

# The Science Studio Interview

## With Julian Hunt

**Roger Bingham:** We're at the Calit2 studios on the campus of University of California, San Diego with Julian Hunt, Lord Hunt, former professor of climate modeling at University College London, and former director general of the British Meteorological Office.

Julian's in town for a panel we've visiting called "Ice, Snow, and Water: Impacts of Climate Change on California and Himalayan Asia".

It was convened by the University of California, San Diego and the University of Cambridge with general support from the Moore Foundation

Would you like to just give a quick summary of what the import of the meeting was?

**Julian Hunt:** Charlie Kennel here used to be a NASA administrator and ourselves at Cambridge recognize the essential importance of dealing with regional climate issues around the world because of their often special nature in different areas.

California has for sometime been extremely conscious and has done a lot of work on it's water, snow problems and I think it was a nice idea to connect that to the focus of water and ice as part of the regional climate problems in India and China. So we have this is a mixture of people from California, China, and India and working with Cambridge where we have this experience of working on climactic meteorological problems. Particularly in fact from Cambridge as I have been working on problems with Antarctic and Arctic questions of climate and meteorology.

But it's not only science but also the policies, policy issues are good to be related as you can see to particular problems in California, issues of the region.

In fact, the conference has been more successful both looking at science and implications, how to move forward both in terms of science and policies and future collaboration.

**Bingham:** So, what you read out yesterday, the sort of summary of what's going on. Nevertheless some fairly scary things have been going on – the monsoon has been weakening becoming more erratic in recent years, in Assam, East India, where we get a lot our tea from, one of the wettest places from earth experienced a drought

California is facing a serious drought, flow in many of the major rivers of China is decreasing, melting glaciers in Asia are forming large mountain lakes.

We know about global warming, the debate going on even though there are some people are insisted this is not happening, we have a serious problem here don't we?

**Hunt:** Well indeed, one of the important points which scientists have commented about and certainly I have - when you change a very complex system, it doesn't just have a slow change.

Tomorrow is not just yesterday with a little bit of extra, actually tomorrow is quite different from today as it is in many different complex systems.

So as we begin to change the overall temperature of the world, in fact we are actually getting much greater heating in the Arctic, Antarctic, high latitude regions. There are very special and regional effects. These regional effects are also not ones that are not steadily increasing, they're actually becoming very erratic.

One just has to look back in history. There was no monsoon 20 million years ago. In fact as the Himalayas rose, the whole flow patterns changed and the monsoons began to develop as we now know them.

So the same way, if the ice begins to reduce on parts of the Himalayas. We can expect as people already see. You see, can understand the variations one season to another. Some seasons you have deep convections and high rain in East Asia and the other seasons you have different.

And those are the sort of variations that can be amplified by climate change

**Bingham:** So, this is a room full of people again who are all pretty much on the same page about the science. I don't want to somehow rehearse the whole "is there global warming or is there not" debate although it is still going on in some blogs and various places.

How much time do we now have? Originally people were saying we have to sort this out by 2100 and then it became 2040 now as a team came back, a Canadian team – they're talking about melting stuff by 2013. It's getting quite alarming from some the people I have been talking to

**Hunt:** Well just the example I'm familiar with was that in the summer of 2002 we had a very large ice sheet connected to the Antarctic Peninsula sort of tundra, stretching out toward south America.

We knew that it was melting but in one month, the ice sheet the size of Wales broke away. So when it happens, it can happen very fast and just to go back to the Assam example. I have spoken to politicians from Assam and they were just amazed. Nobody would be given advice at all about these precautions. They assumed it would be wet in Assam through the summer, they planted all the plants and then there was no rain.

Now on the contrary of the other side of India, the northwest, it's a desert, so nobody plants anything during the summer - in fact there was tremendous rain that summer.

So these are the kinds of – when you get a change in these systems what happens is that, the winds suddenly change in a different direction. In the Antarctic Peninsula, now they come from the west when before they would come from the east. These have enormous local effects.

And that's why the point of the meeting was in order to understand these very acute local effects you need to have strong local studies both in terms of measurements and computation. And at the moment the focus of the last 30 years was to get the broad picture of increasing global temperature right and that was quite important but now we've got to focus on these local effects because they're the ones with politicians and communities have to deal with but also I think it will have a secondary effect. It will really make the issue of climate change more urgent and people will understand how it affects them.

**Bingham:** one of the things I've heard being said – we've had 30 years now of climate science. We've now reached a point where things are urgent, there isn't almost time, I was hearing people say, left to do much more in terms of modeling. We need to do something at the political level quite swiftly.

Does that worry you a little bit in the sense that it sounds like that's – making decisions without evidence?

**Hunt:** Well I think, in the 80s and 90s Arrhenius, Sweden's had the industrialization would increase the temperature of the world by 5 degrees. He wasn't far wrong. The basic overall canopy of the world aspect greenhouse has been predicted for some time.

The humans being what they are you need to point things out to them the urgency with which means you can't water your lawns in San Diego, they're going to be short of water. It's only that politicians have then got their weapons, the kind of arguments to persuade people to change their whole lifestyle

And people will have to change what they do and how they live, how they use water, perhaps what food they eat, all of these changes. And a politician can't suddenly stand up and say that. We're in a more sophisticated world and people need to understand the evidence, the data and the options and what options are facing them, and the governments.

And science is rather good at giving you the possible options and I think that's the new aspect of science.

Because we could now understand more about the implications, variability, and hopefully by interactions with politicians, one's beginning to see that question.

**Bingham:** Are you hopeful about new change of people in power of the United States?

**Hunt:** I think that there is a political dimension but in a way, just to take the counterexample, I've met Republican senators from Texas which perhaps you would consider to be extremely far, very conservative. Actually they realize that there is business to be done by the new scheme. There will be more wind machines in Texas than any country of the world.

Texas is an area of the world that is most anomalous in which they have extremely high winds they also realize the rocks under the Gulf of Mexico did have oil in them and are big reservoirs which you can pump carbon dioxide into.

They realize that there is a tremendous way where Texas of all countries will be at the forefront to help deal with climate change. I think there's a beltway of stuff, but when you actually talk to state Republican senators, for goodness sake in Texas, they seem you know this is the way the world is moving and I think that's been happening around the world.

It's only really a few rather strange economists. Economists have not helped on this particularly if I may say so. Perhaps the recent financial events may lower their credibility but economists have been arguing. This is the most dangerous argument of all is that 30 years from now we'll be so rich because of economic growth then the cost of dealing with climate change will be much more a proportion of the Gross National Product and we'll be easily able to do it

But that is a very dangerous argument because during this period, we're losing our ice, the ecosystems are changing. In fact this is an illegal argument, the governments of the world signed up to buy diversity conventions, which they are committed to reduce the loss of biodiversity. So it's actually like doctors saying "carrying on smoking". It's a deeply immoral argument.

The current issue of Nature, as it happens – 30 April 2009, is *The Coming Climate Crunch*. It's an entire issue on this and there's a review in there of the latest book by Sir Nicholas Stern, Lord Stern I suppose. Stern's review which came out in 2006 was a major document which alerted people on the economic issues involved here. I heard a podcast yesterday in which he was talking about his new book and new suggestion, was making the point, which is making the point, which is the point you are making about the low carbon growth story is the growth story, that if people shift, there can be economic incentives emerging from that change in direction. This is the point you were just making.

**Hunt:** The example that I'm glad now the British government talks a bit about. Stern because he's an economist. Economists hate special cases. But I think most humans actually like to know that being done somewhere or another and they can follow it. That's a different kind of motivation, perhaps an engineer's philosophy. The city Woking outside London and extraordinary man called Allan Jones wrote the [unintelligible] Report in 1988, sustainable development was important, he went back to his borough, they raised a quarter of a million pounds and in 10 years they reduced in all the buildings and systems of the city, which in the British city is a must bigger proportion of the total because there are lots of housing, swimming pools, offices, that sort of thing and they would reduce their energy emissions by 50% and their carbon emissions by 70% . They did a variety of extraordinary things they used Americans call coal generation, heat for burning was used for using warming building and cooling the swimming pool – and they went off the grid they had their own electric wires. So in the summer of 2003 when all the lights went out in Southern England, they stayed on in Woking.

To start, the British government thought they went UD, sorry, – unilateral declaration of independence, this is kind of a British terminology going back to some historical events, but now this idea of localized power and integrated approaches city by city are now beginning to be orthodox. Sweden has extraordinary examples.

So I think that, in fact, such strong economic and technical advantages of having a low carbon society, one that they see bourgeois normal British city demonstrating these kinds of changes.

I think one just has to keep preaching from example and that will be possible. I'm afraid to say there are very hard to find – there are some cities in America that are certainly doing good things but with 40% of American energy coming from transportation, which is much higher than the UK, requires a tremendous transition in how people move and the other point is that American lifestyles have become more energy intensive with tremendous amounts of heating and air conditioning, which again they didn't used to. Last 2 years ago I spent some months of summer in Tempe, Phoenix, Arizona and I thought could I live without air conditioning?

So what I did, which is what they used to do in Phoenix. I slept every night on my porch. Now the point is that you can sleep on your porch in Arizona because there are no bugs. Now if you did that in Texas, there are bugs so I do understand the Texan problem.

People, well I'm sure, will be going back and find it pleasurable to do things in different ways.

**Bingham:** so Tempe right now is about 100 degrees?

**Hunt:** Yes, but in the evening it's fine. In fact if you sleep on your porch, by about 3 in the morning, it gets too cold and you have to come in. I did that for a few months.

Anyway, I think this is what I was saying earlier to you today. There is almost a Hollywood/Bollywood dimension to climate change. If we can find culturally and aesthetically that living in this new way is somewhat fashionable, acceptable, interesting, and pleasurable, then people will do it. At the moment, everybody around the world is sort of enamored with the sort of Dallas-type living. You live in a big house with a big car, a long distance between you and the next house, lot of air conditioning, a lot of heating. And it's very worrying.

I've talked to journalists from India and China and have said "what do you think the rising bourgeoisie of the country want?" and they all want to live like Dallas. And that's extremely worrying, you know, so we've got to sort of turn it around.

**Bingham:** This issue of *Nature*, the editorial says, "It is not too late yet, but we may be very close". *Time* magazine, awhile ago, if you may remember, said "Be worried, be very worried". Now I don't want to harp on this, but it is nevertheless the case that in science magazines, like this one, gets, there are a couple of new papers in here as well.

**Hunt:** Can I attack *Nature*? *Nature* has been rude in the past and I can be rude to *Nature*. There was this one editorial ridiculing some work I did long ago on the effects of wind on people in cities, which I thought was quite important because people get blown down in cities and *Nature* thought this was a ludicrous activity. But *Nature* has refused to publish letters that I have written to them without [*unintelligible*] leading scientists about trying to deal with the problems of nuclear wastes.

The position and *Nature* has had the occasional paper on nuclear power. I believe nuclear power is a very important part of the proceedings and I don't know if they get into this on the article. It is very worrying that even the Obama administration mentions nuclear power from time to time, en passant. It's not actually a central part of their thinking or the politics. The British government

switched, it was a brave move by Tony Blair and Brown and EDF energy which of course produces 80% of the electricity in France by nuclear has been encouraged to come into Britain.

But one of the concerns people, this is why science is really important and I wish more scientists would engage in this – scientists of course, the remarks here are “what are you going to do about those wastes?” So the current policy of the British government and the American government was to put into long term depositories.

But what they don't say then, they don't tell people, in fact that there are researchers in Russia and China and Europe who are actually working on how to deal with those wastes. So there are methods of transmutation. You take the elements that are being stored there and bombard them with neutrons that you might get from a fusion reaction – that's an old idea which I particularly favor of the sources so they turn it into elements that have a half-life of 100 years rather than 10,000 years.

Now this is an area which seems to me, where scientists should say storing wastes is not a permanent solution. Most politicians think that if you have nuclear waste, you've signed up for 10,000 years. Well you haven't signed up for 10,000 years. You've signed up, put them in the ground until you find a solution to deal with that.

But this is not on the agenda. I spoke to a class in California recently and said “do you believe, do you think that nuclear energy is the solution?” To my surprise, these were environmentalists, and 70%. I went to a public meeting in California, and California has been very suspicious of nuclear in the past. And in the United States and others, if people want to continue to have a high energy lifestyle, they've got to find a high energy low-carbon lifestyle.

And maybe in parts there could be solar and wind but nuclear is a very important part of that and I am a bit surprised that the scientific leaders all around the world, and the American academy is not being brave on nuclear either. They're not really addressing this problem and being open about all the things that are really going on and looking at all the possibilities.

**Bingham:** Historically, I think nuclear has some alarm buttons attached to it, does it not? I mean, Sellafield and so on, and the movies that one sees. So what's being promoted is wind power, so on and so forth, electric cars..you don't [unintelligible]

**Hunt:** Well I think that's a possibility. There's a very important man, Socolow, who did a Wedge Idea where you need all the options. We need all the options. It was an absolutely clear conclusion from this big Princeton study, accepted around the world

And yet the governments say in spirit they accept it but actually they only accept a small part of those big elements in the wedge and obviously nuclear is an important part of it.

I personally work on wind. I think one of the interesting points for example is remote farms in the US and highlands with plenty of wind will be able to get water and they can't use the electrical energy they have – they're not on the grid and they can turn that to hydrogen. And hydrogen in a truck, you can take it down use it in your car and there are all sorts of interesting technologies.

But I do think, this conference, it was interesting hearing colleagues from India and China talking that 10%, China and India they expect 10% of their energy to come from nuclear in the next 30 years, they have got to find other methods of reducing their energy, as you say, for more efficient use of energy, conserved and find it also from these completely renewable sources. Solo will be a very important part of that too.

**Bingham:** This is such a huge global problem. Charlie Kennel was making a point yesterday that how do you get this across to people and that people don't live on the globe, they live in communities, they live in regions, so my understanding was that one of the purposes of this meeting was to get regions to focus better on producing data about climate change and that can all be fed into the large global models and make them more accurate. Is that part of the story?

**Hunt:** Yes, they should be, the problem is that the global models can't use the local data that's available. The local data can enable you to make the right policy decisions in your area, so I was very stuck by this. By going to an organizing meeting with the Ghana government and the non-governmental body in England four years ago and we found that on the coastal strip of Ghana, some of the West African cities on the coast were very considerable rise in temperature and decreasing rainfall. But further inland in Ghana, in the forests and so on remained fairly static so on the IPCC kind of charts, Ghana is one big data point and you don't see much change. But the government has to deal with these important areas where most of the people live where there is a very marked climate change. And the same story can be said all around the world. That you have in India, quite different patterns of climate change and different models. The current global models – the resolution is 200 kilometers and that means they're only really modeling things quite accurately within 300 kilometers. They're just not very good. In Northern France and Southern England, the climate models are saying that the temperature that the rainfall is dropping but the temperature is actually rising. The models are good for certain things, very good for temperature and in certain areas they're quite good on precipitation but that we need to look at very carefully at what they're saying. And then we can use other modeling approaches to go in on a very specific basis and that's what we were discussing in this meeting. As starting from the model, what we really know, what we are really measuring, and then work out the kind of trends we should expect.

**Bingham:** Do you have any – is there any doubt in your mind about that this is happening? I mean, what do you say to the people who say “no, no, no, you've started the graph at the wrong place” or “this is a historical blip”?

**Hunt:** Well I mean, I've been crossing swords in the House of Lords with Nigel Lawson, one of these economists who says “this may be a problem, it's a long term slow problem, we'll all be richer in 30 years” more or less weight, if I paraphrase him correctly. But actually, and one of the reasons, that's given him some reinforcement is the fact that the IPCC..I bet that graph is in *Nature* but I haven't seen it. The Inter-governmental Panel graph, which has been chosen to average the temperature of land and the sea. And over the last 10 years, this global average temperature is flat. And the point at the meeting, if you look at the temperature over the land areas of the world - that has been continuing to rise. The reason is that we have had this very strong cooling of one part of the Pacific Ocean over the last of the 10 years, the so-called La Nina phenomenon. And these big oscillations affect the temperature of the sea more than they do over the land and this seems unfortunate to me that the climate modelers of the IPCC has been

choosing the wrong graph in order to present their case, which is quite a serious point. And as a result of lobbying by myself on the British governmental order, you now see the temperature rising. I'm afraid most of the American government websites, although it's scientifically known, this is not in fact the basis upon which they present the case to the public. I think the case being presented to the public is not as urgent as it might be from a scientific point of view.

The moral of this is that scientists must pay close attention to what is being said in the public world. A lot of them I'm afraid are not doing that. They say, "This is what we're doing, you listen to us" but actually the scientists never listened to what the debate is and give information and arguments that will help move the debate on. And that's part of their responsibility.

**Bingham:** To be engaged in the political process?

**Hunt:** Yeah, in the debate.

**Bingham:** Because they don't usually want to.

**Hunt:** They don't want to. They don't want to listen. They want the politicians to listen to them but they don't want to listen to exactly the criticism about the politicians, or listen to what the economists want to say and actually listen to what they're saying. You know, I think they're very bad at listening to what the community debate is about.

**Bingham:** Isn't one of the fundamental problems here, public perception – the public would like some definitive answers on certain things. It's always better to have a clear statement on these things while scientists are in the doubt business. But it's not very reassuring to be told that you're in the doubt business and that things will change, we might have to revise this and so on. People kind of want this certitude.

**Hunt:** Well on the other hand people are betting on Saturday when they're betting on horses. Well actually people, if you've been in weather forecasting as I have, people are astonishingly clever at weighing out the probability or the accuracy of a forecast in terms of how it will affect them. They have the image that if a drop of rain will ruin your washing, you'll take a low percentage and you'll do it but if it's going for a walk and a drop of rain doesn't make a difference, you'll listen to that forecast in different ways. People are very sophisticated and in fact when politicians give data, often with a very carefully graded weighting of certainty of what will happen. So I think that's why we've got to express some things we know a lot about and the climate public has greatly improved in that. They've said "these are the things we're certain about and these are the things we're less certain about" and that's very important. That's been a great improvement in the presentation of climate modeling predictions.

**Bingham:** Take something local, like when you're in charge of telling everybody – or you and your staff – telling people what the weather was going to be like tomorrow. You're running the meteorological office

**Hunt:** Yes

**Bingham:** Did you get it right most of the time?



**Hunt:** Well, yeah, it was improving. There was a really classic case where I was angry about, which was about [*unintelligible*], my son had his 21st birthday and they said it was going to be a brilliant weekend on the Friday and on Saturday there were clouds, and clouds all day. It was so cold and we had to have heaters in the marquis for his party. And I personally know exactly the reason why that is. They didn't send up another balloon. They couldn't send up another balloon early next morning to find out that the cloud layer was quite thick. And probably the RAF did get a more precise forecast. So point is we know there are certain conditions of weather. Though there are on/ off situations and they were very close to a decision point and they made the wrong one. But, to these statistics clearly demonstrate, the forecast for one day could be better, but now four day forecasts are as good as one day forecasts. You know, 20 years ago, hurricanes, when I started in 1991, had an error of about 130-40 mile error for 24 hours and now that's down to about 80 or 90 miles and it happened very quickly. So, there is definitely a huge progress in climate. The first climate statistics had it rising way too fast and we introduced aerosol processes and now they're in greater detail, you can now represent the Gulf Stream, all sorts of things have greatly improved. I don't want to sound negative about this –

**Bingham:** No, I just wanted to put it in context. People's, my experience, is "Yeah that was okay, but now it's wrong – I was expecting it to be sunny and how on earth could they be right about trends of the next X century and what's going to happen in terms of global warming?"

**Hunt:** The famous chaos scientist of America, Lorenz, explained it in a very fundamental way. The difference between weather and climate – climate was the average of weather over 10 years or something and that's when you get climate forecasts. Everybody's going to say whether it's going to be rainy on Christmas Day in 2100. The evidence is that those decayed averages are quite good. Farmers make decisions on every year, politicians on 5 or 10 years. The Dutch for example are making decisions over hundreds of years, increasing dikes, and they have to make that precautionary

**Bingham:** What about potential solutions – I'm reading again the current issue of Nature. Different ways of cooling the planet, some sort of geoengineering – are these realistic proposals? I'm thinking again of a simple issue like it's not so long ago that the river Thames in your home country was foul and there was no fish in it and it was fixed. Now this is a simple analogy but there are certain things that can be done that can be repair situations. Is this just a huge situation or are geoengineering techniques that can address it

**Hunt:** Personally I am very worried – you can't actually predict the trends in rainfall which is the kind of thing we associate with particles, how things behave in the air. It's very worrying to put things in the sky, we don't know what the effect will be. And so that things could go one way or another and the other way. That's what concerns me. There's been quite an interesting debate about the use of weather engineering. A very nice example was in the middle 90's when there was a forest fire approaching Ulaanbataar, the capital of Mongolia and so they sent up airplanes and sprinkled salt in the sky. And suddenly there was a massive snowstorm and they put out all the forest fires and then they were worried about deep snow in their city.

So you can make these big changes, and that's just an extraordinary example, it depends on the area of the world and we don't understand those things very well. Local, for example, if we can plant more trees in the sahel – for example that is happening, that will change the climate, it will

absorb more carbon dioxide, it's completely safe, it will provide livelihoods to people. Maybe it's not so fashionable, but it's the kind of thing we should be focusing on. In many parts of the world, obviously in what we've done in the Amazon, cutting down the trees in an Amazon is having a devastating, de-engineering effect, reducing the absorption of carbon dioxide and I think we should be putting all our efforts into that. I'm afraid to say I went to the Amazon last year and I have some bad stories on some big international companies having illegal ports on the Amazon, importing and exporting products. It's not a good scene, and that's what we should be focusing on.

**Bingham:** Beyond the climate science itself, plainly there are all sorts of issues about in terms of the international community. Where do you go in terms things of economic policy, where do you go in terms of fairness and justice? You are a scientist but you are also in one of the legislative bodies in the United Kingdom – the House of Lords, does that, do those issues get into the debate as well?

**Hunt:** Oh yes, we have an interesting sort of scientific cum justic debate on the question one of the as we say of the House of Lords, one noble peer that we should all completely stop buying products from Africa and fruit, flowers and so on because of the cost of the use of aviation. And using fuel. And buy local, and so on. And as some of us pointed out indeed, the flowers that come from Kenya are using sunshine and then lowering the use, immigrating carbon of the aircraft, we're actually using less carbon by if we were heating greenhouses in Holland and Lincolnshire creating our flowers.

And there are other examples – so we've got to think of this in a pretty overall way. But that was an interesting example where that was a mixture of legislation and strong feelings – but then the facts had to be presented and we had to think about using long term consequences. And just as I've mentioned if we can help some of these sahel countries increase their trees and vegetation then that will have a tremendous good effect locally and globally. Adaptation and mitigation, these words are used separately but there are many ways where we can bring them together.

**Bingham:** So what's the preferred economic solution at this point? Stern's new book sort...caps and tanks.

Yes, it is interesting that some of these economic skeptics – Lawson, he's skeptical, he argues for more of a carbon tax but I think decision makers – with plenty of decisions there has got to be some mixture of areas where you want to appeal to people's motivation, market orientations so you should use taxes to encourage people to use more economical cars, public transport, and so on. On the other hand if you're going to find methods of dealing with nuclear waste to enable people to have confidence of nuclear power – that's a top down, big science decision. So it's not going to be one or the other, but that's the kind of decision whether we can go for nuclear. It's pretty outside the can, particularly if you have someone like Stern who is being informed by the British government on half these issues that are actually important. It's disgraceful how some of these issues are completely un-discussed or not allowed to be discussed by nature. Like the nuclear debate, is not open. Now I believe fusion is the important thing to go for, but there are applications of fusion that people are interested in, in Russia and China but this is considered at the moment very dangerous to discuss because this will upset certain countries who are very anti-nuclear. One of the difficulties is that Germany was the major country in this whole debate

was anti-nuclear. Everybody's tiptoeing around Germany because they've come to a political decision on this and I think that this is very misguided. I mean, Germany will have a few and that is fine. We should be completely open about these options and discuss them openly. And that's not happening at the moment.

**Bingham:** Does that get into a larger sense, like nuclear proliferation?

**Hunt:** Oh yes, that's the reason indeed, to give them credit – the civil servants who are very wary about any open discussion that this leads to proliferation. For example, any technology who would allow you to reprocess fission waste could also be used in the wrong hands to generate plutonium. That's a scientific fact. On the other hand, some of the country one is worried about seemed to have all this good material anyway so this stable door has been open and the horse has fled. Should we be seriously limiting our options because of this possibility of this? That is a very delicate decision but we should be discussing it. It seems to be completely open. So in fact, nuclear proliferation and nuclear security curiously seems to be one of the issues that we need to wind into this climate future debate.

**Bingham:** How did you get into this business in the first place? Science?

**Hunt:** Why, I had a grandfather who was a mathematician, at Trinity College in Cambridge who taught me fractions. But more importantly, we went sailing and rowing and I saw all that and he enabled me with my bricks. Me and my brother to have bricks – to have a bridge that went about 5 feet across the nursery floor by clever weights so I began to be fascinated by that.

**Bingham:** So you built a little bridge -

**Hunt:** I built a little bridge with all these bricks, by weighting them level, with the long Victorian rectangular bricks you could cantilever a bridge out. And he started doing, sat on the nursery floor and I did those things with me. I also had an uncle called Richardson who was an extraordinary man who first invented numerical weather forecasting at the Met office. And was a pacifist as well. He did amazing experiments in the Holy Loch in Scotland where I stayed with him when I was 11 years old and he everything did an experiment. Interestingly enough, he got up in the morning and was sitting next to the radio taking notes and I was like "Why are you doing that?" and he said "you can't believe anything you read in the newspapers" so sort of, it was a deep shock to me. The world is out there, some people you believe, some people you don't believe, you should look at your own evidence. And I've been a bit of a troublemaker ever since then, I think

**Bingham:** So, 'cause you were saying to me the other that you thought that to some extent the art of just doing experiments is somewhat lost.

**Hunt:** Yes I think so, that science to some, is this great excitement – the rockets and going to space. And indeed, I enjoy that too but I have to tell you of my rocket stories. When I spoke to my other grandfather when I was a boy, and said "Wasn't it fascinating to see the Sputnik going up?" And he wrote back to me, "well the Russians were always good at ballistics" because he fought in the First World War and the Russian artillery was supposed to sort of be very good. And that was a sort of tradition of that.

But – experiments – this sort of Victorian idea that you learn from science from experiments and keep doing experiments, I think is not what people do, and experiments have somehow become because we now have our computers and our models, and science is learning about what other people are doing.

Undergraduates come to universities hardly every experimented with anything and [unintelligible] they hardly don't do cooking. There are so few physical things people are doing and I was just saying that I've been stirring soup and I was astonished that once you were started the soup going and you heat it, the soup keeps on going and so the friction is going down.

That's actually not in many of the mathematical models you have for heat and convection. So even in the Met office, the big computer models, the fundamental processes are not well covered. And someone has got to be alert to – as Isaac Newton said – you can do something very simple, jumping or Huygen's Pendulum, and from that you can get ideas that are relevant to the farthest in the planets and I believe you can – I watched my wife making jam and from that I learned some ideas about convection and we wrote about it. I think that's still considered a very eccentric approach to being a scientist but I think that is what a scientist should be partly about.

**Bingham:** So would Newton be one of your scientific heroes?

**Hunt:** Oh yes, certainly, interestingly enough he was another kind of hero as well because he was a Trinity College – he left Trinity College to go and run an agency as I did, he ran the mint, and he made an effort to sort of get rid of the forges and then he became a member of Parliament for Cambridge – he was into politics as well, but the only speech that is recorded that he made in Parliament was "please shut that window" so he was not very vociferous as I remember Parliament. Obviously the interesting point about Newton, he was a human person, was that he might have the jealousies of scientists as well, but saw that science and the application of Newtonian dynamics was that the ocean was navigation at that time and he could see all the important connections.

So when I was at Trinity and I had the opportunity to go to the Met office. I used to say I was the second person to leave Trinity to go to an agency, but actually I was the third, because Walker left at the turn of the century to go and run the Indian Met department. So a Trinity mathematician had left Cambridge to go and he discovered the southern oscillation, El Nino. So I think that it would be difficult in the United States to, though we see some nice examples of scientists here too that go from universities to agencies. That's important.

**Bingham:** What about the meeting – the people from Himalayan Asian, China, and India, so on, did you sense that they were optimistic about these collaborations? How do you see this working, politically?

**Hunt:** Well I think one of the sorts of ideas we've been mulling over together is that we need regional centers where you've got people who look at the science but also then interpret the science for local decision makers. It can't all be done through big international agencies and a nice example of that is The Energy and Resources Institute in Delhi and Shahid Hasan came and spoke from over there and they're looking at the ground truth – what exactly is happening to the glaciers which has not been measured before. And at the same time, they're advising the local

states of India about what to do and they'll have different policies in different areas and that's exactly a kind of model that what we think could be happening in most regions of the world.

**Bingham:** In that area, that part of the world, Hindu Kush and so on, I didn't know that until I talked to some of the people at the meeting, we talk about the melting of the ice caps, but there are huge water reserves there and there is potential massive flooding and so on. Why don't we know about that? Why is it so -

**Hunt:** If you listen to our Indian colleague, he said that are very few Indian scientists or even in terms of recreation. It's not like the Alps where everyone's crawling all over the Alps – Indians don't do that actually. Somehow they look south, they look in different directions and they're not looking at exactly what's going on. Of course there are few people there and so these massive floods that will happen right up in the Tibetan plateau will sort of very, few people are there. But those people who are there – it will be very disastrous for. But we are beginning to see that with less snow pack and floods coming down the rivers earlier, and the Ganges floods, we some also terrible floods just last year on the Ganges Plain and we may well see more of those. This will require the massive defenses or people moving bodily because this will be very difficult because it is an area with a great a population. So, India is beginning to look at that.

The data, for example, the actual information, getting that information has been pretty poor. The floods coming down the Brahmaputra from China, into India, into Bangladesh - that exchange of data has been very slow – been nonexistent in the past, it's growing. So the forecast of the floods has been very different. Water is a very unlike weather, which people exchange information about weather to quite an extent, water is very badly informed even from 1 state to another in India or from 1 country to another. There are no international conventions about exactly how much data you should exchange, I worked on that myself, but there's a lot more things to be done.

**Bingham:** What I'm thinking of, of course, without minimizing the problems in that area of the world, most of the news stories you hear about the Taliban for example. As compared to the size of this issue, this is a huge sort –

**Hunt:** Indeed when disasters happen, the numbers of people who lose their lives and livelihoods is just enormous. And but in a way what's remarkable about it, the country with the biggest population in the world is that despite these disasters, their system of government continues, their societies and the villages continue and they go back and rebuild but these disasters may come so often and frequently in the future that there might be a much more massive disruption in society so there's some sort of great concern. This is one of the things I've been looking at and others have been looking at now. The resilience of society is too individual, separated disasters may be one thing, but you need to be extremely resilient if these disasters are going to come one after another, more frequently and this will require a degree of social organization. Curiously, China - I've been to Chinese villages and seen how the floods come down and how they deal with the floods. It's very impressive but it's a very kind of a structured organization that enables them to do it.

For example, in the Chinese village they have a forecast of a flood, they go around the village , all the elderly people move upstairs, they have concrete houses so the water can just come right

and the electric's all high up. Half the flood comes through, they clean up. It's actually quite useful, the flood moves all the dirt and sediment further out for their allotments in their gardens and then people move downstairs again.

Chinese, in some of the areas, have discovered this extraordinary resilience to these natural disasters, but to even China may well even be overwhelmed by the kind of things we may have happen in the future. So this is the new aspect of climate change that we have to focus on.

**Bingham:** There's a connection here strongly with some sort of information technology, internet and so on. Huge numbers of internet transactions going on 200 million, 250 million now in China, 200 million X people on the web here. I was reading a report the other day that the amount of energy use there is roughly the same as the world's airline usage. But on the other hand, there are ways of using IT to actually provide solutions so it sounds like there is a strong possibility – was this discussed at the meetings?

**Hunt:** Yes we actually had some discussions for the first instance -

**Bingham:** [unintelligible] working on some of these issues -

**Hunt:** For example, for schools around the world, could be networked and be making their own weather observations, quantitative and qualitative data - that would be very amazing so they could see on the web how their data compares to the surroundings. This would be transformative. In fact that's the reason why you motivate voluntary weather, rain gauge people in the United States and Europe because they get back the information on how their data relates to the whole area. So I think the educational and information thing is very important and it should be able to provide the kind of local services to help people look at. It was quite interesting that what they didn't talk about – what we were trying to explore in London – which they talked about the Internet 2.0. And in London what we're doing, we're making forecasts of the pollution street by street with detailed models that the company I helped set up in Cambridge runs. And the information goes to in individual people about the pollution and these are people who are identified as having breathing difficulties. But in future, once would you get those people receiving it they send back a report – did they feel ill that day, and you'll be able to find out their particular sensitivities. As a result of processing that, sending them in fact, in the future, a more individualized forecast. For example, a farmer, every farm actually has slightly different soil, slightly different sensitivities to rain, if you could send farmers information and get back from them exactly what happened, then you would be able to send them much more detailed information.

I think in the business of IT, the IT community world actually has not begun to address this question. It's a sort of a three-way process – a broad one, and a focused one, and then you get the information back, then you process it, and then finally you would be able to with big enough computers, send individuals much more individualized sort information.

As people have commented, the moment you are used to having detailed information, there are problems with secrecy and interference and surveillance and someone's got to find the right option for every situation.

**Bingham:** So I'm just looking at the speech of the chairmen of the International Intergovernmental Panel on Climate Change, the recent one in April 2009, in Turkey. The four points he made were to reduce uncertainties in gaps in knowledge wherever they exist currently, provide greater regional detail pertaining to different parts of the world, which is what your meeting was about, and sure adequate coverage of socioeconomic and humanitarian dimensions on climate change, and carry out assessment of climate change of wide range of plausible scenarios pertaining to the future. Do you think all of that's on track?

**Hunt:** Yes, I think all of those are right but my only point is that slightly the IPCC, as is the inclination of this meeting, this all comes from great international connection of experts and my point is that which as I've seen Africa, a lot of information is very local.

Even if you're a weather forecaster, somebody's been a local fisherman all his life in some area and he knows a lot more about it, more than you do. I don't think there's enough humility or listening to what all these local trends are. Some of the data, we've had some extraordinary meetings in the autumn, in London with zoologists from at the London Zoo, people looking at what animals are doing, and how people are farming, this sort of qualitative information. And the IPCC, which sort of has begun to recognize that.

But how we actually use this citizen's science in an effective way is a fascinating challenge. But I think that unless we do that, we're going to be making clunky, erroneous decisions and predictions, which ones are not necessarily a great.

A local fisherman will often not listen to a weather forecast because he thinks he knows it right but he doesn't always know it right, but it's sort of the same thing with climate. So it's this subtle and I think sensitive business in which the knowledgeable people must recognize the value of the experienced people and sort of find a way in which we know best to use both those kinds of areas of knowledge and experience. And climate and weather are two absolutely strong examples.

**Bingham:** This is also going to force some changes. One of your ultimate areas of specialization is sort of looking at the state of cities. One assumes that there's less traveling by car, people will be more concentrated in urban centers anyway. And urban centers are much more useful in terms of, much more able to economically use energy in this kind of world situation. How is all that going to happen?

**Hunt:** Well, cities as you say, perhaps use less energy. In New York they use much less energy than Dallas or Houston [unintelligible]— like my house in London, I live in a row house and I turn off the heating and I'm getting warm from my neighbors so we're all benefiting each other. So I think cities are places of lower energy but they're also sometimes dangerous places – very, very high winds and high floods, and some people in cities are actually more exposed so we've actually got to be very careful about those. Generally, I think cities are what people are going to.

