ESCAPING INTO THE FUTURE

A self-conversation on innovation in arts, science and technology

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What is the relationship between science, technology and art for you?

All three activities revolve around the idea of research, exploring the new, the not-understood and the not-yet-created. However, the manner in which research is conducted in such areas is different. Science operates by a method consisting of variation + test of a given hypothesis that can be proven incorrect at any time thereafter. Technology does not search for ideas that have general value but for implementations derived from scientific evidence that work here and now for a particular purpose. The technologically-based art may allow the use of technology decoupled from its function or reliability, thus opening the path to innovative (yet apparently useless) breakthroughs. In this aspect artistic production is more akin to that of science: a scientist rarely asks whether a given research is useful; instead curiosity and instinct lead him to identify issues of potential interest.

Are there shared goals between your work in science and art?

For my choice at present the two types of work are separated in practice. However, their distance measured on the scale of my mental approach is diminishing steadily, with an acceleration that was evident especially in the last year. The reasons for this separation have more to do with the division of roles in society than with intrinsic factors. For example, to show my work as an artist in the scientific world would undermine my credibility as a "serious" scientist; on the other hand, the art world, although more easily dazzled by science authority, would not consider me as a "pure" artist, a widespread "meme" – crediting Dawkins for the use of such term. Contamination between the two areas, although seemingly urgent under the pressure of fast computer literacy and technological society, is still epidermic and very unbalanced in favor of science. Indeed it is art that requires more science rather than science to seek greater input from art. The balance is shifting from day to day, so that we might fear future extinction of artistic products and thought as we know them, when we instead should work on a merger plan. The merger will be positive sum, in the sense that benefits to science will not be detrimental to art or vice versa, but both science and art will immensely benefit from an osmosis. To return to your question, the contact point between the two disciplines is *innovation guided by speculation.*

Q: Specifically, what is innovation in science?

Innovation, in its broadest sense, consists in the discovery of new phenomena or processes, or in highlighting applications of a discovery not yet identified. We know that Heron of Alexandria at the peak of the Roman Empire invented the steam engine, the Aeolipile, but his discovery cannot be categorized as innovation: to this aim it would need to be recognized as a vital new development paradigm. The science that I

am more deeply into, cosmology, is no exception in the landscape of contemporary science.
There are *known unknowns*: that is to say, there are things we know we do not know. But this does not necessarily jeopardize our general understanding of the phenomenon under study. For example, we miss the fine details of how a galaxy or a star form, but we do not doubt that our theories describe the global properties of these objects with sufficient precision to interpret the experimental data. No need to know how many hairs on the body has a hungry lion to understand that it is better to stay away! Clearly, understanding the details is intellectually stimulating; in addition, history of science shows that understanding these "details" has led to great changes in the scientific thought (textbook examples are the theory of relativity and quantum mechanics).
However, there are fundamental questions that do not fall among the known unknowns. Examples are the nature of dark matter and the origin of the mysterious vacuum energy that accelerates cosmic expansion; the nature of gravity and its thermodynamic interpretation; the consequences for the space-time; the theories of the holographic universe and the multi-verses. Many aspects of these questions have a strong impact for the *future* evolution of the cosmos. Why should we be interested in the future of the universe, when cosmology has always been devoted to understanding its origins to explain its current structure? Moreover, does it make sense to worry on how future, likely buried in the depths of cosmic time, may look? I argue that innovation should push forward the frontiers of imagination based on trust of the intelligence by which mankind is endowed. Even today we have supercomputers (such as the Jaguar by Cray) that allow a number of calculations per second equal to those of our brain. Developments in technology in the next two to three decades will be impressive, as we have never witnessed before.

Q: Isn't the future the field of science fiction?

Most of our visions of the future in fact come from imaginative writers as Verne, Wells, Asimov, Clarke and many movies on the subject. However, making predictions is the core activity of science. A scientific theory is more valid and useful as many *falsifiable* (à la Popper) predictions can produce. Predictions are then imprinted in science's DNA. Investigating how our universe will evolve in the future relying on the whole arsenal of sound physical knowledge available to us is therefore a plausible claim. Some of these predictions are not falsifiable directly by *ourselves*, but our descendants will be able to do so (if they are still interested). Although some degree of internal consistency can always be verified, a theory about the future does not qualify as totally scientific. However, the price of this loss will be amply repaid by the immense usefulness of that theory as a guide to the many critical and strategic choices that our species will be faced with soon.

Q: What are the consequences for the evolution of the human species?

Some questions about our future seem crucially wire science, technology and evolution in a Darwinian sense. From the first sequence of DNA synthesized by nature, we have come to our brain, the most sophisticated machine in the known universe.

However, there is no reason to think that it will be the last. Evolution will continue without stopping in ambition to create more intelligent beings. Our brains, based on the transmission of electrochemical signals of very low speed, cannot go beyond a certain computing power, a limit that machines will surpass shortly. At that point the machines, our descendants and allied, will further evolve intelligence on silicon rather than organic substrates (with obvious advantages relating to strength, durability, reliability, accuracy, size, speed etc). The intelligence will then expand, detached from its support of wet DNA, ribosomes, proteins, cells, and neurons, to make the whole universe its home and a repository of usable energy (nuclear fusion of hydrogen, stellar radiation, gravitational power from black holes and other compact objects) and matter (interstellar solid objects, like dust and asteroids, rich in chemical elements necessary for the development of nano-tech objects). It is therefore important to find answers to the following questions: Are there traces of advanced intelligences from other planets and, if so, why haven't they been already identified (the Fermi paradox)? Are we ourselves and the whole universe the result of a much more developed intelligence? What type and amount of resources will be available and what technological difficulties will arise in their use? The technological means we will use to travel into deep space will depend on the development stage of nano-technology. Perhaps the biggest mistake we can commit in predicting this already near future is to think that exploration has to be conducted by humans with the bio-soft structure we know. Instead we will perhaps send replicating nano-assemblers.

Q: Why innovation should have a value in art?

From the foregoing a strong link emerges between innovation and intellectual challenges that science and technology (in its engineering declinations of bio- and nano-) propose to us from today. Art *must* be part of all this; even worse, it cannot afford to be excluded. Before any consideration of aesthetics, art has as its main aim the production of *perceptual stimuli*, whether sensory or cognitive. In a reductionist sense, art is therefore a vehicle of knowledge that connects the user with new (sometimes disruptive) elements with respect to those part of his previous experience. As such, it is also an instrument of innovation. Its value is twofold. On the one hand freedom from variation-selection mechanisms allows the design of impossible realities: examples in virtual reality (or better yet "real virtualities") today are growing increasingly common. Moreover, in its path it can afford to rebuild the world following laws that are different from natural ones, helping to experiment solutions which nature could not prosecute (due to the stratified nature of evolution) and that eventually technology will implement, if useful. The second, and perhaps more important, value is to contribute to the understanding of the future we run into, for which there is an urgent need to prepare ourselves. The challenges ahead will require decisions orders of magnitude harder than those taken so far, and to be made on much shorter timescales, given the exponential acceleration of technological development led by super-intelligent machines. Providing us with a glimpse of this future and triggering a broad and comprehensive discussion on ways to tackle it is the biggest challenge facing contemporary art. This challenge holds the promise of finally reunite art with her twin sister, science.