A Chat with Dr Phillip Griffiths

Rochelle Kronzek

[Photo credit: Cliff Moore]

Dr Phillip Griffiths is the winner of the 2014 Chern Medal (an international honour recognising outstanding lifelong achievement of the highest level in the field of mathematics awarded by the International Congress of Mathematics and the Chern Foundation). It is named in honour of the late Chinese mathematician Shiing-Shen Chern who was a mentor, collaborator and dear friend of Dr Griffiths.

Phillip A Griffiths has had a wonderful career to date that has already spanned more than five decades. He shows little sign of slowing down.

Dr Griffiths received his PhD working under Donald Spencer in 1961 in Princeton University. He did post-doctoral work at UC Berkeley under the supervision of S S Chern and afterwards held teaching and/or administrative positions at Berkeley (1962–7), Princeton (1967–72), Harvard (1972–83), Duke (1983– 1991) and from 1991 to 2003 he was the Director of the Institute for Advanced Study at Princeton, New Jersey. Dr Griffiths is currently the Chair of the Science Initiative Group, which is dedicated to fostering science in developing countries.

Dr Griffiths has previously won the Wolf Prize in 2008 (an international prize awarded in Israel for "achievements in the interest of mankind and friendly relations among peoples ... irrespective of nationality, race, colour, religion, sex or political views", the Brouwer Medal in 2008 (presented by the Royal Dutch Mathematical Society and the Royal Netherlands Academy of Sciences; the Netherlands' most prestigious award in mathematics), and in 2014 the Leroy P Steele prize awarded by the American Mathematical Society for Lifetime Achievements in Mathematics.

Academically, Phillip Griffiths initiated the theory of variation of Hodge structure (together with his collaborators), which has come to play a central role in many aspects of algebraic geometry and its uses in modern theoretical physics. In addition to algebraic geometry, he has made contributions to differential and integral geometry, geometric function theory, and the geometry of partial differential equations.

Rochelle Kronzek: It is a pleasure speaking with you again after meeting you during the ICM meetings in Seoul, Korea, recently.

Phillip Griffiths: It's my pleasure.

RK: I'm curious, what first got you interested in mathematics and how did you come to choose it as a profession?

PG: I came to mathematics rather late. I was raised in the South — in rural Eastern North Carolina, where a common tradition was to go to military school for high school. Following that tradition, I went to the Georgia Military Academy where I had a terrific mathematics teacher, Mrs Wilson who made mathematics interesting for me.

RK: Which subjects did she teach?

PG: Geometry, algebra and trigonometry.

RK: Perhaps that's why you became interested in Geometry!

PG: She had a wonderful, mathematical mind. Quite amazing. If it had been another time, she would have accomplished a lot as a research mathematician. Anyway, after high school (in keeping with tradition), I applied to the Naval Academy in Annapolis but I didn't pass the physical so I went to Wake Forest College instead. I was originally a pre-med student but I didn't

Phillip Griffiths was given the Chern Medal by South Korean president Park Geun-Hye

like the chemistry and biology courses. At that point I decided to become a mathematics major. I remained in mathematics and went to graduate school at Princeton University. My Doctoral advisor was Donald Spencer. After my second year, Dr Spencer advised that I spend the summer of 1961 at Berkeley under Dr S S Chern's care. Princeton is too hot in the summer so I was happy to go. Dr Spencer wrote a letter of introduction for me and that is where my relationship with SS Chern began.

RK: You initially went for a summer but stayed for several years. What happened?

PG: I quickly ran out of money that summer. Dr Chern arranged for me to teach in summer school at Berkeley and I made enough to get back home. Later, I received a post-doctorate degree at Berkeley under Dr Chern's supervision and then stayed on as faculty at Berkeley for three more years.

RK: Why did you decide ultimately to return to Princeton after three years as faculty at Berkeley?

PG: I had been a student at Princeton and was very fond of the mathematics department there. I also had a two-year membership at the Institute for Advanced Study, and so, after being a student and then spending five more years in Princeton, I was pretty rooted there.

RK: You continued to work and collaborate with Dr Chern for forty years. Can you explain some of the instances where your paths crossed again?

PG: I went back to Berkeley as a Miller Professor for one year in 1976 and I attended many conferences and workshops with him over the years. One of the many things that we did together was to write what I believe is an important book on "Exterior Differential Systems". There were five co-authors on the book.

RK: Who are the co-authors?

PG: Drs S S Chern, R L Bryant, R B Gardner (student of Chern), Herbert L Goldschmidt (a Spencer student) and me.

RK: Why did the book take so long to complete?

PG: Dr Chern was the founder of MSRI and became its first director. That took a great deal of his time and energies. Although the book took a back seat at times, I became a regular visitor at MSRI with Dr Chern.

RK: What do you feel are the most important contributions of Dr S S Chern to Mathematics and to the Mathematics Community?

PG: Scientifically — Dr Chern was the founder of Global Differential Geometry. He had received superb training in classical geometry from Elie Cartan and also from the Hamburg mathematics community. When it comes to Global and Complex Differential Geometry and the whole spectrum of the field of differential

geometry, Dr Chern's contributions are enormous.

MSRI — Dr Chern founded the ***Mathematical Sciences Research Institute*** or MSRI on Berkeley's campus in 1982 together with Calvin Moore and Isadore Singer. He was its director from 1982 through 1984. Today, MSRI hosts 85 mathematicians and post-doctoral researchers for extended stays each semester and holds programmes and workshops. Some 2000 mathematical scientists pass through the institute each year. MSRI is supported by the NSF and the National Security Agency as well as 90 Universities.

Persona — Chern brought the lesser known work of mathematicians into the public eye. He did it systematically and felt that it was a professional responsibility.

RK: Do you have an example of someone that Dr Chern brought "into the light" from a lesser known to a more studied and revered mathematician?

PG: Some of the early work of Gene Colabi comes to mind. He is of course quite well known for a long time now, but Chern's seminar took up some of Colabi's work that was not fashionable at the time, but later of course this changed.

Personally, Dr Chern helped young mathematicians. He helped me from the time we first met. One of my first times abroad was in China teaching a mathematics course that he arranged. It was in 1980.

Chern also helped to connect the Chinese mathematical community abroad to the mathematical community in the West. He brought the East West and the Western mathematics to the East!

RK: That has been the ongoing mission of World Scientific Publishing as well.

PG: Dr Chern helped to establish important mathematics programmes in China and spent more and more time there as well.

RK: It is clear that Dr Chern was very much a part of your professional life. I hope that I don't embarrass you too much by telling our readers that when I asked you in Seoul during the ICM what it meant to you to win the Chern Medal, you declared that apart from your marriage, it is one of the most moving tributes that you've received and been a part of.

RK: Let's talk more about you now! Tell me more about your own professional life and trajectory. You did post-doctoral work at Berkeley then taught there for three years before returning to Princeton. From Princeton, you taught at Harvard and then took a post at Duke University. All four are terrific schools. What prompted the moves (Berkeley, Princeton and Harvard)?

PG: I was married in Princeton and my wife wanted to attend medical school. There were none of these in Princeton, but as you know there are a number of medical schools in the Cambridge area. After completing her pre-medical studies at Harvard, she went to Tufts Medical School where she was the class mother. We had two young daughters at that time. It was extremely rare for a woman in her thirties to enter medical school, especially one who had a family.

RK: What prompted you to leave Harvard University for Duke University?

PG: Part of my decision to go to Duke University has to do with the traditions of the South, where I hail from.

RK: Please explain that decision to me and our readers.

PG: I was staying with my father in Raleigh, North Carolina one summer. He was very ill at the time. I went over to Durham to visit with Terry Sanford, a former Governor of the State, who was then the President of Duke University and a friend of my father. Terry asked me to consider becoming the Provost at Duke University. He said that there are three constituencies for University administrators: (1) students, (2) alumni and (3) faculty. He said that he would tend to the first two and I would only need to be concerned with #3 — the faculty.

RK: Did you feel compelled to take the job to be closer to your dad, as he was ill?

PG: My dad's illness progressed very quickly and he was gone within a few months. We knew that was going to happen. Terry Sanford was a good family friend. He asked me to do something for him, and for a southern university; and as the traditions of the South goes, I accepted his request and took on the position. My decision to take the Provost's position at Duke was a personal one, and I had a most enjoyable time at Duke from 1983 to 1991.

RK: In 1991, you returned to Princeton a third time as the Director of the Institute for Advanced Study. Please talk about the Institute and your time there.

PG: It was a wonderful period for my wife and me. The Institute is much smaller than Duke University so I had the opportunity to return to my own mathematics research and to supervise students again.

The Institute for Advanced Study was founded in Princeton in 1930 through private funds. Past faculty have included Albert Einstein, who remained at the Institute until his death in 1955, and distinguished scientists and scholars such as Kurt Gödel, J Robert Oppenheimer, Erwin Panofsky, John von Neumann, George Kennan, Hermann Weyl, and Clifford Geert.

RK: Most people think that the Institute is focused upon mathematics but… there are several more programmes than that.

PG: There are four schools within the Institute where research is done: Historical Studies, Mathematics, Natural Sciences and Social Sciences.

RK: According to the Institute's own website, in the eighty-year history of the Institute, over 6000 former members hold positions of intellectual and scientific leadership throughout the academic world. The Institute has hosted 33 Nobel Laureates and 40 out of 56 Fields medalists! Of course, many Wolf and MacArthur Prize winners have been members of the Institute as well.

PG: In addition to Mathematics, which is the oldest of the four schools, and to Natural Sciences which began under Oppenheimer, research in the School of Social Science has had a significant impact on the field of global development. Books by faculty in the School of Historical Studies have become key texts in a range of historical disciplines and, in particular, have made essential contributions to the classics and to art history.

RK: What changes and expansions occurred during your tenure at the Institute for Advanced Study?

PG: In the Natural Sciences we founded theoretical biology and in Mathematics we established a Computer Science and Discrete Mathematics programme. Alan Turing had spent time at the Institute in the late 1930s and Von Neumann was a faculty member from the early 1930s until his passing.

RK: According to your Institute's website again, the beginning of computing, one of the first stored programme computers was designed and built on the Institute's campus, and its structure (von Neumann architecture) has influenced the development of today's computers and formed the mathematical basis for computer software. The foundations of game theory, a powerful tool in economics, were formed in the School of Mathematics at the Institute, and much of the basis of modern theoretical meteorology was laid by research there. Research in the School of Natural Sciences has greatly advanced particle physics, including string theory and astrophysics. WOW!!

PG: Another area is Historical Studies. We added Islamic Studies and there hadn't been any Asian History programme at the Institute. Dr Chern was very instrumental in helping us to establish an Asian History position and involving the Chinese government. We received very helpful encouragement from the Chinese Government due to Chern's help.

RK: Apart from Dr Chern, which mathematical figures have impacted you?

PG: Again, I'd have to credit my high school teacher for instilling an interest in mathematics and my doctoral advisor — Donald Spencer, who was a great mentor. My other "heroes" of mathematics include the French and Italian geometers of the late nineteenth and early twentieth centuries such as Picard, Henri Poincaré, Solomon Lefschetz, Castelnuovo, Enriques, and Elie Cartan… the teacher of Dr Chern.

RK: Why did you lean so heavily on the classic geometers when you were doing your graduate studies?

PG: Well, there weren't many published books in my key area — algebraic geometry, when I was going into mathematics research. The books that were out there were in Italian, French and German. There were more algebra books than in geometry, and I had to learn the subject of Lie Groups from Cartan (French) and from Hermann Weyl (German).

RK: Those are certainly authoritative figures to have learned from! You stepped down as the Institute's director in 2003. What have you been doing since?

PG: While I was the director of the Institute, James Wolfensohn was the chair of the Board of Trustees and

ICM 2002, Beijing, China, Griffiths was third from the left at front row and Chern was fifth from the right at front row

also was the President of the World Bank. He wanted to bring capacity building in science and technology into the Bank's portfolio, and to help to do this he asked me to put together a group of scientists from around the world. This led to the establishment here at the IAS (Institute for Advanced Study) of the **Science Initiative Group (SIG)** in 1999 to provide scientific and administrative oversight for the **Millennium Science Initiative**. The MSI, as it is known, flourished in Latin America and Mr Wolfensohn asked SIG to expand our activities to include Africa. This led to the current project of the group, which is the **Carnegie–IAS Regional Initiative in Science and Education (RISE)**. RISE supports scientists and engineers pursuing MScs and PhDs in selected disciplines through regional university-based networks in sub-Saharan Africa.

RK: It is very exciting that half of $500,000 of your prize money from the Chern Medal goes to a charity of your choice.

PG: Yes, and I have designated that the funds go to **AMMSI**, The **African Mathematics Millennium Science Initiative**, which is a RISE affiliate network.

RK: I want to end my time with you by talking about mathematics education and your thoughts about how it needs to change in the future.

PG: An important aspect of mathematics education is the quality of the teachers… how skilled they are, both in their knowledge of the subject and their ability to work with and guide students in the learning of the subject. In particular, most students seem to be basically interested in the subject but need to see how mathematics is necessary to everyday living (personal finances, technology, etc.) Students need to see what mathematics is good for.

RK: Enlighten us, please. Why is mathematics important? Why do students need to learn it? What are the most obvious applications for mathematics?

PG: Mathematics is the language of science and of engineering. More than that, it provides the tools for expressing quantitatively, the phenomena of science and of modelling those phenomena as they affect our daily lives — think climate change, drug development, GOOGLE, finance…

RK: And for you, Dr Griffiths… tell me about what is elegant about mathematics?

PG: There are long lists of things that are elegant about mathematics. I learn something new every day although I've been studying mathematics intensely for over fifty years.

RK: Thanks very much for spending the time with me, sir.