

New Scientist and Greenpeace Science Debates

Science, technology and our future: the big questions

Technology: taking the good without the bad

14th May 2002

Question & Answer debate



Julia King: Well, we've covered a very broad range of technologies and examples of things that may happen in the future and I think we've heard two of our speakers who feel quite strongly that we should try and do something to prepare ourselves. Ian Pearson gave us a very passionate case to say we needed more basic science and more rational and objective discussion in order to put ourselves into a position to cope with some of the technological developments that were giving him nightmares. Robin Grove-White, I think, also told us that we needed to think about how we prepare for the future but from a very different angle from Ian's, by concentrating more on some of the ethical issues and how we were going to deal with them. And then I think perhaps in very different ways both Brian Aldridge and John Turney said, things will happen. People will do it because it's there to be done and perhaps we have to prepare ourselves to be more responsive to change and to look at the changes that come and see how we can then act to deal with it. So I think we've seen some quite interesting and diverse opinions there and the opportunity now is to throw the debate open to the floor.

If people who have questions would like to put their hands up, microphones will come to you, but if you feel you've got a loud enough voice, then the acoustics here are good so, you may feel you want to start before you get the microphone. Please tell us your name. If you think it's appropriate, please tell us your affiliation as well and we have strict instruction that if you're cabinet-makers or hairdressers, that's essentially important because we need a better score than they had the other night. So, in just a moment we'll get the debate going. Okay, so I'll throw it to the floor and say, who would like to kick us off by asking the first question?

Guy Herbert: On the question of control, I suspect that there is control but it's not conscious, it's not willed. Collectively or individually you can't direct but our reactions feed back on the technology in ways that we can't expect.

Brian Aldiss: Let me give you an example of technology that is controlled and leads to very unpleasant results. In the days of the Soviet Union, they were determined that they would grow cotton in the Central Asian Republics and notably in Turkmenistan, which lies to the East of the Caspian Sea and so they built a canal, leading from the Aral Sea southwards and they irrigated lands that had been more or less desert and cotton, indeed, was grown there under duress. The people had to give up their own little vegetable patches and work in the cotton fields. That's almost the biggest disaster that humankind has ever inflicted on itself. For cheapness, the canal, which I think runs for about 1000 miles, I've seen it, it's a big, open ditch; it's not lined so that the water only soaks into the ground. Of course it evaporates in the heat. There's terrible wastage of water as a result of which the Aral Sea now has divided into two rather large puddles and it's old seabed is covered with poisonous chemicals. The whole microclimate of the area has changed. It's poisonous now. Many people are dying from all kinds of diseases, the least of which I propose is the shortage of good water and of good food. This is an example of technology under central control and it should be a dire warning to us all never to think that way.

Robin Grove-White: Nobody here, I think, is asserting that we can bring technology under control. I think that's common ground but what I draw from what Ian's said and certainly what I was saying is that we're in a new situation. We're entering a new situation with very, very powerful technologies being developed at a very great rate in circumstances where regulation and political control is very problematic and, indeed, where many people have many very different views and very different values in relation with some of these developments, which are emerging ultimately, you know, from commercially-driven processes. That's the situation. That's a very alarming

situation to me. I do find that alarming and I do think there will be responses. There's no doubt that there will be responses, if even half of what Ian is saying is true, and they're most unlikely to bring things under control but I think we'd do well to explore what the implications of this new situation will be.

Elizabeth Durden, DEFRA: I would just like to point out that the negative feelings against GM genetically modified foods are, I think, very short-sighted and very misled and extremely unfortunate and it pulls Britain back and we should all remember that probably the basis of the Egyptian civilisation was because of a naturally occurring modification in wheat, which gave rise to tetraploid wheat, which probably gave these people a massive start and I just hope that people's knowledge and people's attitude to GM foods can be more forward looking and there's just a little bit more of the gambler in all of us, to acknowledge that these modifications may actually prove to be very, very beneficial.

Justin, New Scientist: I wanted to ask the panel about the moral responsibility the scientists have on all this and, in particular, I wanted to bring up the example of the Asilomar conference in the early 1970's which was in the very early days of biotechnology when scientists from the Soviet Union and from the West became so worried about potential of biotechnology for use in weapons of mass destruction that they agreed amongst themselves to prevent or to stop future research in that area while they better assessed the risks and I wanted to ask whether the panel thought scientists could exercise power in a similar way today and whether they should be able to?

Ian Pearson: This is a problem we faced in BT fairly recently and up until a few years ago the new telecom technologies were obviously a good thing. Certainly if we come up with a way of giving you higher quality communication or visual communication or something, it's hard to see any downside for that, only you might get caught short coming out of the bath or something. Now we're starting to face these new technologies, we've started thinking internally, have we actually got our policy right? Are we allowed to do this research and development without reference to the society we're working in?

We've really come to the conclusion that no, we haven't and that we really do have a duty as scientists and engineers (there's not a huge distinction between the two perhaps, sometimes). We ought to think about the ethical consequences of what we're playing with and look at the downsides potentially of anything we're playing

with and, if we spot some potential social consequences, we have a duty as a company to report those to society so that they can decide whether or not they want to make it outlawed so that we can't actually do that R&D. I don't feel I have the right, as an R&D engineer, to do research in areas, which might affect your life without your permission and if I'm doing that research and you don't know about it, well obviously you can't tell me anything about that. I have a duty to inform you before I have any moral right to go ahead with R&D.

Now, BT thankfully has taken that on board in it's social policy recently and is starting to move in the right direction but there are an awful lot of companies in the world other than BT and I don't think we always see that responsible nature. I think the scientists, to some extent, should be just objective and tell us the truth but when it comes to technologies, which are based on fundamental science and that science opens up a whole new raft of technologies, which are obviously going to create major ethical problems and so on, then I think the scientist also has a responsibility to try and look at downsides of these new areas as well.

I think, as long as we inform society, then society has a right to discuss this and to legislate against it or legislate in favour of it; then we should be allowed to go ahead or not, as the case may be. But we have a profound duty, I think, as engineers and scientists to at least tell society of those things we're aware of which might be a potential downside. I don't think it's responsible to do anything else.

Ian Coxwold: Both Brian Aldridge and John Turney mentioned evolution. I wondered what you thought of evolution going forward, especially with respect to the balance between natural evolution and perhaps that evolution that we take in hand ourselves.

Brian Aldiss: Well I think we're in danger of growing a third arm here to hold these little cell phones in place. Seriously, presumably everything in the world is in a dynamic tension and is still evolving. What it's actually doing to us as humans I'm not sure that we've been around long enough to know but, I mean, science fiction is devoted to giving weird guesses about what will happen in the future but I think that this is no the place to exercise some of those guesses but there's no way in which evolution has stopped, anymore than history has stopped, as someone was recently saying.

John Turney: I'm the other person who mentioned the E-word. I think it's going to be one of the key subjects that is invoked in these debates, whether our technological future is figured in evolutionary terms, whether we insert ourselves into our own evolution in more or less calculated ways and you'll be able to see that when Fukuyama's book comes out, when his argument essentially is that there is a fixed human nature and its essence and we have a society which is organised around that, liberal democracy, and that is why other forms of society have not worked and we should stick with it, which means, I think essentially, a moratorium, which is what also Bill Joy was arguing on biotechnology and the other transformative technologies.

There's another school of thought, which says we're here to evolve and let's get on with it and technology is a part of that.

Robin Grove-White: Well yes and surprisingly, I think my own view on this Fukuyama thing, which we are all waiting with baited breath to read of course, is that I think I feel more fluid. I don't feel the depths of fixity of human nature that's being proposed there and I do think that one might picture, more than metaphorically, technology, as it were, continuing these processes but it comes back to the question of who's in control? Who's taking responsibility? Who is making the judgement for these "evolutionary choices" that are being, as it were, introduced? And that begs the question of shared political responsibility.

Male Speaker: I agree with Robin Grove-White that we are in a new situation but I don't agree that the new situation is unambiguously run-away technology like we've never seen before. I mean, obviously, you can make an argument that there are some new technologies and so on but I think there tends to be a slight exaggeration of talks of revolutions and so on. I think the main problem is the point that Robin made about the problem of politics or political control or failure of governments, more to the point. There is, I think, a kind of exaggerated perception of a run-away technology and genetics and so on but I thought it was quite striking that the examples that the panel members raised tonight, on the whole, were maybe even mundane and not very largely threatening; it's more our perceptions about how things aren't working now and therefore obviously, if you're talking about the future, you have to speculate and kind of project our own sense of pessimism really.

I don't agree with Robin Grove-White that cars or nuclear power plants or chemical, agricultural, GM crops... I mean, if you actually do look at those things over the last 40 years or so, I mean, I'd say you'd have to conclude on balance that they've been

a very, very positive thing. So, just to finish with, your analogy about a drunken man searching under a lamp when he should be looking in the dark because that's where he dropped his £10, specifically on GM crops, I would say the analogy is very unreasonable. The real analogy is that actually working under floodlights, and as far as we can see if we're in floodlit areas... Working under floodlights and as far as we can see if we are in a floodlit area and we can see what's going on with GM Crops and yet anti-GM crop campaigners are saying you are looking in the wrong spot, there's a dark spot, what about Puztai's potato, what about the GM maize, what about the Monarch butterfly, all of those things have been proved to be wrong. There has been a lot of rigorous research, there has been a lot of farm trials, very, very rigorous procedure and our best human effort there is not a shred of evidence that GM crops are a problem and yet these campaigners are saying well here's a dark spot, well we've looked where you say there's a dark spot and the GM maize thing was actually retracted, or semi-retracted by nature, it shouldn't have been published.

Julia King: That's a very different take from the ones we have heard expressed. I don't know whether John or Ian want to comment on perhaps their very different take on runaway technology?

Ian Pearson: I think I would like to comment. I think today I'm not terribly concerned about the things that have been done on GM so far. I confess to having very mixed feelings about the fields of maize that were sort of trampled down or so on, I don't really think that's that big a problem, probably yes, but the key thing is that the technology hasn't reached the end yet. We are moving very, very rapidly down the road where we will be able to fully understand the inter-working of all the protein molecules and so on in these organisms we will be able to design them from the ground up, not just change a little gene here and a little gene there, but totally design these from the ground up. But we don't understand even how nature as it exists works in its entirety and if we are putting completely brand new organisms into that, we really don't know what that's going to do. I don't know the details of it, but I remember reading in New Scientist last year that some lady that was sacked from a Biotech Research firm because she leaked a report that said they had tried to get a gene from one organism to another had created some intermediate organism which had it escaped out into the wild, might have devastated every single known species of plant. We might have all starved to death if that had happened. I don't know whether that was true or not, but you know if that's even possible in principle then we ought to be really worried about that. I don't think it is a mundane technology in any

sense, this is a fundamental extremely powerful technology being able to manipulate the entire biological world and the material world using another technology into any shape that we so desire. We don't understand the basic physics and the basic biology and the basic chemistry of the world well enough to do that safely and we are basically playing with our chemistry set which says not for civilisations that haven't got warp speed drive or something yet, because we just don't have the ability to do it safely. We should be very, very careful indeed doing some of these things.

Robin Grove-White: Well I just want to say that Ian put that very well and I wouldn't repeat it, but the point I would make is that these issues that he is talking about, with respect to the longer term future, there is no place for them in current political discussion. The risk assessment does not embrace this, as it were these future, these more conjectural dimensions which are very, very much in people's minds. In many people's minds one has a view sometimes of technology running away in a case like this and it may be much more to do with the lack of political, as it were, encompassing of these sorts of dimensions then it does have to do with the actual nature of the technology itself. I am quite prepared to accept personally that so far no untoward things have happened vis-à-vis GM crops. I strongly suspect that for many people who are concerned GM crops are standing at the surrogate in their minds for the cumulative trajectories as Ian has just been describing.

Doug Parr, Greenpeace: Taking the panellists together when Ian said any sad teenager would be able to drive us to human extinction, Robin says that technologies can't be brought under government control and John and Brian said that they were all inevitable anyway, I mean the only thing left to do is set the date of human extinction isn't it? There's nothing else to it and what I challenge the panel on here is about technology control, because we had a kind of "it's all going to happen anyway" view, there's nothing we can do about it. Well I would strongly say no, that isn't the case. There have already been technology choices, if you look at the elimination of the renewable energy programme in the early 80s, in which we poured lots of money into nuclear power, that was a choice, it might have been dressed up as ideological Thatcherite dogma, but it was a technology choice. If you look at what Monsanto have done with the terminator gene (or their seed subsidiary), they have chosen, for the moment, not to develop it, that's a technology choice, not a regulatory one, not one through public control, but nonetheless a choice.

Now I see the battles over the GM crops at the moment over the reasonable proposition that they are going to become or are uncontrollable, self-replicating

organisms. That's a completely reasonable way to behave in the context of the sort of things that Ian said. If we are talking about technology choice in the context of the sorts of things that Robin talked about, globalised world, corporate power, patents, if we want to get off the trajectory that takes us to a place where multi-national companies are forcing the stuff down our throats that are really dangerous because of the commercial force that's behind them, because we can't go back, then the battle ground over those choices is now, it is being played out in front of us before our eyes over these last few years and yes Greenpeace is a part of that and we are glad to be a part of that. So what I want to challenge those panel members who said, no there is nothing we can do about it, really? Why not? I think there's a lot we can do about it.

John Turney: Yes I'm absolutely in favour of having a politics of technology and campaigning and these are real choices and I agree with the ones you insight. I guess what I am suggesting is that within the whole set there are at least some technological trajectories which will continue because they are driven by our collective desires actually and there are some desires, whether or not you have an essentialist notion of human nature, which derives from the human condition. And I think life extension and possibly GM humans, which I think is much more interesting to discuss than GM crops, which I pretty relaxed about, may well be in that set. Bill Joy didn't use to say moratorium, he said we should consider relinquishment of the set of three nasties and Kirk Style then said it should be granular relinquishment where we pick out the ones that we really want to stop. After the initial flurry of debate on Joy's article that discussion really hasn't advanced at all. The trajectories continue and I don't see that stopping.

Ian Pearson: I think that the environmental movement has probably got access to weaponry that other movements can only dream about in a sense, the future net, if you think 15 years from now, now today's the internet's pretty much a toy that 20%-30% of the population use it on a regular basis, it's not that wide-spread, we don't all use it every single day, all day. But 15, 20years from now we will have a global network, which almost everyone with any wealth at all will have access to and will be using almost all the time. If you were to send off an email message through that saying we don't like the way that the US is developing this GM crop or we don't like their resistance to the acute or treaty, whatever the issue might be of the day, if you could send a message off to all those people and it would get through an awful lot of their personal folders that would just get rid of the trash and stuff and they could

immediately push the green button on the bottom of that which would change the electronic commerce preferences to exclude any business to do with the US. And you have got instantaneous economic sanction of say half the world's population that have got any money, not buying anything from a single country or particularly company, that's a heck of a weapon. And if they decided well we're a proud nation, we're not going to bother with this sort of emotional blackmail, we will resist it. You then link all of those machines together peer-to-peer architecture and develop artificial intelligence based, cyber attacks and you trash the US network. They are quaking in their boots, I have spoken several times to the Pentagon about this issue and they are terrified of that as a weapon, it is a very, very powerful weapon, you can't shoot every environmentalist on the planet, you don't all anymore have beards and sandals, it isn't that easy to see who is who. And that grass routes mobilisation can be done within an hour of hitting a send button.

Julia King: Is this system going to be in place before the red buttons or afterwards?

Ian Pearson: That's why I am so passionate, because you will have access to that level of power it is so much more important that the decisions are made on a thoroughly scientific basis, not an instantaneous knee-jerk reaction that we don't like this because it doesn't suite our environmental dogma it must be done on thorough scientific assessment of what's best and then and only then should a recommendation be made to those people. It is a tremendously powerful weapon and it has to be treated with a great deal of respect, but it is one of the ways which we can resist this new technology if it's going in the direction that people really do not want on board.

Julia King: Well that passionate note about technology providing people power, there are one or two people who have been waiting a very long time to ask a question, there is a woman up here in the gallery.

Clare Marris of environment, philosophy and public policy at Lancaster University: The question is addressed to Ian notably but I would like the panel perhaps to answer my question. As an environmental philosopher, I belong to a school of thought that means that responsibility is a personal thing and not a collective thing. Abstraction creates indifference, indifference is the biggest threat to ethical responsibility. I think much research is executed in abstraction. Do you not think technology would be more ethically responsible if it were pursued in a specific context in a specific situation and not through blanket solutions?

Ian Pearson: I am aware of conflicts even within myself and I am messing about with technologies of putting chips inside people's bodies and most people in this room would find some ethical difficulties with that including myself, but it's good fun. I find as a scientist and as an engineer, scientist by training, engineer by profession effectively, I mean I am slightly schizophrenic in this and I suspect that most people are. There's a certain amount of fun in playing with new technology and looking for some ministry over the world around us, that's what drives scientists and engineers and I wrestle with the potential negative consequences for society and environment and stuff in the background. To be quite honest, some of the time you say well so what, just get on with it and I don't always make the right decision. I try my best, but individually I would like to believe that I do things in a responsible way at least some of the time, but I certainly don't do it responsibly all the time and I suspect that nobody else does either. I think that you won't find very many saints out there who always make the right decision. So it's very nice in terms of philosophy that we would all be doing things in a responsible way, but I don't think it's realistic when you consider human nature and actually applying to people like myself who are everyday scientists and engineers who have got a streak of mischief, let's put it that way.

Robin Grove-White: Well I suppose just to the extent that perhaps it goes back to something that Ian was saying earlier about the obligation that he and his team feel to alert society to untoward potentialities as they encounter them. I wonder whether that's not sort of taking, whether you are still not taking too much responsibility on yourself and whether there isn't a role as part of this new politics of these potentially transformity technologies that you should be involving others who embody other values from outside your circle at much more upstream stages of development, I don't know whether that's the thing that you've in BT thought about. But I certainly think that that is one way of moving towards a measure of control corresponding to.

Ian Pearson: Yes and it's certainly food for thought. I mean we have just started in the last few years looking at the idea of ethics as applied to IT at all, it was an ethically sparse area before that, so it's a new concept for us in BT and I suspect most other IT companies are in the same boat. I think it will take us some years before we have a fully mature way of doing it, but it sounds to me to be a good suggestion.

Julia King: Abusing the chair's prerogative and having a couple of academics on our team. I would be interested to know whether they feel that we are even starting

to tackle the issues about educating our young scientists in terms of their ethical responsibilities for today and this changing future?

Robin Grove-White: My impression is that there is really very limited scope in university, certainly at undergraduate level at the moment. There's certainly a greater consciousness of the need for it, but I don't know perhaps you want to.

John Turney: I think I agree that we have maybe started but we haven't got very far. It's time to view education as a very strong socialisation into one way of thinking which is very functional for reproducing the scientific community which is what the majority of science teachers in university want to do I think, and getting any sort of entry into that is really quite difficult.

Robin Grove-White: I also think if I could just add I think that there is a difficulty and I have certainly encountered this in public policy situations, that scientists' conceptions of ethics or of social dynamics or the sort of questions of value or interpretation that are reflected in these controversies, scientist's confessions are frequently very naïve and partly because of the sort of maybe, if I can say without causing great hostility, because of the way that their own culture works. And I think that that's a very serious problem, it makes communication very difficult on these bigger social questions and that's why I think a very urgent challenge in the sort of context of these dramatic new developments that Ian is describing, it's very important to get perspectives other than those of scientists see at such an early stage.

Brian Aldiss: I think one would like to know what the Chinese are doing about these matters?

Alan Anderson – New Scientist: I would like to know from all the panel, if the possibility there may be some really fundamental change to the society, fundamental shift in power as a result of technologies that are currently being developed. And I want to ask that for a particular reason, every time the word moral, ethical or personal responsibilities come up there has been a sort of round of applause here, which I find frankly nonsensical because what I have mostly heard today is that we don't really have a very clear idea of how technology will affect what we do or the way we live, GM is easy to spot, that's an easy problem to deal with. Let's take the washing machine for example, not a question of great moral debate, but the washing machine by allowing women to get out of the home and work has probably transformed society and the way we live more than any modern object. I have heard

some allusions to it in the talks today, I have heard Brian talk about robots might change the whole family because they would suddenly threaten some of the gender roles that exist within the family. I have also heard asymmetric threat from Ian, the way in which the Internet might develop in a way that suddenly shifts power to people because it's very hard to hit back at them because they are so diffuse whereas centralised power structures won't work anymore but what I would really like to ask is, is it possible that rather than worrying about GM and obvious problems, isn't it much more obvious, isn't it much more a problem that technologies are creeping along, sneaking along behind us is going to change a whole lot of stuff and lead us to a quite different world. I would like you to sort of spot you're favourite changing technology that we just aren't worrying about perhaps because it's so innocuous?

Brian Aldiss: The old smoke stack industries have now disappeared. There was a time when labour posters showed chimneys with smoke pouring out and that was regarded as a good thing. That's completely changed now, and the computer has brought service industries and has enabled many of us to work from our own homes. I mean the social transition that has taken place in the last 25 years is almost beyond comprehension, that we are such an adaptable species; we in a sense don't notice what's happening. What's going to happen next? Well, increased standard of living, but I mean you ended up spending more laboured time in the home maintaining those standards. It was other social forces that liberated women.

John Turney: And not only that, but if you remember the invention of the typewriter which allowed women to go and work in offices and become stenographers that has freed many women, now of course the computer has allowed them to go back and work in the home again.

Alun Anderson: I have to correct you on that one because the invention of the typewriter, the first users were men not women and it was only when it was seen as a low prestige job that it passed to women. I think we are getting off the point, can I get you back to my main point which is let's take the issue of asymmetric threat which in one sense the internet has enabled a diffuse response to develop to a centralised one, let's think of the lone computer virus hacker who now decides to hack real viruses, it's very easy to do it and develop something really nasty. Isn't something rather shifting in the overall power balance of the world that we ought to be taking pretty seriously, that's my real question.

Ian Pearson: I think it is but the trouble is that because things are becoming so complicated, there are so many contending actions it's so easy to miss them, it's almost impossible to spot these things before they happen. If we are very lucky, there are a few things that you can spot as potential threats and you can see the means by which they might become a potential threat and you can highlight those and you can deal with those, but there's an awful lot of other ones you won't notice and it doesn't matter how clever you are or how much you studied the technologies emerging, you still won't notice them. I mean Brian's made a few points now against cell phones and people have been querying whether or not cell phones damage people's health by radiation, we don't believe it does, but supposing it did. You will still find on balance that cell phones are saving lives, why? Because a lot of young girls who would otherwise would start smoking haven't got any money left because they're buying mobile phones.

And then there's the simplest social interactions can turn what's an obvious conclusion totally upside down, we thought that tele and video conferencing would reduce travel, we kept on sneering down our noses at British Airways for how much business travel they would lose because of video conferencing and the more we introduce these new ITs the more they saw their business travel rocket, because people are starting to do business with people all over the world and they want to meet them face to face. Very, very often you miss the key part of the equation and there's nothing you can do about that, you can look at it as long as you like, you still won't see it all of the time, no-one will. So I don't think there is much we can do about it, there will be a lot of threats we haven't accounted for this evening, but the threats, which we have looked at, are still potential threats. We won't have got it spot on but they are still worth looking at as threats and seeing if we can deal with them in some way and if we delay this or do some more science in the background or something, but you are never going to get it 100%, you are never going to get all of the threats.

Julia King: Robin can we go back to this comment about shifts in power?

Robin White-Grove: Well I was going to try and respond on a technology that I noticed out of the corner of my eye and the one that I was going to refer to was the psycho-pharmaceutical drugs, you know Prozac, Ritalin and so forth. Where it does appear certainly in the US that there are medically driven, if you like, redefinitions of not just human mood but re-characterisations of human experience and in fact you might even say human nature going on promoted by pharmaceutical companies as

part of as it were the package those goes with the selling of the drugs themselves. And these have, it's not too much to say that there's a sort of embodied ethical shift in those, and what concerns me personally about that is that with the much muted possibilities arising from the human genome from improved genetic understanding, that we will get more and more of this. So that in a way human nature will be re-characterised by stealth, I think this is on to what Fukuyama was saying, but as I said earlier I don't take quite an absolute as a view on human nature, but I think that's a very insidious trend.

Julia King: Let's move on, there is a man in the audience who is growing a third arm who I feel I must give an opportunity to ask his question.

Eric George, CEO – Dot Com Company: You were all talking earlier on about world trade organisation and globalisation and those sorts of things. Now we are all aware that we live in a market economy where basically as Adam Smith said the invisible hand moves the things around and the invisible elbow moves the things that we don't want into, offloads the things that we don't want into the environment over different costs. If we could live to be 500 year olds or even longer, do you not think for example for Mr. Turney that we would actually be more aware of the way these things work and we would actually figure out, oh hold on we are actually doing damage to the environment here as a future generation we will actually have spending power in terms of this market economy, and actually put our money where our mouth is and actually realise where we are going and actually change these things, rather than just thinking as we are individuals and just do whatever we want?

John Turney: Seems a reasonable speculation, I mean 500 years is on the upside of my prediction, but what would happen clearly is one having reasonable expectation of a much longer life is that your life plan, your internal narrative and the way you relate to larger narratives would change in all kinds of ways that we probably need novelists to try and imagine it for us to give us stories to think through. And having a stake in the future because you might actually be there would be part of that I'm sure.

Female Speaker: I sort of wanted to ask who was really going to benefit from this enhancement of technology. Is it not just going to increase the gaps between information rich and information poor between the first and third world countries?

Robin Grove-White: Well I agree that's very much the point. I mean I shudder to mention GM again but it's such an obvious example and since we are talking about second and third order effect and unintended consequence. I read something just the other day with anecdotes about the internet and connections, someone saying the internet connection was wired into a village in the Gambia I think it was and the woman who was then gifted with this connection with the entire world and for the first time she felt cut-off from all this good stuff that was going on out there, so there will be changes in global consciousness that way as well.

Brian Aldiss: I think we are being very Western oriented. We sit here, we lucky ones at least have pure water to drink, right here and there are people all over the world who never get pure water. What you say about the gap between the rich and the poor has many facets to it and there is going to be a worldwide shortage of water soon and so that I think that this will increase the difficulties between the rich and the poor. You are talking about living 500 years I think again you are talking about the Western world when we know that over most of the globe, people are struggling to live to 50. So this is a very difficult question and I can't see how it's going to be sold by the increase of life span in the Western world. Well for one thing we won't necessarily become wiser if we live for 500 years. Many old men are very nasty old men.

Robin Grove-White: On this question on who is going to benefit from the transformation, well plainly probably the majority of the world's population, is only the most indirect possible benefit would be visible from the source of developments that Ian was highlighting. But the point that I would make is, which is a pernicious thing I think and goes with the grain about what I saying about psycho-pharmaceuticals, is that hand in hand with the development of the technologies themselves and their promotion globally, goes the doctrine in the human welfare of equating welfare with the accumulation and the increasing development of these patterns of development and that plainly is irrelevant to the sort of circumstances that Brian has just been describing.

Ian Pearson: I think there's one important area where the have and have nots ceases to be a problem in the far future and that's in IT. Costs of IT are plummeting every month and already MIT have put all of their educational material free of charge on the net and that's no use to someone living who hasn't even got clean water to drink, but another development that they are working on and we are working on as well, is the idea that you have a computer far more powerful than a palmtop for less

than \$10 which is solar powered and linked in to a free-to-air network, doesn't cost anything to use it, and these people for \$10 would be able to get access to the global superhighway, write software for Microsoft or BT and get rich and then be able to afford to buy their own clean water and the benefits of that are so large and the cost is so small that the military are actually starting to think about giving these things free of charge to people in the developing world because it off-sets a little bit of the asymmetry in due course and therefore alleviate some of the threat in terms of military response. So I think at least in that area future technology is very likely to do a great deal of benefit for the world and to reduce the problems of the have and have nots from that again. I think it's one area which I can't see any obvious downside for that except that we won't be quite so advantageous in position relative to somebody else, that's hardly much of an advantage to crow about I think.

Brian Aldiss: I would like to carry over what you said about the third world, about having enough decent drinking water. Since 1981 there has been an epidemic of Aids, which started off as a case of one person, which has multiplied now to 40 billion people ill of Aids of whom almost all of them will die within about 10 years. In addition to that there is an epidemic of Malaria, which has not been controlled, and Resistant TB, which is just as violent as the Aids epidemic. Now we were worrying about living for 500 years here, people in Africa probably have a life expectancy of about 30-40 years today has decreased about 20 years in the last decade. I think we should worry about these things more than about GM crops now as a direct relevance to the west of the world because viruses and bacteria evolve just like we do, only they evolve very, very quickly and the pursuit of an epidemic is always caught from pathogenic organisms rather than a less one because of natural selection. So we may find that we have further epidemics of Aids in the Western world which communicate with individual by means other than direct contact for example the 1931 epidemic of the bubonic plague in Manchuria so we should take a direct interest about what's going on in the third world with these serious epidemics and so far very little has been done. The pharmaceutical companies have lowered the cost of their anti-viral agents but still not cheap enough for people in Africa to afford it or African countries to afford to treat their own population, they cannot even treat the babies who are born with Aids from their mothers because they can't afford the anti-virals.

We will come to a point where the anti-virals will no longer work and Aids will wipe out whole populations, well that's my comment if somebody wants to have something to say about that.

Tony Gillan – Institute of Ideas: I just wanted to go back to the ethical question raised earlier in relation to Ian Pearson, because I thought it was a little bit ironic, Ian, your answer because you said that where you try and be as ethical as you can, but heh it's a bit of fun, but I will try and be as ethical as I can, well I didn't mind that too much, but prior to that on the GM issue, you dismissed thousands and thousands of genetic scientists and many other people involved in the regulation of the science that have thought about this for years and years and their ethical position and it seems that there is a flippancy in this debate and it comes very, very strongly over in relation to GM crops as if it doesn't matter whether we dismiss the technology, as if it doesn't matter all these people have thought about it and invested a great deal of work into it. So I think if we are going to take seriously the issues that Robin Grove-White rightly raises about politics then we have got to be serious about the debate and we can't keep hiding behind hypothetical concerns and exaggerated concerns. If there is politics to be put on the table, put it on the table, but I think there is too much flippancy and it's too easy to be cynical about these technologies and say it doesn't matter we can throw them away.

John Turney: Well here's an analysis of GM foods they will penetrate the markets when there is an obvious benefit to the consumer at the point of purchase in the West, at the moment there isn't so they are not doing so well.

Ian Pearson: I hope I wasn't criticising the GM scientists. I mean what I am suggesting is that there are a lot of issues ahead. As I said earlier I don't think there has been any serious damage done by the existing GM, I'm not that concerned and I can understand Greenpeace's reservations but I don't think there has been any serious damage done. Robin says he agrees with that as well. I have no doubt that those people have wrestled with the ethical concerns much more than I have in those fields, I have no doubt about that at all. What they might not be worrying about so much because they are worrying that problems they are solving today and tomorrow, they might not have been thinking sometimes about the very long term directions of these and I don't think it's wrong to highlight those concerns here today. I think that I would fully support an awful lot of GM research, what I am suggesting is we look at it a bit more carefully perhaps we have been doing. I think I would agree with Greenpeace the way in which environmental trials were done on GM, there weren't

enough boundaries maybe around the areas and stuff and there were too many options for the fertilisation with wild stuff and what have you, I think we should have done them in rather more careful ways. I think we have been a little bit irresponsible in the way we have done that and I think the scientists who decided to do it in that way deserve a little bit of rebuke, I think they should have been more careful, because they don't know for certain what all of the consequences of those actions would be anymore than Greenpeace know what all of the consequences would be.

I don't think we should throw away all of the potential benefits of GM, I think there are a great many benefits, we might even find that we can genetically modify bacteria to suck CO² out of the atmosphere and ease some of the global warming problem that we have landed ourselves with. We might find all sorts of benefits from GM, but we have to do it in a very, very careful way and there are lots of different value sets and different sets of ethics that will be used and analysed in that. I think the point underlying all of that is that an awful lot of scientists and engineers including myself in the past have been driven by commercial interests and I think that happens to a large degree in big business and ethics doesn't always get an option to come to the front. I have a very privileged position in BT where I can control the way I work, a lot of other people in other companies don't have that degree of freedom, they have to do what they are told otherwise they don't get paid. Now when you are facing the situation where you have got to feed your wife and 3 kids and you have to do some research, I think that the ethics can sometimes push to the background and sometimes their people might not do things in an entirely responsible way and they might be tempted to hide some of the research results if they are not favourable and so on.

I don't believe that we are always objective in the way that we do science because big companies have got an interest in hiding some results, maybe environmental groups have got an interest in hiding some results too. Each side I think is not in an angelic position, I hope I haven't been too flippant but there are some real issues in there underneath the flippancy.

Julia King: I committed to people that we would wind up at 9.30 so I am just going to take 2 last quick questions. But before I do I would like to warn the panel that I would like them all to think of one message or one comment they would like to make to the audience to take away tonight. So while I set you off thinking about that there is a man up in the front row who has been waiting very patiently.

John: I would just like to raise the question, I mean with the movement which seems to have happened in the last 20 or 30 years of science funding away from the public sectors and companies trying to produce the products to give return on its investment. To me the future of science depends on debate like we are having this evening and to me I'm concerned that this movement to the public sector to the private sector, are we actually going to be able to make these decisions in the wake of information on safety with scientists who are asked to make lots of money for their company and the company want the product so much that they would keep things quiet rather than actually flag up potential problems?

Robin Grove-White: I must say that I am very worried about precisely this question and my experience has been that even public sector scientists who are reliant on private sector funding in the biotechnology sphere do not seem to me to be playing the role that we would expect of them in having a certain detachment and independence and capacity to contribute reasonably to these discussions. I won't cite cases but I have noticed some very striking examples of people's behaviour being shaped by their new circumstances and I now it gives rise to a lot of worry amongst scientists themselves that they are put in this situation.

Paul Reeves : The issue I wanted to address with Ian from BT. He brought up this concept about science number standing are sort of a long way behind the actual technology that's coming around. Now I would actually argue that that, to a certain extent that has always been the case, if I remember the aerodynamics for flying weren't worked out until several years after the Wright Brothers had actually done it, Brunel was building bridges years before structural engineering was a science. Now people might say things are quantitatively and qualifiedly different now, but I would actually say basically society produces the kind of risks that it can generally handle, yes there are accidents, we have to learn from things, but basically any disasters or what have you that may come out of nano-technology or GM or whatever are probably appropriate for our level of society. Part of the thing nowadays seems to be that we have to have this concept of absolute safety which is quite ironic given I think at least in the West, probably due to the risks that people have taken previously in the past, at lease the people in this room have probably liked living in the risk-free society that there has ever been, which maybe just gives people the freedom to worry themselves to death almost about the problems that are around. I mean personally I would rather as the woman over there said earlier, take a gamble, I

would rather die from a real disaster than die worrying about what disaster is going to hit me.

Ian Pearson: I think that you might well die from one of these accidents. There has always been that gap and the gap has never been very dangerous before. I mean the only technology we have had really up until a few years ago has probably been nuclear technology where we could have had a nuclear war and killed everybody. But at least in that technology we understood the science first and then we built the bomb, we didn't know how to build a bomb until we did the science to underline that. In that respect I think the science has sort of caught up with nuclear weapons. But in these other areas we just don't know, the environment is tremendously complicated, I mean the best environment models predicted that the Antarctic would warm up and it's actually cooled or the opposite way round, if our environmental models are getting the exact wrong direction for some of these things they obviously need to be tweaked. We don't understand things well enough, it means that we try to mess and we try to fix the environment or whatever we might do exactly the opposite of what we need to do in order to fix it. The stakes are very much higher, we don't know what we are doing any more, the potential for damage is that much higher, I think that the risks are very, very significant, I won't give you a date for human extinction, it has been estimated it at a 30% chance in the next century, my estimate is in excess of 50%, I think that's a fairly significant risk and I think that we shouldn't be too frivolous in looking at this and just dismiss it as life's nothing without risk, you need enjoyment so let's just take a chance. I think it's rather bigger stakes than we have been playing for in the past.

John Turney: You want me to follow that? I guess I am not sure that I am convinced, I think I am still having difficulty deciding whether the world is actually more perilous that it has been in the last 10,000 years or whether we just think it is.

Julia King: Thank you very much for that, we have very much come to the end of our time. I feel from the comments that we have had from the audience we still very much have a divide between those who feel we all need to learn to adapt to the new challenges that affect and those who feel that we need to be doing more preparatory work and looking at how we can better apply some element of control or direction. I would like just to ask the panel finally to give us a couple of last thoughts they would like to send the audience away with, and Brian can I start with you.

Brian Aldridge: We've had an enlightened and civilised discussion here this evening. We are very privileged to be able to do that and here we sit globally at least almost near the top of the world and below us is a world to which we can hardly refer directly except for this gentleman here, the third world where a tremendous struggle for survival is going on. We know this but we cannot take it on board and so I think that really we are living through what has always been a human tragedy, that's the way life is, and if we are going to improve it in this part of the world only, I think we invite ultimately failure.

John Turney: I think actually I have become more optimistic in the course of the evening. We should maybe celebrate our good fortune and not just because we are in the West at the top of the heap but because we are living such a fantastically interesting and extraordinary period in human history. Maybe the stakes are higher now simply because the possibility of what we might do with all this upwelling of ingenuity which I see no end to. I think there's a good chance that in 100 years time we will be celebrating that rather than moaning at it.

Robin Grove-White: I mean I don't want to bang on but I think this is about political capacities for looking after our collective welfare and I bet extends very broadly, but the specific point is that one wants government and as it were institutions with institutional legitimacy in society to incorporate a richer range of understanding the dimensions of the sort of issues that we have been discussing tonight because if they don't they will get overtaken by all kinds of incoherent conflicts, so I think that we can't escape the need to engage with this very quickly and I think tonight has been a very constructive and interesting contribution.

Ian Pearson: I think that we are moving into a potentially dangerous territory, we are in the need for an awful lot of discussion and an awful lot of thinking and we do need better science, but the most thing that we need is the willingness of society to talk to each other and recognise each other's value sets and recognise each other's efficiencies and I think that meetings like tonight are a very good step in the right direction and I congratulate New Scientist and Greenpeace for setting up this kind of discussion because it's only by this sort of thing that we stand any chance at all of survival.