Angered and emboldened by the Wen Ho Lee case, many Asian-American researchers at national labs are decrying their status as "high-tech coolies"—and demanding change

Silent No Longer: 'Model Minority' Mobilizes

When physicist Shao-Ping Chen sifted through his e-mails one Monday morning in August, he came across an unsettling message. "Wen Ho Lee should be supported (by the neck), cut down, drawn, and quartered," read part of a diatribe from a colleague at New Mexico's Los Alamos National Laboratory that had been forwarded to Chen. At that point, the federal government, after conducting a massive investigation of Lee for possible espionage and keeping him in solitary confinement for 9 months, was preparing to put the former Los Alamos physicist on trial for mishandling classified data. For Chen, the e-mail, with its allusions to a lynching, was a frightening reminder of the racial overtones that he believes tainted this case from the start. "It had a very chilling effect on me," he recalls.

In response to the Lee saga and its fallout, Asian-American scientists and engineers like Chen are turning up the heat. The government's case against Lee imploded in September, when prosecutors dropped all but one of 59 charges against him and a federal judge set him free with a stinging indictment of the government's conduct. But many Asian Americans at the nation's weapons labs are now aggressively protesting a culture that they believe has not only singled them out as potential security risks but has also held back their careers. They also have compiled figures, which are disputed by lab officials, indicating that on average they lag in terms of pay. "The term going around now among us is that we're high-tech coolies—if we work hard, we're given more work," says Joel Wong, an engineer at Lawrence Livermore National Laboratory in California.

It's a sudden and surprising turn of events for a community that traditionally has avoided political organization, legal recourse, and conflict with authority. "They don't sit at the back of the bus," says Hugh Gusterson, an anthropologist at the Massachusetts Institute of Technology who has studied both Los Alamos and Livermore. "But they feel marginalized, alienated, and persecuted." And given the growing numerical muscle of Asian Americans in both public and private labs, the budding movement—if sustained—will be felt far beyond the secure fences of the Department of Energy's (DOE's) weapons labs. AIDS researcher David Ho of the Rockefeller University in New York City, who sits on a presidential panel examining the status of Asian Americans and Pacific Islanders, says that the case is having a "dramatic effect" on Asian-American researchers. And he predicts those effects "will ripple through the academic community as well."

Outspoken. Livermore's Joel Wong decries Asian-American status at lab.

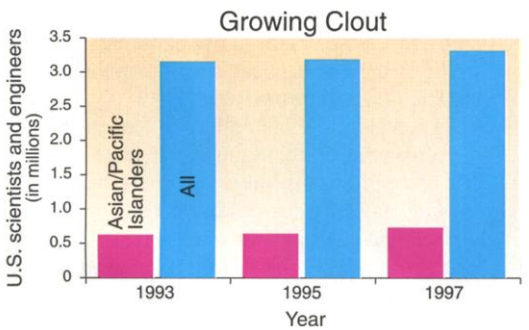
The ripples likely won't stop there, others add. "The Lee case is likely to be seen as a watershed" for Asian Americans by future historians, says Paul Igasaki, vice chair of the U.S. Equal Employment Opportunity Commission (EEOC), which is investigating discrimination charges at both Los Alamos and Livermore. Steven Aftergood, a security analyst at the Federation of American Scientists in Washington, D.C., agrees. "The case has catalyzed a new degree of organization and activism—among Chinese Americans in particular and Asian Americans in general—that is irreversible," he says.

Chen, who spent nearly 2 weeks of his vacation time sitting through hearings on the Lee case this summer in Albuquerque, gives lab management 2 years to address what he sees as egregious salary and managerial inequities. If there's no change, the 15-year Los Alamos veteran adds, "I'll leave the lab." And Wong says that he, too, is ready to quit. "The Wen Ho Lee case woke us up," he adds. "It tells us that hard work and being humble are not enough."

Number power

Such strong statements are reverberating through the weapons laboratories, which are already struggling to retain and hire high-quality researchers amid a post–Cold War economic boom. Although Lee is now a free man, and many of the most drastic security measures imposed in the past 18 months have been relaxed, the allegations of espionage, concerns about racial profiling, foreign travel restrictions, plans for polygraph testing, and a call for a national boycott of all DOE labs by Asian Americans have made the labs seem less than welcoming (*Science*, 6 October, p. 22).

Feelings of alienation are far from universal among Asian Americans in the labs. Many say they have not experienced overt discrimination, and others point to language difficulties and cultural traditions which frown on self-promotion that can block career advancement. But the growing sense of anger and frustration that many Asian Americans are now expressing is a particularly worrisome development for those who oversee the labs. "If we can't make the labs an attractive place for Asian Americans," says Livermore director Bruce Tartar, "then we lose big time."



More muscle. Asian Americans in the 1990s were an increasingly larger presence in the U.S. science and technology workforce.

CREDITS: (TOP TO BOTTOM) R. KOZAK; NATIONAL SCIENCE FOUNDATION

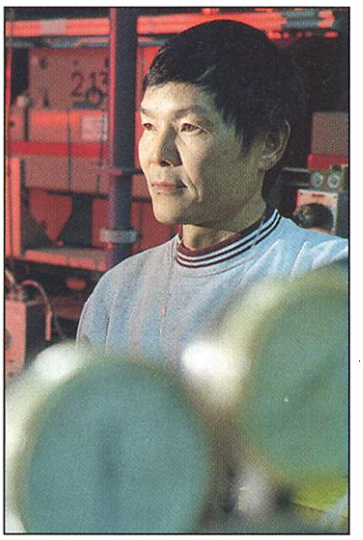
Lee Case Births a Reluctant Activist

MENLO PARK, CALIFORNIA—With his black hair, lean frame, and "Far Side" T-shirt, Alex Chao looks more like a busy postdoc than a 51-year-old senior physicist at the Stanford Linear Accelerator Center (SLAC). But his 26 years at government laboratories afford him a nuanced view of the status of Asian-American researchers in the labs.

Until the past year, Chao tended to keep his views to himself. "My natural inclination is to avoid this kind of thing," he says. But the Wen Ho Lee case turned Chao into a reluctant activist who has contributed money for Lee's defense, helped organize rallies in the San Francisco Bay area, and talked to his neighbors about the injustice he believes Lee and other Asian Americans have suffered.

Chao, like many Asian-American researchers, is not vocal about his own experiences as a minority scientist. The Taiwanese-born physicist says he has avoided senior managerial positions because he prefers research to bureaucracy. But when pressed, he says that wasn't always so. While serving in the 1980s on the doomed Superconducting Super Collider (SSC) project, he applied for an important management job for which he felt he was well qualified. "I cannot of course say why," Chao says. "But I just had a feeling that I was just not being considered for the job" despite his impressive résumé. "At that time—I was young—I really cared about having a position." But he also adds that he did not feel comfortable lobbying for the job. When the position went to a white male, he let it go and returned to SLAC, where he had worked previously. He says he is happy doing research, and he has since eschewed the management track. "I said, 'Why should I bother?' "

Chao says he's aware of a glass ceiling separating many Asian-American researchers like him from senior management. It exists even at the ethnically diverse SLAC, which solely does unclassified research and is open to scientists from around the world. "If a position comes open, or there is an important talk to give," Chao says, managers "have a tendency to think of a person close to the person in power." And Asian Americans "tend to be on the second list." The discrimination is largely unconscious, he says, guided by the social net that runs through every lab. And Asian Americans themselves bear some of the responsibility, he says, because they are reluctant to voice complaints or promote their own interests. "Cultural differences make it harder to speak up," he says, adding that this probably accounts for his own failure to pursue the SSC job more aggressively.



Lost innocence. SLAC's Chao avoided politics until now.

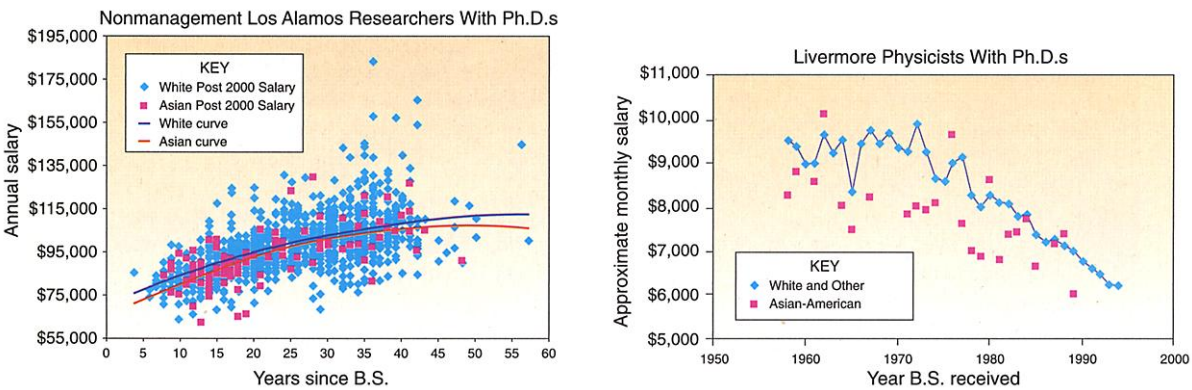
Chao does not advocate ethnic quotas for hiring and promotion: "That sounds like strong medicine for the illness." But in light of the Lee case, he doesn't want to let the issue of discrimination drop. He will continue his activist work—although not if it means doing less research. "My respect for our system has gone down a notch because of this," he says. "I don't want all Chinese Americans to be seen as potential spies—I would like to have the innocence returned to this group of people."

–A.L.

The number of researchers and managers who are leaving the weapons labs is increasing. Attrition rates at Los Alamos have risen from 2.7% in 1996 to 4.1% in 1999. Jonathan Medalia of the Congressional Research Service estimates that about half of the entire workforce of the weapons labs will have retired by 2010. Finding a new generation to baby-sit the world's largest nuclear arsenal is already an enormous challenge. The higher salaries, stock options, greater flexibility, and fewer intrusive security measures in the booming private sector already have made the competition tough.

Asian Americans—a heterogeneous group that includes recently transplanted Indian computer scientists, highly educated physicists who fled China's Cultural Revolution, and biologists who are third-generation Americans of Japanese descent—are an increasingly important source of top-notch recruits. They constitute the fastest growing ethnic group in the country—expected to more than double to 10% by 2050. They are also highly concentrated in science and engineering. Almost 70% of doctorates earned by Asian Americans are in the life sciences, physical sciences, and engineering—far above the average for other ethnic groups. One-fifth of all U.S. doctorates awarded in these fields go to persons of Asian heritage, and Asian Americans are three times more likely to be scientists or engineers than is the average American. At Los Alamos, 4.5% of professional staff members are Asian American—a jump of one-third in just 5 years—while at Livermore nearly one in 10 professional staff members is of Asian heritage.

There is already evidence that fewer Asian Americans are applying for jobs since Lee's firing in March 1999. From June 1997 through February 1998, there were nearly 900 applicants for jobs at the three weapons labs, 18% of whom were of Asian origin. From March 1999 through February of 2000, the number of applicants stayed roughly the same, but the percentage of



Pay grade. Asian-American researchers at both Los Alamos and Livermore labs say that on average they earn less than their primarily white colleagues, from the start of their careers to the end.

CREDITS: (TOP) M. KLIMEK/THE LIAISON AGENCY NETWORK; (LEFT) LOS ALAMOS EMPLOYEES; (RIGHT) LIVERMORE EMPLOYEES

Asians dropped below 10%.

DOE officials say there is little question that the Lee case and its aftermath are partly responsible for the decline. And they agree that morale has suffered. "The Wen Ho Lee case has raised a lot of fear, distrust, and suspicion," says Jeremy Wu, appointed by Energy Secretary Bill Richardson in January to monitor potential discrimination. It also raised "long-standing issues of the glass ceiling and pay inequity."

Data dispute

The scant data available on those "long-standing issues" appear to support Asian American concerns. Their growing numbers have not translated into managerial power. As with women, Asian Americans easily enter the doors of academia and government laboratories but then generally fail to rise as high or as fast as their white male colleagues.

At Livermore, nearly one in 10 members of the professional staff is Asian American, but only one in 25 is a manager or supervisor. Similarly, at Los Alamos, about one in 25 professionals is of Asian heritage, but just one of 99 top managers at the lab is Asian American. Employees and lab managers alike acknowledge this glass ceiling, although there is disagreement over why it exists and how it should be broken.

Documenting pay inequities is more difficult, because employees and lab managers disagree on how to interpret the data. According to a group of Livermore Asian Americans, the average salary of an Asian-American physics Ph.D. at the lab is as much as $12,000 a year below that of other physics Ph.D.s. The group also maintains that salary discrepancies increase with the length of service, and that the inequities have changed little over the past decade. Robert Kuckuck, Livermore's deputy director of operations, disputes this analysis. "We see no significant differential in salary," he says. But he declined to provide data, noting that "it's still in a preliminary state."

Likewise, Los Alamos managers take issue with an analysis by Chen that shows a $3000-a-year average salary gap between Asian Americans and their Los Alamos colleagues. "The lab found a statistically insignificant difference in salaries between the two groups," says Jacqueline Paris-Chitanvis, a lab spokesperson. But Los Alamos officials, like their Livermore colleagues, say they cannot release their data.

Catalyst for action

It took the Lee case to bring these issues of pay and the glass ceiling out in the open. Lee's treatment, and the harsh lab security measures imposed in the wake of his March 1999 firing, prompted two organizations—the Asian Pacific Americans in Higher Education and the Association of Asian-American Studies—to call for an employment boycott of all DOE labs.

Asian Americans, however, are sharply divided over whether a boycott is the proper approach. "It is hurting the labs and creating a wall at a time when we need dialogue," says Manvendra Dubey, a Los Alamos atmospheric chemist and chair of the Asian-American diversity working group. But during a recent gathering of a half-dozen Asian-American Livermore employees, five of the six said they backed the boycott as a way to put pressure on management. Says Ling-Chi Wang, the ethnic studies professor at the University of California (UC), Berkeley, who proposed the boycott: "This is a vehicle to express our collective outrage and get the message across."

Although the media spotlight has primarily been on Los Alamos, the level of distrust between employees and managers seems particularly intense at Livermore, which is located in a region with the highest proportion of Asian Americans in the country. As the Lee case snowballed last fall, nine Livermore employees submitted formal complaints charging UC—which operates both Livermore and Los Alamos—with discrimination in pay and promotion opportunities. Kalina Wong, one of the nine and a group leader in controlled materials, says management has not taken Asian-American concerns seriously enough. Adds one of the employees: "I haven't gotten a promotion in 16 years—I feel blackballed."

Livermore nine. Kalina Wong and eight colleagues filed a formal complaint about pay inequity.

CREDIT: M. KLIMEK/THE LIAISON AGENCY NETWORK

The complaints prompted the California Department of Fair Employment to investigate. If the department's report backs the allegations, says the group's lawyer, Jack Lee, he expects to file a class-action suit. Meanwhile, the federal EEOC is conducting its own investigation. "It's very unusual for both to be investigating the same entities," says Lee, of the San Francisco law firm Minami, Lew & Tamaki.

Livermore managers decline to discuss the investigations but dismiss the idea that there is systematic discrimination. "We've been looking at these same issues for 5 years," says Susan Houghton, public relations chief at the lab. "And you are always going to have people who feel differently."

Reluctant critic

George Kwei, a senior physicist who has worked at both Los Alamos and Livermore, is one of the reluctant activists. Kwei, who came from Taiwan at the age of 12, would seem to be a poster boy for Asian-American success. He arrived at Los Alamos in 1974, excelled in laser research, rose to deputy associate director at the lab, and continued vibrant research in neutron scattering. "He's done a lot of fine work in a remarkable number of fields," says his Harvard mentor, Nobel Prize–winning chemist Dudley Herschbach.

Kwei also helped Los Alamos director John Browne's office draft memos and public releases during the Lee crisis. He vociferously opposes the boycott and fears that both Los Alamos and Livermore are losing prestige. But recent events have put him in the critics' camp. He was shocked by what he felt were an intelligence official's racist comments during a lab security seminar and by the pay and promotion data passed around among Asian-American employees. So when a pet research project he proposed at Los Alamos was continuously rebuffed, and when he was passed over this summer for a senior job at Livermore for which he believes he was well qualified, Kwei says he began to wonder if his ethnicity played a role.

He reached this conclusion reluctantly, he says, but last month he filed a request for an administrative review as to why he was not selected for the job. "Their response was totally unsatisfactory," he says, adding that he has since asked for an independent review. "I could find a lawyer and sue the lab and UC," Kwei adds. But he says the real purpose of his complaint is to underscore that management must be more aggressive in putting Asian Americans into leadership positions.

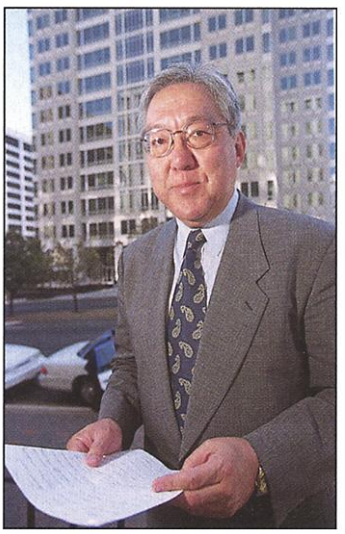
Lab managers declined to discuss Kwei's case. Joseph Thompson, Kwei's former Los Alamos group leader, says he doubts Kwei's proposed project was de-

railed because of prejudice, and other former co-workers say that Kwei sometimes could be prickly and abrasive. But Kwei's disaffection, whatever the particular merits of his complaints, illustrate that distrust has reached the highest level.

Asian Americans disagree on whether lab management and DOE are taking their concerns seriously. Kwei believes senior management at both Livermore and Los Alamos are sincerely attempting to address the problems, although he worries that that commitment drops off at lower levels. But Livermore's Dorothy Ng is skeptical that the senior management will make changes without intense pressure from DOE and employees. "If we don't hold the lab accountable, nothing will get done," she says.

DOE's Wu notes that the department is hampered by its arms-length relationship to the labs, which are run by private contractors. But he points out that Richardson last month ordered DOE's inspector general to investigate whether security clearance procedures mask racial profiling. He also recently ended a ban on foreign visitors from certain countries—including China and India—to the weapons facilities. And Wu hosted a recent conference bringing together various Asian-American researchers from around the DOE complex. DOE managers also say that they aim to give Asian-American employees a voice through a new ethnic organization. But critics say the department has made many blunders beyond the Lee case, such as last year's security video that included a woman with East Asian features in a trench coat, fedora, and carrying a spy's tiny camera.

Lab managers say that they are trying to create a dialogue by promoting discussion of diversity and strengthening career-enhancement efforts. Both Browne and Livermore's Tartar have met in recent weeks with groups of Asian-American employees to discuss their concerns. With the 2001 budget out of the way, Tartar says he intends to make it a top priority. Adds Steve Younger, who leads Los Alamos's famed X division where Lee worked and which oversees the design of nuclear weapons: "It's not our intention to exclude people." But he agrees that the lab has "its own peculiar culture—and it's a culture that needs to change."



Blocked? Despite scientific success, George Kwei feels stymied in his attempt to move up.

Culture clash

Indeed, change is coming to all the national labs, as well as to academia and industry, says Rockefeller's Ho. "How many Asian Americans do you see doing science, and how many do you see as leaders?" he asks. "There's clearly a huge gap."

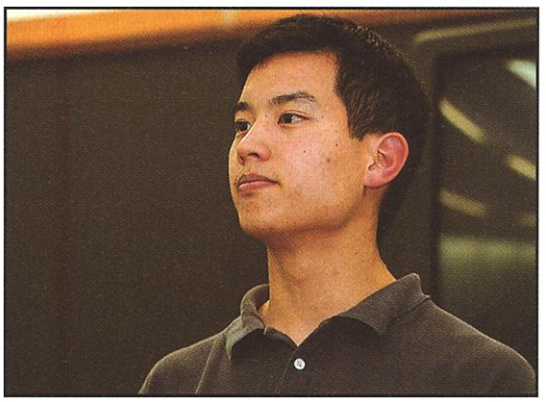
Many Asian-American researchers acknowledge that smashing the glass ceiling and redressing apparent pay inequities require change within their community as well.

New Breed of Protester Asks: Why Not Us?

BOSTON—On a rare hot night this past June in Cambridge, Massachusetts, computer science grad student Roger Hu tossed and turned in his stuffy apartment. For nearly a year he had been following with increasing anxiety the case of Wen Ho Lee, the Los Alamos National Laboratory physicist who had been arrested and jailed in New Mexico under suspicion of mishandling classified data. Unable to sleep, Hu fired off a 3:00 a.m. e-mail to a West Coast venture capitalist, an Asian American and longtime mentor to Hu.

"I asked him right off—I don't know if protesting is the way to go. That seems to be something reserved for other people." The response was immediate and unambiguous: "Let your voice be heard," his mentor responded. "Protesting is an important aspect of the political process." Hu took the advice, and the 22-year-old has become a key organizer among Asian-American scientists and engineers in the Boston area.

Now Hu struggles to keep up with his Massachusetts Institute of Technology (MIT) classes in computer science and electrical engineering in his new life as an activist. In one 5-day period in September, he packed an MIT lecture room with students and professors for a teach-in on the Lee case, helped raise $14,000 for Lee's defense from a Boston Chinese-American group, and led a protest rally at the University of Massachusetts, Boston, the night of the first debate between presidential contenders George Bush and Al Gore. Two weeks later he was invited to a private audience with MIT President Charles Vest to discuss the Lee issue.



Wake-up call. Roger Hu went from self-described MIT "nerd" to key Boston organizer.

Such political activism, he insists, is not in his blood. With a father who is an electrical engineer, a mother who's a chemist, and two computer scientist siblings, "we sometimes call ourselves a bunch of nerds." Nor did Hu—who was raised in Palo Alto, California, describes himself as a "diehard Bay Area kid," and speaks in the typical lingo of California youth—learn much while he was growing up about the culture and language of his parents' native Taiwan and China. "We're entirely Westernized," he says. And he doesn't see himself as a victim of racial bias: "I can't quite relate to discrimination, though I know it exists."

Lee has been released from prison, but the handling of the case was an eye-opener, Hu says. During final exams last December, he was astonished to read that the federal case against the physicist was going forward. But even more disturbing, he says, was the bored reaction of his classmates when he showed them news clips. Last spring, he helped organize some small events, and "everything snowballed from there."

Hu has energized many Asian Americans, but remains critical of the lackluster response of MIT students and faculty, who "have not really spoken out." He did meet privately with Vest last month, at the president's request. As a result, MIT is considering hosting a forum next year on the impact of the case on Asian Americans and the scientific community. But Hu has warned: "This is a wake-up call—if you think this is over, you're wrong. We have to protest." **–A.L.**

CREDITS: (TOP TO BOTTOM) RICK KOZAK; SAM OGDEN

Harbinger of a Litigious Future?

When the chair of the pharmacology department at the University of California (UC), Davis, pledged in writing to find a permanent position for microbiologist Ronald Chuang, Chuang and his wife Linda—a researcher who works in his lab—were delighted. The position would put him on the tenure track and make him less dependent on the grants from the National Institutes of Health that powered his AIDS research.

A dozen years later, the delight has turned to anger. Ronald Chuang still has no permanent position, and he and his wife filed suit in 1997 over what they allege is a long and egregious series of discriminatory acts by the university. The university's defense team rejects the charges of discrimination, and a lower court backed the university in 1998. But 2 months ago, a federal appeals court reversed that ruling, giving a green light for the case to go to trial, perhaps in the next year.

Academics suing their institutions is hardly a new phenomenon, but Asian Americans traditionally have been far less litigious than members of many other minority groups, say university and Asian-American officials. That may be changing in the wake of the Wen Ho Lee case. "There's been a steady rise in complaints [among Asian Americans] in the past decade," says Margaret Fung, executive director of the New York City–based Asian American Legal Defense and Education Fund. "But after Wen Ho Lee, we have heard from many more scientists and researchers who were very unhappy with their treatment." The Lee case, she adds, "has led to a lot of mobilization" that is likely to translate into more complaints and suits. That view is seconded by other Asian Americans who work on such issues.

Originally from Taiwan, the Chuangs did their graduate work at Davis. In 1981, Ronald Chuang was made an assistant professor of pharmacology, and shortly after that, Linda Chuang became a research assistant. In 1988, the department chair wrote a memo to an assistant dean committing the school to finding a permanent position for Ronald. But that position never came through, despite five retirements in the pharmacology department after 1989. For the next decade, the Chuangs maintain that they were subjected to a pattern of racial harassment, from alleged slurs to a hallway fight—claims strongly rejected by UC Davis.

The final straw came in 1996, when the Chuangs' lab and that of another Chinese-American researcher were moved to the basement—next to the morgue—as part of a general reorganization. "No Caucasian faculty member with active research was required to relocate," states the appeals court decision. That relocation, the court noted, "had a calamitous effect" on the Chuangs' research, as their space was reduced, the floor design complicated their work, and their offices were on the fourth floor. A technician, grad student, and undergrad quit shortly thereafter. The move also upset the Chuangs, who maintained that working so close to the morgue was particularly offensive for persons of Chinese heritage.

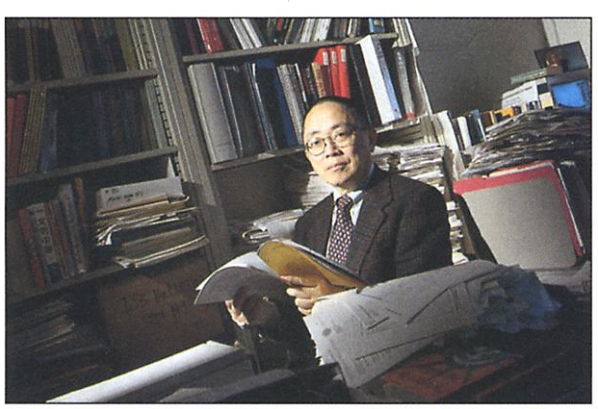
The Chuangs filed a complaint that year with the Equal Employment Opportunity Commission and, in 1997, they filed suit in California's eastern district U.S. court. The university argued that Ronald Chuang's position was never in jeopardy, that the dean was prepared to cover his base salary if his research grants dried up, and that the relocation was necessary to accommodate another program that was growing more quickly and was more in line with the university's long-term research plans. The district court ruled that "Ronald Chuang fails to come forward with adequate evidence" of discrimination.

But the appeals court strongly disagreed, and Peter Sandman, Chuang's attorney, says a settlement is unlikely. "The university has been utterly intransigent—it's remarkable and amazing the university does not recognize the way they've treated these people." UC counsel Eric Behrens says "the university feels very strongly it has done nothing wrong."

–A.L.

Academic battleground. Research facilities at UC Davis, where the Chuangs allege discrimination.

Language difficulties can pose an obvious barrier to advancement, but many Asian-American researchers say that cultural differences discussed less openly also are holding them back. "People of Chinese, Japanese, and Korean backgrounds generally do not want to rock the boat," says William Chu, a Korean-American biologist at Lawrence Berkeley National Laboratory in California. "It's a cultural thing." Kwei agrees. "In general, Asian Americans have been brought up to work hard and not make waves—to let our work speak for itself."



Outraged. Berkeley's Wang led call for lab boycott.

Don Tsui, a physicist at Princeton University in New Jersey and a 1998 Nobelist born in China, says this low-key and self-effacing approach no longer is enough in the competitive world of U.S. research: "The general attitude that you just do your work is completely out of date." U.S. researchers, he adds, must realize that "if you don't toot your horn, no one will do it for you."

Asian Americans also may have trouble adapting successfully to a system that tends to reward aggressive and outspoken individuals. "That is treasured in American culture," says Kunxin Luo, a rising biologist with a joint appointment to Lawrence Berkeley and UC Berkeley who came from China a decade ago. "In most Asian cultures, being modest is the number-one virtue." She recalls her difficulty in negotiating her own salary: "My American supervisor said I should be much tougher, but I just couldn't do it."

The result is a form of self-imposed discrimination in which Asian Americans avoid the managerial track and stick to the lab bench. Simon Yu, a senior high-energy physicist who has worked at Livermore and now is at Lawrence Berkeley, insists he prefers research to shuttling back and forth

CREDITS (TOP TO BOTTOM): OFFICE OF PUBLIC AFFAIRS/UNIVERSITY OF CALIFORNIA, DAVIS; M. KLIMEK/THE LIAISON AGENCY NETWORK

to Washington or chairing administrative meetings. Although he's vocal on technical issues, he acknowledges that he becomes "shy when jostling for a position." He recalls a meeting of U.S. and European physicists where everyone literally fought for the best seat. "I told my wife that night, 'I don't belong here.' "

Americans of East Asian heritage say that they must constantly navigate the conflicting currents of their two cultures. "I've tried—consciously—to be as Americanized as I can," says Luo, as she bustles around her office. "Until Asian-American scientists can understand the differences and purposefully try to melt into this culture a little bit better, there will be problems." But others put an emphasis on what their native cultures can bring to the lab—such as a more careful and collaborative approach. "Since we come from a basically poor resource environment, we usually plan two or three steps ahead," says Livermore's Joel Wong. And the East Asian tradition of collaborative efforts, as opposed to the rugged individual model of the West, is a good fit for an era of large and complex scientific endeavors, he adds. And, Wong says, "I don't want to lose my cultural traits. Each immigrant brings to this country a gift."

But the hard lesson from the Lee case, says Berkeley's Wang, is that Asian Americans must learn to play by traditional American rules when necessary: "It's fine to retain our traditional cultural values, but democracy only works for those who participate." If you don't take part, he adds, "you'll be run over." But there is an alternative—at least for those who have not been in the United States for generations—Wang notes. An increasing number are voting with their feet by moving to the booming universities and high-tech companies of Hong Kong, Singapore, Taiwan, and South Korea, which often offer tempting salaries, benefits, and working conditions. "The best and brightest will move on, which will hurt American science," worries Henry Tang, chair of a New York–based group of prominent Asian Americans called the Committee of 100. Adds Wong: "So if this country wants to avoid a reverse brain drain, it will have to accommodate us." **–ANDREW LAWLER**

EVOLUTIONARY BIOLOGY

In Search of Biological Weirdness

William D. Hamilton was drawn to the unusual and paradoxical. His observations led to new insights into social interactions and sex

BERKELEY, CALIFORNIA—The late William D. Hamilton (1936–2000) liked to dwell on the fringes of biology. When most of his colleagues were caught up verifying natural selection and survival of the fittest, fairly straightforward aspects of evolutionary theory, Hamilton was instead drawn to life's apparent paradoxes. Why, for instance, do individuals make sacrifices for others instead of just looking out for themselves? Or why does sex exist, given that asexual reproduction is a more efficient way to pass on all of one's genes? A dedicated student of nature—some say he was the quintessential eccentric British naturalist—Hamilton had an eye for the unusual: the fig wasp that produces mostly female progeny instead of equal numbers of both sexes, the sterile worker bee who nevertheless works hard for the good of the hive. He thought deeply about how these arrangements might have evolved.

Those thoughts and the theories that resulted have inspired a generation of evolutionary biologists, providing them "with a scientific basis for studying the weirdest possible things," says Wayne Getz, an applied mathematician at the University of California, Berkeley. Getz, Berkeley's Phil Starks, and Robert Page of the University of California, Davis, organized a symposium here in October to honor this giant of evolutionary biology, who died of malaria in March at age 63. There, they and about 70 others discussed where Hamilton's ideas have taken them.

By studying life on biology's fringes, "you can begin to understand how the whole [of life] is constructed," Getz explains. Just as the gaudiness of a peacock's tail helped tip off biologists that a female's choice of mate was important in evolution, extreme lifestyles and living arrangements help researchers discern other hard-to-see biological principles. A few researchers, such as Francis Ratnieks of the University of Sheffield, United Kingdom, have found exquisite support for some of Hamilton's ideas. Others, like Getz, are coming up with theories that complement those Hamilton proposed.

All in the family

Hamilton's work on what he called inclusive fitness is seen as perhaps his most important contribution to biology. In 1963, Hamilton introduced the idea that social groups would evolve if there were enough additional benefits, in terms of passing on an individual's genes, to those participating in the group. That added benefit exists because each individual shares certain genes with relatives—the number depending on how closely related they are. So, to varying degrees, each relative's young helps perpetuate an individual's genetic legacy. Hamilton argued that participation in the group should vary according to the benefit each individual received.

He also realized that because self-interest is always partially at odds with group needs, individuals might vie to tilt the odds in favor of their own genes being passed on—even if that meant cheating on their fellow group members. As a result, conflicts could arise among group members. "The work revolutionized our understanding of reproduction, altruism, cooperation, and conflict," says Ratnieks.

Ratnieks has been exploring the conflicts that arise in social groups of ants. "We have used inclusive fitness theory to make novel predictions about areas of social life that were not [explicitly] covered by the theory before," he explains. In particular, he and Sheffield's Thibaud Monnin have been looking at how hierarchies develop and persist within ant colonies and how worker ants make sure that as many of their genes as possible are passed on even though they themselves are not laying any eggs.

Ever the field biologist. William D. Hamilton, here in Africa, believed that almost all ideas were worth pursuing.

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