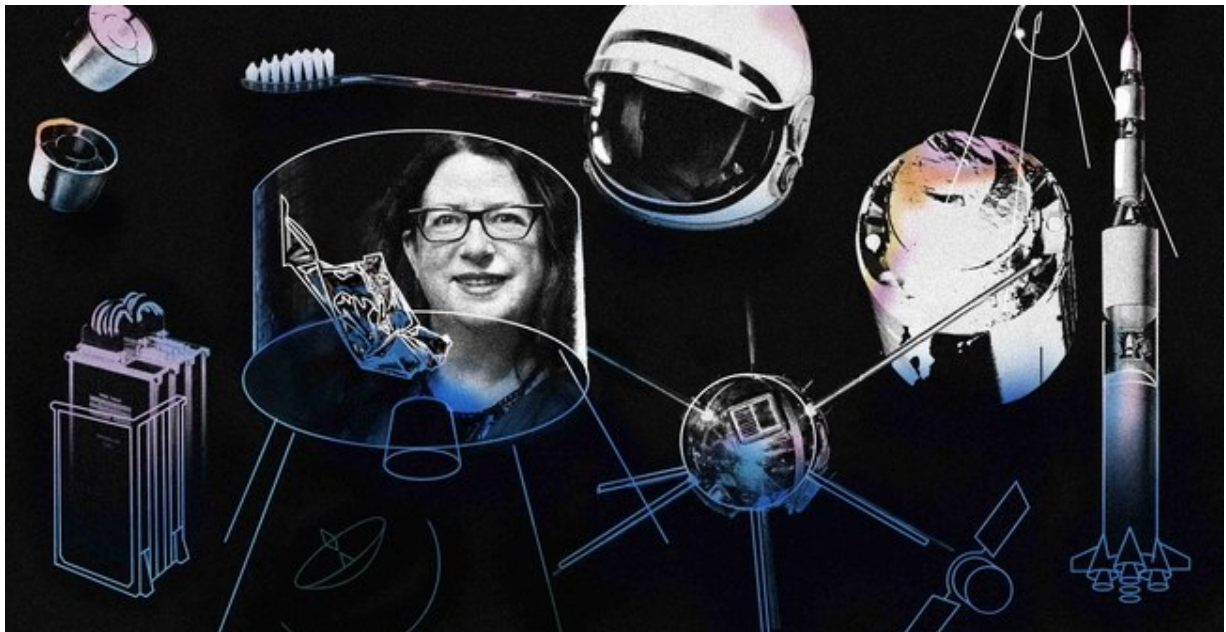


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DR. SPACE JUNK UNEARTHS THE CULTURAL LANDSCAPE OF THE COSMOS

By **Ceridwen Dovey** September 1, 2017



Alice Gorman is a pioneer in the emerging field of space archeology.

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When Neil Armstrong stepped onto the moon, in 1969, the first images of his momentous leap were received and relayed by antennas at the Honeysuckle Creek Tracking Station, nestled in the foothills of a remote mountain valley in the Australian Alps, south of

Canberra. Nothing now remains of the station but its concrete foundations. Nearby lie the ruins of another Australian satellite-tracking station once owned by NASA, called Orroral Valley, which supported the Space Shuttle Columbia missions, among others; it was closed in 1985, and later demolished. Most visitors gaze upon these abandoned sites and dwell on what has been lost. Alice Gorman looks at them and instead sees what might be found. A pioneer in the emerging field of space archeology, she wants to know what the material culture of the Space Age—the artifacts left behind both on Earth and in outer space—can tell us.

Gorman, who is fifty-three, teaches at Flinders University, in Adelaide, and blogs under the name Dr. Space Junk. A few years ago, she took her students to Orroral Valley to do an archeological survey. While kangaroos hopped between the pylons of the Minitrack antenna, the students used a magnetometer to detect intact subterranean cables, which had once connected antennas to processing units. They did a pedestrian-transect survey—noting discoveries along a set route—which revealed hundreds of plastic zip ties hidden in the grass. These had been snipped or burned open, presumably to release the cables as the antennas were dismantled—and they led Gorman down the obscure scholarly rabbit hole of zip-tie design, back to their American invention, in 1958, virtually the same time that the first satellites were launched into space. Zip ties, it turns out, were crucial to bundling wiring safely.

The point of the exercise, Gorman explained to me recently, was to show her students that even an artifact as unremarkable as a zip tie could be an enabler of space exploration. Archeology can be defined as the study of *material* objects, not just old objects, and Gorman believes that considering things like an oxygen tank from Skylab, a glove dropped on the moon, or a defunct satellite still circling our planet as

archeological artifacts helps reframe our relationship to space. How might we think differently, she asks, if we considered space as a cultural landscape with richly layered scientific, political, and religious meanings, instead of as an empty vacuum that anybody with heroic ambitions—and a bank balance to match—can venture into with impunity? By considering our heritage in space, Gorman asks us to think carefully about the next steps we take out into the cosmos.

In 2001, Gorman was working as a consultant on Indigenous heritage in central Queensland. After a day documenting a site containing scarred trees once used by Aboriginal people to make bark canoes, she was sitting on the verandah of her cottage, looking up at the stars. She spotted a speeding twinkle, and wondered idly whether it could be a satellite. The open country and the wonder-rush of looking at the stars untouched by light pollution brought back memories of her childhood on a farm, and her dreams, back then, of becoming an astrophysicist or an archeologist. On the farm, there were Aboriginal grinding stones used as doorstops, abandoned wells once dug by Chinese workers, a disintegrating homestead made of rammed earth. She was fascinated by an illustrated children's book on archeology sent by a family friend, about Neanderthals and Neolithic Swiss lake villages. But she also loved deciphering the night sky using a star chart in an encyclopedia her father had purchased from a travelling salesman.

At boarding school, Gorman's confidence in her science abilities was knocked; when she got a low mark in physics, she decided that there was no way she could become an astrophysicist. At university, in Melbourne, she studied classical archeology. On that memorable night under the stars in the outback, she realized that she'd finally hit upon a way to integrate her two passions. She threw herself into a self-guided research project on early satellites, and began to work her way back into academia. A few years later, already deep into studying space junk, she

was thrilled to discover the work of the late scholar William Rathje, who, like most archeologists, believed that one person's trash is another's treasure, and that studying rubbish can challenge received ideas about what has value and why. In 1999, he'd coined the term "exoarchaeology," in an article on the potential for archeological study of orbital space debris (though his main focus was terrestrial trash—he founded the field of "garbology," in 1973, by launching a study of Tucson's landfill).

NASA estimates that there are now more than five hundred thousand bits of human-made debris the size of a marble or larger in Earth orbit. The visual models are striking: Our planet is like a giant beach ball completely surrounded by a dense layer of M&M's (the debris in low Earth orbit), and also by sparser concentric circles of M&M's (the debris at other altitudes, such as geostationary orbit, mostly used for telecommunications). This doesn't even take into account the millions of pieces of debris that are smaller than one centimetre. The Australian researcher Ben Greene says that within twenty years space could be so clogged as to be unusable.

In a recent evening lecture at the Sydney Observatory, Gorman explained that this trash consists of everything from probes, modules, "satellites, rockets, fairings, bolts, flecks of paint, vented fuel, and even human waste." Some of it can, technically, remain intact and in stable orbit for anything from decades to hundreds of years. Despite international efforts to track this debris, nobody has a complete catalogue of exactly what's up there. The Space Age is only six decades old, and already its documentary record is riddled with gaps.

I'd arrived at the observatory, a stately sandstone building overlooking the dark waters of the harbor and the candy-colored city skyline, expecting to be shown into a lecture hall. Instead, the guard directed me downstairs, to a stuffy room in the basement. Gorman was there as the

guest speaker at a meeting of the Sydney Space Frontier Society, a chapter of the National Space Society of Australia. The room was packed, which seemed to have taken the organizers by surprise; the elderly secretary of the society fretted that she hadn't put out enough biscuits.

The Society's vision is space settlement—"A Spacefaring Civilisation with people living and working in thriving communities beyond Earth"—and my quick and admittedly prejudiced scan of the audience suggested its ethos is that of a fringe movement: open to anybody, amateurs and experts alike, enthusiasts and the slightly nutty. At the podium, in a black dress, wearing cat's-eye spectacles, her curly dark hair loose, Gorman was unfazed. She'd warmed up the room by asking us to consider our "robot avatars" in space: the fourteen hundred or so active satellites on which our interlinked, technology-addicted way of life depends. The irony, of course, is that we barely manage to look up from our phones to walk down the street, let alone to gaze up at the night sky—which may seem peaceful, Gorman said, but is in fact heavily overpopulated by our own trash. The room had gone quiet. We were hooked.

One difficulty unique to Gorman's choice of research topic is the impossibility of doing actual field work in space, at least for now. She has to be creative in how she uses her tool kit to join the dots of our history in space in ways that non-specialists can understand. From the swarms of debris in the slide she'd projected on the observatory's basement wall, Gorman singled out satellites, telling their stories as if they were old friends. She introduced us to Vanguard 1, the oldest human-made object in space, and the first to use solar power. Launched in 1958 by the U.S., the tiny spacecraft was at the time disparagingly called the "grapefruit satellite" by Khrushchev. It may have been small but its ambitions were big: Vanguard 1 proved that Earth is not a

perfect sphere but closer to being ever so slightly pear-shaped.

Next, we met the U.S. Navy-launched *TRAAC* satellite, which relayed data on the devastating effects of the Starfish Prime high-altitude nuclear tests, performed in 1962 (the Soviets did their own tests the same year). The tests created an artificial radiation belt around the Earth, which eventually disabled a third of all satellites in orbit at the time, *TRAAC* included. But it's still up there, with the bizarre distinction of having taken the first poem into space, etched on its instrument panel. Thomas G. Bergin was commissioned to write the poem, which Gorman described as "slightly sinister, as it views human spacecraft as weapons against the gods, who have until now had us at their mercy," though she also admitted that she's always moved by the final line—"And warm with human love the chill of space." Paying close attention to such artifacts can demonstrate, sometimes disquietingly, how random the path to the present has been. *TRAAC*, for example, is a relic of Cold War nuclear-weapons testing in the years before 1967, when the U.N.'s Outer Space Treaty was signed. That agreement obliged all signatories to accept a definition of space as a global commons, safe from territorial claims and to be used only for peaceful purposes.

The stories that Gorman most likes to tell are those that have been obscured by the grand narratives of space exploration. She draws a web of meaning between launch or support sites on Earth—which are often located in supposedly non-spacefaring nations—to show that the nations that are rich or powerful enough to have a stake in space have always depended on less wealthy nations to get there. She has done research at the Woomera Rocket Range, in South Australia, where Aboriginal people were forced from their traditional lands so that Britain and Australia could do nuclear and missile tests nearby, and which was later used by the U.S. as a spacecraft-monitoring facility.

She's spent time at French Guiana's Kourou rocket launch site, one of the busiest spaceports in the world, which was established, in 1964, on land expropriated from local people, and is the site of regular protests, most recently in 2016.

Gorman also likes to revive some of the lost tales of missed opportunities for more global cooperation in space. In one article, she tells the story of how NASA, before the Apollo 11 mission, considered sending a United Nations flag to be planted on the moon, rather than an American one, out of respect for the new Outer Space Treaty. In the end, the agency recommended the stars and stripes. "Congress backed this decision and altered NASA's appropriations bill to prevent flags of other nations, or international associations, from being placed on the moon on expeditions funded solely by the U.S.A.," she explains.

The American space archeologist Beth Laura O'Leary is one of Gorman's frequent collaborators, and another founder of the field. Like Gorman, O'Leary, who is sixty-six, has a background working in cultural-resource management in First Nations communities and had always dreamed of working in space—"but there weren't any female astronauts when I was young," she told me recently. She was excited to discover Gorman's early space-junk research and to connect with a peer thinking along the same lines. At the 2003 World Archeological Congress, in Washington, D.C., the two of them co-hosted (with John Campbell, an underwater archeologist also interested in space artifacts) the first conference session dedicated to space archeology.

In 2000, O'Leary and one of her past students at New Mexico State University, Ralph Gibson, led a small team to launch the Lunar Legacy Project, an effort to inventory the human-created features and the more than a hundred artifacts abandoned at the Apollo 11 landing site—everything from food bags to boots, defecation-collection devices, and

even the plastic covering used for the U.S. flag. The astronauts had eight minutes in which to decide what to dump and what to take back to Earth. It struck O’Leary that this was similar to the “drop zone” and “toss zone,” which her mentor, Lewis Binford, had observed while doing field work with Nunamiut people in Alaska. In a classic 1978 paper, Binford noted that items entered the archeological record through being dropped (at the hearths where men ate) or tossed (chewed bones chucked over the men’s shoulders). O’Leary called up the elderly Binford, who had been on her Ph.D. committee, to tell him about the connection. “That’s pretty good,” he said. “Eskimos and astronauts.” (Gorman pointed out to me that, in both cases, the archeological record also only reflects high-status activities—hunting, visiting the moon—from which women were excluded.)

O’Leary soon realized that the Apollo 11 site fits the criteria for the U.S. National Register of Historic Places, but NASA’s lawyers told her that any attempt to frame Tranquility Base as a National Historic Landmark could be perceived as a claim of sovereignty. In 2011, however, O’Leary was invited to provide input on NASA’s set of heritage guidelines for anybody planning to go to the moon in the near future. Gorman agrees with O’Leary that the trail of boot prints left by the astronauts in the lunar regolith has enormous significance for our species—as much as the 3.6-million-year-old footprints left by early humans in volcanic ash in Tanzania—yet all it would take to erase them forever is one misguided Google Lunar XPRIZE rover landing in the wrong place.

The controversial U.S. SPACE Act of 2015—the outcome of extensive lobbying by companies set to profit from harvesting space resources—now allows U.S. citizens (and, by extension, corporations) to “engage in the commercial exploration and exploitation” of natural resources found in space, including minerals and water, but excluding biological life.

Supporters of the act say that it is a much-needed boost for the commercial space industry. Critics believe that it threatens the Outer Space Treaty's mandate of preventing nations from making sovereign claims in space. Whatever camp you're in, the reality is that commercial entities are going to set foot on the moon, and *soon*. Richard Branson keeps promising that Virgin Galactic's SpaceShipTwo is only a couple of years away from taking the first tourists into space, and Branson's fellow space-cowboy billionaires, Elon Musk and Jeff Bezos, are jostling to launch their own ventures.

Gorman is not opposed to the idea of space tourism per se. But she does think we should see this interpretation of our future in space, often presented as inevitable, as simply one possible future among many. And, in order to choose which future we want, we need to absorb the lessons of the past. Consider the tale of the U.S. Department of Defense's Project West Ford, which launched hundreds of millions of tiny needles, each one a copper dipole antenna, into Earth orbit, in the sixties, in order to create an artificial ionosphere to reflect radio signals in case the Soviets cut undersea cables. If the project had continued, it would have killed radio astronomy, since the dipoles blocked radio signals from coming *in*, too. One small error for man is always in danger of becoming one giant mistake for humankind.

The morning after Gorman's talk at the Sydney Observatory, I went with her on an informal visit to a research facility in Marsfield, in Sydney's northern suburbs, run by the Australian Government's scientific research agency, CSIRO. Lately, Gorman has become interested in the rich histories of large radio-dish antennas, and she knew of two old 13.7-metre antennas on site, fallen into disuse.

We walked out to a grassy oval beside the office block. Two paraboloid antennas stood on opposite sides of the oval, the peeling paint on their

stems still bright enough to give off a glare. Gorman became visibly excited as we approached. “Antennas are monolithic, heavy things, but they get reused and repurposed a lot, because the technology of receiving a signal has essentially stayed the same over time,” she said, shielding her eyes as she gazed up at the big dish. We circled the antenna, inspecting the cables still attached to the base. Gorman stopped in her tracks. “Cable ties!” she said, picking up a bit of plastic from the grass.

John Bunton, a renowned CSIRO research scientist with white hair and a white beard, who works on the massive Square Kilometre Array radio telescope, came out to the oval, looking a little suspicious. As soon as Gorman mentioned cable ties, his gruffness evaporated. It turned out that he had been the engineer in charge of the antennas in their original field site in the eighties, when they’d been part of the highest-resolution radio telescope in the southern hemisphere at the time. When he’d returned to the site years after it was decommissioned, he’d discovered them submerged in water, surrounded by bulrushes, cattle grazing nearby. He pointed to a stain halfway up the antenna’s base, the watermark from the flooding. “Do you feel an emotional attachment to these antennas?” Gorman asked. Bunton paused, then smiled. “Well, I call them mine,” he said, and for a moment he looked like he might cry.

Ceridwen Dovey is the author of the novel “Blood Kin” and the short-story collection “Only the Animals.” [Read more »](#)

Video

A Civilian's Space Race

Ky "Rocketman" Michaelson battles through bureaucratic red tape to pursue his dream of launching a rocket into space. Directed by Colette Sandstedt.

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