The Shaw Prize 2004 Award Presentation Ceremony

THE SHAW PRIZE
邵逸夫獎

The Shaw Prize: an Introduction

Social and cultural progress has always depended on the tireless efforts of men and women of great talent. Their innovations and inventions in various spheres of human activity have been the foundation of civilization; their pioneering spirit is rightly admired throughout the world. The Shaw Prize is established as a tribute to these pioneers, and an encouragement to men and women dedicated to the advancement of civilization. The Prize honours individuals, regardless of race, nationality and religious belief, who have achieved significant breakthrough in academic and scientific research or application, and whose work has resulted in a positive and profound impact on mankind.

The Shaw Prize for 2005 consists of three annual awards: the Prize in Astronomy, the Prize in Life Science and Medicine, and the Prize in Mathematical Sciences. Each prize carries a monetary award of US$1 million. The nomination process begins in September 2004; the winners to be announced and the prizes presented next year in the summer and early autumn, respectively.

The Shaw Prize is an international award managed and administered by The Shaw Prize Foundation based in Hong Kong.

Founder's Biographical Note

The Shaw Prize was established under the auspices of Mr. Run Run Shaw. Mr. Shaw, born in China in 1907, 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. Mr. 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 the arts.

Message from the Chief Executive

Science and technology have advanced the frontiers of knowledge and significantly improved the quality of life of the human race. Thanks to the hard work of generations of scientists who have made fascinating discoveries, dreams that seemed so remote to us in the past have become day-to-day applications today.

Great scientists are characterized by an unflinching passion for knowledge and truth, and an unrelenting effort to challenge what may seem to be the obvious. These are qualities that our education system aims to nurture among our young people. The Hong Kong Special Administrative Region Government is committed to investing in the human capital, through establishing an education system that can liberate creative minds and encourage research.

The Shaw Prize is a prestigious award to recognize leading scientists, both for their personal accomplishments and their contributions to mankind. I would like to congratulate the six prize winners who receive this award today, and I wish the Shaw Prize continued success in encouraging distinguished scientists to strive for excellence.

TUNG Chee Hwa
Chief Executive
Hong Kong Special Administrative Region

Message from the Founder

Every age has its benefits, and the benefits of any age are gifted by men and women whose curiosity compels them to conquer the unknown. Some choose a lifelong journey in pursuit of knowledge and their remarkable discoveries and the benefits to mankind are their true reward. In establishing The Shaw Prize we recognize and celebrate their achievements, and hope to strengthen the aspirations of those who would follow in their footsteps.

Run Run Shaw

Message from Chairman of Board of Adjudicators

Progress in science and technology in the 20th century have enormously raised living standards and increased human productivity. Progress in science and technology in the 21st century will certainly further accelerate such developments. It will, however, also bring forth new and difficult challenges for mankind. With foresight and generosity, Mr. Shaw has established the Shaw Prizes not only to promote scientific and technological developments, but further to help ensure that such developments will continue to benefit mankind. Tonight at this first ceremony we are here to witness the beginning of the annual award of Shaw Prizes which will surely become one of the great permanent institutions in the history of the world.

Chen Ning Yang

Chen-Ning Yang

The Shaw Prize Medal

The front of the medal displays a portrait of
Sir Run Run Shaw, next to which are the words and
Chinese characters for the title of "The Shaw Prize".
On the reverse, the medal shows the award category,
the relevant year and the name of the prizewinner.
A seal of imprint of the Chinese phrase "制天命而用之"
(quoted from Xun Zi – a thinker in the warring states
period of Chinese history in 313 – 238 B.C.) meaning
"Grasp the law of nature and make use of it"
appears in the upper right corner.

AGENDA

Arrival of Officiating Guest and Winners

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Speech by The Honourable Tung Chee Hwa,
Chief Executive of Hong Kong SAR, China

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Welcome Speech by Professor Chen-Ning Yang
Chairman, Board of Adjudicators, The Shaw Prize

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Speech by Professor Frank H. Shu
Member of Board of Adjudicators
Chairman of the Prize in Astronomy Committee

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Speech by Professor Arthur K. C. Li
Member of Board of Adjudicators
Chairman of the Prize in Life Science and Medicine Committee

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Speech by Professor Wentsun Wu
Member of Board of Adjudicators
Chairman of the Prize in Mathematical Sciences Committee

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Award Presentation

Grand Hall
Hong Kong Convention and Exhibition Centre
September 7, 2004

AWARD PRESENTATION

(Category listed in alphabetical order)

Astronomy

Professor P. James E. Peebles

Life Science and Medicine

Prize One Winners

Dr. Stanley N. Cohen & Professor Herbert W. Boyer

Professor Yuet-Wai Kan

Prize Two Winner

Sir Richard Doll

Mathematical Sciences

Professor Shiing-Shen Chern

Professor Frank H. Shu
Member of Board of Adjudicators
Chairman of the Prize in Astronomy Committee

Professor Shu is a world-renowned scholar, widely acknowledged to be among the top theoretical astrophysicist in the world. He is the member of the American Astronomical Society. Professor Shu is currently the President of National Tsing Hua University of Taiwan.

The Prize in Astronomy 2004

P. James E. Peebles

for his groundbreaking contribution to cosmology.
He laid the foundations for
almost all modern investigations in cosmology,
both theoretical and observational,
transforming a highly speculative field
into a precision science.

P. James E. Peebles

I have always been fascinated by how things work. My parents indulged me in my explorations, even when I was more successful at taking something apart than reassembling it. I do not remember being urged to concentrate on some possibly productive direction, and I think for me this was a good thing, because my career has a similar lack of concentration: in astrophysics one is led to consider processes ranging from subatomic physics to the expanding universe.

When I entered the University of Manitoba as an undergraduate I was not at all sure what academic subjects to study. I am indebted to the faculty there, and to my fellow students, for showing me that I love physics. It was wonderful to me then, and is wonderful to me now, to see how a relatively few simply prescribed laws of nature allow analysis of a spectacular variety of phenomena. Equally important to my life, our fellow students introduced me to my wife Alison.

When I entered Princeton University as a graduate student I thought I would like to study elementary particle physics. I suppose I could have found a career in this subject, but was fortunate to find work for which I am much better suited. I was inspired by Robert H. Dicke. At the time he had turned from a distinguished career in quantum optics to the study of gravity physics. We had then an elegant theory of gravity, Einstein's general relativity, but little evidence that the theory is a good approximation to reality. One tests gravity physics through its effect in laboratory experiments, by observations of its effects on planets and stars, where the gravitational force is much larger, and by analyses of the large-scale structure of the universe — cosmology — where gravity is even more important. The breadth of explorations in all these areas of physics impressed and excited me.

When I started work on cosmology, in the early 1960s, I felt uneasy as well as excited, because the long extrapolation from well-established laboratory results to the physics of our expanding universe was supported by exceedingly limited empirical evidence. I remember thinking I might complete two or three projects in this subject and then move on to something less speculative. That never happened because each project led to ideas for others, in a flow that was too interesting to resist.

My first book on what we were learning, *Physical Cosmology*, was published in 1971. I meant the title to signify analyses that, through comparisons of theory and observation, might show us whether our thoughts about the physical nature of the universe are moving in the right direction. I was able to survey everything I considered relevant in less than 300 pages. This represents a still modest empirical basis, but large enough to make me feel less uneasy.

Many of the ideas that kept me occupied in the 1970s trace back to this book, and before that to the doctoral dissertation of my first graduate student, Jer Tsang Yu, who is now Chief Information Officer at the City University of Hong Kong. Our programme was to find measures of the large-scale distribution of matter, analyze the theory of the evolution of these measures, and then seek promising signs of consistency. I spent considerable time analyzing data sets that had been too large to handle before we had high speed computers. The results, and analyses of their physical meaning, are summarized in my second, larger, book, *The Large-Scale Structure of the Universe*, in 1980. By now the empirical basis was large enough to make me feel reasonably sure we were thinking in the right direction. The basis is even more rich now, but a graduate student in cosmology today would recognize the theme and methods of the 1970s.

At this time we had become aware of the importance of dark matter. Work with my colleague Jerry Ostriker at Princeton explored the astronomical evidence for the existence of this new form of matter. Equally important, to my mind, is my work with Marc Davis that indicated that the amount of this dark matter is not likely to be large enough to agree with the simplest of all possible relativistic universes, in which gravity forever slows but never stops the expansion. The most reasonable way to understand that, to my mind, was to return to Einstein's old idea of a cosmological constant.

In the 1980s I began to feel uneasy again, now about the enthusiasm with which colleagues were accepting ideas I considered speculative. In particular, a case I had considered for a universe dominated by dark matter was quickly accepted by the now rapidly growing cosmology community, at least part because the analysis of its physical properties is particularly simple. Since simplicity of analysis did not seem to me to be a good argument for reality, I spent a lot of time offering alternatives to this case. Now, to my surprise, the simple case proves to fit tests that have become quite demanding. The elegance is marred, however: we need the cosmological constant, a term that makes no real sense within physics as we understand it.

I see a general lesson. It is remarkable, but clearly demonstrated, that the physical world operates by rules we can discover. The discovery is a continuing process of successive approximations. Some advances are in part anticipated by arguments from simplicity to elegance. Some advances are quite surprising. And the process is unendingly fascinating.

Professor Arthur K. C. Li
Member of Board of Adjudicators
Chairman of the Prize in
Life Science and Medicine Committee

Professor Li is currently the Secretary for Education and Manpower of Hong Kong SAR, China. He was the former Vice-Chancellor of the Chinese University of Hong Kong and Professor of Surgery and Dean of the Faculty of Medicine, made significant contributions to research and teaching.

The Prize in Life Science and Medicine 2004
- Two Prizes

Prize One Winners
Half jointly to

Stanley N. Cohen & Herbert W. Boyer

for their discoveries on DNA cloning and genetic engineering;

Half to

Yuet-Wai Kan

for his discoveries on DNA polymorphism and its influence on human genetics.

Stanley N. Cohen

In the late 19th century, my grandparents emigrated to the United States from eastern Europe and settled in the small New Jersey town of Perth Amboy, where my mother and father were both born and raised. I was born in 1935 in Perth Amboy and lived there until graduation from high school. I have one sibling, my younger sister, Wilma. Our mother, Ida Stolz, worked as a secretary and bookkeeper. Our father, Bernard, had begun engineering training, but this was aborted by the economic catastrophe of the great depression. Luckily, he was able to find employment as an electrician, and the income produced by two working parents enabled our family to live in reasonable comfort in a small rented house.

During my childhood Perth Amboy was a wonderful paradigm of ethnic, religious, and racial diversity – and the friends I played basketball, football, and Monopoly with came from a broad spectrum of backgrounds. The town was small enough so that my parents and I knew, and were known by, much of the community. From age 11, I worked at various jobs after school and on weekends and sold subscriptions to magazines. As a teenager, I found work at summer camps in the mountains of New York, New Hampshire, and Connecticut. I learned to play the piano and ukulele, and later – when I developed a serious interest in American folk music – the five-string banjo. In secondary school, I began to write songs and through a combination of perseverance and good fortune, managed to have one recorded by an internationally-known vocalist. However, while I enjoyed playing and writing music, it was clear to me that music should remain a hobby.

My father was a man of insatiable curiosity about the workings of nature, and enthusiastically supported and nurtured my own curiosity about the natural world. While growing up, I was torn between a career in physics versus one in medicine and biology. During high school, my interest in biology grew and I decided to become a physician. I attended Rutgers University for pre-medical studies, and in the fall of 1956 entered the University of Pennsylvania School of Medicine. I had gifted teachers, and the lectures that I attended as a medical student excited me about the field of cellular immunology. Under the mentorship of Professor of Pathology, Charles Breedis, I carried out after-class and summertime experiments aimed at elucidating the basis for immunological rejection of foreign skin grafts. My research results attracted the attention of other cellular immunologists and gained me the opportunity to spend a summer working in the London laboratory of Professor Peter Medawar.

Stimulated by the excitement of addressing fundamental biological questions by laboratory experimentation, I concluded that I was more suited to a career in academic medicine, where I would do research and teaching, than to one as a practicing physician. A postdoctoral appointment at the U.S. National Institutes of Health attracted me to the then-emerging field of molecular biology, and after further training in the laboratory of Jerard Hurwitz at the Albert Einstein College of Medicine, I joined the Stanford University faculty in 1968 as an Assistant Professor in the Department of Medicine. I taught clinical medicine to students and medical house-staff and concurrently established a laboratory to begin experiments aimed at understanding the molecular mechanisms by which small DNA circles called plasmids enable bacteria to become resistant to antibiotics. I particularly wished to know how plasmids had evolved and were propagated. The experiments I devised to answer these questions, together with advances made separately in the laboratory of Herbert Boyer, led to the collaborative discoveries recognized by the Shaw Prize. I have remained at Stanford throughout my professional career, later transferring my faculty appointment to the Department of Genetics and becoming Chair of that department. I currently hold the Kwoh-Ting Li Professorship at the Stanford University School of Medicine.

In 1961, I married Joanna Lucy Wolter, whom I had met while I was a medical student. We have two children, Anne and Geoffrey.

Like most scientists, I feel that the opportunity to spend each day doing work that I love is a great joy. Part of this delight is the opportunity to interact with students and to communicate to them the excitement of discovery that is the foundation of science and technology. I take pride that during the three and a half decades that I have been a member of the Stanford faculty, my laboratory has trained well over a hundred scientists from 18 nations. During these years, my students, postdoctoral fellows, and I have continued to investigate the biology of bacterial plasmids and also have helped to elucidate mechanisms underlying the control of gene expression, of cell growth and development in higher organisms, and of aging. An important focus of my current research is to understand the functions of cellular genes that are recruited and used by disease-producing viruses.

On a personal level, I like to ski, sail, and hike. I also still enjoy playing the five-string banjo – when my family can tolerate it.

Herbert W. Boyer

The American Boyer family began with the immigration of Jacob Bayer from Germany in 1709, with a change of the family name occurring at a later date. The Boyers were originally farmers and tradesmen. My father and grandfathers worked for the Pennsylvania Railroad. My grandfather died when my father was thirteen years of age and at that time he left school to support his family. My mother was a high school graduate when she married my father, and my sister and I were born shortly thereafter. My youth centered around athletics and out door activities. In my first year of high school I had little interest in my academic studies but loved football, basketball and baseball. My football and basketball coach also taught all of the science and most of the mathematic courses.

Not only was he a great coach, he also was a talented teacher. This man brought about a significant change in my ambitions and I excelled in all of his courses. I managed to overcome my initial academic delinquency and I entered St. Vincent College, the first Benedictine College in the United States, in 1954. Shortly thereafter I became familiar with the seminal work of Watson and Crick establishing the molecular structure of DNA. I graduated in 1958 with an A.B. degree in Biology and Chemistry. After failing to enroll in a medical school, I decided to attend graduate school at the University of Pittsburgh, and pursue my interests in genetics, which had been stimulated by the Watson and Crick publication of 1953. I became engaged in an overly ambitious research project for my thesis, using microbial genetics, to elucidate the genetic code. I managed to generate enough data to write a thesis on the structure of a set of related genes in lieu of my original goal, which had been solved very elegantly by others, and received my Ph.D. degree in 1963.

As chance would have it, during the course of research for my thesis, I came upon some interesting phenomenology, affecting the transfer of chromosomal DNA from one strain of bacteria to another. I continued research on this when I went to Yale University to learn more about microbial plasmids. My mentor, Professor Edward Adelberg, encouraged me to pursue my graduate research. I demonstrated that my observations were based on the restriction and modification of DNA, whose molecular basis had been described by Werner Arber. I then began to isolate and characterize the enzymes postulated to be the basis of the restriction and modification of DNA.

In 1966 I joined the University of California, San Francisco, as an Assistant Professor of Microbiology. My research programme centered on restriction endonucleases and modification methylases as model systems for elucidating how proteins recognize unique sequences of DNA, and for generating unique fragmentation of small bacterial plasmids and viruses. This research led to the discovery of the first DNA endonucleases to generate termini at unique sites in the DNA with overlapping sequences. Having an interest in vitro recombination of DNA dating to my years at Yale University, I realized that these enzymes could be used to this end. After some initial frustration with experiments on in vitro recombination of DNA, largely due to inadequate technology, I began a collaboration with Professor Stanley Cohen, at Stanford University. Professor Cohen had discovered a small bacterial plasmid and we found that it could be cut once by one of our DNA endonucleases. This allowed us to take any piece of DNA cut by this same enzyme and recombine it with the cleaved plasmid, insert it into a bacterial cell, and recover the recombined DNA molecule. This became known as recombinant DNA technology. My laboratory continued to explore the improvement of this technology with the development of plasmids with more efficient and flexible utility. We engaged in a project with Drs. A. Riggs and K. Itkura at the City of Hope Hospital in Pasadena, CA., to demonstrate that chemically synthesized DNA could be recombined with natural DNA and recovered as a viable and functional molecule. With the development of techniques for determining the sequence of nucleotides in a DNA molecule, in vitro recombination, and the ability to chemically synthesize DNA a new horizon appeared.

At this time I was approached by a young venture capitalist, Robert Swanson, inquiring about the feasibility of starting a company based upon the above-mentioned technologies. After several discussions we obtained funding to demonstrate that it was possible, by using chemically synthesized DNA to direct bacteria to produce a human protein. With this proof of concept we proceeded to form the first biotechnology, Genentech, Inc.

The extraordinary technological and scientific advances of the last quarter of a century have generated scientific, genetic engineering and biotechnology achievements that were unimaginable to me as I started graduate school in 1958.

Yuet-Wai Kan

I was born in Hong Kong in 1936. My early education at the True Light Elementary School was interrupted by the Japanese occupation of Hong Kong during the Second World War. After the War, I entered Wah Yan College, from which I graduated in 1952. As my older siblings had entered business, banking, insurance, and law, my father told me to study medicine. I graduated from the University of Hong Kong in 1958 with an M.B., B.S. degree. After a two-year internship and residency at the Queen Mary Hospital Department of Medicine, I decided to forego the then conventional medical path that led to study in the U.K. and the M.R.C.P. exam. Instead, influenced by Professors Alec McFadzean and David Todd, I pursued the study of hematology in the U.S. I joined Frank Gardner at the Peter Bent Brigham Hospital, where my interest in research began. From Boston I went to the University of Pittsburgh to complete my clinical training under Jack Myers and then to MIT to learn hemoglobin chemistry under Vernon Ingram.

The first day I started at the Brigham, I met Alvera Limauro, who also started work in the Gardner laboratory on that day. We started dating two years later and married in 1964 in Boston.

From MIT we moved to Montreal, where I obtained additional hematology training under Louis Lowenstein. As fate would have it, that fellowship determined my future research interests. I was called to consult on a newborn who died of a severe anemia immediately after a premature birth. Previously, this condition was described by Lie-Injo Luen Eng of Indonesia as a severe hydrops due to α-thalassemia. Little was known about this disease, and I thought it would be interesting to investigate it.

After working briefly again with Frank Gardner at his new laboratory at the University of Pennsylvania, David Nathan, a former colleague from Brigham Hospital, invited me to join him to study thalassemia at the Boston Children's Hospital. I welcomed the opportunity to pursue my interest in thalassemia. At Children's Hospital I used the system devised by John Clegg and David Weatherall to study protein synthesis in various thalassemic conditions, and we helped to define the different thalassemia syndromes. Bernard Forget brought to the laboratory a new technology to study globin RNA. During the early 1970s, reverse transcriptase was discovered by David Baltimore at MIT, and his postdoc Inder Verma showed how it could be used to generate cDNA from the globin mRNA. Although this was an exciting period in Boston, I left to accept a position to head the Hematology Division at the San Francisco General Hospital in 1972.

Andrée Dozy, who joined my laboratory at the Children's Hospital, moved with me to San Francisco. We learned reverse transcription from the University of California, San Francisco laboratory of Michael Bishop and Harold Varmus and used it to study the gene structure of the thalassemia syndromes. Since newborns like the one I saw in Montreal did not have any α-globin, we suspected that there was something wrong with the α-globin gene. We used the cDNA to study the α-globin gene and showed that, indeed, the α-globin gene was lost in patients with this type of thalassemia. This was the first time a gene deletion was defined in a human disease. We immediately translated this finding to a clinical test as we soon encountered a patient who had had a previous fetus with this lethal condition. We did a DNA test on the cells obtained from the amniotic fluid during pregnancy and determined that the fetus carried just the trait and was not affected by the severe homozygous condition of her previous child. This was the first time a DNA test had been used to diagnose a human condition.

We also used Southern blot analyses to analyze the gene structure of various α-thalassemia syndromes. Using a mixed α- and β-globin cDNA probe to study a patient with α-thalassemia who also had sickle cell anemia, noticed that there was an unusually large fragment of DNA that contained the β-globin gene on digestion with a restriction enzyme. With additional analysis, we determined that it was due to a single nucleotide mutation at a sequence downstream of the β-globin. As we studied the DNA of other patients with sickle cell anemia, we noticed that a majority had this larger fragment. Thus, we could use this finding to indirectly detect the sickle mutation. Thus began the use of DNA polymorphism as linkage analysis of human diseases, and this approach has now been used for gene discovery as well as for what is now known as the single nucleotide polymorphism to study evolution and pharmacogenetics in various genetic traits.

My present work continues the search for DNA tests. It has been known for some time that a few fetal cells do leak into the mother's circulation. We are trying to identify and use these cells for diagnosing fetal conditions. I am also engaged in research to study various genetic approaches to treat thalassemia and sickle cell anemia and to use gene therapy to treat human genetic diseases.

The Prize in Life Science and Medicine 2004
- Two Prizes

Prize Two Winner

Sir Richard Doll

for his contribution to modern cancer epidemiology.

Richard Doll

Sir Richard Doll was born on October 28, 1912 in Hampton on the fringe of London, son of a general practitioner and a concert pianist. He had no ability for music, but found he had a flair for mathematics and intended to study it at Cambridge. An accident, however, deflected his aim and he studied medicine instead at Thomas' Hospital Medical School, London. He qualified in 1937 and obtained membership of the Royal College of Physicians two years later. After 6 years war service in the Royal Army Medicine Corps he obtained an appointment with the Medical Research Council to help Dr (subsequently Sir) Francis Avery Jones in a study of occupational factors as possible causes of gastric and duodenal ulcers and has continued in medical research ever since.

Doll worked with Professor (later Sir) Austin Bradford Hill in the Medical Research Council's Statistical Research Unit at the London School of Hygiene and Tropical Medicine (1948-62) and after Sir Austin's retirement he directed the Unit (1962-69). Subsequently he was able to conduct research whilst Regius Professor of Medicine at Oxford (1969-79) and warden of Green College (1979-83) and, after retirement, as an honorary member of Sir Richard Peto's Epidemiological Studies Unit in the same University.

Two topics constituted subjects of research throughout: the effects of smoking since 1948 and of ionizing radiation since 1955. Research on smoking began as part of a study to find the reason for the enormous increase in the UK mortality from lung cancer that had occurred since the first decade of the 20th century. A case-control study found that cigarette smoking was an important cause of the disease and the increase in cigarette smoking, combined with improved diagnosis, could account for the increase in mortality. Few people however, accepted the conclusion and a new study of a different type began in 1951 in which information was obtained about people's smoking habits and these were linked to their subsequent mortality. The results soon confirmed the earlier findings and showed that the risk of the disease was proportional to the amount smoked. Surprisingly, with the passing of time, other diseases also began to be linked to smoking, and the study was continued with periodic update of the subjects' smoking habits, for 50 years. By then some 20 other diseases were found to be caused by smoking. Moreover the mortality of continuing cigarette smokers was found to be more than double that of life-long non-smokers throughout middle and old age and the risk was found to be reduced when smoking was stopped, being almost eliminated if it was stopped before 40 years of age.

Research on ionizing radiation was begun in 1955 in response to the Medical Research Council's request following the first test explosion of a hydrogen bomb which caused radioactive fallout throughout the

Northern Hemisphere. More than 13,000 patients irradiated for ankylosing spondylitis were identified, estimates made of the doses they received in different tissues, and their subsequent mortality related to the doses received. The first results showed that the risk of leukaemia was proportional to the dose to the bone marrow and suggested that there might be no threshold below which no effect was produced. Later results confirmed the first and also showed that cancer was produced similarly in other irradiated tissues.

Other work showed the reduction in the mortality of radiologists as protection was improved and provided an estimate of the risk of lung cancer associated with the concentration or radon gas that accumulated in houses.

Two other major projects were to determine the effects of steroid contraceptives and to quantify the effect of exposure to asbestos. The first was begun when occasional cases of pulmonary embolism were reported after their use. A case-control study showed that the risk of deep vein thrombosis (leading to a risk of pulmonary embolism) was increased about fourfold by the use of these contraceptives, dependent on the dose of oestrogen. The study was extended to show a smaller effect on the risk of coronary and cerebral thromboses. A follow up study was then designed to obtain a balance of risk and benefit, which was continued by Professor Vessey. The second, on asbestos, was a successor to Doll's demonstration that asbestos caused a substantial risk of lung cancer. It was carried out over many years with the help of Julian Peto and a concerned industry and eventually provided a quantitative estimate of the risk per unit exposure to chrysotile (white asbestos) fibres in the air. Other research included quantification of the occupational hazards of the refining of nickel ore and exposure to coal tar fumes in the coal gas industry, the effect of immunosuppression in patients receiving renal transplants, and demonstration of the infective origin of cervical cancer.

Doll's most important work when in Oxford was however, the review of the causes of cancer that he carried out with Richard Peto at the request of the US Office of Technology Assessment, which laid to rest the claim, commonly made at the time in the US that most cases were caused by occupational hazards or chemical pollution of air, food and water. The review demonstrated the greater importance of smoking, alcohol, infection and diet.

In the last 15 years Doll initiated and chaired for most of the time two committees: one that reviewed, on behalf of the National Radiological Protection Board, the effects of non-ionizing radiation and another that organized a case-control study of the causes of childhood cancer that included all eligible cases in the whole of Britain over a period of 4-5 years. He retired from both in 2003, but their work continues.

Doll has served on many national and international committees and received many awards, but nothing in his life was so important to him as his marriage in 1948 to Joan Mary Faulkner (née Blatchford) who worked for the Medical Research Council as a research administrator for 35 years and died suddenly and peacefully on October 22, 2001.

Professor Wentsun Wu
Member of Board of Adjudicators
Chairman of the Prize in
Mathematical Sciences Committee

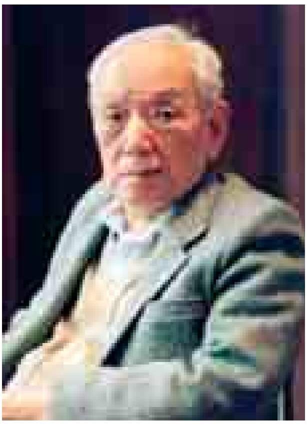
Professor Wu is the fellow of the Chinese Academy of Sciences, fellow of the Third World Academy of Sciences, and the recipient of the State Pre-eminent Science and Technology Award in 2000; now the deputy director, honorable director and researcher of the Institute of Systems Science, Academy of Mathematics and Systems Science in the Chinese Academy of Sciences.

The Prize in Mathematical Sciences 2004

Shiing-Shen Chern

**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 centre of contemporary mathematics,
with deep connections to topology,
algebra and analysis, in short,
to all major branches of mathematics of
the last sixty years.**

Shiing-Shen Chern



I was born in 1911 in Jiaxing, Zhejiang Province, China. I graduated from Nankai University in 1930. After graduation I spent four years (1930 – 1934) at Tsinghua University in Peiping, the first year as an assistant in the Department of Mathematics and the last three years as a graduate student. In 1934 I received the M.Sc. degree from Tsinghua and was awarded a two-year scholarship to study abroad. I went to the University of Hamburg in Germany to study with Professor Wilhelm Blaschke and received the D.Sc. degree in 1936. The next year I worked with Professor Elie Cartan in Paris and made progress in my studies, which affected all my scientific work.

In 1937 I was appointed a professor at Tsinghua University. Unfortunately Japanese aggression became more open that year, beginning with the Marco-Polo Bridge incident. The university was forced to move to the further interior. I became a professor of the South-West Associate University located in Kunming in southwest China.

In 1942 I received an invitation from The Institute for Advanced Study in Princeton. I was anxious to accept the invitation, but the trip from Kunming to Princeton looked formidable. At that time China and the US were allies in the war against Japan and the US was sending support to China with returning planes almost empty. So the Chinese government arranged for me a seat on an US Air Force plane from Calcutta, India to Miami, US. The trip took a week, through Africa and South America.

I was at the Institute for Advanced Study from the summer of 1943 to the fall of 1945. During this period I probably did some of my best mathematical works.

The Second World War ended, and I planned to return to Tsinghua in Peiping to teach. I arrived in Shanghai in the spring of 1946. It turned out that the Academia Sinica, the Chinese Academy of Sciences, was planning to start an institute of mathematics and I was entrusted with the job.

In 1946-1948 I was moving between Shanghai and Nanking (then the capital), planning and working on the new institute.

In September 1948 I unexpectedly received an invitation from Robert Oppenheimer, then the director of the Institute for Advanced Study, inviting me to visit the Institute. I accepted and went with my family. This began a long stay in the US, while tremendous changes occurred in China.

I left China on December 31, 1948 and arrived in San Francisco on January 1, 1949. In 1949 I joined the Department of Mathematics at the University of Chicago, which was under reorganization by Marshall

Stone, later known as the Stone period. In 1960 I moved from Chicago to the University of California at Berkeley, where I retired in 1989.

My election to the US National Academy of Sciences was a prime factor for my US citizenship. In 1960 I was tipped about the possibility of an academy membership. Realizing that a citizenship was necessary, I applied for it. The process was slowed because of my association to Oppenheimer. As a consequence I became a US citizen about a month before my election to academy membership.

The US Natural Science Foundation set up the first mathematical research institute to be named MSRI (Mathematical Sciences Research Institute) and I was appointed its first director. This position lasted till 1985, in which year I became the director of the Institute of Mathematics at my alma mater, Nankai University in Tianjin, People's Republic of China. I became director emeritus in 1993.

I have been honored by many national academies in the world, as members or foreign members. Among them are the following:

- *Academia Sinica 1948*
- *National Academy of Sciences US 1961*
- *American Philosophical Society 1989*
- *Royal Society of London 1985*
- *Academie des Sciences Paris 1989*
- *Russian Academy of Sciences 2001*
- *Chinese Academy of Sciences 1994*
- *Academia Nazionale dei Lincei 1988*
- *Third World Academy of Sciences 1983*
- *Brazilian Academy of Sciences 1971*

I have also received honorary doctoral degrees from the following universities:

- *University of Hamburg 1971*
- *University of Chicago 1969*
- *Eidgenosisse Technische Hochschule Zürich 1982*
- *Notre Dame University 1994*
- *State university of New York at Stony Brook 1985*
- *Nankai University 1985*
- *Technische Universitat Berlin 2001*
- *Chinese University of Hong Kong 1969*

The following prizes have been awarded to me:

- *Cheveny Prize, Math Ass. Am 1970*
- *Steele Prize, Amer MathSoc 1983*
- *National Medal of Science, US 1975*
- *Wolf Prize, Israel 1984*
- *Lobachevvsky Prize, Kazan Russia 2003*

In my education and career I owe a deep gratitude both to my native country and my adopted country. It is my earnest hope that the friendship of the two peoples will last forever.

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Booklet designed by

Journalism and Media Studies Centre
The University of Hong Kong
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