

Cosmic Beauty: Between Symmetry and Asymmetry

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In the beginning, around 14 billion years ago, the universe was infinitely dense and hot. This singular moment is called the big bang. However, there was no bang. There was just this initial state of perfect unity and symmetry which, all of a sudden and within a fraction of a second, was lost. Since then the universe has been expanding and cooling, and during a long history of continuous creation the world we live in took shape. Creation is the unfolding of the many from the one. Physically speaking, this happens through a chain of broken symmetry. The first break of symmetry to take place was the unfolding of the presently-known four fundamental forces of nature, which in the very beginning were indistinguishable. Next was the loss of symmetry between particles and antiparticles and the loss of democracy among the various species of elementary particles. Particles and antiparticles of all species had been equally abundant in the beginning, but with falling temperature and density antiparticles were annihilated, and heavy particles got too heavy to be created in the primordial soup. But note, we are still within the first second after the big bang. Only half a million years later, the first atoms were formed, launching the macrocosmic evolution of growing differentiation. Tiny inhomogeneities in the primordial density distribution led to the collapse of gas clouds and the birth of the first stars and galaxies. Several generations of stars had to pass until the first planets could form. Even the late phase of evolution may be subsumed under the general topic of broken symmetry. For the evolution from symmetry to asymmetry is not so much a course from order to chaos, though symmetry is of course related to order, but one from the undetermined to the determined, the general to the special, the potential to the actual. Cosmic evolution is bifurcating, taking a decision, breaking a symmetry at every moment.

But there is also an evolutionary course in the opposite direction, a virtual way back to the initial symmetry. At least on one of the planets, planet Earth, and possibly elsewhere in the universe, dead matter began to organize itself into ever more complex life forms, building up new order on the background of environmental chaos, building new symmetries where symmetries had been lost. At a certain stage of the evolution, the mind appeared. The essence of the mind and consciousness remains enigmatic, but their effect is essentially to provide us with a model of the world. Our attempt to understand the world is also an attempt to understand its origin, our origin. Philosophical reasoning and

scientific experiment are leading us on a virtual path back to that initial state of perfect unity and symmetry called the big bang. Thus human life is part of a cosmic oscillation from symmetry to asymmetry and back to symmetry. And such is also our sense of beauty. Chaos is ugly, order is beautiful. Or is it? Not quite. Perfect order, perfect symmetry is lifeless and is rarely perceived as beautiful. Life is the result of symmetry breaking and symmetry building; the mind is the striving for symmetry. Perfect symmetry is a singularity, an ideal like a Platonic form, never a reality. But the tension between symmetry and asymmetry, between the ideal and the real, which might also be viewed as the soul of the world...is it not precisely the source of our sense of beauty?