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Design and Evolution: Morphogenesis and Metamorphosis

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Abstract:

Conventional wisdom asserts that human designers are responsible for shaping the artificial world, and evolution is responsible for shaping the natural world. However, we may begin to notice something strange is afoot by looking at various inanimate objects in Nature, systems that are ‘designed’ right before our very eyes. The weather presents a host of fascinating examples, such as intricate and very beautiful snow crystals, powerful hurricanes and tornadoes, elegantly sculpted rock faces, and other curiosities. The form, or morphology, of these objects has been the subject of various disciplines of the natural sciences for decades and even centuries. Hence inquiring minds can now find satisfactory explanations of how these systems came to be, why they look the way they do...what they are doing here.

The important thing to note, and the theme of this paper, is that no conscious designer is needed to generate or guide the design of these objects. They are literally ‘forced’ into the forms we observe. So the term ‘design’ is not quite applicable. We need to be able to talk about their structure, and how that structure changes over time (or ‘evolves’) without reference to a designer. In place of the term ‘design,’ we can use a more heady scientific term, ‘morphogenesis,’ which literally means how physical structure is created.

But what shall we say when speaking about artificial design, where human designers deliberately design new things? Is design in the artificial sense really any different from design in the natural sense (morphogenesis)? The thesis of this paper is that the answer to this question is ‘No,’ that natural design and artificial design are really the same thing at their core, driven inexorably by the affordances of dynamic systems, and not by individual designers. Taken to its logical extreme, this argument suggests that there are no designers, only morphogenesis, and no evolution, only metamorphosis.

In order to build this case, however, we will need to take a dramatic survey of the natural and artificial worlds, borrow ideas and terminology from a wide range of disciplines, and stake out some entirely new ground of our own. The end result is a vital new way to view the world around us, with potentially dramatic consequences to our understanding of the natural world, and how we ought to shape the artificial world.

Conference theme: “evolution and design history”

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Jonathan R.A. Maier, Ph.D. is currently a Research Associate in the Department of Mechanical Engineering at Clemson University in Clemson, South Carolina, USA. His research interests broadly include design theory and methodology. In particular, Dr. Maier is a leading proponent of affordance-based design. Dr. Maier has published several articles on topics including product family design, the complexity of design, and affordance-based design. Dr. Maier completed his Bachelor of Science degree in mechanical engineering at the Georgia Institute of Technology in 1999, his Masters of Science in mechanical engineering at Clemson University in 2000, and his Doctoral degree in mechanical engineering at Clemson University in 2005. Dr. Maier is a member of ASME, Pi Tau Sigma, and Sigma Xi.