

## Science and Invention in Literature—

### Divergent Views of Daniel Defoe and Jonathan Swift

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**Abstract—The seventeenth and eighteenth centuries saw remarkable advances in science and technology in the Copernican Revolution. Roger Bacon and John Locke gave new meaning to individual investigation and objective analysis of objects of perception. Science fostered the development of the telescope to discover the truths of celestial bodies; the invention of the microscope enabled researchers to delve into the structure and composition of natural organisms. Daniel Defoe, world-renowned as the author of *Robinson Crusoe* (1719), wrote *A General History of Discoveries and Improvements in Useful Arts* (Commerce, Navigation, and Plantation) (1727) where he supported progress and invention. Jonathan Swift, author of *Gulliver's Travels* (1726), did not understand theoretical science and attacked modern invention in his satire.**

#### Philosophical Context

**T**HE SEVENTEENTH CENTURY brought forth the inventions of the telescope and the microscope that were to confirm Baconian theoretics. The eighteenth century saw the confirmation of Lockean rationalistic pragmatics. Both centuries advanced the hypotheses of Copernicus (1473–1543) who revolutionized world thought by the reduction of Earth from its centripetal seat in the Ptolemaic universe with the earth as the center of the universe to its orbital reductive as one among many planets circling the Sun.<sup>1</sup> Marjorie Nicolson in a series of essays from 1935 to 1940 provided the pathway to our understanding of these momentous changes in perception, imagination, and invention.<sup>2</sup> The rational controlled science.

Circumstances, then, offered perceptions of space other than that of singular Man on an orbiting planet, unique though he might be, but now one amongst many. In the universal scheme, the Earth owned its special orbit and could perform to its potential in that single orbit—following the theory of plenitude, which allowed full expression and development within a single and limited sphere of influence—just as others in distant planets with like discrimination might project their own worlds. Daniel Defoe wrote that “Copernicus no sooner set up his Astronomical Lectures at Rome, but all the Virtuosi of that Age flockt to him, till...he taught them to be Wiser than himself, and



Photo by Debbie Bush

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they improv'd upon his schemes” in such areas as geography and arithmetic.<sup>3</sup> Thus, Francis Godwin’s narrative of Domingo Gonsales’ space flight in *The Man in the Moon* (1638), Cyrano de Bergerac’s *Histoire Comique des Etats et Empires de la Lune et due Soleil* (*A Comical History of the States and Empires of the Sun and the Moon*) (1656), Aphra Behn’s play *The Emperor of the Moon* (1687), and Daniel Defoe’s fictional *Consolidator* (1704), depicting the Man in the Moon, now had Galileo’s report of earth-like features as authority for their lunar inhabitants. Theirs was a voice substantiated by scientific demonstration unlike primitive classical works such as Lucian’s *Dialogue of Icaromenippus* (ca. A.D. 125–190) describing an ancient voyage to the Moon, which could only contemplate, but not actually see, earthly configurations in space.

#### Baconian Empiricism

The nature and context of the scientific revolution may be found in *The Advancement of Learning* (1605) by Francis Bacon (1561–1626). Vickers identifies Bacon as the spirit of applied science: “Nearly everything that Bacon advocated concerning the advancement of learning was actuated by his belief that scientific pursuits should lead to technological progress.”<sup>4</sup> Bacon’s philosophical direction was to use scientific knowledge (inductive or deductive) to improve mankind by achieving practical goals: “True and fruitful Natural Philosophy,” he wrote, “has a double scale or ladder, ascendent and descendent, ascending from experiments to axioms and descending from axioms to the invention of new experiments.”<sup>5</sup> Experimentation leads to the development of new inventions. Bacon seeks “a line and race of inventions that may in some degree subdue and overcome the necessities and miseries of humanity.”<sup>6</sup> Free access to new

ideas, novel experiments, and labor-saving or life-saving inventions characterized the work of the Royal Society founded in 1660 and predicated upon meetings as early as 1645 of scientists engaged in the study of natural and experimental philosophy.<sup>7</sup>

John Locke (1632–1704) in his *Essay on Human Understanding* (1690)<sup>8</sup> sought to understand the individuating capability of the mind as a perceptive organ. In Locke's epistemology, humans identified their cosmos by witnessing each object of the primary imagination in multiple detail—by its shape, contour, gravity, passivity, weight, and extension. The multiplicity of detail translates into an “idea”—a chair, a window, a power plant—and humans give names to these ideas to enable communication. One abstracts these names into symbols and from the intellectual level of symbolization achieves notions that enable the employ of the secondary imagination—the ability to conceive spatially. Thus, researchers are able to develop hybrid automobile engines and space vehicles. Whether to look into the Heavens or to study the fundamental nature of the earth, seventeenth-century scientists nurtured the development of our most important scientific inventions, the telescope and the microscope.

### **Invention**

Nicolson finds classic reports of telescopic glasses to be primitive in concept and design. The telescope, as we know it today, seemed to have arrived in 1608—with claims for its invention from scientists in Holland, Germany, France, and Italy. The modernism of the instrument lay in its design and use by Galileo Galilei (1564–1642) who reported the construction of the advanced instrument on August 29, 1609, that was to bring about “discoveries which were to transform human imagination.”<sup>9</sup> It may be an inexplicable curiosity to discover that two of the greatest inquiring and inventive minds of the world were born in the same year, 1564, Galileo and William Shakespeare (1564–1616). Or it may be reasonable to assert that they were born into a world that offered discoveries of such moment as to encourage imaginative expression.

The invention of the microscope is a study of the history of the perception of small living creatures. Nicolson attributes to Robert Hooke (1635–1703) primary authority in England for the development of the microscope because of his observations on leeches and mould reported to a meeting of the Royal Society on April 22, 1663, and for his observations of a female gnat on May 6; also, his study of the head of an ant on May 20, 1663.<sup>10</sup> Hooke received authorization to publish his *Micrographia* in 1664.<sup>11</sup> Nicolson attributes to the Dutchman Antony van Leeuwenhoek (1632–1723), a manufacturer of microscopes and designer of microscope lenses, the most impressive and advanced uses of the microscope. In particular, Leeuwenhoek initiated modern biological research and comprehended medical applications with his discovery of “little animals” in water and his study of intestinal protozoa, reported in his “Letter on Protozoa” in 1676.<sup>12</sup>

### **Daniel Defoe and Jonathan Swift**

Two eighteenth-century authors demonstrate how differently writers understood the scientific revolution. Daniel Defoe,

world-renowned as the author of *Robinson Crusoe* (1719), wrote *A General History of Discoveries and Improvements in Useful Arts* (1727) where he lauded progress and invention in commerce, navigation, and agriculture. Jonathan Swift, author of *Gulliver's Travels* (1726), did not understand theoretical science and attacked modern invention in his satire.

Daniel Defoe published *An Essay on Projects* in 1697 which comments on new technology—fire engines, methods of casting guns from metal and boring them for greater accuracy, and the construction of water mills. A tradesman, himself, who went bankrupt in the brick-making industry and found himself in debt after trying to sell the musk of civet cats for perfume, Defoe reviews a number of innovations in business and industry in his *General History of Discoveries and Improvements in Useful Arts* (1727).<sup>13</sup> This work is important as a celebration of new invention. Defoe offers to “show some Schemes of Improvement and some Discoveries, well worth the undertaking of those who have the most enterprising Genius;” (5). He draws a distinction between ships that were brought to the Siege of Troy—“large open Boats, merely made for transporting their Soldiers, in the calm Weather channels of the Aegean Seas”—and modern ships designed with sophisticated equipment for all-weather sailing: sails, masts, rigging, anchors, rudders, and cables (53). Defoe traces the improvement of military firepower from Match-locks to Musquets (229) and notes improvements in cannon such as mortars, howitzers, and hand grenades—“all perfectly new” (231).

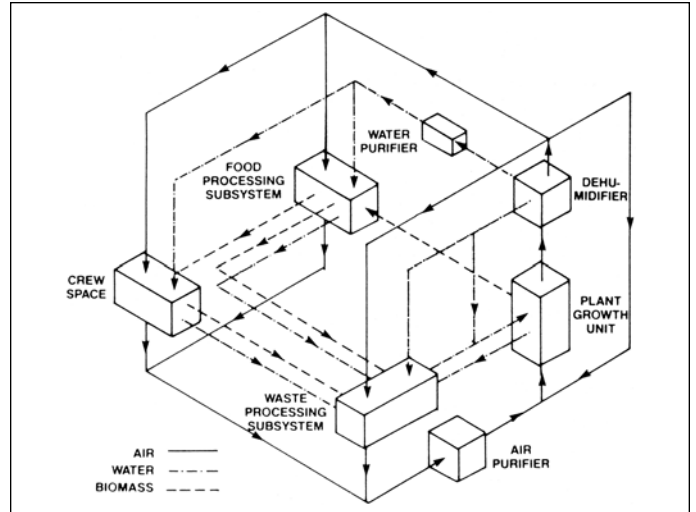
He contrasts the world of the twelfth century with enterprise in his own lifetime—“They had Philosophy without Experiment,” he wrote (233). Voyagers of the past, he notes, had no compasses, no telescopes, no printing presses. Theirs was a world of “Chirurgery [surgery] without Anatomy, and Physicians without the *Materia Medica*...[who] cur'd Agues without” modern medicines (234). He celebrates the development of the magnet (250–63). To the invention of the compass he attributes the growth of exploration. He would have been impressed but not surprised at man's ability to navigate space as with the Stardust mission that collected materials from the tail of a comet during a seven-year journey which had a spacecraft travel 3 billion miles and return to Earth in January 2006.<sup>14</sup>

He devotes a number of chapters to commercial development in the Americas with “Discoveries in the Bay of St. *Laurence*, the Rivers of Canada and *Mississippi*, and...the Inland part of *North America*” (301) resulting in “Furs from the Land, and Fish from the Sea,” enriching the nations from whence came the explorers and the settlers. Daniel Defoe celebrates exploration, innovation, invention, and progress.

On the other hand, Jonathan Swift ridicules modern science in *Gulliver's Travels*. His characterization of scientific research in the Academy of Lagado maximizes his satire on science. Swift was not unfamiliar with research being conducted in the Royal Society, for he visited Gresham College on December 13, 1710. He read *The Philosophical Transactions* of the Society. Indications are that all or most of the experiments he ridicules may have had some analogue in ongoing research in laboratories in London and Oxford.<sup>15</sup> In Book III, Gulliver meets a number of scientists in the Academy of Lagado who are engaged in



Figure 1. Gulliver meets the scientist trying to extract food from human excrement. (Illustration by Luis Quintanilla, in Jonathan Swift, *Gulliver's Travels*, introd. Jacques Barzun. N.Y.: Crown Publishers, 1947, p. 205).



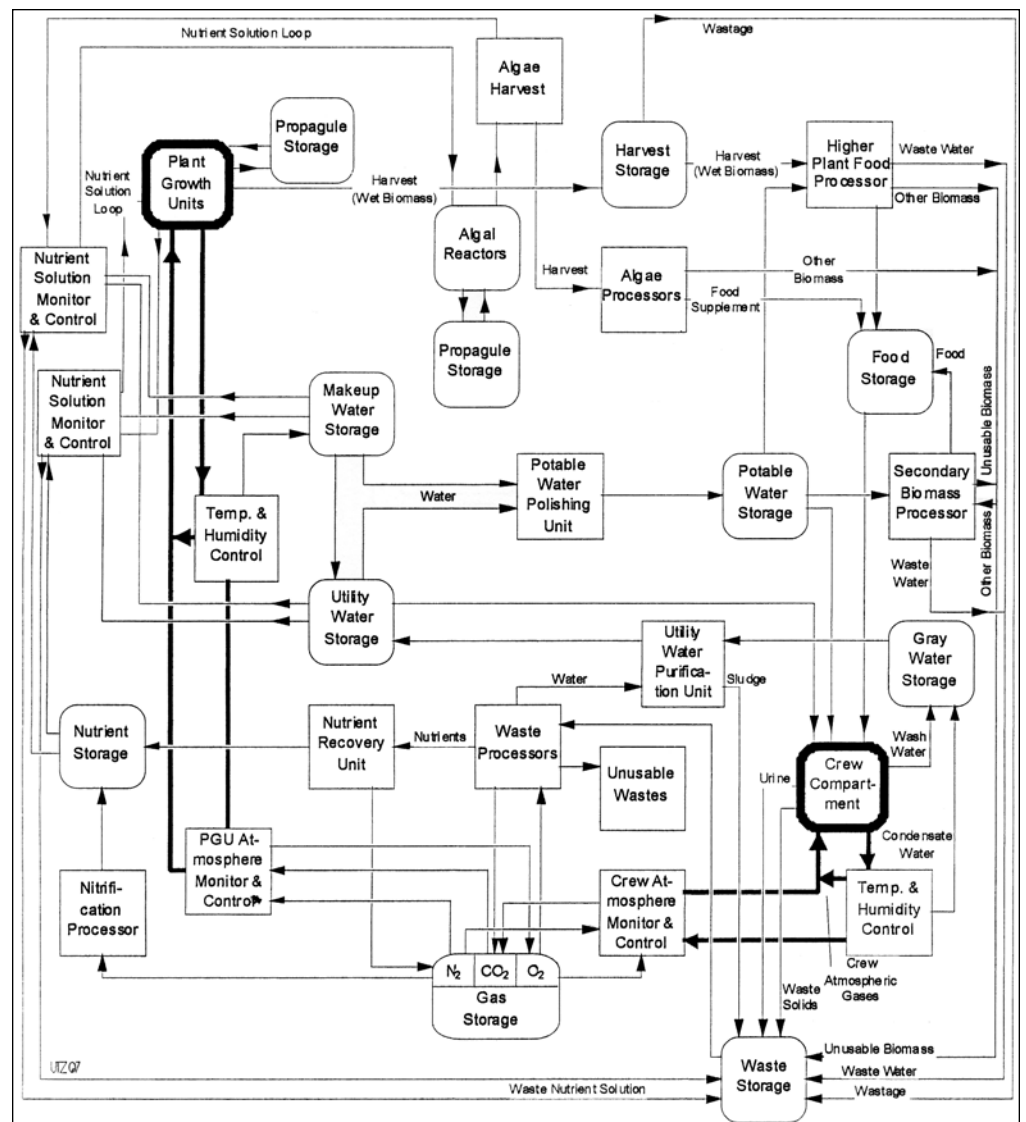
FROM EXCREMENT TO FOOD—(Above) The CELSS Concept with its plant growth unit, in *Lunar Base Agriculture*, p. 146. (Below) The CELSS Initial Reference Configuration, in *The Lunar Base Handbook*, p. 408.

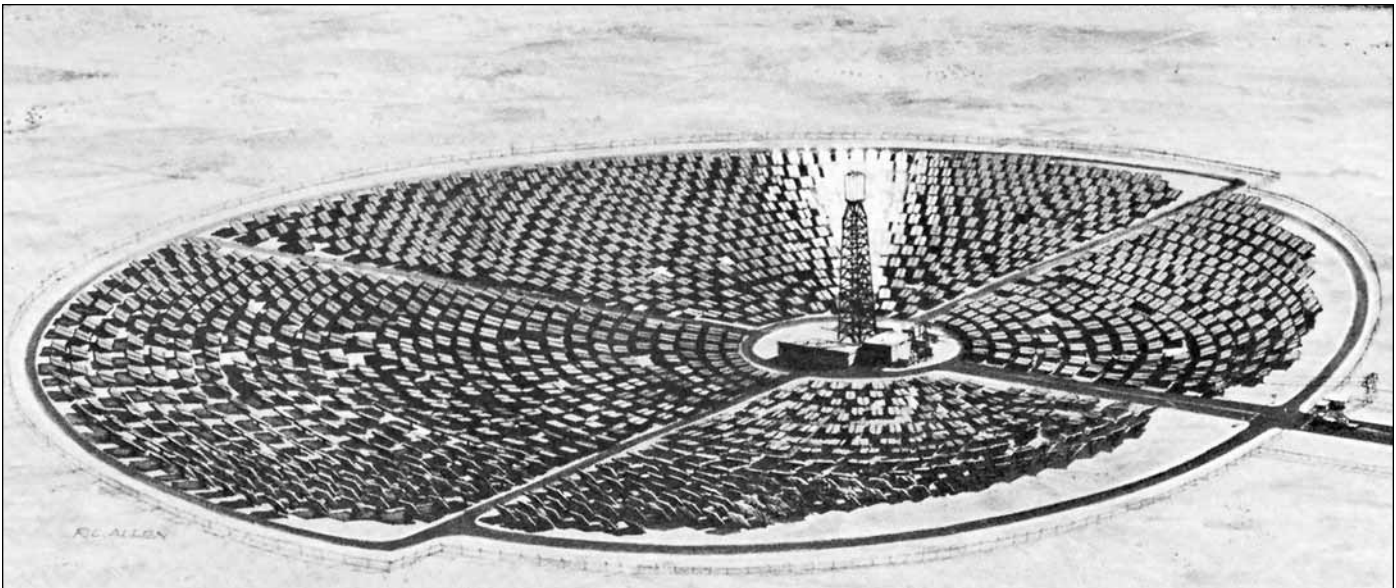
the most improbable of experiments. One seeks to extract food from excrement and restore it to its original state.<sup>16</sup> Another has spent eight years extracting sunbeams from cucumbers trying to store them in hermetically sealed vials so that he can harness the warmth of the sun in “raw inclement Summers” (151).<sup>17</sup> He anticipates needing another eight years to complete his task.

### Modern Applications

#### *Transforming human waste*

Swift ridiculed these experiments because he had neither the scientific knowledge nor the prescience to understand needs of the twenty-first century. Both experiments have been subjects of research in the twentieth century and are yet essential in achieving national goals for energy conservation and space research. In *Gulliver's Travels*, the scientist conducting research in excrement receives one barrel per week of human ordure. His task is to separate “the Gall, making the Odour exhale, and scumming off the Saliva” (152). Gulliver is offended by the stench of this scientist who embraces him, having had few occasions to





**SOLAR ENERGY PLANT**—The Solar Power Plant Design Concept for the Southern California Edison Facility in Barstow, California. The plant was a cooperative effort of McDonnell Douglas, the UH Energy Laboratory, the California utility, and the U.S. Department of Energy. (*Energy Laboratory Newsletter* 1.3 [1979]: 6.)

welcome visitors during the course of his research. The problem is germane to NASA's plans to establish colonies of human beings on the Moon and Mars. NASA estimates that "on a two-year trip to Mars, a crew of six humans will generate more than six tons of solid organic waste—much of it feces."<sup>18</sup>

NASA-JSC and UH researchers are dealing with efforts to transfer the nutrients of human waste into beds that will grow crops for space populations. They have been long engaged in problems of waste utilization through the CELSS Project (Controlled Ecological Life Support System). The CELSS concept has the crew producing human waste (urine and feces) that is delivered to a physico-chemical waste processing system that extracts nutrients necessary for the growth of edible plants. The processed waste is next fed to a plant growth unit for the production of food. The concept has been refined into Bioregenerative Life Support Systems (BLSS) The cycle is completed when the astronauts sit to a meal that includes plants grown through the process.<sup>19</sup> Swift's isolated scientist had not yet developed the processing system for separating waste from its nutrients.

New technology will treat human waste to provide for pure drinking water, fertilizer, and electricity. Dr. Bruce Rittman, a professor and NASA Principal Investigator at Northwestern University, is currently developing a membrane microbial fuel cell to generate electricity that will obtain its electrons from organic waste.<sup>20</sup>

#### *Collecting sunbeams from cucumbers*

The projector at the Academy of Lagado who seeks to store sunbeams from cucumbers in glass vials could not have envisioned thermal storage technology developed at the University of Houston. He was, however, well aware of three requisites—(1) the use of the sun as a source of energy, (2) a process for collecting the sun's energy, and (3) a method of storage. In 1969-1970, physicist Dr. Alvin F. Hildebrandt and his colleagues developed their methodology for collecting and converting the energy of

the sun on earth. By 1974, Hildebrandt and Dr. Lorin Vant-Hull, UH physicists, had conceptualized and designed a Tower Top Point Focus Solar Energy Collector. In 1988, Dr. Michel Izygon, French adjunct professor and computer software specialist, joined Hildebrandt and Vant-Hull in the Energy Laboratory to perfect heliostat controls and to develop more sophisticated technology for the storage of thermal energy so that the plant could operate at night or when sunshine was minimal.<sup>21</sup>

In 1976, H. William Prengle, Jr., of the Chemical Engineering Department and colleagues developed a chemical storage system utilizing a cycle based on the decomposition of ammonium hydrogen sulfate (AHS) to water, ammonia, and sulfur trioxide.<sup>22</sup> By 1985, an experimental facility—10-Mwe Solar I—based upon the UH design was built at Barstow, California, constituting an array of heliostats (mirrors) which collected the sun's rays (sunbeams) and reflected them upon a central receiver set on a 330 m tower. The central receiver was later comprised of heat pipes containing liquid sodium "for absorbing and conveying the collected solar energy."<sup>23</sup>

UH scientists did not collect sunbeams from cucumbers; theirs was a four-point system: "(1) a solar concentrator which focuses solar energy on the heat pipe; (2) the heat pipe with a selective optical coating; (3) a heat-transfer loop connecting the heat pipe to a thermal storage unit; and (4) a thermal storage unit which receives thermal energy from the transfer loop and releases it to the power cycle working fluid," i.e., to a generating plant.<sup>24</sup> The initial collection system consisted of designed heliostats (mirrors on pedestals) that included a sophisticated set of azimuth controls to align the heliostat along the sun's passage.

Jonathan Swift designed his projectors for the satirical purpose of ridiculing the narrow focus and impossible aspirations of scientific experimentation—one collected human waste to restore its food value, and another collected sunbeams from cucumbers to retain heat. He would have done better to emulate

his contemporary, Daniel Defoe, who better understood the nature of invention and technical progress.

## Endnotes

<sup>1</sup>Ptolemy (Claudius Ptolemæus), Greek mathematician, astronomer, and geographer, served during the reigns of Hadrian and Antoninus Pius in Alexandria from A.D. 127–141 or 151 (Liba Chai Taub, *Ptolomey's Universe: The Natural, Philosophical, and Ethical Foundations of Ptolomey's Astronomy*. Chicago: Open Court, 1993). Copernicus (Nicolaus Koppernigk) (1473–1543), Polish astronomer, placed the Sun at the center of celestial bodies of the universe and, overturning Ptolemaic theory, changed the perception of the physical world. A modernist, he anticipated new theories of perception. See Edward Rosen, *Copernicus and the Scientific Revolution* (Melabor, Fl.: Krieger, 1984).

<sup>2</sup>Marjorie Nicolson, *Science and the Imagination* (Ithaca: Cornell UP and London: Oxford UP, 1956); hereafter cited as Nicolson, *Science*. This collects her published essays: “The Telescope and Imagination,” *MP* 32 (1935), 233-60; “The ‘New Astronomy’ and English Imagination,” *SP* 32 (1935): 428-62; “Kepler, the Somnium, and John Donne” *Journal of the History of Ideas* 1 (1940): 259-86; “Milton and the Telescope,” *ELH* 2 (1935): 1-32; “The Scientific Background of Swift’s Voyage to Laputa,” *Annals of Science* 2 (1937): 299-334; and *The Microscope and English Imagination*. Smith College Studies in Modern Languages (1935). See Frederick N. Smith, “Scientific Discourse: *Gulliver’s Travels* and *The Philosophical Transactions*,” in *The Genres of Gulliver’s Travels*. Ed. Frederick N. Smith. Newark: U of Delaware P and London and Toronto: Associate U Presses, 1990. 139-62; Smith does not mention Gulliver’s meeting with the scientist studying methods of extracting food from human excrement.

<sup>3</sup>Daniel Defoe, *A General History of Discoveries and Improvements, in Useful Arts, Particularly in the Great Branches of Commerce, Navigation, and Plantation, in all Parts of the Known World....To be continued Monthly*. Numb. 1 for October. London: Printed for J. Roberts at the Oxford-Arms, in Warwick Lane. [1727], pp. 225-26.

<sup>4</sup>Ilse Vickers, *Defoe and the New Sciences* (Cambridge: Cambridge UP, 1996), p. 12.

<sup>5</sup>Quoted by Vickers in “The Legacy of Francis Bacon,” p. 13, from Francis Bacon, *Works*, ed. J. Spedding. R. L. Ellis, and D. D. Heath. 14 vols. (London: 1857-74). *Great Instauration*, 4:343.

<sup>6</sup>Quoted by Vickers from Bacon, *Works*, 4:27.

<sup>7</sup>Thomas Sprat, *The History of the Royal Society*, ed. J. I. cope and H. W. Jones. St. Louis, MO: Publisher, 1959.

<sup>8</sup>John Locke, *An Essay Concerning Human Understanding* (1690), ed. P. H. Nidditch (Oxford: Oxford UP, 1979). Locke

<sup>9</sup>Nicolson, *Science*, 12-13. <sup>10</sup>Nicolson, *Science*, 161-62.

<sup>11</sup>Nicolson, *Science*, 163. <sup>12</sup>Nicolson, *Science*, 165-66.

<sup>13</sup>Daniel Defoe, *A General History of Discoveries*. See above.

<sup>14</sup>Warren Leary, “After 3 Billion Miles, Craft Returns Sunday Bringing Cosmic Dust Older than the Sun,” *The New York Times*, Jan. 10, 2006, Sec. F, p. 3.

<sup>15</sup>Nicolson, *Science*, 135. See, also, Douglas Lane Patey, “Swift’s Satire on ‘Science’ and the Structure of *Gulliver’s Travels*.” *ELH* 59 (1991): 809-39 and Marjorie Nicolson and

Nora Mohler, “The Scientific Background of Swift’s Voyage to Laputa,” *Annals of Science* 2 (1937): 299-334.

<sup>16</sup>Nicolson finds that the passage on excrement may have been borrowed from François Rabelais’ iconoclastic *Gargantua and Pantagruel* (1542–1546), in *Science* 139. William A. Eddy devotes a section to Rabelais’ influence on Swift in *Gulliver’s Travels: A Critical Study* (1923; rpt. N.Y.: Russell & Russell, Inc., 1963), 57-60. See, also, Norman O. Brown, “The Excremental Vision.” *Life Against Death: The Psychoanalytical Meaning of History*. Middletown, CT: Wesleyan UP, 1959. 179-201.

<sup>17</sup>Jonathan Swift, *Gulliver’s Travels*, ed. Albert J. Rivero. A Norton Critical Edition. N.Y. and London: W. W. Norton & Company, 2002.

<sup>18</sup>Karen Miller, “Harnessing the Power of Poop,” May 19, 2004. *Space.com*. Jan. 9, 2006, from *The Boston Business Journal*, Nov. 12, 2005, p. 18. <[http://www.space.com/business/technology/astronaut\\_electricity\\_040519.html](http://www.space.com/business/technology/astronaut_electricity_040519.html)>.

<sup>19</sup>Maurice M. Avner, “Controlled Ecological Life Support System,” p. 146, illus. 11-1, in *Lunar Base Agriculture: Soils for Plant Growth*, ed. D. W. Ming and D. L. Henninger (Madison, WI: American Society of Agronomy, Inc., Crop Science Society of America, Inc., and Soil Science Society of America, Inc., 1989; also “BLSS” in *The Lunar Base Handbook*, ed. Peter Eckart. Space Technology Series. N.Y.: McGraw-Hill Company, Inc., 1999, pp. 404-08.

<sup>20</sup>B. E. Rittman, M. Hausner, F. Löffler, N. G. Love, G. Muyzer, S. Okabe, D. B. Oerther, J. Peccia, L. Raskin, and M. Wagner, “A Vista for Microbial Ecology and Environmental Biotechnology,” *Env. Sci. & Tech.*, Feb. 15, 2006, p. 1101; see, also, B. E Logan, “Simultaneous Wastewater Treatment and Biological Electricity Generation,” *Water Sci. Technol.* 52.1-2 (2005): 31-37.

<sup>21</sup>“Solar Energy,” *Van Nostrand’s Scientific Encyclopedia*. 5th Edn. Ed. Douglas M. Considine. N.Y., Cincinnati, London et al: Van Nostrand Reinhold Company, 1976. 2032-33, 2045.

<sup>22</sup>H. W. Prengle, Jr., and E. C.-H. Sun, “Operational Chemical Storage Cycle for Utilization of Solar Energy To Produce Heat or Electrical Power,” *Solar Energy* 18 (1976): 561; see, also, H. W. Prengle, Jr., “Chemical Storage of Solar Energy—The Ammonium Hydrogen Sulfate Cycle,” *Energy Laboratory Newsletter* 11 (1985): 31-33.

<sup>23</sup>*Scientific Encyclopedia*, 2033. <sup>24</sup>Prengle, 32.

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