>.
- 19 Layendecker, “Sex in Outer Space,” 108.
- 20 Layendecker, “Sex in Outer Space,” 109.
- 21 Thilini P. Schlesinger, et al., “International Space Station Crew Quarters On-Orbit Performance and Sustaining,” NASA, 2013, 2, <https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20130011142.pdf>.
- 22 Layendecker and Pandya, “Logistics,” 4.
- 23 Layendecker, “Sex in Outer Space,” 108.
- 24 Bonta also invented a “Jet shoe” that shifts from a “flat” to a “pump.” She told one reporter, “A pump is dangerous in zero gravity . . . But when you land, you want attractive footwear.” Jennifer Adkins, “Sex and the Stratosphere,” *Inventors’ Digest*, May 2009, <https://web.archive.org/web/20130409125140/http://www.inventorsdigest.com/archives/591>.
- 25 Adkins, “Sex and the Stratosphere,” 5.
- 26 “Personal Statement: Kees Mulder,” Spacelife Origin, <https://spacelifeorigin.com/en> (accessed July 22, 2019).

- 27 Tod Martens, “New Force Hits Town,” *Los Angeles Times*, June 2, 2019, E8.
- 28 “Astronaut Training Experience,” Kennedy Space Center Visitor Complex, <https://www.kennedyspacecenter.com/explore-attractions/all-attractions/astronaut-training-experience>.
- 29 “Mars Base 1,” Kennedy Space Center Visitor Complex, <https://www.kennedyspacecenter.com/explore-attractions/all-attractions/mars-base-1>.
- 30 Sandra Häuplik-Meusburger, Kim Binsted, et al., “Habitability Studies and Full Scale Simulation Research: Preliminary Themes following HISEAS mission IV,” 47th International Conference on Environmental Systems (conference paper), July 2017, 2.
- 31 Lisa Spence, phone interview with author, June 21, 2019.
- 32 Lindsay Larson, Leslie DeChurch, Suzanne T. Bell, Noshir Contractor, “Team performance in space crews: Houston, we have a teamwork problem,” *Acta Astronautica*, May 2019, <https://www.researchgate.net/publication/332854348>.
- 33 Marina Koren, “The Asteroid Mission that Never Leaves Earth,” *The Atlantic*, December 22, 2017, <https://www.theatlantic.com/science/archive/2017/12/wow-its-cramped-in-here/549032/>.
- 34 Lisa M. P. Munoz, “Brains in Space: The Important Role of Cognitive Neuroscience in Deep-Space Missions,” *Journal of Cognitive Neuroscience*, December 21, 2017, <https://www.cogneurosociety.org/brains-in-space-cognitive-neuroscience/>.
- 35 Munoz, “Brains in Space.”
- 36 Christian Davenport, “How Much Does a Ticket to Space Cost? Meet the People Ready to Fly,” *Washington Post*, October 2, 2019, <https://www.washingtonpost.com/technology/2019/10/02/how-much-does-ticket-space-cost-meet-people-ready-fly/>.
- 37 Kenneth Chang, “Virgin Galactic Unveils Jumpsuit for Space Tourists,” *New York Times*, October 16, 2019, <https://www.nytimes.com/2019/10/16/science/virgin-galactic-spacesuit.html?action=click&module=Editors%20Picks&pgtype=Homepage>.
- 38 Oliver Morton, *The Moon: A History for the Future* (New York: Public Affairs/Hachette Books, 2019), 215–220.

CHAPTER EIGHT—THE MOON

- 1 Arlin Crotts, *The New Moon: Water, Exploration, and Future Habitation* (New York: Cambridge University Press, 2014), 2.
- 2 James Joyce, *Ulysses* (Mineola, NY: Dover Books, 2018), 679.
- 3 “The Myth of Moon Phases and Menstruation,” *Clue*, July 14, 2016, <https://helloclue.com/articles/cycle-a-z/myth-moon-phases-menstruation>.
- 4 C. P. Thakur and Dilip Sharma, “Full Moon and Crime,” *British Medical Journal* (Clinical Research Edition) 289, no. 6460 (1984): 1789–791, <http://www.jstor.org/stable/29517732>.
- 5 Kepler, *Somnium*. Frosty Drew Observatory, <https://frostydrew.org/papers/dc/papers/paper-somnium/>.
- 6 William D. Moore, “Riding the Goat: Secrecy, Masculinity, and Fraternal High

- Jinks in the United States, 1845–1930,” *Winterthur Portfolio* vol. 41, no. 2/3 (2007), 164.
- 7 Moore, “Riding the Goat,” 395.
 - 8 Memo, JFK to Lyndon Johnson, April 20, 1961, <https://history.nasa.gov/Apollomon/docs.htm>.
 - 9 Memo, von Braun to Johnson, April 29, 1961, <https://history.nasa.gov/Apollomon/docs.htm>.
 - 10 Memo, Lyndon Johnson to JFK, April 28, 1961, <https://history.nasa.gov/Apollomon/docs.htm>.
 - 11 John F. Kennedy, “Excerpts from ‘Urgent National Needs Speech to a Joint Session of Congress, 25 May 1961,’” <https://history.nasa.gov/Apollomon/docs.htm>.
 - 12 Norman Mailer, *Of a Fire on the Moon* (Boston: Little, Brown and Company, 1969), 344–45.
 - 13 Mailer, 372–381.
 - 14 Frederick Ordway III, et al., “Project Horizon: An Early Study of a Lunar Outpost,” *Acta Astronautica* 17, no. 10 (1988), 1109.
 - 15 “Project Horizon, Volume One: Summary and Supporting Considerations,” U.S. Army, 1959, 15.
 - 16 “Project Horizon,” 81.
 - 17 Ordway, “Project Horizon,” 1118.
 - 18 “Propose Moon Base,” *Science News Letter*, May 30, 1959, Archives Department, NASM, SI, Technical Files, Space Colonies, Folder 649150-01.
 - 19 Arthur J. Snider, “Easy Life for Moon Colonists,” *Philadelphia Inquirer*, October 12, 1960.
 - 20 Thomas R. Phillips, “Value of a Moon Base for Military Operations,” *St. Louis Post-Dispatch*, September 27, 1959, 29.
 - 21 Von Braun to Otto Binder (editor of *Space World*), September 25, 1961, Library of Congress, Wernher von Braun Collection, Box 5, Folder: 1961B.
 - 22 “Red Says Moon Won’t Be Armed,” *Washington Star*, October 5, 1959, 6.
 - 23 Asif Siddiqi, email to author, January 20, 2020.
 - 24 Oleg Yegorov, “Why Did Soviets (And Americans) Want to Nuke the Moon?” *Russia Beyond*, August 29, 2019, <https://www.rbth.com/history/330892-ussr-usa-nuclear-bomb-moon>.
 - 25 A. Perry, “Moon City Planning—Hobby of Red Astronautic Civil-Defense Chief,” n.d., Archives Department, NASM, SI technical folders, “Space, Colonies, Lunar, Russia,” 649240-01.
 - 26 Gerard J. De Groot, *Dark Side of the Moon: The Magnificent Madness of the American Lunar Quest* (New York University Press, 2006), 234.
 - 27 Bryan Green, “While NASA Was Landing on the Moon, Many African-Americans Sought Economic Justice Instead,” *Smithsonian*, July 11, 2019, <https://www.smithsonianmag.com/history/nasa-landing-moon-many-african-americans-sought-economic-justice-instead-180972622/>.
 - 28 Steven Morris, “How Blacks View Mankind’s ‘Giant Step,’” *Ebony*, September 1970, 33.

- 29 William Sims Bainbridge, "The Impact of Space Exploration on Public Opinions, Attitudes, and Beliefs," in Steven J. Dick, ed. *Historical Studies in the Societal Impact of Spaceflight* (Washington, DC: NASA, 2015), 15.
- 30 Crotts, *The New Moon*, 340.
- 31 Peter Kokh, "Of Milestones and Goals," *Moon Miners' Manifesto*, no. 23, March 1989.
- 32 Crotts, *New Moon*, 348.
- 33 Ian McDonald, *Luna: New Moon* (New York: TOR, 2015), 19.
- 34 Peter Kokh, "Prinzton, a Rille-Bottom Settlement for Three Thousand People," *Moon Miner's Manifesto*, no. 26, July 1989.
- 35 L. A. Taylor and T. T. Meek, "Microwave Sintering of Lunar Soil: Properties, Theory, and Practice," *Journal of Aerospace Engineering* vol 18, issue 3, July 2005.
- 36 Peter Kokh, telephone interview with author, August 30, 2019.
- 37 Andy Weir, email to author, August 19, 2019.
- 38 Alan Boyle, "NASA Could Go Back to the Future and Revive Moon Base Plans from a Decade Ago," *Geekwire*, October 6, 2017, <https://www.geekwire.com/2017/nasa-go-back-future-revive-moon-base-plans-decade-ago/>.
- 39 Deborah Netburn, "Soon, a Female Moonwalk," *Los Angeles Times*, July 20, 2019, A1.
- 40 As of this writing, NASA and the administration were pushing for a Moon landing by 2024, while Congress preferred 2028.
- 41 Netburn, "Soon, a Female Moonwalk," A8.
- 42 Fiona MacDonald, "NASA Scientists Say We Could Colonise the Moon by 2022 . . . For Just \$10 Billion," *Science Alert*, March 22, 2016, <https://www.sciencealert.com/nasa-scientists-say-we-could-colonise-the-moon-by-2022-for-just-10-billion>.
- 43 Eric Berger, "Buzz Aldrin Is Looking Forward, Not Back—and He Has a Plan to Bring NASA Along," July 9, 2019, *Arstechnica*, <https://arstechnica.com/science/2019/07/buzz-aldrin-is-looking-forward-not-back-and-he-has-a-plan-to-bring-nasa-along/>.
- 44 Jeff Faust, "NASA's Lunar Space Station Is a Great/Terrible Idea," *Spectrum: IEEE Journal*, July 8, 2019, https://spectrum.ieee.org/aerospace/space-flight/nasas-lunar-space-station-is-a-great-terrible-idea?fbclid=IwAR1EF89SLPI8vZz3X6-IV6Lx_wVGd2QgOMUtX5DgtE26CTzZ0plzEjYqo.
- 45 Andy Weir, email to author, August 19, 2019.
- 46 Dale Skran, email to author, August 2, 2019.
- 47 Jeff Foust, "NASA Takes Gateway Off the Critical Path for 2024 Lunar Return," March 13, 2020, *SpaceNews*, <https://spacenews.com/nasa-takes-gateway-off-the-critical-path-for-2024-lunar-return/>.
- 48 Robert Zubrin, email to author, March 19, 2020. This book went to press before further NASA announcements.
- 49 Oliver Morton, *The Moon: A History of the Future* (New York: Public Affairs, 2019), 272.

- 50 Crotts, *New Moon*, 364.
- 51 Jan Woerner, “A Vision for Global Cooperation and Space 4.0,” European Space Agency Press Release, 2016.
- 52 Colin Koop and Daniel Innocente, phone interview with author, November 19, 2019.

CHAPTER NINE—GOING INTERSTELLAR

- 1 “The Ultimate Migration,” British Interplanetary Society, <https://www.bis-space.com/2012/03/23/4110/the-ultimate-migration>.
- 2 Louis Friedman, *Human Spaceflight: From Mars to the Stars* (Tucson: The University of Arizona Press, 2015), 51.
- 3 J. D. Bernal, *The World, the Flesh, and the Devil: An Enquiry into the Future of the Three Enemies of the Rational Soul*, 2nd edition, (Bloomington: Indiana University Press, 1969 [1929]), 18–24.
- 4 Bernal, *The World, the Flesh, and the Devil*, 28.
- 5 Bernal, *The World, the Flesh, and the Devil*, 29.
- 6 Bernal, *The World, the Flesh, and the Devil* 42–46.
- 7 E. Mallove and G. Matloff, *The Starflight Handbook: A Pioneer’s Guide to Interstellar Travel* (New York: John Wiley & Sons, 1989), 4.
- 8 Mallove and Matloff, *The Starflight Handbook*, 24–25.
- 9 Mallove and Matloff, *The Starflight Handbook*, 173.
- 10 Nikos Prantzos, *Our Cosmic Future: Humanity’s Fate in the Universe* (Cambridge University Press, 2000), 131.
- 11 Jatila van der Veen, email to author, December 6, 2019.
- 12 James Benford, “Sailships vs. Fusion Rockets: A Contrarian View,” *Journal of the British Interplanetary Society* 70, (2017): 175.
- 13 Paul Gilster, *Centauri Dreams: Imagining and Planning Interstellar Travel* (New York: Copernicus Books, 2004), 4.
- 14 Freeman Dyson, phone interview with author, October 3, 2019.
- 15 Nikos Prantzos, *Our Cosmic Future: Humanity’s Fate in the Universe* (Cambridge University Press, 2000), 105.
- 16 James Benford, “Sailships,” 175.
- 17 Mallove and Matloff, *The Starflight Handbook*, 195–7.
- 18 Michio Kaku, *The Future of Humanity: Terraforming Mars, Interstellar Travel, Immortality and Our Destiny Beyond Earth* (New York: Doubleday, 2018), 14.
- 19 Kaku, *The Future of Humanity*, 268.
- 20 Miguel Alcubierre, “The Warp Drive: Hyper-Fast Travel within General Relativity,” *Classical and Quantum Gravity* 11, no. 5 (1994): 73–77.
- 21 See Kaku, *The Future of Humanity*, 165, and Gilster, *Centauri Dreams*, 4.
- 22 Adam Frank, “Are We About to Send Spacechips to the Stars?” NPR 13.7 “Cosmos and Culture,” May 10, 2016, <https://www.npr.org/sections/13.7/2016/05/10/477448335/are-we-about-to-send-spacechips-to-the-stars>.
- 23 Joel Davis, “With Antimatter to the Stars,” *New Scientist*, June 24, 1989, 67.

- 24 Geoffrey A. Landis, “Advanced Solar and Laser-Pushed Lightsail Concepts,” NASA Institute for Advanced Concepts, May 31, 1999, 3.
- 25 James Benford, email to author, February, 13, 2020.
- 26 James Benford, “Starship Sails Propelled by Cost-Optimized Directed Energy,” *Journal of the British Interplanetary Society* 66, (2013): 85.
- 27 Philip Lubin, March 14, 2019 lecture at Santa Barbara City College.
- 28 Philip Lubin, March 14, 2019 lecture.
- 29 Philip Lubin, interview with author, March 3, 2019.
- 30 Philip Lubin, interview with author, March 3, 2019.
- 31 Benford, “Sailships vs. Starships,” 177.
- 32 Freeman Dyson, interview with author, October 3, 2019.
- 33 Rachel Armstrong, *Star Ark: A Living, Self-Sustaining Spaceship* (Chichester, UK: Springer-Praxis, 2017), i.
- 34 Armstrong, *Star Ark*, 141.
- 35 Armstrong, *Star Ark*, 91.
- 36 Armstrong, *Star Ark*, 28.
- 37 Armstrong, *Star Ark*, 30.
- 38 Armstrong, *Star Ark*, 33.
- 39 Freeman Dyson, interview with author, October 3, 2019.
- 40 Martin Rees, “To the Ends of the Universe,” in *Starship Century*, 435.
- 41 Friedman, *Human Spaceflight*, 6.
- 42 Friedman, *Human Spaceflight*, 5.
- 43 Meghan Neal, “Our Best Bet for Colonizing Space May Be Printing Humans on Other Planets,” *Motherboard*, May 29, 2014, https://motherboard.vice.com/en_us/article/ypwwpy/our-best-bet-for-colonizing-space-may-be-printing-humans-on-other-planets.
- 44 Kim Stanley Robinson, *Aurora* (New York: Orbit, 2015), 178.
- 45 Robinson, *Aurora*, 179.
- 46 Robinson, *Aurora*, 418.
- 47 Kim Stanley Robinson, email interview with the author, March 13, 2019.
- 48 Geoff Ryman, et al., “The Mundane Manifesto,” 2004, <https://sfgenics.wordpress.com/2013/07/04/geoff-ryman-et-al-the-mundane-manifesto/>.

CHAPTER TEN—THE METAPHYSICAL LURE OF DEEP SPACE

- 1 Excerpt from John F. Kennedy acceptance speech of democratic presidential nomination, July 15, 1960, <https://www.jfklibrary.org/asset-viewer/archives/JFKSEN/0910/JFKSEN-0910-015>.
- 2 O’Neill, *High Frontier*, 205.
- 3 Zubrin, *The Case for Mars*, 304.
- 4 Kaku, *The Future of Humanity*, 35.
- 5 Krafft A. Ehrlicke and Elizabeth A. Miller, “From Closed to Open World: The Extraterrestrial Imperative,” *EIR*, August 26, 2011, 38.
- 6 Matthew H. Nitecki, “Discerning the Criteria for Concepts of Progress,” in Matthew H. Nitecki, ed., *Evolutionary Progress* (University of Chicago Press, 1988), 6.

- 7 From a 1984 speech by Ehricke, cited in Joseph A. Angelo, *Space Technology* (Westport, CT: Greenwood Press, 2003), 282.
- 8 Joseph Kirby, "Toward an Ecological and Cosmonautical Philosophy," *Journal of Evolution & Technology* 23, no. 1 (2013): 5.
- 9 Michael Ruse, "Molecules to Men: Evolutionary Biology and Thoughts of Progress," in Matthew H. Nitecki, ed., *Evolutionary Progress* (University of Chicago Press, 1988), 97.
- 10 Stephen J. Gould, "On Replacing the Idea of Progress with an Operational Notion of Directionality," in Matthew H. Nitecki, ed., *Evolutionary Progress*, 319.
- 11 Ehricke and Miller, "From Closed to Open World," 40.
- 12 Lee Billings, "It's Never Aliens—Until it Is," *Scientific American*, January 9, 2018, <https://www.scientificamerican.com/article/its-never-aliens-until-it-is/>.
- 13 William A. Gale and Gregg Edwards, "Models of Long Range Growth," in William A. Gale, ed., *Life in the Universe: The Ultimate Limits of Growth* (Boulder, CO: Westview Press, 1979), 71.
- 14 Gale and Edwards, "Models of Long Range Growth," 93.
- 15 Arthur C. Clarke, "The Challenge of the Spaceship," in *Greetings Carbon-Base Bipedes! Collected Essays 1934–1998* (New York: St. Martin's Press, 2000), 34.
- 16 Teilhard de Chardin, *Activation of Energy* (New York: Harcourt Brace Jovanovich, 1970), 273.
- 17 Charles Collins, "Actor Finds Document Teilhard Forced to Sign Affirming Church Teaching," *The Crux*, February 23, 2018, <https://cruxnow.com/church-in-uk-and-ireland/2018/02/23/actor-finds-document-teilhard-forced-sign-affirming-church-teaching/>.
- 18 Marshall Savage, *The Millennial Project: Colonizing the Galaxy in Eight Easy Steps* (Boston: Little, Brown, and Company, 1992), 356.
- 19 Savage, *The Millennial Project*, 17.
- 20 Savage, *The Millennial Project*, 19.
- 21 Savage, *The Millennial Project*, 23.
- 22 Savage, *The Millennial Project*, 328.
- 23 Savage, *The Millennial Project*, 371.
- 24 Savage, *The Millennial Project*, 356.
- 25 Carl Sagan, *Pale Blue Dot: A Vision of the Human Future in Space* (New York: Random House, 1994), 264.
- 26 Dmitri Donskoy, "Space Environments Ecovillage" website, <http://dmitridonskoy.com/see/faq.htm> (Accessed April 18, 2019).
- 27 "6 Billion, the Game of the New Millennium," <http://members.optusnet.com.au/bnbg6billion/6billion.htm>.
- 28 Emily Pollock, "UN Brings Back Controversial Floating City Concept," *Engineering.com*, April, 15, 2019, <https://www.engineering.com/BIM/ArticleID/18941/UN-Brings-Back-Controversial-Floating-City-Concept.aspx>.
- 29 Savage, *The Millennial Project*, 357.
- 30 Savage, *The Millennial Project*, 361.
- 31 Savage, *The Millennial Project*, 355.

- 32 Br. Guy Consolagmo, email to author, April 1, 2019.
- 33 Rusty Schweickart, *L5-News* October, 1977, vol. 2, no. 10, 2.
- 34 Stephen Hawking and Leonard Mlodinow, *The Grand Design* (New York: Bantam Books, 2010), 153–54.
- 35 Hawking and Mlodinow, 159.
- 36 Fred Hoyle, “The Universe: Past and Present Reflections,” *Annual Review of Astronomy and Astrophysics* 20, (1982): 4.
- 37 Hoyle, “The Universe,” 16.
- 38 Kurt Vonnegut Jr., *Breakfast of Champions* (New York: Dial Press, 2002 [1973]), 3.
- 39 Paul C. W. Davies, “Life, Mind, and Culture as Fundamental Properties of the Universe,” in Steven J. Dick and Mark L. Lupisella, eds., *Cosmos and Culture: Cultural Evolution in a Cosmic Context* (Washington, DC: NASA, 2009), 385.
- 40 Hawking and Mlodinow, *The Grand Design*, 136.
- 41 Freeman Dyson, interview with author, October 3, 2019.
- 42 Mariette Le Roux and Laurence Coustal, “After Death, Hawking Cuts ‘Multiverse’ Theory Down to Size,” May 6, 2018, *Phys Org News*, <https://phys.org/news/2018-05-death-hawking-multiverse-theory-size.html>.
- 43 Le Roux and Coustal, “After Death, Hawking Cuts ‘Multiverse.’”
- 44 Dan Peterson, “The Vatican’s Astronomer on God and the Stars,” *Patheos*, December 22, 2018, <https://www.patheos.com/blogs/danpeterson/2018/12/the-vaticans-astronomer-on-god-and-the-stars.html>.
- 45 Interview with Br. Guy Consolagmo on Connect 5, October 26, 2016, <https://www.youtube.com/watch?v=AV3fPU7ZpEU>.
- 46 Wendell Mendell, “Space Activism as an Epiphanic Belief System,” in Steven J. Dick, ed., *Historical Studies in the Societal Impact of Spaceflight* (Washington DC: NASA, 2015), 581.
- 47 Sagan, *Pale Blue Dot*, 404.
- 48 Rabbi Steven Cohen of Congregation B’nai B’rith Congregation in Santa Barbara, California, helped me track down this quote.
- 49 Olaf Stapledon, “Interplanetary Man?” *Journal of the British Interplanetary Society* 7, no. 6 (1948), 22.

CHAPTER ELEVEN—THE SPACE RAVE

- 1 Nell Greenfield Boyce, “After 50 Years, Space Monkeys Not Forgotten,” *NPR online*, May 28, 2009, <https://www.npr.org/templates/story/story.php?storyId=104578202>.
- 2 “Religion and Science,” Pew Research Center, October 2015. This survey polled 2,002 adults in August 2014.
- 3 This result was gleaned a year after Yuri’s Night, but probably accurate for 2018 as well. “Attitudes Toward Space Exploration,” C-Span/Ipsos Poll, 2019, <https://www.ipsos.com/en-us/news-polls/cspan-space-exploration-2019>.
- 4 “Majority of Americans Believe It Is Essential that the U.S. Remain a Global Leader in Space,” Pew Research Center, June, 2018.