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ALCOA FOUNDATION'S CONSERVATION AND SUSTAINABILITY FELLOWSHIP PROGRAM

sustaining gondwana

Harnessing local, place-based knowledge for sustainable outcomes

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The theory and practice of ecomimicry

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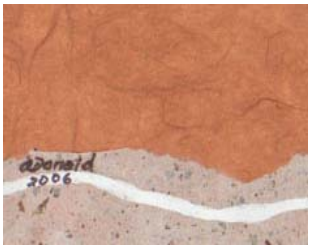

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Advancing Sustainability

Curtin University of Technology

sustaining gondwana
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Contents

BIOMIMICRY IS THE PRACTICE OF MIMICKING NATURE IN ORDER TO IMAGINE AND DESIGN NEW TECHNOLOGIES. BIOMIMICRY ASSUMES THAT NATURE IS CREATIVE BY NECESSITY AND THAT OVER EONS OF TIME--SOME 4 BILLION YEARS -- IT HAS EVOLVED SUSTAINABLE SOLUTIONS TO MANY OF THE RESOURCE AND POLLUTION PROBLEMS WE HUMANS ARE GRAPPLING WITH NOW. THUS, NATURE CAN SERVE AS AN IMPORTANT MENTOR AS WE ADDRESS THESE PROBLEMS. IN THIS PUBLICATION, THE THEORY BEHIND THE REFINED CONCEPT OF ECOMIMICRY IS EXPLAINED.

THE AIM OF THE PROJECT ON WHICH THIS PUBLICATION IS BASED IS TO INITIATE A PROGRAMME OF ECOMIMICRY WITHIN THE SOUTH COAST OF WESTERN AUSTRALIA BY IMAGINATIVELY DRAWING TOGETHER THE KNOWLEDGE OF LOCAL COMMUNITY MEMBERS. SOME OF THE PRELIMINARY IDEAS FOR ECOMIMICRY-INSPIRED INNOVATIONS ARE PRESENTED IN ORDER TO PROVIDE A FORETASTE OF THE BOOK THAT WILL ULTIMATELY BE WRITTEN, WHICH IS PROVISIONALLY TITLED ‘DESIGN RUNNING WILD’.

Dr Alan Marshall is interested in science and society. He completed the first year of his Fellowship at Curtin in 2006, and has taken a one-year interlude to work at Presou University, near the Slovakian part of the Carpathian Mountain Range, where he is conducting research and teaching about ecomimicry. He will return to Curtin University in 2008.

ALCOA FOUNDATION
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Series Editors: Professor Jonathan Majer & Professor Daniela Stehlik

Introduction

Innovation has many sources of inspiration. One source is Nature. Before Leonardo da Vinci was leaving hidden codes in his paintings he was crafting flying machines based upon observations of birds and bats (Laurenza, Tadei & Zenon 2006).

In recent decades there has been an attempted formalization of what we can call 'bio-inspired design'; design inspired by living Nature. This formalization has proceeded from a field called bionics, through a field called biomimetics to a latest incarnation known as biomimicry. These forms of bio-inspired design may be chronologised in the following way:

Bionics is a term invented by Jack Steele of the US Air Force in 1960 at a meeting at Wright-Patterson Air Force base in Dayton, Ohio, to describe the prospective field involving copying, imitating and learning from Nature. Since then the term in English has become focused upon mimicking human tissues and organs for biomedical purposes (thus it might be thought contiguous with biomechanical engineering). There are numerous bionics departments around the world's schools of engineering or medicine.

Biomimetics is a term that was coined by American inventor Otto Schmitt to cover all aspects of bio-inspired design but the way it is applied by practitioners tends still to be in hardware sciences such as bioengineering and biomaterials. It is also used by various bio-designers as an enveloping term that would sufficiently cover bionics, robotics, animatronics and bio-inspired computing. There are a number of Centers of Biomimetics at universities in the English speaking world, including NYU, Duke University, Georgia Technical University and the Universities of Bath and Reading.

Biomimicry is a catch-all phrase coined by Janine Benyus in the 1990s that would cover the terms biomimetics and bionics. Benyus has environmental sympathies that imbue the concept with a Green tinge. So far, no 'Department of Biomimicry' exists but there is a Biomimicry Institute in Montana that offers workshops and coordinates some biomimicry practice. It might be noted that many practitioners see biomimicry and biomimetics as synonymous.

This paper seeks to describe yet another incarnation of bio-inspired design, one that draws upon biomimicry but fashions it anew with the spirit of environmental conservation and community participation. It might be defined like this:

Ecomimicry is the practice of designing socially responsive and environmental responsible technologies for a particular locale based upon the characteristics of animals, plants and ecosystems of that locale.

Whether such a form of bio-inspired design is unique and sustainable, or even possible or meaningful, is currently under study within the *Sustaining Gondwana* initiative. In the autumn of 2006, I began the Ecomimicry Project as a Research Fellow under the auspices of the *Sustaining Gondwana* initiative in the Department of Environmental Biology and the Alcoa Research Centre for Stronger Communities at Curtin University of Technology.

The *Sustaining Gondwana* initiative has as its area of study the coastal part of the Great Southern region of Western Australia. The aim of the Ecomimicry Project is to draw inspiration from the unique ecology of the Great Southern region of Western Australia in order to design technologies and practices based upon the local wildlife and the local landscape. This paper reports on work completed to date.

Ecomimicry as an exercise in innovation and design

Ecomimicry is basically a process of innovation. It involves mimicking local animals and plants (or their ecological settings) to produce innovations that foster sustainability. Whilst similar to fields variously known as 'biomimicry', 'biomimetics' and 'bionics', it is more careful to draw strength from the local natural history to give rise to innovations suitable for local applications. The theory is that the animals and plants native to a particular landscape are very well adapted to utilising the physical and biotic environment without inflicting inordinate harm upon it; therefore they serve as the best inspiration for designing technologies and practices that also fit into the local environment.

The obvious question for those involved in innovation and/or design would be 'why do any of this?' Designers, for example, have been churning out their products without the need to copy Nature for many hundreds of years, using tools and traditions with a greater track record than bio-inspiration has yet to offer. To add a biological reference to the design process in the manner that biomimicry fans advocate (see below) may well seem a pointless series of extra steps in the competitive struggle to quickly and efficiently satisfy the Marketplace or the Public Good.

Even when it comes to designing environmentally-friendly goods and services, designers have in recent years developed tools and traditions such as environmental auditing, sustainable design, life-cycle analysis etc, all with a point to

bring some sort of eco-friendliness to designed products and services, without directly copying Nature.

Proponents of biomimicry feel that the structures and functions and behaviours of the world's plants and animals represent solid tools and traditions that have successfully helped organisms cope with their unique environments for ecologically significant periods of time. It is not waste of time or effort, biomimicry adherents would suggest, if we are able to give rise to novel and/or sustainable solutions.

Ecomimicry as an environmental exercise

Proponents of biomimicry believe the extant animals and plants of the world have not only survived through supremely good design but they have largely managed to integrate themselves into a wider environment without destroying it. If humans somehow mimic these patterns of ecological integration as we design new technologies, then we may have a better chance of making the technologies sustainable. Thus, the process of biomimicry is said to be capable of achieving two things in tandem:

- It will enable humans to avail themselves of some really novel technologies; and
- It will provide these really novel technologies in an inherently sustainable way.

Whilst the most popular work on biomimicry, Benyus (1998), comes across quite strong about the eco-friendly nature of biomimicry, this is not always how the practice of biomimicry unfolds. For instance, if we take a short trip through some recent research projects in biomimicry, we find projects devoted to:

- Designing undetectable surveillance cameras based on the compounds of insect eyes (Duparre & Wippermann 2006; Toko 2005);
- Emulating biological molecules, such as DNA, to create industrial nanomachines (Bar-Cohen 2006; Lerner 2000; Martin 2006);
- Exploring other planets with spacecraft inspired by insects, spiders and worms (Ayre 2004; Thakoor 1999);
- Inventing new military technologies based on all kinds animals and plants (Forbes 2003; Butler 2005); and
- Fashioning new consumer bio-inspired products, from bionic automobiles (Mercedes Benz 2005) to genetically-engineered fibres (Teule, Aube, Ellison & Abbott 2004).

Without exploring the possible merits and demerits of such biomimetic technologies, as listed above for one or other sector of the economy, it is still hard to see them as any where near environmentally friendly.

None of these projects have pronounced sustainability credentials. Some probably involve expanded ecological footprints and others a high degree of environmental risk. It is also noteworthy that the prime funders of large-scale biomimicry research are tending to be the defense industry, along with various large corporations. What this suggests is that biomimicry may indeed be a profitable way to render Nature's secrets available for human use but it is a tool with as much capacity for environmental harm as for eco-friendliness.

Given all this, it might be thought that biomimcry is but another form of Green Wash. After all, doing things as Nature does them, does add a veneer of Green in the minds of clients and consumers. According to Vincent (2000:1), if you "tell someone that an idea comes from Nature, you're halfway toward selling it".

Benyus, perhaps one of the most eco-sympathetic voices in biomimicry, is also attempting to publicize the notion of 'giving thanks' to organisms that serve to inspire human innovations (Benyus 1998). She encourages those organizations that have benefited from mimicking Nature to devote some of their profits to conserving the piece of Nature that inspired the technology. This approach can be criticized as a tokenistic, end-of-pipe solution to the systemic problem of wilderness destruction rather than a systematic re-arrangement of industrial practice.

The purpose of the ecomimicry concept, in regard to all of these points, is to clearly round out a principle of bio-inspiration, whereby the sustainability factor is explicit. I propose the ecomimicry label to apply only to those forms of bio-inspiration which are outwardly environmental.

When judging what is or is not 'environmental' as one contemplates ecomimicry designs, numerous established indicators may be referred to. A number of biomimicry proponents have advanced some which are potentially relevant, and in this project the designs produced are stacked up against the principles espoused by scholars such as Janine Benyus (1998). It is equally possible, though, for other traditions of environmental evaluation to be relevant, such as Green Accounting and Technology Design Assessment (see, for example, Dorf 2001).

Ecomimicry as a political exercise

As various commentators have noted, Markets encourage innovation but they do not necessarily ensure the public interest. Those authorities charged with

ensuring innovation to please the Market might also be said to be serving Market needs and not those of the Public, by sponsoring commercialisable products rather than socially and environmentally responsible ones (and measuring their success or failure in purely commercial terms). Ecomimicry does not preclude the possibility that Market needs, Government goals, and social needs are always mismatched. However, in line with many social critiques of technology (Winner 1986), it is wary that the Markets (or experts working for governments) can provide for the rise of democratically chosen technologies that suit the needs and desires of people and their local physical and social context.

A fundamental political tenet of ecomimicry, and one that harks back to the principles of localism, might be that the design of technology needs to have community input in someway. When it comes to the implementation of a major new technology for instance, I believe that the local community should be consulted about the process from the very beginning and then included in the actual decision-making and design process.

Usually, the first possibility for the public to react to a technological innovation is when they are forced to adjust to its introduction by a private or public service provider. By this time, the technology has been decided upon, researched, developed, and mass produced. The technology will be bound to create winners and losers of various community members, altering their work or personal lives or challenging their values in some way or another. Most of the winners from a technological project would like us to be philosophical about technological change, accepting it as inevitable and suggesting that it offers new opportunities for all. The losers, however, would steadfastly class the change as disruptive, divisive or demeaning. Realizing the impossibility of community members to approve or veto most technological decisions, ecomimicry would encourage far earlier involvement with technological innovations to the point where people become the designers of what they perceive to be their own technological needs. In this way, even if their designs will not be built, they will gain social and ecological tools that help them learn about their environment and they will engage in deconstructing the necessity and assumptions of current technologies before going on to develop skills in envisaging technologies. In this way, they will be far less likely to be the passive losers in any technological innovation.

Ecomimicry would also encourage a broadening of the concept of innovation beyond commerciality and mass-produced goods. A difference between ecomimicry and biomimcry thus lies in their different positions regarding the ‘Market’. Biomimicry proponents would work to identify a ‘target market’, whereas ecomimicry proponents

would comprise the target market itself. As well as this, ecomimicry allows space for community members to use design as a playground for exploring alternative futures, for taking control of technology, and for arresting innovation and design from being made to conform to profit-motives. By contrast biomimicry:

- May or may not involve eco-friendly technological design;
- Is invented and regulated by experts; and
- Works within the mass market without much democratic input.

Ecomimicry, on the other hand, will operate to be:

- Inherently sustainable from an environmental and social point of view;
- Encouraging of decentralization and localism;
- Democratic when it comes to decision-making over technological change;
- Understood by all, not just by the experts; and
- Will be sensitive to the need to disperse power rather than to concentrate it (for the benefit of local people and their environment).

One of the parallel fields in this regard is the appropriate technology movement (Dorf & Hunter 1978; Hazeltine & Bull 2002) which seeks to utilise local human knowledge to solve local development needs rather than importing dependence-creating solutions from elsewhere. All these suggestions work within the social dimension of design and can be woven into the practice of bio-inspired design in order to synergistically get the most out of human communities as well as biotic communities.

The introduction of the label ‘ecomimicry’, does not, of course, have to be an interpreted launch of a grand new philosophy and practice of technology, it may merely act as a categorization system that delineates between practices of mimicking Nature that aren’t particularly socially and environmentally responsible (biomimicry) and practices of mimicking Nature that aim to be environmentally-sensitive and socially just (ecomimicry). Within the Great Southern, for instance, a number of established projects might already qualify as being ecomimicry, such as:

- The Gondwana Link project, which seeks to restore the degraded landscape of South West Western Australia so that it mimics the diversity and scale of the pre-European landscape (Recher 2004);
- Ongoing research with regards to agro-forestry systems that mimic natural vegetation systems (Lefroy, Hobbs, O'Connor & Pate 1999);
- Permaculture farms in the South West of Australia such as the Rosneath Eco-Village; and

- Ian Weir's eco-architectural perspectives South Coast.

Ecomimicry as a philosophical exercise

One might believe imitation to be the greatest compliment. If so, then are we complimenting Nature when we seek to emulate her? In one way, biomimicry proponents are paying homage to the ingenuity of Nature; admitting that Nature has solved some generic physical problems better than human designers have. At the same time, though, the practice of biomimicry seems to show deep disrespect to Nature; stealing ideas from Nature" (Vincent 2002) in a manner that borders on biopiracy (Shiva 1997). If Nature has four billion years of research and development waiting to be tapped into, as the biomimics like to sloganeer, then do they not instantaneously objectify the members of the ecological community into mere resources rather than regarding them as subjects worthy of interaction, care and respect?

Ecomimicry, though, would strive to not only learn from Nature, but also to respect the intrinsic values of animal and plant species within the process of design. Thus, if the design is not environmentally-friendly and endangers the existence of non-human species, it would not be referred to as ecomimicry.

Nature is a big thing, of course; both physically and conceptually. There are many levels within it that may serve as a basis for bio-inspiration; from the molecular level, through the organismal level to the ecosystem and biosphere levels. There is also a lot going on in Nature: birth, death, sex, cooperation, competition, parasitism, predation, scavenging, nurturing and care, movement and mechanics, cycling and recycling, growth and decay etc. Some of these processes appear quite amazing and wonderful to us humans, some of it wasteful and cruel. Philosophical reflection upon the great diversity of processes in Nature might lead one to regard it as so riddled with self-contradictory diversity that it is impossible to extract any general principles from it. For all the examples we may give where Nature seems dynamic and regenerative, for instance, there are plenty of examples that show it to be sluggish and degenerative.

Despite the amazing diversity of nature, Benyus (1998) believes it is important for biomimics to take account of certain basic laws of Nature when they engage in the practice of biomimicry. For her, there are nine such basic laws:

- Nature runs on sunlight;
- Nature uses only the energy it needs;

- Nature fits form to function;
- Nature recycles everything (finding a use for all wastes);
- Nature rewards cooperation;
- Nature banks on diversity;
- Nature demands local expertise;
- Nature curbs excesses from within; and
- Nature taps the power of limits.

If ecomimicry is sympathetic to the idea of respecting natural laws, then it still would be prudent to reflect upon the fact that critics from a positivist slant (whereby it is held that true knowledge about Nature is obtainable if you use the correct approach) would surely like to point out that all these basic laws of Nature are broken by Nature herself. For instance, with regards to the seventh law above, there are generalist organisms that rove around wildly different geographic regions with no great adaptations to local situations, yet they still thrive. Similarly with regard to the first law, some organisms deep in the ocean feed within ecosystems totally removed from the impact of solar radiation. From this point of view, there may be a problem in practicing biomimicry based on any 'basic law of Nature', since what is or isn't a 'basic law of Nature' is entirely contestable. Nature, at least biological Nature, is just too diverse to be generalizable into laws.

Critics from a constructionist slant (whereby the secrets of Nature are believed to be constructed by humans rather than revealed by them) would suggest that these 'Laws of Nature' have been projected on to Nature by Benyus because she feels they reflect worthy or workable goals and values (from both a technical and philosophical perspective). Other biomimics--in a project to strengthen the focus of biomimicry--have also engaged in relating what they see as basic 'laws of Nature' worth mimicking; Stach (2004) indicating "self-organisation is the defining principle of Nature", for example, and Faludi (2005) and Zhang, Yokoi & Zhao (2006) indicating that fractal organization and self-assembly are 'General Principles in Nature'. Various constructionist reactions to these proffered "laws of Nature" offered by biomimics might be:

- Don't trust the 'laws of nature' espoused by biomimics and ecomimics since they are filtered through the values and politics of those that espouse them and so are mere delusions;
- Don't trust the laws of Nature espoused by biomimics and ecomimics since they are filtered through the values and politics of those that espouse them and may well be ideologically distasteful (the ideological

danger of naturalistic mimicking can be observed, for instance, when proponents of biomimicry, like Rothschild (1990) say that the functioning of ecosystems prove that liberal capitalism is the natural--and best--form of human social organisation); or

- Interpret the 'laws of nature' espoused by biomimics and ecomimics with a grain of salt as myths and metaphors that serve some purpose but judge them by that purpose and by the politics and values they espouse rather than their claimed authority from Nature. From this perspective, although we know that the laws of Nature are myths and metaphors, they might actually work to make the world a better place if the values within them complement social and ecological welfare.

If you approach bio- or ecomimicry from a positivist slant, believing at least some of our human knowledge about Nature reflects true reality, then at some point you are going to have to wrestle with what Nature actually is. In our professional lives, scientists, technologists, designers and philosophers struggle to codify the term 'Nature'. Depending on what particular rhetorical struggle we might be engaged with at any one moment:

- Nature may be everything that is, excluding humans or God;
- Nature may be everything that ever is, including humans and God; and/or
- Nature may be everything that didn't come about by human artifice. So human bodies may indeed be natural but the things we make with our hands and minds (in response to various forces) are artificial.

Mapped on top of this, we also have ideas that Nature may be discrete living things (bugs, birches, birds and buffalo, for instance) or discrete non-living things (rocks, rivers, rain etc). Nature may also be indiscrete processes (evolution, self-generation, self-assembly, homeostasis, natural selection, etc).

Given the diverse categories of things that are natural, and given the diverse principles that we ascribe to Nature, it is likely we act both in accordance with Nature and against it at the same moment. Thus, we might be said to be mimicking Nature when we share resources in a cooperative manner since this is what various parts of Nature happen to do (penguins form social crèches to take care of their young, bacteria cooperate symbiotically with trees to provide nitrogen etc). Also, though, we might be said to be mimicking Nature when we fight and compete for resources (since parts of Nature are said to be 'Red in Tooth and Claw').

Given this, there is ample space for intellectual contest over what Nature is

trying to teach us. Philosophers have often resorted to the 'is-ought' problem (Schulz 1997) when reflecting on these tensions (stating that what 'ought' to be done does not logically follow from what 'is' in Life or Nature) but biomimicry proponents do not have this luxury since they are advocating that what 'is' in Life or Nature ought to be mimicked in the technological and industrial world of humans.

If the concept 'Nature' is slippery within the field of biomimicry then so is the concept of 'mimicry'. Mimicry means imitating something but biomimics admit that their not really involved in imitation *per se* but in emulation. Thus what we are doing is not copying but gaining insights that might be of use. Benyus, would sum it up by saying that Nature should be regarded as our teacher. By this reckoning, Nature can guide us toward developing our own solutions.

When contemplating Nature as a teacher, it soon becomes clear that Nature can be thought of as a teacher in two main ways:

- As a teacher of values and morals (in which case we can be guided by Nature in what Rolston (1979) says is in an 'imitative ethical sense'); and
- As a technical advisor (in which we follow nature in what Rolston (1979) suggests is in a 'tutorial' manner).

Most biomimics would probably want to suggest that the technical part is the main preserve of biomimicry and this might well apply to Janine Benyus as well. For all her talk of Nature's wisdom, and the need to respect it, she spends most of her *Biomimicry* book remarking upon the need for humans to adopt the amazing 'technologies of Nature'.

According to a number of workers on the social studies of both Nature (Mirowski 1994; Horigan 1988; Marshall 2002) and technology (Winner 1986; Mayr 1986; Mitcham 1994), it is nigh on impossible to have:

- stories about Nature without values embedded in them; or
- technologies without values embedded in them.

This means that the practice of biomimicry would have a double-set of values as it goes about its bio-inspired designs. On this score, also, any biomimicked product that is said to mimic a certain natural phenomena or object will necessarily be replete with two (and probably more) sets of values.

Technical advice gleaned from Nature will contain a cocktail of undeclared values. The exact mix of values for any biomimicked technology will probably be unique to that technology and require intensive study to identify. Cursory examples might include the following three suggestions:

Permaculture is a form of biomimicry that mimics natural ecosystems for

agricultural purposes. It is thus a riddled with a whole bunch of values related to challenging industrial farming, celebrating local resource use, and the promotion of better eating, communalism and stepping lightly on the environment. The permaculturalists have a whole litany of philosophical principles that they believe accompany the practice of permaculture (see Holmgren 2002 and Hemenway 2001) from preserving natural balance to intergenerational ethics.

Space biomimicry is a field that attempts to learn techniques from animals and plants that will be useful in space projects (Ayre 2004; Siochi, Anders, Cox, Jegley, Fox, & Katzberg 2002). The values within such research, of which NASA and the European Space Agency are key sponsors, imply that space development and colonisation is a good thing and that public investment in big science projects (with minimal social return) is a worthy way to spend tax-payer funds.

Industrial Ecology is a form of biomimicry that tries to mimic natural ecosystems in an industrial setting. The idea is to mimic the processes going on in Nature, for instance, recycling of waste materials. The values of such an ambitious project reflect the idea that industrialism can, and ought to be, made more eco-friendly, and that technical expertise in translating (either figuratively or literally) the patterns of ecosystems is the way to do this. Since the precise notion of Nature that industrial ecologists use is a 'system', the goal of preserving the 'system' rather than its members (be they species or people) is the implicit result.

Because ecomimicry acknowledges the social background of present technology far more than biomimicry, it may well be in a better philosophical position to acknowledge the way values and morals impinge on all designed technologies and so will be more reflective about the way values infiltrate its own design process.

Ecomimicry as a method of innovation

One of the ways to show the distinctions between biomimicry and ecomimicry is to layout a summary of the respective methodologies (acknowledging that both of these can be considered 'works-in-progress').

The biomimicry strategy of innovation might be summarised as follows (from Biomimicry Guild 2007):

- Develop a design brief of the human/market need (in consultation with commercial enterprise);
- 'Biologize' the question; identify nature's solutions (in consultation with biologists and specialists in the field);

- Develop ideas and solutions based on the natural models;
- Evaluate according to sustainability criteria (including via Janine Benyus and the 'nine Basic Laws of nature").

This method of innovation is actually quite traditional (except for the fact that biological inspiration is involved) since it relies on experts and it places great emphases on a perceived Market need (or regulated Market requirements) rather than the specialised needs of local areas. The above strategy is also to be implemented by a new breed of expert; what Benyus calls bio-design experts (biologists with design training or designers with biological training). None of this is to say that the above is not effective, it just that it may be more effective in contributing to *status quo* product design and to environmental modernisation than to helping people and saving the environment.

Conversely, the ecomimicry strategy of innovation would be this:

- Invite community members to become involved in design projects whether they are experts or not;
- Define social, economic and environmental needs of a particular locale with or through these community members;
- As individuals or in groups, encourage the members to get to know their local animals and plants and to identify the strategies these animals and plants have which help them solve problems in their lifeworlds;
- As individuals or in groups, develop ideas and solutions based upon the natural models and then judge them against both social and environmental context.

This strategy is at once informed by biomimicry but also breaks out of the traditional design mode. First of all, it down-plays the all-encompassing significance of experts; preferring to encourage design from below. A variation would be to include experts in design, conservation and biology as consultants at the various stages of the process.

Preliminary Designs of the Ecomimicry Project

The Ecomimicry Project seeks to design ecofriendly technologies based upon inspirations gleaned from the natural history of the Great Southern. It is an international project focused upon the unique flora and fauna of the southern Western Australia.

After conducting workshops in the Albany campus of the University of Western

Australia, the Albany office of the Alcoa Research Centre for Stronger Communities and the Curtin University of Technology main campus in Perth, a series of designs emerged both from groups and from individuals. By the time the project is finished it is hoped that many more designs will be developed and finalised. These designs will be presented in a colour book of some 150-200 pages which has the working title *Design Running Wild*. As befitting the discipline of Design, the book will be a 'Creative Production' as far as categories of Curtin University Technology outputs are concerned.

Recently, as well, the Project has expanded into another study area. The author has been awarded a fellowship to teach and research ecomimicry at the Faculty of Humanities and Natural Sciences at the University of Presov in Slovakia. This fellowship will enable the author to repeat the work done in Western Australia in the geographical area of the Carpathian Mountains in Eastern Europe during 2007. If successful, the designs that emerge from this study area will also be included in the book.

Basically, *Design Running Wild* will be a 'design book', with copious drawings of design ideas, as well as photographs and information about the animals and plants which inspired the designs. With the help of the designers, and with assistance from ecologists and conservationists of the Great Southern and the Carpathian Mountains, the author of this paper will edit and compose the layout and text of book. The text will introduce the designs, the animal or plant the design was based upon, and the reasons why the designs will be of benefit to the people and environment of the Great Southern or Carpathian Mountains.

It is assumed that the local flora and fauna of the Great Southern or Carpathian Mountains will serve as the best templates from which to imagine eco-friendly technologies since it is the local flora and fauna that have adjusted themselves to fit their specific environments without being overtly destructive.

As well as encouraging ecomimicry projects in other regions of the world, it is also hoped that the finished book will highlight the unique flora and fauna of the Great Southern and Carpathian Mountains to conservationists worldwide.

For the remainder of this working paper, a collection of sample pages of provisional designs (as well as an introduction to ecomimicry) is attached. The layout is the provisional layout as planned for the final book. The designs, too, are provisional and much of their technical and theoretical background is still being developed. At the moment, only Great Southern designs are represented, since the Carpathian Mountains part of the project has not commenced.

THE ECOMIMICRY PROJECT

LOCAL SOLUTIONS

Nature is an immense thing, both conceptually and spatially. While there may be some universal processes that affect *all* living things, many animals and plants have evolved highly specific solutions to their local environmental challenges.

The Ecomimicry Project is an experiment in innovation. The hypothesis is that Nature may serve as inspiration for eco-friendly design. Animals and plants in the natural world have had to invent all sorts of solutions to the physical and environmental problems they have faced. Given the great diversity of these solutions and the millions of years over which they have been perfected, it is quite probable that there is an abundance of clever ideas out there just waiting to be tapped into.

An important part of ecomimicry is to consider the flora and fauna of local settings as the bases of innovations since the local biota will be best adapted to the local physical limits. If innovations are to be eco-friendly and sustainable then inspiration from local species is likely to be most fruitful.

The Ecomimicry Project works creatively with the knowledge of designers, biologists and conservationists, as well as interested members of the local community, to draw up designs and ideas that might foster sustainability in the Great Southern region. This publication exhibits many of the designs that emerged in this project. It is a publication that serves as a manifesto and a prospectus. It is a manifesto for designing products, technological systems and artworks in an alternative way and it is a prospectus to offer up the designs for further collaboration and development.

Design Running Wild

A LOCAL PROJECT, A GLOBAL PROJECT

Despite drawing design ideas from the local ecology, when it comes to human communities, the project has both a global element and a local element. The former involves worldwide submissions of bio-inspired designs based on the wildlife and landscapes of the Great Southern. The local element involves gathering together interested members of the Great Southern together into a design workshop to do the same. The project is also being expanded to include another study area; the Carpathian Mountains of Eastern Europe.

A Descendent of Biomimicry:

The concept of ecomimicry presented here is descended from the concept of biomimicry (as developed by the likes of Janine Benyus[1] and Steve Vogel[2]) Ecomimicry, though, is more careful to imagine solutions that serve the local environment and local community rather than the global marketplace.

The term Ecomimicry alludes to ecofriendliness in design whilst also suggesting that the interactive ecology of nature should inspire design ideas rather than just one organism. This project does not require strict adherence to the second of these aspects and even the first can be interpreted in an imaginative way.

1. Janine Benyus, 1998, *Biomimicry: Innovation Inspired by Nature*, HarperCollins, N.Y.
2. Vogel, Steve, 1988, *Life's Devices: The Physical World of Animals and Plants*, Princeton University Press, Princeton, N.J.

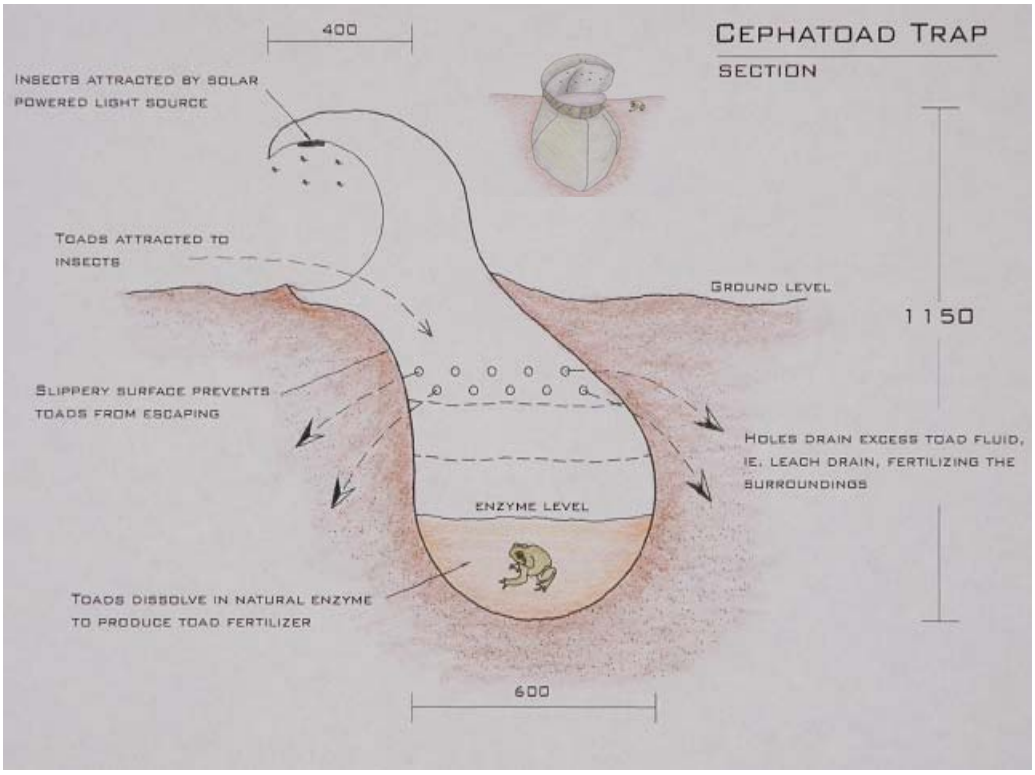
The Cephatoad Trap

Designers: Jessica Rodici, Cathy Groso, Rosanna Douglas, Emil Roskoszny

Cane toads (*Bufo marinus*) were introduced to Queensland, an eastern Australian state, in the 1930s to control pest insects in the sugar cane fields. Since then they have bred excessively and expanded their range westwards to become a major pest. Soon, it is likely they will make headway into Western Australia. Cane toads bid their destruction by eating and being eaten. They predate upon useful insects (like honey bees and dung beetles) and they themselves get predated upon by Australian vertebrates, an act which more often than not poisons their attacker. Snakes, lizards, crocodiles, birds and domestic dogs, have all succumbed to poison as they have attempted to eat cane toads.

The Cephatoad Trap design is based on the features of *Cephalotus follicularis*, also known as the Albany Pitcher Plant. The plant is carnivorous, gaining essential nutrients from ants and other small insects that get trapped in its pitcher. It works by luring the insects with sweet smelling nectar. The insects cannot escape due to the smooth walls and jagged lip so they soon drown and dissolve within the fluid filled pitcher.

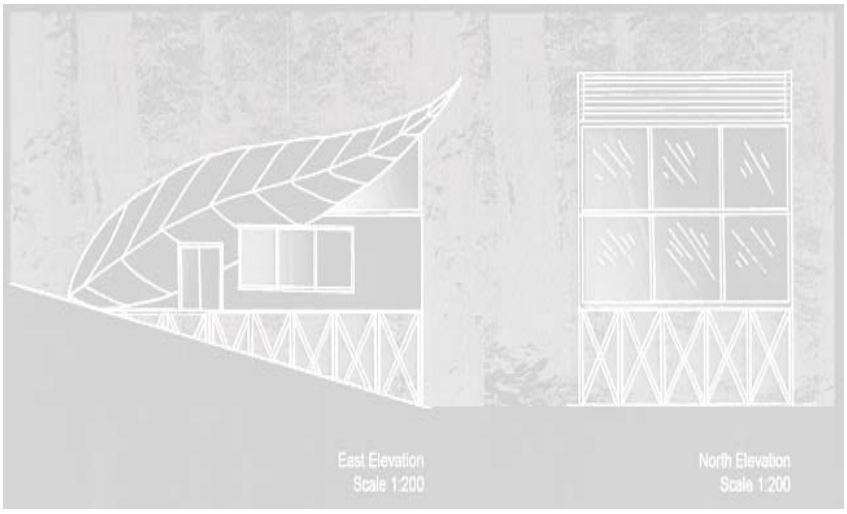
The Cephatoad trap works in much the same way except on a larger scale. The toads are lured to the trap by insects hovering around a light source. If they venture too near the slippery precipice, they fall into a subterranean pitcher and dissolve in the natural enzymes contained therein.



The Denmark Wildlife Museum

Designers: Scott Wong, Valentina Ponomariova, John McSweeney

The Denmark Wildlife Museum aims to educate people about conservation of the Great Southern's flora and fauna. The museum, raised from the ground to avoid disrupting the land, allows people to not only learn from the displays inside but also by observing nature from the observation point on the second floor. The roof, shaped like a Eucalyptus leaf, collects rainwater for washbasins and bathrooms, whilst also housing solar panels to collect energy for lighting.

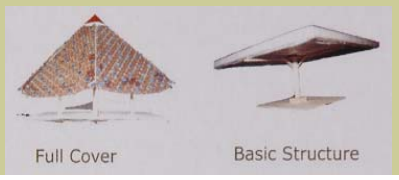


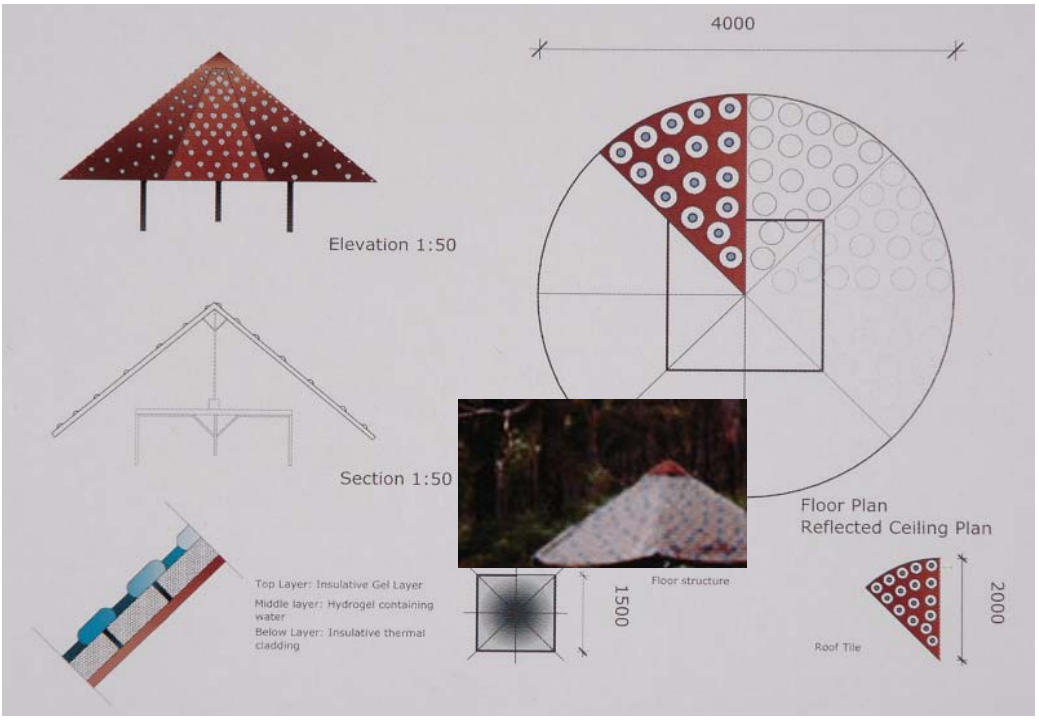
The Toadstool Shelter

Designers: CJ De Silva, Samantha Covarr, and Claire Smith

The toadstool is a mythological home to fairies and pixies in both European and indigenous Australian culture. The designers of the Toadstool Shelter play with this idea as they developed a concept for shelter that can be erected for the protection of human bushwalkers in the Great Southern landscape.

The distinct coloration of the Toadstool Shelter derives from the hydrogel units embedded in the middle layer of the cap which regularly extends out through the surface. This layer retains water that falls upon it and can be extracted for drinking by thirsty bushwalkers. Whilst these drawings detail a semi-permanent structure, the designers also envision a collapsible variation to be transportable by bushwalkers; one that folds into a pack-sized bag.

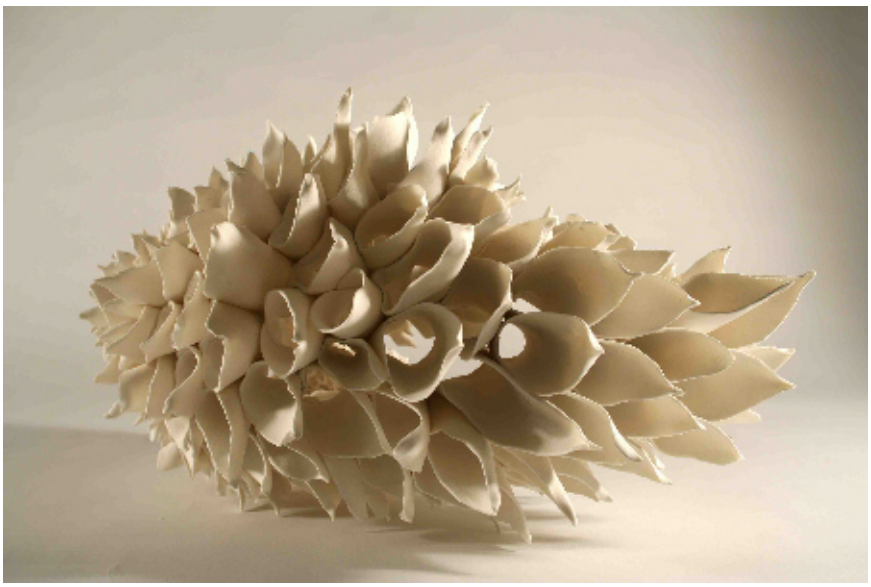




Banksia Sculptures

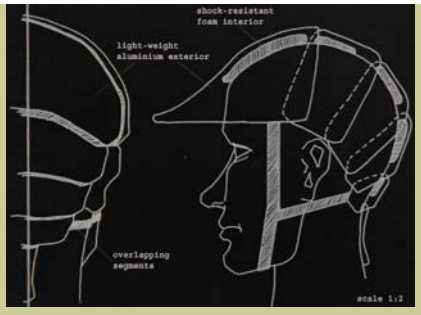
Designer: Nuala O'Donnell

Nuala O'Donnell has been inspired by the patterns and proportions of *Banksia* seeds as a starting point for these sculptures in fibre. According to her, the uniqueness of each seed type is an exercise in recognising the great diversity of form in Nature. The variations in natural forms are also a record of responses to disruptions in the growth cycle. Whilst not overtly visible, the arid environment of parts of the Great Southern is reflected in the aesthetics of the sculptures.

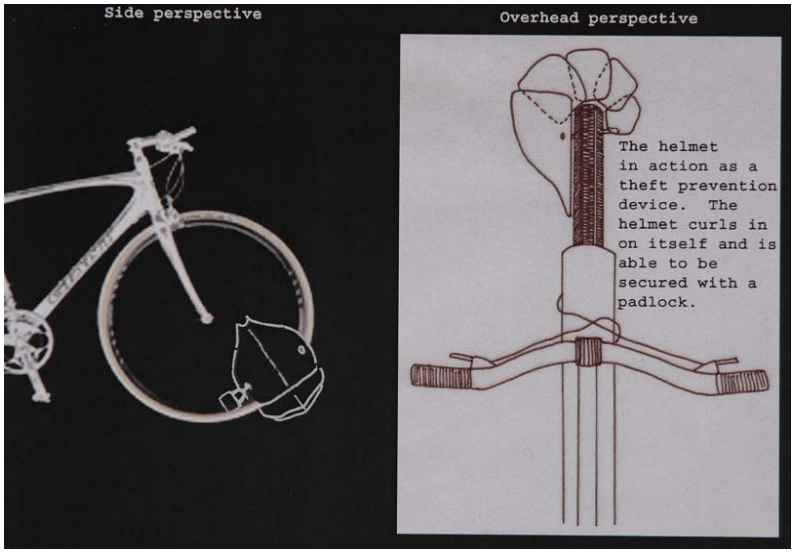


The Crustacean Helmet

Designers: Young Kyun Ahn, Ross Connolly, Maja Doslo.



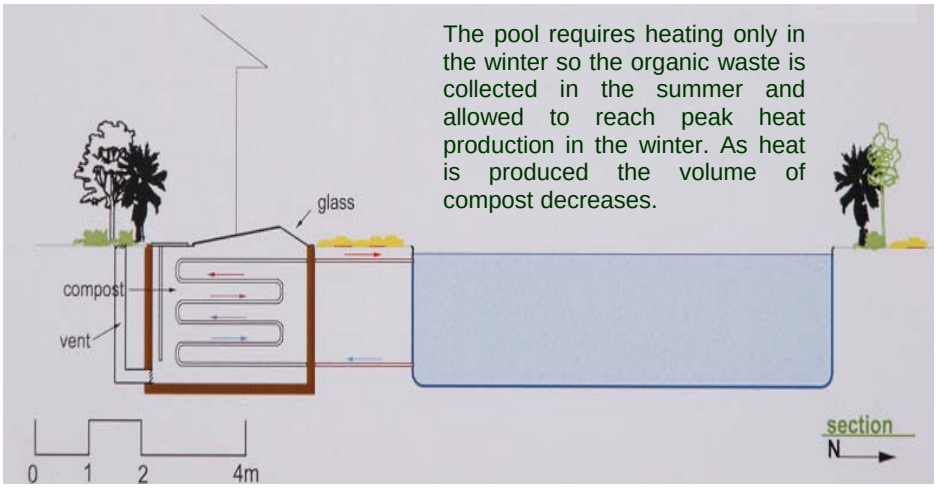
The inspiration for the bicycle helmet comes from the Marron *(Cherox tenuimanus*), a freshwater crayfish that is native to the Great Southern region of Western Australia. One of the main functions of the Marron's exoskeleton is to protect its interior organs. The exoskeleton of the Marron is flexible, and during the spawning period, the female Marron is able to curl her tail in on itself to protect her eggs. The Crustacean Helmet reflects this defensive mechanism as it mimics the Marron's flexible, interlocking exoskeleton to conform to the wearer's head. Its primary purpose is to protect the wearer from head injuries. When not worn the wearer has the option of securing the bicycle helmet to the bicycle tyre for defence against theft.



The Maleefowl Nest Swimming Pool Heating System

Designers: Rebecca Millar, Lucy Lane and Damien Smith

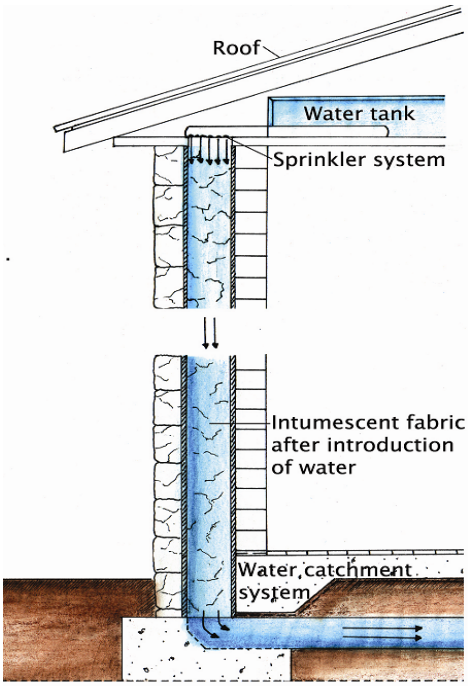
This design is inspired by the Mallefowl nest. As the organic matter decays in the nest, heat is generated. The design outlined above and below involves the use of organic waste to generate heat. The compost is composed of human and domestic waste collected over the summer months. Decomposition is gradually activated with help from the sun.

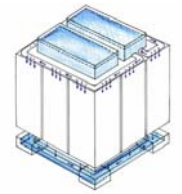


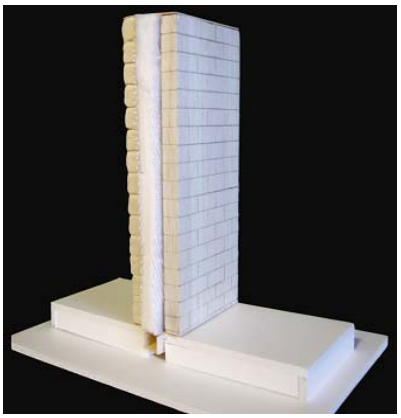
The Internal Fire Protection System

Designers: Emily Durkan, Hannah Gosling, Jessie Nguyen

In this fire protection system, inspired by the woody Kwongan plants of the Great Southern, an internal fabric system is employed to cool down the wall structures. When heat and smoke are detected in combination, the grey water stored in a tank in the roof is gradually released through the wall cavities, causing the intumescent fabric to swell. This acts as a barrier to fire and heat. The intumescent fabric is contained within the wall cavity by mesh and damp-proof membrane. Excess water passes under the house and is pumped back into the water tank to be re-circulated. The designers believe the system can be applied to any wall, provided there is a wall cavity.

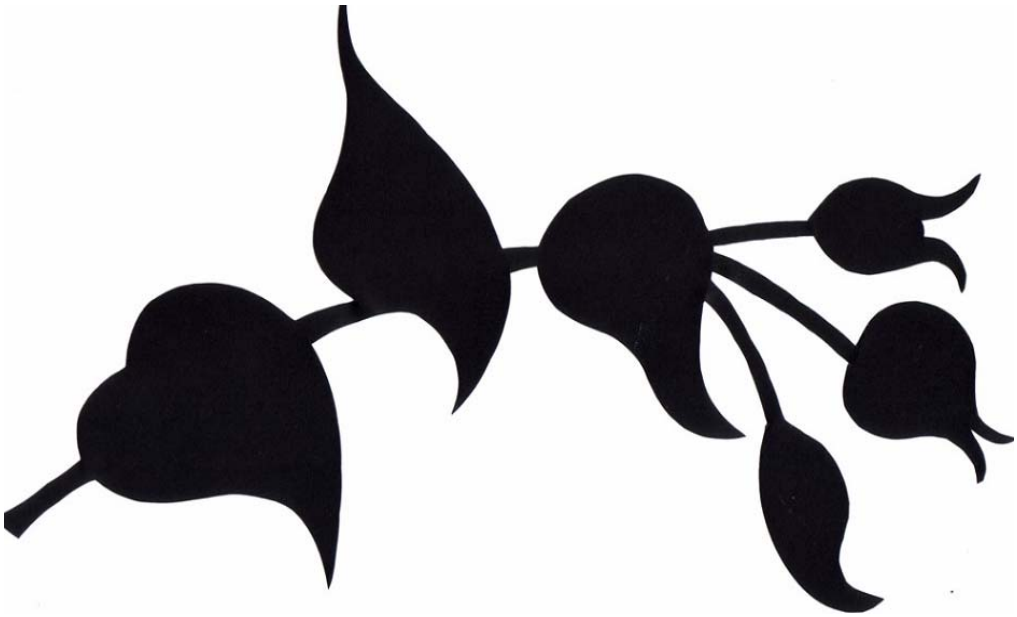






The Bookleaf Logo

Designer: Norma Lyons



When registering a business name for her desktop-publishing business, Norma Lyons decided a native plant was apt given many of the publications had an ecological theme.

Daviesia cordata - the Bookleaf (so named because of the book-like formation of bracts enclosing its seed-pods) seemed doubly suited; not just due to the name but because the way its bracts enclosed the seed-pods was highly metaphorical of the way books enclosed the seeds of ideas.

The artwork presented above became the logo for the first book of poetry published by Bookleaf, drawing on the idea that ecomimicry can create an ecological aesthetics; i.e., that the beauty of nature's forms can be mimicked to celebrate both Art and Nature at the same time.

The Biological Mimicry Installation

Designer: Peta Davies

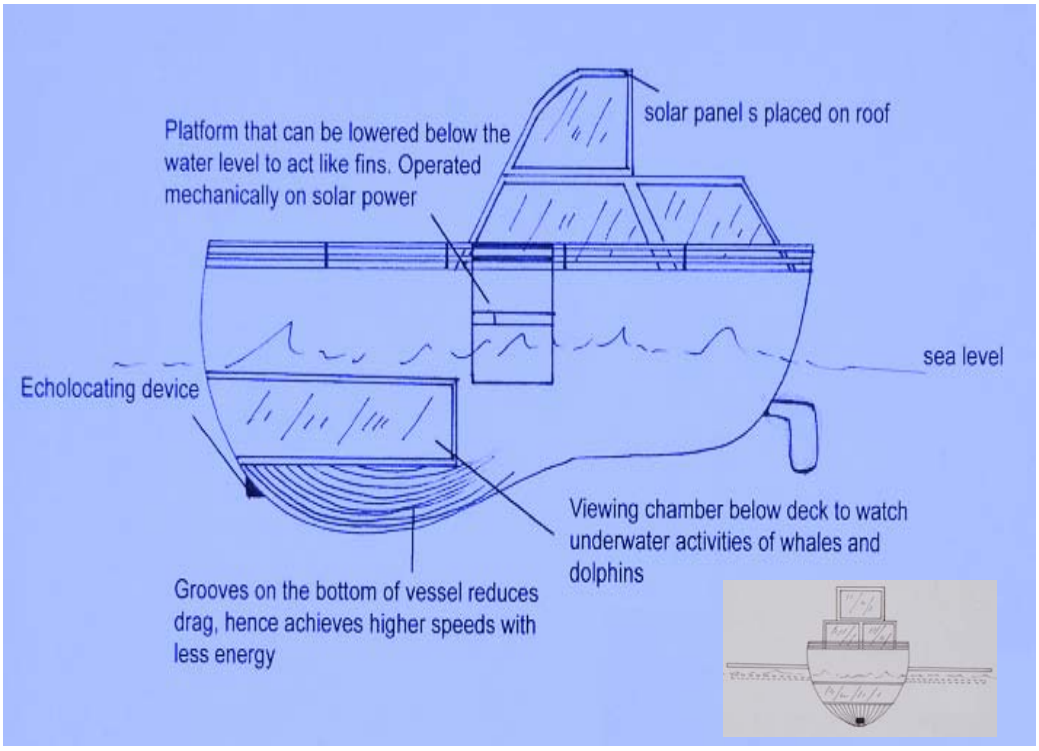
Just before we designers get too clever and begin to think humans are the only ones capable of mimicking Nature, Peta Davies reminds us in her installation that Nature has been doing it a lot longer. The phenomenon of biological mimicry, where one organism mimics another, is a familiar biological phenomenon. Above, for example is a photograph of a pair of Tawny Frogmouths who mimic the tree they are perched upon. In Davies' installation, she twined *papier mache* eucalypt leaves to a real eucalypt tree to mimic the way nature mimics itself.

Whale Boat

Designers: Baneen Khadroo, Aisbath Zana Zubair and Mishant Patel

GREAT SOUTHERN WHALES

The Great Southern coastal waters are a favorite migration route for myriad whale species, from small species such as the Scamperdown whale, to the largest such as the Blue whale. Two species whose regular and predictable appearances draw tourists to the area are the Humpback and the Southern Right whale. The designers of the Whale Boat below believe they have perfected a vessel to enjoy these whales, one that combines eco-efficient fuel consumption, subsurface viewing and stability and safety.



The Heliotropic House

Designer: Alan Marshall

The Heliotropic House mimics sun-tracking plants in order to maximize collection of solar rays. It's slightly concave, semi-circular roof is paneled with solar cells and also channeled with grooves to collect water. The collected solar energy can be used to power the home and the collected water is stored in tanks for later use.

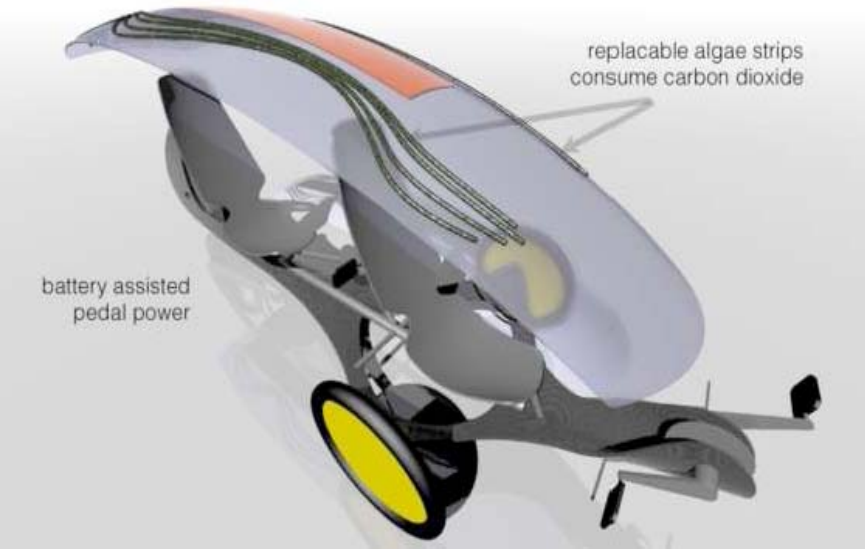
The Heliotropic House is suitable for urban areas but may reach its greatest potential away from city services where energy supply and water services are deemed too expensive.

The Carbon-Slurping R4

Designer: Barry Patterson

A CARBON SINK CAR?

In a technological world that hopes to mimic nature, the global warming crises may possibly be ameliorated by algae. Algae come in all shapes and sizes but collectively they are responsible for fixing carbon at a greater rate than terrestrial forests. Barry Patterson has designed the R4, a vehicle that has a series of water filled algal tubes lining the roof. This acts as an onboard removable biofiltration unit that will actually take in carbon dioxide.



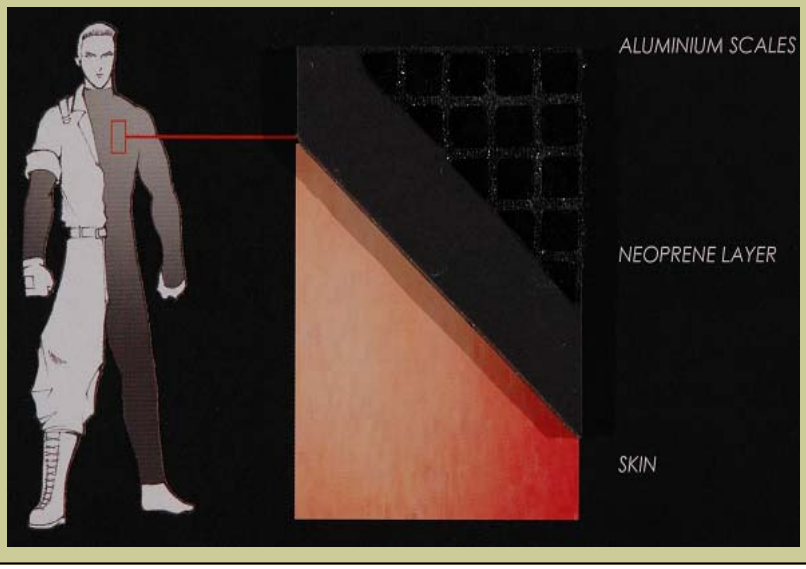
The carbon-slurping nature of the R4 is only one of its climate-saving features. The vehicle is powered by four renewable forms of energy. When parked, wind-blades shaped like wind-dispersed seeds, are unfurled to convert the Great Southern breezes into energy that will be stored in a compact battery. The second mode of energy involves pedal power, not to propel the vehicle but to create electricity for the battery. The third energy source is via the regenerative antilock breaking system that captures energy from deceleration and puts it back into the battery. The fourth form of power is solar panels positioned between the algal strips on the roof.

Black Tiger Snake Bushwear

Designer: Jan Nibbelink, Murray Ellis and Abdul Hafiz Mat Husin

HIKING THROUGH THE BUSH

The Great Southern is a noted area of ecotourism. High on the list of things to do is to go walking in the Bush. The Bush is not only beautiful though, it is often rugged and inhabited by dangerous creatures. The designers of the Black Tiger Snake Bushwear, for instance, have all been either bitten, cut, stung or injured in some way by various rocks, plants and animals as they walked through the Western Australian Bush. For this reason, they designed a complete body suit, similar to that of a wet suit, which serves as a light and protective garment against a potential dangerous physical environment. The suit is covered by small aluminium scales which mimic the scales of the Black Tiger Snake, being both flexible and strong.



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ALCOA FOUNDATION'S CONSERVATION AND SUSTAINABILTY PROGRAM

Sustaining Gondwana is a strategic initiative of Curtin University of Technology that has been funded by the Alcoa Foundation's Conservation and Sustainability Fellowship Program and by the University. Its aim is to research conservation and sustainability issues along the south coast of Western Australia, from Walpole to just east of Esperance. The vegetation and fauna of this area is so diverse that it is considered to be one of the world's bio-diversity hotspots. The five year program, which is connected internationally with other Universities and Sustainability Institutes, was launched in November 2005.

The initiative is co-ordinated by four cabinet members, professors Daniela Stehlik, Jonathan Majer, Fiona Haslam McKenzie and Dong-ke Zhang. Six postdoctoral fellows are being appointed to work on issues related to this region, and their research will be augmented by activities of the cabinet members themselves as well as their graduate students. It is anticipated that the findings will be published in journals, conference proceedings and books. However, there is a need to communicate early findings, data sets and activities of group members in a timely manner so that stakeholders can benefit from outputs as soon as they become available. This is the aim of the *Sustaining Gondwana Working Papers* Series, which will be produced on an occasional basis over the life of the initiative.

The papers are not subject to peer review, but are edited by cabinet members in order to maintain standards and accuracy. Contributions from researchers and practitioners who are active in the region of focus can also be considered for publication in this series.

For further information about Sustaining Gondwana or the program Working Paper Series, please contact: strongercommunities@curtin.edu.au or visit http://strongercommunities.curtin.edu.au
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