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## Architectural Technology

*Using a definition of technology that stresses its role as a body of knowledge rather than an artifact, this paper takes on two issues of architectural practice through the avenue of recent scientific advances. The discussion explores the particular organizational structure that exists within the process of architectural practice and second it questions the architectural "pursuit of form." By including cultural aspirations, or organizational structures of a civilization with the construction of an artifact, forms can be distinguished from simply stylistic variation. Architectural forms in the future will require new organizational systems that can process the increasingly complex information that is changing our society.*

Joseph Lambke, Monday, 24 October 1994



**Stable Architectural Form**  
Parthenon, Greece - circa 435 B.C.

Architectural form has the potential to clearly embody a cultural form. Greek architectural form embodied a stable, Mediterranean culture that evolved over many centuries. Other examples include the beautiful Japanese temples built repeatedly over many centuries, in a particular climate.



**Stylish Cross-Fertilization**  
Chicago Public Library, Thomas Beeby

Cross-fertilization is a messy process, giving rise to many different styles, European forms transported to the U.S. as in the above case, which subsequently die off. Another example is Peter Eisenman's Exhibition Hall in Columbus Ohio, which was completed as many are tired of the frenzied and discombobulated environments of that style. Eventually, forms reflective of their place and time stabilize, allowing life to shine freely.

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Recent scientific contributions to our understanding of the evolution of life, have the potential to radically change the architectural "pursuit of form." Recently this pursuit has yielded a proliferation of personal aesthetic styles, quite distinct from authentic forms. If we assess the organizational structure of the profession today, it becomes apparent that it is closer to antiquated organizations of the past, than to any living structures evolving in the world today. The reliance on standard A.I.A. practices encourages the development of styles rather than forms, focuses attention on the artifact rather than the interactions that make places "alive," and continues to distance an already disillusioned public, from the elite practitioners' architects tend to consider via their trade journals. From a simplistic evolutionary standpoint, some might explain this as the cross-fertilization of cultures during a time of rapid globalization. However, the culture-based architectural forms that clashed 100 years ago, should have fleshed this out during that time of intellectual globalization. Today it is not the dispersal of cultural forms but rather a clash between a general public embracing historical forms, attempting to find authenticity, and the inconsequential play of stylistic games by architectural designers.

*"Foucault points out that up to the end of the 18th century, life [organization] does not exist, only living beings [artifacts]. Natural history dominated the classical age and is foremost a naming exercise: 'The naturalist is the man concerned with the structure of the visible world and its denomination according to characters. Not with life.' There is a concurrent interest in how things work, but it is an interest that remains disconnected and in tension with the naturalist tradition."*

this and the following quotes are from Walter Fontana, Gunter Wagner, and Leo Buss, in 'Beyond Digital Naturalism' the Artificial Life Journal Spring 1994.

It may seem very distant to blame our procedures for the superficiality of architecture today, but carefully inspected there seems to be some validity. During the first half of this century our society, caught up in the excitement of industrialization and a deterministic future, over-emphasized the artifact at the expense of the interactions experienced between artifacts. We built many gigantic structures utilizing the latest materials, expressing the hopes of our society. Speed and size became goals within themselves, and we lavished attention on physical things. It's no wonder we became

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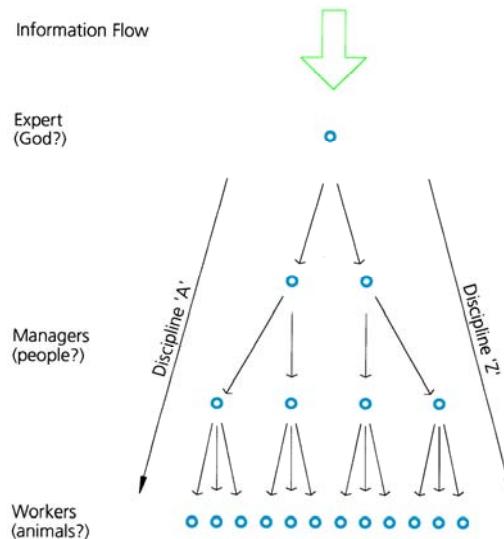
the most consumptive culture ever. But there was more. Quietly along with ever new, bigger and faster artifacts, came the simultaneous development of organizations that operated in these environments. The belief in an authoritarian, expert-at-the-top management structure seemed to be the ultimate solution. A clear example was the assembly line of Henry Ford fame, criticized by Charlie Chaplin. Under simpler conditions and within the excitement of a new type of culture, this organizational structure mass-produced artifacts in the biggest factories, at an unprecedented rate. Henry Ford really did know how to build a simple car, the 'mindless' workers received healthy wages relative to other places in the world, so by the 1950's everything was just peachy.

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### Specialization without Integration

- typified by one way information flow
- typified by vertical partitions according to discipline
- singularly designed

examples: IBM Corporate Desktop  
Frank Lloyd Wright Dining Experience  
ie. micro-management



Similarly in the architectural profession, Mies really did know how to build buildings of steel, stone, glass, and wood. However in the later half of this century, the complexities of running a truly global, modern corporation became too much for one CEO to have expert-knowledge over every aspect of business. The unintended consequences of this autocratic structure, prohibited workers at the lowest levels from thinking and decision making. The treatment as rational machines, deprived the workers of their distinctly human qualities. It was not the speed or the size of the artifacts, *it was the organizational structure that was dehumanizing people*. There was no place for experiential knowledge to be reappropriated into the system, and these are essential components of any living system.

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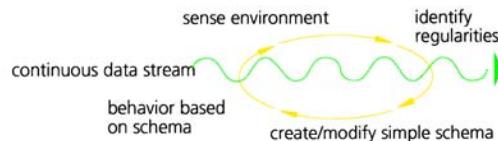
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Detroit has since abandoned these practices due to an external selection pressure, that of the energy crunch, and the recent globalization of commerce on a practical basis. That crisis gave rise to the complexities of international joint-ventures; small, clean factories; participative work teams; and frankly, better cars. Today our profession is prolonging the existence of this autocratic organizational structure. Why wouldn't we, it's nice to be in control of the organizational pyramid! Architectural determinism places us as the sole creator of artifacts despite the ever growing complexities of processes, materials, tools, and demands of the user. The inability to really know all aspects of the industry, and the limitation on the incorporation of worker knowledge, surely contributes to our diminishing role relative to the sum of all construction every year. Our extinction is self-perpetuated by our aspirations to build only the high-profile commissions: art museums, grand projects, and the like, remember even Le Corbusier built a tiny facility for a municipal waterway in the French countryside. This preoccupation with the visual aspects of buildings is a diversion from the very difficult task of revising our organizational procedures. Lately architects have yielded many attempts at new forms, ranging from Brutalism to Deconstructivism, resulting in an array of short lived styles. Guided by an outmoded, autocratic, organizational structure, all of these attempts were quite incompatible with any relationship to life.

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### A Complex Adaptive System

- each iteration the system competes/cooperates with other "cas"
- consistent across all scales, cosmic to fundamental particles

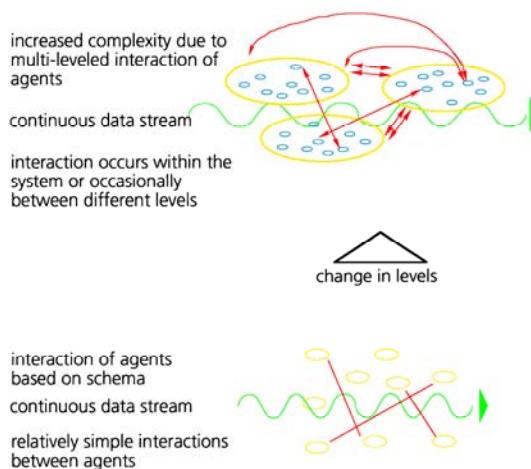


In contrast, living systems have feedback mechanisms, are not anthropocentric or ego driven. There is no single creator of the system, it co-evolves through the interactions of many agents, and the iterative functioning of the system. Murray Gell-Mann refers to these processes as Complex Adaptive Systems. Each level consists of many agents, each of which compresses the available information into regularities, or formulates a schema, and then develops a behavior according to their schema. The agent acts, changing the environment, and requiring a reinterpretation of it. Subsequent iterations continually refine the schema integrating it with the changing environment that supports the variety of agents. Change is continuous, and adaptability is a sign of life within a particular system. The two sources of change are: the continuous flow of new information into the system, and the changing behavior of other agents within a

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particular level. At each level there exists a curious dance of competition and cooperation, challenging the agents to develop increasingly accurate schema of the environment around them. Among various distinct levels however, the systems are predictable in generalities. Selection pressures of a particular fitness landscape act on the system, and in the form of feedback, change the behavior of the individual agents.

**Scale/Levels among distinct Complex Adaptive Systems**  
-there is a tendency towards higher levels and greater complexity, and a corresponding tendency towards the simplest schema through the arrow of time



The excessive focus on the aesthetic of physical things, combined with a perception that technology has destroyed 'nature' and the diverse cultures around the world, has left little opportunity for architects to understand the developments in science. The following definition does not assign such derogatory meanings to the word technology:

technology- 1. *The branch of knowledge that deals with the creation and use of technical means and their integration with life, society and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science.*

Random House Dictionary, Second Edition, Unabridged

Here, technology is a complex adaptive body of knowledge, co-evolving with the society that uses it. The environmental devastation that we've experienced this century is typically the result of human attempts to dominate and control the natural landscape. Science has validated that deterministic control is an impossibility, and that cultural forms change according to particular fitness landscapes that change with the

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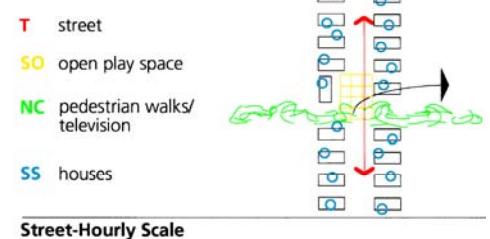
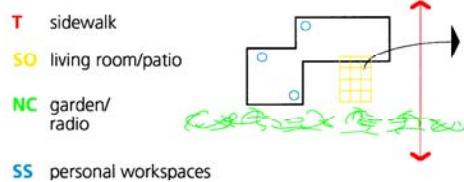
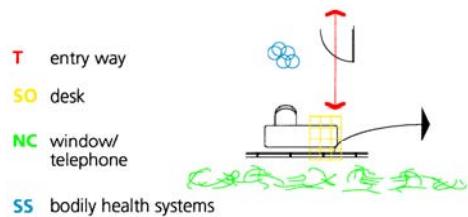
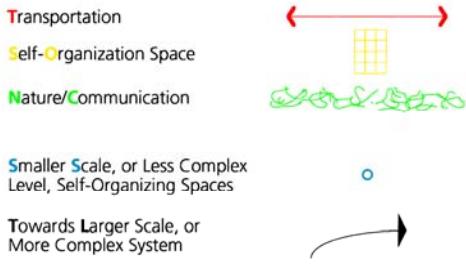
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arrow of time. Clearly understood today, technology has a purposeful connotation for humans. It is the schema we use when interacting with the natural landscape. This illustrates that we are an interwoven part of the natural world, not separate from it.

### Self-Organization and Scale

The need to organize our environments by scale has developed because of the advances in transportation and communication. Typically new technologies compete with existing ones, but occasionally, a new technology will open up enormous vistas for exploration. This can lead to the addition of another level to the world we interact with on a periodic basis. Organizing our environments by scale allows us to retain those pleasantly human-scaled smaller places, and gain the advantages of a thoroughly connected global world of the future. At the intersection of communication and transportation is typically the point in space-time where life occurs. Below are some examples of how complex adaptive systems can be interpreted at various levels where we live in the world.

### Key Symbols



### Personal Workspace-Moment Scale

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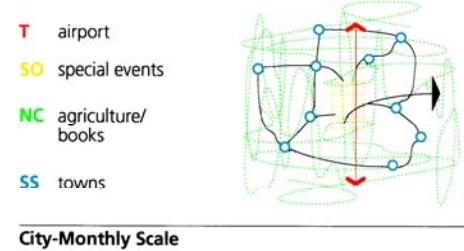
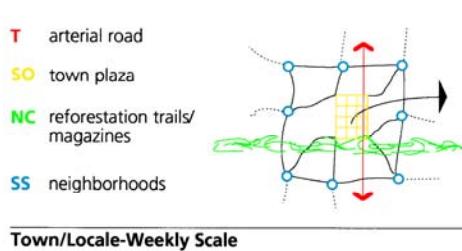
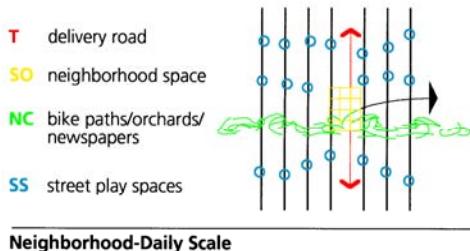
Architectural form, has been/is/can be, the physical embodiment of a culture's ideas. Occasionally this has limited the discussion of architectural form to Western religious monuments as the archetypal standards. This has led to arguments of form based on morality according to David Watkin. Another route taken early this century, perhaps in response to the cross-fertilization of nationalistic architectural forms, was the idea that form could be an expression of the unity of human beings on this planet. Such ideas gave rise to a universal, and so-called international form. Working with an understanding of evolution and punctuated equilibrium, illustrated in a number of colorful books by Stephen Jay Gould, we can see that form is simply the resulting variation of life in a geographic place, through time.

*"In the early 19th century, natural history makes a decisive step toward a biology when the notion of character [artifact] becomes subordinate to the notion of function [organization], when classification becomes comparative anatomy. Life is conceptualized as something functionally organized, and organization is foreign to the domain of the visible."*

The evolution of various cultures directly relates to the place and time period they occur in. Architectural form as a manifestation of cultural form, changes in step with cultural evolution. Similar to cultures, architectural form reflects the possibilities within a certain time period, the possibilities within a geographic location, the possibilities within a climatic region, and the possibilities within the belief system, or purposefulness of the people. All of these factors contribute to the development of architectural form. Occasionally certain societies are stable over time giving rise to the stable architectural forms we refer to as the classical periods of architecture. Examples of clear architectural forms go beyond the religious forms of Greek Temples, Roman Basilicas, French Cathedrals, to include Native American Teepees, Eskimo Igloos, Anasazi Pueblos, etc. Due to the fits and spurts of evolution, occasionally places exist with many different, mutually exclusive belief systems, which represents a cross-fertilization of cultures and gives rise to a chaotic array of architectural shapes.

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Interestingly, today in this country, we do have prevailing architectural forms: the platform framed, "traditional" Neo-English wood house, as well as bar-joist and concrete block strip malls. Similarly we have a prevailing city form: the center-core of wealthy organizations, surrounded by co-centric decaying rings, followed by the co-centric suburban race away from the closely trailing decay. We may not agree or like these "forms" but they are spreading like a virus. Apart from these plentiful developments, we have instances of an architect's sporadic novelty, in the shape of another stylistic image, or another Neo-traditional town plan. Clear architectural forms, emerge when the conditions are robust, and disintegrate either by becoming too stable, such as the Inca civilization which was unable to adapt to external information in the form of the Spanish; or they can disintegrate from too much chaos, as in the fall of the Roman Empire. An important element that is scarce within the architectural profession today, although common among the aforementioned prevailing forms, is the ability to reiterate construction techniques.



If we attempt to 'plug in' some of this new technology into our profession, it would have to account for the increasing amount of client experiential-knowledge and demands, the appearance of design/build organizations, and the impact of information processing technology. Clearly the days of God-like architects controlling the design of everything down to the silverware, as Frank Lloyd Wright did, are disappearing. Clients at particular levels do have valuable knowledge about how they operate best, and the flexibility provided at these levels can assist in fine tuning their facilities. Design-build teams have the potential to organize interdisciplinary work groups that iteratively learn how to better the entire process, from financing, to design, to construction. One of the principal advantages is of course, that the entire team is striving to provide a better product, but the other excellent advantage is the potential for interdisciplinary teams to develop coordinated products. Lastly, the computer infiltration of our industry is close-at-hand. The potential in store is the development

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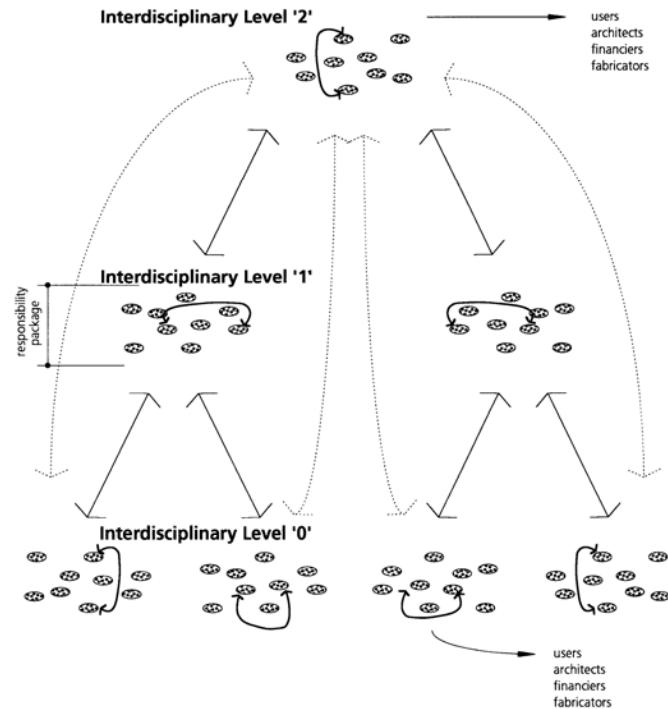
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of construction systems capable of consumer designed adaptability. The practical challenge is the integration of tremendously complex data, and the architectural challenge is to develop an organization that originates beautiful environments.

Excellent systems would be easy to use, so that the user could layout well designed places, poor quality systems will have a minimal chance of building beautiful places.

### Decision-making by Level

- typified by two way information flow
- typified by horizontal "responsibility packages"
- adaptable to fluctuations



Analogy's of the production of buildings to the production of autos, another physical product are not new, and may continue to provide insights. However at another level, analogies to the computer industry, an information processing tool, can be helpful when developing new construction systems that account for the flow of information in many directions. Many times the initial goal is to get your system up and running, and in the hands of many users. Subsequent spin-off companies can then develop customization packages for an unlimited number of reasons, some of which were not foreseen by the original system instigators. Few would have predicted the tremendous ability to customize a computer to individual working habits as little as ten years ago. Today, within the framework of an interface, there are an unlimited variety of environments for people to work with. It is in this manner that form co-evolves with the people that use it.

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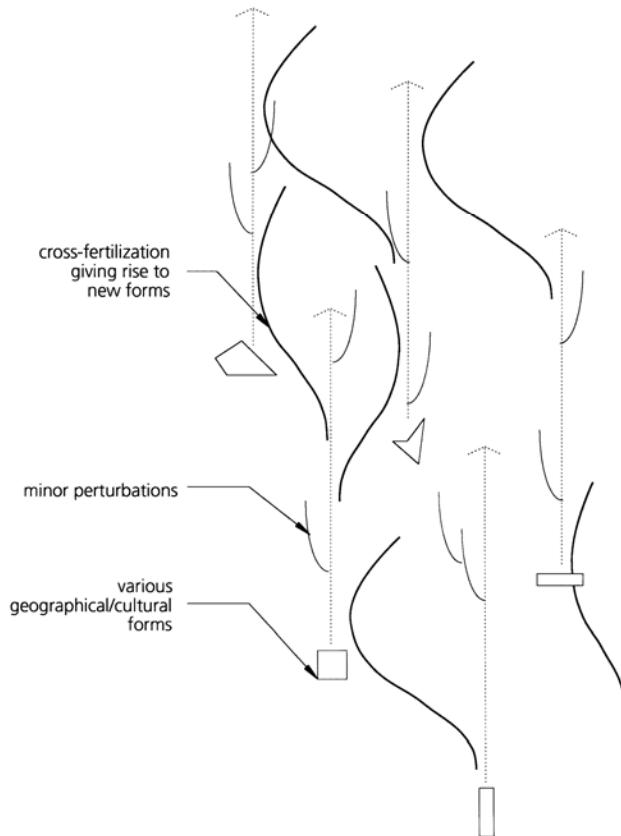
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If we attempt to utilize technology inspired knowledge in the management of cities, it would need to address Planned Unit Developments, the increasing demands of community groups, and the significance of access points to transportation. Clearly mixed use P.U.D.'s are the developer's answer to an obsolete zoning ordinance based on functional zones drawn on a map. Mixed use areas are successful for a variety of reasons, one advantage is they can adapt to unforeseen changes in the way people live. This success though, does not require abandoning all tools. Managing cities is very complex and does require some sort of mechanism to be able to affect change on the scale of the city. Similar to a client's experiential-knowledge base, community groups also maintain a certain amount of knowledge about their place that is critical to the development of authentic forms of place. Incorporating "self-organizing" spaces allows the community to redefine itself iteratively, according to new incoming data streams. This keeps the community alive and develops its sense of purpose.

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### Evolution of Architectural Form

-change occurs often due to outside influences such as the industrial revolution or changes in the peoples belief system



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*"The principle problem in evolution is one of construction: to understand how the organizations upon which the process of natural selection is based arise, and to understand how mutation can give rise to organizational, that is phenotypic, novelty. A solution to this problem will allow one to distinguish between those features of organizations that are necessary and those that are coincidental"*

The gradual unfolding of form is very similar to the process at work in a complex adaptive system. Continued investigation seems to point toward a management strategy based on the sliding scales of probabilities akin to quantum mechanics. David Rusk calls this the "elasticity" of a city. The predictable pattern of decaying co-centric rings around the core-city, is very closely related to access points of efficient transportation. There exist various scales of transportation and the corresponding access points, such as global scale and airports, regional scale and highway interchanges, local scale and intersections of artery roads, down to the smallest scale of homes and pedestrian walks. At every level there needs to be adaptability of mixed uses and the iterative functioning of a community, and yet among the different scaled levels there is a certain predictability of events.

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### Conclusion

*"Causal argumentation is reversed: A character [typical, suburban built 'architectural form'] is not important because it occurs frequently, but rather it occurs frequently because it is functionally important."*

The existing organizational structure supported by the A.I.A. is an authoritarian one. This occurs because the intended flow of information is unidirectional, although increasingly there are many exceptions. Contrarily, the evolution of form demands a dynamic system that responds to information flow in multiple directions. Living systems support much adaptation and change within levels and exhibit probabilistic predictability among levels. Schema within a level, tend to evolve toward the simplest description, whereas the system evolves toward higher levels of complexity. From a scientific perspective, styles tend to exemplify novelty within levels, while architectural form tends to exemplify integrity among levels.

... I guess there are some who believe that there is no such thing as true integrity or authenticity, I would agree that there is not a single form, furthermore there may not even be a single form within an epoch. In the end though, it seems that living systems have more integrity, and you may still disagree, but they are more effective at dealing with complex cultural and economic environments, and so will prevail. Static person designed architecture falls to develop an authentic form and languishes in the realm of "just another different shape," whereas dynamic evolutionary systems maintain the possibility of generating authentic architectural forms, for better or worse.

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### Annotated Bibliography

[Ever Since Darwin](#), by Steven J. Gould

Essays on the complex processes occurring in evolution. Also an excellent discussion on the geographic variation of humans.

[Cities without Suburbs](#), by David Rusk

A clear assessment of the livability of elastic cities versus the trauma of inelastic cities.

[Artificial Life II](#), by Christopher Langton et. al.

A scientific exploration into the interactions that are common to all forms of life, with a nice distinction between cultural evolution and biological evolution.

[The Meaning of Things](#), by Mihaly Csikszentmihalyi

An excellent discussion on the interaction of people and their environments, resulting in the co-evolution of the system.

[Dreams of a Final Theory](#), by Steven Weinberg

A thorough discussion of what finally seems to be the fundamental particles of matter, and a nice discussion on the value of science.

[Christian and Oriental Philosophies on Art](#), by Ananda Coomaraswami

A clarification of art as a verb, as the interaction, rather than the artifact or object.

[The Quark and the Jaguar](#), by Murray Gell-Mann

A thorough discussion on complex adaptive systems and how they manifest themselves in our world: from particle physics, to cultures, to the origin of the universe.

[The Consequences of Modernity](#), by Anthony Giddens

A sociological perspective on our time - without nostalgia. An explanation of many commonly misunderstood complex phenomenon, and hints at the potential future.

[Surely You Must Be Joking Mr. Feynman](#), by Richard Feynman

A fun discussion on the scientific perspective, and a clarification of integrity.

[Morality and Architecture](#), by David Watkin

Essays on the arguments of architectural forms.