

## **A pea in a very big pot**

Few of us will ever see the planet that we walk and feed on from this angle, but as a species we have been to space and we have taken back photographic images and verbal accounts of that vision. Those of us who are not astronauts can trace their flight with our imagination. We might then come to understand what Neil Armstrong meant when he said: *It suddenly struck me that that tiny pea, pretty and blue, was the Earth. I put up my thumb and shut one eye, and my thumb blotted out the planet Earth. I didn't feel like a giant. I felt very, very small.* Against the black space of a universe made up of more than one hundred billion galaxies, the Earth is just a little pea. But the tiny, blue pea that is orbiting the sun on the outskirts of the Milky Way is our home, and it contains more countries than we will ever see, more languages than we will ever hear, and more mysteries than we have time to explore. To begin understanding our place on the pea we must look at how we arrived here in the first place, and why the Earth turned blue and not red like our neighbour, Mars.

From observations that the universe is expanding in time, scientists came to the understanding we know today as the theory of the Big Bang. Models based on this theory and on observations with giant telescopes looking out into space date the beginning of the expansion of the universe to about 13.7 billion years ago. It is supposed that the universe expanded from an infinitely hot and dense initial condition where the laws of physics break down and there is neither time nor space. Nine billion years after the universe came into being, about 4.6 billion years ago, a supernova exploded in one of the spiral arms of the Milky Way, and perturbed a giant cloud of interstellar dust and gas. The cloud condensed and collapsed under its own gravity to form the solar nebula, a giant rotating disc which formed a star and orbiting pre-planetary matter. Particles began to condense and form small proto-planets (planetesimals) which collided to form larger bodies (a process called accretion). These bodies eventually became the planets that we know today. The single most important event in the formation of the Solar System, from the point of view of life on Earth, was the formation of the Moon. It is thought that the Moon is the assemblage of the debris from a collision with a planetesimal the size of Mars. The energy released from this collision melted the Earth and heavier materials like iron sank to the centre while lighter rocks stayed at the surface and eventually formed the crust. Without the Moon the Earth's tilt would vary by much larger amounts and seasonal cycles would become much longer.

This story may not be exactly how it happened, we will never know, but it is the most likely story we have, recreated from observations and inferences based on the physical laws of the universe. It contains some awesome ideas, like the idea of an infinitely hot and dense (i.e. small) point from where you and me, our houses and our planet, *the whole universe*, appeared. It contains the idea of no time and space, *nothing*. It contains a notion of time in billions of years, and it contains a big question about the expansion of our universe. All these ideas are so big that our intelligence stretches to the limit and we are left dizzy from the exertion. It will usually make us feel like Neil Armstrong when he blotted out the planet: very small. If we seize this feeling of our actual physical size in the world, we can maybe for a moment surrender and acknowledge the astonishing way our universe works, as well as the mesmerizing and beautiful patterns it has given rise to. From the level of cell growth and spiders' webs to living planets and spinning galaxies the universe contains magnificent patterns of order and beauty. And, according to our epistemology, we are an interconnected part of all this; when we come to think about it, we are what make all these observations possible in the first place. Observing the patterns and understanding their structure and relations will also further our understanding of our place in them.

Feeling small in this way can be elating but, if we don't get carried away by it, feeling small can also

make us forget ourselves (some might say that this is not a feeling of smallness at all). We have all had moments where we are not stirred by our environment or our thoughts. In these moments we don't *identify*, we simply see the world as it is. It may be walking through the park on a spring day or a moment of quietness before sleep. Then we are not imposing our own ideas on the world, we are just observing it. Careful observation is one of the most important principles behind the scientific method and this is the state of mind we aspire to in our enquiry – we aspire for an objective and reasoned account of our world.

The first thing I remember after realising that collectively we are influencing the global climate was a feeling of surprise. The ozone hole was discovered a few years after I was born and I remember first making the link between deodorants (I didn't know what CFCs were) and the ozone layer. It was a strange thought that this small can was causing what I imagined to be a hole in the atmosphere. Having seen how many cans there are in the world it no longer seems so surprising, but I think it is this link between something small, like our personal use of energy, and something big, like the melting of the North pole, that makes it difficult for people to believe what scientists tell us. Some simply refuse to understand but they are neither objective nor reasoned. Later I discovered that this element of surprise was a consequence of the cosmology in which I lived – it didn't make the connections. Anthropogenic climate change has been going on since the first peoples started playing with fire, we just haven't paid attention to (or ignored) the signs of it. This is not to say that we individually make a conscious choice to avoid these questions, the infrastructure of our thoughts and lives simply didn't regard it to be an issue.

We have long moved past the debate whether physical human induced climate change is or is not happening, yet we are aggravating the problem. We understand the role of carbon dioxide in the greenhouse effect and we think there might be 'tipping points' beyond which much greater warming becomes unavoidable. And still our carbon emissions grow year by year. It seems the structures that underpin our society are neither sustainable nor easy to change, and they leave us feeling powerless in the face of the massive task of changing them. This feeling is maybe more devastating to any action than all the arguments of climate sceptics put together. It makes us feel small but there is nothing exciting about it because we remember who we are and what we stand to lose.

It is this false picture of being part of a rigid, fragmented world that cannot be changed that got us into the trouble in the first place. To build a more coherent and realistic picture we must understand what difference there is between the self-regulating system of the little, blue pea and the self-destructing tendencies of our global socio-economic system.