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The Biomimicry Way **(This is the third installation in a series of three articles.)**

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In the previous two articles (Building the Future of Buildings, from RMI Solutions, Fall 2002 and Biomimetic Buildings, RMI Solutions, Winter/Spring 2003) we learned what biomimicry is and what it means for buildings. We learned that there are stunning materials in Nature with enviable properties that we are now beginning to emulate. We also learned that nature can help inform some of our process design (i.e. natural ventilation systems). But biomimicry's ultimate promise goes well beyond better material and process design in individual buildings. If we kept the focus there we would miss an essential point of biomimicry: rewarding cooperation and making symbiotic relationships work. This third and final article in the series addresses the synthesis so often found in nature, and how using that as a model might aid us in not only the development and site selection, but also the physical construction of the building. We shall also explore how nature can provide a model for designing communities to work together.

If we remember from the first article and from Janine Benyus's groundbreaking book, *Biomimicry*, nature:

- Rewards cooperation and makes symbiotic relationships work
- Fits form to function efficiently
- Develops diversity of possibilities to find the best solution and survival
- Recycles and finds use for everything
- Requires local expertise
- Avoids excesses and "overbuilding"
- Taps the power of limits
- Runs on the sun and other 'natural sources' of energy
- Uses only the energy and resources that it needs

If our buildings are to help us flourish on this earth it is essential that they follow the above precepts. Until now our industrialized society has managed to get by through a process of constant expansion: enter a new locale with virgin resources and leave your trash behind. But as the planet fills, and people demand higher standards of living, this short-sighted strategy will fail us, just as it fails the prairie grasses that grow rapidly in the wake of a fire but only last a few short months before a diverse, co-operative, long-term mix of species takes its place and creates a forest.

This 'type III' ecosystem is replete with interlocking and interdependent systems, and encompasses a staggering diversity of animal, fungal and plant life – each uniquely attuned to local environmental

pressures and niches. Trees and animals have, over time, developed customized attributes to help them thrive in these niches. Thicker bark, more or fewer leaves, deeper roots, water storing strategies etc., etc. all vary from place to place.[1] Aspen trees only grow in certain climes with snowy winters and hot summers. Similarly, other species have adapted to other conditions, suggesting that each climate/location inspires an optimal design, and that taking a cookie-cutter model and planting it another state doesn't work for trees (nor for comfortable houses). Today's architects are beginning to realize that their designs can leap-frog standard comfort levels and efficiencies if they take into account sun paths and other such local weather patterns and build to fit the houses location.

When Nature grows something new (for example a tree in a forest) this growth is an exercise in flexibility. The tree doesn't grow up and bulldoze everything out of its path, nor does it have a larger footprint (i.e. resource drain) that it can sustain with its built-in root structure. When we go to an existing urban community and put up a new building, we should be sensitive to existing buildings and local functions, and design accordingly. When we go to a greenfield (undeveloped land) we should design around existing landscapes and trees[2] – this has been successful on a number of occasions. Given that we are running out of new space to build, and that a large percentage of the buildings we built so hastily after the second world war are now in need of more than just a facelift, now is the perfect time to get our community design and building philosophies right. Who knows, but it might even help to bring in a coral reef specialist to share his knowledge of how that successful community works (what balance of features and players (species) is required). It certainly will help to examine communities that already work, and buildings (like 2211 West 4th) that succeed. Industrially speaking, it might help to take a closer look at the EcoPark in Denmark, a community of industries that share each other's "waste", to increase each other's profit.

One of the best examples of green building that has also had a marked effect on local community strength is a mixed-use building in Canada. The 2211 West 4th building in Vancouver, B.C. exemplifies the principles of biomimicry: rewarding cooperation, requiring local expertise and avoiding overbuilding. In essence, the building succeeded at finding and utilizing a niche. The developer, Harold Kalke, spent a year studying the local community – asking what residents felt was needed in a new development. This gentle probing brought the neighbourhood around from their initial, confrontational stance to one of enthusiastic approval. With their help and his intuition about what a community needs he created a building that now acts as a magnet for all of Kitsilano (a suburb of Vancouver) and his unique, sensitive development process has become the standard for the entire city of Vancouver. 2211 West 4th (also known as the Caper's building) features offices, retail stores and homeowners, all coexisting side by side. Much like a tree that houses a myriad of different species under one 'roof', this building provides a healthy balance of diversity and cooperation.

In our industries, there is also room for cooperation. A common maxim Nature lives by is 'waste for one species is food for another'. One place where this co-existence and waste-sharing is already happening is an "Eco-industrial park" in Kalundborg, Denmark. A cluster of industries and businesses have formed what might be called an island of sustainability, based on the principles of a natural ecosystem where flows of waste from one process become food for another cycle. The participants (a coal-fired power plant, a refinery, a pharmaceutical and industrial enzyme plant, a wallboard company and the town's heating facility) exchange a variety of resources (steam, hot water, and materials such as

synthetic gypsum, sulfuric acid, and biotech sludge) in a manner that is mutually beneficial to everyone involved – companies save on landfill costs, generate revenues from previously unusable by-products, and green their corporate image as well. Another eco-industrial network sprung up (this time unguided) in the province of Styria. There, an Austrian researcher[3] uncovered a much larger industrial recycling network which had sprung up largely without organized guidance, one company at a time. In fact, when asked about this 'industrial symbiosis' the plant managers weren't even aware that there was a larger network all around them! Each individual had made fiscal decisions to take "waste" from others to use it as raw material for their own processes (in some cases, these by-products were of higher quality than available primary materials).

In the United States, the President's Council on Sustainable Development for 1996 addressed the issue of eco-industrial parks and approximately 20 such parks in various states responded via a workshop and survey. Since then these parks have worked steadily to achieve their goals of creating job growth, increasing tax bases and protecting the environment.

The implications of these eco-industrial parks are enormous. If modelled on nature, our industrial society can still churn out the material goods we rely so heavily on, yet do so in a way that encourages producer product responsibility, and does not drain our dwindling natural resources. Only then will we have a workable system that can be exported all over the world to bring previously unreachable levels of material wealth, comfort and health to the billions who now lack it. This *must be* what our industrial society is continually evolving toward. It cannot afford any longer to devalue its richest resource–Natural Capital---and must learn to fit in with existing limitations and structures (principle #7 "taps the power of limits"). The prior model of unchecked expansion – always reaching for the next resource and leaving a wake of trash behind is fundamentally unsustainable, and we can abandon it at a profit.

Other wastes based on the inefficient design of cities can also be eliminated with a holistic, biomimetic approach. For example cities where people do not need to commute by car have less pollution, less noise, less stress, fewer automobile deaths, and people know their neighbours better. Surveys show that people in these communities (i.e.Village homes in Davis, CA) are happier, healthier and feel safer than national averages. Mixed-use dwellings are a great stride in the direction of sustainability in urban settings. When the true price of movement is more accurately revealed in our future, we will look back to the 1920's and realize that the mixed-use dwellings created then were sensible, not stylistic. And if we combine new technology and understanding about architecture and energy flows we can create buildings that, like trees, only use resources proportional to their footprint.

Our buildings could be more like trees. They could have a 'root' system for collecting water, or one that takes rain and stores it, or drinks fog like Coastal Redwoods (*Sequoia sempervirens* 'Adpressa'). Installing solar panels and storing the electricity produced would allow the building to be self-sufficient energy-wise as well. Finally, a flexible exterior that adapts to changing seasons (like a tree drops its leaves) and a flexible interior that adapts to changing uses (a mixed-use building) would increase any building's value. The water and energy strategies, combined with a wastewater and food scrap recycling program would make the building independent of outside sources and relieve the need to constantly pump in electricity and fresh water, and pump away sewage and garbage. Organize a whole cluster of similar buildings in a particular locale and you have the beginnings of a futuristic, sustainable community.

Tying together everything we have explored in this series, we can come up with a vision for how buildings can enhance our lives *and* our economies. Individually, a fully biomimetic building would be made from local materials with little energy input. It would be naturally ventilated and illuminated and use a minimum of energy for moving fresh water around. Composting toilets and Living Machines would be standard. The building would not be connected to the electricity grid, instead using only current solar income, and the majority of the building structure and materials would be re-usable at the end of its lifetime. Landscaping would welcome animals and plants from local ecosystems and provide food for building occupants. And on a community level, buildings would 'work together', each performing ancillary functions to the benefit of all, with enough levels of redundancy so that, like a tropical forest, if one species or building fails temporarily, the web of others can support the flourishing neighbourhood until it gets back on its feet.

[1] Interestingly, the physical shape of the community (not just the individual tree itself) also has an impact on its effectiveness. In high, windy altitudes the species of Crumolt trees form themselves into a tear-drop-shaped copse in order to minimize damage from the wind and maximize protection.

[2] As surprising as this sounds, on several noted occasions whole developments have been erected without destroying a single tree (for example Dewees Island, South Carolina)

[3] Erich Schwarz

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