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While his team has stumbled, Dan Cey has exceeded all expectations.

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# THE DAILY CALIFORNIAN

Independent  
Student Press.  
Established 1871.

VOLUME CXXV, NO. 60

CELEBRATING 125 YEARS

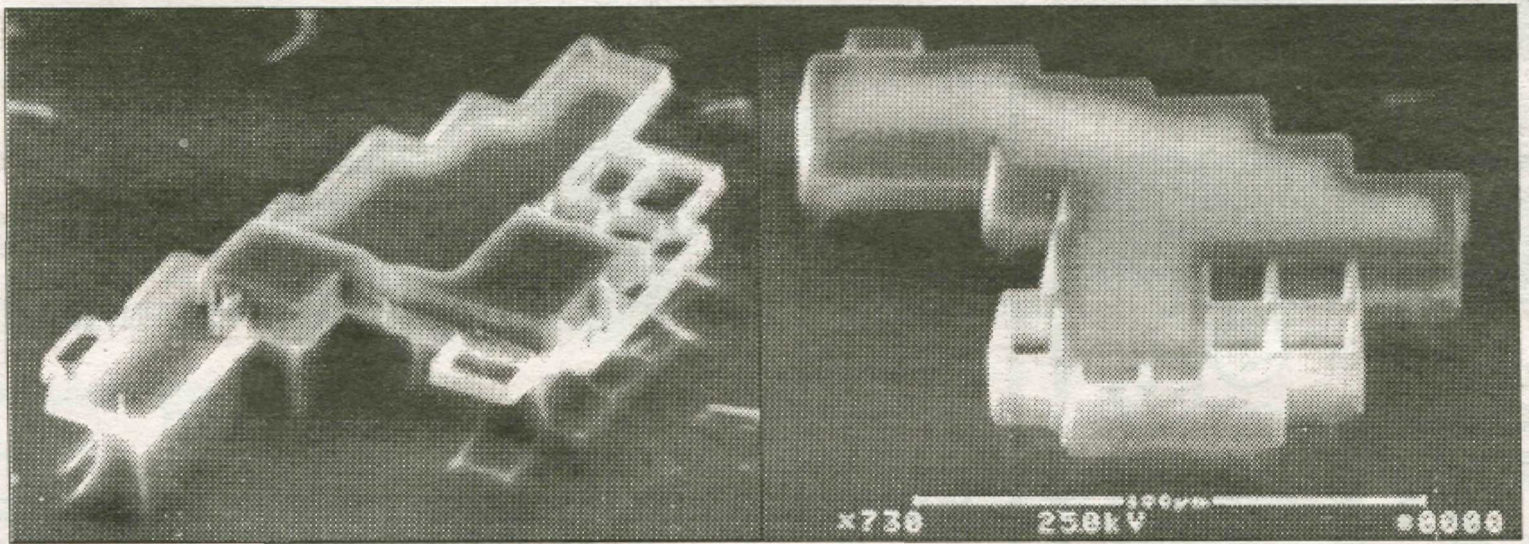
BERKELEY, CALIFORNIA

# Putting a Mansion on a Pinhead



Staff/Noah Berger

**SMALL WORLD:** Ken Goldberg, above, engineered a miniature model of Frank Lloyd Wright's house, Fallingwater, on a silicon chip. The model can be viewed only with a microscope. *See story, page 2.*



# Computer-Chip House An Engineering Marvel

**By Sunny Paul**

Contributing Writer

Imagine an image so small that it fits within the period at the end of this sentence. It sounds futuristic, but such ideas are now a reality due to some creative construction in Etcheverry Hall.

Ken Goldberg of UC Berkeley's department of Industrial Engineering and Operations Research, along with friends Karl Bohringer and Bruce Donald of Cornell University, have created a micro-miniature masterpiece. On the surface of a silicone chip, the group constructed a three-dimensional model of Frank Lloyd Wright's famous house, Fallingwater.

Completed in 1936, Fallingwater is considered one of the most significant architectural achievements of this century. The house, which literally rests above a waterfall, pioneered the idea of an architectural feature called a cantilever.

A cantilever is a ledge that hangs over another surface and serves as a method for distributing forces

within a structure. It is also a crucial component in many silicon devices, such as collision detectors in airbags. Airbags are released in response to the action of a cantilevered piece of silicon that shifts in the event of an accident.

Given the connections between silicon and cantilevered devices, it is quite appropriate for Fallingwater to be the first model built on a silicon surface of this size.

"The key is the cantilever," Goldberg said. "It plays a role in both scales, the macroscopic and the microscopic."

According to Goldberg, the project was also inspired by Kris Pister, who designed a similar microscopic model of the Campanile three years ago.

Construction of a model on a one-tenth millimeter scale is no small task. Goldberg's team began with a blueprint of the house, and, with the aid of the Berkeley Sensor and Activator Center, transcribed it into a model that they could manipulate on the computer screen.

# Chip

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The computerized picture was converted into a three-dimensional image that they sent to a silicon fabrication company in Southern California. A silicon chip was treated with a photographic cast of the three-dimensional design. After repeated acid baths and a few more casts, a computer chip bearing a model of Fallingwater emerged.

The model, which spans the width of two to three human hairs, can only be seen with a microscope. The team hopes someday to see it displayed in a museum or art gallery.

“It’s a demonstration of what is possible in relating art to technology,” Goldberg said.

For additional information, explore Goldberg’s home page, at <http://www.icor.berkeley.edu/~goldberg/flw/>.