Anales de Química

Dr. Venkatraman Ramakrishnan

Dr. Venkatraman "Venki" Ramakrishnan was born in 1952 in Chidambaram, India. Ramakrishnan moved to Vadodara in Gujarat at the age of three, where he had his schooling at the Convent of Jesus and Mary School, except for spending 1960-61 in Australia. He did his undergraduate studies in physics in the Maharaja Sayajirao University of Baroda, on a National Science Talent Scholarship, graduating in 1971. After graduation, he moved to the U.S., where he obtained his PhD degree in Physics from Ohio University in 1976 for research into the ferroelectric phase transition of potassium dihydrogen phosphate supervised by Tomoyasu Tanaka. Then, he spent two years studying biology as a graduate student at the University of California, San Diego. Ramakrishnan began his work on ribosomes as a postdoctoral fellow with Peter Moore at Yale University. He continued to work on ribosomes from 1983-95 as a staff scientist at Brookhaven National Laboratory. In 1995, he moved to the University of Utah as a Professor of Biochemistry, and in 1999, he moved to his current position at the Medical Research Council Laboratory of Molecular Biology in Cambridge, England. In 2009, Ramakrishnan was awarded the Nobel Prize in Chemistry along with Thomas A. Steitz and Ada Yonath, by his studies in the determination of the atomic structure of the 30S ribosomal subunit. He got India's second highest civilian honor, the Padma Vibhushan, in 2010. Ramakrishnan was knighted in the 2012 New Year Honors for services to Molecular Biology. Currently, he is the President of the Royal Society.

El Prof. Ramakrishnan en el Palacio de la Magdalena el día de la entrevista

We interviewed Dr. Ramakrishnan at the Palacio de la Magdalena (Santander) during his participation in the IV summer school in Integrative Molecular and Cellular Biology (UIMP). During the opening of this School Dr. Ramakrishnan was awarded with the Medal of Honor of the UIMP.

–We begin the interview with some personal data. You attended school and pregraduate studies in India. There you went to a catholic school. That seems interesting.

Many of the schools in India that teach in English are run by nuns or Jesuit priests. When my family and I moved to Vadodara, we didn´t speak the local language (as different as moving from Greece to Sweden). My parents wanted to send me to an English school, and the only English school in town was run by nuns. The interesting thing (for me) was that was a girls´ school. When I was in 3rd grade the Jesuits started a boys' school in English, so our school stopped taking boys and became a girls' school. Although the boys who had already enrolled were allowed to stay on, gradually the ratio of girls to boys in my class became about 4:1.

–How did catholic education influence you?

Not much at all. India has very strict rules about teaching religion at school. Catholics were required to go to catechism classes but they were only about 10 % of the pupils in my class.

–What about your way of thinking?

My thinking may be more western not because it was a Catholic school but because my education was in English. At the school, we were exposed to English and American literature and ideas, and I think this influenced me more than the fact that it was a Catholic school.

–Both your parents were scientists. We guess this fact greatly influenced your decision of becoming a scientist.

Indirectly, not directly. For a long time, I had no real interest in being a scientist. I was more influenced by two other things: one was a high school teacher who made me feel I was good in science and mathematics; the other was that at that time I could have studied medicine, engineering or basic science. My mother encouraged me to apply for a nationwide scholarship which was only for basic sciences. I didn't score high enough in the national exams to get into the top engineering or medical schools, but I got the National Science Talent scholarship so I went into basic science.

–After your graduation in Physics in India, you moved to the USA and obtained a PhD in Physics at Ohio University under the supervision of Tomoyasu Tanaka. Later you were a graduate student in Biology at the University of California in San Diego. What did guide this transition from Physics to Biology?

I think that in theoretical physics it is very hard to do really first rate research. You spend a lot of time doing calculations (as I did during my PhD) but to make a really big advance is quite difficult. For example, high temperature superconductivity was discovered around 30 years ago and there still isn't a good theory to explain it. Biology seemed to be different. In the seventies, big advances were constantly made, and that is true even now: every few years some new revolution happens. This is partly because of rapidly changing technology. So I thought that if I moved from physics to biology I would have more of a chance to do cutting-edge, really interesting work.

> ***"To do 1st grade research in theoretical physics is very hard so I moved to Biology where the possibilities of doing cutting edge work are much higher"***

–What do you consider yourself, a physicist or a biologist?

Definitely, I consider myself a ribosome molecular biologist. There are physicists who moved into biology and remained physicists without really understanding what the biological questions are. The most successful transitions from physics to biology were by people like Crick or Delbrück who really became biologists, thinking about biological questions rather than looking at everything as a physics problem. Having a physics background helps you indirectly, for example, to think quantitatively. You are well trained mathematically and have a feel for numbers. For example, during the ribosome project, there was a point when I had to decide whether there would be enough signal to noise, and for that my physics background helped. But you have to think like a biologist.

> ***"Definitely, I consider myself a molecular biologist"***

–How did you begin to work in ribosome?

Partly, it was an accident. After my PhD in physics, I decided to go to graduate school again to get a PhD in biology. During that time, I read an article in Scientific American by two professors at Yale, Don Engelman and Peter Moore, who were using neutron scattering to study the ribosome. By then, I thought I had learnt enough biology to start working as a postdoc. So, after reading that article, I wrote to them and Peter Moore offered me a postdoctoral fellowship. At that time I knew enough biology to know that the ribosome was important and quite complicated, so it seemed like a good field to go into.

"After failing to get a job in 50 universities in the U.S. the fundamental thing to me was to kept my options open"

–After your post-doctoral period, you initially could not find a faculty position even though you applied to about 50 universities in the U.S.

I really can understand that. I got my PhD in theoretical physics, then I did my studies in biology, and people said "why do you have to go two years to the graduate school again?". Then I worked in the ribosome which was a classical problem. Moreover, I was using neutron scattering in my research, which requires a nuclear reactor. So overall my career at that point seemed a bit crazy. I really understand why they did not want to hire me. I also applied for a job in teaching colleges. They probably thought "this guy has a weird background and he is a foreigner and we don't even know if he speaks English properly". So, for quite different reasons, neither research universities nor teaching colleges wanted me.

–Could you summarize this period of your life? Some young students are already discouraged at the end of their PhD because they find difficult to find a stable position.

It is very difficult. I considered myself very lucky and one reason it worked out is that I kept my options open. I took whatever position I could get where I could do some research. When I didn't get a faculty job, I went to Oak Ridge National Lab who hired me because they had a neutron scattering facility, and I thought I could do some biology on the side. Then I moved again when I realised I could not do any independent biological research. The idea is keeping your options open for as long as you can. But, even when I started an independent position at Brookhaven National Lab, I had a plan B or even a plan C in case the science didn't work out. At that time, far fewer people knew computer programming so I thought maybe I could join some computer company, doing some kind of scientific programming, or I thought I could teach science in a high school.

–In 1999 you moved from the USA to the UK where you have worked since then as a group leader at the Medical Research Council (MRC) Laboratory of Molecular Biology (LMB) on the Cambridge Biomedical Campus, UK, where you are also the Deputy Director. What were the reasons to move from USA to the UK? Was the UK offering you new challenges or better facilities to develop your work than the USA?

El Prof. Ramakrishnan impartiendo su conferencia de apertura de la IV Escuela de Biología Molecular y Celular Integrativa (UIMP)

> ***In Cambdrige the goal was not to have many Nobel Prizes but to support long term research projects***

Universities in the USA are funded by grants usually from the federal government (NIH or NSF). These grants are typically awarded from 3 to 4 years, so if you have a 4-year grant, after three years you have to apply for your renewal. People like Ada Yonath had been working on the ribosome with a large group at a Max Planck lab in Hamburg in addition to a lab in Israel and support from a third lab in Berlin, and still progress was quite slow. We did not have any idea how long it would take to do something like the ribosome, and at the time we did not even have good crystals. I had already done a sabbatical at the LMB in Cambridge a few years earlier. The lab is known for its many Nobel Prizes, however the goal is not the Nobel Prize, but rather to work on important and challenging problems. Moreover, there were many people around specialists in crystallography and other techniques to help me in the case I ran into difficulties. So stable funding, a tradition of tackling long-term problems and the technical expertise of colleagues were the reasons behind my move from the USA to Cambridge.

> ***To make decisions people need to know about Science***

El Prof. Ramakrishnan recibe el Premio Nobel de Química de 2009 de manos del rey Carlos Gustavo de Suecia

–The Royal Society is the world´s oldest and most illustrious scientific body, founded three and a half centuries ago with the mission to promote the use of Science for the benefit of humanity. 1,600 fellows, world´s most eminent scientists among them, identified by their peers, etc.

At the RS web page it is said: "We are the independent scientific academy of the UK and the Commonwealth, dedicated to promoting excellence in Science".

–After two years of Presidency, what is your consideration about these statements and what are the future directions of the RS?

I became President on the 1st of December 2015 and, at that time, one of my priorities were to engage with the public more because we live in an incredibly technical world and science and technology are changing very rapidly. For example, in biology, new technologies like genome editing or synthetic biology are going to create issues that society has to deal with. Society has to decide if we are going to allow elimination of genetic diseases. And if we do, are we going to allow changing genes that might make us taller, with blond hair or wherever is desirable? These are social problems and ethical questions. To make decisions people need to know about science.

Another big issue is in digital technology. All these companies, like Facebook or Gmail, are offering free accounts. Why? If you are given free accounts you are not the customer, you are the product. The real customers are the people who advertise, and you are the product that they are selling to these customers. This is a scary thing, where everybody owns personal data about you. The use of these data depends on lots of technical things. Data is going to be minded in increasingly smart ways by machine learning, and machine learning is also going to replace a lot of jobs. We are going to a place where technology is going to dramatically advance and we will have to deal with the consequences, so it is very important that play a lead role in informing the public: what is possible, what are the risks, what are the benefits and how do we make the choice. I think this kind of debate is very useful..

Another issue is the importance of science for the economy. In bad times, governments often cut science, but without science there won't be any radically new technology. In fact, without a knowledge of science even today's technologies will not be understood properly. You need to support science even in bad times and you need to commit to certain amount of the GDP to science. That is another case that the academies need to constantly make to government.

A third issue that I did not anticipate at all and it is taking a lot of my time is Brexit. This was an unexpected move and 90% of scientists in Britain voted to remain part of the EU. Most scientists in the UK see the importance of Europe-wide collaborations and having a Europe-wide pool of talent. Britain has been a great magnet for talent worldwide; we are second only to the US in attracting foreign scientists. We have been in extensive talks with European academies and high level administrators in European science, and expressed our desire to continue to collaborate and state how important it is for us to stay engaged in Europe. At the same time we want to convince our government that Britain needs to continue to be part of European Science networks. We are hoping that science will have a good outcome in the negotiations, and the Royal Society is playing an active role in this.

–You have mentioned that we live in an increasingly technological world where Science has reached very high levels of development. This puts society in a position where we believe that Science can solve all our problems, and, as you mentioned, we cannot forget ethics in the use of Science and technology. Are we making a good use of scientific knowledge? On the other hand human beings put their hopes in pseudoscientific therapies (homeopathy, reiki, etc.) or follow a pseudo "natural" life style, for instance, not vaccinating their children. What is your opinion about this? Which are our responsibilities as scientists on this matter?

The current problem is that, partly as a result of the internet, we have various voices being heard. You find information on the internet and you don't know whether it is true or complete nonsense, or even whether the writer is at all qualified to talk about it. Scientists have the responsibility to explain why pseudoscience can be dangerous. You might say that some pseudoscientific treatments may be harmless but the real harm is when they prevent people from seeking real solutions to their problems. If you have a serious disease and there is a real treatment you should try that and not pseudo-therapies.

Sometimes folk medicine has real value, but as soon as it has real value it simply becomes incorporated into mainstream scientific medicine. An example is paclitaxel, which is used for treatment of cancer, and was discovered in some bark in America. People knew about its properties but they didn't know what the ingredient was, and that was finally identified. Another more recent example is the use of plants from Artemisia sp., which came from traditional Chinese herbal medicine. Some plant extract was used to treat malaria. A team in China decided to fractionate these extracts and identify what the active ingredient was. In both cases, as soon as it was verified that there was something real there, it was incorporated to mainstream science.

People need to realize that science is not dogmatic about where the discoveries come from. If it is real and works, it will be studied and will become part of science.

–How can we combine scientific advances and ethics?

I will give you an example. We have produced reports on cybersecurity, machine learning and data governance. For data governance, the Royal Society collaborated with the British Academy, which is the academy for humanities and social sciences. The reason for that is data governance is not purely a technical issue, it is also a social and ethical issue. So, I think that by bringing together different sectors of experts and society you can move forward to make informed decisions. One of the important things that came out of it is that transparency is very important. People need to know how data is being used. Another important thing is that there should be some fundamental principle and this is that, in data use, humans should flourish. If you use this as your guiding principle that would help you decide what good and bad uses of data are.

> ***"People need to know how data collected from Internet and other sources are being used"***

“For Europe, we want to try to continue strong collaborations”

Con Sonsoles Martín Santamaría y Miguel Ángel Sierra el día de la entrevista

–What is the UK expecting as a result from Brexit? A stronger cooperation between the UK and USA? How is that going to affect UK Science?

I am hoping there will not be a substantial change for science after Brexit. My hope is that we will continue to be part of large scale European programmes, including Horizon 2020 and its successor, FP9. Beyond that, we would like to encourage not only Europeans but worldwide researchers to come to Britain. The process might change and applications might be required to work in the UK if you are European but that should not be a problem if we make the procedures straightforward. As scientists, we need to make immigration for everybody more straightforward, and try and reduce barriers for all scientists not only from Europe but from throughout the world.

–Finally, what is your opinion about Spanish Science? We will really appreciate an evaluation of the situation of our country in the most competitive field in the world?

I felt that Spanish science improved dramatically when Spain joined the EU. There were lots of EU funds available and Spanish scientists could move easily around Europe to get trained and move back. As a result of the economic crisis there were large cuts made in Science and this was a mistake. By contrast, when Britain imposed austerity, science was protected even when other areas were cut, including the military. Britain recognizes that the only way to survive in the modern world is to invest in innovation and science.

It takes ten years to train scientists, so if you cut science in bad times, lots of people, especially young ones who are the future, leave science. Then when things improve, you have to train new people and in the long run, it is a waste of money. So it is a bad idea to cut science during economic downturns, especially considering that science is a very small part of the overall budget.

Another important thing is that young people in the UK and the US are given independence and freedom at a very early age, right after their postdoc. They don't work under somebody's umbrella. Even Germany, that used to be very hierarchical, is not doing that anymore. I believe that you are bold and imaginative when you are very young, and you have time to undertake long term projects. I think Spain needs to have more of that, more independence and freedom for young scientists to do what they want to do.

With this we finished the interview. Many thanks for your time, and for your opinions.

“Spain needs to give more independence and freedom to their young researchers”

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