Freeman Dyson on genetic engineering and more

Freeman, what are some of the more outstanding scientific breakthroughs you've personally lived through?

The most outstanding, of course, was the double helix, the discovery of the structure of DNA. As soon as we saw that little two-page article in Nature in 1953, I think we all recognized that this was the big step forward. And it has been, I think, the big event of the last fifty years.

Talk about some of your inventions for the benefit of all humankind. I hear freeze dried fish, warm-blooded plants, and even turtles with diamond-tipped teeth are involved.

Yes, that's genetic engineering. This is a hugely powerful technology but it's not something that just comes suddenly into the world. It has to be developed slowly and carefully over long periods of time. I'm particularly interested in using genetic engineering to make sunlight available all over the world as a cheap source of chemical fuels and other chemicals, and this we don't yet know how to do. The question is whether by using genetic engineering we couldn't make trees with leaves that were 10% efficient rather than 1% efficient, as they currently are. In other words, could we grow trees with silicon leaves instead of green? I don't know why not. If it could be done it would transform the world, bring wealth to poor countries, and spread the wealth much more evenly over the earth.

What does the biotech industry today share in common with the nuclear industry in terms of public misconceptions?

I think the public is rightfully scared of both. The reason the public is scared of the nuclear industry is because it's also associated with bombs. I think the public is distrustful of the biotech industry because some of its first applications were putting poisons into food – that is, putting pesticides into crop plants. That was a tactical mistake just as it was a tactical mistake of the nuclear industry to build the bombs first.

There are other things you can do with biotech, of course, like producing food with much higher nutrient value or producing plants that will grow in poor soils or in unfavourable conditions, which is what the world badly needs.

Let's talk a little bit about your work on the Orion project. It certainly sounded to me like a great plan to get rid of the military use of nuclear weapons. Were you designing and intending to fly these yourselves?

Right at the beginning of the space age we had this idea we could use nuclear bombs to drive a really big spaceship all over the solar system. And, in principle, the thing worked. We never built it, but as far as we could tell, if it had been built, it would have worked and we could have gone sailing around Mars and Jupiter and Saturn, which is what we intended to do. I was very serious about that. It turns out, if you explode thousands of bombs, you make a great deal of radioactive contamination. So it's not good for the local ecology. That was the main reason why we didn't do it.

Explain the work you've done with adaptive optics.

Adaptive optics is a new kind of telescope, which has been talked about for about forty years and now finally it's getting built. You make very rapid changes in the shape of a mirror in order to compensate for the rapid changes in the atmosphere. If you have an adaptive optic system on a telescope then you can actually correct for the distortions produced by the atmosphere at the rate of about 1,000 times a second; it has to be done very fast to keep up with the rapid motions of the atmosphere. This way, a telescope on the ground could have as good a resolution as a telescope in space. Instead of having one Hubble telescope in space, we could have a lot of ground-based telescopes, much cheaper and with equal resolution. The French, in fact, are leading the world in this game. They have put the adaptive optics system on the European telescopes in Chile and these are working quite well.

The Dysonsphere, which of course made you so famous among Trekkies, is a wonderful concept. How did you dream this up?

The Dysonsphere is a joke. It's not something to be taken seriously. My idea was to look for intelligent aliens. Many people have been looking for intelligent aliens in the sky for a long time; we haven't found any yet. Normally, the way to look for intelligent civilizations way out beyond the solar system is to look for radio signals. If the aliens are intelligent they quite likely communicate by radio and they might even be wanting to communicate with us, so they might be sending radio signals which we can listen to. Forty years ago, it occurred to me that it would be interesting to look for non-communicating aliens. Suppose the aliens don't want to communicate, which is certainly quite likely, then how can you detect them? I thought you could still detect them by looking for heat radiation, as any advanced civilization with a big technology and a large population would have to get rid of waste heat, which is radiated into space in the form of infrared radiation. So the thing to do would be to look for sources of infrared radiation in the sky.

This Dysonsphere, as it's come to be known, is not at all likely to be a big round ball. It's much more likely to be a cloud of objects orbiting around a star. I believe it's still worth looking for.

When you find yourself arriving upon a piece of elegant mathematics, do you wonder if it might be a clue to the universe, or maybe even the origin of life?

What I do is calculate particular problems. I don't think in terms of general laws or grand ideas. I look for little problems that I can solve with mathematics, and then when I find something that works, I try to carry it as far as I can. That's what I did with [Richard] Feynman's physics and also what I've been doing with the problem of the origin of life. I haven't solved the problem of the origin of life. Nobody knows how life originated. I made a little mathematical model that I can play with which may have some relevance, or it may not. Essentially, I build little models and play around with them.

With all your knowledge and life experience, you're still imagining a better world through applied science. What of your insight on the future can you leave us with?

We still have to face the problem of the genetic engineering of humans. This is a much more delicate and dangerous subject than the genetic engineering of crop plants, but it's something we have to face. It's right and proper that the world is paying a lot of attention to it; it's going to be the main subject of our next hundred years, in my opinion. Essentially, the question is, "Will you allow the parents to decide what kind of babies they want to have?" That's really the problem. It's not so much a scientific question; it's a question of the human rights of parents compared with the social problems of society as a whole. We have to somehow find equilibrium to give the parents some freedom, but not too much.

Freeman Dyson is a mathematical physicist.

Massive Change Radio is a project by Jennifer Leonard, Bruce Mau Design, the Institute without Boundaries, and CIUT FM, Toronto.