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Bringing live into future architecture / disartificializing architecture

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Summary: The greatest challenge of today and our future is the dwindling resources of our planet. If we hold dear the endurance of our species, humankind must radically change it´s behavior, which includes not only our way of life but all human technology and our artifacts of production. By embracing a study of bionics, new paths may open up that will lead us closer to our goal of sustainable development. We do need not to copy nature, but to be nature itself.

Keywords: *Biomimicry, Living Architecture, Synthetic Biology, Tissue Engineering*

ABSTRACT

Nature has always been an example for humans on different levels. In particular, it has played an immense role on our technological achievements. The development of human technology, however, has emerged in major parts to produce artifacts based on human logic and understanding, totally disconnected from natural evolution and its selective, design driven forces.

To reconnect these two diverging systems, the motivation behind the study of bionics - to learn from nature how to design technical systems and constructions - is directly comprehensible to anyone: the latest organisms, constructions and structures we see today are the result of our planet's 500 million years lasting improvements on itself. Understanding these systems is of major scientific interest, since we can learn about their uses for structural or functional devices. [1]

Due to the increasing costs of energy we need for heating and cooling our buildings, architects and engineers seek smart solutions in nature which deal with similar or equivalent problems, only in a different way. Usually, we answer these requirements by using an enormous amount of technical investment (for air ventilation, energy recovery or filtering etc.) Nature solves these requirements with smart, low-tech solutions, which have proven their mettle over millions of years.

Yet, there seem to be some crucial differences between natural and human thinking which prevent a one-to-one transfer of natural optimizations to human affects. Despite all efforts of achieving nature-like efficiency, artificial human technology has not been capable of equivalent performance. Spider silk, for example, has never been artificially reproduced and its physical attributes have, to this day, no man-made counterpart.

It´s here that there seems to be a basic need to rethink the whole bionic idea and take it one step further. By reassessing the significance of biological studies in our technological research, we will unconstrain our technological achievement and enter a new era of development and human production. Taking the step away from human artifacts (which all our creations have been from the beginning on until today) to "designed biology" will drastically change the performance of our inventions and will be the most important step to solving almost all existing disadvantages human technology has to face today.

Synthetic biology means to actively engage ourselves with genetically programmed organisms, disassembling and classifying all of their DNA sequences and reorganizing them by our own needs and imagination. Today´s science is capable of combining DNA segments originating from different life forms. In this way, the DNA sequence responsible for bioluminescence in bacteria can be implemented in the genetic code of a rat to make it glow at night.

In addition to reshaping and reorganizing existing life forms to new and suitable designs by manipulating their genetic code, there is second approach. Originally developed for medical purposes, the science of tissue engineering will enable us in the nearby future to create organic tissue and even organs to our wishes and needs.

At the Stuttgarter Fraunhofer Institute IGB, there exists the first fully automated organic tissue manufacturing site to produce organic tissue in growing amounts for the demands of the pharmacy industry. Also, the Helmholtz-Institute at the RWTH Aachen has successfully tested a process of creating an entire cardiac valve by means of spray casting technology.

The fact that organic cells are similarly configurable to other artificial materials enables us to use known production mechanics, such as rapid prototyping, for cellular deploy- and arrangement. This simple way of mastering complex geometric structures with the help of digital tools seems promising, as well as manageable.

We will have to consider different ways of making structures and materials with life-like technologies, such as protocells, to ‘grow’ more ecologically compatible buildings in the future. [3] This would finally enable us to design materials and structures and even entire organisms using all the advantagse of natures evolution regarding optimization and efficiency.

Multifunctionality, adaption to external surrounding parameters, optimized energy consumption, direct and indirect use of sunlight energy, temporal limitation instead of outlasting artifacts, total recycling abilities, self healing, growth and self organization are just a few of the imaginable parameters awaiting us.

References

[1] Braun, D. H., *Bionisch inspirierte Gebäudehüllen*, Dissertation, University of Stuttgart (2008)

[2] Nachtigall, W., *Das große Buch der Bionik, Neue Technologien nach dem Vorbild der Natur,* Dva (2003)

[3] Armstrong, R., *Living Architecture, How synthetic biology can remake our cities and reshape our lives,* TED Books (2012)