

# Chern Receives Shaw Prize

SHIING-SHEN CHERN of Nankai University has received the first Shaw Prize in Mathematical Sciences. Awarded by the Shaw Foundation, the prize carries a monetary award of \$1 million. The prize ceremony took place on September 7, 2004. Chern is honored “for his initiation of the field of global differential geometry and his continued leadership of the field, resulting in beautiful developments that are at the center of contemporary mathematics, with deep connections to topology, algebra, and analysis, in short, to all major branches of mathematics of the last sixty years.”

## An Essay on Shiing-shen Chern

The members of the selection committee for the 2004 Shaw Prize in Mathematical Sciences are: Jean-Pierre Bourguignon, Institut des Hautes Études Scientifiques; Phillip A. Griffiths, Institute for Advanced Study, Princeton; Chang-shou Lin, Taiwan National Chung Cheng University; Wentun Wu, Chinese Academy of Sciences (chairman); and Le Yang, Chinese Academy of Sciences. What follows is an essay about Chern, written by the selection committee.

Shiing-shen Chern is the foremost geometer of our time. His mathematical work, centering on geometry and spanning almost seven decades, has shaped large areas of modern mathematics. More than any other mathematician, he defined the subject of global differential geometry, one of the central areas in contemporary mathematics. The depth and originality of his mathematical insight is seen in the many basic concepts of modern mathematics to which his name is attached: Chern classes, the Chern-Weil map, the Chern connection, the Bott-Chern forms, Chern-Moser invariants, and the Chern-Simons invariants.

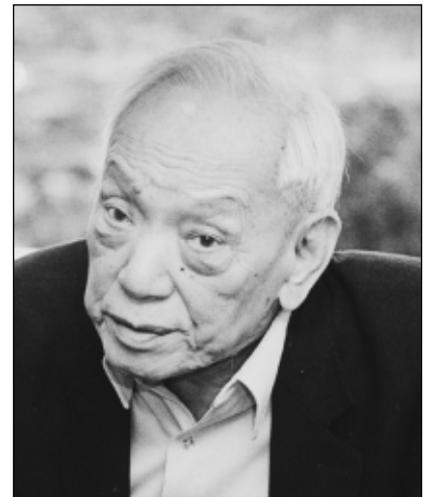
Chern’s talent became apparent early. He completed his undergraduate work at Nankai University and his M.Sc degree work at Tsinghua University. In the 1930s he was sent to Europe, where he studied with Wilhelm Blaschke in Hamburg and Élie

Cartan in Paris. Guided by their influence he wrote, in effect, two theses: one on web geometry and one on the differential invariants of a third-order ordinary differential equation. Both works were published and remain of interest today.

Chern then returned to China to teach at Tsinghua University which during the war had moved to Kunming in southwestern China. After several years in Kunming he made his way out of wartime

China and, by a circuitous route via Africa, managed to reach the United States. There Chern began a highly productive stay at the Institute for Advanced Study in Princeton at the invitation of Oswald Veblen and H. Weyl. It was during this period that he gave the first intrinsic proof of the general Gauss-Bonnet formula. In hindsight, one may say that from this proof evolved many fundamental concepts in topology, such as transgression in sphere bundles introduced from a differential geometric perspective. In addition, he began the monumental work that introduced Chern classes and, as a by-product, initiated the subject of Hermitian differential geometry. This work brought to the fore the relationship between differential geometry and topology; it also opened fertile new areas for other mathematicians and remains of central importance to this day.

He completed his work on the Chern classes during a brief return to China after the war. Then he moved to the University of Chicago, where together with Weil and others he helped to establish one of the leading mathematics departments in the world. During this period his work arrived at the center of mathematical life. Through it and his influence on colleagues, Chern guided the field of



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differential geometry and led it into interaction with essentially all aspects of geometry, including topology, algebraic geometry, integral geometry, complex geometry, exterior differential systems, global analysis, and partial differential equations.

Chern's contributions typically begin when he engages a specific problem; then, through his geometric insight and computational mastery, he brings it to resolution; eventually his work has been seen to open up productive new areas for other mathematicians to develop. This pattern, which continues to this day, is an extension of the classic tradition of Cartan, supplemented by a deep and far-reaching global perspective.

Two examples, one specific and one general, may serve to illustrate the continuing influence of Chern's mathematical work in the scientific community. One that is of great current interest derives from the Chern-Simons invariants, which inform both theoretical physics and three-dimensional topology. Another is Chern's recognition of the special role that a complex structure plays in differential geometry. Examples of this are evident throughout his work, including the introduction of the Chern classes of holomorphic vector bundles via curvature forms, the study of minimal surfaces and harmonic maps using the conformal structure, Chern's geometrization of complex function theory, and the geometry of CR-structures. Reflecting the pervasive role of the complex structures, the differential geometric properties of complex algebraic varieties are of central importance in modern theoretical physics and in number theory.

At the end of the 1950s Chern moved to the University of California at Berkeley, where he was a professor of mathematics and, in 1980, became founding director of the Mathematical Sciences Research Institute (MSRI). A few years later, he also established a mathematics institute at Nankai University where he had earlier received his undergraduate education. He continued his professional life in Berkeley until five years ago, when he moved to reside at Nankai. Throughout these times he has remained mathematically active, most recently initiating a revitalization of the subject of Finsler geometry.

At Berkeley, as in all his positions of leadership, the influence of Chern as a practitioner of mathematics was matched by his warmth and skill as a teacher and leader. He was always an attentive and generous mentor to younger people. When one of us (Griffiths) first went to Princeton as a graduate student, his advisor sent him to Berkeley in the summer of 1961. Upon his arrival Chern immediately invited him to lunch, initiating a friendship and professional collaboration that continues through the present.

As a welcoming and collaborative friend, Chern likes nothing better than to gather people of all ages

and perspectives to talk about mathematics. He has taken special pleasure in advancing the professional lives of those who have had the opportunity to work with him. He has always been among the first to understand the importance of the work of his colleagues and to bring it to the attention of the wider mathematical community. Chern's former students now populate the mathematics departments of major universities across the US, and his influence is, and has always been, widely felt in China.

The first Shaw Prize is awarded to Professor Chern in recognition of his singular contributions to, and influence on, the mathematical life of our time.

### **About the Prize**

The Shaw Prize was established under the auspices of Run Run Shaw in November 2002. Shaw was born in China in 1907 and is a native of Ningbo county, Zhejiang province. He joined his brother's film company in China in the 1920s. In the 1950s he founded the film company Shaw Brothers (Hong Kong) Limited in Hong Kong. He has been Executive Chairman of Television Broadcasts Limited in Hong Kong since the 1970s.

The Shaw Prize is an international prize managed and administered by the Shaw Prize Foundation. There are three annual prizes in astronomy, life science and medicine, and mathematical sciences, each bearing a monetary award of US \$1 million. The purpose of the prize is to honor scientists, regardless of race, nationality, or religious belief, who have achieved significant breakthroughs in academic and scientific research or applications and whose work has resulted in a positive and profound impact on mankind.

Run Run Shaw has also founded two charities, the Sir Run Run Shaw Charitable Trust and the Shaw Foundation Hong Kong, both dedicated to the promotion of education, scientific, and technological research, medical and welfare services, and culture and art.

*—From news releases of the Shaw Foundation*