

Chapter 3

***Space Junk***



# Article Summaries

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## I. THE PROBLEM OF SPACE JUNK

**Schmid, Randolph, "No Way to Dispose of Junk in Space," *Toronto Star*, January 20, 2006, p. A18.**

The problem of space junk is already a serious one. NASA scientists say it is expected to get worse with each passing year. Thousands of pieces of space junk are currently orbiting our planet, and experts say there currently is no effective, economical way to clean them all up.

Even if no more items are launched into space, the problem of space junk will continue to worsen. That is because all of the pieces of debris that are already in orbit will continue to collide with other pieces, breaking into more pieces. Much of the existing junk collection has come from explosions of satellites. By 2004, Russia had become the largest contributor of space junk and the United States was the second largest. Additional sources of space junk include China, France, India, and Japan.

-----, **"Space is Running Out in Space," *New Scientist*, February 25, 2006, p. 27.**

Space is becoming more and more crowded today. As a result, the risk of collisions between spacecraft, satellites, and space junk continues to increase. To minimize that risk and keep everything flowing properly in space, experts maintain that some sort of outer space equivalent to air-traffic control is required. At the same time, they suspect that it will take a major collision or two before spacefaring countries around the world will begin to actively address this potentially hazardous state of affairs.

-----, **"9000," *Ecologist*, April 2006, p. 8.**

As of April 2006, there were approximately 9,000 pieces of space junk floating around in space. The pieces of space junk that are four inches long or longer, once combined, weigh approximately 5,500 tons. According to scientists, we currently lack the technical means to clean up all of these items. As a result, they currently continue to orbit our planet.

**Sorenson, Dan, “Interest Rising as Sun Cycle Quickens,” *Arizona Daily Star*, September 25, 2006, online edition.**

Space junk comes from various sources. One of the lesser-known sources is solar-activity flare-ups, which typically occur during the middle of eleven-year cycles. In addition to filling the nighttime skies with eye-catching lightshows, such flare-ups occasionally turn functional communication satellites into defunct space junk that continues to orbit the Earth. That means the potential costs and risks associated with solar-activity flare-ups continue to increase. As a result, the ability of the flare-ups to damage satellites and compound the problem of space junk is leading to renewed government and corporate interest in predicting solar activity.

**Washburn, Mark, “What Was That Light in the Sky?” *The Charlotte Observer*, January 26, 2007, online edition.**

Every now and again, people witness colorful, eye-catching items flashing across the night sky but have no idea what they are. On Wednesday evening, a “bright blue-green ball with a white tail” that resembled a flare was spotted in the Southern sky. Some witnesses thought it was Venus. Others suspected it was a stricken plane. Still others assumed it was space junk. It appears that they were all wrong. According to an astronomy professor at Appalachian State University, it was most likely a fireball.

The professor and other experts are confident that it was not space junk because the North American Aerospace Defense Command (NORAD) in Colorado tracks individual pieces of space junk, including lost screwdrivers and astronaut gloves. On the evening in question, NORAD says there were no re-entries of sizable manmade objects into the Earth’s atmosphere.

**Guetersloh, M. K., “Suspected Meteorite Hits Bloomington Home,” *The Pantagraph*, March 5, 2007, online edition.**

A chunk of metal came crashing through the bedroom window of David and Dee Riddle’s home in Bloomington, Illinois. According to the preliminary analysis conducted by a group of geology professors from Illinois State University, the falling item was either a meteorite or a piece of space junk.

The dense, gray metal-based object from space is approximately the same size and shape as a regular deck of playing cards. Given the steep angle and speed with which it entered the Riddle’s house, the geologists are certain that it could not simply have been thrown through the couple’s window. Whatever it ultimately turns out to be, this incident serves as a reminder that items falling from space are likely to become more common in the years to come as the problem of space junk continues to intensify.

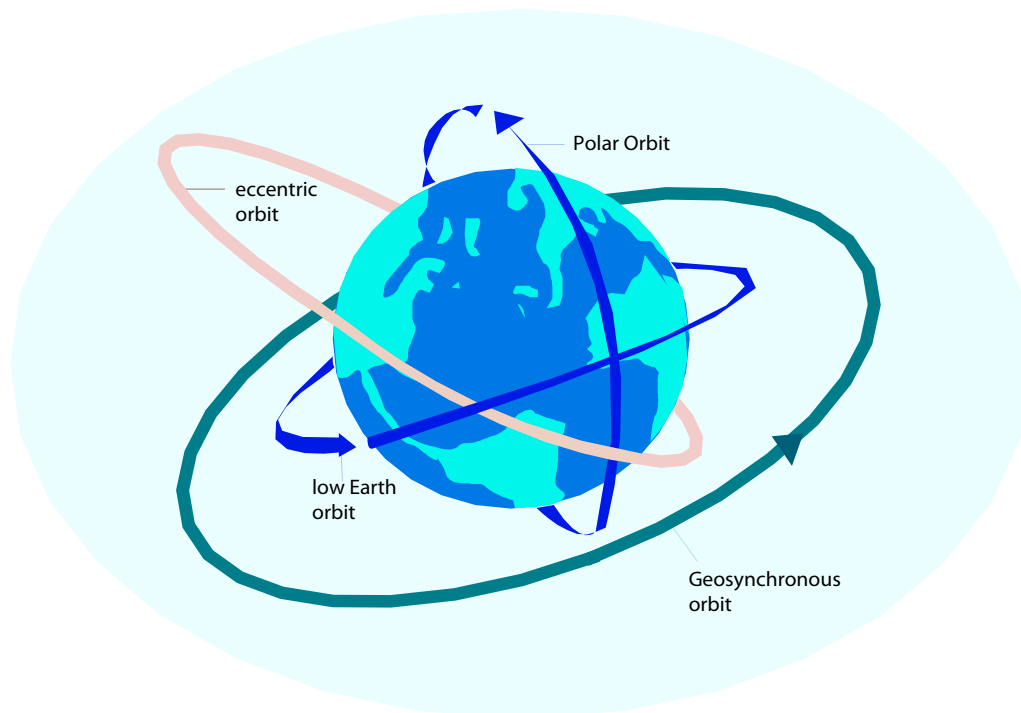
**Hackett, James, “Much Ado About Space Debris,” *The Washington Times*, April 25, 2007, p. A18.**

When the space age began five decades ago, the number of manmade objects in space was zero. Since then, however, more than 25,000 pieces of manmade space junk the size of a baseball or larger have been tracked. To date, approximately 10,000 of those items have re-entered the Earth’s atmosphere and have either landed or disintegrated. So far, over the past fifty years, it has been fortunate that no humans have been injured or killed by falling space junk.

The majority of space junk, when and if it falls back toward Earth, ultimately burns up on the way down. In this regard, today’s existing problem of space junk may not be quite as bad as some people make it sound. At the same time, there is no denying that at least some pieces of space junk hold the potential to harm humans as they fall to Earth, especially if they do not end up disintegrating along the way. In addition, space junk also holds the potential to strike active spacecraft, even if this also does not actually happen very often.

-----, “Litter Kings,” *Popular Mechanics*, July 2007, p. 81.

Some forms of space junk, such as spent rocket boosters, are difficult to eliminate. Other forms, such as the bags of garbage continually discarded into space from the MIR space station by Soviet cosmonauts for more than a decade, are far more inexcusable. In recent decades, several countries around the world have contributed to our global space-junk woes. The United States has produced 3,176 of the pieces of space junk that are currently in orbit. Similarly, Russia has produced 2,917 such pieces and China has produced 1,822. According to experts at the Center for Space Standards and Innovation, approximately 85 percent of all new pieces of space junk will still be orbiting the Earth a century later.



**Munday, Matt, "One Giant Skip for Mankind," *The Sunday Times*, October 7, 2007, p. 82.**

Space travel has turned the universe into a dump. Nobody knows precisely how many items of space junk are currently orbiting our planet, but it is certainly a large and ever-increasing number. Many such items re-enter the Earth's atmosphere without ever causing significant harm. Others, such as the ones discussed below, are noteworthy for the potential problems they may one day cause.

The British spacecraft Beagle 2, after leaving the European Space Agency's Mars Express orbiter in June 2003, was scheduled to enter the atmosphere of Mars six months later. However, after it left the orbiter, it was never seen nor heard from again. Even today, its whereabouts remains unknown.

Although NASA does its best to avoid adding new litter to space, it made a major exception in July 2007. Realizing that it was too large to fit on returning U.S. space shuttles, NASA released a 1,400-pound refrigeration tank into space. The tank had previously been housed in the International Space Station. It is expected to re-enter the Earth's atmosphere next spring. NASA officials have stated that they will provide warnings if it appears the refrigeration tank might end up hitting someone or something as it returns to Earth.

The oldest piece of space junk currently orbiting the Earth is Vanguard 1, a small satellite launched by NASA in 1958. Six years later, its transmitter stopped working, and the satellite has not provided any data since. There is little chance it will come crashing to Earth anytime in the near future, however. NASA officials estimate that the orbital lifetime of Vanguard 1 is approximately 400 years.

**-----, "Saving Space Junk," *Archaeology*, November/December 2007, p. 16.**

Approximately the size of a cantaloupe, Vanguard 1 is the oldest piece of space junk that is still in orbit today. This tiny satellite was actually the fourth manmade object in space. To date, it has circled the Earth approximately 200,000 times.

Even though the Vanguard 1 meets the definition of space "junk," it provides an example of the saying that one person's trash is another person's treasure. To archaeologists, Vanguard 1 represents the world's most ideal artifact for revealing the effects of long-term exposure to the environment of outer space. No other artifact can do the same, as no other piece of manmade space junk has been in orbit longer than this satellite. So whether space junk actually represents trash or cultural treasures, archeologists would like to see various pieces of space junk saved for posterity, whenever possible.

**Hutchens, Bill, "Marvelous New 'Super Mario Galaxy,'" *The News Tribune*, November 20, 2007, online edition.**

The problem of space junk is so well known today that it has begun being incorporated into pop cultural offerings. For example, the new video game Super Mario Galaxy features its central character, Mario, traveling from one galaxy to the next in order to obtain Power Stars that are hidden on what appear to be planets. In actuality, many of these planet-like formations are either small spheres of space rock or uniquely shaped pieces of space junk. This reality holds the potential to introduce the problem of space junk to players from a very young age.

## **II. TYPES OF SPACE DEBRIS**

-----, **“Heard This One?” *San Jose Mercury News*, March 8, 2006, online edition.**

If a Canadian golf-club maker gets its way, the next piece of space junk will be a golf ball. As part of a marketing campaign, the manufacturer is seeking NASA’s approval of its plan to have an astronaut launch the ball into orbit, using one of the clubs it makes, from a platform located on the International Space Station. If such approval is received and this plan gets carried out, the golf ball is expected to orbit the planet for four years before burning up upon re-entry into the Earth’s atmosphere.

-----, **“Spatula Off on Space Odyssey,” *The Australian*, July 15, 2006, p. 17.**

Astronaut Piers Sellers has contributed the most recent piece of space junk to the Earth’s orbit: a \$2,700 putty knife. The spatula slipped out of Sellers’ tool kit recently while he was conducting tests outside the space shuttle Discovery during a seven-hour spacewalk. “My spatula has escaped — it was tethered to me,” Seller informed ground controllers once he realized the putty knife was missing. “It’s gone, gone, gone. Nobody’s going to find it.”

The shuttle’s commander was likely a bit surprised as he saw the spatula, through his window, floating off into the darkness. Sellers completed his work safely with five additional spatulas still in his possession. The lost object is currently being tracked by NASA and the U.S. Space Surveillance Network to ensure that it will not pose a threat to Discovery or the International Space Station.

**Goddard, Jacqui, “One Giant Lump from Mankind,” *The Times*, September 4, 2006, p. 3.**

The European Space Agency has intentionally turned its Smart-1 lunar probe into space debris. The unmanned probe had completed its three-year, 62-million-mile mission to provide information about the chemical and geographical composition of the moon and needed to be taken out of service. It continued beaming pictures and information back to Earth until just moments before it was forced to crash into the moon’s lunar surface, breaking into pieces upon impact. As such, additional pieces of space junk have been sent to that “great dustbin in the sky.”

-----, **“NASA Rescuing Hubble Telescope,” *The Herald*, November 3, 2006, online edition.**

Until recently it appeared that the Hubble Telescope might become yet another piece of space junk. For two years NASA officials have been debating what to do about the 16-year-old telescope, which is in need of repairs. Without them, its batteries and stabilizing machines are expected to die by the year 2010. Initially, NASA felt that a manned shuttle flight to fix the telescope was far too dangerous so they planned to send a special robotic device to do the job. When that proved to be an unreliable and far too expensive option, NASA reversed its earlier decision, announcing that a manned shuttle flight to fix the Hubble will occur in spring 2008.



**Stauffer, Thomas, “Space Junk to Intrude on a Celestial Queen,” *Arizona Daily Star*, December 28, 2006, online edition.**

A huge piece of space junk — the Lacrosse 4 Rocket — will pelt celestial monarchy with garbage this evening. The ankle of Cassiopeia the queen will be approached by the body of the rocket which, in August 2000, served to launch the fourth in a series of U.S. spy satellites into the Earth’s orbit. This celestial offense is expected to occur at 7:11:35 p.m.

**Amos, James, “Mysterious Light in Sky was Russian Space Junk,” *The Pueblo Chieftain*, January 5, 2007, online edition.**

For thirty seconds on the morning of January 4, a bright light was seen moving quickly across the western sky. Eyewitnesses thought it might be a comet, a meteor shower, or even a UFO. They were wrong. It turns out that what they saw was actually a piece of Russian space junk.

According to the North American Aerospace Defense Command (NORAD), the entity was the debris of a Russian rocket that had recently launched a French telescope into space. NORAD personnel have since been informed that a piece of the rocket may have hit the ground in Wyoming and are en route to investigate.

**Oberg, James, “Waste Management: Just Throw it Out,” *Astronomy*, February 2007, p. 24.**

If NASA approves its pending plans, the International Space Station will soon be producing a huge new piece of space junk that will pose a hazard for those who navigate space as well as a potential threat to those who live on Earth. The station’s External Ammonia Supply (EAS), installed by astronauts in 2001 to provide a backup supply of coolant, will soon become obsolete — it is being replaced by a permanent thermal system. As such, it needs to be removed from the International Space Station.

The EAS is approximately the size of an ordinary household refrigerator. It weighs 1,500 pounds. Originally, NASA officials had planned to bring it back to Earth as part of a shuttle mission, but recent reductions in shuttle launches have forced them to rethink their initial plans. The current plan is to have astronauts release and manually push the EAS away from the International Space Station so that it begins to orbit in a path that should keep it safe from ever colliding with the station itself. This means that future personnel on spacecraft traveling to the station will always need to know where the EAS is in order to avoid colliding with it themselves.

**Frazier, Ian, “On Impact,” *The New Yorker*, July 9, 2007, p. 72.**

In the afternoon of January 2, 2007, a piece of metal from space hit the home of the Nageswaran family in Freehold Township, New Jersey. Upon investigating the source of the loud bang, the family encountered shredded insulation, damaged Sheetrock, and pulverized plaster dust in one of their bathrooms. Looking up, they noticed an approximately four-inch-long hole in the bathroom’s ceiling. It was while they were sweeping up the mess that the family discovered the croissant-shaped, brownish-silver piece of space debris. In this particular instance, however, the space debris was not manmade. Instead, based on its appearance, density, magnetism, and related properties, a group of scientists determined that it was most likely an iron meteorite that successfully fell to Earth, rather than burning out in the atmosphere as a meteor.

**-----, “Space Station Crew Dump Trash Overboard,” *New Scientist*, July 28, 2007, p. 6.**

In addition to a refrigerator-size ammonia tank, a NASA astronaut and a Russian cosmonaut have released a camera mounting from the International Space Station into space. Officials are planning to track both of these items by radar until they re-enter the Earth’s atmosphere. It is believed that the camera mounting will disintegrate entirely upon doing so, therefore, re-entry should pose no threat to humans below. Experts say that pieces of the ammonia tank, which are expected to stay in orbit for ten months, are much more likely to survive re-entry and could end up landing on the ground rather than in the ocean. They emphasize, however, that there is only a 1 in 5000 chance that the pieces are likely to endanger a populated area.

**Kay, Liz, and Tyesha Dixon, “It Came from Outer Space,” *The Baltimore Sun*, October 22, 2007, online edition.**

Sometimes, space debris turns out to be semiprecious. That is certainly the case for a 1,400-pound chunk of non-manmade interplanetary space debris, composed of iron and olivine, that fell to the Earth recently. The item is now on its way to a New York auction, to be sold to the highest bidder. It has been described as “a nice collector piece or museum piece” that is likely to fetch between \$630,000 and \$700,000. If purchased by a private collector, it will serve as an impressive out-of-this-world conversation piece.



### **III. CHINA AND SPACE JUNK**

**Dayton, Leigh, “Blast Leaves More Junk Littering Earth’s Orbit,” *The Australian*, January 20, 2007, p. 12.**

China recently tested a new anti-satellite weapon to destroy an aging Chinese weather satellite. As a result, millions of new pieces of space junk are now orbiting the Earth. And, if experts are correct that it was destroyed at an orbit of approximately 850 kilometers, those pieces pose a substantial threat to commercial and scientific satellites alike.

With regard to the ever-increasing problem of space junk and the threats it poses, experts say that it would have been preferable for China to damage the satellite — thereby putting it out of commission yet leaving it whole — rather than to destroy it. Prior to this weapon test by China, NASA’s Orbital Debris Program Office was already tracking 9,949 pieces of space debris that are larger than 10 centimeters in size.

**O’Brien, Dennis, “China’s Clutter is Not Lost in Space,” *The Baltimore Sun*, January 20, 2007, online edition.**

By blowing up its own satellite on January 11, China produced a large debris cloud that substantially exacerbated the increasing threats that space junk poses to spacecraft and other satellites. Pieces of the destroyed satellite spread immediately across 2,000 miles of space. Approximately 800 of these are 10 centimeters or larger, which is about the size of a softball. Two million pieces or more are smaller than that, but they can still cause damage to other entities in space.

“It used to be with space flight people worried about meteor showers. Now the much bigger danger is from manmade debris,” explained Harvard astronomer Jonathan McDowell. Nicholas Johnson, chief scientist with NASA’s Orbital Debris Program Office added that as a result of China’s anti-satellite weapon test, “everybody’s job today is a little harder than it was maybe two weeks ago.”

**Henderson, Mark, “Explosion Will Create Hazard for Other Craft,” *The Times*, January 20, 2007, p. 41.**

It is clear that the space junk China’s satellite destruction test has created poses a threat to other orbiting entities in space. What is less clear is the likely extent of the threat that it poses. That is because the amount of damage any of those pieces of space junk might cause depends on the specific circumstances of the actual collision. Experts are hoping that the aging weather satellite was destroyed using an effective projectile (a “bullet”) rather than an explosive (a “bomb”). If that turns out to be the case, the size of the space-junk cloud that the destruction created will be more limited in size.

**Gertz, Bill, "U.S. Halts China Space Ventures," *The Washington Times*, February 2, 2007, p. A1.**

In response to Beijing's test of an anti-satellite weapon last month, the Bush administration has called off planned space ventures with China. Prior to this announcement, the United States was considering carrying out various space projects in conjunction with China, including joint exploration of the moon and the development of joint space-debris-avoidance methods.

According to a spokesperson from the National Aeronautics and Space Administration, China's weapon test violated an agreement made between U.S. President George W. Bush and Chinese President Hu Jintao last spring. In response to the Bush administration's announcement, a Chinese spokesperson reiterated China's desire for an international treaty that bans development of space weapons, a proposal that has to date been rejected by the United States.

**Morring Jr., Frank, "Worst Ever," *Aviation Week and Space Technology*, February 12, 2007, p. 82.**

Next month in Vienna, representatives of the world's spacefaring nations will gather together to adopt international guidelines aimed at substantially reducing the growing problem and threats posed by manmade space junk. At that meeting, China's representatives will be expected to explain their country's recent actions, which instantly produced a 10 percent increase in the amount of space junk that has been created over the past five decades.

Because the altitude at which China's aging weather satellite was destroyed was so high, the majority of the resulting pieces of space junk are expected to remain in orbit for more than a century. U.S. officials and others are hoping that Chinese officials will respond to their recent requests for a complete explanation of China's actions and how, if at all, they correspond to that country's stated goal of ensuring only peaceful uses of space in the decades to come.

**-----, "Hunkering Down," *Aviation Week and Space Technology*, February 19, 2007, p. 93.**

A United Nations panel is currently meeting in Vienna to establish international guidelines for reducing manmade space junk. During the opening session of the United Nations Committee on the Peaceful Uses of Outer Space, China's delegates have received substantial criticism from France, Germany, Japan, and the United States. Working together, representatives from various countries are to undertake the substantial task of finalizing proposed space-junk-mitigation standards. The draft guidelines, prepared by members of a technical subcommittee over the past two years, require the intentional breakup of any space object to be done in such a way as to not produce space debris that will remain in orbit for a long period of time.

**Gertz, Bill, “Beijing Space Test Scattered Debris,” *The Washington Times*, April 10, 2007, p. A1.**

According to senior officials with the U.S. Air Force Space Command, China’s January 11 test of an anti-satellite weapon has motivated an in-depth review of space-monitoring activities within the U.S. military’s space defense command. Prior to that test, the U.S. military was tracking approximately 14,000 objects in space. As a result of the Chinese test, that number increased instantly to 15,000 objects that are actively being monitored.

According to Air Force Brigadier General C. Donald Alston, China has been investing heavily in space-related matters in recent years. He says that China is expected to possess enough anti-satellite missiles by 2010 to destroy virtually all U.S. satellites. He is calling for the deployment of a new space surveillance satellite to help safeguard U.S. interests in space.

**McCarthy, Erin, “Waste Mismanagement,” *Popular Mechanics*, July 2007, p. 80.**

China’s anti-satellite test on January 11 caused concern among several of the world’s countries. In part, government and military leaders across the globe are concerned about the risks posed by the Kessler Syndrome, which is the point at which the low Earth orbit becomes so packed with space junk that collisions make space almost entirely unusable. That point may be reached more quickly than anyone has imagined, since space junk typically takes numerous decades to decay, and because only larger pieces of it are carefully tracked, nobody really has a clear sense of exactly just how much space junk currently exists.

**IV. RISKS POSED BY SPACE JUNK****Williamson, Mark, “Space Junk Makes an Impact,” *IEE Review*, January 2006, p. 40.**

It’s the stuff of science-fiction movies: some form of space debris makes a hole in a spacecraft, astronauts work diligently to plug the hole, and the crew is spared an agonizing death in space. The bad news is that it can happen more readily today than many experts in the space industry want to publicly admit.

Consider, for example, the significant risk that space junk poses to a space shuttle orbiter. According to Nicholas Johnson, manager of NASA’s orbital debris program, space debris represents today “the single largest threat to shuttle operations from launch to landing.” That serves to explain why, since the mid-1990s, the standard flying configuration of U.S. space shuttles has been tail first and upside down. This approach is the best way to safeguard a shuttle’s fragile components in order to minimize the risk of disastrous results.

-----, **“Shuttle Damage Missed,” *New Scientist*, October 14, 2006, p. 7.**

Last month, the space shuttle Atlantis encountered one of the biggest space-debris hits ever in NASA’s history. After the shuttle touched down safely on September 21, ground inspectors found a 12-millimeter-by-2.7-millimeter-wide hole in a radiator located within its right payload bay door. Experts say that the object that created the hole was most likely either a fast-moving meteoroid or a piece of space junk. The hit remained unnoticed during three rounds of inspections carried out right before the space shuttle landed.

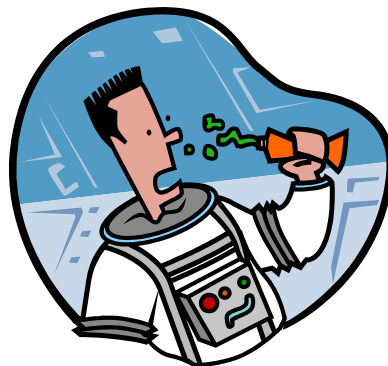
**Watson, Traci, “Shuttle Crew Conducts Unexpected Inspection, Delays Deliveries to Station,” *USA Today*, December 12, 2006, p. 9A.**

After sensors indicated a possible blow to the spacecraft’s left wing while they were sleeping, the crewmembers of space shuttle Discovery conducted an unplanned inspection on Monday. That process delayed one of the shuttle’s most significant deliveries to the International Space Station by 30 minutes: a two-ton girder that will be attached to the station’s framework by astronauts undertaking a six-hour spacewalk.

Experts say that the ding to the wing was likely caused either by a fragment of space junk or a speck of orbiting rock. One of the reasons the sensor’s warning was taken so seriously is that an undetected hole in approximately the same exact area resulted in the disintegration of space shuttle Columbia. The entire crew of seven was killed in that disaster.

**Watson, Traci, “Unplanned Spacewalk to Target Solar-Panel Problem,” *USA Today*, December 18, 2006, p. 18A.**

Whenever astronauts are engaged in a spacewalk, such as to undertake today’s extremely risky procedure to fix a troublesome solar panel on the International Space Station, they run the risk of encountering problems posed by space junk. One of the greatest risks is that a spacewalking astronaut will be hit personally by space junk moving at a very high speed. If this occurs, it holds the potential to pierce the astronaut’s spacesuit, resulting in the loss of air. Also, anytime a spacewalking astronaut gets distracted, he or she runs the risk of falling victim to the vacuum of space. The risks that astronauts face from space junk last for several hours at a time because typical spacewalks last between five to seven hours each.



**Creedy, Steve, “Jet’s Near Miss with Satellite,” *The Australian*, March 29, 2007, p. 3.**

After Russian space experts miscalculated the re-entry time of a falling satellite, the crew and passengers of a jetliner flying over the Pacific Ocean were put in harm’s way. Flaming pieces of the satellite are believed to have come within five nautical miles of the aircraft, which was traveling from Chile to Australia. During the near miss, the plane’s pilot indicated that he could hear the rumbling noise of the pieces of space junk over the regular noise of the aircraft itself. Authorities will now work through international channels to find out what went wrong with the integrity of the information that was provided by the Russian space experts.

**-----, “Orbiting Junk, Once a Nuisance, is Now a Threat,” *Future Survey*, April 2007, p. 22.**

In recent decades, space experts have feared the day when a speeding piece of space junk ends up smashing a spacecraft into hundred of pieces, launching a chain reaction of collisions in space that might continue for centuries. Such fears have intensified over the past decade as the proliferation of space debris has intensified. China’s January 11 test of an anti-satellite rocket likely means that such a chain reaction will begin even sooner than previously thought. When and if it does, advanced satellites worth billions of dollars will be at tremendous risk of harm. If nothing is done to remedy the problems posed by space junk in the very near future, the space surrounding the Earth may soon become so filled with junk that space launchings of any kind will no longer be possible.

**Zaitsev, Yury, “The Problem of Space Junk,” *The Monitor*, June 12, 2007, online edition.**

When humans launched their first satellite into space, they likely had little idea that they were unveiling one of the world’s greatest garbage chutes. Nevertheless, since then space has been turned into a gigantic waste dump. A single piece of fast-moving space junk — even one as small as half a millimeter across — can easily pierce an astronaut’s spacesuit. A piece the size of approximately one centimeter can entirely disable an active satellite. Collisions with larger pieces of manmade space junk pose even greater threats to satellites, spacecrafts, and sometimes even people on the ground.

The seemingly endless accumulation of space junk is also increasing levels of radiation in the environment surrounding the Earth. Russia is responsible for nearly four dozen radiation sources — resulting from satellites, fuel assemblies, closed-down reactors, nuclear-fuel assemblies, and other entities — that are currently orbiting our planet. The United States represents another contributor to rising radiation levels in the near-Earth environment. If Russian or American nuclear satellites ever collide with space debris and fall apart, they pose the threat of contaminating major portions of near-Earth space. As a result, in the worst-case scenario, the Earth’s atmosphere would thereby become highly contaminated.

**Watson, Traci, "Shuttle Coming Home Day Early as Dean Nears," *USA Today*, August 20, 2007, p. 3A.**

The space shuttle Endeavour's most recent visit to the International Space Station was cut short on Sunday out of fear that it would be threatened by Hurricane Dean. As a result, an abridged spacewalk on Saturday left the task of securing some of the shields designed to protect the station from space junk undone, rendering it at greater risk for damage than was originally planned and desired. In contrast, the crew of the Endeavour spent the majority of its time on Sunday inspecting the shuttle's exterior, keeping a careful eye out for potential damage by space junk to the spacecraft's wings and nose.

**-----, "Shuttle Gets Dinged Again," *Time*, August 27, 2007, p. 16.**

The space shuttle Endeavour has encountered a chip in its heat-resistant tiles after being hit by debris. NASA officials are quite concerned about this because it is the same kind of damage that led to the earlier disintegration of the space shuttle Columbia. The ding is located near one of the shuttle's wheel wells, which could potentially provide an entry point to the spacecraft's interior parts. Although other shuttles have successfully survived worse dings, NASA officials are unlikely to relax until after Endeavour has completed its successful re-entry into the Earth's atmosphere.

**Muir, Hazel, "The Satellites Above Us," *New Scientist*, September 8, 2007, p. 5.**

Prior to the launch of Sputnik 1, there was no manmade space junk orbiting the Earth. Today, there is a plethora of it, and experts maintain that the sheer volume of space debris today is nearing critical levels. "It's a runaway problem," says Mark Matney, a scientist who specializes in space debris at NASA's Johnson Space Center. "Even if we stopped launching anything today, the environment will continue to get worse for a century."

According to Heiner Klinkrad of the European Space Agency, although everyone knows that numerous satellites are orbiting the Earth, far fewer individuals realize that approximately 93 percent of all known objects in the Earth's orbit are useless space junk ranging from abandoned rocket stages to lost lens caps. Other junk includes strange clumps of copper needles that were launched during the 1960s as a unique experiment in radio communication.

**Basu, Sourish, "Hit or Miss," *Scientific American*, October 2007, p. 36.**

One of the primary risks resulting from space junk is the possibility of collision. According to NASA experts Eric Christiansen, Bill Cooke, and Mark Matney, there is currently a 0.12 to 0.2 percent chance of a space shuttle impacting with space debris. In addition, the chance of losing a space shuttle as a result of such impact is somewhere between 1 in 500 to 1 in 300.

**Whitelaw, Kevin, “The Problem of Space Debris,” *U.S. News and World Report*, December 17, 2007, p. 44.**

It is no surprise today that chunks of space junk endanger satellites and equipment in the Earth’s lower orbit. It is also no surprise at this point that China’s destruction of a weather satellite using an anti-satellite weapon earlier this year, to use NASA’s words, was “the single worst contamination of low Earth orbit during the past 50 years.” Although Chinese scientists have stated that, according to their calculations the risk of collision as a result of that incident has increased by less than 1 percent, recent evidence suggests otherwise. For example, U.S. space experts have witnessed the number of near misses between satellites and space debris more than double since China’s test of that anti-satellite weapon occurred.

## **V. ADDRESSING THE PROBLEM OF SPACE JUNK**

**Kennicott, Philip, “The Heavenly Science of ‘Cosmic Collisions,’” *The Washington Post*, January 31, 2006, p. C1.**

Before the problem of space junk can be addressed, more people need to learn about it and its various realities. To that end, *Cosmic Collisions*, a 23-minute planetarium show, will soon debut at the National Air and Space Museum. The new show, which is narrated by Robert Redford, exposes its audience members to the power and threats that result from colliding asteroids, space debris, and other entities in space. Before it concludes, Redford invites all audience members to consider their own ideas for saving our planet from collision-related devastation.

**Davidson, Keay, “Space: The Final Junkyard,” *San Francisco Chronicle*, March 12, 2006, p. A1.**

According to NASA officials, even if humankind never launches another rocket, approximately 18 existing satellites in the Earth’s orbit can be expected to encounter major collisions over the course of the next 200 years. Approximately a dozen of those collisions are predicted to be “catastrophic” in nature. Because new satellites continue to be launched and new items of space junk continue to appear, however, those numbers are actually predicted to be even higher.

What can be done in the coming years to begin addressing the problem of space junk? International agencies have been trying to answer that important question for years. One strategy is to require spacefaring nations to build more resilient rockets that do not blow up in space in order to prevent them from spewing additional debris everywhere. Another strategy is to provide appealing incentives that will motivate cutting-edge inventors to develop advanced laser beams or related creations that are capable of safely “sweeping” space junk from above.

**Ford, Jason, "Space Angels," *Engineer*, April 10, 2006, p. 13.**

The U.S. Air Force Research Laboratory will soon be acquiring a new breed of satellite designed to provide Space Situational Awareness to military satellites. The new nano-satellites will work in conjunction with host satellites to warn them about nearby space junk or forms of hostile technology being launched by enemy forces.

This unique kind of nano-satellite is being referred to as the Autonomous NanoSatellite Guardian for Evaluating Local Space (ANGELS). It will function for satellites in much the same way as a vehicle's advanced evaluation systems are able to notify their owners of potential problems (such as low oil pressure). Rather than replacing the regular functions of a host satellite, the nano-satellite offers an extra level of protection in the form of an additional advanced evaluation tool.

If everything goes as planned, the first ANGELS satellite will be sent into orbit in 2009 where it will remain for a period of one year. If all goes well with that, future ANGELS satellites will remain in the Earth's orbit for a period of three years at a time.

**Gaffney, Timothy, "Fairborn Company Working to Keep Satellites Safe," *Dayton Daily News*, December 26, 2006, online edition.**

Along with various other threats including solar flares and enemy anti-satellite systems, space junk can readily degrade or even disable the numerous satellites that fly thousands of miles above the Earth. To help keep the world's satellites safer, the Design Knowledge Company is developing an automated evaluation system that informs commanders about likely threats to their satellites. The system's technology was developed as a result of Small Business Innovation Research contracts from the Air Force Research Laboratory at Wright-Patterson Air Force Base.

**Marks, Paul, "Satellites vs. Space Junk: Evening Up the Odds," *New Scientist*, February 24, 2007, p. 30.**

A new method of measuring remaining fuel levels in the tanks of satellites can serve as a useful means of assisting satellites to avoid collisions with spacecraft and space junk. To effectively avoid such collisions, satellite operators need to have very precise knowledge of how much fuel is left in a satellite so that they can determine how much of it to use to thrust a satellite out of the way of other objects.

Currently, satellite fuel levels are determined by one of two imprecise means: by estimating how much fuel is likely used up on every thruster burn or by having a sensor measure gas pressure levels in the fuel tank. Neither approach works especially well once fuel levels get low. To overcome such deficient methods, two aerospace engineers with the Indian Institute of Science in Bangalore have designed a superior satellite fuel tank that contains titanium alloy. It uses an ultrasound beam to much more accurately determine the amount of fuel left in the tank.

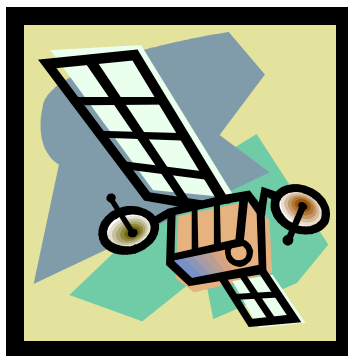
-----, “Debris Decision,” *Aviation Week and Space Technology*, February 26, 2007, p. 79.

The United Nations Committee on the Peaceful Uses of Outer Space has approved a set of guidelines to begin reducing the amount of space junk that exists today. They will next propose the guidelines to the United Nations General Assembly this summer, which is expected to adopt them. Representatives from China were among those from the world’s spacefaring nations to approve these important guidelines. “People had expected that they [the Chinese] would try to make changes, and they didn’t,” explained Kenneth Hodgkins of the U.S. State Department. In part, the new guidelines detail appropriate procedures for carrying out intentional breakups of space junk in the Earth’s orbit.

**Morring Jr., Frank, “Safe in Space,” *Aviation Week and Space Technology*, March 5, 2007, p. 106.**

The International Space Station remains at risk of damage from space junk. That is just one of the noteworthy findings contained in a new report from the International Space Station Independent Safety Task Force that was released last week. In that report, the members of the task force emphasized that China’s January 11 anti-satellite weapon test added 10 percent to the quantity of manmade space junk currently orbiting the Earth. They also indicated that, as a result of that reality, there is an 18 percent chance that the International Space Station will need to be abandoned as a result of a collision with space debris given its current design and a 9 percent chance that a penetration caused by space debris will lead to the loss of the station, its crewmembers, or both.

To help reduce those odds, the installation of state-of-the-art debris shields appears to be a promising option. The effective addition of today’s most advanced debris shields to the station’s Russian Zvezda service module would alter those odds as follows: there would then be a 14 percent chance that the International Space Station will need to be abandoned as a result of a collision with space debris and an 8 percent chance that a penetration caused by space debris will lead to the loss of the station and/or its crewmembers. Currently, 23 debris panels have been delivered to the International Space Station. They are scheduled to be installed during spacewalks to occur by the end of the year.



**Zizzo, David, “NASA Workshop Brings Space to Educators,” *The Daily Oklahoman*, May 29, 2007, online edition.**

As part of special NASA workshops being held by dozens of aerospace educators at locations across the United States, current and future teachers are learning how to get today’s students interested in, and thinking about, ways to potentially solve the various problems and challenges posed by space junk. The educators are provided with numerous hands-on activities that can be carried out in their own classrooms. In one such activity, participants use balloons to represent astronauts and cover them with protective layers to see if they are capable of surviving a potentially deadly collision with space junk, which comes in the form of a nail punch dropped through a five-foot piece of pipe directly onto the “balloon-o-nauts.”

**Grego, Laura, “The Battle for Peace in Space,” *New Scientist*, September 8, 2007, p. 51.**

The world will soon celebrate the 50th anniversary of the space age. Given the current problems posed by space junk, there may be little cause for celebration. Generating effective approaches to mitigating space debris has become an urgent priority that must be addressed by the international community over the next 50 years and beyond.

On October 10, 1967, the Outer Space Treaty became a component of international law. Since then, the treaty has been ratified by virtually all countries that are currently engaged in spacefaring activities. “The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind,” the treaty maintains.

The establishment of the Outer Space Treaty was highly significant in its era, for it officially acknowledged that effective laws and internationally agreed-upon principles pertaining to space are necessary. With the 40th anniversary of the Outer Space Treaty upon us, the time is now for the international community to revisit, and revise as needed, global space law. In part, this may involve a ban on intentional destruction of orbiting satellites. It will also likely involve the establishment of contemporary international rules and regulations for how the world’s various countries are allowed to operate in space.

**Hall, G. E., “Space Debris — An Insurance Perspective,” *Proceedings of the Institution of Mechanical Engineers*, December 2007, p. 915.**

Space insurance can help the world’s spacefaring nations respond to the damage and deleterious effects caused by space debris. The risks associated with space debris, including manmade objects and fragments in addition to naturally occurring entities, can be incorporated into this unique form of insurance as one of several environmental hazards that might be encountered. Although the various instances of a collision between spacecraft and space junk in orbit have not resulted in insured losses to date, that reality is likely to change in the coming decades. If such losses occur, it would very likely have a negative impact on both the future availability and cost of space insurance.