John A. Hoskins

Reigate, Surrey, UK

Global Warming Is True – Isn't It?

Scientists are now sure that global warming is a real phenomenon. No ifs or buts, this is a definite statement. It's true. Three of the past 8 years have been the hottest since at least the Middle Ages. What could be more definite? Three years in the last 500, maybe 600 years and they were all in the last decade. In the past if weather got a kick in the pants it used to be due to volcanic eruption, unusual changes in the sun-spot pattern or the now infamous El Niño behaving oddly. Now it's us. We keep on burning things, mostly fossil fuels but also forests. This last year has been particularly bad for forest burning. Burning carbon containing material produces carbon dioxide and that is a 'greenhouse gas'. I know that a few years ago we worried about CFCs and their effect on the ozone layer but that is another story and they no longer seem to be major players in any doomsday drama, today carbon dioxide is at the front of the stage. However, the role of carbon dioxide is not entirely clear. We know that the amount in the atmosphere has increased since the time before the Industrial Revolution. This increase is probably the most believable part of the story because we can measure the levels very accurately and have been able to do so for many years. In the pre-industrial era carbon dioxide levels were around 280 ppm, by the time of the second world war they were still only around 290 ppm but now that figure has increased to around 355 ppm. If and how this increase is responsible for and related to global warming is a difficult problem and there seems to be little consensus between the experts involved in its study. Some will say that the increased level plays a major part in the global warming that we are experiencing. Others will deny that we are experiencing global warming or if we are then the role of carbon dioxide is greatly overstated. So I

should restate my opening sentence and say that some scientists are absolutely convinced that the biosphere is hotting up and that carbon dioxide is largely responsible. I am sitting on the fence.

The Intergovernmental Panel on Climate Change (IPCC) has said in a report [1] that 'carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future'. The increase in carbon dioxide levels is continuing and in the future there will be a lot more. How much more depends on the credence you give to the many scenarios that have been proposed so 'a lot more' seems to be accurate enough as a description. Of course the problem is compounded by the fact that the relationship between carbon dioxide in the atmosphere and the mean global temperature is not, as I said earlier, a simple one. During the Cretaceous period carbon dioxide levels were in excess of 2,000 ppm and yet temperatures were little different to those today.

Arguments about changes taking place in geological time have the advantage that vagueness is to a degree acceptable. A year, a century, or even a millennium are unimportant. The correct order is important; before this but after that and about the same time as are necessary and adequate. Exactly when something occurred is less so. If we go back in the time of the history of the Earth by some 3 billion years we arrive in an era when life had begun but the degree of cellular organisation had not got a long way beyond one. There may have been colonies of cells but such aggregation was probably disorganised. Most importantly for the march of evolution the biosphere was anaerobic. Oxygen, strictly dioxygen, levels were constrained to below 0.001% of the present atmo-

spheric levels by the chemistry of the day. The oxygen was there of course but it was all chemically bound. Much earlier in geological time the Earth had been very hot and it was thermodynamically impossible for elemental oxygen to exist. By three billion years ago the Earth had long cooled sufficiently for reactions that liberated oxygen to be irreversible. It was up to evolution to produce the structures that could do the chemistry. By 2.7 billion years ago cellular organisation evolved to multicellular and chemistries evolved that released oxygen [2]. Evolution hotted up as cellular organisation became increasingly complex. Substantial amounts of carbon dioxide were released into the atmosphere. Photosynthesis combined the carbon dioxide with water to produce sugars and oxygen.

Now if every molecule of dioxygen in the atmosphere came from a molecule of carbon dioxide there must have been an awful lot of carbon dioxide. It has been proposed that levels as high as 200,000 ppm [3] could have existed in the developing oxygen rich atmosphere. What was the temperature of the biosphere then?

The principal accusation of global warming protagonists is that we have upset some global homeostasis and are suffering the consequence. No longer geological time but now, or at least within the next hundred years' time. We cannot wait aeons for disaster it has to be in the foreseeable future and preferably in our lifetime or it is not news. In prebiotic times the chemistry was comparatively simple: carbon dioxide formed carbonates which broke down to form carbon dioxide which reacted to form more carbonates. The advent of photosynthesis and the evolution of the many ecosystems changed all that. The atmosphere changed to the one we know today which is probably largely maintained by these ecosystems. They are very important; the forests of the world alone account for 90% of the annual flux of carbon between the atmosphere and

the Earth's surface [4]. We should be worried that this is so important. Burning forests for absurdly short-term gains by a very small number of people is a very bad idea.

All the elements which form the biosphere have their natural cycles. Some of these elemental cycles are short as organisms develop, have their being and then die when their elements are recycled and go round again. Other cycles are much longer. We are disturbing the carbon cycle. Some carbon cycles slowly as carbon dioxide in the hydrosphere, combines with calcium to form calcium carbonate, which forms the shells of marine animals and which in time breaks down so that the cycle continues. This cycle has a turnover time of maybe 30,000 years [5]. In the shorter term carbon is taken up as carbon dioxide by green plants, algae, etc. and turned into sugars and other organic materials. Some of these compounds are used for growth, others for energy creating chemistry which liberates oxygen back into the biosphere. Burning forests affects this but it doesn't, in the longer term, put any more carbon dioxide into the biosphere. It just turns it over faster. Faster because new growth needs more carbon dioxide than mature growth. If all that we burnt was the trees it wouldn't be so bad but a lot of the carbon in the sedimentary layers of the planet is not oxidised. Fossil fuel is the carbon dioxide of the Cretaceous period reduced to carbon and through carbon to hydrocarbon by millennia of chemistry. By burning fossil fuel we are putting some five billion tons of extra carbon dioxide back into the atmosphere every year. That's what is causing the increase in carbon dioxide levels. If as a result we turn our atmosphere to that which existed all those billions of years ago I am sure something will happen but I don't know what it will be. I am still not convinced that it could be called global warming. So, let those who are convinced argue their case against those who are not. Meanwhile waverers like myself will sit back and wait. Make a cup of tea, throw another piece of coal on the fire – or should that be a log?

References

- 1 Intergovernmental Panel on Climate Change: Cambridge University Press, 1990.
- 2 Fraústo da Silva JJR, Williams RJP: *The Biological Chemistry of the Elements*. Oxford, Clarendon Press, 1994, pp. 512–516.
- 3 Emsley J: CO₂ controversy (letter). *Chem Br* 1995; November: 870–871.
- 4 Winjum JK, Dixon RK, Schroeder PE: Forest management and carbon storage: An analysis of 12 key forest nations. *Water Air Soil Pollut* 1993;70:239–257.
- 5 Williams RJP, Fraústo da Silva JJR: *The Natural Selection of the Chemical Elements*. Oxford, Clarendon Press, 1997, pp 585–586.