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You Can't Eat These Chips, But Some Find Silicon Addictive

A Select Few See Beauty in Computer Brains; Museum-Quality Industrial Artistry

By
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WELLINGTON, Nev.—From his basement in a sparsely populated part of northwestern Nevada, Patrick Mulreany operates a museum that attracts about four visitors a year. Its focus: semiconductors and the shiny disks used to make them.

The former Hewlett-Packard Co. engineer's private collection of about 120 displays highlights advancements in the electronics industry. It also points to the peculiarities of a small number of people whose passion is silicon platters.

"There's a lot of stuff around here that's one of a kind," said Mr. Mulreany, smiling as he led a visitor down a long hall with dozens of framed displays of chips and wafers on the walls.

Stamp or coin collectors can usually point to the artistic characteristics of their holdings. Not people who seek out semiconductor wafers, which are processed in factories and diced up to yield individual chips.

Though wafers are largely indistinguishable from one another to the untrained eye, collectors see aesthetic merit.

"If you hold them in the sunshine, they just spit rainbows right back at your face. They're beautiful," says Joyce Haughey, a graphics designer from Trafalgar, Ind., who keeps several thousand scrap wafers in her studio.

Some enthusiasts, like Timothy Sears of Huntsville, Ala., use microscopes to view the industrial artistry inside chips. "Like futuristic cities with roads and buildings, hundreds of millions of components are connected in vast landscapes only visible at ultrahigh magnifications," he says.

But motivations vary widely among wafer lovers, a tiny tribe who have never been reliably counted and don't typically engage in organized activities.

Ms. Haughey, for example, turns electronic components into works of art. Others assemble displays based on technical or historical significance. Still others seek profit by finding unusual wafers or chips and reselling them.

Wafers, created by slicing up silicon ingots, are processed using costly machines that trace complex circuit patterns and selectively add and remove silicon and other materials. To yield more chips per batch, manufacturers have increased wafer diameters over the years from an inch or two to 12 inches in some cases.

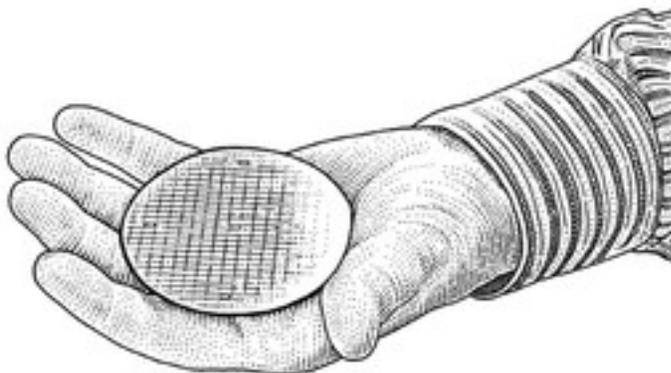
Collecting them can take effort, since wafers are an interim manufacturing step rather than a product companies sell. Those deemed not suitable for commercial purposes—if not recycled by manufacturers—may wind up as gifts to employees or partners, in scrap heaps or funneled to flea markets or websites like eBay.

Collectors typically seek out processed wafers, which give off an iridescence when light strikes them at certain angles.

Visual effects draw people like Antoine Bercovici, a postdoctoral researcher from Paris who collaborates with a friend to take colorful microphotographs of the inside of chips.

A microscope can sometimes uncover surprises, Mr. Bercovici notes. One H-P chip from the 1990s, code-named "Hummingbird," includes a picture of that bird that is revealed under heavy magnification. It's a kind of inside joke, a decoration few will ever see. Another, dubbed "Velociraptor," sports a tiny image of the dinosaur. Many such images end up in "Silicon Zoo," an

online gallery run by Michael W. Davidson, a Florida State University researcher and photographer.



Silicon wafer

Wafers don't always give up their secrets easily. Many are unmarked by manufacturers or have logos or numbers that aren't easy to interpret.

Steve Tinter, a collector in Sydney, Australia, says he sometimes spends hours studying wafers under a microscope to identify chips and their manufacturers. His

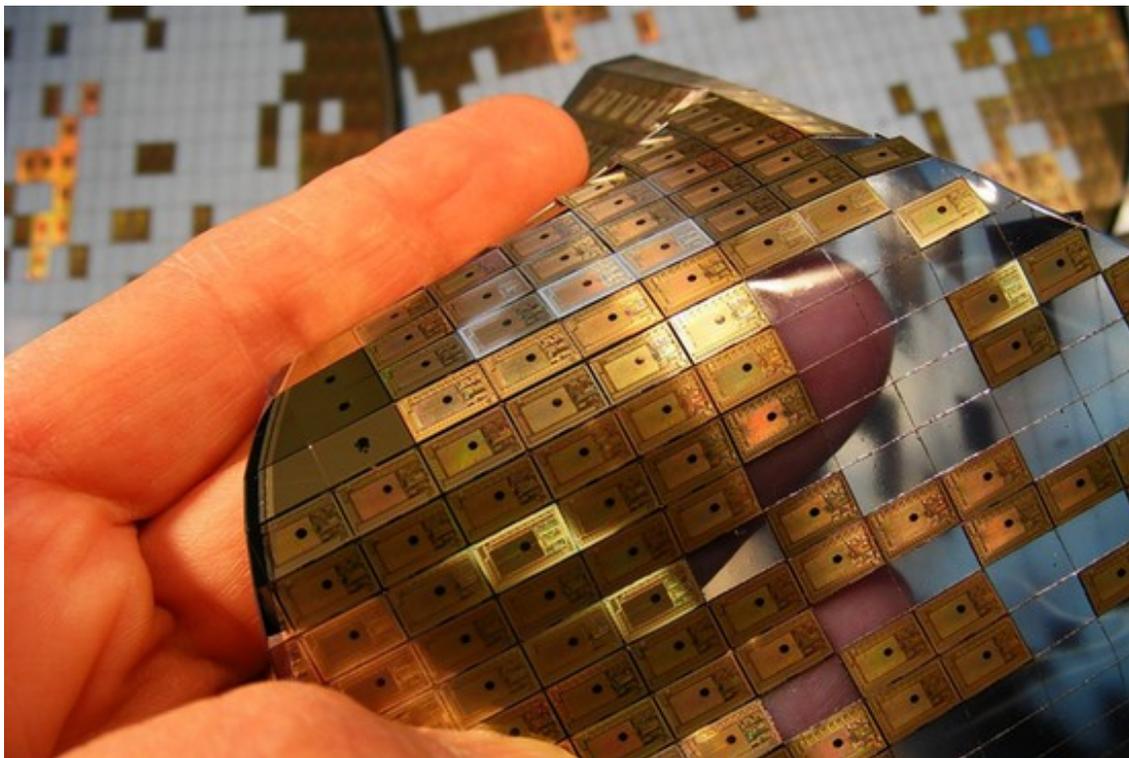
holdings of more than 1,000 wafers include rarities like creations of former supercomputer maker nCube Corp. and many unidentified wafers from Xerox Corp. "I have no idea what they are even after trying to find out for more than a year," he says.

Steve Emery, a collector from Winter Park, Fla., who owns about 20,000 wafers in complete or partial form, says he spent many hours over a five-year period figuring out the provenance of one wafer.

Most wafers aren't worth much, but some finds can pay off. Those with aesthetic appeal are often listed on eBay for \$10 to \$20 each. Historically significant chips can fetch thousands of dollars. Mr. Tinter, who says he sells wafers sometimes to "feed the addiction" to buying and selling recently placed a \$1,000 price on eBay for a wafer featuring Motorola 68000 chips—a variety used in computers like Apple Inc.'s Lisa, from the early 1980s.

Mr. Emery says he can quickly flick through such online listings and identify chips and when wafers were fabricated and judge whether a purchase of \$15 to \$20 might be worth hundreds. "There's definitely a high when you hit it," he says.

He estimates that one tiny wafer sporting chips from industry pioneer Fairchild Semiconductor, which probably cost him \$20, is now worth \$5,000 to \$10,000. On the other hand, Mr. Emery says he bought about 4,000 wafers for roughly \$600, an average cost of around 15 cents each.



Ms. Haughey holds a scrap wafer from her collection. *Joyce Haughey*

Collectors do more than search through eBay. One person who buys and sells wafers speaks of meeting factory workers years ago in cars at remote quiet locations, receiving disks wrapped in work gloves. "Some of the guys that did supply to me got in trouble [with their employers] and were probably fired" for taking company property, says Bob Lewis, a Sunnyvale, Calif., resident who has been gathering and selling silicon wafers for more than three decades.

Ms. Haughey once drove 85 miles to gather a 900-pound box of scrap wafers, and then spent about a month sifting through it. "It was cold, it was Christmas," she recalls. The wafers were "out in the shed, and to get to the bottom of the box I was like almost standing on my head leaning in."

While they don't gather formally, some collectors stay in touch to trade wafers and share experiences. Others have more specific reasons for connecting.

Mr. Emery, for example, [assembles what he calls "chipscares"](#)—displays showcasing various historical semiconductors. He has sold hundreds of them to buyers around the globe, including museums. One client is Mr. Mulreany, who bought about 90 displays for his private collection before starting to design his own, sometimes supplemented by Mr. Emery's artwork.

The collection is one of Mr. Mulreany's many hobbies. He is also a ham radio operator and electronics tinkerer. He spent 34 years working on a 1,920-page tome on standard verbs in the Irish language. He is open to the idea of letting the public see his semiconductor collection someday, but he seems satisfied to operate a silicon museum that attracts a very small audience.