Acceptance Speech

Your Majesty, Your Excellencies, Ladies and Gentlemen

I am astonished to find myself in the company of a very distinguished group of mathematicians, the nineteen previous winners of the Abel Prize. Very unexpected. My sincere thanks to all involved. Pure mathematics is a wonderful subject, and I feel very privileged, not only to have been a research mathematician, but to have enjoyed it and to be now rewarded for it. Here are some thoughts about how I ended up here.

First, it is already significant that there is such a prize. Mathematics has been studied for several millennia and has been central to both scientific and philosophical thinking. I can identify two opposite facets; the usefulness of mathematics as a language of science and the intellectual pleasure of invention. Mathematicians tend to be driven by the second and to lose sight of the first. Often there is a long delay from the formulation of the mathematics to its applications. Many thanks to the Norwegian government for establishing the Abel Prize, and to The Norwegian Academy of Science and Letters for awarding us recognition: that we may celebrate both sides and remember mathematicians like Abel, whose mathematics we still use today.

While my parents had an intellectual bent, as a girl I was not designated for a profession except perhaps as a high school teacher. In 1957 during my second year of high school the Soviets launched the satellite Sputnik. The United States woke to the realization that as a country we were not producing mathematicians and scientists. I benefited directly a few years later from a few of the many programs put in place to "catch up". It was such an important goal that women and minorities were explicitly included in the target audience. During my years at the University of Michigan, these programs fit my background and abilities. I was much encouraged by my professors, and I received a National Science Graduate Fellowship, which funded four years of graduate study.

My parents were pleased, as my education had cost very little and I was qualified to teach high school. But to progress in a research career, more had to happen! A post doctoral position and then a professorship were necessary. At the time, this seemed unrealistic. If I had been five years older, it would not have happened. While the first wave of feminism resulted in women obtaining the right to vote (1920 in the US but earlier starting in 1913 in Norway), the second wave of feminism started in the 1960's with demands for equal job opportunities and equal pay. We read Virginia Woolf's "A Room of One's Own", Simone de Beauvoir's "The Second Sex" and Betty Friedan's "The Feminine Mystique". I was having none of it. I wanted to do mathematics, not change the world. How I would do this is unclear, but for the most part my friends, teachers and husbands encouraged me. I only applied to programs which accepted women and was helped around discriminatory attitudes and laws.

In 1972 the US federal rights law, known as Title IX, unlocked the already battered door. This law prohibits discrimination on the basis of sex in any federally funded US education program. By then I was assistant professor and the legal barriers were down. My understanding is that women mathematicians in Norway also began obtaining professorships in this time frame. This would not have happened without the second wave of feminism.

I started my thesis work with Richard Palais in 1965 in the rapidly developing field of global analysis. Roughly speaking, a function is a transformation between mathematical spaces. In the new view, a function is a point in an infinite dimensional space. Minimization, flow equations and cumbersome complicated partial differential equations could be put in a different framework. Ideas from geometry, topology and mathematical physics were reformulated. I was immediately entranced by this admittedly grand viewpoint, but also set myself to learn the technical underpinnings needed to shore it up. The initial promise of this approach did not really begin to pay off for a decade or so. I credit S. T. Yau's solution of the Calabi conjecture in 1976 with the start of the big payoffs. Global analysis was renamed geometric analysis with S. T. Yau at the helm, and I was perfectly situated to tackle some of the problems. This is the story of the "bubbles".

Meanwhile, high energy theoretical physicists discovered that some of the ideas in global analysis were tremendously useful to them. I mention the Atiyah-Singer index theorem; both Michael Atiyah and Is Singer have Abel prizes. The resulting dialogue between mathematics and physics continues to this day. I heard four lectures by Michael Atiyah on the Yang-Mills equations, dug out the very obtuse basic texts on fiber bundles (I did pity the poor physicists), and had the right combination of technical background plus viewpoint to help lay the foundations of the field.

The connection between mathematics and physics remained enticing. From physics papers I learned about loop groups and began a long profitable collaboration with Chuu-Lian Terng on integrable systems. Ed Witten pointed out to me the appearance of the KdV equation in what is now quantum cohomology. I sadly have never understood a convincing explanation of this phenomenon. As an aside, I wonder if this is not just part of the "unreasonable effectiveness of mathematics". If there is a mathematical idea around, it will be used!

Attitude change was an important ingredient in both the success of my mathematics and my progress professionally. The idea of who will do mathematics and science is still changing. It gives me great pleasure, in addition to thanking the Norwegian government and the many people who have encouraged and helped me, to watch the younger mathematicians, many of whom now are women, create new ideas and directions. And while we are looking towards the future, each of us might consider contributing to the health of the planet by taking one less airplane flight in the coming year.