

New Scientist and Greenpeace Science Debates

Science, technology and our future: the big questions

What is 'natural'? questions and answers

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	Patrick Holden	PH
	Aubrey Manning	AM
	Chris Leaver	CL

MS: Hello my name is Basil Walker. I have just finished a Theology degree so that is my own perspective. I'm slightly surprised that no one has mentioned medicine at all or only very briefly and the reason I have brought that up is because I think that although many people would perhaps subscribe to alternative medical technology, even they have less problem with taking an aspirin to stop their headache, there is less of a problem with medicine as somehow unnatural than there is with genetically modified food so it is much more of a grey area. The reason I introduce it is because I think it touches on something which for me is quite important in this debate which is the type of rationally based science debates doesn't reflect what I think comes out quite clearly which is the fact that obviously it is about world agendas or political opinions or perhaps to put it slightly more – metaphysics, touching with physics that actually what the science, what is natural and how we define natural is not simply about facts and figures, but it is whether you are a Darwinian, about whether you are a member of the Soil Association, about whether you are a Christian or a Muslim and that these things are not simply open to debate in the way that perhaps the title of these selections are put – I am just wondering!

PH: Just a little about the medicine issues I think is really fascinating because in a way looking for instance at the use of medicines in organic agriculture, draconian intervention, or more draconian intervention using modern drugs is permitted but its not permitted for use is good husbandry; the first approach will be to try to promote the health of the animal through sound management and then to use complimentary treatment strategies where the animal falls sick, and fire engine control measures including the use of modern drugs are only permitted when the animals life is threatened or there is a welfare issue, or there is not a know complimentary treatment, and maybe that illustrates partly the nature of this debate as where that kind of scientific innovation meet what I think is certainly in human medicine as well as in animal medicine a growing trend, I don't agree with you that in human medicine there's less interest in complimentary therapy I think its growing just as rapidly, but the interesting point is where the two meet I suppose that one is the question I'll leave with you.

RD: Can I say something about complimentary medicine at least in the opposite which Patrick mentioned earlier, I presume that's largely what you're talking about? Homeopathy as I understand it is giving doses of supposedly active ingredients which are so dilute that there are no monitoring of them at all in the treatment. This means if you think about it that it is in principle impossible, to do a double blind control trial to decide whether the thing works, because the control is pure water or whatever the solvent is and the experimental is pure solvent, so unless there is some mystical means by which the active ingredients imprints its character on the water molecule which is indeed what modern homeopaths are now resorting to, it cannot work. Now if there is some means by which molecules are the active ingredient while they've been diluted and before they've been diluted away, imprints itself upon the water then the scientist who discovered that will get a Nobel prize, not just for medicine but for physics as well, and you might think therefore that they would be beavering away at trying to demonstrate this effect instead of which they are collecting money for quack remedies for which there is no evidence at all that they work.

PH: Well that really strikes the nub of it because I think you are speaking in a disparaging way about the possibility that energies might be involved which hadn't yet been measured or fully understood by science is that right?

RD: I am all for investigating that which we do not understand if there is a putative medicine which is supposed to work, then the test for whether it works is a double blind control trial.

PH: Yes but if we, historically we've only made decisions based on evidence and that's still the current Government orthodox thing, you do something until the evidence shows its wrong, then I'm suggesting that actually society is changing now, where we don't always wait for the evidence before we do something. Now certainly that's the case with homeopathy which is widely used and if life is a study of energy which in a way it is, and science understands coarse energies very very well but the subtlety of say emotional chemistry, does science fully understand emotional chemistry? No, do we accept it exists? yes, have we got the tools to motor it? possibly not yet but we will have tomorrow, have we got the tool to measure homeopathy? probably not yet but we might have tomorrow, do we wait for science to prove homeopathy in a double blind trial before we accept it? Surely we have to open ourselves up to the possibility that something has an effect without exactly understanding it.

RD: It is not necessary to understand how something works in order to demonstrate by double blind trial that it works. By all means demonstrate that it works and if you can do it then everybody will be falling over themselves to find by and large how it works.

MS: Hello my name is John Stafford, I'm an apprenticed scientist that happened a long time ago but I'm now a cabinet maker so when you refer to, you may be sitting next to a cabinet maker I didn't know if you could read my mind. There are a couple of thoughts first of all, what troubled me is there seems to be confusion between reductions and philosophies of science and its application through technology with the first speaker. I would like to draw a line somewhere if it's possible and be clear there. On the issue of what's natural I wondered if I might differentiate between the use of bio-mass as a fuel rather than fossil fuels and therefore you might try and draw a line there but of measure of energy take to be drawn somewhere along that line and a return to the [] will an awesome and wonderful thing to do. But the real thing I wanted to pose the question and a certain despair on my part, how will it ever where one could have a situation where you can see people can understand a huge growth in the human population, but we still have a Houses of Parliament which will congratulate Tony Blair and Cherie Blair on the birth of their fourth child. Does anybody actually have a route and someone please tell me of how we can do this without being classed having stones cast as Cassandras to say no to a personal choice at this level, we can do it and to escape from this more is good, we don't need to be Mormons to make this mistake but any offerings please I'd love to know something I can say to people that would actually get through from the rational level of debate, to a personal change of behaviour because I think we're in the Western World really have to think this one through, please any offers I'd like to hear them.

AM: Well I nod my head now because I so much agree with you, certainly I don't congratulate my friends on their production of fourth children, one maintains a sort of silence and I guess they probably know. I think that the Booths were grotesquely irresponsible. I said the Booths didn't I? yes that was quite an interesting slip, but I'm quite intrigued, it is very difficult, I mean people talk about death as being the last unspeakable subject, I don't think that's true I think, I know from personal experience whenever you talk about population control you immediately unleash a wave which regards one as being anti human and so on. I thought how you put it Richard, was exactly right, this really is anti Darwinian action. All I can say is that we are, I do believe, that part of our biological programme is the idea that growth gives you a nice warm kind of feeling and of course economic growth is identified with all other kinds of growth particularly a Western failing and I'm afraid that you know, a new baby arriving is seen as a warm event, and it's very difficult to get the idea across. I think slowly we are doing this, I lot of big progress on the population front but I do despair, particularly in the rich Northern Western nations because our population is already grossly too high and if you rate this the consumption of earth resources its obvious that one extra Briton is going to put much more strain on the planet than 15 extra Bangladeshi's which we often talk about. So I salute you for your efforts Sir

RD: I think you've identified the problem which we've all known for a long time, I mean the demographic projections are suggesting in fact that population is probably going to stabilise or decrease in the so called developed world will dramatically increase in the developing world and there have been numerous world congresses ever since I can remember reading about, and one trying to control population. The major way to decrease the birth rate is by increasing the standard of living in nutrition, the birth rate drops precipitously and I think this is probably going to happen in a big way in China which represents only 7% of the land surface but 25% of the world population, they've had fairly strict sort of legislation on birth. They also I think are realising that they can feed their population in this perfectly ultimate way so I say that we should use food to act as a contraceptive device if we start feeding people then we can reduce the world population. The world probably sustainably can only support about 3 billion, if we're lucky, using all the technologies available.

MS: Paul [inaudible] ... like dumping cars in the Med where was supposedly not much light or wasn't a lot of light, just because the organisms aren't larger that we can see doesn't necessarily mean that they are not as worthwhile, what about the organisms that live off the very very small mass of matter falling from above and have developed or adapted themselves to live off those smaller masses. They will be tend to be ousted by creatures with a higher metabolic rate and you know so on and so forth.

Just because we can see a larger organism doesn't necessarily mean that it is worth more. Sorry, that is it.

RD: Fair enough I was just making a point about diversity I mean there's quite a lot of blank sea beds left we don't have to feel we're ousting the smaller organisms you refer to, also of course it has been used to practical conservation of coral reefs in Indonesia local population who have been, their population has been increasing over fishing on the reefs, artificial reefs which have been provided are now offering an alternative and removing some pressure from the natural reefs.

GW Thank you. I will now indulge in just a little bit of preferential selection – Peter.

Peter: Thank you I actually wanted to comment that Aubrey Manning made, I thought you departed from your own definition of nature when you started to talk about nature in the rainforest I think you said nature with the [] and then nature on its own was a phrase you used when you talked about the elephants fighting, that didn't seem to me to be the use of the word nature which you were exposing and saying everything is natural but rather different and I think more realistic and accurate use of the word. But where I strongly disagreed with is exactly on this point about dumping things in the ocean being good for bio-diversity, and your bird analogies I thought well were both inaccurate, I don't think there is any evidence that geese which are not now being shot which obviously wasn't something that happened to the populations in years gone by before guns were invented has suddenly started to cause huge problems in the spring breeding grounds. The geese population that you are talking about on the whole is controlled by predation in the Spring and that tends to be weather dependent whether arctic foxes can reach their nesting sites or not.

Provision in nest boxes for the young doesn't increase the population of birds it depends whether nest sites or the lack of nest sites was the limiting factor on the bird population, and that's actually much less often the case that human beings would like to assume. Similarly dumping things in the ocean and attracting lots of fish for them may look superficially as if you're increasing bio-diversity, but most of the long term studies and it's not always the case because sometimes that a limiting factor to the bio-mass in the ocean but generally speaking world growth studies have shown that we haven't increased the overall bio mass, but what you've done is attract it to places and the Gulf of Mexico is a commonly used example, and its popular there because it makes the fish available to fisherman more conveniently, hasn't done anything for the overall population or species that are extinct, or anything else and the general points I would draw from what I think is a misuse and an accurate use of examples, is that you underestimate our ignorance. You under estimate the complexity of the natural

world, I think it's a real word with a real meaning and you assume that human intervention can control and manipulate this much more easily and effectively than is in fact the case. So I make a plea for the acknowledgment of ignorance and some humility in the face of the natural world.

AM: Humility was exactly the last phrase I used. I assure you I don't under estimate our ignorance but I still think that my general point if we take the geese for instance, the reason why the geese have increased so enormously is of course because human agriculture has provided them with astonishingly rich feeding grounds in the winter, and this is where the conflict as you know with the [] and farmers arises because they try to get a nice crop of grass for their cattle to get out in the early spring and the geese arrive first. I would defer to your knowledge about the breeding grounds, I did hear from a Icelandic ornithologist that they thought there were problems because geese numbers were rising. Certainly there are problems in Scotland, and my point is which I put back to you is about management. Because of human agriculture, because of human protection, the goose numbers have been rising very very steeply, I can't remember the figure but it's 4 times I think. At some point would you not agree that some kind of limit has to come in because I don't think natural predation is going to do it. There are not enough natural predators in Britain in the winter that's for sure, so that was the only point I'm trying to make that, it's very difficult to manage just once then go away again. I'm all for going away and leaving natural things on their own but I think you have to prepare the ground, I'm not sure that agriculture land in Islay can just be left like that, but that's the only point I make. Humility I completely agree with you sir

GW: Thank you, I don't want to intervene from the Chair other than just to, may I just indulge this small point of course the agricultural system on Islay itself is hugely heavily subsidised as the tool of public policy and it is that particular system of agriculture which has provided extraordinarily rich feeding grounds and it is a complete artefact and in a sense your in management argument would lead you I think to consider whether the agricultural system we are subsidising on Islay, it has very much rationality at all. I'm sorry, that is an indulgence from the Chair!

MSS My name is William Bruce and I'm an environmental consultant in the corporate world. I just wanted to ask Aubrey Manning again, I completely agreed with everything you said I just wanted to ask you, is your definition is that everything is natural does that let humans off the hook in terms of degradation on the earth?

AM: Well no it doesn't for the reasons which I mean Richard illustrated that we have got beyond short term issues and we have the ability to get to the long term ones. My

point about being if you like rather provocative in absolutist was that I'm completely unclear and maybe some of you can provide some kind of dividing point between what is natural and what is unnatural. I'm afraid I think that human beings as a result of natural selections of a particular sort, operate in a particular way. I don't see how that can be called unnatural, that's my point, but responsibility as Richard has eloquently illustrated, we are the one species which can adopt such responsibilities and it is our only way out. People seem to think talking about protecting the earth, I don't think we need to worry about the earth as a planet as Lovelock has pointed out, the planets going to go on nothing we can do will affect that, the only real question is whether we will be aboard it.

MS: My name is Nigel Harper. I was just wondering is it actually important? Are we important? Do we not only think of nature as a concept of importance because we can conceive it but were a cataclysmic comet should hit the planet tomorrow and wipe the whole lot out, the solar system would still go on pretty much as usual and its not really important whether we are here or not, but more than that I was wondering, I want to know from Patrick and from Chris why do they think bio-diversity is important? We can generally solve most problems, sure some of us may die off, a lot of us may die off, some of us may continue live in caves but why do they think bio-diversity is important in the natural world then.

CL: I think bio-diversity is important for a whole range of reasons not just at least partly because I think we all like to see diversity, we like to see, I mean think of the popularity of Aubrey's programmes, Attenborough's programmes, everyone's programmes and nature is a wonderful beautiful place which we all enjoy living in. I think bio-diversity has a more practical use, we have many monocultures and again the technology I am talking about where actually I would claim increase bio-diversity because instead of breeding down to one completely homogenous gene which would support growth of that plant, you can put your special favourite gene in which has a defined and controlled output into place whether its resistance to pest and disease or whatever. I think the other thing is that the crop plants which we have now days since the invention of man lack many of the genes which are potentially beneficial in a natural way and they exist in some plant which is not a crop plant, and if we can identify those genes then we can use a more natural approach to resistance for pest and disease, to ability to withstand drought or heat or whatever, so I think bio-diversity is something to be fought very strongly to preserve, but also as a potential source, I mean 25% of all the medicines that we take come from plants of one kind or another, there are probably a lot more out there that we don't even know about so I see them as nature's bounty which we can identify preserve because they will help us sustain us in the future.

PH I was trying to work out earlier what it is that separates us makes us actually less than I anticipated in this discussion but I think that question about our purpose on earth is a very interesting one and in a way that's why I don't think you can divorce that from a metaphysical or spiritual prospective, but maybe one of the questions which arises exactly which can prompt us all is how if we whether we are important or not in the bigger scheme of things we want to avoid a Gaian catastrophe, the Gaian catastrophe being that nature red in tooth and claw will sort things out and if we have over population it will as it were Gaia will deal with it by having plagues and pestilence and we'd all be wiped out in the process. Nobody wants that and therefore how do we harness our current level of understanding to avert that ecological catastrophe which would put things right as it were in the bigger scheme of things, and maybe there is a difference in our perspectives because everyone signs up to the idea of bio-diversity but from the organic prospective bio-diversity is an absolute key to making things work agriculturally and Chris is saying splice genes and produce a certain kind of bio-diversity that way but certainly from my perspective that isn't going to work. Also if you look at what is happening in agriculture at the moment I don't think this has had enough discussion, there is the catastrophic narrowing of the gene pool of crops and livestock used in agriculture globally from AI in cattle and developing these super breeds which now dominate global cattle breeding programmes to seeds and I am afraid the organic movement is not exempt from this problem to develop agricultural seeds we have an extraordinarily narrow gene pool and if you subscribe to the idea that bio-diversity is important and I certainly do, I think we're getting in to really dangerous water, we need to rethink the way which varieties are related to place which is a way of learning from nature whereas Chris's line is saying no we can just you know sort of ...

CL No no I don't believe in quick gene fixes, I'm saying that there is a lot of bio-diversity and if you look at the soya beans in the world there are 400 different strains of soya bean which are grown depending on the day length all over North and South America. If you want to introduce a gene which makes it resistant to a pest which can wipe it out instead of breeding and mixing all these genes and you can take a single gene to that specific eco type growing in that part of America and solve this problem or at least address the problem.

MS: Thank you Stephen Tindale from Greenpeace. I wanted to put that same question to Richard Dawkins actually from the perspective of Darwinian scientist does bio-diversity matter? Given the species that have always gone extinct and will continue to go extinct. But I had a separate perhaps related question to you as well. You said that you were pleased that humanity didn't operate solely on the basis of Darwinian natural selection and that in politics and society we rose above that and behaved in

an unnatural way and taking that argument to the extreme which I don't think you were doing, but you can say therefore that nature is a dangerous thing I think to be tamed or ultimately replaced. If you don't go to that logical extreme or absurdity on what basis do you decide what criteria do you use for deciding what is good about nature and what is bad.

RD: Yes, I'll take the first one first. It is true that in the history of life there have been cycles of mass sometimes brought about by about cataclysmic events in which bio-diversity is greatly reduced and then there's a long slow climb back up to the sort of diversity which we have today, and I value that on a very uniquely aesthetic ground. I mean I love living in a world which is not [] the result of a very long period of evolution, mutual co-evolution of different species and I think it would be a very very sad catastrophe if we were to lose a lot of that diversity. I also think that humans have done some very wrong things in the past, viz a viz the dispersion of species, before people realised the importance of respecting the bio geographic boundaries which have arisen over long periods. People would introduce species without complete equanimity and the whole fauna of New Zealand was ruined by people importing for more or less sentimental reasons, British species because they felt at home with them, and so I think that that's something where humans should exercise their responsibility which they haven't in the past, and I'm struggling towards an analogy which left me uneasy about certain aspects of genetic manipulation. When the Duke of Bedford introduced as, I believe it was, introduced grey squirrels into this country just for fun he didn't realise what the consequences would be. I worry about when we introduce genes from one not just species but from one class or one phylum to another we are or we might be doing something rather similar to what the settlers in New Zealand did introducing a species that hadn't been in New Zealand for a very long time. We are introducing genes from fish into tomatoes say –well something similar say.

CL: No, this is what people are saying, it is not being done, I'm sorry.

RD: Ok, well then there will be something comparable to that, may become feasible in the future.

CL: It's feasible but it's not being done

RD: Good

CL: We have a choice we have a responsibility.

- RD:** Fine all I'm saying is that we might reflect, one additional reason for hesitating before doing that might be the analogy with the bio geographic solution which are not very long ago the forebears didn't, I don't think it's not a reason for doing it, but I think it's the reason for being very very cautious and thinking about it very carefully.
- CL:** The international union for the conservation of nature say the single greatest threat to worldwide diversity is invasive alien species of plants, there are about 16 hundred native, so called native species of plants in this country, getting on for four thousand alien species have been introduced by horticulturalists over the years. Eight hundred to nine hundred of these are established in the wild, sixty of them are hybridised with native species and we all know about rhododendron, ragwort and so one so the major cause of the introduction and pest destruction of bio-diversity country is the introduction of alien native species which we buy listening to the TV programmes and our local horticulture and garden centres, and that's one of the major sources of problems and if you go to the United States of America there's some major problems with alien species and this is something we've got to watch and control.
- GW:** Thanks very much – I want to give Alan a chance and then this gentleman over there.
- MS:** Alun Anderson from The New Scientist. I would like to change the subject slightly and ask the panel what they think about Peter Singer's ideas of the rights of apes. The reason I do this is because I felt the [] of Richard that he was almost pre-Darwinian, he talked about [] and how dreadful the natural world was but man rose above it, man had a big brain and man could think differently. This great brain that evolved seems to be another way of reinventing the soul, and some [] are set apart from the nature, not a part of nature and [] to display to the rest of nature. I was much more surprised of Aubrey who I know very well, because I did my PhD with him, was nodding when Richard was saying this and agreeing that man is different, but Aubrey was saying everything is a part of nature. I'd like to know how this distinction is beginning to slip back in from Aubrey and Richard [].
- RD:** It's not an absolute distinction I am a strong supporter of the Great Ape I wrote a chapter in the original Great Ape project book and the reason, the Great Ape project I should perhaps explain is an initiative of this Australian philosopher Peter Singer to grant to Great Apes as near as can be achieved the same moral and ethical status as humans have, and it's a profound and difficult argument, you can approach it from many different ways. My way of approaching it was an evolutionary one precisely the one that [] to say that they're relating to you between us the great ape and beyond them to all other species of course and if you were to imagine the thought experiment that all the intermediate Homo Erectus etc had all survived a similar intermediate - if

all the intermediates had survived which they easily could have done, they just haven't then in order to practice our speciesist discrimination against all other species other than us you would have to indulge in some horrific apartheid like courts of discrimination to decide whether such and such an individual would pass for human or not, that was my reason for supporting the Great Ape project. Now Alan now says how can I at the same time say that humans are the only species that are capable of rising above cruel nature. There is a continuum, it's a quantitative continuum but out of a continuum what can be interpreted as qualitative distinctions can arise and we have language no other species not withstanding [] and similar talented individuals no other species has language in the full sense that humans have so I wouldn't deny the possibility that there might be other species that could rise above nature in this respect, I just don't think that the great majority even of humans can rise above it and I didn't say that humans did rise above it, I said that humans are our last best hope of rising above it.

AM: I completely agree with what Richard has said. I've often speculated that it's a good thing that the intermediates no longer exist, at one time I thought they would probably be as science fiction writers have had them you know down the uranium mines because that's the way we treat such, it's deeply shocking, I feel it repugnant the thought that quite a lot of human beings eat apes, I understand if you know the right place to go to you can actually eat chimpanzee in London. It's a shocking thought, I would have great difficulty I have to say in just confining it to apes because I think that elephants and whales both of which are very long lived and have huge - in evolutionary history and that does impose particular responsibilities on us. I certainly don't feel that it gives us any kind of right to displace other forms of life. I think the tragedy of the present imbalance between human numbers and demand for resources and the rest of the planet is that so often human beings are put into direct conflict with the rest of the natural world. It's utterly tragic that elephants in Africa are effectively being moved from pillar to post because of the enormous demands and with which we must sympathise of human beings to develop grazing and so on. Unless we get back to some kind of better balance, and I have to say - I mean this is not just the standard you know goodie political point that the rich north doesn't have the elephants but they have huge responsibility in this matter. Unless we can get back to a balance I think we're not going to get anywhere and we are unique in the sense of that we have that ability to be responsible in the way that Richard says, but I don't think that makes us un-natural or even different from nature in many other ways.

GW: I think that's merely an illusion. Chris.

CL I think this is fine for debate but it's a distraction we can afford to debate. I think the terrible thing is there are almost a billion people disenfranchised in this world who are

starving. The major cause of that is still mal-nutrition and so to talk about these abstractions, about the rights of apes and I'm now trying to be provocative. It think it is wonderful that we have a far greater responsibility, to think about these people, where the apes exist, who are dying.

This gentleman is being very patient. Thank you yes.

MS: Thank you. Greg [Clase] is my name. I have several hats to wear, one is as a registered organic farmer, the other is as a science teacher. I have a real concern when you get to the place where you want to draw the line or decide what's nature and what's not nature because of the push by creationists and other religious fundamentalists in trying to introduce a new topic called intelligent design. Every time they get to the place where science can't explain everything, they call that intelligent design and attribute it to some higher power, but also with respect to the carpenters and the ordinary, I'd like to know if genetic manipulation is with me on taking that square gene out of the catnip plant and putting it into trees so we can waste less of the elder and is it possible, is it really possible to manipulate goats genetically so it only eats weeds because this would help out enormously. I'd like Chris to confirm if you would for the audience that the overwhelming majority of the genetically modified food crops, I'm glad you mentioned soya throughout the whole of South America is being produced at the cost of the rain forest destruction specifically to produce animals that are ground up often times with hormone enhancement to feed the burger chains. I don't know how they do it, you know three patties and bacon and cheese for like 2 cents or something. This is ridiculous. There's got to be a cultural alteration of paradigm shift or we're going to go right off the edge with like the 3 billion that we can't afford when the oil barrel runs dry. I teach, I've taught for 25 years and I'm going to continue to teach because I see that as the only answer and what's staring us in the face is really scary. If we could convince all the people that eat meat to eat the other people that eat meat, that would like allow I take it that we can

CL You are quite correct, just about 30% of all cereals and soya bean are fed to animals which produce the meat thing which gives us the global warming. The important thing about soya bean I think is that if you can increase – you know if you can get 2 bushels of soya bean where there was one on the same amount of area and you can do that agricultural practice, by breeding or genetic manipulation, then you've cut down less rain forest. I mean that's my point and you know that's increased efficiency. I'd rather grow crops for our use where we can and that will save the biodegest in the rain forest elsewhere. I would argue, whether it's put into burgers or not, well you obviously sound as though you've come from that part of the world which invented them I would imagine.

MS: I'm not going for one corner; the whole world is my native land. Okay, I'll come back to the other – I'll save my repast

MS: My question is to Chris Leaver. You alarmed us that the potential 50% increase in the world's population and also pointed out the fact that there is a diminishing availability of oil supplies on the planet.

CL The diminishing availability of fossil fuels, of oil.

MS Monoculture, modern chemical agriculture uses approximately 10 calories of energy to produce 1 calorie of food energy, and that's before the further inefficiency of converting it into hamburgers. You held out some hope in that by technology could produce crops that would replace fossil fuels, but at the moment those crops require 10 units of fossil fuel energy to produce one unit. How do you resolve that mathematical conundrum. How are you going to grow enough crops to produce the fuel that will produce the agrochemicals that will produce the crops. I don't see the mathematical solution to that.

CL Again I would not claim that biotechnology will solve all the world's problems. We have of course caused most of them, but I think we can use our scientific knowledge to address them. If I come forward to the use of plants as bio-refineries then there is the potential to make bio-polymers and a certain amount of energy. Already in South America quite a lot of the fuel is made from methanol, from its gas called gasohol. I think the nitrogen fertiliser which you talked about which in fact has been a vital component of the self sustainability almost of the Indian population, the harbour moth process has been very important, still has a future. If you're suggesting we should be using the organic approach, I mean it's been estimated by the FAO that organic agriculture could support half the world's population but would require twice the land mass for a start and you would have to probably at least double or triple the number of animals and there's consequences of that. So you know we're looking for the best that we can. At the moment this technology is in its infancy, but I think what are the alternatives to producing polymers from fossil fuels. Can you come up with an alternative. I think that natural plants which are the only organisms capable of capturing the only renewable source of energy which is for some, there are no other alternatives.

PH: At the moment I could say organic farming could produce double for the crops and in fact you know from experience that genetically engineered proteins are producing lower yields

CL Well I can challenge that and I would like to see the evidence for that.

MS: [] State University and I'm checking on the figures that [] has provided. []

MS: This whole file goes – I mean that seems to be a very serious point of many to follow up afterwards in terms of that we have conflicting pieces of evidence. Actually it's a bit indulgent, sort of flirtation, sort of [].

GW: A bit, yes . There's a lady being very patient there.

FS: Fiona Fox, Science Media Centre. I would like to dwell for a second on this exchange about Cherie Booth which I found rather revealing, because I think it characterises the real contrast on the panel. It seems to me that what Patrick Holden and Aubrey Manning are seeing is a very very negative view of human beings, that any human intervention is necessarily going to be destructive and that therefore you come to this what I found quite alarming conclusion that more humans necessarily means more destruction and that responsibility is to have less of us and more of nature and more wilderness. What I actually found very inspiring about what Richard Dawkins said in his introduction was that what you knew about the essential of humans is that they can intervene to make things better, that they can actually make a nature which is better for us in the long term and for future generations and it seems from the kind of response to some of the discussion here that that positive view of humanity is actually disappearing from us, and that's a really disturbing thing.

AM: I like human beings and in general I hope that we have a future. An organisation that I belong to has in its slogan "more humanity but less humans". I mean I believe that the increase in human numbers has in fact made it more difficult for human beings to lead a rich and varied existence. I mean I don't know what you would feel, but I would argue that certainly even in a highly developed country like Britain most people only reach about a half of their potential. I can certainly show you young people emerging from full time secondary education near where I live who really are not reaching a tenth of their potential. I tend to see ultimately there is a complete conflict between quantity and quality and therefore I don't think it's denigrating at all to suggest that people should limit the number of children they have. Most people are doing it as best they can anyway, so I don't regard that as being anti human at all, but quite the opposite – pro human. I'm really worried by the lack of opportunity which we have, the lack of richness of life which we have in densely populated countries like the British Isles.

GW: Thank you. A thing I would like to do is – we've got 10 minutes left. I'd like to change the shape of it. I'd like to take three short questions and put them to the panel and get a little []. If you've got short questions I'll take them in three. Yes Sir.

MS: [] some of these issues. The Economist ran an article by Peter [Drockage] just before Christmas stating the population of Italy was going to drop dramatically from something like 58 million to 40 million over the next 20 years. If you think that we are going to solve these problems while we're faced with economic meltdown in the Northern economy, then there's a complete naivety around the whole of this issue. You know a growing economy is part of a necessary background to provide the resources, to find the technology solutions, and I've been covering it for several

months now. I've seen – there's almost a missing chair here tonight and it would be sponsored by The Economist and it's a pity there isn't somebody there giving that sort of sanity background that the necessary economic [] for this whole debate.

GW: Thank you Sir, can I have a short question. So let's just clearly get it filed, but I'm going to persist and yes Sir.

MS: []

GW: One more.

MS: []

GW: Okay, those three. Who would like to crank up first. Any one or more of one of those.

CL: I could talk about the []. Agriculture, agrochemical industries have been incredibly successful. We can, if we can get the politicians and other people [] to feed 6 billion people. That is a very significant humanitarian achievement. I think we are naïve, we live in a fairly capitalistic society which explains why you can all afford to buy a ticket here this evening and why I got in free, and I think the important thing is that the naivety that – and I accept there are major problems with multi nationals and globalisations and I will sign up for a lot of the criticisms that Greenpeace have, but a lot of this progress has been because of the intense and very high level of spending by agrochemical industries and [] and pharmaceutical industries and if you – that kind of investment is not being put in by the public purse – I mean we've witnessed this in this country and I think we've got to have a far greater public/private debate on investment and I think this problem of creating an economy in Western Europe to replace the one of fewer people is a major challenge. I think what we've got to do is we've got to give people in developing world where a lot of the things we've been talking about would be needed, the capacity to develop their own economies with advice, with knowledge, the training and let them make the choice of how they deploy this technology or not.

PH There is nothing wrong with the profit motive and there's nothing wrong with growth, as long as the growth is of environmental capital and not capital associated with economic activity which actually undermines and uses up environmental capital. I think the great problem with the economy for the world today is that it is if we are spending environmental capital and treating it as income, and unless we introduce proper accounting in the way that we look at the economics of the future, to talk about continued growth is just illusory because if we're doing that at the expense of top soil,

rain forests and other forms of environment for capital, we're actually – it's not real profit. So I don't think we should get deflected into thinking that those of us who are proactive are promoting a more ecological approach are against this idea of working with nature to harvest the surplus as it were.

RD The question on this there is gene for enlightened self-interest. The question was deliberately posed in a way that was designed to be provocative. I could answer it in two ways, either concentrate on the enlightened self-interest and after that interest or focus on the idea of a gene flow – anything complicated and talk about the difficulties of using that kind of language []. When one talked about a gene for something complicated one doesn't mean that the gene is solely responsible for that complicated thing. It means that the difference between that gene and can under some circumstances be responsible for the difference between the presence of the complicated thing which I found and so you could rephrase the question by saying if you had 10,000 years and the freedom to breed whom you wished, and mate whom you wished with whom, could you by a special selection breed an increase in enlightened self-interest. I think you will find enlightened self-interest in some way and I believe the answer is probably yes, but it would be very very complicated and it might turn out that what you are actually breeding for could better be characterised as something else. But I – well I mean when you think you're breeding for one thing it turns out that a whole lot of other things are coming along in its wake, so I think it's a genuinely interesting question, is there anything that we couldn't breed for and I suspect the answer is probably no, you could certainly breed for all sorts of weird things if you wanted to. The funny thing is that although we've been breeding cows and pigs and cabbages and maize plants and things for thousands of years by artificial selection, the one species we don't deliberately breed for anything at all is our own and the fact that we haven't done that is probably reassuring in a funny kind of way. Thank you.

GW: One more round of three. Who is feeling hard done by?

FS [inaudible]

GW: Thank you. Panel – tackle any one or more.

AM: I'm still cogitating on the thought that economists have a great deal to offer us on this debate. It depends what you mean by naïve, I suppose really, I mean – economists have a very difficult thing to do, it's applied psychology and psychology is a very difficult subject and dealing with very difficult issues, but I think the idea that

they have one way forward is not one that I go along with and I don't think we've missed them too much tonight – I mean we can fill in with them later. Thank you.

PH: This point about destructiveness – the destructiveness of nature reminded me of something that Schumacher said. He said – Fred Schumacher wrote “Small is Beautiful” in fact he was the president of the Soil Association, so he died. We speak of the battle with nature, but if we win that battle we will end up being on the losing side and in a way that question I think is perhaps a prelude to a long hopefully fireside conversation I could have with Richard which could include the origins of the Soil Association, but I - for me it's a really complicated issue because I think of nature as a teacher and Sir Albert Howard, who was an agriculturist at the beginning of the 20th century was sent out the India to teach the Indians how to farm and saw actually that Indian agriculture had more to teach the West than the other way round. He said we should come to regard pests, parasites and diseases as nature's perfecters of good husbandry, because they reveal to us the consequences of bad management. So this whole question of is nature destructive and have we got to sort of liberate ourselves from it in some way and with our intelligence escape it and how the moral dimension, the emotional dimension comes into that. I mean there are so many questions there and I don't feel as if I've got the answers, but I think these issues are very important to us.

MS: If I could make a comment - If I understood your question is what contribution can biotechnology make to the developing world – is that

FS: [inaudible]

CL: To feed the capitalist non-scientos of this world. I think the important thing is that there are many new technologies. We all like the benefits, we don't like the potential risks. We've got to learn how to handle risk. Most of us do handle it without even thinking about it. I mean I drove here from Oxford which is a pretty risky thing this afternoon, but I accepted that risk. Richard apparently flew in whereas that's risky. I think the other thing is that when this technology was introduced for a whole variety of reasons, particularly by American colleagues, it was introduced enthusiastically, it was a very acceptable to the American population, it didn't take account of culture sensitivities, but the technology is here and it's a technology which is here to stay and my expectation is that it has an important contribution to make. I think it potentially has a far more important contribution to make to the developing world than for the developed world, and we have the ultimate responsibility despite the activities of non-representative groups, groups like Greenpeace Novus who for their own political and other ends which are mainly anti globalisation and many others and they have to use

this bandwagon at the moment it was [] so many years ago, I think that we have the responsibility for letting the developing world understand the potential, to fully evaluate that potential with assistance in any way we can provide it and then to deploy it if it is seen to be appropriate. But it's not the exclusive magic silver qualities I've said, but I think that we must take that responsibility and I think that is far better than giving them food aid, if they can develop their own technology that would alleviate poverty which is the major skirmish in this world at the moment.

GW: Thank you. I think on that note I am going to ask any panel speaker if they've got one last observation on anything they would care to leave the audience with. It's not compulsory. The fact is we've never known them lost for words.

PH: Well I am!

GW: Richard, anything else.

RD: No, I think it would just open up another whole can of worms. Yes

GW: In thanking our speakers just two or three points. There's a lot of what we expected, constructive controversy there. In the middle of all of that I pick out I think slightly more a surprising degree of commonality in things than I was expecting and there were some there, and I expect that just amongst those I observed that I think all of our panel do accept homo sapiens as part of nature, all of them accepted the enormous aesthetic values in respecting other life form, all of them respected – used words in their own words some concept of moral duty towards other life forms and I can't remember which panellist it was, but I thought I would just like to leave you with this little quote “we have choice, we have responsibility” and I think that's the point I would like to take out from all four panel speakers and I would like you now to, in a customary manner, show your appreciation.

Debate ends