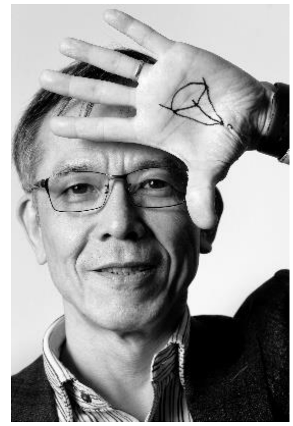
Shigefumi Mori | Mathematics

Works on three-dimensional algebraic varieties, proved Hartshorne’s conjecture in 1978, received the Fields Medal in 1990, was president of the International Mathematical Union for several years, and has an asteroid named after him.



Professor Mori, you were born 1951 in Nagoya in Japan. Please tell me a bit about your family background.

My parents were running a small company, selling textiles, where they both worked. Therefore they didn’t have much time for me and sent me to a private tutoring school after school. In those days, the tutoring school was giving exams regularly and the kids who did well were listed. I never managed to be among the top 30. I just wasn’t interested in learning. Mathematics became one and the only subject that ever touched me personally. One day we were given a quiz where everyone who solved the problem correctly, would get a piece of a big cake. That day, somehow, I was the only one with the right answer. So I won the whole cake. The teacher actually had to accompany me home and explain to my parents, why I would bring home such a big prize. Because usually, I was lazy and didn't do well. But this special quiz problem had somehow aroused my curiosity and I had really tried hard to solve it. When the teacher told my parents about my success, they praised me for the first time. That was a very precious moment for me.

And so you discovered your love for mathematics?

It didn't have an immediate effect, but it evoked some feeling within me, that I might like to do something with mathematics. Later, when I was in senior high school, I was reading a book on mathematics and I came across a statement that the number π is a kind of magic number called a transcendental number. I wanted to understand how it was proven. So I spent one long day at the school library searching for it and I got really intrigued. The way the mathematical proof was done was really beyond my imagination. I think that this fascination was pushing me further on. I also found a monthly magazine called “Mathematics toward University”. It also featured a monthly set of problems and I started sending my solutions to them and after two months, they put me on the list of the people who did well. I really got hooked and I went from doing well to very well. Sometimes I even was the first. And I decided that I wanted to continue studying mathematics. I told my father that I had chosen to do mathematics. No one in our family has been an academic so far, so going into science was something totally strange for them. My father must have expected that I would succeed him in his business. The first thing he asked me, was: "How can you make a living out of that?" But as he realized that he couldn't force me, he agreed. Of course, they supported me, they were really generous.

You studied at Kyoto University and you got an assistantship there.

Originally, I wanted to study at the University of Tokyo, but the entrance exams were canceled because of student riots. So I entered Kyoto University. But then the students occupied the College there as well and I couldn't take a regular calculus or linear algebra course. During the first half year the college was closed, and there were no lectures. In the second half, they gave only some condensed courses, and I really didn't have the chance to properly study mathematics during that time.

Did you take part in the riots?

No, I didn't participate in the students riot either. I just wasn't interested. Instead, I started with a few friends a seminar for ourselves. Everyone had to read a chapter of a book about mathematics and then one person explains the contents to the others. The others were asking questions, pointing out mistakes and all started a vivid discussion. That was important to me, not the student riots. We even managed to convince a professor to tutor our seminar.

After your PhD you went to the US, to Harvard. That was certainly a big step into a different world. How was it for you?

Actually, it wasn’t my idea to go to the US. My advisor, Professor Masayoshi Nagata, arranged that. I decided to give it a try, and if I wouldn’t do well, I could always go back home again. But actually, I was relatively scared. I think my curiosity won in the end and my life as an assistant professor in Boston started.

My stay at US was quite fruitful in research and I myself changed a lot. Then I moved from the US to Nagoya around 1982, where I started my favorite style of doing research: in the cafeteria. Maybe I was a difficult professor for my students and demanded too much from them. It took me quite some time till I got used again to the Japanese style.

Were you also demanding a lot from yourself?

At that time, I was pushing myself hard to do research, because there were things I absolutely wanted to finish. I was really working day and night. My research style was that I would work totally concentrated for a few months on my topic and keep on thinking and thinking until it was finished, and afterwards I got lazy again for a few months.

At least, you found enough time to look for a woman.

I temporarily came back from Harvard in 1980, moved to Nagoya University, and was to go back to US in a few months.

It was an arranged marriage during the busy time. Somehow, my wife thought I was okay. After the marriage, I went back to US and my wife followed me. Our first boy was born when we were at Princeton in 1981. Even our parents came and visited us at the US for that event. But I was only interested in my research and I didn't think much about my family. Now, looking back, I am grateful to my wife and I can see how much I owe her.

You were totally obsessed with your research?

That's the right expression. When I was staying at Institute for Advanced Study Princeton, I found a topic I wanted to pursue and I kept researching it until 1988. I don't think I was a very good husband at that time. While I was doing research, I couldn't pay attention to anything else, but somehow, my wife always managed to drag me to museums and exhibitions. Originally, I wasn't really interested, but now I quite enjoy accompanying her. When I go abroad, I always take her with me. While I'm doing business, she sorts out interesting places for art and when I have time, we go there together and so we can share the experience.

Once, you were saying, "I'm not a positive person." Why did you say that?

I used to be a worrisome person. Only with the help of my wife I learned how to appreciate life. It was a difficult process for me. But now, I understand that there are various ways to look at things and I try to see also the good points and appreciate them. My wife also did amateur paintings. I still think that painting is just a lot of work, so it is nothing for me - but you never know, maybe one day. Paul Klee once said about art, that it is not just reproducing what you see, but making invisible things visible. I was amused to see that it applied to science as well. My field, algebraic geometry, studies figures by using equations. My attitude toward algebraic varieties is comparable to that of painters toward paintings. There is definitely some correlation between algebraic geometry and abstract paintings like Paul Klee.

Mathematical findings are often not easy to understand. Can you still describe your research in an understandable way?

One of my research was a simpler way of expressing algebraic variety in a simple figure (an invariant), something like a cone. This method was originally discovered by Heisuke Hironaka and Steven Kleiman. What I found was that in this cone-like figure there are some edge-like shapes (called extremal rays), which carries a geometric meaning of the original algebraic variety. My research can be put as follows. An algebraic variety is actually something one cannot really see. It's higher dimensional, but in algebraic geometry, we express it in terms of a much simpler looking cone, shaped like an ice cream cone. I find an extremal ray in it and analyze it more closely. That's why I compare it to Cubism paintings. Cubism also expresses objects by using simplified figures.

And that's how you developed the concept of minimal models for what you got the Fields Medal?

Algebraic variety can appear in many slightly different forms and we want to study the essence of this variety. One way to do this is by getting rid of the inessential parts and to study it in its simplest form. That's what people call minimal model. The way to obtain a minimal model is guided by the cone mentioned earlier, and I found the extremal ray. I cannot really touch on algebraic variety directly, but I can see the cone and an extremal ray. Through these, I can recognize some geometric structure. Using this, I make some operation on the original one and by repeating this over and over again, I get the minimal model, the simplest shape.

And the famous mathematician Hironaka was saying about your research: I'm not a genius, but Mori is! He is a discoverer, who finds things that people never imagined.

Well, that was very nice of him to say. But he is actually the genius. I only got interested in this extremal ray through the notion of a cone that he himself found. I pursued this new object and I somehow succeeded in reaching the minimal model. Until then the minimal model was only known in dimension two, but it was considered impossible in dimension three. When I started my research, in 1981, I did not intend to prove the existence of the minimal model. I was just attracted to some question in front of me and I couldn't stop working on it. And in 1988 I finally could prove the existence of the minimal model in dimension three.

So if everyone thought this was impossible, did you sometimes have doubts?

First, I was doing all the computations by hand. The computation took longer and longer, and after a few examples, I couldn't finish the computations anymore by hand. So I learned programming, I bought a computer and then I found many more examples. That was what actually convinced me that I was on the right track, and I could keep doing it. When it comes to research, one has to be stubborn. Once a direction is set, one has to prove it or disprove it. I do not follow the fashion, I just follow my curiosity, that's what I am best at, as this fits my personality. I wanted to find my own way.

What is so fascinating about science for you?

That I can find the solution by just thinking hard. This applies especially to mathematics and it is absolutely amazing. At least, that's what happened to me. Just by changing my way of thinking and of looking at things, they can become extremely simple, all of a sudden. A great mathematician was once asked about mathematical ideas. He said, that he cannot define them. But if he was given an article he could judge whether it contained a mathematical idea or not. A mathematical idea is something like a beauty. Beauty is not something you look for while working, but something you get after the work is perfect. You will be charmed once you experience it.

Do you think a good student should ask a lot of questions?

It's important to be curious and to ask questions. But actually, I respect students, who don't listen to me all the time. It was the same with me. When I was young and attending a lecture, once I got interested in some special question, I stopped listening, as I must keep on thinking about this one point and I totally forgot about the lecture. So it is important that students or kids have their own mind, and don't follow the trend. That is how I have been doing it.

Were you a difficult child?

I was not good at listening to my parents. If I made a mistake, my parents got mad, but there was nothing I could do about it. In that sense, I was a difficult child. It only got better after they praised me in that quiz. That was a real turning point. But when looking at my own kids and grandkids, I see that maybe I was not particularly special. I keep telling other parents, that they should try to find the good points to praise in their kids, but in order to do that, they really have to watch them closely.

Do you have a message to the world?

Nowadays, people tend to want immediate results. But immediate application sometimes also becomes immediately useless. In mathematics, it takes time to develop a useful application, but once you have found one, it usually lasts very long. So it is important to be patient. But nowadays, that is getting more and more difficult. Governments want immediate results as they had made huge investments, but that doesn't happen in mathematics. It is rather slow and so am I.

What makes you happy in life?

That I just have been doing what I wanted to do and I was able to pursue my research. That's quite something. If I had been unable to choose mathematics, I would have been unhappy. Mathematics is my life. When I was offered this important position, the first President of the International Mathematical Union from Asia, it was also a chance for me to pay something back to mathematics.