

SPACE ECOLOGY

THE FINAL FRONTIER

OF ENVIRONMENTALISM

By Lynda Williams

First there was the “Big Ocean Theory”, which basically meant that the ocean is so big that humans could dump any amount of waste into it without environmental consequence. Of course, that theory has proven to be false as ocean ecosystems today suffer from dying coral reefs and fish populations poisoned with mercury and other pollutants. Next came the “Big Atmosphere Theory”, which assumed that we could belch out billions of tons of air pollution and carbon dioxide from our smoke stacks and tail pipes without environmental repercussions. We all know how that idea has impacted the planet: air pollution, acid rain, ozone depletion and global warming. Now we have a “Big Space Theory”, namely, that space is so big that the waste we create in it will cause no harm. That’s right folks, fifty years after Sputnik launched the space age, humans have turned space into yet another junk yard, with millions of pieces of manmade debris orbiting the Earth. The space debris problem is becoming so critical that space may become too trashed to use at all. What the world needs now, before it becomes too late, is an environmental movement in heaven: Space Ecology.



The U.S. monitors over 12,000 pieces of space debris like dead satellites, exploded rockets, nuts, bolts and other pieces of space technology, including 32 defunct nuclear reactors totaling over a ton of radioactive fuel. All of this trash competes with more than 850 active satellites in low Earth orbit. A collision with a piece of space trash the size of a grape (1cm) can seriously damage or destroy a satellite, and a collision with a larger chunk of junk can explode a satellite causing large amounts of additional debris.

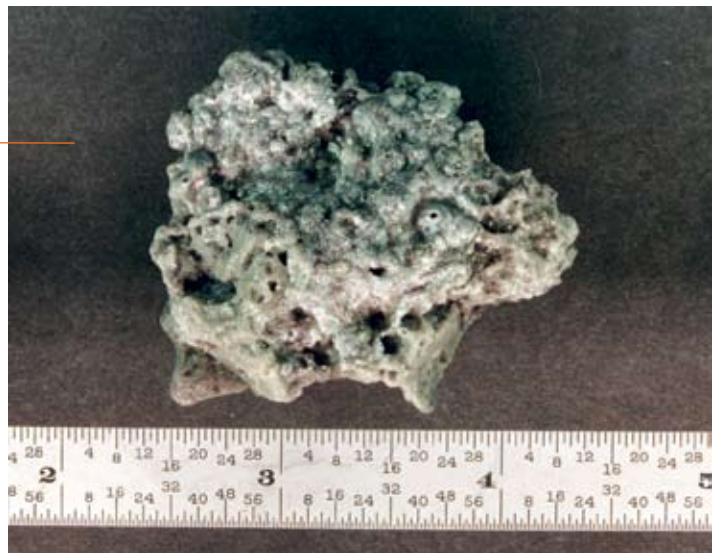
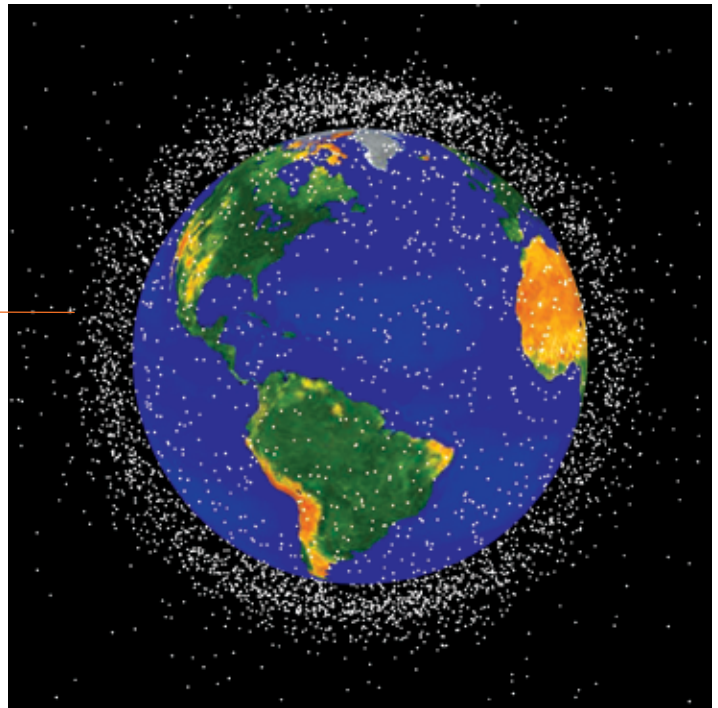
The region of space within 2000 km of Earth's surface is called "low Earth orbit" (LEO) and is the most concentrated area for space junk.

Collisions between defunct satellites and debris have been observed, and some mysterious breakups and explosions may have been due to collisions with debris too small to observe from Earth. In February of 2007, the 'Breeze-M' upper stage of a Russian Proton Rocket mysteriously exploded over Australia, littering space with more than a thousand pieces of junk. In the same month, a retired China-Brazil spacecraft mysteriously broke into dozens of pieces, possibly due to a collision with space debris.

Aluminum oxide slag is a byproduct of Solid Rocket Motors (SRMs) used to boost satellites into higher orbits and are potentially a significant source of centimeter sized orbital debris.

Traffic in space is getting so congested that satellites must be periodically nudged in their orbits by remote control from Earth in order to avoid collisions with debris. More often, however, predictions are not accurate enough for any action to be taken by satellite operators. According to John Campbell, a VP of Iridium Satellite, "We grit our teeth and hold our breath; that's our action." Even if no further space junk is put into space, the existing debris will break up in time and dangerously increase the amount of trash. A piece of space debris can have an orbital lifetime of days to hundreds of years depending on its size and altitude. There are currently no means to remove or mitigate space waste, though schemes for 'space garbage ships' are being studied. The costs for such programs are astronomical and, ultimately, would be paid for by taxpayers.

View of an orbital debris hole made in the panel of a Solar Max Satellite.





This is the main propellant tank of the second stage of a Delta 2 launch vehicle, which fell from space and landed near Georgetown, TX, on 22 January 1997.

There are hazardous risks on the ground from satellites and space debris that re-enter the atmosphere and do not burn up completely during re-entry and land on Earth. Some satellites may be navigated into a safe landing in an 'uninhabited' region of an ocean but most often the satellite randomly re-enters the atmosphere and it very difficult to predict where it will hit Earth. In March of 2007 pieces of space junk from a Russian satellite coming out of orbit narrowly missed hitting a jetliner over the Pacific Ocean. In 1978 the Soviet satellite Cosmos 954 disintegrated over Canada, scattering across a vast area thousands of radioactive pieces of radioactive debris. Although nobody has yet been killed by falling space debris, as the number of intended re-entry events and accidents increase, so will the risk. "Of course," says Ken Hodgkins, of the office of Space and Advanced Technology at the U.S. State Department, "the probability of real damage being caused is low, but if something does happen, the consequences could be catastrophic for everybody."



On 21 January 2001 a Delta 2 third stage reentered the atmosphere over the Middle East. The titanium motor casing, weighing about 70 kg, landed in Saudi Arabia about 240 km from the capital of Riyadh.

If the prospect of the sky literally falling on our heads isn't bad enough, people on the ground are already paying for the legacy of our space age with their health from the launching of rockets. Ammonium perchlorate, a toxic ingredient of solid rocket propellant that disrupts thyroid hormone function and can affect the brain development of fetuses, is increasingly discovered in soil and water throughout the U.S. In September of 2007, a Russian Proton Rocket exploded two minutes after takeoff, showering central Kazakhstan with debris and toxic heptyl rocket fuel, which can kill if, digested, rendering thousands of acres of farmland useless for agriculture. The village of Ploskoye, in Siberia, is also under the flight path of Russian launch vehicles. When the first stage of the rockets separates, a large amount of unused rocket fuel explodes and rains down on the village. Ploskoye and its neighbors report cancer rates 15 times higher than the national average.

The greatest threat to the space environment is the testing and deployment of missile defense and anti-satellite (ASAT) weapons. In January of 2007, China launched a ground-based missile into space and blew up one of its defunct weather satellites, producing over 2,000 pieces of debris larger than 5 cm, thereby increasing the total amount of space trash in low Earth orbit by 20% in the worst space debris incident ever. The single explosion increased the risk of debris collision by over 15%. Currently, there are no international laws restricting the testing of ground based anti-satellite systems. Anyone can blow up their own satellite in space without any legal consequence.

Some progress towards regulating space debris is being made both in national and international arenas. The FAA and FCC require that licensees demonstrate plans for space debris mitigation and end-of-life disposal of satellites. For Low Earth Orbit (LEO) satellites, this entails moving the satellite to a lower altitude where it will eventually re-enter the earth's atmosphere and be destroyed either by burning up or crashing to Earth

within 25 years of deactivation. Satellites in high Earth orbit are moved to higher orbits where they can remain for hundreds and thousands of years. Space ecology at this time consists of nothing more than having what goes up come crashing down or, alternatively, leaving it up indefinitely, orbiting the Earth, until we can figure out how to clean it up.

Recently the general assembly of the United Nations adopted guidelines on space debris mitigation from the UN Committee on the Peaceful Uses of Outer Space (COPUOS), which are largely based on U.S. policy, although they are non-binding and unenforceable. Hence, China has suffered no legal ramifications from trashing space with its ASAT test, and the political fallout from the test has been less than severe. Interestingly, the NY Times reported that the Bush Administration knew about the test before hand but didn't take any actions to negotiate with China to stop it.

The problem of space debris promises to get worse in the future unless international action is taken. Worldwide, between fifty and a hundred new satellites are launched every year. Missions to the moon and beyond by the U.S., Russia, and China promise to increase space traffic and trash. The booming space tourism industry will increase the number of launches and amount of space litter. Missile defense, anti-satellite testing and a looming weapons race in pose the greatest threat to permanently trashing space. Indeed, detonating a nuclear weapon in low earth orbit could destroy most of the satellites there, in addition to producing more space trash by breaking large, manageable chunks of debris into millions of small pieces, which could render space unusable. Ironically, if space does become sufficiently trashed, the reflection of sunlight by the junk could possibly have a net cooling effect on the Earth and solve the global warming problem.

At this moment in time, the "Big Space Theory" works. But like the "Big Ocean" and "Big Atmosphere" theories that came before it, it is doomed to fail us as we continue to exploit and trash the space environment. In order to prevent an ecological disaster in space, international treaties must be strengthened so that they manage space debris and prohibit anti-satellite weapons on the ground or in space. A weapons race or war in space would destroy the space environment. Over the past decade, many countries, including the U.S., have thwarted efforts to begin negotiations to ban a weapons race in space. According to David Wright, co-director of the Global Security Program at the Union of Concerned Scientists, "the U.S. should be promoting negotiations to protect our future in space as well as security on Earth." It is time for all the passengers on space ship Earth to embrace an ethic of space ecology, now, before space becomes too trashed for us to reach the final frontier of our dreams. ■



Columbia main engine powerhead recovered from Fort Polk in Louisiana.



Trash from The International Space Station (ISS) was stuffed into this old Russian spacesuit and tossed into space.

- All Photos Courtesy of NASA -

For more information on space debris and space ecology, check out:

NASA Orbital Debris Program Office: <http://orbitaldebris.jsc.nasa.gov/>

Lynda's Space Ecology Website:

<http://www.space-ecology.com>