France's industrial profile is on the whole similar to Germany's: Both countries are strong in machinery, transportation equipment, chemicals and pharmaceuticals, and both are weak in electronics.

The report notes that publicly funded nonuniversity research represents a relatively small part of total research funding in the United States (16%) and a large part in Europe (37%), with Japan in between (with 25%). Within Europe, public funding for nonuniversity research grew strongly during the 1980s in France, decreased in Britain and held steady in Germany.

Europe as a whole produces about the same quantity of scientific publications as the United States, with Japan running a distant third. Among the European countries France has the fewest scientific collaborations with the United States and the most with the rest of the world.

Those are among the findings contained in *Science et Technologie—Indicateurs 1992*, which can be obtained for 300 francs from Editions Economica, 49, rue Héricart, 75015 Paris, France.

—WILLIAM SWEET

SHOOTING AT UNIVERSITY OF IOWA CLAIMS FOUR PHYSICISTS, ADMINISTRATOR

On the afternoon of 1 November, during an early snowstorm, a former physics graduate student of the University of Iowa shot and killed three professors and a research associate in his department as well as a university administrator. The gunman, Gang Lu, then took his own life.

Among the victims were Christoph K. Goertz, a professor of physics; Dwight R. Nicholson, a professor of physics and chair of the department; Robert Alan Smith, an associate professor of physics; and Linhua Shan, a postdoctoral research investigator in the department. The university's associate vice president for academic affairs, T. Anne Cleary, was also killed. Miya Sonya Sioson, a student who worked part-time as Cleary's receptionist, was seriously injured and remains paralyzed from the neck down.

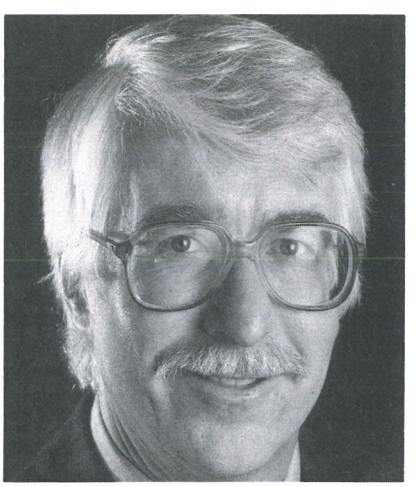
In the days and weeks following the incident, a kind of explanation has been pieced together about the events of 1 November and the motivation for Lu's actions, but many questions remain unanswered and unanswerable. It is generally believed that Lu, who had received a PhD in physics from the university in May and was considered one of the brightest students in the department, saw his attack as a means of settling grievances he had with certain people on campus, including all of those slain.

Tragic events

On the first day of November the members of the space physics theory group had gathered in Room 309 of Van Allen Hall, the building that houses Iowa's physics and astronomy department. Goertz and Smith, the group's leaders, were there, as were Shan and Lu, although Lu no longer had official ties to the group or the university. Such Friday afternoon meetings were a regular event for the group, which has been doing analytical and numerical studies of diffusion, heating and acceleration processes in the boundary layers between large-scale regions.

At about 3:40 Lu stood up and quickly and deliberately shot Goertz, Smith and Shan, according to eyewitnesses, who were uninjured. Lu then walked down one floor and shot Nicholson, who was in his office. Returning to the third floor Lu shot Smith several more times. He then walked over to Jessup Hall, an administrative building, where he shot Cleary and Sioson. Although he visited at least one other site on campus, apparently in search of victims, his only other act was to shoot himself. The entire episode lasted about 10 minutes.

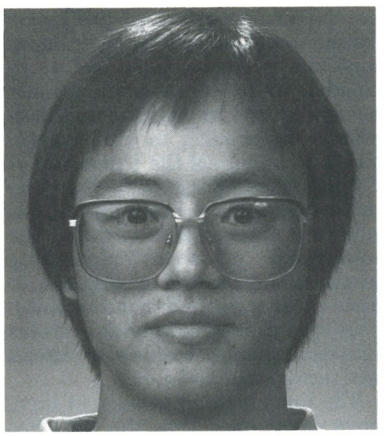
What motivated Lu to act as he did is still a matter of speculation—and it goes without saying that there can be no rational explanation. He had apparently been contemplating his deed for months: Last May he filed for and received a gun permit and in July purchased the handgun used in the shooting. Several letters that Lu had written and addressed to news organizations and family members give some clues as to his motivation, according to news accounts of the event, although the exact contents of the letters had not yet been made public when this story went to press. Among Lu's grievances were his inability to find a job despite an excellent academic record, criticisms of his dissertation during his thesis defense, which Goertz, Smith and another



Christoph K. Goertz, professor of physics, did research on Jupiter's moon Io, electron beams in auroral field lines, the spokes of Saturn's B ring and the magnetospheres of Earth, Saturn and Jupiter. A native of Germany, he earned a doctorate from Rhodes University in South Africa in 1972 and came to Iowa the following year. He was senior editor of the *Journal of Geophysical Research—Space Physics*.

Dwight R. Nicholson, department chair and professor of physics, was a plasma theorist who studied Langmuir turbulence, stability properties, solitons, nonlinear phenomena and neural networks. He wrote a widely used textbook, *Introduction to Plasma Theory* (Wiley, 1983). He earned a PhD in plasma physics from the University of California, Berkeley, in 1975 and joined the Iowa faculty in 1978.

Robert Alan Smith, associate professor of physics, was an expert on double layers, the Jovian magnetosphere and Jupiter's moon Io. Smith worked at the Naval Research Lab for 11 years and received a PhD in physics from the University of Maryland in 1973.



Linhua Shan, a research investigator in the physics department, received a PhD from Iowa in December 1990. His thesis, a Monte Carlo simulation evaluating the origin of Saturn's B ring, suggested that the B ring is not much older than 100 million years.

professor had conducted, and Nicholson's nomination of Shan rather than him for a university award called the D. C. Spriestersbach Prize, which is given to a science student only once every three years. Lu was also angered by the way he was treated when he filed a complaint to protest Nicholson's decision; Cleary was one of the university officials who handled the matter. Of the six victims, Sioson was apparently the only unintended one.

Although it had also been suggested that Lu was afraid of being sent back to China because he was unemployed, in fact he was aware that this would not occur. Under an executive order that President Bush issued ten months after the Tiananmen Square massacre, Chinese nationals are allowed to remain in the US until at least January 1994. Both Shan and Lu were participants in the highly selective and competitive China–US Physics Examination and Application Program. (CUSPEA was organized by T. D. Lee of Columbia University and from 1980 to 1989 brought more than 1000 of the best physics students from the PRC to the US for graduate study.) Shan had arrived at Iowa in January 1987, having transferred from Texas A&M University. Lu, who had been an undergraduate at Beijing University, came to Iowa from the PRC in August 1985.

Lu's acquaintances, teachers and fellow students were for the most part stunned by his actions. Although he was considered by some to have a violent temper and to be a loner, others have described him as sociable and good-natured. What is also puzzling, says Wayne Polyzou, a professor of physics at Iowa, is that Lu seemed to be on good terms with Smith, Nicholson and Goertz, all three of whom had reputations for being very fair toward their students and had made significant efforts to find work for Lu. According to Polyzou, who had taught Lu in a class and had written one or two job references for him, Lu was "possibly the brightest student I've had .... Nothing in the way he behaved would have made you think he'd do this. I think he would have had a decent career in front of him if he had been more patient."

Not an isolated case

The Iowa incident was not an entirely isolated episode within the science community. A little less than a year before the events at Iowa, a similar incident took place at the University of Crete in Greece. On 27 November 1990 a former physics graduate student there fatally shot two physics professors, Basilis Xanthopoulos and Stephanos Pnevmatikos.

The Iowa shooting also brings to mind the August 1978 murder of a mathematics professor at Stanford University by a doctoral student named Theodore Streleski. Streleski, who had been working toward his PhD for 19 years, bludgeoned to death Karel De Leeuw, who he felt had mistreated him and withheld fellowships and other departmental awards from him. Streleski served eight years in prison and has since been released.

In 1969 a math grad student at the University of Pennsylvania who had become frustrated over his slow progress shot and killed his adviser during a late afternoon colloquium.

Following the shooting at Iowa, graduate students and faculty members gathered to talk about the events leading up to 1 November, and during the course of the discussion, several students also expressed concern about the pressure they felt, Polyzou said. He and others in the department now feel it will be "important to keep a dialogue open with the students, to get their feelings" on such matters.

But Gary Althen, assistant director of the school's Office of International Education and Services, which works with Iowa's 2000 or so foreign students, thinks it would be "a serious misconception" to attribute the incident to the pressure felt by a foreign student. "That is not an adequate explanation," Althen said. At the same time, Althen does hear complaints from students, regardless of discipline, about their study and work environments. "Some students feel they have no choice but to work far more hours than they're paid to," Althen said. "And it's not rare that faculty will fail to credit students for research they've done."

"Students may feel like they're nameless ciphers, toiling away without recognition," Althen said. "Some may want more personal respect, more attention from faculty members, more individual concern."

Aftermath

The physics and astronomy department, which has 26 regular faculty and about 85 graduate students, has gradually resumed its normal routine, with some modifications.

The American Geophysical Union is now searching for a new editor for the *Journal of Geophysical Research—Space Physics*, of which Goertz was senior editor at the time of his death. James Van Allen, who is an emeritus professor of physics at Iowa and for whom the school's Van Allen Hall is named, has been appointed acting editor.

The Independent Federation of Chinese Students and Scholars, headquartered in Washington, DC, has coordinated support for the victims' families and has appealed to other Chinese students around the country to send letters of sympathy. Shortly after the incident, members of the Friendship Association of Chinese Students and Scholars at Iowa held a press conference to express their concern for the victims

and their survivors. Quite understandably, other Chinese students do not want Lu's actions to be interpreted as those of a typical Chinese. The Iowa physics and astronomy department currently has 10 graduate students from the PRC.

The memorial service for Shan, the last of the victims to be buried, was delayed until 15 November, so that his brother could arrive from China. The award that had become the focus of so much bitterness and pain was presented to Shan's widow, Yilang Yang, ten days later, on what would have been his 27th birthday.

—JEAN KUMAGAI

QUESTIONS RAISED ABOUT BEIJING CONFERENCE

The American Physical Society's Committee on the International Freedom of Scientists has raised questions about participation in an international conference on semiconductor physics, which is to take place next August in Beijing, with the sponsorship of the International Union of Pure and Applied Physics. The questions concern the safety of Chinese wishing to return to the People's Republic for the conference, in light of the fact that several Chinese physicists—Liu Gang, Wang Juntao and Wang Youcai—have received stiff prison sentences for participating in the 1989 movement that culminated in the demonstrations and crackdown at Tiananmen Square.

The concern of the APS human rights committee and other humans rights organizations arises from a letter addressed to conference organizers in November 1990 by He Jinqui, director general of the department of overseas students in the PRC's state education commission. He Jinqui said it was the government's policy not to hold responsible students studying abroad who had made "rash statements" or "engaged in rash activities" during the 1989 student insurrection. But He Jinqui immediately added that China would welcome those who joined anti-government organizations, *provided* they "break away from those organizations and end activities designed to oppose the People's Republic of China."

Together with the Committee of Concerned Scientists, the New York Academy of Sciences and the Royal Swedish Academy of Sciences, among others, the APS Committee on the International Freedom of Scientists has written to IUPAP officers pointing out that the policy enunciated by He Jinqui would appear to be in clear conflict with the principle that participation in IUPAP conferences must not be limited by political considerations. Responding to such entreaties, Lu J. Sham of the University of California, San Diego, who chairs the IUPAP semiconductor commission, has said in a number of letters that the commission is closely monitoring preparations for the conference to assure free access and that the conference organizers will provide overseas Chinese scholars wishing to attend with advice and assistance.

The human rights groups, in turn, have complained that the PRC has not provided a list of "anti-government organizations" and that, under the circumstances, any Chinese student or scholar who had engaged in political activities during the past few years would be ill-advised to attend the conference. The human rights groups have taken the position that IUPAP should demand from the Chinese government, as a condition of its continued sponsorship, a written statement of policy assuring free entry and exit to all Chinese scientists who are qualified to attend the conference.

At an IUPAP meeting in the early fall, it was decided that the organization's secretary general would write to Chinese authorities restating IUPAP's conditions for conference sponsorship, that IUPAP would continue to monitor conference preparations and that it would withdraw sponsorship if anything was amiss.

SURVEY FINDS GLOOMIER JOB MARKET FOR PHDS

The first signs of the recession's effect on the physics job market have turned up in the latest graduate student survey conducted by the American Institute of Physics. The survey, which polled all physics and astronomy graduate students studying in the US in 1990, found among other things a rise in the percentage of physics PhD recipients who received no job offers and a drop in the average salary for those who did find work. Additionally, the number of industrial openings for new physics PhDs fell by 13% and for physics master's degree holders by 17%.

One measure of the health of the job market is how many job offers graduates receive. The proportion of doctorate recipients who had no job offers rose from 7% in 1989 to 12% in 1990, while those who got more than one offer fell from 48% to 38%.

Among those physics PhDs who did find potentially permanent work, average monthly salaries were $3500 in 1990, compared to $3540 the previous year. For those accepting postdocs, the median salary was $2420 per month in 1990, a 5% increase over the 1989 median salary of $2310. Master's degree recipients fared somewhat better, with a median monthly salary of $2760 in 1990, compared with $2600 the previous year. And, in contrast to previous years, astronomy postdocs in 1990 commanded salaries as high as those of physicists; permanent positions in astronomy had median monthly salaries of $3000.

Although industry continued to be the number-one source of potentially permanent jobs for new physics PhDs in 1990, there was a six-percentage-point drop—from 46% to 40%—in the proportion hired by industrial firms. Those who found permanent work at Federally funded research centers fell from 12% in 1989 to 8% in 1990. Among physics master's degree recipients, the proportion employed by industry fell from 58% to 48% during the same time period.

During the past decade American physics PhD recipients have increasingly opted for postdocs. Among the 1990 physics doctorate recipients who were US citizens (710 of the 1183 PhDs), 60% took postdoctoral positions and 34% found potentially permanent jobs. In 1980, in contrast, US physics PhDs accepted permanent jobs over postdocs by a ratio of 3:2. In the past five years alone the number of US citizens accepting physics postdocs rose by 40%.

Among foreign students who earned physics PhDs in 1990, 67% accepted postdocs, while 27% found permanent work. The report noted in particular the rise in the percentage of foreigners hired by US companies—from 13% to 18%. This rise is noteworthy given that employers must go through a more expensive and time-consuming process to hire noncitizens, says Susanne D. Ellis, the survey report's senior author.

The number of years needed to complete a physics PhD has risen in the past decade, the survey found. In the class of 1990, the percentage of PhD recipients who spent five years or less in graduate school before earning their degrees was 28%. But in the class of 1985, 42% of the PhD recipients took five years or less, and among those who graduated during the early 1980s, the percentage ranged from 38% to 46%.