S & CB (2002), **14**, 181–182 0954–4194

CORRESPONDENCE

Some Thoughts on Causality and Design

"We are accidental tourists as we cruise through Nature in our bizarre way." (Ian Tattersall, Scientific American, Dec.2001)

Because mutations happen at the molecular level they exist in a world dominated by random thermal energy – which not only drives the diffusion (ie transport) processes in the living cell but enables ligands there to dock onto receptors and off again, molecules to wind and unwind as in the processes of gene replication and translation and enables the chemistry of life to take place. At environmental temperatures this motion is not strong enough to destroy the integrity of molecular and cell structure. Typically the thermal energy of a molecule at environmental temperatures (25 dec.C) is 2.5 kilojoules (kJ) per mole compared with some 350 kJ per mole for covalent bonds which hold molecules' structures together. Bonds such as the hydrogen bond responsible for molecular interactions in the cell need 4kJ per mole to break them which explains why their thermal energy can do this. So thermal energy is 'just right' to preserve molecular integrity and to promote molecular activity. Without thermal energy (ie. zero at absolute zero temperature) nothing would ever happen; it makes 'all things possible' at the molecular level giggling the cell into life in producing the perpetual motion and reactivity of its molecules. It drives what we may call molecular causality.

Gene replication is a special case in that DNA has the remarkable ability to replicate itself immortally and in this way its effect emerges at the macroscopic biological level by this process of binary multiplication. Test tube chemistry produces effects in the 'real world' by bulk averaging of numerous molecular reactions. A back of the envelope, order of value, calculation helps us appreciate this. A single change/mutation (caused by thermal energy) in a gene in a single egg cell will, by replication of this cell, appear in the 10^{12} cells of our bodies. If the change say modifies an enzyme molecule of which there are typically 1000 in a cell, and we assume that the gene expression for this enzyme occurs in all cells to this extent, we will have 10^{15} molecules of this enzyme. Assuming its molecular weight is 10,000 and using Avogadro's number this means we have almost a milligram of this molecule in our bodies. In this way a change in one molecule has produced a macroscopic effect by a process of linear replication. In test tube chemistry you start with a milligram to get a milligram. Here there is a loss of the individuality of each reaction in the bulk billing of the total macroscopic effect. In DNA chemistry uniqueness is preserved in a process of genetic causality.

Random thermal mutations are vital to the evolutionary process. If replication was infallible then the earth today would be covered with clones of the single celled organisms from whence we came some three aeons ago. Because on

average an 'error' in replication occurs about once in a million, this makes for the possibility of change, and the kind of novelty this produces through the natural processes of selection, results in a diversity of creatures like you and me.

Unfortunately words like 'error' and 'accident' have gripped the imagination of people like Tattersall and Monod ('Chance and Necessity') whereas the real interest should be in the design features of the natural universe of which random thermal motion is part.

Billiard ball causality inflexibly tied to Newton's Laws of Motion happens in the macroscopic world determining the paths of planets and the motion of machines where the effects of thermal energy are normally totally insignificant. Motion is completely predictable undisturbed by the vicissitudes of thermal energy. Having said this I am reminded of a paper I read in the American Journal of Physics many years ago which calculated that after some 13 collisions the final trajectory of a billiard ball would be unpredictable by several degrees due to the effect of Heisenberg's Uncertainty Principle, supposedly only of significance at atomic levels. More recently Roger Penrose has argued that this same Principle may directly effect the actions of our neurons and hence the way we think. Remembering too that in the quantum world phenomena such as entanglement enable effects to travel faster than the speed of light, we can appreciate that quantum causality may have effects in the 'real' world.

The design arguments of Paley some 2000 year ago took the causality of the Newtonian universe and applied it to living systems. But you cannot compare the design processes and operation of a watch with those of the eye, the latter originating in molecules of DNA not in the watchsmiths workshop. So for Dawkins the designer is not supernatural but a 'blind watchmaker' where the design features are to be found in the natural processes themselves.

Theism can fit into this picture through a natural theology where God works according to His own natural laws rather than according to the arbitrary will of Allah. It is through the emergent phenomena of the former that we see the hand of the designer or architect (to use a Biblical word) fashioning the world through His own natural laws.

In this comprehensible universe, Dembski's idea of 'intelligent causes' suggests that the watchmaker may not be so blind after all. In this case we may perhaps be forgiven for suggesting that, instead of regarding ourselves as 'accidental travellers', we might turn out to be more like 'happy pilgrims'!

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