

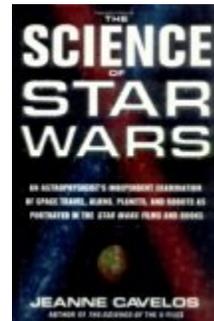
H-Net Reviews

in the Humanities & Social Sciences



Jeanne Cavelos. *The Science of Star Wars*. New York: St. Martin's Press, 1999. xv + 256 pp. \$22.95 (cloth), ISBN 978-0-312-20958-2.

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George Lucas and Science in the Star Wars Universe

Disclaimer: The opinions expressed in this review are those of the author and not of his employer or any other federal agency.

This volume was published to coincide with the release on 19 May 1999 of George Lucas's long awaited *Star Wars* prequel. It offers the reader a unique perspective on the scientific plausibility of the phenomenon now depicted in four *Star Wars* motion pictures: Episode I: *The Phantom Menace* (1999); Episode IV: *A New Hope* (1977); Episode V: *The Empire Strikes Back* (1980); and Episode VI: *Return of the Jedi* (1983). Episode IV was commonly referred to as *Star Wars* before the other episodes were filmed and released. In Jeanne Cavelos's book and in my evaluation, *Star Wars* as a term refers to all of the episodes (filmed and planned) in the nine-episode saga.

Cavelos, the author of *The Science of Star Wars*, has a BS in astrophysics, did graduate work in astronomy, and taught astronomy at Michigan State University and Cornell University before working in the Astronaut Training Division at NASA's Johnson Space Center in Houston. She admits to an early interest in science fiction, including Charlton Heston in the motion picture *Planet of the Apes* (1968), and she states that she saw her first *Star Wars* film in Syracuse at age seventeen, and immediately became (and continues to be) a fan. These events led to her being intrigued with space exploration and in alien life forms. This interest in science fiction led to an eight-year career in publishing and she was a senior editor for science fiction/fantasy at Dell Publishing. Leaving New York in order to pursue her own writing career, she wrote *The Shadow Within*, Book 5 of the *Babylon 5* novels (New

York: Dell, 1997), and now also teaches at St. Anslem and New Hampshire colleges. At the latter institution, Cavelos also directs and teaches at "Odyssey," the annual six-week summer workshop for writers of science fiction, fantasy, and horror. She is also the author of *The Science of the X-Files* (New York: Berkeley/Boulevard-Penguin Putnam, 1998), published last November, and since nominated for the 1999 Horror Writer's Association's "Bram Stoker Award for Superior Achievement in Horror." In addition, she has a website that includes additional material on the scientific issues raised in *Star Wars*: <http://www.sff.net/people/cavelos> Indeed, Jeanne Cavelos brings a unique background to this assessment of science - and science fiction - in *Star Wars*.

The purpose of her current book is to scientifically explore the *Star Wars* universe, so that in her analysis, in addition to the four theatrical motion pictures and the "Special Editions" of Episodes VI through IV (1997), she also refers to the *Star Wars Holiday Special* (a two-hour made for television video dating to 1978), and Stephen J. Sansweet's *Star Wars Encyclopedia* (New York: Ballantine, 1998). Cavelos's book has a one-page list of "Recommended Readings" containing 18 citations to books and websites, and a very useful 11-page triple-column index that conflates topics and proper nouns (including characters, species, and planets that appear in *Star Wars*). She draws upon a variety of scientific disciplines and at least 47 named experts from various fields in her anal-

ysis. Unfortunately, Cavelos does not provide any direct citations to publications, correspondence, or her oral interviews with the “experts,” so that even direct quotations lack any references, precluding the verification of the quoted statements. This is particularly distressing should the reader wish to investigate a specific topic without having to do a major library or online reference search. Nonetheless, the reader can enjoy a flowing narrative uncluttered with in-notes, footnotes, or endnotes. Invariably, she cites a source as “Dr. so-and-so” (proper noun name). The Ph.D. scientists whom she quotes span an extraordinary range of disciplines from evolution and human paleontology (Owen Lovejoy, Tim White, and Bruce Janowsky), to intelligence (Michio Kaku and Clifford Pickover), paranormal and remote viewing (Hall Puthoff and Jessica Utts), computing and robotics (Rosalind Picard), and psychokenetics (Matt Visser), to gravity and wormholes (Miguel Alcubierre), desert ecosystems (Uwe George), and the classification of civilizations (Nikolai Kardishev). Stephen Hawking, Carl Sagan, and Ron Hubbard are also mentioned, but less frequently than Igmoie, the author’s iguana (six references). The book has no illustrations, charts, or diagrams.

Following her orienting “Introduction,” Cavelos divides the book into five topical chapters. I shall characterize the contents of these individual chapters, providing commentary and an assessment of each, prior to my concluding remarks. As she proceeds from environment to aliens and androids to spaceships and weapons, and finally “The Force,” the chapters become longer and more detailed (chapter lengths increase from 38 to 67 pages). Every chapter has internal subheadings and relevant “sidebar essays” (each one paragraph to three pages in length contained in shaded boxes and printed in a font different from that of the narrative). The chapter titles are straightforward but the internal headings and essay titles are often whimsical.

“Chapter 1: Planetary Environments” has four sidebar essays and seven sections with headings such as “You Can’t Have an Empire without Real Estate” and “The Bright Center of the Universe.” The subjects covered include planet formation, star systems, tidal forces, biochemical factors needed for life, high-energy particles, Tatooine’s desert environment, and Owen and Beru’s moisture farm. We learn that “life is common, that there are two billion earth-like planets in our galaxy, and that water is the best medium for carbon-based chemical reactions. One essay, “Twin Suns” evaluates and challenges the probability that Tatooine would have two suns, while another considers Endor’s moon and potential radiation

problems. In sum, the chapter is informative but “thin“ in content in comparison to those that follow. The environments of various planets described in the Frank Herbert novel *Dune* (Radnor, Pa.: Chilton, 1965) and depicted in the motion picture *Dune* (1984), as well as episodes from all four of the *Star Trek* television series and the nine theatrical motion pictures might have been introduced as parallels. However, this might serve only to “clutter“ the essay and confuse some readers. See, for example, planetary entries in Willis E. McNelly’s *The Dune Encyclopedia* (New York: Berkley, 1984).

Cavelos’s “Chapter 2: Aliens” has eight sections and three essays. She notes (p. 39) that “the universe according to Lucas is filled with life” – Jawas, Hutts, Ewoks, Gungans, Wookiees, etc. Section topics include “How Alien are Alien?” which deals with bacteria, mutations, and the pentadactyl (five digit) advantage; “Do Your Ears Hang Low?” concerning eye mobility, heat dissipation, and flexible necks; and “The Dawn of Wookiee,” in which bi- and quadrupedalism are assessed and questions raised about why Wookiees lived originally in trees. “Slugfest” characterizes Jabba (Hutts are slugs) and the predator Space Slug (but what would it eat ordinarily?); “When Teddy Bears have their Picnic” reviews the physiology and behavior of koalas, chimpanzees, and Ewoks; and “Did You Leave Your Headlights On?” in which Jawas and Sand People, optics, photoreceptors, and bioluminescence are evaluated. Alas, one significant point – it is highly unlikely for aliens from different planets to survive in a single environment, such as the Mos Eisley cantina (p. 63). Being a slug, Jabba supposedly travels using wavelike motion on a coating of secreted slime, but in the enhanced 1997 version of Episode IV, Jabba moves with ease in the xerophytic environment of Tatooine – he should be desiccating. Also, as another unexplored topic – I believe that there may be some parallel to the Third Stage Guild Navigators of *Dune* and the Hutts.

Chapter “3: Droids” is comprised of eight topics and two essays. “Wheels or Legs?” assesses the relationships of body shape, coordination, and locomotion; while “I, Droid” delves into subjects including neural networks, rule-based versus case-based systems of intelligence, and memory wipes. Other sections, such as “Do You Hear What I Hear” assesses the concept of speaking with intelligence, will, understanding, and emotions, as well as pronunciation and accents; and “Do Droids Dream of Electric Sheep?” explicates the role of the brain in decision making and personality development. In addition, “I’m Okay, You’re an Overweight Glob of Grease” reflects assessments of neurochemistry, emotions, instinct,

logic, and holography; and “I Whine, Therefore I Am” concerns conveying emotions – with Furbys and Tamagotchi entering into this discussion. “The Six-Million Dollar Sith” enters the world of prosthetic limbs, amputations, industrial accidents, airway-lung damage in burn cases, and voice augmentation devices (like the one used by the actor Christopher Reeve). An entire section reveals “Why Han and Threepio Will Never be Friends.” Age, sex, culture, education, and situations that affect learning and emotion are some of the factors considered. Cavelos also raises an interesting but unresolved proposition (p. 108): “can and should we create a robot that feels pride, fear, frustration, and affection?” A world inhabited by C-3POs...? Or R2-D2s? A very useful discussion about Verbmobile software left this reviewer wanting references or citations to pertinent literature. One delightful essay considers the efficacy of “All-Terrain Armored Transports” (ATATs). This is a very fine essay but there is much more on robotics that might be incorporated into the discussion.

In “Chapter 4: Spaceships and Weapons,” with ten topics and three essays, Cavelos moves to another area of future technology. The velocity of light, the laws and principles of Newton and Einstein, fuels requirements (chemical fuels vs. nuclear fusion), matter and antimatter, hyperspace and wormholes (the latter suggested initially by Einstein) are topics elaborated in sections entitled “When ‘Faster than A Speeding Bullet’ Just Isn’t Fast Enough” and “When You Came in Here, Didn’t You have a Plan for Getting Out?” Citing Marc Millis, Cavelos (p. 142) likens a black hole to falling down a well where there is a definite bottom, while a wormhole, although transient, is more like a tunnel - these are very appropriate analogies. However, there is no mention the wormhole on *Star Trek: Deep Space 9* or of the ability to “fold space” as Third Stage Guild Navigators are able to do in guiding spacecraft from planet to planet in Frank Herbert’s *Dune*. “Getting Something for Nothing” concerns concepts from quantum physics, inertia, and gravity; “The Music of the Spheres” reviews superstring theory (pp. 155-158), a new view of particle theory, and a multidimensional universe (ten dimensions); “Which Way is Up?” and “Which Way is Down?” reveal principles about gravity, artificial gravity, and antigravity craft (such as Jabba’s Sail Barge). Cavelos offers at least six explanations in the section titled “Han’s Boast” (e.g., the error that he “made the Kessel Run in less than 12 parsecs”) - parsecs are measurement of distance, in this instance, 228 billion miles -which is like saying “I ran the 100 yard dash in 100 yards.” “When in Doubt, Blast!” and “Light-

ning Bolt on a Stick” assess weaponry, laser technology, the inability to focus six laser beams (too bad then for the efficacy of the Death Star’s weapon), lasers that stun (Leia as an example early in Episode IV), the probability and improbability of plasma weapons, and the inability to control light saber beam length. Current laser efficiencies (1 to 30 percent) and heat dissipation are also discussed. There are some interesting parallels to a book by physicist Lawrence M. Krauss, *The Physics of Star Trek* (New York: Basic, 1995), but Cavelos has a unique and informative writing style.

The final and longest part, “Chapter 5: The Force” has ten sections and seven essays, and obviously holds great interest for Cavelos herself. She documents elements (the Greek earth, fire, air, water, and ether = force?), concepts of zero-point energy, neutrinos, precognition, tachyons, and five types of forces (strong nuclear, weak nuclear, electromagnetic, and gravity, plus “The Force”). She reviews the interesting proposition that “The Force” is similar to vacuum energy as Michio Kaku postulates. Telekinesis, the EPR paradox, control and consciousness, hypnotherapy, parapsychology, telepathic communication, clairvoyance, remote viewing, and psychokinesis are among the other major topics considered. “May the Force Be with You,” “Where Jedi Fear to Tread,” “Zen and the Art of Nerf Herding,” “Peeping Jedi,” and “A Jedi Pick-me-up” are some of the section titles. Eight views by various scientists are presented in the essay “Could a Scientist be a Jedi?” - the answer is a qualified “yes.” Other essays are titled “Are You Online with the Force” concerns mind control and levitation, and “Invaders from the Fourth Dimension” reflects upon superstring theory.

Readers interested in alien biology, artificial intelligence, and computer languages may wish to consult a number of volumes that deal with some of the same scientific phenomena - such as alien life forms - in the world of *Star Trek*. These volumes include Athena Andreadis’s *To Seek Out New Life: The Biology of Star Trek* (New York: Crown, 1998), Susan and Robert Jenkins’s *Life Signs: The Biology of Star Trek* (New York: Harper-Collins, 1998), and Robert Sekuler and Randolph Blake’s *Star Trek on the Brain: Alien Minds, Human Minds* (New York: Freeman, 1998). Likewise, Richard Hanley’s *The Metaphysics of Star Trek* (New York: Basic, 1997) makes an interesting comparison, as does a book reviewed earlier this year on H-PCAACA, Jon Wagner and Jan Lundeen’s *Deep Space and Sacred Time: Star Trek in the American Mythos* (Westport, Conn. and London: Praeger, 1998). H-NET Review HYPERLINK <http://www.n-net.msu.edu/reviews/showrev.cgi?~path=9650922720720>

In conclusion, the narrative sections and sidebar essays in Cavelos's *The Science of Star Wars* range widely, mentioning many scientific concepts, science fiction topics, and *Star Wars* characters. Among these are gravitons, mucous secretions, wormholes, and the Heisenberg Principle, Namib ground squirrels, the Furby Autopsy Web Page, the Energizer bunny, Greedo, the Sarlaac, and (yes) Jar Jar Binks. Specific references in Cavelos's narrative to the individual *Star Wars* motion pictures are fewer than one might assume: Episode I: *The Phantom Menace* (4 references); Episode IV: *A New Hope* (22); Episode V: *The Empire Strikes Back* (10); and Episode VI: *Return of the Jedi* (4). In addition, specific entries listed in the *Encyclopedia* (1998) are mentioned 11 times.

Your reviewer was intrigued particularly by Cavelos's reference (p. 146) to Michio Kaku's book, *Hyperspace* (New York: Oxford University Press, 1994), in which the concept of a Russian astronomer, Nikolai Kardishev, elaborate Types 0, I, II, and II civilizations; I wanted further references. A Type I civilization is planetary; it controls the forces on its planet, manipulates the weather, gains energy, and has colonies on other planets within the solar system. Type II civilization is stellar; solar flares are its energy source, and it has begun to colonize neighboring solar systems. A Type II civilization is galactic; it employs the power of billions of stars, blackholes, and supernovae, and can manipulate space-time. Needless to say, the civilizations of the Empire and the Republic in *Star Wars* equal Type III. Earth, presently, has reached the level of a Type 0 civilization. We have a long way to go, but George Lucas and others have suggested some possibilities.

When *Star Wars* (Episode VI) premiered in 1977, it – and its sequels – became a significant part of American mythos and popular culture, witness the popularity of artifacts, memorabilia, videotapes, serialized novels, fan clubs, web sites, and the fifteen-month exhibition at the National Air and Space Museum of the Smithsonian Institution in Washington, DC. The exhibition “*Star Wars: The Magic of Myth*” was viewed by nearly one million visitors. For a discussion of the exhibit and its concept, see Mary Henderson's *Star Wars: The Magic of Myth* (New York: Bantam, 1997).

In the last half of the twentieth century both *Star Wars* and *Star Trek* have become a significant part of American culture, mythos, popular science, and science

fiction. Indeed, both phenomena can claim to have had an impact on the teaching of science and in attracting young persons to scientific endeavors. Another current example is “Learn Science at the Movies!” – the title of a popular article by David H. Levy that appeared in the national Sunday supplement, *Parade Magazine* (July 18, 1999, pp. 12-13). 2001: *A Space Odyssey* (1968), *Tron* (1982), *WarGames* (1983), *Contact* (1997), *Deep Impact* (1998), and – of course – *Star Trek* and *Star Wars* Episode I are featured. Warp drive, wormhole transit, transporters, communicators, and the like may seem “futuristic” or scientifically implausible, but then again so were Dick Tracy's “Wrist TV” or sending human beings to Earth's Moon. Cavelos cites Steve Grand, Director of the Cyber-life Institute, (p. 234): “I never try to let scientific implausibility get in the way of a good story!”

In sum, Jeanne Cavelos has, indeed, in her independent examination of “science” as used and misused in *Star Wars*, given us a good story and has transported the reader from science fiction to science fact and probability, bringing to our attention, for example, the interrelationships of the principles of quantum physics and the propulsion and armaments of the Millennium Falcon. There is a great deal of scientific material presented in an upbeat, non-trivialized, well-written and engaging style. One does not have to have a scientific background to understand the aspects of science she presents because the information is conveyed with the expertise of an accomplished teacher and editor. I know of no other science writer who has attempted to assemble and explicate so many diverse scientific realms – including astronomy, biology, computer science, cosmology, ecology, geology, physics, psychology, and zoology, among others. Most authors confine their writing to biology or to physics, or to psychology – Cavelos integrates these, and others, exceedingly well. While *Star Wars* is mythological, as Mary Henderson (1997) notes, Cavelos demonstrates how George Lucas and his colleagues as have infused the latest science fact into science fiction and how science is catching up with Lucas. This delightful volume is appropriate reading for seasoned and young scientists, *Star Wars* and other science fiction fans, and the general public.

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