professor shiing-shen chern
msri's founding director
Shiing-Shen Chern, a towering figure in mathematics, can look back on a career that has spanned continents and cultures. Teacher, researcher, and founder of three mathematical research institutes—the renowned geometer has helped forge links with scientists around the globe while advancing knowledge in differential geometry, his own important field of study.

Professor Chern was born in China in 1911 and educated in his homeland, Germany and France. He launched his American mathematical career in the 1940s with an extraordinary passage.

In 1943, while teaching at Tsing Hua University in Kunming in southwestern China, Chern received an invitation from the Institute for Advanced Study (IAS) in Princeton, New Jersey. Chern’s early work on isotropic surfaces had caught the attention of researchers at IAS, including Hermann Weyl, who championed Chern both within and beyond the Institute.

But getting to New Jersey amidst the turmoil of two wars—World War II and the Sino-Japanese conflict—was no simple task. Chern left Kunming and headed west, taking a remarkable series of flights on a wide array of military aircraft. “We flew on military flights to Bombay and Calcutta,” Chern recalls as though it had happened yesterday, “then to Africa, then Brazil, from South America to Central America, and finally to Miami, where I boarded the train to Princeton. We would stop at a military base, they would feed me and I could shower and sleep, and then I would simply wait for the next available seat on a plane that was going in the same direction I was.”

The drama of the journey was followed by an invigorating and remarkably productive two years at IAS—a time he refers to as “unforgettable.” The peaceful, intellectual atmosphere at Princeton was a salve for the trials he endured in war-torn China.

While at IAS, Chern developed his pivotal work on the Gauss-Bonnet formula. André Weil and Allendoerfer had just published their paper on Gauss-Bonnet; Weil and Chern struck up a lasting friendship which is both scientific and personal. As Chern wrote in 1992: “I still consider this my best piece of work.”
The wartime circumnavigation was not Chern’s first adventure in travel. As a child he traveled through China, as his father, a judge, carried out his legal duties across the nation. Though the young Chern necessarily moved frequently, his intelligence and curiosity —apparent quite early—made the continual dislocation anything but a problem. In fact, he recalls skipping grades wherever he went. “Even then,” Chern says of those early years, “I found math so easy, though at the time, I did not know it was such a great subject.”

Most mathematics books were written in English, a fact that started Chern on the road to becoming the polyglot he is today.

Following middle school, Chern entered Nankai University and promptly skipped two years. His mentor at Nankai, Professor Li-Fu Chiang, received his Ph.D. from Harvard under Julian Coolidge—a connection that led Chern into intensive studies in geometry during his senior year. While performing graduate work at Tsing Hua University in Beijing, Chern drew inspiration from Wilhelm Blaschke’s books on differential geometry. Blaschke’s visit to Beijing in 1932 convinced Chern more than ever of his prime area of interest, and after receiving his master’s degree in 1934 he traveled to Hamburg on a fellowship and continued his link with Blaschke.

He received his doctor of science degree from Hamburg in 1936 and then went to Paris to study with the eminent geometer, Elie Cartan. As Chern said in the volume honoring him, published in 1992:

“Cartan was a wonderful teacher. He suggested ‘little problems,’ some of which became the subjects of my papers. Probably because of my responses to his questions he allowed me to visit him at his home, about once every two weeks... It was an interesting and unforgettable year.”

In 1937, Chern returned from his European studies to a China torn by war. He became a professor as planned, but Tsing Hua University was forced to join with two other universities in a move to the safer, more isolated city of Kunming in southwestern China.

The isolation of the region, and the scarcity of books beyond his small personal library, led Chern to write to Cartan, who generously sent him numerous reprints of his earlier works. Chern immersed himself in the work of Cartan—a perfect prelude to the adventure that took him to Princeton and those two significant years of study.

In 1945, following his wartime sojourn at IAS, Chern returned to Beijing when his mother fell ill. He was soon thereafter appointed to organize the Institute of Mathematics at the Academia Sinica, the Chinese National Academy. Chern worked to attract the best mathematical talent from across China, and created programs where scholars could teach
Political instability once again changed the course of Chern’s career and his life, as well as that of his family. As the Nanking government collapsed, his friends at Princeton made it possible for him to leave China and make the United States his home.

“There was never any commitment from the Institute to hire me. I later realized that what had happened was really a rescue mission, that the idea was to save me, to get me out of China as the government fell.”

“So here I was suddenly in America, with my family, and I needed a job,” he remembers. “Fortunately, because of my earlier time at Princeton, I knew many people in the field and did not need any introductions.”

Numerous invitations to join academic departments came his way, yet Chern remembers clearly why he chose to accept a position at the University of Chicago in 1949. “I selected Chicago,” he says, “because it had become one of the major mathematics centers in this country.”

“Chicago was a very desirable place to study and teach,” Chern says, adding that the university was unique in another way that appealed to him. “All the universities in America have many purposes in higher education, but at the University of Chicago the main purpose was to advance knowledge.”
Chern’s parallel courses of teaching and research were perfectly matched at Chicago. He pursued his research in algebraic topology and geometry, maintained a close association with colleague André Weil, and taught classes that sometimes contained “a brilliant galaxy of students.” His work with those students produced 10 PhDs, most of whom pursued careers in mathematical research and teaching.

Eleven Chicago winters passed before Chern accepted an invitation to join the ascending mathematics department at the University of California Berkeley. But this was only one of a constellation of reasons for his move west. Even the cool, gray fog that sometimes envelops his home near the Berkeley campus could not approach the harshness of the Midwestern winters.

Says Chern of his decision to leave Chicago: “Berkeley’s math chairman at the time, G.C. Evans, had always been very nice to me and had tried to recruit me several times, but every time I hesitated. For a long time, the East Coast had been the center of mathematics, and it was logical to be in the East. But with the ease of air travel and the expansion and rising status of Berkeley, I decided to make the move.”

He took a sabbatical between positions to spend a year in France and Switzerland, a personal and professional return to the places where he had done his seminal work under Elie Cartan.

For Chern, Berkeley was as productive and stimulating an environment as Chicago had been, even with Berkeley’s much larger campus and population. He was flattered by talk of being named as successor to Evans, but declined the chairmanship to focus on his work and the projects of his students. From 1960 until his official retirement in 1979, Chern oversaw the work and theses of 31 PhD students.

“I am happy to say,” Chern says with satisfaction and a burgeoning smile, “that I have always had, and in fact I still have, very good relationships with my students.”

That smile broadens when Chern reveals one of the more unusual rewards of his years of teaching. “One of my students won the California lottery,” he says. “I think it was $22 million, and he donated $1 million to establish the Shiing-Shen Chern Visiting Professorship at Berkeley.”

Says Professor Chern possesses a remarkable grace and ease, and an understated civility that has impressed colleagues and students alike. But, in addition to his poise and calm he has always had a clear focus on the importance of research to the future of mathematics, and a powerful drive to actualize that vision.
That strength and clarity of vision surfaced during his first years of teaching in China, when Chern taught and studied in a region isolated by war. Later, after his exposure to the benefits of the research institute that he observed in Princeton, he helped build up the mathematics institute of Academia Sinica in Nanking, serving as Acting Director (1946-1948). He returned to China in the 1980s as the founder of the Nankai Institute.

In 1978, just as Chern was about to retire from the Berkeley faculty, he and two fellow mathematics professors decided to propose a new mathematics research institute in a nationwide competition sponsored by the National Science Foundation. “We started having discussions in the late 1970s, before the competition, but once it began, our discussions became more serious.”

“When the NSF invited us to submit a proposal, I was pleased to work on it with Calvin Moore and I. M. Singer. Most of the work, the writing, was done by Cal Moore,” Chern recalls with appreciation. “He was very young, and very energetic.”

Fortunately, many individuals and institutions and corporations have understood the importance of MSRI and have supported it.

Chern, Singer (now at M.I.T.), and Moore (now chairman of the UC Berkeley Mathematics Department) succeeded in winning NSF approval for the program: a new, research-oriented, nonprofit, independent institute to be established in the hills overlooking the Berkeley campus: the Mathematical Sciences Research Institute, MSRI.

“It took such a long time before the Institute became a reality,” Chern says of those formative days for MSRI. “The NSF had long been wanting to establish an institute, and I believe many academic institutions had hopes of being the home to the new institute.”

Chern was able to draw from his lifetime of experience, not only as a teacher and accomplished researcher, but as a visionary who understood the importance of mathematical research for the future of the sciences and their applications. He recognized that beyond the fundamental need to train mathematicians as future teachers, at the highest levels, there was a need to create a place, an ideal environment, for high level mathematical research.
The strength of the Mathematical Sciences Research Institute, says Chern, is that from the beginning the Institute not only had the support of UC Berkeley, but also had a very strong relationship with other institutions, including Stanford, other University of California campuses, and universities throughout the West. Since then, the Academic Sponsors group has grown to include 80 of the strongest mathematics departments in the United States and in several other countries. “From the beginning we were a kind of confederation,” he says.

Shiing-Shen Chern was awarded the United States' National Medal of Science in 1975, the Wolf Prize, in Israel, in 1983/84, and the Shaw Prize in Mathematical Sciences in Hong Kong in 2004.

Chern was also founding director of the Nankai Institute of Mathematics in Tianjin, China, established in 1985.

His collected works are published by Springer-Verlag.

Professor Chern is also a member of:

- Academia Nazionale dei Lincei
- Academie Peloritana
- Academica Sinica
- Académie des Sciences à Paris
- American Academy of Arts and Sciences
- American Philosophical Society
- Brazilian Academy
- Chinese Academy of Sciences
- National Academy of Sciences
- New York Academy of Sciences
- Royal Society of London
- Russian Academy
- Third World Academy of Sciences

He has received honorary degrees from:

- University of Chicago
- University of Notre Dame
- State University of New York at Stony Brook
- Chinese University of Hong Kong
- University of Hamburg
- Eidgenössische Technische Hochschule, Zürich

Photo captions:

Cover (from left)
With his grandmother, age three.
With his family (Chern at top right), age 17.
With his father, age five.
At home, August, 2000.

Numbered Photographs

1. At home, August, 2000.
2. Upon graduation from Nankai University, 1930.
3. In his room while pursuing studies in Hamburg, 1935.
4. With his wife, Shih-Ning.
8. At the threshold of MSRI, 1985.
13. Accepting citation for the establishment of the Nankai Institute from the mayor of Tianjin.
Gauß-Bonnet Formula

A) On a 2-dim Riemannian manifold with

\[ \sum_i \int_M d\phi_i = \sum_i K_i A_i = 2\pi \chi(M) \]

where the first sum is the sum of exterior angles at the corners, \( K \) is the sectional curvature of the sides, \( K_i \) is the Gaussian curvature and \( \chi(M) \) is the Euler characteristic.

For a right-angled triangle in the Euclidean plane, \( a = \theta, \theta = \theta, \) the formula gives the theorem that the sum of angles of a triangle is \( \pi \).

\[ \frac{\pi}{2} \]

\[ M \]

\[ \theta \]

\[ \theta \]

\[ \theta \]

B) On a 2n-dimensional manifold without boundary.

Let

\[ \Omega_{2i} = \sum R_{ijk} dx^i \wedge dx^j \wedge dx^k \]

be the curvature form, and

\[ Pf = \sum_{\sigma_1, \ldots, \sigma_{2n}} \Omega_{\sigma_1} \Omega_{\sigma_2} \cdots \Omega_{\sigma_{2n}} \]

be the Pfaffian, where \( \sigma_i \) is +1 or -1 according to whether it is an even or odd permutation of 1, ..., 2n and is otherwise zero. The sum over \( \sigma_1, \ldots, \sigma_{2n} \) is extended over all indices from 1 to 2n. The formula is

\[ \left(-\frac{1}{2\pi\sin(\pi/m)} \right)^n \int_M Pf = \chi(M) \]

where \( \chi(M) \) is the Euler-Poincaré characteristic of \( M \).