



### On Being

Lying back on Brooklyn Bridge, appreciating the skyline of New York in its fragile beauty and skyscraping architecture, having Alicia Keys in my ears, I hold in my hands Peter Atkins's most recent book *On Being*. What an extraordinary moment, since the book shifts the view on the origin of architecture and culture, on organisms and human existence, and expands my mind to both the origin of the universe and its end. New York, visualized through the distinct eye of Atkins, expresses its stone-printed fight against entropy production in form of matter and energy that tend to disperse in disorder.

The reader recognizes that the Second Law of Thermodynamics is the favorite law of Atkins. It acknowledges—even if none of the mathematic entropy-expressing equations is illustrated in the textbook—that matter and energy tend to disperse and disorder. Left to itself, matter crumbles and energy spreads. The astonishing thing is, according to Atkins, that this natural spreading can result in the emergence of exquisite form. If the spreading is captured in an engine, then bricks may be hoisted to build a town. If the spreading occurs in a seed, then molecules may be hoisted to build an orchid. If the spreading occurs in your body, then random electrical and molecular currents in your brain may be organized into an opinion. Atkins outlines that the purposeless spreading of matter and energy in even greater disorder is the root of all change. The author insists that even when that change yields to the formation of a biosphere with living organisms or results in seemingly purposeful action the underlying spreading of matter remains purposeless. Purposeless decay as expressed in the Second Law of Thermodynamics is the origin of it all.

Our understanding that thermodynamics are crucial for deciphering the entropic driving force of life has advanced due to the work of Prigogine. But Atkins is right in being convinced and optimistic that the physical sciences in general can be applied in an even wider context to the great questions of beings, such as the origin of the universe, the emergence of life and the ends of both. The scientific method should even be used to do so in order to replace myths that surround these great questions of beings.

The inception of the universe by the Big Bang has been addressed in many popular textbooks and is consequently not entwined by Atkins. Instead,

and this is unusual and of particular interest, he puts thoughts into space and time before the Big Bang. Doing so, he does not present a theory of any ex nihilo creation of something out of nothing. He interprets the formation of the universe as a separation of a formerly mixed state. To give a first example: for electrical charges to exist and for the overall charge of the universe to be zero, there must be an equal number of positive and negative charges. Before the Big Bang, there was no charge. But instead of creating the charges out of nothing Atkins hypothesizes that the formation of the universe was accompanied by the separation of 'no charge' into opposites. Charge was not manufactured, electrical 'nothing' was split into equal and opposite charges, instead. A second example describing the angular momentum goes similar. The third example concerns the total energy of the universe and this example requires particular attention: Atkins underlines that the overall potential and kinetic energies of the universe, which sum up with the energy due to the mass of all galaxies is equal to the energy due to the gravitational attraction between all components of the universe. This gravitational contribution reduces, according to Atkins, the total energy of the universe to zero. For the beginning of the universe energies were thus separated, not created. These separations still require explanations, but it is less overwhelmingly fearsome than the process of positive, specific, munificent creation.

In the following chapters Atkins lines out how chemists currently decipher the reactions that form prebiotic molecules. He describes evolution by natural selection as the random generation of successful junk, instead of the purposeful acquisition of complexity. Humans are not the apotheosis of creation; they are better interpreted as top junk churned into existence as matter and energy unwind. In his language life is the avoidance of a certain kind of equilibrium, death is the usually unwilling achievement of that equilibrium. Atkins emphasizes that not only we are stardust, we are the children of chaos.

The book *On Being* is ideal for dispersing one's mind sitting on Brooklyn Bridge. In the universities library, however, students should choose Atkins's textbook on Physical Chemistry.

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