

Terraforming in popular culture

Terraforming is well-represented in popular culture, usually in the form of science fiction.^[1] Author Jack Williamson is credited with inventing and popularizing the term "terraform". In July 1942, under the pseudonym Will Stewart, Williamson published a science fiction novella entitled "Collision Orbit" in *Astounding Science-Fiction* magazine. The series was later published as two novels, *Seetee Shock* (1949) and *Seetee Ship* (1951).^[2] American geographer Richard Cathcart successfully lobbied for formal recognition of the verb "to terraform", and it was first included in the fourth edition of the Shorter Oxford English Dictionary in 1993.^[3]

Literature

Date	Title	Author	Planet/Moon	Notes
1910	«La Journée d'un Parisien au XXI ^e siècle» ("A Day of a Parisian in the 21st Century") ^[4]	Octave Béliard	Moon	The Moon is gradually given an atmosphere, and vegetation is acclimated in order to turn the Earth's satellite into a natural reserve or sanctuary for endangered species, but also to allow human colonization.
1927	<i>The Last Judgment</i>	J. B. S. Haldane	Venus	An essay that proposes how life on Earth might end and speculates on the evolution of humanity, space exploration and colonization, and adaptation to new environments. Venus is proposed as a new home. ^[5]
1930	<i>Last and First Men</i>	Olaf Stapledon	Venus	Following up where Haldane left off, Stapledon's future history provides the first example in fiction in which Venus is modified, after a long and destructive war with the original inhabitants. ^[6] Early fictional accounts of the process are frequently handicapped by the inaccurate contemporary knowledge of the actual conditions, as in Stapledon's example, which has Venus covered in oceans.
1950	<i>Farmer in the Sky</i>	Robert A. Heinlein	Ganymede	A family emigrates from Earth to the Jovian moon Ganymede, which is being terraformed. <i>Farmer in the Sky</i> is a historically significant novel in relation to terraforming in popular culture, as it was one of the first to take the subject more seriously than simple fantasy, portraying terraforming with scientific and mathematical considerations. ^[7]
1951	<i>The Sands of Mars</i>	Arthur C. Clarke	Mars	First instance of Martian terraforming. However, Clarke uses questionable methods for terraforming the planet, such as generating heat by igniting Phobos into a second sun, and growing plants that break down the Martian sands in order to release oxygen. ^[8]
1952	<i>The Martian Way</i>	Isaac Asimov	Mars	Terraforming of Mars using ice from Saturn's rings. ^[9]
1954	<i>The Big Rain</i>	Poul Anderson	Venus	Terraforming Venus. Anderson considers the great time scale inherent in planetary engineering and its effects upon society. Later, the title ("big rain") became associated with scientific terraforming models. ^[8]
1958	<i>The Snows of Ganymede</i>	Poul Anderson	Ganymede	Terraforming of Ganymede ^[9]
1969	<i>Isle of the Dead</i>	Roger Zelazny	Illyria	Francis Sandow is the last surviving human born in the 20th century who becomes a "worldscaper" - a terraformer with godlike powers. ^[9]
1984	<i>Greening of Mars</i>	James Lovelock Michael Allaby	Mars	One of the most influential science fiction novels on the actual science of terraforming. The novel explores the formation and evolution of planets, the origin of life, and Earth's biosphere. Spacecraft are illustrated in a realistic manner, and terraforming models in the book foreshadowed future debates regarding the goals of terraforming. ^[10]

1986-1988	<i>Venus of Dreams</i> <i>Venus of Shadows</i>	Pamela Sargent	Venus	Terraforming of Venus. ^[9]
1992	<i>Mining the Oort</i>	Frederik Pohl	Mars	Terraforming by diverting comets from the Oort cloud to Mars
1992-1999	<i>Mars Trilogy</i>	Kim Stanley Robinson	Mars	Three novels (plus one collection of short stories) provide a lengthy description of terraforming Mars spanning centuries. The novels represent contemporary scientific and philosophical developments in the field. ^[8]

Terraforming of fictional planets in literature

- H. G. Wells alludes to what today might be called *xeno-terraforming* - alien life altering Earth for their own benefit - in his 1898 novel *The War of the Worlds*. When the Martians arrive they bring with them a red weed that spreads and (temporarily) overpowers terrestrial vegetation.
- Terraforming is one of the basic concepts around which Frank Herbert's Dune novels are based: the Fremen's obsession with converting the desert-world Arrakis to earthlike conditions supplies the fugitive Paul Atreides with a ready-made army of followers (In later books, the focus shifts to those trying to "arrakisform" earthlike planets to support the giant sandworms and produce their desired 'spice' secretion). The Imperium's capital world Kaitain has all its weather controlled by satellites. Pardot Kynes, the Planetary Ecologist from Arrakis visited the world, and commented that the nature of the control meant it would eventually bring about disaster, which is why Arrakis should be terraformed through more natural processes.
- Liz Williams' novel *The Ghost Sister* offers a critique of terraforming. The ruling elite of Irie St Syre, the Gaian priestesses, believe that humanity has a right to adapt the climate and biosphere of planets to its own needs. They send out emissaries to a lost colony, Monde d'Isle, who have adapted humanity to their planet, not the other way around.
- Roger MacBride Allen's novel *The Depths of Time* features a fictional planet, Solace, on which terraforming is failing and bringing about climatic and ecological collapse.
- Laura J. Mixon's novel *Burning the Ice* is set on an imagined frozen moon of 47 Ursae Majoris b which is being terraformed by induced global warming.
- Chris Moriarty's novel *Spin Control* features a fictional planet, Novalis, on which terraforming is progressing in a speed and direction which defy scientific theory.
- *Building Harlequin's Moon*, by Larry Niven and Brenda Cooper, shows the creation of a substantial moon by smashing several smaller moons together, and the very lengthy process of terraforming it over 60,000 years.

Television and film

Date	Title	Country	Notes	IMDB
1982	<i>Star Trek II: The Wrath of Khan</i>	USA	<i>Project Genesis</i> , a device for rapidly terraforming worlds to make them suitable for settlement and food production is introduced. At the end of the film, a Genesis Device is detonated in the Mutara nebula. This results in the creation of a main sequence star and a habitable planet known as the Genesis Planet.	[11]
1984	<i>Star Trek III: The Search for Spock</i>	USA	Spock's body has been resurrected by the terraforming device on the Genesis Planet, created at the end of <i>Star Trek II: The Wrath of Khan</i> . Due to unstable "proto-matter" used in the terraforming process, the planet's evolution is accelerated, leading to the eventual premature destruction of the Genesis Planet. The nine-disc <i>Star Trek: The Motion Picture Collection</i> contains a director's cut of <i>Star Trek III</i> which has an extra featurette on the "real-science applications of terraforming". ^[12]	[13]

1986	<i>Aliens</i>	USA	LV-426, the planetoid from <i>Alien</i> where Ellen Ripley's crew first encountered the alien eggs, is now home to a terraforming colony.	[14]
1988	<i>Star Trek: The Next Generation: Home Soil</i>	USA	USS Enterprise is instructed by the Federation to check on the terraforming colony on Velara III. However, the "lifeless" planet already has an inorganic, yet intelligent alien life living below the surface.	[15]
1990	<i>Total Recall</i>	USA	Aliens have built a terraforming device on Mars, which when turned on, fills the atmosphere with oxygen, allowing humans to live on the surface. ^[9] <i>Total Recall</i> was one of the first films to portray terraforming on Mars, however it was criticized for its scientific inaccuracy. ^[16]	[17]
1990	<i>The Arrival (film)</i>	USA	Aliens have built multiple terraforming facilities on Earth, disguised as power plants, causing global warming by pumping greenhouse gases into the atmosphere. They plan to alter the Earth to match their own ecological needs.	[18]
1993	<i>Star Trek: Deep Space Nine: "Second Sight"</i>	USA	Richard Kiley plays a terraformer who has successfully terraformed several planets.	[19]
1995	<i>Star Trek: Deep Space Nine: "Past Tense"</i>	USA	Venus is mentioned as currently being terraformed.	[19]
2000	<i>Red Planet</i>	USA, Australia	After humanity faces heavy overpopulation and pollution on Earth, uncrewed space probes loaded with algae are sent to Mars with the aim of terraforming and creating a breathable atmosphere.	[20]
2000	<i>Stargate SG-1: Scorched Earth</i>	USA, Canada	Episode centers around an attempt by an extinct alien culture to repopulate an already inhabited planet using terraforming techniques.	[21]
2002–03 and 2005	<i>Firefly (TV series) and film sequel Serenity</i>	various	The original planet Earth (known in the series as "Earth-That-Was") "got used up," forcing most or all of humanity to find a new star system. In the new system, they terraformed - and apparently are still terraforming - many planets and moons. Each one has been terraformed with varying degrees of success; the inner planets boast a lush climate while the outer edges of the large solar system are populated by desolate, dry moons reminiscent of the Wild West, or can be, as in the case of St. Alban's (featured in the episode <i>The Message</i>), bitterly cold. The movie goes one step further by actually showing what terraforming might look like, as well as stating that the process took decades. The series takes place in the early 26th century. Possibly of note is a mention in an early <i>Firefly</i> episode (" <i>The Train Job</i> ") of "each [terraformed moon or planet] ha[ving] its... quirks," including environmentally-triggered diseases such as Bodin's Malady.	[22]
1998-1999	<i>Cowboy Bebop</i>	Japan, USA, Canada, Europe, United Kingdom	Many episodes take place on numerous terraformed worlds including Venus, Mars, Ganymede, Io, Callisto, and Titan. While terraforming is ubiquitous, it is depicted as having varying scales, effects, and degrees of success on a case by case basis, sometimes spectacularly so in the case of Ganymede and Venus.	[23]
2006	<i>Origin: Spirits of the Past</i>	Japan	<i>Origin: Spirits of the Past</i> is the story of Agito, a young boy living in a dystopian Japan set 300 years in the future. This apocalypse was brought about by extensive genetic engineering on trees, conducted at a research facility on Earth's moon, in order to produce trees capable of growing in harsh, arid conditions. The trees became conscious and spread to Earth in a fiery holocaust, wiping out most of modern civilization and fragmenting the moon.	[24]

2007	<i>Battle for Terra</i>	USA	The human colonists deploy a massive spider-like terraformer, which converts the existing atmosphere, which is poisonous to humans, into a nitrogen-oxygen mix similar to Earth's. The (apparently) only existing device is capable of converting the entire atmosphere of an Earth-like planet. The gas conversion technology also exists on smaller scales, seen inside the Ark (the colony ship).	[25]
2009	<i>Doctor Who: The Doctor's Daughter</i>	United Kingdom	The TARDIS takes The Doctor, Donna and Martha to the planet Messaline where a generations-old war between humans and Hath rages on. The Hath and humans were initially meant to live in a peaceful colony, but were divided over a dispute about "the Source" (a terraforming device), which both sides believe to be theirs.	[26]

Games

Deforming terrain, as used in such games as *Perimeter* and *Red Faction*, is occasionally known as terraforming but is not related to planetary engineering.

As a game mechanic

Date	Title	Genre	Notes
1990	<i>SimEarth: The Living Planet</i>	Life simulation	Management of Earth under a Gaia hypothesis model. In full game mode, no win condition and a time frame from planetary formation to the point where the Sun becomes a red giant; in some versions, beyond that. Several more limited scenarios, such as terraforming Mars or Venus, or Daisyworld.
1990-2003	<i>Spaceward Ho!</i>	Spacebound 4X	Ultra-streamlined galactic conquest. The profit limits of each world are measured in gravity (constant) and temperature (improves with investment, "terraforming.")
1992	<i>SimLife: The Genetic Playground</i>	Life simulation	Control over genetics and evolution, with the ultimate goal of fashioning a self-sustaining ecosystem.
1992	<i>Dune</i>	Strategy/adventure	Wide-scale experiments in introducing vegetation to the desert world Arrakis amidst a struggle for it.
1993	<i>Master of Orion</i>	Spacebound 4X	Abstract terraforming as the cornerstone of a competible space empire. Investment can multiply a planet's population limit and therefore its output. Greater increases are researched through most of the game, and being absolute (e.g. +60, not +60% to a size 30 planet), they make all worlds desirable. Bonuses for installing and enhancing biospheres.
1994	<i>Outpost</i>	Construction and management simulation	Terraforming facilities as an optional late-stage extra in constructing a colony on an alien planet.
1996	<i>Master of Orion II: Battle at Antares</i>	Spacebound 4X	Terraforming works indirectly by shifting a planet's classification towards Earth-like. A highly developed empire may become a lush garden as a side effect. Increased micromanagement scatters planet enhancements into <i>Civilization</i> -style installations.
1999	<i>Sid Meier's Alpha Centauri</i>	4X	Clearing native fungus and building infrastructure as part of colonizing an alien planet. Native life can be treated as allies or as enemies. Regional landscaping: planting forests, constructing canals or isthmuses or adjusting mountains. Making the atmosphere breathable was considered ^[27] , but not implemented.
2000	<i>SimMars</i>	Strategy	A cancelled game of Mars exploration, colonization and terraforming. A trailer was bundled with <i>SimCity 3000</i> .
2002	<i>Haegemonia: Legions of Iron</i>	Real-time strategy	In the game, there are 3 major races: Humans, Kariaks and Darzoks. Each race will terraform planets differently to promote growth and productivity. Humans prefer conditions like those of Earth (ocean, forest, Gaian), Kariaks prefer harsh conditions (rocky, acidic, Arctic), and Darzoks prefer absolutely barren planets.

2002	<i>OGame</i>	Real-time text-based MMO	Terraformer can be built and upgraded to increase usable surface on planets. Requires increasing amounts of resources. Ingame description tells that the terraformation process is done by using nanomachines.
2003	<i>Master of Orion III</i>	Spacebound 4X	Redesigned terraforming with more details than in the previous installments. Tracking planetary fertility by region rather than identifying each planet by one dominant biome.
2007	<i>UFO: Afterlight</i>	Real-time tactics	Resource management and squad-level combat on Mars. The construction of terraforming stations makes harsher areas of the planet traversable. <i>En masse</i> they create green plains and oceans in the cheerfully unscientific span of a year.
2008	<i>Spore</i>	Multiple	Terraforming (or unterraforming) planets ^[28] in a matter of seconds in the spacebound sandbox phase. A handful of tools to affect heat and humidity, then introduce life. Planetary landscaping.

As a plot element

Date	Title	Genre	Notes
1989	<i>Millennium 2.2</i>	Strategy	Colonization of the Solar System with the ultimate goal of returning Earth to habitability.
1992	<i>Star Control II</i>	Multiple	The fungoid Mycon terraform geologically active worlds to their liking, shattering the crust, giving direct access to the mantle.
1995	<i>Millennia: Altered Destinies</i>	Simulation?	The invention of the terraformer usually kills its species; it must be copied, prevented and reintroduced later to a more mature society. Success marks the end of guarding sentient species against an invader and begins the more tedious task of balancing them against each other.
1995-2008	The <i>Command & Conquer</i> Tiberian series	Real-time strategy	Earth ravaged by the alien substance Tiberium, a self-replicating mineral extractor crystal that works on a planetary scale.
1997	<i>Outpost 2: Divided Destiny</i>	Real-time strategy	A failed attempt at terraforming an alien planet precipitates the game's events as inhabitants flee "the Blight" and lava flows.
1999-2008	The <i>X series</i>	Space flight simulator game	Earth has built a race of terraformer ships which have started to build colonies on uninhabited planets throughout the <i>X Universe</i> . These robotic machines then turn on their owners due to a programming error and wage a war against them, destroying the Terran colonies and attacking Earth itself. They now exist as the Xenon.
2000	<i>Armored Core 2</i>	Third-person shooter	Mars is undergoing the last stages terraformation during the events of the game. It has a breathable atmosphere, surface temperatures comparable to Earth's and a sizable ocean.
2002-2008	<i>Escape Velocity Nova</i>	Space trading and combat	Mars saw the first use of terraforming technology, becoming a ball of toxic algae sludge. Other planets have been terraformed and colonized using the now-corrected processes. An optional sidequest involves hauling terraforming equipment to a barren world that becomes more hospitable.
2004	<i>Half-Life 2</i>	First-person shooter	Earth under terraformation by the Combine Empire for new inhabitants. Examples include the draining of the oceans (evidence of a receding shoreline can be seen near the coast) and depletion of natural resources. A "Suppression Field" prevents humans from reproducing.
2006	<i>Resistance: Fall of Man</i>	First-person shooter	The "Chimera" cool the Earth for their purposes, making it snow in London in July.
2007	<i>Crysis</i>	First-person shooter	An alien ship begins forming an ice sphere around the island it has landed on, affecting weather patterns and ultimately making the Earth more habitable for them.
2008	<i>Fallout 3</i>	RPG/First-person shooter	A prototype module capable of terraforming large areas of land and creating life itself from inanimate matter, designed to be used following a nuclear war, is central to the game's storyline.

2009	<i>Red Faction: Guerrilla</i>	RPG/FPS	Mars is in the process of being terraformed to allow colonists and miners to walk the surface of the planet without any advanced protection. Light vegetation can be seen in certain parts of the game.
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Notes

- [1] Flatow 2004.
- [2] Fogg 1995, p. 16.
- [3] Fogg 1995, p. 9.
- [4] Octave Béliard, «La Journée d'un Parisien au XXI^e siècle», *Lecture pour tous*, Christmas 1910.
- [5] Fogg 1995, p. 13.
- [6] Fogg 1995, pp. 13–16.
- [7] Fogg 1995, pp. 17–19.
- [8] Fogg 1995, p. 19.
- [9] Bly 2005, p. 261.
- [10] Fogg 1995, pp. 19–22.
- [11] <http://www.imdb.com/title/tt0084726/>
- [12] Goodale 2002.
- [13] <http://www.imdb.com/title/tt0088170/>
- [14] <http://www.imdb.com/title/tt0090605/>
- [15] <http://www.imdb.com/title/tt0708730/>
- [16] Muirhead 2004, p. 228.
- [17] <http://www.imdb.com/title/tt0100802/>
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