

Interview: Freeman Dyson spills the beans

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INTERVIEW

Freeman Dyson spills the beans

UK-born physicist Freeman Dyson talks to David Smith about some of the great names in physics, his rather unorthodox education and the future of physics as a subject.

DS: You arrived at the Institute of Advanced Study (IAS) in Princeton a few years before Einstein's death. Did you meet him?

FD: Not really. I always saw him around – he would walk back and forth from his home to the Institute every day – but I never exchanged a word with him.

Someone told me that you inherited his office?

No – all I inherited was his shabby black music stand, which is now on display at an exhibition in Bern!

Brian Cathcart (author of *The Fly in the Cathedral*) told me that the head of the Cavendish Laboratory in Cambridge (Sir Malcolm Longair) is fed up with people only asking about Maxwell and Rutherford – nobody seems interested in what the lab is doing now. Is it the same at the IAS?

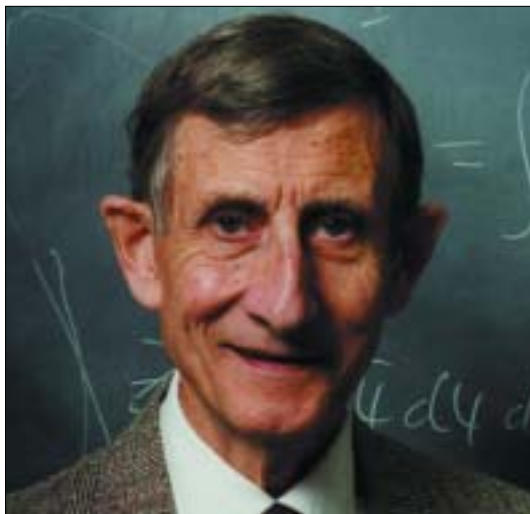
Absolutely – Einstein is a black cloud that hangs over us. Everyone who comes here wants to visit his office, but of course there is nothing to see.

You must have met most of the big names in physics during the second half of the 20th century. Who impressed you most?

My mentor – Hans Bethe – taught me almost everything I know. He was unbelievably caring and took personal responsibility for his students as well as being a great physicist himself. I came to Cornell to study with him and this was just what I needed – he wasn't flamboyant, just very rock-solid. Of course Feynman, who was flamboyant, was there at the same time. I think in many ways he was more brilliant than Bethe, but not quite as great a physicist.

Did Feynman handle his fame well?

Oh yes. He was very different from Peierls and Bethe. They were both leaders of schools of research and liked to organize things. They worked very successfully on rather conventional problems. Feynman



Freeman Dyson: "If you want people in space it should be because it's an international sporting event, not because it's science."

was quite different – he had rather a short attention span, which meant that he would move on and often leave his students behind and then he didn't particularly care. He wasn't an easy person to deal with but I loved him and we got along fine – I just didn't expect him to organize my life.

You excelled in mathematics at school. Were those happy days?

Yes, on the whole. We were very lucky because everything was screwed up by the war – I remember in my last year at Winchester having only seven hours of classes a week. It was wonderful – we were free to get our own education. The teaching was fairly good, but didn't make much difference – we learned much more from each other than we did from the teachers. There were four of us, who were about the same age, who became fellows of the Royal Society – the Longuet-Higgins brothers, Sir James Lighthill and I.

Wasn't Lighthill a provost of University College London?

Yes – he was absolutely first-rate at aerodynamics and was responsible for understanding jet noise and

all kinds of other things. His work was magnificent. I see Michael Longuet-Higgins quite frequently in San Diego. He's an oceanographer at the Scripps Institution and has also done very well.

Were your teachers up to the task?

Most of them were away fighting the war. The one who did have a big effect on me was Eric James. He became high master of Manchester Grammar School and then the first vice-chancellor of York University (as Lord James of Rusholme), so he went on to glory. He was our chemistry teacher, but he just read us the latest poetry. He told us not to bother about the chemistry because we could find it all in the book.

Current developments in UK education are supposedly aimed at producing 'scientifically literate' 16 year-olds, but the joke goes that they'll then be able to appreciate what the engineers of the Far East and Eastern Europe are making without being able to do it themselves. Do you have any views on the way that physics education is going?

I don't know about 16 year-olds, but I think that on the whole young people are pretty wise when it comes to making choices. They can see very clearly that physics perhaps doesn't have such a great future while biology probably has. A lot of them go into biology and I think that's quite reasonable – we don't want to overproduce physicists.

So you feel that supply is meeting demand?

Well you never know, of course – it's unpredictable. What is true is that many of the good American universities are suffering from a shortage of students. It's not that the education is not being provided, it's just that there are not enough students able to take advantage of it. The main problem with the US is the idiotic visa regulations to stop the foreigners from coming in, although I've benefited from this because I belong to an international academy committee that is talking about biohazards. Normally we would have our meetings in Washington DC, but since you can't hold an international meeting there anymore because of the visas, we held the last one in Cuernavaca, so I got a free trip to Mexico!

Would you say that having a grounding in physics is the best way to move into biology?

Not necessarily. Of course physicists have certainly



Hyperion as viewed by the Cassini probe.

made a big contribution to biology, mostly because they're good with computers, and that will continue.

So do you believe that the age of physics is past and that biology is the future?

Yes. Not that physics is over by any means, but it just hasn't made the progress that biology has. In biology you have a discovery every couple of weeks; in physics it may be every few years. Sorry, I'm not deliberately trying to make your job more difficult!

You appear to harbour strong views on technology and its appropriate use. What should teachers be doing to encourage more students to go down that road?

I actually know very little about this, but I have a friend called Martin Fisher who organized an operation called ApproTEC (now called KickStart). He's been my main source of information and has been running this project in Kenya for about 15 years. It has been doing so well that he is now responsible for about 1% of Kenya's GNP [gross national product]. He designs machines that are cheap enough for farmers to buy from materials that the local industry can produce, and that are suitable for the local distribution system. The final requirement is that they have to pay for themselves in four months. The local farmers are accustomed to buying seeds and getting the cash back in four months, so they are only willing to spend money on other things on the same basis. Anyway, he invented a simple irrigation pump that you can work with your feet. Under Kenyan conditions it has actually managed to double incomes overnight, so it's been a very hot item

and has sold in great numbers. There are also other machines, which squeeze oil out of sunflowers, for example. It's very low-grade technology, but done very well, and it's a shame there isn't more of that.

Is that because the people who have the skills to do such things would prefer to design new MP3 players?

I think so – it's a case of the rich inventing for the rich, including the Africans. Those who are highly educated think in terms of modern hi-tech stuff rather than of the stuff that would be most appropriate.

Are you excited by the possibility of a resurgence of nuclear power?

Not exactly excited, although I think it would be good if it happens. It's not going to be in my time because individual plants take so long to build. What we really need is mass production of nuclear plants.

Weren't you responsible for the design of a reactor?

Not a power reactor – it was mainly for producing short-lived isotopes for use in hospitals. However, it did extremely well – we sold about 75 and quite a lot are still operating.

Where do you stand on fusion?

We ought to be researching it, but I think we should not be building huge demonstration plants that aren't going to show anything useful. I don't think that the present project – ITER – is going in the right direction. It won't produce anything economic as far as I can see. What we need is a real research programme that looks at plasma physics as a scientific problem.

Weren't you also involved in the development of adaptive optics?

Yes. I wrote a paper exploring the limits of what adaptive optics could do, but it was a long time ago before the method became practical. Now it's all about producing science in the infrared – what's made it feasible is that there are good detectors now for infrared and it works much better in that region.

Why is that?

Because as the wavelength increases, the patches in the sky that you can correct get larger and the number of actuators that you need on the mirror get smaller. It makes a big difference – if you go to a wavelength of 2 μm , the number of actuators needed

compared with working in the visible is reduced by a factor of 10.

Is it true that you solved the Feynman–Schwinger problem on a bus journey to Princeton?

Yes, but it was to Chicago not Princeton! I'd worked hard on this problem for about six months and then had a holiday in California and took the bus back.

What would you say is the greatest work you've done?

Definitely the work I did on the bus – what I called cleaning up the mess. I didn't invent anything, I just took the existing theories of atoms and radiation, which were physically correct but mathematically inconsistent, and tidied up the maths so that the thing became usable.

Space science has obviously been another big interest of yours. The last person I interviewed was Carolyn Porco, leader of the Cassini imaging team. Have you followed the mission's progress?

Did she show you the image of Hyperion? It's the weirdest thing I've ever seen. It was known for a long time that it was a weird object because of its irregular rotation curve, but it turns out to have this amazing spiky appearance. What Carolyn's doing in bringing back these pictures is wonderful – it really is a celestial zoo out there.

Would you like to see manned missions beyond Earth's orbit again?

Yes, but not for science. The important thing is to make that clear. If you want people in space it should be because it's an international sporting event, not because it's science. I think that both views are valuable, but you shouldn't confuse them. Let's hope that the Chinese will oblige by giving us some real competition in this area.

You seem to approve of competition. You've said, for example, that current reactors are not very good as there's been no competitive need to build a better one.

Indeed. It was great when we had the Russians to compete with – that's what made the Apollo programme possible. That was an international match that we won and then things fizzled out. If you want to have human beings in space it has to be like that, but if you want to do science then for heaven's sake keep the people down on Earth!