From Clouds to Chaos

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In a lonely, late-evening stroll I got lost in memories and absorbed by the seemingly rich surroundings. I thought about chaos, figs and their tiny seeds. I thought about time - did it glide smoothly or hop discretely like a sequence of cosmic motion-picture frames. I thought about clouds, their hues and their flow. Clouds represent one side of nature that mainstream physics had passed by, a side that is fuzzy, detailed and unpredictable. I being a physicist thought about such things quietly and unproductively.

For a physicist, finding particles theorized by super symmetry, such as the Higgs Boson, at the LHC is a legitimate problem; solving the Riemann conjecture, understanding dark energy, questioning the Baryon asymmetry and thereby questioning our existence and the origin of our universe are all serious problems.

In the early 1900s, Einstein, with his theory of general relativity revolutionized the entire idea of absolute space and time. He said that space and time are warped by mass. Later on, quantum field theory emerged which eliminated the Newtonian dream of controllable measurement process. In the end of the 20th century, the field of high energy particle physics emerged. A whopping amount of 7.5 billion Euros was spent to makes the world's largest particle accelerator- The Large Hadron Collider at CERN in Geneva. But around the same time a new science called Chaos and Non-linear Dynamics emerged silently and went unnoticed.

I get an eerie feeling, on realizing that chaos could lead us to answering the ultimate questions on our existence. Believers in chaos (I could call them evangelists or converts from classical physics) study systems like the random dripping of water from a tap, the formation of clouds, the fluctuating population of non-elephant animals, wind currents that stir the grass and those which cause cyclones, turbulence in water bodies, neural and blood

capillary networks and all other finer details of human scale science.

I find it very difficult to resist my temptation to say Chaos is in all of nature and science is inherently non-linear. Chaos is not just randomness or entropy. Chaos is the exponential sensitivity to initial conditions. This means that a small error in the initial state of a system can cause results which are dramatic. This is popularized by the butterfly effect which goes as follows: The flap of a butterfly's wings in Brazil can set off a tornado in Texas.

Everything in the universe that we know, are linked and entangled. An effect is a cause for another. A famous physicist says:

Big whirls have little whirls that feed on their velocity
And little whirls have lesser whirls and so on to viscosity

In the beginning, our universe was point energy. The terms inside and outside had no significance, for it was just a point. However at time zero an error occurred. The universe grew from a point to the size of an apple in less than a fraction of a second. The error was an asymmetry (called the Baryon asymmetry). The particles outnumbered the antiparticles. If their numbers were equal, it is more likely that they would have annihilated. But it didnt happen. This error amplified as time evolved, giving rise to a rich spectrum of manifestations. Life is yet another error which occurred much later. And today as we speculate about our origins errors still amplify. To make things worse here we are, the human system trying to understand ourselves thereby falling into a loop.

I do not know the deeper reason behind that error. May be it is in hands of God, or may be a newer generation of errors would find that out. It may even turn out to be a question that is not to be asked, as it once was. All I can do is to wonder. All I can say about nature is that it is infinite, indefinite and indescribably beautiful.