

# In Memoriam: S.-S. Chern



On December 3, 2004, the world lost a brilliant mathematician and a generous spirit. On that day, Shiing-Shen Chern died at his home in Tianjin, China, at the age of ninety-three. His profound mathematical gifts and ebullient personality were warmly remembered at a memorial service held on the campus of the University of California, Berkeley, on February 13, 2005. The service was organized by the Berkeley mathematics department, where Chern was a faculty member for two decades just before his retirement, and by the Mathematical Sciences Research Institute, which Chern helped to found.

Chern's prominence in the academic world was demonstrated at the memorial service by the presence of UC Berkeley's chancellor, Robert Birgeneau, and of the Consul General of the Chinese Consulate of San Francisco, Peng Keyu. Several members of Chern's family were in attendance, and his son, Paul Chern, presented remarks to close the service. Most of the speakers were Chern's students and colleagues, who warmly remembered him as a mathematician and as a friend. All mourned the passing of this great and distinguished man.

Chern was born on October 26, 1911, in Jiaxing, China. He showed an early interest in mathematics and enrolled at the age of fifteen in Nankai University, where he majored in mathematics. After receiving a master's degree from Tsinghua University in 1934, he left China for Germany and earned a doctorate from the Universität Hamburg in 1936 under the direction of Wilhelm Blaschke. He then spent a year in Paris, where he was deeply

influenced by Élie Cartan. At that time, the field of geometry was at a low ebb. Apart from Cartan's foundational work, which took decades to be fully understood, there were only isolated advances, and geometry was not thriving as were other areas, such as algebra, topology, functional analysis, and number theory. "Differential geometry paled by comparison," said Hung-Hsi Wu of UC Berkeley in his remarks at the memorial service.

When Chern produced his intrinsic proof of the Gauss-Bonnet theorem in 1944 and introduced what are now known as Chern classes in 1946, he was "far ahead of his time," Wu said. A few prescient mathematicians—such as Heinz Hopf, André Weil, and Hermann Weyl—understood the magnitude of what Chern had done, but it was quite a while before the mathematics community changed its perception of differential geometry as a field, Wu remarked. Chern told Wu that G. D. Birkhoff once asked him—very politely, of course—"But isn't geometry just a part of analysis?" "It is not every day that a single person is entrusted with the task of carrying a whole field forward, no matter how briefly," Wu remarked. "Professor Chern did what was given to very few to do, and he did it extremely well."

Chern took a position at the University of Chicago in 1949. At the time Isadore Singer was a graduate student there, working on his dissertation in functional analysis. He took a course in differential geometry from Chern and slowly began to understand the importance of the new ideas Chern was expounding. "I realized reluctantly that maybe

### Speakers at the Memorial in Honor of Shiing-Shen Chern

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Chairman, Department of Mathematics,  
University of California, Berkeley

Robert J. Birgeneau  
Chancellor, University of California, Berkeley

Peng Keyu  
Chinese Consul General

David Eisenbud  
Director, Mathematical Sciences Research Institute

Isadore M. Singer  
Massachusetts Institute of Technology

James Simons  
President, Renaissance Technologies

Robert Uomini  
Independent Software Developer

Calvin Moore  
University of California, Berkeley

Alan D. Weinstein  
University of California, Berkeley

Hung-Hsi Wu  
University of California, Berkeley

I'd made a wrong choice in subject, that if only Chern had come a year earlier, I might have become a geometer," Singer recalled. When Singer went to the Massachusetts Institute of Technology as an instructor the following year, his colleague Warren Ambrose asked to be brought up to speed on Chern's course. Singer said it took them about ten years to really understand Chern's ideas and point of view. "Ambrose and I considered ourselves disciples of Chern during that period," Singer said. Later on, in the 1970s, Chern and Singer became colleagues at Berkeley.

As a student at MIT, James Simons absorbed Chern's ideas through Ambrose and Singer. In anticipation of Chern's arrival in Berkeley in 1960, Simons went there for his Ph.D. One day while he was giving a seminar talk, Chern walked in. Simons said he was doubly surprised: He did not expect such a distinguished professor to come to a seminar by a mere graduate student, and he did not expect Chern to be Chinese. "I assumed [his name] was a shortening of Chernowsky or something like that," Simons said. "I expected him to be a Jewish

fellow." Chern did not end up directing Simons's thesis, and they overlapped only that one year in Berkeley, but they became fast friends and remained in contact. It was some years later that Simons came to Chern with an idea he had been working on that was an application of something Chern had done years earlier. Chern suggested they collaborate, and in this way the Chern-Simons invariants were born. "That was certainly the high spot of my mathematical life," Simons said, "and I would think that anyone collaborating on a project with Chern would probably have said the same thing."

Simons also recalled Chern's impish sense of humor. In 1972 Simons was a member at the Institute for Advanced Study in Princeton and Chern had come for a short visit. This was at the time when the formidable André Weil was on the faculty. At the end of Chern's stay, Simons was to drive Chern to the train station. Chern had a good deal of luggage, and he mused over how to deal with it. Then he said, "I know. You and I will go ahead in the car, and Weil will follow with the bags." "Anyone who knew André Weil would laugh a lot at that notion," Simons remarked. "Chern had quite a twinkle in his eye when he said that."

"In some ways Chern was an enigma," Singer said. He was unassuming, direct, cordial, always eager to be helpful. At the same time, his revolutionary achievements established differential geometry as a major and thriving branch of mathematics. "And overriding these two parts of him was his personal presence, indeed a personal nobility that I have not found elsewhere."

The day after the memorial service, Wu gave a lecture in the Berkeley mathematics department about Chern's work. Wu noted that this work lay between two extremes in geometry: the study of intrinsic metric structures on Riemannian manifolds on the one hand, characterized by the work of, for example, Marcel Berger and Wilhelm Klingenberg; and on the other hand, the hard estimates of geometric analysis, the domain of practitioners like Shing-Tung Yau and Richard Schoen. In that in-between area, it is easy to fall into purely formal, empty mathematics, Wu said. "But when a master does it, there is a magical feeling to it." He made the point that Chern was always on the lookout for important problems that would advance the field. Sometimes he succeeded in solving them, sometimes he did not, and sometimes he simply suggested the problems to others. But he was always ambitious and forward-looking in what he chose to focus on. This spirit also imbued Chern's teaching. Wu remembered that Chern "was sweating blood" over a graduate course he taught on the Atiyah-Singer index theorem. Chern had not mastered the topic, but he understood its centrality to geometry and wanted the students to be exposed to it.

One of the speakers at the memorial service was Robert Uomini. As an undergraduate student at Berkeley, he took a course in differential geometry with Chern. Despite the huge number of students—undergraduate as well as graduate—attending the course, Uomini said each lecture was like “an individual conversation with Chern.” It was through Chern’s personal intervention that Uomini was accepted as a graduate student at Berkeley. He earned a Ph.D. in 1976 under the direction of Blaine Lawson and went on to become a software developer. As the years passed, Uomini came to realize how greatly his experiences in graduate school had enriched his life and how much he owed to Chern. In 1995 Uomini was able to express his appreciation: He won \$22 million in the state lottery and used part of the funds to endow a visiting professorship in the Berkeley mathematics department, named in honor of Chern. In the following years he and his family established a close and warm friendship with the Cherns. In 2002 Uomini traveled to China to see Chern; this was the last time the two would meet.

Chern embodied an unusual combination: a great mathematical thinker with a talent for knowing what practical measures would benefit the field. Together with his Berkeley colleagues Calvin Moore and Isadore Singer, he was the driving force behind the establishment of the Mathematical Sciences Research Institute (MSRI) in Berkeley in 1980 and served as its first director. Few could resist a phone call from Chern with an invitation to come to a workshop or to organize one or to serve on a committee, Singer recalled. “If Chern called and asked, everyone said yes. That was part of the success of MSRI in attracting really great people.” Since those early years MSRI has come to be a model for many other institutes around the world and stands as one of the most successful. As current MSRI director David Eisenbud noted in his remarks at the memorial service, Chern remained very supportive of the institute over the years and was a key figure in the drive for a new addition to the MSRI building, now under construction. After the addition is completed, the building will be named Chern Hall.

MSRI was actually the third institute founded by Chern. The first was the mathematics institute at the Academia Sinica, which he created in 1946, first in Shanghai and then in Nanking. In 1984 he founded the Nankai Institute of Mathematics at Nankai University in Tianjin. When he moved to Nankai permanently after his wife’s death in 2001, he lived in a home that the university had built for him near the institute so that he could come in every day, even though he was by then in a wheelchair. He served as honorary director of the Nankai Institute until his death. In his remarks during the memorial service, Calvin Moore noted that Chern’s creation of the geometry group in the Berkeley



Photographs by Peg Skorpinski.

mathematics department could almost be considered a fourth institute founded by Chern.

While Chern spent most of his career outside of China, his ties to his homeland were always strong. He was one of the most influential figures in promoting mathematical ties between China and the United States. His fame in China was tremendous. At the International Congress of Mathematicians held in Beijing in 2002, whenever Chern would appear, a crowd would collect around his wheelchair. In recalling other occasions in China when Chern was mobbed by enthusiastic young people wanting his picture or autograph, more than one speaker at the memorial service likened his fame to that of a rock star.

In China the outpouring of feeling upon Chern’s death was extraordinary. According to his son, Paul, a continuous stream of people, totaling perhaps 10,000, came to pay their respects during Chern’s four-day lying-in-state at Nankai University. A musical concert performed in his honor was broadcast on television monitors so that the crowd outdoors could listen. Students held an all-night vigil on the night he died. They ringed his home and a lake with lighted candles and folded a thousand white origami cranes, which symbolize the journey to heaven.

Because Chern was considered such an important national figure, some of the arrangements for his funeral were handled by Chinese government officials. There was some discussion of whether he should be draped in the flag of the People’s Republic of China or in the flag of the Communist Party, of which he was not a member. His daughter, May, stepped in with a solution: he would be draped in a plain white cloth. Chern was not a political figure. He was simply a mathematician.

—Allyn Jackson