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Orbital ruins

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Abstract

When satellites or meteorites fall back to earth they draw attention to the extraterritorial domains that extend up from the surface of the planet; through the atmosphere, stratosphere, and ionosphere, into the multiple orbital paths and out to the edges of the super-synchronous or 'parking' orbit, where satellites go to die.

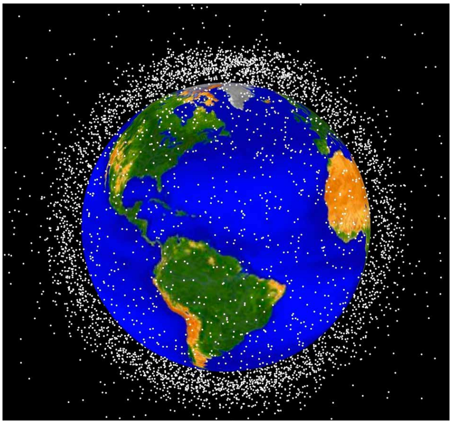
Keywords: capital, satellites, space, waste

Thousands of satellites and space objects have fallen back to earth since the space age began. In May 1968, the Nimbus B-1 weather satellite plummeted into the Pacific Ocean just off the coast of Santa Barbara. The fallen satellite was recovered, intact, from the bottom of the Santa Barbara channel, but its failure caused an enormous stir because of the four pounds of plutonium it had on board. The event prompted an investigation that moved from the depths of the ocean to the launch pad at Vandenberg Air Force base, out to orbit and back down to Earth. The fall of Nimbus B-1 in California's coastal backyard serves as a provocative reminder of the environmental risks, high costs, and unique materialities and spatialities of fallen satellites, while also connecting to more recent events such as the collision of a ten-ton meteorite into Russia's Ural region on 15 February 2013. Both human-made objects and space matter have the potential to impact life on earth.

When satellites or meteorites fall back to earth they draw attention to the extraterritorial domains that extend up from the surface of the planet; through the atmosphere, stratosphere, and ionosphere, into the multiple orbital paths and out to the edges of the super-synchronous or 'parking' orbit, where satellites go to die. While this vertical domain is conceived as a layering of spheres and flight paths, it is also a site of capital accumulation, filled with metallic hardware, synthetic materials, and toxic waste. This massive aero-orbital space trafficked by aircraft, rockets, satellites, and signals is a dynamic field of technologised objects and electromagnetic activity, as well as a giant graveyard where dead satellites float. It is a place that most of us will never visit – one that only astronauts have seen – and yet it is a place we cannot afford to overlook.

After five decades of satellite launches and space probes there are now thousands of objects in orbit. According to a 2010 report from the U.S. Space Surveillance Network and NASA's Orbital Debris Program Office, there are 15,550 satellite-related objects currently orbiting the planet.[1] These objects range in size from a massive rocket fuel tank to a tiny paint chip. Only 3,333 of them are functioning satellites,[2] while the rest are considered orbital debris. In addition to being filled up with debris, orbital space is trafficked primarily by objects deployed by the former Soviet Union (CIS), the United States, and China. Of the 15,550 satellite-related objects in orbit, 14,045 are from these three countries.[3] Most objects in orbit are leftovers from Soviet, United States, or Chinese space projects.

To draw public attention to the problem of orbital debris, NASA has released a series of visualisations over the years.[4] The 2009 graphic shown in figure 1 spotlights the heavy concentrations of debris in low-earth orbit, posing risks to satellites in the vicinity as well as to the planet's atmosphere and surface.[5] Some of these objects are projected to remain in orbit for 150 years.[6] In 2010, for the first time ever, the United States government released a Space Policy that identified curbing the growth of orbital debris and preserving the space environment as top national priorities.[7]



NASA visualisation, 2009.
Credit: NASA. Orbital Debris Program Office.

Since 1957, as the launching of thousands of satellites has generated vast scatterings of orbital debris, it has also compelled nation-states, corporations, and public interest groups to confront a variety of security, economic, and environmental concerns. State officials are concerned that large pieces of orbital debris may plummet to the planet and threaten populations, properties, or valuable resources. Satellite owners worry that orbiting debris will damage or interfere with their functioning satellites and compromise their investments. Environmentalists contend that orbital pollution could adversely impact the atmosphere as toxic materials and gases leak from old satellites. When satellites fall back to the planet, they typically incinerate as they re-enter the atmosphere, but sometimes fragments survive the extreme heat and fall to the planet's surface, as in the case of the Mir space station. In such cases, orbital debris crashes into the Earth's surface, inscribing its presence in the geological crust or underwater, and becoming both techno-trash and archaeological relic.

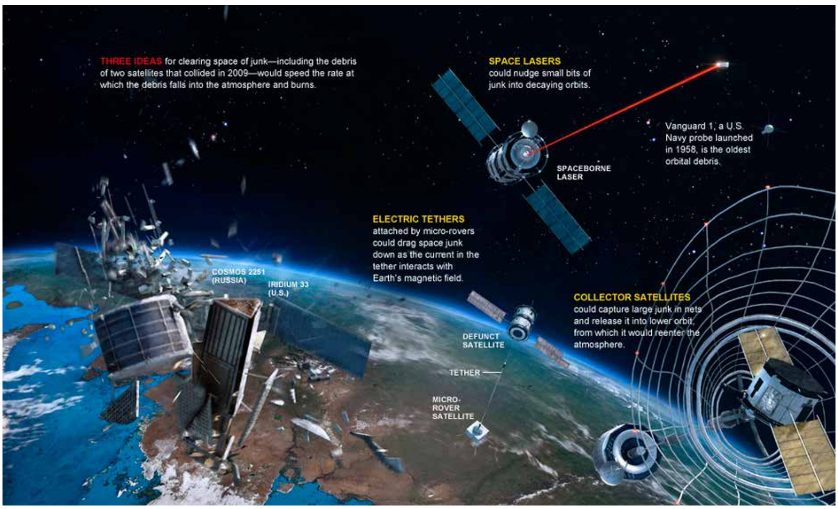
While orbital debris provokes an array of security, economic, and environmental concerns, it also can arouse new critical curiosities and ways of thinking about orbital matters. We live in an age in which extremely expensive machines are made and installed in orbit without public knowledge, only to be spectacularly blown away and become total losses before our eyes. Given such scenarios, the study of satellite failures, finances, and futures remains a vital path for scholarly investigation. As Thomas Elsaesser suggests, failure and uncertainty can generate 'productive pathologies' that 'open up to a future' and create 'a different kind of relation to the man-made, routinized, or automated surroundings … [and] also to the more "cosmic" energies….'[8] Understood in this way, failure is *productive* rather than destructive; it is something to learn from rather than to mitigate.

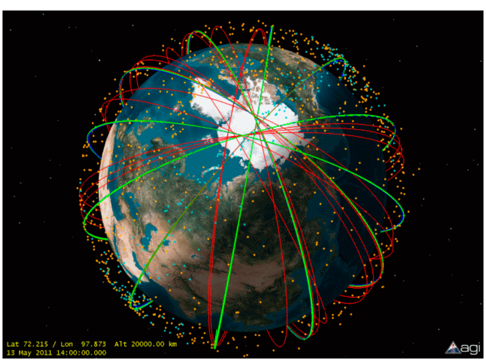
From this perspective, a spate of recent satellite failures, which instantly turned objects of value into waste, produces possibilities for rethinking relations between the technologised environs and concepts such as value, loss, responsibility, and capital. In January 2007 the NSS-8 satellite owned by Netherlands-based SES New Skies was destroyed during its lift-off from the ocean-based launch pad known as Sea Launch.[9] Later that year the JCSAT-11 satellite fell to the Earth after a Proton rocket failed to enter its second stage after launching from the Baikonur facility in Kazakhstan. In February 2009, Russia's Cosmos 2251 collided with a U.S. Iridium 33 satellite over northern Siberia while traveling at more than 15,000 mph. This was the first time that two satellites collided in orbit. The collision generated enormous debris clouds and has posed serious risk-management challenges for satellite owners, as the floating debris could impede other functioning satellites in orbit.[10] Later that month, NASA's $280 million Orbiting Carbon Observatory satellite, designed to conduct global warming tests, tumbled fatefully into the ocean near Antarctica.

The satellite industry is interwoven with one of the most complex and expensive insurance industries on the planet. For satellite operators such as Intelsat, Eutelsat, or SES, insurance premiums are typically the second largest expense. Any given satellite can have 10-15 large insurers and 20-30 smaller companies issuing policies for different phases of the satellite's development, transport, launch, in-orbit operation, and termination. In 2003 a basic premium for a satellite worth $250 million cost between $40-55 million.[11] Intelsat paid 19 companies to insure eight of its satellites for $1.5 billion in 2007. With a fleet of 52 satellites, Intelsat also 'self-insures' by manufacturing back-up satellites rather than purchasing costly policies.[12] Satellite operators also regularly maneuver or adjust the positions of orbiting satellites in order to avoid debris and mitigate damages.[13]

Satellite failures and collisions not only represent hundreds of millions of dollars in losses, they are also symptomatic of what I call the 'dandelion economics' of the satellite industry. Just as the capital to manufacture, launch, and operate a satellite accumulates and the technology takes shape, the object can be blown away in an instant, its fragments either darting cataclysmically toward the Earth's surface or floating into the oblivion of space. While a dandelion can be blown away by the force of the wind or a human breath, leading to either pollination or wish fulfillment, satellites can be obliterated in a single accidental implosion that proliferates risk and negative value. The concept of dandelion economics accounts for the instant annihilation of meticulously designed and extremely costly technologies – technologies that took years of state and commercial funding, labor, materials, and knowledge to produce. When Cosmos 2251 and Iridium 33 collided in February 2009, each of the satellites became a total loss in a flash, and their collision created enormous debris fields containing thousands of particles. The U.S. Space Surveillance Network cataloged 521 pieces of debris (23 pieces of which have already decayed from orbit) associated with Iridium 33 and 1,267 pieces of debris (50 pieces of which have decayed) associated with Cosmos 2251.[14] Both of these satellites remain in orbit, but now exist as scatterings of debris rather than as functioning satellites. Hence their value instantly shifted from that of multi-million dollar satellites to that of multi-million dollar liabilities.

Graphics experts have attempted to visualise the Cosmos/Iridium collision and the fragments that remain in orbit. An animation created by Analytic Graphics, Inc. (AGI) reveals the two satellites crashing and creating immense debris fields, represented in the figure in red. The red debris clouds move in opposite directions and disperse in low-Earth orbit where hundreds of other functioning satellites are located.[15] AGI also released a series of static visualisations. One of them illustrates the relative positions of the satellites prior to their collision as city lights on the Earth's surface, implying the proximity of the collision to populated areas on Earth. Another tries to predict debris trajectories and shows the 'new debris' as scatterings of red dots intermixed with all other 'existing space objects' shown in green, implying the high level of risk to functioning satellites.[16] T.S. Kelso, who tracked the debris of USA 193, also monitored the ruins of this collision and presented findings on his CelesTrak website.[17] Finally, a layer modeling the Cosmos 2241/Iridium 33 collision appeared in Google Earth, so that users could 'fly' through the debris fields, check the altitude of each fragment, and grasp the proximity of these satellite ruins to the surface of the planet.[18]





Such visualisations are used not only to monitor debris trajectories and prevent collisions, but also to mitigate damages and manage risks.[19] They have become the primary means by which satellite operators and insurers identify liabilities and prove damages. One satellite operator describes these 'risk-visualization tools' as being just as important as insurance.[20] In this context, these images can be understood as instrumentalising the visualisation of orbit. Their production is motivated by the need to identify, count, track, and evaluate thousands of objects of value – whether of use or risk value – so that current and future capital investments on Earth and in orbit can be protected. However, these visualisations need not be tethered so tightly to the agencies or agendas of those who generate them, and they can inform critical assessments of satellite failure.

Such images can be repurposed and used to articulate struggles and contestations over the meanings and uses of satellites and orbital space. I interpret these visualisations of satellite ruins as powerful symbols of the precariousness of capital and capitalism in orbit. They not only remind us that enormous accumulations of capital can turn into negative value in an instant – they also reveal imploded technology and investments where no one is there to witness them. In this sense they reverberate symbolically with the desert explosions in the finale of Antonioni's film *Zabriskie Point* (1970), during which capital accumulations (consumer products such as refrigerators, electronics, clothing, food, and other home commodities) beautifully implode against a smoky blue sky in an unforgettable pyrotechnic display.

Exploding capital accumulations in Zabriskie Point.

One of the most intriguing representations of the Cosmos 2251/Iridium 33 collision appeared in *National Geographic*. Artist Stefan Morrell tried to imagine and represent what the crash may have looked like up close.

Morrell's rendition shows the two satellites thrashing into one another at great speed, signaled by a blurring effect, as a dispersion of parts sprays out into orbit.[21] The visualisation is useful because it models satellite capital in ruins while simultaneously creating a position for viewing satellites as objects in close up. Morrell's orbital crash scene compels a recognition of the unique material conditions immediately surrounding the earth such as congestion, speed, heavy metals, pollution, and risk.

Such scenes of orbital ruins evoke the economic concept of 'creative destruction', as they stage instances of wealth accumulation and annihilation under capitalism.[22] Within this concept, waste is conceived as an essential byproduct of technological innovation as well as a dimension of planned obsolescence. Not only are products innovated with their own termination in mind, but their unexpected failure is always accounted for and can become part of the value chain. As David Harvey observes:

> [t]he effect of continuous innovation is to devalue, if not destroy, past investments and labour skills ... Innovation exacerbates instability, insecurity, and, in the end, becomes the prime force pushing capitalism into periodic paroxysms of crisis.[23]

Satellite failure is a necessary crisis within capitalism, and even orbital ruins have value. Companies have in fact begun to capitalise upon orbital waste by designing special spacecraft that capture and decrease the velocity of debris particles so that they will not cause damage to functioning satellites.[24] Researchers at Switzerland's Ecole Polytechnic Federale Lausanne have developed a $10 million 'janitor satellite' called CleanSpace One, which would deploy a robotic arm to force debris into the re-entry zone where it would incinerate.[25] The costly new space janitor is designed to alleviate orbital congestion and mitigate the risks associated with having too much matter in orbit.

Rather than embrace the logic of creative destruction, we might turn to the work of J.K. Gibson-Graham and imagine orbital ruins as a starting point for an anti-capitalist epistemology. *The End of Capitalism* (*as we knew it*) complicates the totalising and unified ways in which 'capitalism' has been invoked in critical discourse. Gibson-Graham sets out to inscribe *difference* within the study of capitalism and catalyse the study of noncapitalist projects.[26] She suggests that such an intervention is vital to creating a world beyond capitalism. As Gibson-Graham writes, 'how do we begin to see this monolithic and homogeneous Capitalism not as our "reality" but as a fantasy of wholeness, one that operates to obscure diversity and disunity in the economy and society alike?'[27] She continues:

> [m]y intent is to help create the discursive conditions under which socialist and other noncapitalist construction becomes a 'realistic' present activity rather than a ludicrous or utopian future goal. To achieve this I must smash Capitalism and see it in a thousand pieces. I must make its unity a fantasy, visible as a denial of diversity and change.[28]

Spinning this idea in a slightly different direction, what happens to capitalism when a satellite breaks into a thousand pieces? Can this moment be used to fracture and diffract the meanings of capital and capitalism so that orbital matters are discursively broken down, differentiated, and better understood? Mediated moments of satellite failure serve as important discursive sites because they trigger questions about key terms such as *value*, *loss*, *risk*, and *responsibility*, and in doing so can provoke a reassessment of the meanings of *capital* and *capitalism* as well. Instances of satellite failure challenge us to imagine and recognise the unique materials, operations, costs, locations, scales, distances, speeds, and durations of satellites, and to create new political, economic, and cultural concepts and theories tailored to orbital conditions.

The concept of dandelion economics is a small step in this direction. It questions what it means to have a satellite (representing immense capital accumulation, as a satellite is worth more than the GNPs of many nation-states) instantly lose all value, whether by chance or by force. It recognises the lingering, dispersed, and unpredictable material effects of satellite failure or destruction. Also, it challenges us to think about the liabilities and negative value of satellite ruins and orbital debris. In so doing, it begins to inscribe an orbital layer within the discursive fields of 'capital' and 'capitalism', pushing us to consider how matters of orbit might alter critical thought.

While critical theorists regularly engage with questions of property, ownership, and value in relation to parcels on Earth, fewer have considered how the value of a satellite is calculated, how it is insured and by whom, and which orbital slots are most valuable and why. Information about real estate and property values, insurance, and traffic patterns on the surface of the planet abound, but what about the equivalents in orbit? How much does it cost to use a transponder on a satellite, and who uses them the most? After 50 years of satellite use such information should be more widely available – yet information about the business of satellites is often proprietary and costly, and is sometimes classified. Rethinking capital and capitalism in orbit involves expanding the kinds of knowledge about satellites that circulate in public, considering the agency and power of satellites as well.

Notes

1. 'Satellite Box Score', July 2010.
2. Ibid.
3. Updates of this data are published regularly in *Orbital Debris Quarterly News*, http://orbitaldebris.jsc.nasa.gov/newsletter/newsletter.html (accessed on 23 March 2011).
4. See the Orbital Debris Graphics section of the NASA Orbital Debris Program website, http://orbitaldebris.jsc.nasa.gov/photogallery/beehives.html (accessed on 23 March 2011).
5. Space.com Staff, 'Space Junk Problem Detailed', Space.com, 12 September 2009, http://www.space.com/news/090912-space-junk-images.html (accessed on 24 March 2011).
6. 'Junk Science: The Problem of Space Pollution', *The Economist*, 19 August 2010, http://www.economist.com/node/16843825 (accessed on 21September 2013).
7. 'New U.S. National Space Policy Cites Orbital Debris', July 2010.
8. Elsaesser 2009. I thank Wanda Strauven for encouraging me to make this connection.
9. Ray 2007. http://spaceflightnow.com/sealaunch/nss8/ (accessed on 24 March 2011).
10. Jones 2009. http://www.allbusiness.com/insurance/aviation-insurance-spacecraft-satellite/11870631-1.html (accessed on 24 March 2011).
11. Maleter 2003.
12. Daniel 2007. http://www.satellitetoday.com/via/features/Satellite-Insurance-Operators-Returning-To-Outside-Providers_19461.html (accessed on 24 March 2011).
13. 'Space Junk Problem Detailed', 2009.
14. Kelso 2009 (updated 28 April 2010). http://celestrak.com/events/collision/ (accessed on 24 March 2011).
15. 'Iridium 33 – Cosmos 2251 Collision', 2009. http://www.agi.com/media-center/multimedia/current-events/iridium-33-cosmos-2251-collision/ (accessed on 24 March 2011).
16. Ibid.
17. Kelso 2009.
18. 'When Two Satellites Collide, in Google Earth', 2009. http://www.barnabu.co.uk/when-two-satellites-collide-in-google-earth/ (accessed on 24 March 2011); 'Knee Deep in Satellite Debris', 2009, http://www.barnabu.co.uk/knee-deep-in-satellite-debris/ (accessed on 24 March 2011).
19. Valsecchi & Rossi & Farinella 2000, http://www.springerlink.com/content/m43u-101p2665546l/ (accessed on 24 March 2011).
20. Daniel 2007.
21. Stefan Morrell's illustration is included at the outset of Lemonick 2010, http://ngm.nationalgeographic.com/big-idea/12/space-trash (accessed on 24 March 2011).
22. Schumpeter 1975 (orig. in 1942). I thank Sandra Braman for encouraging me to consider this connection.
23. Harvey 1995, pp. 105-106.
24. Werner 2010, http://spacenews.com/civil/100809-atk-satellite-fight-space-debris.html (accessed on 24 March 2011). Thank you to James Schwoch for sharing this article with me.
25. 'Cleaning up Earth's orbit: A Swiss satellite to tackle space debris', 2012, http://actu.epfl.ch/news/cleaning-up-earth-s-orbit-a-swiss-satellite-to-tac/ (accessed on 10 June 2013).

26. Gibson-Graham 1996, pp. 1-5. Given the immense capital investments made in satellite technologies, not to mention the growth of the aerospace industries and privatisation of orbit during the past 50 years, it might seem counterintuitive to imagine satellites beyond the bounds of capitalism. Yet since the 1970s, artists, scientists, educators, and non-profit organisations have used satellites in noncapitalist ways, whether for long-distance art collaborations, environmental activism, or refugee relief efforts – and many aspire to further use and experimentation.
27. Ibid., p. 260.
28. Ibid., pp. 263-264.

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