Points of view

The reason for all the talk of pictures will become clearer as we enquire further. Meanwhile a few more observations regarding epistemology are necessary.

Everything exists *in relation*. Imagine two separate oranges still in an empty space. If one orange moves, increasing or decreasing the distance to the other, it is impossible to say *which* did the moving so long as there is nothing against which to measure the movement. Only if we imagine an apple sitting still next to the oranges can we say that one particular orange moved in relation to the other one and the apple. (What if two oranges exhibit captured rotation moving at similar speed in opposite ends of a circular orbit around a spinning apple? If we imagine this picture so that there be no difference in relations between oranges and apple we might say they were still.) Everything is a complication of this picture. So measurement is always the arbitrary, and *use*ful, division of the relations between things. And however we describe the oranges and apple, whatever picture we use, our description reflects relationship.

As well as existing in relation, things exist *in connection*. Everything is part of something, which we may call systems. Systems exists at levels from neutrons to atoms to molecules to organisms to brains to galaxies. And they are all interconnected. The behaviour of one system at one level may be conducive or damaging to the integrity of another system at any other level. Note that the definition and distinction of *different* systems are, again, somewhat arbitrary. There is constant interaction between systems, making distinctions difficult. Think of the human body. Although one might say the body is separate from its environment, body and environment constantly interact to blur this distinction, organic matter 'from outside' is circulating our digestive system, we breathe the air of our immediate environment, and our thoughts are persistently interacting with our surroundings. Cells in the body are constantly regenerating so that the physical composition of our bodies change many times over a lifetime. There is a continuous flux of energy through the skin to our surroundings (and back). Changes in the environment affect our bodies as well as bodies (and minds!) change the environment. It is highly useful to have the distinction body/environment, and there are obvious boundaries (less obvious for body/mind) along which to draw the distinction, but we must not confuse this linguistic differentiation with reality.

If we accept these observations it follows that *perspective* is all important in understanding our world. This becomes evident when we think about climate change. We may be accustomed to thinking about the world in terms of minutes waiting for the bus, the working week, holidays, years, and events in our recent history, but if we are to understand ourselves in the context of current climatic changes we will have to acquire a broader view.

One example of this circumstance is the changing positions of Earth in the solar system and of the solar system itself in the galaxy. The regular variations in Earth's orbit are known as Milankovitch cycles. The elliptical orbit of our planet around the Sun (eccentricity) creates variations in the distribution of solar energy across Earth's surface (insolation). Along with changes in the 'tilt' of Earth's spin axis (obliquity) and changes of the spin axis around the vertical (precesssion), eccentricity influences seasonal temperatures on time scales from tens of thousands of years to a hundred thousand years. These periodic changes are thought to be related to the intervals in which glaciation occurs. On a much larger time scale some scientists relate a 26 million year periodicity in the rate of extinction, revealed by the fossil record, to the position of the solar system in the Milky Way. The interaction of the solar system with interstellar clouds and dust may lead to periodic disturbances in the orbit of asteroids and comets, causing some to cross Earth's orbit around the Sun at regular intervals. It might have been one such disturbance that caused the impact of the meteorite

which is thought to have killed off the dinosaurs 65 million years ago in the Cretaceous-Tertiary mass extinction. Although such a cosmic event is rare relative to human time scales it serves to illustrate that even a tiny planet, such as ours, is inseparable from, and interacts with, the rest of the universe. And like the last dinosaurs were connected with a giant extra-terrestrial rock, so are we. As the Dinosaurs vanished from Earth, mammals evolved as part of the new ecological niches that appeared.

This example also tells a story about science. Milutin Milankovich was a Serbian mathematician who conceived the theory of how orbital variations affect climate. His hypothesis proposed that summertime insolation at high northern latitudes determine continental glaciation in the Northern Hemisphere. Although he was able to demonstrate the connection between his mathematical theory and the sparse geologic data of his time, his theory was at first largely rejected by the scientific community. Science, as a process of proposing, testing, revising and recreating presuppositions, never proves anything. It is a way of perceiving; it enquires about the relations between our observations. Hypotheses are accepted or rejected on the basis of this correlation. As geological data mounted it seemed consistent with Milankovich's theory; various feedbacks might explain the discrepancy between the scale of the orbital forcing and the climatic responses. It was thus accepted and is today widely believed to explain glaciation. However, recent geologic evidence is hard to reconcile with the theory, and the argument continues. The scientific community operates on the basis of a tradition, and it can take a long time before new ideas reach the mainstream. And sometimes the mainstream actively resists new theories. Scientists are also human beings with reputations and CVs, and it might be hard to face the flaws of the work on which careers are built. Thus, the history of science shows that it can take a long time before ideas of thinkers with the gift of extraordinary vision reaches the collective consciousness.

In the light of these observations it is clear that any change in a state of affairs will depend on the perspective adopted and what measure of scale is used. The World Meteorological Organisation suggests that average climatic conditions over a thirty year interval be used to measure climate. Climate change, in this perspective, is the difference in average conditions between two such intervals. However, there is no fixed standard, no 'normal climate', in assessing variations. All we can say is that climate change is occurring in relation to the 'average climate' of this or that time. Making such comparisons will reveal a trend against which we can judge the current climate. Earth's climate has varied immensely from the time the planet was formed to the evolution of life and an oxygen-rich atmosphere, and temperatures have fluctuated in response to a variety of conditions on Earth.

It is in this regard that perspective becomes all important because it is the background against which we understand the present. What does a 0.6 °C increase in average global temperature during the twentieth century mean? Looking a few hundred years back it may seem to be a recovery from a colder interval. Going further back it could look like a fluctuation in a cooling trend from a temperature peak in the Holocene Climatic Optimum. But in the context of temperature fluctuations in the longer periods of Northern Hemisphere glacial intervals we are already in a warm interval. The Intergovernmental Panel on Climate Change (IPCC) calls the warming trend 'abrupt' in the context of the last millennium. Changing perspective naturally changes our view of the picture. As a species our well-being is connected to the health of the biota, so it makes sense to adopt the perspective of the planetary condition(s) in which life thrives. And indeed, this is our perspective here.

Understanding present climate change is unfortunately more complicated than comparing temperatures over time. Climate is effectively the distribution and recycling of energy across Earth, and some

understanding of the interactions between the various natural reservoirs involved in this process is necessary. The functioning of Earth is an intriguing process to watch and it might reveal invaluable principles of organisation. Earth, perceived as a large self-regulating system, is capable of maintaining a steady state, a stable condition, in which life thrives. This is no small wonder in a universe which embodies the laws of thermodynamics. The processes involved in climate change are further complicated by human activities which amplify or diminish their effect. It is beyond doubt that the change in the chemical composition of the atmosphere resulting from deforestation and the combustion of fossil fuels leads to higher average global surface temperatures (this is 'global warming' which is different from the natural fluctuations in the climate system). So to understand climatic changes we must also look at why human beings burn fossil fuels and chop down trees.

And so we return to the pictures of pictures of the human condition.