On Navajo Needlework and Moon Missions

Photographs of weavers, many of them women of colour, who played a pivotal role in creating the core memory that took Apollo spacecraft to the moon, reveal a counterhistory long hidden in archives.

Text by Daniela Rosner and Samantha Shorey

When American professor of media studies Lisa Nakamura dug into the archives of a computer history museum, I don't think she was expecting to find rugs. Particularly handmade rugs, artefacts that — through their knots, tears and inconsistencies — point to the Navajo weavers that made them. A scholar of computing, Nakamura was probably used to dry circuit diagrams and abstract mechanical specs. But there in the archives lay a full-colour photograph of thick woven floor-covering material.

Around the same time, we learned of a complementary textile through a documentary about the Apollo moon missions. It showed a woven material called "core memory" being made at Raytheon Technologies Corporation. The multinational company had been in the electronics business since the 1920s, producing everything from air conditioners and refrigerators to missile guidance systems. The clip we saw, filmed in the 1960s, depicts two anonymous operators, at least one of whom looks to be a woman of colour, as they pass an elongated needle back and forth through a matrix of holes in a process that resembles weaving. What they produced turns out to be a crucial technology for the Apollo moon landing, a kind of information storage that helped direct the trajectory of the spacecraft from earth. Core memory was manufactured by numerous corporations throughout this time and in various technological iterations. Prior to Apollo, it was foundational for the first digital computer (the Whirlwind) and it propelled Cold War computing for the next decade.

The textile nature of core memory is illustrated through archival images that depict women engaged in handwork. A set of images at MIT shows two operators who appear to be women in set-curls, heads bowed in concentration as they string beads and wires for the core memory in Whirlwind. In a Raytheon public relations pamphlet, a person who appears to be a young Black female operator poses in front of the loom-like instrument. She looks down at a wire held taut between her hands. Study the photograph and it's easy to imagine the photographer compelling the woman to sit in front of the camera, modelling as the ideal worker. An accompanying caption reads: "SPACE AGE needleworker 'weaves' core rope

memory for guidance computers used in Apollo missions." A natural weaver becomes a natural assembly worker, it seems to suggest.

In a landmark 2014 article titled 'Indigenous circuits', Nakamura designated visuals like these as a kind of "racial and cultural argument for recruiting young female workers in the electronics [industry...]" To illustrate this claim, she describes finding the rug in a 1969 brochure produced by Fairchild Semiconductor, a titan electronics company that was emerging during the early years of Silicon Valley. The firm made chips for the US military's Minuteman Missile Guidance Computer and NASA's Apollo Guidance Computer. To do so, Fairchild Semiconductor set up a large manufacturing plant on a major Navajo reservation in Shiprock, New Mexico. Over the course of a decade, the plant became one of the largest employers in the Navajo nation with over a thousand employees, many of them women. Next to the rug, the brochure shows a circuit board with an uncanny visual resemblance to the rug. Following those objects, enlarged photos depict Navajo women weaving. In one, the threads of a textile warp obscure a woman's face, almost merging with her body. A natural weaver becomes a natural assembly worker, once again.

What does it mean to be a natural weaver of rugs, core memory, or microchips? As we began to consider the connections between textiles and computing, we saw the potential for telling a different story of engineering accomplishment. Seen through labour histories, an innovation such as the Apollo mission no longer belonged to the white male engineers or astronauts like Neil Armstrong, but to the engaged collaborations of women of colour such as Hilda G. Carpenter, an MIT technician, or the women featured in the *Moon Machines* documentary series. But when cast as textile labour, those accomplishments face a double blow: the negative stereotypes associated with feminized and racialized bodies seep into the already diminished status of work that is seemingly rote, unthinking and repetitive. This intertwining of value across bodies and labour, this framing of particular work (such as textile or chip manufacturing) as suited to particular populations (such as women of colour), derives from a long history of labour exploitation.

The rug, like other commodities, is perilously close to the conditions of exploitation it once helped erect. On the pages of a technology marketing brochure, it justifies industrial expansion by rendering labour as easily extractable because of the worker's "natural" skills in needlecraft and weaving. From this viewpoint, the imagery of the Raytheon and Fairchild assembly lines exposes the limits and possibilities of counterhistories. Counterhistories tell stories hidden within archives. They listen to residues of erasure and speak from scenes of subjection, as scholar Saidiya Hartman reminds us in her 1997 book *Scenes of Subjection*.

Troubling their liberatory potential, Hartman suggests counterhistories work as “an aspiration” but one that isn’t immune to “the risks posed by reiterating violent speech and depicting again rituals of torture.” Looking to Venus, a Black enslaved woman missing from the archive of Trans-Atlantic slavery, Hartman seeks a form of writing and retelling that does not reproduce the brutal orders of subjugation. “Why subject the dead to new dangers and to a second order of violence?” she asks.

Informed by this question, the images connecting computing and textiles histories can be seen to pose both danger and possibility. The rug is not a passive container. It isn’t just a vessel that carries a story previously captured and presently retold. The rug and its traces of handwork trouble the mechanisms of racialization, becoming a machine for counterhistories that respond to erasure. Unlike modern microchips, the textile unveils its inner workings. Stitch by stitch, what it leaves behind can be re-traced and re-seen. A textile recalls labour because it embodies labour. The threads mark an inconsistency here, an extra tug there. They manifest a process. Always a process. And what a process reveals is time. The vertical wire had to enter the core bead at a particular moment during the construction. The diagonal wire had to wrap around the core bead after the grid was complete.

Yet, on the reservation, as in the suburban factory, a counterhistory machine never runs its course. If the textile reveals time, then what it obscures is stability — the stability afforded by structure. We don’t see, for instance, the various ways in which threads meet up with military industrial logics. We don’t see the justifications of nation-state expansion, or the politics of the space race, or the federal investments in surveillance and warfare technology. A process (and its machinic form) cannot tell those stories. Much remains unknowable about the women photographed at Fairchild and Raytheon. We cannot confirm whether they were paid, exploited, willingly part of the world to which they contributed. We cannot know whether they identified as women at all. We lose access to their desires within the confines of the photographic frame.

To inquire into those conditions, we need to do what historians have long done with photographs: to interpret the artefact as and through its encounters with the world around it. Motivated by this insight we partnered with quilter Helen Remick and colleague Brock Craft to produce a speculative quilt that re-examined those labour histories. Such reconstructions explored the material as what Tina Campt has called “records of intentions” — depicting not only particular figures but also particular desires: hopes, wants, yearnings and fears of those relating inside and outside the frame. In and through their juxtaposition, the artefact’s

intentions collide. They show how much we cannot change, but also how much we can know when, as Nakamura once said, “we’re basically told there’s nothing to see.”

Look up close at a microchip and you might be surprised by the form. The brass incisions, the colourful metal flecks, the spiral geometry. The prose describing its features could resemble those found in an art history textbook. Many technology scholars have wondered about such resonances. Some have picked up the visual references, and even explored their artistic merit. But within those comparisons — and perhaps more accurately, at their core — exists a different reading of technology and textiles. It’s a reading that places coloniality at the centre of analysis. Look under the rug of the computing industry, and you will find the haunts of social and racial injustice.

[Endnote]
Instructions for weaving your own counterhistory can be found at MakingCoreMemory.com

Imagery

SPACE AGE needleworker "weaves" core rope memory for guidance computers used in Apollo missions. Memory module will permanently store mission profile data on which critical maneuvers in space are based. Core rope memories are fabricated by passing needle-like, hollow rod containing a length of fine wire through cores in the module frame. Module frame is moved automatically by computer controlled machinery to position proper cores for weaving operation. Apollo guidance computer and associated display keyboard are produced at Raytheon Company plant in Waltham, Massachusetts.

SPACE AGE 49925A

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Figure 1: (Left) An unknown woman weaves core memory in a photograph from a Raytheon Apollo 11 Press Kit. (Right) Photo caption describing the woman as a “space age needleworker.” Raytheon photos courtesy of the collection of David Meerman Scott, author of *Marketing the Moon: The Selling of the Apollo Lunar Program* (Cambridge: MIT Press, 2014).

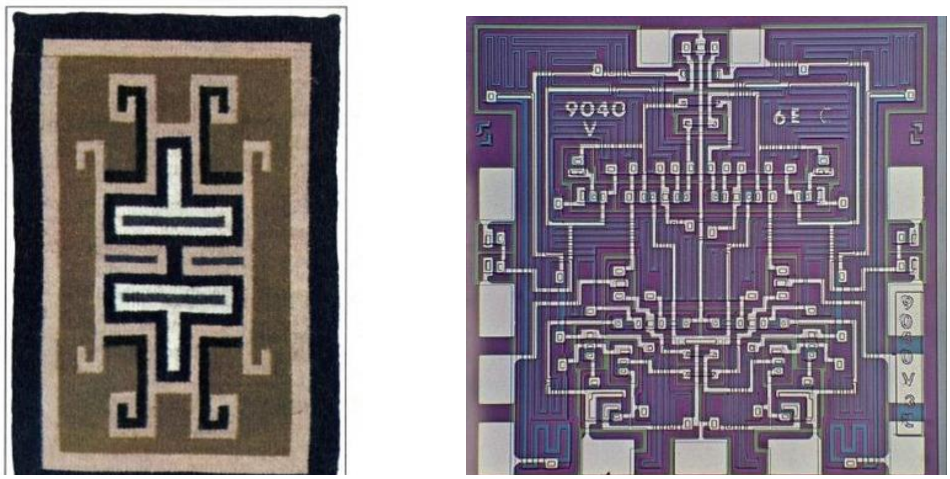

Figure 2: https://computerhistory.org/blog/indigenous-circuits/