The C Words

I talk a lot about Climate Change. Why? Not because I enjoy bringing you bad news. But because I care about you and I want you to understand the impact climate change is going to have on your life. Climate change is the single biggest threat to all of us.

There are things I don't know much about, and there are others about which I might be useful on that pub quiz team. I know more about Climate Change than most people – I started working on climate change issues more than twenty years ago.

- *Climate change is really serious and 2014 is year we all need to act*

Are the latest storms evidence of Climate Change? No-one can say for certain, but they are consistent with climate change. The climate is becoming more energetic and less stable. More wind. More and heavier rainfall at times, less rainfall at others. The storm surge along the North Sea coast (5/6th December 2013) was exactly what we have been preparing for for decades. We've seen serious river flooding as well, and flooding from rainfall so heavy there's no time for water to drain away (pluvial flooding). Two years ago, though, we were in a long period of drought.

Other countries have been experiencing extreme weather too, often record-breaking. Droughts, storms, bush fires, heatwaves, flooding.

- *Climate change is happening*

The science is really clear. Glaciers are melting. Sea ice, such as in the Arctic, is reducing in extent and thickness. The growing season for plants is changing. Wild animals are moving or dying out. In the ocean, coral is dying, as the oceans become both warmer and more acidic. The Earth's average surface temperature is increasing. Of course, it is always possible to find specific places and specific periods of time for which the temperature has reduced. But the overall pattern is very clear.

- *Climate change is caused by us humans*

Not only is climate change happening, but it is almost certainly caused by human activity. Greenhouse gases such as carbon dioxide and methane are increasing in concentrations in the global atmosphere, and this is almost certainly (at least 95% certain according to the IPCC) due to us. We burn fossil fuels in our homes to keep warm and wash, to move around, to make things, to grow food, especially meat. And we also cut down the trees which could help absorb some of these gasses.

- *Climate change is going to get worse*

The climate system is complicated, and although there are many very sophisticated computer models of the climate, we still don't understand all the interactions within the system. But what is clear in all the models is that as the concentration of greenhouse gasses increases, average temperatures increase and the climate system gets more unstable.

- *There is a tipping point beyond which we won't be able to stop climate change*

As temperatures increase, there are "positive feedbacks", factors which add to the increase. For example, as the Arctic ice retreats, the Arctic Ocean, now dark, absorbs more energy from sunlight than previously. As the permafrost thaws, methane frozen inside it is released. To be fair, there are also negative feedbacks. For example plants and trees grow more vigorously and absorb more carbon, but they tend to be weaker. Eventually there comes a point where the feedbacks take over, the climate change becomes uncontrollable. We know this, but we don't know exactly what that point is.

- *Turning round the climate system will take a long time*

Even if we all stopped using fossil fuels tomorrow, the climate would continue to get warmer for 20-50 years. There is already a lot of future increase built into the system.

- *Exploration for more fossil fuels must stop*

The maximum amount of extra carbon dioxide we can afford to put into the atmosphere is less than that which would result from burning the fossil fuel reserves we already know about. We can't even get away with burning all the fossil fuel that 's ready to be extracted. So there is no point in making our global problem worse by finding more fossil fuels which we then have to leave alone.

- *The issue isn't the science but our psychological reaction to it*

The science is clear. But we behave as if it isn't, as if climate change wasn't really happening. So why don't you believe in climate change? When I say believe, I don't mean like believing in God or Father Christmas. I mean believing like you believe that brushing your teeth will help to prevent tooth decay, that diseases are caused by bacteria and viruses and not by evil spirits or humours, that eclipses are caused by the positions on their orbits of sun and moon, not by upsetting the gods. That is, a general belief in applied scientific knowledge.

The main reason is not science but psychology. Your friends don't believe in it. Or at least they seem not to believe in it. Who wants to be different from all of their friends? We are social animals and are trapped by what our peers permit, by group thinking. Social networking can make this problem worse - how accurate is the information you receive from your friends? And then there are the advertisers.

Also, it's rather inconvenient. If you believed in climate change, you would have to change. No-one likes change, especially if life is comfortable. If you have children, you wouldn't be able to reassure them about an ever-improving world.

So it is easier to label the climate change believers a strange doomsday cult, like the Jamestown massacre people, or a bunch of pessimists, or a bunch of tree-hugging lunatics. Climate change is not a belief system, but our best estimate of the future based on knowledge of the past and of the mechanisms of the climate system. As our knowledge improves, our estimate changes. There is no holy text or prophet to climate change. The only test is whether the prediction is accurate.

- *Each and every contribution matters*

And let's also deal with issue of pessimism. On this issue, the pessimists are the people who say we can't do anything, that it's too late because other people (for example the Chinese or the Americans) won't change, or that my little contribution as one person won't make any difference. The only way we will get change is if billions of people all DO make their own individual contribution.

I am not a pessimist, though equally I am not an optimist either. As a mathematician, I try to take a balanced view of the odds. But one of the characteristics of humans above all animals is our ability to learn. We don't just behave by instinct. We can take in information, analyse it and change the way we behave. We are also social beings who can communicate and organise our societies. So we have the ability to deal with climate change, this problem we have ourselves created.

Climate change is a global issue and needs a global solution. There is no point in creating scapegoats. We have all contributed to the

problem. The only global solution on the table at the moment is Contraction and Convergence. The world needs to reduce its greenhouse gas emissions drastically to avoid our shared planet becoming too hot to sustain 7 billion humans. C&C is a workable model for reducing them in time. Under C&C, each person in the UK needs to reduce their carbon footprint to 3.0 tonnes of carbon dioxide equivalent (tCO_2)by 2020, reducing to 1.0 by 2050.

This would achieve a reduction in greenhouse gas emissions which is, on balance, likely to keep the average temperature of the Earth from rising more than 2°C. This is the internationally accepted target. But let's be clear, a 2°C rise is not a picnic. It still means some island and coastal communities would be wiped out. It still means drought and famine in some areas, water shortages in others, more forest fires and floods. But it is thought that human life could largely continue in most of the world. Whereas on our current path, the temperature would go on rising and human life, and indeed the lives of most other species, could no longer be supported in the biosphere.

Each year in December there is a big international meeting about climate change called COP. Last year's COP was in Warsaw. There was consensus, as ever, that climate change is an urgent issue, and they decided to put together a protocol to discuss, not this year but in 2015 in Paris. It is clear that this process is not achieving what is so urgently needed.

- *You can reduce your contribution to climate change*

Here's my annual carbon footprint for 2013:

Household	2.6	(2012: 3.0)
Road transport	1.3	(1.8)
Air travel	0.0	(0.0)
Total	3.9	(4.8)

A return flight from London to Malaga emits 0.4 tCO_2, to New York 1.5 and to Sydney 5.6.

You can work out your own using Web tools such as
http://www.climatecare.org/home.aspx
- this is not an endorsement and don't buy an offset. Of course, there's more to a carbon footprint. It is affected by what you eat, all the goods and services you buy, all the things the Government does on your behalf. But household and transport use are the largest items and the ones you can do most to change.

Easy ways to reduce your carbon footprint are:

- Don't fly, especially long-haul
- Travel less, especially by car and cruise ship
- Insulate your home
- Have an energy-efficient boiler
- Energy-efficient lighting and appliances: washing machine, dishwasher, fridge, freezer
- Check the energy use of anything you leave on stand-by
- Eat less meat

- *You can prepare yourself for the changing climate*

The climate is going to change, yes, even here in England. We expect more heavy rainfall and flooding, like recently, but also more periods of drought and heatwaves. The weather is going to be less predictable. Transport disruption is just the most obvious effect, and will have impacts on our work lives as much as our personal ones. Travel will become more subject to delays and cancellations, and yes, even more dangerous. Harvests are going to be more erratic, around the world, so food prices

could vary considerably. Water could be scarce at times, so store some. Don't live in or even near the current floodplains. Ensure your home is prepared for extreme weather. Energy supplies and communications may be interrupted more frequently in the future.

In an emergency, don't expect to be rescued: in big events, the emergency services may themselves be affected and there will be many others who need rescuing before you. Be prepared to rescue yourself.

We need a Copernican revolution in our beliefs about climate change and what we are going to do about it. No-one still believes that the Sun orbits the Earth, and soon no-one will still believe that climate change isn't happening, or that it is all caused by sunspots or volcanoes, or that even if it is happening, it's nothing to worry about.

- *Stop living in denial and do your bit to rescue the world from climate change*
- *Vote for a political party that has real proposals for tackling climate change?*

Climate change is like a collective cancer. There is a social stigma to talking about it. Yet while we are all in denial, it is not going to get the treatment it needs. The difference is that it's not going to kill just one or even a few of us. If we don't sort out climate change, it's going to kill all of us. Not all in one go, but gradually through a miserable litany of increasingly extreme disasters.

- *You still don't believe me*

We have grown up in a very comfortable age. By and large we don't worry about food, water, a roof over our heads, law and order, peace (at least at home). We even grew up with good education and health services. And we have been brought up with Western narratives of progress, pilgrimage and redemption, and modern social media is even more demanding of positive stories. So it is difficult for us to accept that it could all change for the worse, and with no cavalry coming over the horizon.

The natural human "optimistic" reaction is to think that these storms are just a one-off (or two-off, or three-off), but they aren't. You still think I'm a pessimistic merchant of doom, so start at the beginning again and work out where you disagree, then do the research.

- *We can deal with climate change, but only if we act now*

We have the knowledge and the technology. What we don't have yet is the will. And the trouble is, time is running out.

- *2014 is the year to start taking climate change seriously*

Matthew Chell, January 2014