

## New Scientist and Greenpeace Science Debates

### Science, technology and our future: the big questions

#### What is 'natural'?

16<sup>th</sup> April 2002

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Good evening ladies and gentlemen. You will see that I am unfortunately not a professional like some of my predecessors who gave an excellent presentation. However I have watched the Christmas lectures with a great pleasure and I've got a few props with me which I hope I can use. My impression is that I was invited here to some extent to strike a balance and to be the caricature of the reductionist scientist. My origins are far from that. I come from a very small village in East Devon; my interests were the Lyme Regis Exmouth landslip and I was an entomologist, I was interested in butterflies and moths. I spent a lot of time in the world - early '60s I was on two Arctic expeditions to Spitsburg and the Amarian, and there from being a field scientist, an ecologist, I became what is now called a molecular scientist biochemist. I am emotional, I do my job completely emotionally, and I can appreciate art and nature and a beautiful face and a child and an old couple in love just as much as anyone else.

But I would like to try and give you my take on why I'm here and it's no secret that I really believe that GM technology has a place, it may be a limited place, in solving or at least addressing some of the major challenges.

Now what is natural? I had no idea what was going to be spoken about and I'm aware of some of the books, I've done some background reading on The Soil Association, but I won't address that. I think if people wish to enjoy the bountiful profits of organic agriculture they're very willing to do so. I have a lot in common with many of the aspirations Greenpeace purports to support.

What I want to tell you a little bit about is that since, I would guess, 1960, the population of the world has gone from 3 billion to 6 billion. In the next 50 years it's going to go to 9 billion,

we're going to have to double our food productivity on essentially the same amount of land with decreasing water supplies (and that will be a major challenge for the future – drought, salinity) and with decreased agricultural inputs. We all would love not to have to solve the problems of high input agriculture. We need to have increased yield with lower inputs, and there are a number of solutions that we can think about. We can feed the whole 6 billion people in the world at the moment. For a whole variety of reasons, poverty and malnutrition, which leaves 850 million people starving, is not due to our lack of productivity. Modern day agriculture, which is dependant upon plant breeding, the use of agri chemicals and pesticides and mechanisation, has been incredibly successful. We have gone from essentially 1 billion people in the 1800s to 6 billion now. The population has doubled since 1960. And in fact genetic manipulation has been around a long time. What I've got here in fact is an ear of maize 10,000 years by selective plant breeding, which involves a great deal of chromosome rearrangement, we've gone from something called teosinte, which is on the lower right hand side, to maize. And maize is one of the three major crops in the world. There are only eight major crops – maize, rice and wheat are the others. We've gone from something like this, in the Middle East the three very different plants, which are not much use to anyone – the ears shatter, by combining three completely different genomes we've come up with modern day bread wheat, which was the basis of the so-called green revolution which has helped feed a very significant proportion of the world. We've gone from a small poisonous progenitive potato in Peru – and this is what they're like, and they used to be purple and poisonous – to the modern day potato which some of you will buy and bake and peel, but many of you will buy without the skin on as chips or french fries or something else. We've gone from these very small tomatoes and peppers in the lower right hand side to the large things that you love to spend your hard earned cash on in Sainsburys and Safeways. And we have created in the last [three] hundred years all these brassicas; these are all completely the invention of man. The cauliflower was a tumorous growth which is a flower. The others you can all recognise. These are the result of massive chromosome engineering by plant breeding and repetitive selection and they are all the creations of man. They could not exist in nature, and in fact if you took most of these plants and you put them out in the wild they would die almost straight away.

What we have to do in the next 50 years is to face a number of challenges. The population, of which we can already not feed 850 million, is going to go up by 50%. This increase is going to be occurring in the developing nations, not in our nations.

Rainforests want to preserve bio-diversity so we have to increase efficiency from the land that we've got, and we have to do this with respect to the environment, with respect to nature. We have heard quite a lot about monocultures, we do have mono cultures, and most modern day plants as I said cannot exist without man because they are the creation of man. With the modern gene technology which has been around for about 25 years an expanse twice the area of the U.K is already under GM crops. The GM crops which are being developed are

those which provide input traits - they provide resistance against pests and disease and against weeds. We already lose, despite the intensive use of agrichemicals, 40% of all crops before they can get to the market place.

So we can look forward to a technology which together with conventional plant breeding, more precise and knowledgeable use of agri-chemicals, could go some way towards feeding and providing the environment which people in the future will want to live in. But it's not just resistance to pest and disease which will lead to lower influx of all the agri-chemicals which we have all learnt to love and to hate as the case may be, but it's developing for more precision based technology based on knowledge and not on ignorance. I am a member of the general public, I have children, I also wish to preserve my life and my lifestyle, but I'm very worried that a great large number of people, the Guardian-readers of this world of which I'm one, would seek to make decisions about the application, about technology and the testing of technology with the right checks and balances which are making decisions for the rest of the world.

In another place I would call this neo-colonialism; what right have we got to deny people the opportunity to evaluate a technology which together with other technologies could make a difference. And these technologies not only should give you more precision based resistance to pest and disease an increased efficiency agriculture on the same footprint, which means we won't have to slash and burn and develop rain forests, it also can give tolerance to stress for heat global warming, to drought, something like 40% of all crops in the world are irrigated. I spent two months in Western Australia last year where salinity is a major problem. We have major problems with acid soils, heavy metal contamination particularly in South America, and we have the capacity of developing existing traits in plants which lead to so called phyto-remediation which will allow us to cure our previous historical travesties where we have polluted soil using so called phyto and bio-remediation.

The other thing you realise is, that the population will peak in about 2050 and it should give or take a few million be about 9 billion. The majority, or very significant proportion of that population will be old, rather like I am and you will be. Increasingly we're understanding using the modern technology for links between health, nutrition and what we eat, and it's not just what you read in the Sunday colour supplements, it's realisation that the right kind of diet, which can be achieved by conventional breeding and by GM technology, can be very useful. A large proportion of the world actually are very short of the micro nutrients which you and I take for granted or assume that we can pay large sums for, will supplement and support our lifestyle. I think the other thing is we're very worried about where the energy's going to come from. The fossil-based fuel reserve, the oil and the coal which we depend on nowadays, was a lot of plants laying down their lives many years ago so we could sustain our lifestyles and drive motorcars. Those reserves are declining quite markedly. People have said 'no' to

nuclear power, wind power may be acceptable, recycling willows may be acceptable, but I think that pretty soon, not only as the source of energy, we're going to have to start using plants as bio refineries, refineries to make the polymers which have the added advantage of being among other things bio-degradable and therefore independently recyclable, whereas fossil based fuels and polymers are not, in plants by genetic manipulation from selection.

We also have the potential of bio-farming, Phase 2 clinical trials of vaccines against hepatitis and a whole range of other diseases including, I just read today, potential for HIV have already been created and are being tested. People are already having customised vaccines made in plants against the Hodgkins Lymphoma. These are all proof of concept at an early stage with oral vaccines made in plants, are but one example of what we might look forward to. I believe that this technology is not a silver bullet, it's not exclusive but it's a technology that needs to be evaluated.

I think the other thing, and I think perhaps finally is that we in the developed world by high input agriculture, have put ourselves in a position that we have poisoned the environment to a certain extent. I think the developing world who are going to have to feed most of the next 3 billion people should be spared the high input experiment that we went through, and to try and find ways of co-existence of low input agriculture which may from some appropriate cases involve GM technology.

I've got one last thing that I would like to read out to you and it is that every citizen has the right to benefit from the advances in science and technology but those rights also involve responsibilities which were alluded to before, and as a scientist I consider myself very responsible, which was why I am very pleased to be involved in some of these debates. We heard about technology and again it can be a tool for human development. The roll of good public policy is to shake the course of its progress and make it happen and this why we should be more involved with the public and with our politicians. That public policies nationally and globally have so far fallen short of the task is a compelling reason to rethink and reform, not to condemn the technology. So technology alone is not a magic bullet but will feed the world. Nor will it eliminate poverty. It's technology together with existing plant breeding, for technologies and improved agriculture practice may provide us with a solution for some of the challenges and improve the quality of life. Reverting back to this mythical rural idyll in the past is not the answer - doing nothing is not an option, Thank you.