# TECHNOLOGICAL EVOLUTION AND CREATIVITY

*"And Strange to Tell Among that Earthen Lot,*
*Who is the Potter, Pray, and Who is the Pot?"*
***Omar Khayyam***

As Kurzweil and Gell-Mann, among others, have argued, the development of technology is an expression of evolution. In fact, technological growth exists at the leading edge of evolution. What's more, technological evolution is moving faster than biological evolution and the rate of change is increasing. Kurzweil proposes that the evolution of information technology, in particular, obeys the "*law of accelerating returns*," whereby advances that occur feed back into the total Gestalt of information processing devices, contributing to further evolution. It is an accelerative positive feedback loop.

Yet, even if technological evolution is accelerating, would we want to describe it as a creative process? How can machines be creative? How can machines, in fact, drive their own evolutionary development since humans are integrally involved in the creation of machines? Don't humans guide the development of machines?

One opening point to keep in mind in answering these questions concerns the nature of evolution. As described above, the history of evolution involves novel emergent forms often arising through the synthesis of simpler constituent forms. Evolution in its creative thrust moves in the direction of increasing complexity–and one could also argue–in the direction of increasing intelligence and creativity; successive products of evolution speed up the process of evolution. Hence, even if humans are integrally involved in the creation of machines, the technological systems being produced could in fact turn out to be more complex, intelligent, and even creative than the biological systems (us) that were involved in their creation. The created can exceed the creator.

The contemporary writer, W. Brian Arthur, has recently proposed what I would describe as an ecological theory of technological evolution and creation. New technologies emerge through the combination and functional synthesis of existing technologies. In fact, for Arthur all technological innovation is really just combining together existing technologies into novel configurations. Note the similarity with those theories already reviewed which describe creativity as a synthesis of existing elements; the same applies to technology. (Competition and a "*natural selection*" process invariably refine the products further).

Continuing this comparison with biological evolution, Arthur treats technology as an ecosystem consisting of a plethora of "*technological genes*". Instead of imagining each machine as a distinct and separate reality, imagine instead that the universe of technologies is a pool of various techno logical elements (genes) that are used to create new machines; the same technological genes (for example, the wheel or the circuit) can be used (or form part of) numerous different machines. And therefore, each time a new technology is created it enters the gene pool of available technologies to be potentially used in the creation of other technologies.

Further, the technological ecosystem forms a hierarchy of parts within parts, just as individual machines usually consist of sub-components which in turn consist of smaller components. The technological ecosystem is a vast and ever growing reserveof component genes to be combined together in ever more complex configurations. Yet, even if there are innumerable and varied parts out of which new machines can be built, a machine only achieves reality if its parts form a functional whole–if the parts work together to efficiently realize some purpose. Functional machines–like creative ideas–are holistic and efficacious syntheses. Moreover, though the raw material of technological evolution is provided by the gene pool of existing technologies, in synthesizing parts, there is invariably tweaking and modification of the parts so they harmoniously work together as a whole.

At this point we come to the significance of humans in the process of technological evolution. Based on the ideas of Andy Clark, I would propose that humans are "*natural born cyborgs*". Since the beginning of tools and other instrumentalities, humans have been functionally united with their technologies to realize their purposes and ways of life. The human and the machine is a functional Gestalt; there is, in fact, no human without the technologies. Everything humans do involves either the direct involvement of technologies or the support of technologies.

We are technologically enhanced beings that exist in a technologically enhanced environment.

One could argue that humans guide the creation and use of machines, but this is too one-sided a viewpoint. Technologies provide affordances for human use, that is, opportunities for action or the realization of ends, and humans are influenced and guided by the technologies at their disposal. Technologies are not value free or neutral. Further, we increasingly use technologies to create new technologies; that is, the creator is clearly no longer just the human but the cyborg. And in both regards, technologies often present unanticipated effects that go beyond what the human creator envisioned. Hence, there is a novel and creative aura surrounding the ever-growing sphere of human-technological systems.

Consequently, if we are to accurately describe the creative evolution of technology we should see the process more as the creative evolution of cyborgs or functional syntheses of humans and machines. All of Arthur's main points still apply, only now we bring a new component– the human–into the ecosystem and gene pool. Humans, of course, are creative in this evolution, not only getting ideas for new inventions but stimulated and informed by knowledge of existing inventions. But it is undeniable that the tool informs the user. We may ask who indeed is the user? Are not humans the vehicle for the re-production and evolution of machines? We are being molded and transformed in this process as much as the machines are, and the machines clearly contribute to the overall technological evolutionary process as much as humans do.

There is, indeed, creative evolution in the world of technology.

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