Martin Rees

Born 1942.
Life story interview by Alan Macfarlane.
Available online at www.livesretold.co.uk

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The text of this life story is transcribed, with thanks and acknowledgement, from the collection of Filmed Interviews with Leading Thinkers at the Museum of Archaeology and Anthropology at the University of Cambridge. The interview was carried out by Prof. Alan Macfarlane on in August 2007, and was transcribed by Sarah Harrison. The video is here: https://www.sms.cam.ac.uk/media/2440778

1. My Early Life

I was born in York and brought up on the Welsh borders. My parents were both school teachers who in 1948 started their own school, a progressive boarding school, in south Shropshire. As an only child got a lot of personal attention. My father a versatile man who painted, composed, wrote and was interested in politics. So learnt a great deal from him as well as through formal education. Until I was thirteen attended the school my parents ran and was then sent to Shrewsbury.

As a young child had no particular interest in stars or science; I always found languages the worst subject and to avoid these I tended to shift into science and mathematics.

Bedstone School.

2. Shrewsbury School

Shrewsbury School.

At Shrewsbury there were very good teachers, especially in science. The senior physics master, then in his sixties, had been told he was not good enough to do research when at Cambridge so he went into teaching. One of his year was Neville Mott, one of the greatest physicists of the century. It shows the quality of people that went into teaching in the 1930's. His name was Bill Matthews, and he was one of several, including Geoff Chew, later a keeper at the Science Museum and now in his nineties, who was an excellent teacher.

I was also interested in music and learnt to play the piano and sang in the choir. Singing in the chapel was one of the most pleasant memories of school. My high point in sport was coxing a rowing four.

At A level I did mathematics and physics and applied to Trinity College, Cambridge.

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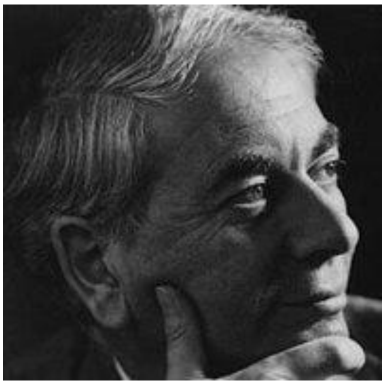
3. Cambridge University

At Cambridge I did mathematics though in retrospect I should have done science. I realized I was not a real mathematician so in my final year I shifted from pure maths to applied maths. I did think of going into economics.



A bit of good luck was to get a research studentship to stay in Cambridge. My most important piece of good luck was being assigned to a good supervisor, Dennis Sciama (right). This was 1964-5 and my research topic in astronomy and cosmology was at an exciting time when black holes and the big bang were being discussed.

It was also a subject where everything was new and it was possible for a young person to make an original contribution. Cambridge had been a centre for radio astronomy since the previous decade. Some of the first evidence against the steady state theory came from the radio astronomers in Cambridge. Also the first evidence that black holes existed came from by-products of the work that they were doing. It was an exciting time that suited my style of thinking as I have never been all that good at long deductive chains of reasoning.

I have always preferred a more synthetic or synoptic style of thinking; making sense of fragmentary and disconnected seeming data and seeing whether it fitted into a pattern which would explain it. This is the theme of the work I have done ever since. At that time I was part of a group in the Applied Maths department but I had close links with the group in radio astronomy and went to their seminars. The discovery of pulsars came in 1968 when I was in CALTEC for a few months and Dennis Sciama wrote to me about the important seminar that Anthony Hewish had given.

At that time Dennis Sciama was a very important role model, an articulate person who had broad interest within and beyond science. He was very encouraging and also had a good set of students including Stephen Hawking, Brandon Carter and a number of others. We learnt from each other as well as from him.

Fred Hoyle (right) was still around but was an isolated figure due to departmental disputes. I got to know him in 1967 when I got my Ph.D. He opened a separate institute and offered me a job as a post-doc. However, as a scientific mentor he was never as important at Sciama because, although unique in the subject, by then he was a rather isolated figure and cut off from the main stream. He was a Yorkshire man and a warm character whom I admired. In 1972 he resigned from Cambridge and I, by then a professor at Sussex, was appointed as his successor. He had always been supportive even though I had been writing papers contradicting his preferred theory. He was never reconciled with the big bang theory and preferred the steady state though he later compromised and believed in some sort of steady bang.

Stephen Hawking (right) was two years ahead of me and when I joined Sciama's research group. He was in his third year; his disease had already started and Sciama had indicated that it was not certain he would finish his Ph.D. One would never have predicted his future career but we are now celebrating his achievements forty years later. In terms of work our scientific interests have slightly diverged in that my work has been more closely linked to observations where he has moved to more speculative areas so we have never collaborated.

'Short History of Time' was an extraordinary phenomenon though as a book it wasn't particularly good; it did do a great deal of good for the subject as, apart from the work of Carl Sagan, Stephen made the widest impact making people aware of the work in astronomy and cosmology. It seems to me that although the details are rather arcane and technical, it is possible to get over the concepts to a general readership. It is gratifying that a wider public is fascinated.

I would get less satisfaction from my own work if I felt that I could only discuss it with a few colleagues. Looking at the interests of the wider public focuses on the fundamental questions of origins. I have been glad to be able to convey ideas of the origin of the universe to a wider audience. It is also good for professional scientists to speak to people outside their special expertise because it forces them to think of the bigger problems that their own work feeds into. Most of my books have stemmed from lecture notes or articles and have been tested. I am not a natural writer. I don't enjoy lecturing but I do like preparing lectures.

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4. My Academic Career

After my Ph.D. I got a three year research fellowship at Jesus College but almost immediately went off to US for short spells, six months at Caltech, back to Cambridge, then six months at Princeton.

In 1972 went to Sussex University as professor and at the time had no expectation of coming back to Cambridge; but I have been based here in Cambridge ever since 1973. I went to Institute of Advanced Study at Princeton and have frequently visited but for my subject Cambridge has been a strong centre. Having visited many places in the USA have not found anywhere that offers the combination that Cambridge does of the good departmental structure in nice surroundings and the extra dimension of colleges and interdisciplinary contacts.

The latter has been important in my life if not my subject. My own department is well known for its informal interaction where everybody meets for coffee and works with doors open and lots of visitors come and go. It is very important indeed for young people to be in a place where they can easily meet senior people. Contact with people in other spheres has been very important in my own education; as a fellow of King's College for a long time it gave me the chance to get to know people like Sidney Brenner, Frank Kermode, Dan McKenzie, leaders in their subjects, and to do that even as a young person.

In American universities you are unlikely to routinely meet people from other departments as we do in Cambridge where each college is a microcosm of the university. I found it very helpful as a young professor to be involved in the selection of college research fellows, comparing people across different subjects and getting a feel for the different criteria and standards, something only senior people get in the US system.

My own work tries to use physics to understand what is out there in the cosmos. I have worked on a fairly broad front, trying to understand how the universe changed from being a hot amorphous gas in the first million years after the big bang to its present state where it is very diffuse. Trying to understand how the first stars and galaxies formed, what they were like, how we can use observations to test conflicting theories.

The second thing has been to understand extreme phenomena in the universe to throw light on the laws of nature. I have worked on gamma ray bursts which release in a fraction of a second more power than the sun puts out in its entire lifetime. I have tried to get clues on the nature of matter under extreme conditions, and the nature of black holes etc.

So two main areas are how structures originated in the universe and how we can learn from extreme phenomena in the present-day universe more about the laws of nature. Also doing more speculative things on the nature of the laws of nature themselves. I ask is the part of the universe we can observe most of physical reality or just some tiny fragment of it? Could there be other big bangs? Some are hopeful that we may be able to complete the program which started with Newton and continued with Maxwell and Einstein of trying to unify together the different forces of nature, electricity, magnetism, nuclear forces, gravity etc.

There may be such a unifying theory but it may be beyond human brains; there is no particular reason to believe that human brains are matched to understand the deepest level of physical reality. So we have to accept that there may be a theory but it may be beyond us. If we had such a theory it would be the end of a certain style of science but it would not be the end of science because most scientists are trying to understand phenomena in the everyday world. They are held up by the complexity of what they are studying but not by what happens inside an atomic nucleus. Unified theory will complete the work of Newton and Einstein, but the most complicated challenge in science is to understand things like ourselves.

My work has been phenomenology. Although a theorist, I have been in close contact with observations. I have adopted a fairly synoptic or synthetic style of thinking trying to link together unrelated data obtained by different techniques. At the start of my career evidence was coming in for the big bang origin of our universe and for black holes etc. and it was possible to have naive and novel ideas. I am fortunate that my subject has not stagnated largely through improved technologies, and the rate of discoveries has remained very high.

In the last few years a new force has been discovered which is pushing the universe and making it accelerate. We have learnt more about the very first incipient stages of how galaxies and stars form and also that our solar system is far from unique which has opened up an entirely new subject. The cosmos has become much more interesting as the body of data has been enriched by new technologies. I tend to sit and think but get a lot from collaboration, talking about ideas. The social side of science is a very important part of it - conferences, e-mail and internet collaboration.

Sub-nuclear physics relies on experiments that are very difficult to do and has been held up for twenty years though there is hope for new advances next year when the new accelerator at CERN in Geneva comes on line. However that is only one branch of science as biologists are not impeded by not knowing what goes on in an atomic nucleus but by the complexity of what they are trying to understand. Each science has its own irreducible concepts and tries to interpret things in terms of those concepts. So understanding the sub-nuclear world is not important for the rest of science.

However understanding the beginning of our universe is important. At present we can extrapolate back with a good deal of confidence to a point where the universe was about one billionth of a second old. At this point conditions get more and more extreme and the laws of physics we can test in the laboratory break down. We need some new knowledge of fundamental physics. Cosmic science needs quantum science at this point. I suspect that the whole idea of space and time has to be revised.

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5. Space Technology

Space technology has been very important for my science. We have been able to send probes to the planets and have understood more about the solar system as a result. Also having sent telescopes up into orbit we can observe in a way that you can't on the ground. Above earth's atmosphere you get much sharper images but also certain kinds of radiation infra-red, ultra-violet and x-rays which are emitted by cosmic objects and which don't get down to ground level as they are absorbed in the atmosphere.

Some of the things I have worked on like cosmic explosions would not have been possible without this. Space technology is a by-product of Soviet-US rivalry and developments continue for both military and commercial purposes. The latter now exceeds the former in expenditure. Scientific expenditure is a tiny spin-off from this. Future plans for large instruments in space will study back in time to where the stars and galaxies were forming and to see planets round other stars, even planets like the earth.

Within twenty years we should have telescopes in space which would be able to image a planet like the earth orbiting another star. The question of whether there was life on other planets would be left to biologists; the question of the origin of life isn't understood here on earth yet. The development of space science and technology it has also been motivated by sending people into space. The American moon landings crash program was driven by superpower rivalry, now thirty-five years ago. What is the long-term future of people in space is a subject of debate. The international space station doesn't really inspire people.

The Americans have a long-term program to go back to the moon and to Mars but I am unsure whether this will materialize. The American civilian program is risk averse because of shuttle accidents. My personal view is that the only future of manned space flight lies in high-risk private enterprise, as adventurers and explorers. The practical case for sending people gets weaker all the time with each advance in the miniaturization of robotics.

The European effort in space has been rather low level compared with the US but I feel we should eschew manned space flight completely and spend all our money on advanced robotics and then we can fully match what the Americans do on a much lower budget. Just as the leading particle physics lab is at CERN in Geneva so we can make leading space science an activity which is driven from Europe.

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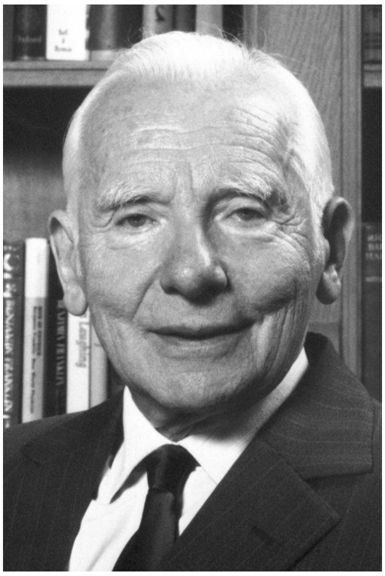
6. Public Understanding of Science

Education must maintain our expertise in science and technology in the UK but the wider public should be given a feel for science and technology. Young people are growing up in a world ever more moulded by science and technology and are facing ever more ethical choices about how to apply science. We need a public that is informed enough to take part in such debates on these questions. It should not be left to professional scientists to decide on the applications of science as they have no special ethical sensitivities. Scientists should feel the obligation to explain the scientific background; people should understand the key ideas. not the details, and the fact that we are never really certain about things. Nothing is ever risk free.

With regard to outreach, new communication media via the internet are crucially important. If a scientist wants to get ideas over clearly then writing a book or an article is the surest way. Television is frustrating because of the compromises you have to make but with the internet it is possible to make videos available to discerning viewers so there may be a revival of serious documentaries. Apart from expounding ideas, dialogue is important and scientists have been rather remiss in not getting into dialogue with the public. Scientists are regarded as ghettoised in comparison to other intellectuals. This is bad for the image of the scientific profession.



Scientists have a responsibility to engage with the public when their work has implications of an ethical or societal character. The classic case of this is the atomic scientists in World War II. Many of the physicists who had worked on the bomb later went back into academia but did maintain a long term concern and responsibility to do all they could to urge steps towards arms control. Joseph Rotblat (right) and Hans Bethe, who were involved in Los Alamos, devoted part of the rest of their lives to campaigning for control of nuclear weapons.

I have been involved in Pugwash-type activities - in 1950's Bertrand Russell and Albert Einstein signed a manifesto drafted by Joseph Rotblat and in consequence an institution was formed to get together scientists of east and west and first meeting was held in Pugwash, Nova Scotia. Pugwash conferences were especially important in the 1960's as at that time there was very little opportunity of scientists in the Soviet Union and the west to meet. After meetings participants could report back to their governments which helped to get the partial test ban treaty in 1963 leading to the anti-ballistic missile treaty about 1970. I was privileged to know Joseph Rotblat who worked almost until his death two years ago campaigning to rid the world of nuclear weapons. People such as Robert McNamara became convinced that this should be a long-term goal.

7. The Future

The 21st century is special as it is the first time that human beings both collectively and singly are going to have an effect on the whole planet. It is good that the destruction of the planet has come up the political agenda as a long-term concern. I am worried about whether we can cope with rising population and the aspirations of the developing world without a long term bad effect on climate and biosphere generally.

New risks come from us living in a more interconnected world where individuals are empowered more than ever before which means that society is far more vulnerable. Technologies are advancing faster and on a broader front than ever before. As a scientist of cosmology and astronomy I have an awareness of the long term future as well as the past. There is a view that humans are the culmination but I know as an astronomer that the sun is less than halfway through its life and any creatures that witness the demise of the sun won't be humans, but will be as different from us as we are from bacteria. If we destroy the future of life on earth in the21st century this could resonate far beyond into a post-human era. We do not know if there is life elsewhere in the universe but this is the challenge for the 21st century.

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8. Reflections

King's College and Trinity College

King's College is famous for its chapel and the excellence displayed there is an important feature. Comparing it to Trinity, similarities outweigh the differences. Trinity is a larger and somewhat more formal place. Trinity College chapel is not so famous but there is outstanding music there. As Master I find the role even more non-executive than the master of other colleges. This because there is a very large fellowship with a very strong commitment to the college.

I have been very impressed by the willingness of the fellows to devote time to the college; it is a great privilege to be there and do enjoy it.

The year after my appointment as Master of Trinity I was appointed President of the Royal Society which is also a privilege. But it is quite time consuming. To be honest, if I had known that I was taking on the Royal Society I might not have taken on the Mastership of Trinity.

The Royal Society

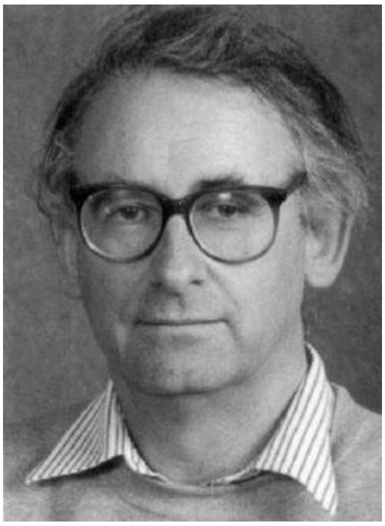
The Royal Society is changing and is concerned to look towards the future. In 2010 we celebrate our 350th anniversary and for this we are trying to raise £100m. The Royal Society is already engaged in policy over a wider range than before as science and technology enter into Government policy on more fronts. We want to ensure that decisions can be made on the best available scientific evidence.

The international aspect has expanded into things like pandemics and climate change. Three years ago a routine meeting of the academies of the G8 (now G8 plus 5) countries was established in the lead-up to the summit. The academies make statements which can feed into the summit. Above all the Royal Society is trying to retain excellence and quality of science in this country which is crucial for the country.

House of Lords

I am now in the House of Lords as a cross-bencher. Unlike most scientists I have always been fascinated by politics so would like to spend more time there. I do try to attend twice a week; I hope to be able to participate more in the future.

The Nature of Ideas



There are few Kuhnian revolutions in science. Einstein extended Newton's laws but didn't overthrow Newton. Science is an evolutionary procedure. In my subject advances have been made through new observations made possible by technical advances. There are key insights which are most important in the development of science.

Dan McKenzie (right) was involved in such with continental drift and tectonics that unified lots of data. The other big contrast between science and humanities as regards creativity is that in science although your work is durable it generally loses identity. Einstein is an exception. Kuhn's examples include Galileo v Copernicus. Another is the quantum revolution of the early twentieth century. Marvel at how far we can get with commonsense intuitions in making sense of the physical world.
