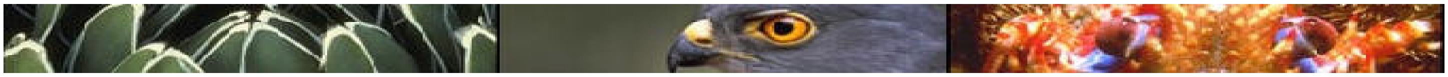


BioInspired!

Volume 4, Issue 3

September 22, 2006

THE BIOMIMICRY INSTITUTE

Highlights of the September 2006 Newsletter

Thanks to everyone who sent feedback on the July issue, which I only realized recently was the 10th since the original *Biomimicry Newsletter* was launched in October 2003. Please keep the cards and letters coming - your input keeps the newsletter fresh and interesting.

This issue introduces four new contributors writing on a range of topics that demonstrate the breadth of Biomimicry:

- Dr. Timothy Finnigan describes innovative ways of harnessing the power of ocean waves and tides, by working with nature instead of fighting it.
- Greg Donoghue discusses sustainable agriculture based on the principles of Biomimicry and highlights a specific regeneration project near Broadford, Victoria.
- Professor Hugh Bruck presents the undergraduate mechanical engineering curriculum for bioinspired product and device development at University of Maryland.
- Ian Abbott-Donnelly describes how principles of ecology can be applied to organizations.

We are also including the first installment of "Triggering Self-Assembly of Biomimetic Green Chemistry in Nepal" by Mark Dorfman, a regular contributor. The conclusion will be published in November .

Lastly, if you are looking for volunteer opportunities, check out the article "Patterns in Nature".

Norbert Hoeller
newsletter@biomimicry.org

Inside This Issue:

Biomimetic Ocean Power Conversion

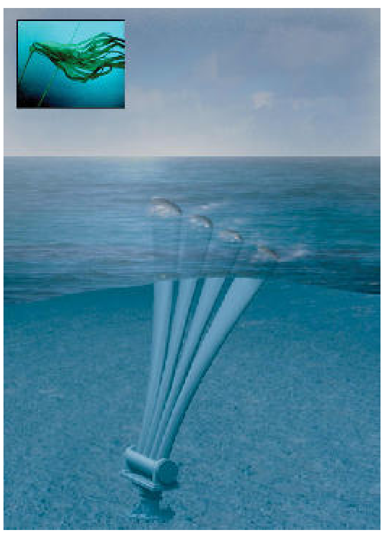
Rising oil prices and growing concern about global warming are spurring on development of alternative energy sources. For years people have looked at ocean waves and tides as potential sources of renewable energy. Over the past decade a number of technologies have been proposed and an ocean energy technology industry has emerged. This industry is still in its infancy, relative to say wind power, but there are many technology developers hoping to capitalize on a looming global market. To date, the challenge has been to come up with viable technologies that can produce power at competitive prices. This has required the developers to address several issues associated with survivability and operability in the harsh marine environment.

Since 1999 I have worked on various ocean power technologies in both R&D and business related roles, and have been faced with some of the challenges noted above. After some time it became clear to me that the traditional engineering structures used by many developers may not be economically viable. Large rigid structures may be economical if you are extracting oil or gas but may be prohibitively expensive when harnessing the more diffuse energy associated with waves and tides. Along the way I began thinking of ways in which ocean power devices could be more economical. Clearly, the key would be in reducing the structural demands on the systems. At the same time, I thought it would be advantageous to come up with systems that are still efficient but also easy to install, have little or no environmental impact, are gentle and present no danger to marine creatures, and, most importantly, are out of human view (to avoid public opposition due to aesthetics).

Biomimetic Ocean Power Conversion (continued)

One day I was sitting at my office desk and looking out the window. I was watching a large tree bending and swaying in the wind. From this image, it occurred to me that plants in the ocean had developed a natural mode of swaying in the presence of waves, as well as an effective anchoring system and an ability to bend over more and more to shed excessive forces when waves become large. This train of thought carried forward and eventually led to development of a new biomimetic concept for ocean wave energy conversion (see below).

Around the same time, I was working on a new type of tidal current energy converter that would have no moving parts but would require some fairly powerful magnets. When my calculations finally showed that the technology would require superconducting magnets, I began to lose hope as these would make the systems unwieldy and way too expensive. Nevertheless, I pushed on until late one night I finally resigned to the fact that the concept was not viable. It was actually a relief as I could now relax and look forward to a peaceful clear-headed sleep. So off I went to bed having been freed from the confines of the tidal energy concept. I only managed about three hours of sound sleep when I was jolted awake by an idea that confronted me with a large and looming image in my head of a fish-like device swimming in a tidal stream and extracting kinetic energy from the flow by the swaying of its tail. So much for sleeping. I soon set to work laying down the framework for the concept, which has now emerged as a new biomimetic marine current energy conversion technology.



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As alluded to above, survivability is one of the primary issues that has hindered ocean power development. Ocean power devices are designed to convert power in moderate day-to-day conditions but they must also be engineered to withstand the largest forces that occur during extreme weather events. This tends to drive up capital costs which, in many cases, preclude commercial viability. Biomimicry has provided a solution which diverges away from traditional marine engineering structures that are designed to stand firm and react against the forces of the ocean. Using biomimicry, the above ideas have been developed into unique designs that are lightweight, pliable, and tend to move and respond with the forces of the ocean. In doing so, these devices are the first to avoid destructive ocean forces and this allows them to be designed to far lower force tolerances, which translates directly to lower capital costs. The benefits inherited from biological systems provide the technologies with distinct advantages in terms of cost, efficiency, environmental impact, and survivability.

After some further development, the ideas became concept designs that are now being commercialized by BioPower Systems Pty. Ltd. We have adapted the efficient motions and survival mechanisms of certain marine organisms into ocean wave and tidal current energy conversion devices. In doing so, our technologies benefit from evolutionary optimization that has occurred in the marine environment. The resulting ocean energy conversion systems are simpler, easier to install, and less expensive, on a price-per-unit-of-power basis, than other ocean power technologies currently being commercialized.

Biomimetic Ocean Power Conversion (continued)

Three key biomimetic technologies are now being developed under a strategic plan to produce commercial units by early 2009. The bioWAVE™, which is modeled on the motion of large sea plants under wave action, has distinct advantages related to the absorption of incident wave energy and the inherent ability to avoid excessive wave loads in extreme conditions. The bioSTREAM™ is a system that harnesses the kinetic energy in tidal streams and marine currents using an oscillating hydrofoil that is modeled on the most efficient swimming species in the ocean, namely Thunniform-mode swimmers such as shark, tuna and mackerel. The bioBASE™ provides a common installation and mounting system for both of the power conversion systems. It is modeled on the distributed-force anchoring mechanism used by large sea plants and is similarly adaptable and environmentally unobtrusive.

Computer simulations have already indicated robust performance for both the wave and tidal current energy conversion systems. Megawatt scale power output appears viable in moderately good conditions. The company is now planning to conduct lab-scale model testing, and follow this with a full-scale ocean-based pilot program in 2008. Commercial units are expected to be available in 2009.

For more information, visit http://www.biopowersystems.com

Dr. Timothy Finnigan
BioPower Systems Pty. Ltd.

Sustainable agriculture: what it is, what it is not, and making it pay.

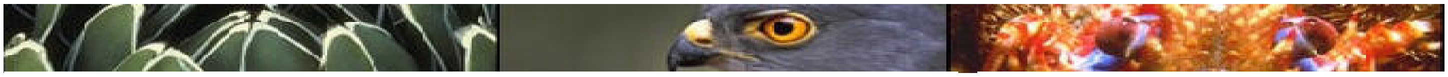
Introduction Nature has, for many millions of years, evolved an almost infinite variety of life forms and processes – we have discovered only some of them, and understand even fewer. Yet in our industrial age, we persist in creating machines and processes which not only ignore the incredibly intricate work of nature, but in many cases, run counter to it.

We create machines which rely on resources whose supply cannot be sustained, and simultaneously ignore the only source of energy for our planet (the sun). We create agricultural systems, and produce agricultural products, which require unsustainably high volumes of fresh water, while ignoring the methods which nature have developed to maintain unimaginable biodiversity in even the most inhospitable of environments. And we insist on spoiling our own nest throughout – creating sometimes irreversible damage to our atmosphere, our soils and our waterways – again ignoring the perfect solutions which nature has evolved to constantly recycle – and expand - its biomass.

The Natural Processes By mimicking the natural processes, we can arrive at a far safer, more equitable and sustainable place. By watching, understanding and copying nature's ways, we could abandon the application of excess fertilizers on our soils, and to seek to understand and apply the principles of the complex soil microbiology. Three such bio-mimicry approaches are salient: firstly, application of biological or micro-organism technology, using the pioneering work of Professor Higa with Effective Micro-organisms (EM) and Dr. Elaine Ingham of the Soil Food Web Institute. Secondly, the application of landscape hydrology using the principles developed by Mr. Peter Andrews of Natural Sequence Farming. And thirdly the recycling of organic materials as developed by Eco Organics.

Biological Models The understanding and application of beneficial microbes to agricultural soils is well known. These microbes are seen as central to plant (and therefore human) health, and soils which lack them in the right balance cannot provide good food. Microbial diversity can be improved by the application of two types of material – solid or liquid. In solid form, biologically active composts promoted by Ingham provide both microbes and organic material to the soil. Prof. Higa's method involves the production of Bokashi – a fermented grain material which has been inoculated with his EM cultures.

Both scientists have seen enormous success in their practical applications: elimination of chemical fertilizers, vast reductions in the use of pesticides and herbicides, and little or no loss in productivity. The net result – one which our struggling farmers will relish – is that profitability can go up, not down, by using these natural methods.



Sustainable Agriculture (continued)

Landscape Hydrology Peter Andrews' central thesis is that the Australian landscape has, over millions of years, evolved mechanisms which can ensure increasing biodiversity even in an arid climate with unreliable rainfall patterns. The Australian landscape has developed a natural fertigation system - chains of ponds – swamps and wetlands, sometimes covering hundreds of square miles – connected only in flood times by intermittent streams. Water is retained in the landscape and does not flow unused to the ocean. Instead, it percolates through organic matter and naturally irrigates large areas of the landscape. Plant and animal forms have adapted to this natural sequence, and thrive in what often appears as a barren and inhospitable landscape. As plant biomass increases, the flow of water is slowed, causing water levels in the swamplands to increase, thus providing more opportunity to grow more plants – and on goes the cycle. The result – increased biomass, and increased biodiversity.

Peter Andrews' model mimics this natural sequence, and his results have been remarkable – low cost, highly effective and totally sustainable farming on even the most marginal of lands. Effective implementations of the system have halted and reversed erosion, increased biodiversity and farm profitability – and now after years of battling bureaucracy, Peter's system is being hailed by international scientists.

Organic Wastes In nature, all by-products are processed then consumed where they fall. An organism's byproducts are exuded to maximize the benefit to both the surrounding environment and the organism itself. Our current methods of waste management, however, involve transporting vast masses of waste material across vast distances. And instead of viewing such materials as resources, we view them as wastes and accordingly dump them in oceans or landfills where they cause untold environmental damage.

Pothole forming – this is the first sign

Then underground channels form

Finally the channels collapse—this one is nearly 2 meters deep

Sequence of erosion at different parts of the farm. The leftmost photograph shows the total absence of topsoil due to removal of vegetation

Mimicking the natural process would see us recycling such "wastes" in-situ. This is particularly salient in the treatment of paper and organic wastes, which in most cases, can be used on site as a farm/garden supplement. Composting, worm farming and more recently bokashi and microbial fermentation provide very simple methods for sustainably reusing organics.

There is only one place our excess carbon must go – it must be returned to the soil. Carbon, if released to the atmosphere as CO_2 (where it contributes to greenhouse) is a threat to our survival. If it is returned to the soil, as organic matter, it contributes to our prosperity and the planet's sustainability.

An integrated Approach Eco Organics' Glenaroua Project is an attempt to demonstrate how these sustainable practices can be implemented in a profitable way. It is being established on a 40 acre property near Broadford Victoria – a property in an area beset with erosion, salinity and productivity problems, where most of the land is agriculturally marginal at best, and usually not in profitable production.

The project will implement all of the above models, in an integrated way, as follows:

Stage 1: Farm Purpose Apply permaculture principles and make the best, most sensible, use of the land.

Stage 2: Harnessing Water Application of Natural Sequence Farming principles to ensure sustainable use of water.

Stage 3: Organic Matter Apply vast quantities of organic material from "waste" sources, which have either been fermented or composted.

Sustainable Agriculture (continued)

Stage 4: Natural Fertility Application of EM liquids, compost teas and composts to ensure natural fertility, with the elimination of chemical inputs.

Stage 5: Reforestation Planting of a diverse range of tree species for farm profit.

Conclusion The Glenaroua Project is an attempt at an integrated and intelligent application of sustainable models in a new paradigm – one where environmental sustainability can be achieved in conjunction with economic sustainability. One cannot be had without the other.

The cost of not addressing environmental sustainability – or not doing so in time – may be catastrophic. And not just for our own species.

References This is an edited excerpt of the full article which can be downloaded from the Glenaroua Farm Project (near the bottom of the page). A full update on the progress of the project can also be found in the Farm Diary.

Peter Andrew's Natural Sequence Farming:

- http://www.nsfarming.com

Soil Food Web: http://www.soilfoodweb.com

Efficient Microbes:

- http://www.scdworld.com
- http://www.eco-organics.com.au

Greg Donoghue
Eco Organics Pty Ltd

University of Maryland: Undergraduate Mechanical Engineering Curriculum for Bioinspired Design

With an ever-increasing focus on the confluence of nanotechnology, information technology, and biology (aka, nano-info-bio), there is a need to educate undergraduate Mechanical Engineers to think differently about the way they design new products and devices using biological principles, which are embodied in bio-inspired products and devices. Current mechanical engineering curricula do not cover the manufacturing technologies and design principles relevant to the development of bio-inspired products and devices. At the University of Maryland, we have been enhancing the mechanical engineering undergraduate curriculum by integrating recent advances in the design and manufacturing of bio-inspired products and devices through the following activities:

1. Inserting a new sequence of instructional materials on bio-inspired concepts into the mechanical engineering curriculum, including a new bio-inspired design repository and multi-piece/multi-stage molding process for realizing bio-inspired products.
2. Developing a new course in biologically inspired product and device development focusing on bio-inspired robotics.
3. Disseminating the materials developed for the new modules and course notes through a dedicated web site (http://www.bioinspired.umd.edu).

By implementing this new curriculum, we have been able to transform the way students are approaching the solution of engineering problems in order to educate a new generation of engineers who can develop superior products for a wide variety of applications. As a result of their educational experience, students are able to:

1. Consider bio-inspired sensors and actuators as potential design options
2. Consider kinematics and dynamics principles utilized in nature as potential design options
3. Consider use of compliance as a means of realizing articulation
4. Select appropriate manufacturing process for a given bio-inspired design concept
5. Identify material and geometry-based limitations for each of the processes
6. Identify advantages of the new manufacturing processes over conventional processes for fabrication of bio-inspired concepts

This curriculum development effort involved a team of experienced researchers and educators in the areas of design, manufacturing, materials, and mechanics. Our familiarity with the subject and our experience as educators

University of Maryland (continued)

have enabled us to seamlessly introduce and institutionalize these exciting new ideas to the design and manufacturing portion of the undergraduate ME curriculum.

In addition to the development of new curriculum for ME programs, there have also been broader impacts in the following two areas: (a) undergraduate students who might not otherwise pursue studies in mechanical engineering will be attracted to the multidisciplinary area of bio-inspired products, and (b) a biologically-oriented pedagogical approach to engineering education that ensures broader access to the knowledge needed to enhance the interest and skills of future engineers and researchers.

For more information, contact me (link below) or Prof. Satyandra K. Gupta.

Prof. Hugh Bruck

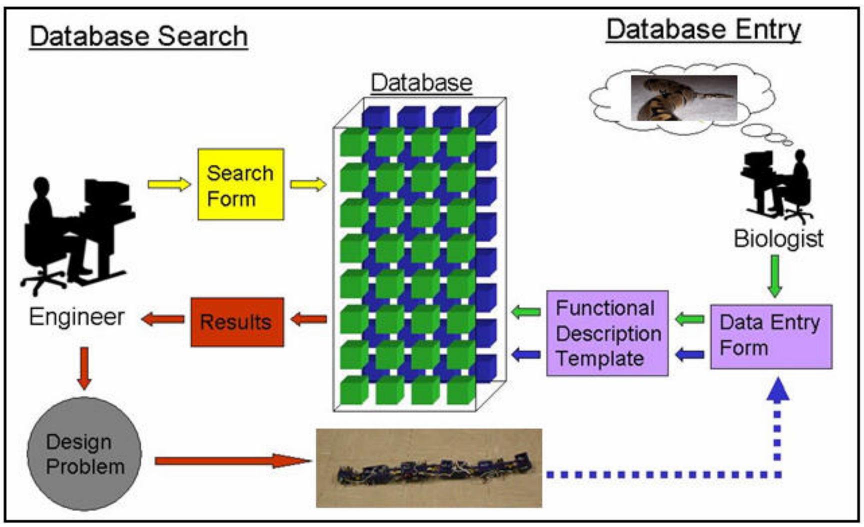


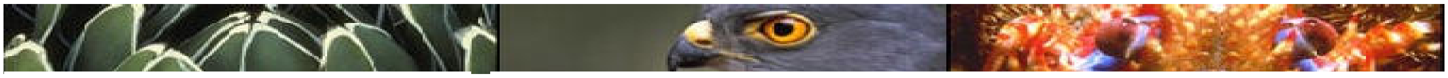
Figure 3: Overview of bio-inspired design repository system developed at University of Maryland for realizing bio-inspired products, such as the snake robot shown in the figure, as part of the new undergraduate ME curriculum (from Bruck *et al*, "New Educational Tools and Curriculum Enhancements for Motivating Engineering Students to Design and Realize Bio-inspired Products", in *Design and Nature 2006*).

'Organizational Ecology'

Applying the principles of ecology to organisations can influence culture, structure and physical operations. This article describes how some of these principles can make a difference to the way we think about the way we work.

Open Networks Wherever we see life, we see networks; at the cell level we see chemical networks, at the ecosystem level we see food networks. Some of the most successful business models are based on business networks that connect suppliers, integrators and customers in intricate ways. These network structures create a stable yet flexible form through a flow of material and information in and out of the system. Very often we restrict our capacity to participate in networks by our hierarchical ways of working. Our aim should be to enable open networks that thrive at many levels: projects, teams, programmes and partners.

Membrane boundaries Few boundaries in nature are impermeable. Nature often creates membranes rather than walls. Membranes create a kind of connection space that can recognise information, filter, transform, process and signal. Our team and organisation boundaries need to be designed to behave like membranes more often than walls. This can be in terms of physical layout which enables people to interact with the team or at a more cultural level where outsiders are welcomed and even systematically engaged wherever possible.

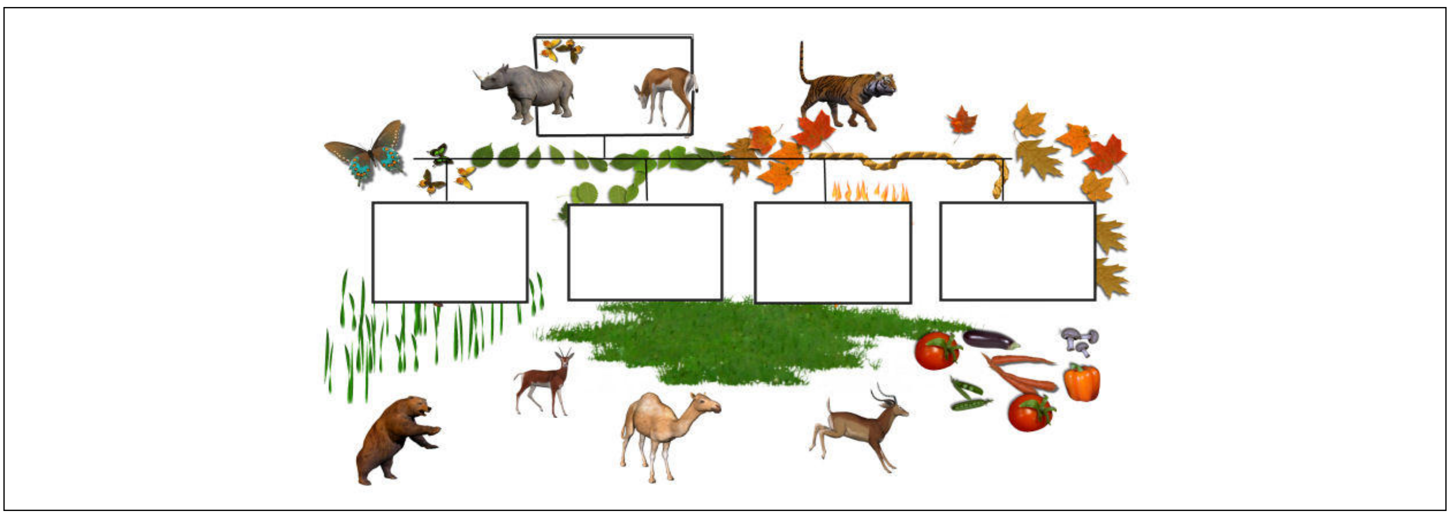


'Organizational Ecology' (continued)

Self generating metabolism One of the fundamental characteristics of healthy ecologies is that they are self-generating. There is an incessant chemistry of adaptation and self-maintenance. Perhaps the organisational equivalent to this is our capacity to learn, to share knowledge and to adapt. Creating this learning culture is much more than the formal training agenda - it is about the curiosity of people, the willingness to explore and to experiment. Organisations can easily stifle these processes through a 'command and control' focus on task and efficiency. We need to ensure that people and processes are not driven at 100% capacity so that that there is space and encouragement to take managed risks.

Catalysts Nature uses catalysts as a powerhouse for change since they have the ability to combine and re-use material to accelerate processes. In organisations, people in cross cutting roles act like catalysts - significantly increasing the rate of interaction in the organisation. In a network organisation, these roles are not left to chance - they are designed into the organisation.

Examples of catalyst roles are Service Champions, Knowledge Management specialists and Facilitators. These roles make things happen by knowing who's who and having the scope to move between teams, systematically increasing the rate of interactions. I believe that almost any role can have a catalyst function. And when catalyst roles work well, the people around them thrive.



Evolution Science describes three routes to evolution: gene transfer, symbiosis and random mutation.

The organisational equivalent of the gene transfer in reproduction is transfer of knowledge, processes, technology and people between an organisation and its suppliers/ partners. This is especially true when they actively collaborate on projects.

The equivalent of symbiosis (a beneficial relationship between different organisms living in close association) is the dynamic interactions of suppliers, partners, employees, volunteers and customers in the daily operations of business. When we talk about listening to the customer and providing responsive services we are talking about a symbiotic relationship.

The equivalent of random mutation is when new people join the organisation or when people get the opportunity to 'walk in other worlds'. These interactions can be very ad hoc experiences or more formal secondment opportunities. Whatever the method the key is to bring back something unexpected.

Our aim for organisation should be to create rich opportunities for evolution.

Diversity Team diversity has many parallels with biodiversity. As an organisation much of our resilience, creativity and capacity to adapt will come from our team diversity. We therefore need to nurture diversity in our people and our project teams; this includes not only recruitment policies, but also the day-to-day behaviours. Fundamentally, we need to demonstrate tolerance of different points of view and use these to fuel our creativity.

'Organizational Ecology' (continued)

Sensing the environment Organisations often slide towards an inward focus since the organisation itself is the thing that is most visible to staff and its demands and priorities are tangible. It is easy to concentrate on what you do best and build on past experience to plan a way forward. Though this is an important part of a learning organisation, it needs to be balanced by continual sensing of the wider business environment. Nature has developed elaborate methods of sensing through sight, smell, touch and taste. Organisations need to actively develop its senses and build them in to the business processes.

Work on customer focus, service culture and stakeholder engagement has a big role to play in providing the information to allow us to sense our environment. The challenge is to remain receptive to the information we sense, it is ever so easy to build filters that make us feel comfortable. Our organisational senses should be continually exploring for opportunities and threats.

Ian Abbott-Donnelly

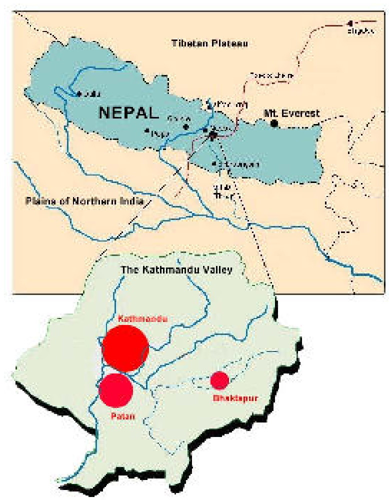
Triggering Self-Assembly of Biomimetic Green Chemistry in Nepal

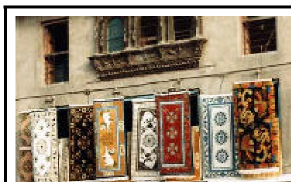
In March 2006, with a small grant from the Green Chemistry Institute in Washington, D.C., I took off for Kathmandu, Nepal to lead several workshops for college freshman and sophomores to spur interest in green chemistry and biomimicry.

Roughly the size of Florida and at about the same latitude, Nepal is host to a dramatic landscape. The country's 100 mile width soars from 200 feet above sea level at its border with India to nearly 30,000 feet along the spine of the Himalayas forming its border with Tibet.

Her main population center, the Kathmandu Valley, is a 25 mile wide former lake bed at an altitude of 4,500 feet. Today, urban sprawl and its accompanying pollution blur the distinction between the cities of Kathmandu, Patan, and Bhaktapur (once upon a time kingdoms in their own right) and is quickly encroaching upon many smaller towns within the Valley.

Until recently, industrial production in the Kathmandu Valley and other areas of Nepal had been associated with agriculture (production of cooking oils, dairy products, beer, leather tanning, soaps, and ayurvedic medicines), art and religion (paper making, casted brass or copper statues of Hindu and Buddhist deities, gold jewelry, and production of pigments used in religious paintings, textiles, and carpets), and architecture (firing of bricks and clay roof tiles). See "Traditional industries in Nepal" depicted below.





Carpets

Tanka paintings.

Carved metal statues.

Green Chemistry in Nepal (continued)


Ayurvedic medicines.


Silk saris and fabrics.


Dairy.


Brass and copper


Agriculture

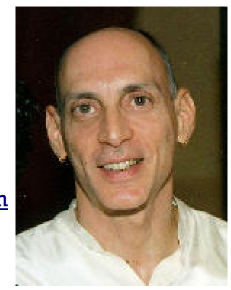

Textiles

Traditional industries in Nepal.

With the opening of the country to the outside world in 1950 and the transition from an absolute monarchy to a parliamentary democracy in 1990, the pace of industrial change has been dramatic. Modern industries that use synthetic, petrochemical feedstocks have emerged, such as dry cleaners, and manufacturers of plastics, foams, batteries, pharmaceuticals, etc. As a result, air and water pollution levels have increased exponentially (see photos below).

My experiences conducting biomimicry and green chemistry workshops in Nepal will appear in the November issue.

Mark H. Dorfman




Solid wastes.


Untreated factory wastewater.


Untreated air emissions from brick factories scattered across the Valley.


Cement factory pollution (low white cloud in distance).


Farmer washing vegetables in polluted river en route to market.


Mixture of metallic mercury and gold applied to metal statue. Mercury is fired off by hand-held torch posing exposure risk to workers.


Hardware store in Kathmandu. All items are manufactured, used, and disposed of in Nepal.

Pollution and potential hazards from traditional and modern industries in Nepal

Patterns in Nature—Volunteers Needed!

Multi-disciplinary collaboration is essential to practicing Biomimicry. At the same time, the trend towards specialization in the research and design disciplines makes communicating information amongst professionals challenging, regardless of the topic. In a new field such as Biomimicry, organizing information in a structured fashion can also be an issue.

Pattern Language shows promise in addressing both concerns. The concept was developed in the late 1970s by Christopher Alexander. Patterns are descriptions of common solutions to recurrent problems within a specific context. They capture insights that have 'stood the test of time', allowing users to focus on the important issues during problem analysis. By using simple terminology, patterns are accessible to anyone, regardless of discipline or level of expertise. This allows patterns to be communicated, shared and applied within a team or community, enabling everyone to contribute.

Patterns can be arranged into a network or hierarchy. A specific pattern is embedded in larger patterns, surrounded by patterns of the same scale, and is composed of smaller patterns that complete it. By using a common terminology at all levels, a Pattern Language placed problems and solutions in the larger context and encourages us to consider how individual solutions interact with the larger environment. It can also organize information at increasing levels of detail by expanding on component patterns and sub-solutions.

A Pattern Language does not dictate solutions—part of problem analysis involves identifying those patterns that are relevant to the particular context. Adjacent, larger and smaller patterns are explored to help reach a deeper understanding. This unique combination of relevant patterns leads to solutions that are at the same time aligned and flexible, able to adapt to changing conditions. Such an emergent or organic development can result in a complexity and vitality missing in many top-down designs.

Pattern Languages have been developed for architecture and software development. EcoTrust recently sponsored development of a Conservation Economy Pattern Language, an effort led by Stuart Cowan (co-author of *Ecological Design*).

I am looking for volunteers to help develop a Pattern Language based on natural principles. The goal is to get enough participation so that the individual work effort is small:

- For those with a biology background, write up a new pattern and critique an existing pattern.
- For non-biologists, provide a technical example and counter-example for two patterns.

To whet your appetite, download a preliminary version of Patterns in Nature. If you are interested, please contact:

Norbert Hoeller
patterns@sinet.ca

Society for Experimental Mechanics – 2007 Annual Conference

Mechanical and microstructural analyses of biological systems and materials represent a growing area of research and educational interest. To address this interest, the Society of Experimental Mechanics is organizing a Track for their 2007 Annual Meeting in Springfield, MA to bring together researchers and educators interested in developing novel tools and translating established mechanical techniques to address biological and bio-inspired problems in society, human health, and the natural world, as well as to educate students about them. The measurements that are made with these techniques have enabled a new understanding of nature that are resulting in improved biomedical devices and entirely new approached to engineering advanced materials and systems based on biological principles. While mechanical behavior has been at the core of these experiments, biological materials and systems are far more complex than their synthetic counterparts. Nature takes advantage of many different types of materials with multiple functionalities that are integrated together from the nanoscale through the macroscale. Furthermore, the exact nature of biological processes is being revealed through a better understanding of the chemical and physical principles involved at these length scales. Efforts to experimentally characterize these processes range from nanoscale studies of deformations in biological materials, to microscale sensors that have been designed to characterize biological processes, to macroscale structures that have been inspired by their biological counterparts. There are also many unique experimental challenges that are being been addressed, including measurements made in environments with extreme humidity and measurements

SEM – 2007 Annual Conference (continued)

acquired in biological systems comprised of both fluid and solid materials. Even problems such as fracture are complicated by the unique chemical bonding and physical characteristics present at the interface in biomaterials.

In this track, sessions are been organized that reflect the diversity of experimental research being conducted on biological and bio-inspired materials and systems, as well as the complementary effort to educate students about using this knowledge. Experimental research and education issues that will be addressed in this track include:

1. Bio-inspired Materials and Biomimetic Composites
2. Experimental Mechanics of the Natural World
3. Animal Biomechanics
4. Kinematics of Motion
5. Bio-MEMs or MEMs
6. High Strain Rate Testing of Biological and Soft Materials
7. Fracture of Biological Materials
8. Optic Methods for Biomechanics
9. Bioinspired education

More information about the meeting is available at http://www.sem.org or contact the Track organizer, Prof. Jane Grande-Allen at grande@rice.edu.

Prof. Hugh Bruck

Calendar of Public Events

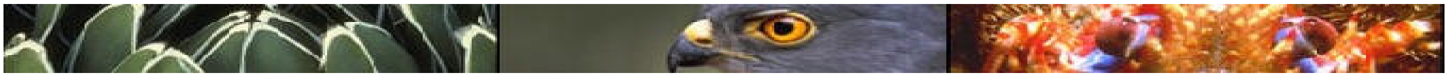
Date	Location	Event
Sept. 30	Providence, Rhode Island	New England Environmental Education Association conference (DB)
Oct. 4	New York, New York	Association for Contract Textiles 1st Annual Conference (JB)
Oct. 6	Chicago, Illinois	International Interior Design Association, Leader's Breakfast (JB)
Oct. 11-14	Las Gaviotas, Columbia	(JB)
Oct. 16	Fargo, North Dakota	Northern Great Plans Public Lecture, call 701-364-1349 (DB)
Oct. 17		North Dakota State University, University of North Dakota, University of Minnesota Crookston, 701-364-1349 (DB)
Oct. 21	Dartmouth, Massachusetts	Bioneers by the Bay, University of Massachusetts (JB)
Oct. 25	Berkeley, California	Public Lecture (JB)
Nov. 2	New York, New York	Advertising Age and Creativity Conference: Redefining Creativity, Teressa Iezzi (JB)

Date	Location	Event
Nov. 15	Laramie, WY	US Forest Service Sustainable Operations Summit, call 307-674-2615 (DB)
Nov. 18	Chicago, IL	"Massive Change and the City: Global Visionaries Symposium", (DB)
Nov. 26-Dec. 2	Japan	ZERI collaboration (JB)

Table 2: Biomimicry Guild Events

Date	Location	Event
Sept. 17-20	Chanhchun, China	International Conference of Bionic Engineering
Sept. 29	Reading, UK	Biomimetics 11: Biomimetics and Sustainable Environments
Oct. 20-22	San Rafael, California	17th Bioneers
Dec. 17-20	Kunming, China	Conference on Robotics and Biomimetics
June 3-6, 2007	Springfield, Massachusetts	2007 SEM Annual Conference and Exposition

Table 3: Other Events



"Biomimicry (from *bios*, meaning life, and *mimesis*, meaning to imitate) is a new science that studies nature's best ideas and then imitates these designs and processes to solve human problems. Studying a leaf to invent a better solar cell is an example. I think of it as "innovation inspired by nature."

The core idea is that nature, imaginative by necessity, has already solved many of the problems we are grappling with. Animals, plants, and microbes are the consummate engineers. They have found what works, what is appropriate, and most important, what lasts here on Earth. This is the real news of biomimicry: After 3.8 billion years of research and development, failures are fossils, and what surrounds us is the secret to survival.

Like the viceroy butterfly imitating the monarch, we humans are imitating the best and brightest organisms in our habitat. We are learning, for instance, how to harness energy like a leaf, grow food like a prairie, build ceramics like an abalone, self-medicate like a chimp, compute like a cell, and run a business like a hickory forest.

The conscious emulation of life's genius is a survival strategy for the human race, a path to a sustainable future. The more our world looks and functions like the natural world, the more likely we are to endure on this home that is ours, but not ours alone."

A Conversation with Janine Benyus

BioInspired! is published quarterly and is posted on a public-access Weblog hosted by TypePad. For those of you familiar with RSS Readers, TypePad supports various feed formats (look for the *Subscribe to this blog's feed* link in the right navigator).

Comments can be posted on the newsletter Weblog. At this time, the TypePad RSS feed does not deliver comments.

If you wish to subscribe to this newsletter, please complete the BioFeedback form and check off 'Newsletter'.

Last, but not least, please send any feedback or comments to:

newsletter@biomimicry.org

Norbert Hoeller

Clippings, Resources and Events

Three public-access Weblogs hosted on TypePad are now available to share information of interest to the Biomimicry Community.

- Clippings contains short articles on issues relating to Biomimicry.
- Resources contains pointers to more extensive information.
- Events covers workshops and relevant conferences.

These Weblogs can be viewed with your favorite RSS Reader. Anyone can post comments. Please be aware that TypePad requires an e-mail address and will display this address to people viewing the comment. Each Weblog has a 'sticky' post at the top with suggestions on how to reduce the impact of getting SPAMed.

Past issues of John Mlade's BioInspire magazine are posted on ThinkCycle. BioInspire will be migrated to TypePad shortly.

Contributions of clippings, resources and events are greatly appreciated! Please see the note at the top of each Weblog for instructions.

Thanks,
Norbert Hoeller

Biomimicry Guild Job Openings

The Biomimicry Guild has three job openings:

- Investigative Scientific Researcher
- Biologist at the Design Table
- Business Catalyst

For more information, please contact Rose Tocke at roset@biomimicry.net or 1-406-495-1858.