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Zuoyue Wang discusses the role of Chinese-American engineers in the Southern California aerospace industry. (credit: D. Day)

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# Blue skies on the West Coast: a history of the aerospace industry in Southern California

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## Hollywood, immigrants, and Silicon Valley

The next panel addressed issues of science, technology and business and featured Peter Westwick, a historian at the University of California at Santa Barbara, Glenn Bugos, a historian at NASA's Ames Research Center, and Zuoyue Wang, a historian at California State Polytechnical Institute at Pomona.

Westwick was one of the organizers of the conference and is the author of [a recent book on the history of the Jet Propulsion Laboratory](#), or JPL. He spoke about the links between JPL and Hollywood in the field of computer graphics. Although it is now common for computer-generated imagery to appear in everything from blockbuster films to home movies, much of this technology originated at JPL in the 1970s and the NASA-funded research and development center was once a dominant leader in that field. Westwick recounted how JPL's Jim Blinn provided imagery for Carl Sagan's 1980 PBS series *Cosmos*. That imagery had been developed by Blinn to help visualize the Voyager

flybys of Jupiter and Saturn that occurred in the late 1970s and early 1980s. JPL's Digital Image Animation Lab (DIAL) also performed more mundane work for Hollywood, such as erasing the power lines from the Egyptian skyline in the 1981 movie *Raiders of the Lost Ark*. DIAL also digitally cleaned up old *Star Trek* television prints. But DIAL soon produced ground-breaking imagery, such as a detailed sequence for the 1982 movie *Star Trek II: The Wrath of Khan*. According to Westwick, JPL also made other less direct contributions to Hollywood imagery by putting its basic research in the public domain, where other computer specialists could access it and build upon it.

Some DIAL imagery experts left the lab to work for Disney, and by the mid-1990s Hollywood surpassed JPL in computer imaging technology. This was part of a much larger trend of the decline of aerospace and the rise of entertainment in the southern Californian economy, and by 1995 entertainment employment surpassed aviation employment in the region.

Westwick concluded by stating that today some of that has reversed and rather than computer specialists going to Hollywood, some of the Hollywood-trained computer imagery specialists have now moved into other industries, including aerospace.

Glenn Bugos is the historian at Ames Research Lab and the author of a book on the F-4 Phantom interceptor. Ames is not really a southern California institution, but is located near San Jose, 550 kilometers north of Pasadena, in what is commonly considered by Californians to be northern California—and the heart of American electronics entrepreneurship. Bugos said that Ames is “probably the one place in the world where secure government jobs are seen as a drain on the economy.”

The theme of his talk was on overlooked aspects of California’s aerospace history and the things that historians should investigate. Bugos did not focus on Ames, but instead discussed a

**Although it is now common for computer-generated imagery to appear in everything from blockbuster films to home movies,**

number of document collections on the aerospace industry as well as issues that aerospace historians should address. For instance, he noted that many corporate aerospace archives, if they ever existed, were destroyed during consolidations and takeovers, making a corporate history of aerospace hard to research.

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However, an early president of Lockheed left his papers to Stanford University. Bugos noted that the corporate archives of several other important companies, including Litton, Varian, Ampex, and Raytheon Semiconductor also went to Stanford.

Bugos said that the modern computer industry in the San Francisco Bay area owes a lot of credit for the development of clean room technology to Lockheed. When Lockheed established its missiles and space facilities in Sunnyvale, the company built clean rooms for its spacecraft and hired virtually every heating and air conditioning

contractor in the region. They developed techniques and technologies for clean rooms that were later employed by other industries in the region.

Bugos concluded by discussing several subjects that he feels deserve greater attention from historians. These include the roles of “cross-pollinators and intelligence-gatherers.” During the development and evolution of the aerospace industry various people served to spread information from one organization to another. These included government “resident inspectors” at aerospace companies and people who were brought in to expedite programs. He suggested that government contract files might yield important insights into how technology spread between companies and from one industry to another, and singled out the files of the National Advisory Council for Aeronautics (later NASA) Western Support Office which was based in Los Angeles. Those papers are now stored at the National Archives in Laguna Niguel, south of Los Angeles.

In response to a question about the relationship between civilian economic development and the role of military spending on high technology, Bugos said that the debates about this subject may be missing a key issue. He suggested that economists need to look not only at technologies and tech transfer, but also at the role of the military mindset and the management influence on technology development.

Zuoyue Wang spoke about what he called his “work in progress” on the role of Chinese American scientists and engineers in southern California aerospace. He said that after the 1949 Communist takeover of China, approximately 5,000 Chinese students were “stranded” in the United States. Several hundred returned to China, but most of them stayed, and he is trying to understand how some of them entered the aerospace workforce. In addition, approximately 2,300 refugees also came to the country. These were all technically trained people.

Wang also discussed the story of Tsien Hsue Shen, who had worked on

missile projects at the Jet Propulsion Laboratory and taught at Caltech. When Tsien decided to return to China after the revolution and packed up his unclassified technical library to take it with him he was suspected by the FBI of being a possible spy, detained for a short time, and then placed under house arrest. After several years Tsien was allowed to return to his homeland, where he eventually helped the country develop its own ballistic missiles, initially by copying the V-2 rocket.

Wang said that Asian Americans have risen high in technical positions in aerospace, but not in their companies' leadership. He also noted that whereas many white Americans discuss Chinese Americans as if they are a monolithic group, within the Chinese American community there is not much coherence, and more diversity than is apparent by the color of their skin. For instance, the community includes American-born Chinese Americans as well as immigrants from mainland China, Hong Kong, and Taiwan. They all have different cultures and customs



and do not consider themselves part of the same group.

Finally, Wang discussed the continuing issue of the loyalty of Chinese Americans and noted several spy scandals in addition to the well-known Tsien case in the 1950s. These include Peter Lee in 1997, Wen Ho Lee in 1999, and Chi Mak in 2007.

### **The sociologist, the feminist, and the angry artist**

The final panel of the first day focused upon aerospace society and aerospace cultures and was billed as “a conversation” between DJ Waldie, author of *Holy Land: A Suburban Memoir*; MG Lord, author of *Astro Turf: The Private Life of Rocket Science*; and Allan Sekula, an artist who created a multimedia presentation called *Aerospace Folktales in the 1970s*. A common theme of all their talks was how the aerospace industry affected the families of those who depended on it. This was not always an uplifting story.

DJ Waldie, a sociologist who works

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for the public information office of the city of Lakewood, delivered a well-polished speech about the development of Lakewood, California, southeast of Los Angeles and only a few miles inland from Long Beach. Waldie noted that Douglas Aircraft in Long Beach had employed 50,000 people during World War 2 and 100,000 during the height of the Cold War. Today there are a total of 30,000 people working in aerospace and 70,000 in related industries. He recalled how during the Cold War aerospace workers were commonly ridiculed as hicks in the popular press. They were “aviation okies” who had emigrated from Oklahoma and other unglamorous states and were constantly whipsawed by the economic swings of the industry.

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Waldie said that unlike other aspects of California’s past, such as the Gold Rush, it is unclear if there is any nostalgia associated with the decline

of the once vital aerospace industry in the region.

MG Lord spoke about her book, *Astro Turf*, recounting the history of her father's work at the Jet Propulsion Laboratory in the late 1960s and early 1970s. She said that this had been a difficult time in her family's life. Her mother was dying of cancer, but her father disappeared almost completely into the male-dominated world of JPL, where he was working on the Mariner 10 spacecraft for Northrop. "What we needed was a full-time husband and father, and what we had was a Cold War engineer," she said.

Lord said that when she was a young girl, her father wanted her to be an engineer and encouraged her to make model airplanes and rockets. But he lost interest when she entered puberty and her father began referring to her as a member of "the servant gender." She joked that it was a sign of her neurosis that she had to find out about "where daddy went" when she was little. She showed several humorous photographs illustrating the chauvinistic culture of JPL, including a picture of the winners of

JPL's "Miss Guided Missile Pageant," later renamed the "Queen of Outer Space" Pageant.

Lord also talked about the first women to enter into the male-dominated world of JPL. These included Marcia Neugebauer, JPL's first woman project scientist, who studied the solar wind; and Donna Shirley, JPL's first female engineer, who later ran JPL's Mars program. There was a saying at JPL at the time that "Neugebauer studied waves and Donna made them." Of Shirley she said that "As soon as she was admitted to the clubhouse she wanted to change all the passwords"—and make it possible for more women to follow her.

Aerospace workers tended to be patriotic, but also lived in fear that their government would take away their jobs. In response to a question about the role of religion in aerospace families, Lord noted that "MG" stood for "Mary Grace" and recounted how her mother used to take her to church and encourage her to "ask God to preserve daddy's job... and God, of

course, had other plans.” Aerospace was a feast and famine industry.

Photographic artist Allan Sekula explained how his father had been an aerospace worker in the 1960s and he had followed in his footsteps as a technician in the aerospace industry in the early 1970s, as the Vietnam War was winding down. His father was a materials engineer who worked on the Army’s AH-58A helicopter and also paint for the Lockheed L-1011 Tristar passenger jet. But he was laid off and then spent the next three years unemployed, getting up every morning and putting on his short-sleeve shirt and tie as if he was going to the office, but spending the rest of the day writing employment application letters to other companies. This too represented part of the history of aerospace in southern California: large numbers of workers laid off when companies lost major government contracts or civilian orders, and then forced to scrounge for work until the next boom cycle. During the height of his unemployment, Sekula’s father

calculated that it cost 35 cents per person per day to feed his family.

Sekula himself hated working as a materials technician, which he did for a couple of years before realizing that he did not have to do that his entire life and could instead pursue his artistic ambitions. He started taking photographs of his family, and recording conversations with his mother and father, eventually incorporating these into a presentation that featured projected images accompanied by the recordings he had made, as well as a narration of his family story.

The family lived in a small rented house across from Fort MacArthur, near a spot where the Army trained new recruits to deal with tear gas. “My brother and I could smoke pot on the porch and watch soldiers come out of this chamber and vomit,” he said. He also remembered how his high school gym coach would make them climb ropes by standing underneath them and shouting “The VC are coming after your ass!”

## The first

Sekula recalled that during this time PBS was showing a groundbreaking documentary called *The American Family*, but Sekula did not like it because it ignored the economics of family life. What about the unemployed? He also showed photographs of what he referred to as stereotypical examples of American middle class life, such as the books of great literature that families obtained through subscription and then rarely read. These included titles such as *Grimm's Faerie Tales*, but also many nautical themed books because his mother had been an ensign in the Navy WAVES during World War 2. He also showed a photo of one of his father's books titled *The Effects of Nuclear Weapons*.

women at JPL included Marcia Neugebauer, JPL's first woman project scientist, who studied the solar wind; and Donna Shirley, JPL's first female engineer, who later ran JPL's Mars program. There was a saying at JPL at the time that "Neugebauer studied waves and Donna made them."

During the question and answer period Sekula complained about the

current position of aerospace in American society, occasionally speaking in apocalyptic tones. He referred to national missile defense by saying that “I find these priorities bizarre and threatening to the future of humanity.” He also said that it was terrifying to him that Christian fundamentalists were so prevalent at the Air Force Academy, and they would eventually have access to nuclear weapons and might believe that they had a role to play in fostering armageddon.

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