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Science Can Still Captivate Us All

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The BBC broadcaster and highly esteemed David Attenborough has repeatedly expressed that "I don't know any child that's not fascinated with the natural world", a comment practically invariably followed by his believe that such fascination sadly wanes out as we grow up. I partially disagree in that it is not only children who are fascinated by the natural world. In fact, David's documentaries about the natural world are yet to stop captivating audiences of all ages.

To highlight my – only partial - disagreement I will share with you a little of my own experiences in this respect. For example at social gatherings, dinner parties and the likes, when the persons next to me ask me "what do you do?" and I boringly respond that I'm a molecular biologist - if they do not immediately rush to the toilet to never coming back – there is a short silence followed by the "one-needs-to-be-a-genius-to-do-science" comment. Yet, after a while, and/or a few drinks, I find that most grownups are still captivated by nature, whether it is the environment or astronomy although rather by biology and biomedicine. My wife (hardly ever) complains that I seem to divert nearly any conversation into the scientific field, something that I do not necessarily agree with but I would be open to experimentation with controls on that adjudgement. To the extent that I feel it is rather the other way around: people are *naturally* curious about the natural world and themselves and thus they divert *me*, unwillingly but not resisting, and so to explain some of the most exciting, like David's documentaries, wonders of biochemistry and molecular biology. Moreover, they (particularly children) often ask good questions, such as "why do we *have* to die?", "why we age?", or "why do we get sick?"

Indeed, down at the molecular level, living organisms are not less enthralling, and, in many ways, mysterious than the majestic blue whale, the incredible sound imitating talent of the lyrebird, the clever cracking nuts chimps, or the way that some species of orchids lure and cheat on bees or wasps who (unsuccessfully) try to mate with them – these orchids have figured out how to fiddle the exchange of expensive nectar for assisted reproduction (AR) and instead they exchange *virtual sex* for AR.

In the last century we have unravel to understand the biological systems in more detail than anybody in the previous billions of years of life on this planet. And yet there are many questions to be answered. In fact, what happened about 3.5 billion years (give or take a few million years) that gave rise to the first living organism(s) on Earth is by far the largest mystery of all. And although we, by now, know the components of living organisms, we are still far from starting life from scratch. This is due to the complexity of living organisms, whom have had thousands of millions of years to get things *right* through the astounding process of evolution.

Nevertheless, despite the perplexing complexity of living organisms, life scientists are not abated, au contraire, there is no better times to understand living organisms as now. Just like the natural world documentaries, it all began with *explorers* visiting remote or unknown places, often bringing back *samples* as *trophies* to be studied in zoos or natural history museums, or simply decorating palaces. These approaches eventually moved to the natural world itself to study it *in situ*. Likewise, biochemistry has moved from trying to understand biological reactions out of the cell, in bubbling test tubes as depicted in films, which reminds the wasp and the orchid story (above), to try to understand them *in situ* – in actual living cells or organisms. Not satisfied with this, biochemists and molecular biologists are learning the way to manipulate such reactions in living organisms in an unprecedented manner. The emerging fields of synthetic and systems biology are living proof that we are on the verge of controlling organisms at

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will, for example to produce medicines or materials for the benefit of our societies and humankind at large.

One of the fascinations of studying biological systems at the molecular level is that the barriers of *species* play significantly lesser roles. We can take one enzyme from one cell - as a gene or the gene product - and transfer it to another one, whether these cells have been originated from a plant, bacterium, diatom, elephant (a long-gone mammoth, even), or human is not quite as important as to understand and manipulate their functions. Already, we are beginning to control gene expression, to activate protein-protein interactions or even behaviour by light (a whole new field called optogenetic), use RNA as enzymes, use a protein that glows like a star (sensor) when an specific event occurs inside the cell, to mention but a very few, and all this by activating (or inactivating) cell components with ease as apps in an iPhone.

Indeed, following the development of super-computers and high resolution microscopy, a small compound entering the binding *pocket* of a receptor can be *seen*, and thus improve the compound's design by bioinformatics analyses e.g. creating better and safer medication. Modelling disease conditions using cells, organoids and animal models, soon 3D printing of mini-organs too, let us to understand ourselves rapidly and effectively. And do not forget too, the reversal of differentiated adult cells into stem-like cells, which has major impact to replenish and repair damaged or ageing tissues.

My main interest, besides hoping to one day clone a dinosaur, is into the deeper understanding of how cells work, and knowing this, to programme them so they create whatever we want them to. Imagine algae-powered cars, bacteria generating electricity, viruses that attack our worst enemies - nasty slimy bacteria, or pets that live as long as us… and what about us living still longer?. These are not the delusions of biologists under the influence of natural ingredients – biochemical - such as those in coffee or cacao; they are areas of scientific research that are quickly becoming reality. You will find more information regarding such topics if you periodically read this journal and the remarkable commentaries by its editors.