Essence of Permaculture (Version 3; April 2004)

by David Holmgren

The word permaculture was coined by Bill Mollison and myself in the mid-1970's to describe an *integrated, evolving system of perennial or self-perpetuating plant and animal species useful to man.*[i]

A more current definition of permaculture, which reflects the expansion of focus implicit in *Permaculture One*, is '*Consciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs*.' People, their buildings and the ways in which they organise themselves are central to permaculture. Thus the permaculture vision of permanent or sustainable agriculture has evolved to one of permanent or sustainable culture.

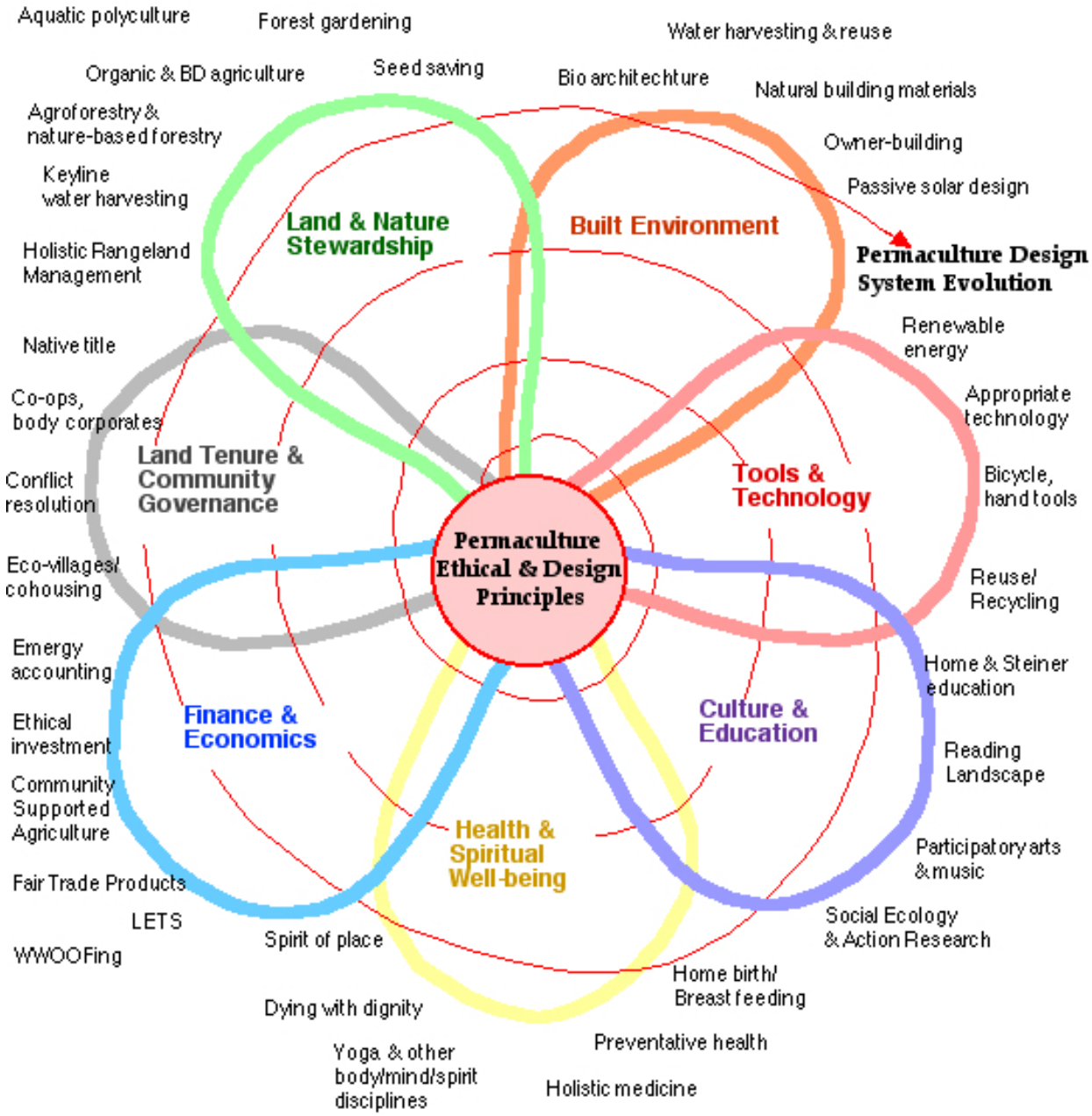
The design system

For many people, myself included, the above conception of permaculture is so global in its scope that its usefulness is reduced. More precisely, I see permaculture as the use of systems thinking and design principles that provide the organising framework for implementing the above vision. It draws together the diverse ideas, skills and ways of living which need to be rediscovered and developed in order to empower us to provide for our needs, while increasing the natural capital for future generations.

In this more limited but important sense, permaculture is not the landscape, or even the skills of organic gardening, sustainable farming, energy efficient building or eco-village development as such, but it can be used to design, establish, manage and improve these and all other efforts made by individuals, households and communities towards a sustainable future. The Permaculture Design System Flower shows the key domains that require transformation to create a sustainable culture. Historically, permaculture has focused on Land and Nature Stewardship as both a source for, and an application of, ethical and design principles. Those principles are now being applied to other domains dealing with physical and energetic resources, as well as human organization (often called invisible structures in permaculture teaching). Some of the specific fields, design systems and solutions that have been associated with this wider view of permaculture (at least in Australia) are shown around the periphery of the flower. The spiral evolutionary path beginning with ethics and principles suggests knitting together of these domains, initially at the personal and the local level, and then proceeding to the collective and global level. The spidery nature of that spiral suggests the uncertain and variable nature of that process of integration.

The Permaculture Flower version 3

Starting with ethics and principles focused in the critical domain of land and nature stewardship, permaculture is evolving by progressive application of principles to the integration of all seven domains necessary to sustain humanity through energy descent.



Adapted from Permaculture: Principles & Pathways Beyond Sustainability 2002

The network

Permaculture is also a network of individuals and groups spreading permaculture design solutions in both rich and poor countries on all continents. Largely unrecognised in academia, and unsupported by government or business, permaculture activists are contributing to a more sustainable future by reorganising their lives and work around permaculture design principles. In this way they are creating small local changes, but ones that are directly and indirectly influencing action in the fields of sustainable development, organic agriculture, appropriate technology and intentional community design.

The Permaculture Design Course

Most of the people involved in this network have completed a Permaculture Design Course (PDC), which for over 20 years has been the prime vehicle for permaculture inspiration and training worldwide. The inspiration aspect of the PDC has acted as a social glue bonding participants to an extent that the world-wide network could be described as a social movement. A curriculum was codified in 1984, but divergent evolution of both the form and content of these courses, as presented by different permaculture teachers, has produced very varied and localised experiences and understandings of permaculture.

Impediments to the Spread of Permaculture

There are many reasons why ecological development solutions that reflect permaculture design principles have not had a greater impact over the last few decades. Some of those reasons are:

- Prevailing scientific culture of reductionism that is cautious, if not hostile, to holistic methods of inquiry.
- The dominant culture of consumerism, driven by dysfunctional economic measures of well-being and progress.
- Political, economic and social elites (both global and local) which stand to lose influence and power through the adoption of local autonomy and self-reliance.

These and related impediments express themselves differently in different societies and contexts.

For the five billion or so majority for whom the cost of basic needs is high relative to real income, the opportunities to maintain or redevelop more self-reliant means of providing for needs are extremely limited. The depletion of local natural resources by population pressure, innovation in resource extraction technology, ethnic and migratory conflict, as well as government and corporate exploitation, have all reduced the productivity and viability of old co-evolved sustainable systems. At the same time, growth in the monetary economy has provided more opportunities for farm and factory labour, thereby increasing measured income, but failing to take account of declining well-being. The lure of opportunities in the rapidly growing cities has been like the dangled carrot , enticing country folk to move to the city. This process follows a model as old as Charles Dickens' character Dick Wittington, who believed the streets of early 19th century London were paved with gold. At the same time, government provision of health, education, and other services have all been slashed by IMF and World Bank imposed structural adjustment. This failed system of economic and social development is extraordinary in its ubiquity and repetition.

The same system of power that extracts and exploits the less powerful, soothes the billion or so middle-class people, mostly in the North, into complacency with low, and even falling costs relative to average incomes, of food, water, energy and other essential derived goods. This failure of global markets to transmit signals about resource depletion and environmental degradation has insulated consumers against the need for developing more self-reliant lifestyles,

and disabled the drive for public policies which might assist these necessary adaptations. The flood of new and cheap consumer goods has stimulated consumption to a point of super-saturation, while at the same time measures of social capital and wellbeing continue to fall from peaks in the 1970's.
The craven acceptance of economic growth at all costs, and the powerful established corporate and government interests, which stand to lose power from such a transition, makes clear the radical political nature of the permaculture agenda.

Focus on opportunities rather than obstacles

While permaculture activists are acutely aware of these impediments to what they do, permaculture strategies focus on the opportunities rather than the obstacles. In the context of helping the transition from ignorant consumption to responsible production, permaculture builds on the persistence of both a culture of self-reliance, community values, and the retention of a range of skills, both conceptual and practical, despite the ravages of affluence. The identification of these invisible resources is as important in any permaculture project as the evaluation of biophysical and material resources.

While sustainable "production" (of food and other resources) remains the prime objective of permaculture strategies, it can be argued that permaculture has been more effective at pioneering what has come to be called "sustainable consumption". Rather than weak strategies to encourage green consumer purchasing, permaculture addresses the issues by reintegrating and contracting the production/consumption cycle around the focal point of the active individual nested within a household and a local community.

Although permaculture is a conceptual framework for sustainable development that has its roots in ecological science and systems thinking, its grassroots spread within many different cultures and contexts show its potential to contribute to the evolution of a popular culture of sustainability, through adoption of very practical and empowering solutions.

Fundamental Assumptions

Permaculture is founded on some fundamental assumptions that are critical to both understanding and evaluating it. The assumptions on which permaculture was originally based were implied in *Permaculture One,* and are worth repeating:

- Humans, although unusual within the natural world, are subject to the same scientific (energy) laws that govern the material universe, including the evolution of life.

- The tapping of fossil fuels during the industrial era was seen as the primary cause of the spectacular explosion in human numbers, technology and every other novel feature of modern society.

- The environmental crisis is real and of a magnitude that will certainly transform modern global industrial society beyond recognition. In the process, the well-being and even survival of the world's expanding population is directly threatened.

- The ongoing and future impacts of global industrial society and human numbers on the world's wondrous biodiversity are assumed to be far greater than the massive changes of the last few hundred years.

- Despite the inevitably unique nature of future realities, the depletion of fossil fuels within a few generations will see a gradual return of system design principles observable in nature and pre-industrial societies, and which are dependent on renewable energy and resources (even if the specific forms of those systems will reflect unique and local

circumstances).

Thus permaculture is based on an assumption of progressively reducing energy and resource consumption, and an inevitable reduction in human numbers. I call this the "energy descent future" to emphasise the primacy of energy in human destiny, and the least negative but clear description of what some might call "decline", "contraction," "decay" or "dieoff". This energy descent future can be visualised as the gentle descent after an exhilarating balloon flight that returns us to the Earth, our home. Of course that earth has been transformed by humanity's "energy ascent", making the future as challenging and as novel as any period in history. In openly accepting such a future as inevitable we have a choice between fearful acquisitiveness, cavalier disregard or creative adaption.

The conceptual underpinning of these assumptions arises from many sources, but I recognise a clear and special debt to the published work of American ecologist Howard Odum[ii]. The ongoing influence of Odum's work on the evolution of my own ideas is made explicit in the dedication and extensive references to Odum in *Permaculture, Principles & Pathways Beyond Sustainability*, as well as articles in *David Holmgren: Collected Writings 1978-2000*[iii].

Among the recently published works on fossil energy peak and consequent descent, Richard Heinberg's wonderfully titled book, *The Party's Over,*[iv] probably provides the best overview of the evidence and issues, with appropriate acknowledgement to Campbell, Leherrere and other retired and independent petroleum geologists who, in the mid 1990's exposed the real facts about the world's fossil fuel reserves, and the critical nature of peak as opposed to ultimate production of oil and gas.

Permaculture Principles

The value and use of principles

The idea behind permaculture principles is that generalised principles can be derived from the study of both the natural world and pre-industrial sustainable societies, and that these will be universally applicable to fast-track the development of sustainable use of land and resources, whether that be in a context of ecological and material abundance or one of deprivation.

The process of providing for people's needs within ecological limits requires a cultural revolution. Inevitably such a revolution is fraught with many confusions, false leads, risks and inefficiencies. We appear to have little time to achieve this revolution. In this historical context, the idea of a simple set of guiding principles that have wide, even universal application is attractive.

Permaculture principles are brief statements or slogans that can be remembered as a checklist when considering the inevitably complex options for design and evolution of ecological support systems. These principles are seen as universal, although the methods that express them will vary greatly according to place and situation. These principles are also applicable to our personal, economic, social and political reorganisation, as illustrated in the Permaculture Flower, although the range of strategies and techniques which reflect the principle in each domain is still evolving.

These principles can be divided into ethical principles and design principles.

Ethical Principles of Permaculture

Ethics act as constraints on survival instincts and the other personal and social constructs of self-interest that tend to drive human behaviour in any society. They are culturally evolved mechanisms for more enlightened self-interest, a more inclusive view of who and what constitutes "us", and a longer-term understanding of good and bad outcomes.

The greater the power of human civilisation (due to energy availability), and the greater the concentration and scale of power within society, the more critical ethics become in ensuring long-term cultural and even biological survival. This ecologically functional view of ethics makes them central in the development of a culture for energy descent.

Like design principles, ethical principles were not explicitly listed in early permaculture literature. Since the development of the Permaculture Design Course, ethics have generally been covered by three broad maxims or principles:

- Care for the earth (husband soil, forests and water)
- Care for people (look after self, kin and community)
- Fair share (set limits to consumption and reproduction, and redistribute surplus).

These principles were distilled from research into community ethics, as adopted by older religious cultures and modern cooperative groups. The third principle, and even the second, can be seen as derived from the first.

The ethical principles have been taught and used as simple and relatively unquestioned ethical foundations for permaculture design within the movement and within the wider "global nation" of like-minded people. More broadly, these principles can be seen as common to all traditional cultures of place, although their conception of "people" may have been more limited than the notion that has emerged in the last two millennia.[v]

This focus in permaculture on learning from indigenous, tribal and cultures of place is based on the evidence that these cultures have existed in relative balance with their environment, and survived for longer than any of our more recent experiments in civilisation.

Of course, in our attempt to live an ethical life, we should not ignore the teachings of the great spiritual and philosophical traditions of literate civilisations, or the great thinkers of the scientific enlightenment and since. But in the long transition to a sustainable low-energy culture we need to consider, and attempt to understand, a broader canvas of values and concepts than those delivered to us by recent cultural history.[vi]

Design principles

The scientific foundation for permaculture design principles lies generally within the modern science of ecology, and more particularly within the branch of ecology called 'systems ecology'. Other intellectual disciplines, most particularly landscape geography and ethno-biology, have contributed concepts that have been adapted to design principles.

Fundamentally, permaculture design principles arise from a way of perceiving the world that is often described as 'systems thinking' and 'design thinking' (See Principle 1: Observe and interact).

Other examples of systems and design thinking include:

- The Whole Earth Review, and its better-known offshoot the Whole Earth Catalogue, edited by Stewart Brand, did much to publicise systems and design thinking as a central tool in the cultural revolution to which permaculture is a contribution.

- The widely known and applied ideas of Edward De Bono[vii] fall under the broad rubric of systems and design thinking.

- As the academic discipline of cybernetics,[viii] systems thinking has been an esoteric and difficult subject, closely associated with the emergence of computing and communication networks and many other technological applications.

Apart from the ecological energetics of Howard Odum, the influence of systems thinking in my development of permaculture and its design principles has not come through extensive study of the literature, but more through an osmotic absorption of ideas in the cultural ether which strike a chord with my own experience in permaculture design. Further, I believe many of the abstract insights of systems thinking have more easily understood parrallels in the stories and myths of indigenous cultures, and to a lesser extent in the knowledge of all people still connected to land and nature.

Permaculture principles, both ethical and design, may be observed operating all around us. I argue that their absence, or apparent contradiction by modern industrial culture, does not invalidate their universal relevance to the descent into a low-energy future.

While reference to a toolkit of strategies, techniques and examples is the way most people will relate to and make use of permaculture, these are specific to the scale of systems involved, the cultural and ecological context, and the repertoire of skills and experience of those involved. If principles are to provide guidance in choosing and developing the useful applications, then they need to embody more general systems design concepts, while being in language that is accessible to ordinary people and resonates with more traditional sources of wisdom and common sense.

I organise the diversity of permaculture thinking under 12 design principles. My set of design principles varies significantly from those used by most other permaculture teachers. Some of this is simply a matter of emphasis and organisation; in a few cases it may indicate difference of substance. This is not surprising, given the new and still emerging nature of permaculture.

The format of each design principle is a positive action statement with an associated icon, which acts as a graphical reminder and encoding some fundamental aspect or example of the principle. Associated with each principle is a traditional proverb that emphasises the negative or cautionary aspect of the principle.

Each principle can be thought of as a door into the labyrinth of systems thinking. Any example used to illustrate one principle will also embody others, so the principles are simply thinking tools to assist us in identifying, designing and evolving design solutions.

Principle 1: OBSERVE AND INTERACT

'Beauty is in the eye of the beholder'

Good design depends on a free and harmonious relationship between nature and people, in which careful observation and thoughtful interaction provide the design inspiration, repertoire and patterns. It is not something that is generated in isolation, but through continuous and reciprocal interaction with the subject.

Permaculture uses these conditions to consciously and continuously evolve systems of land use and living that can sustain people through the era of energy descent.

In hunter-gatherer and low-density agricultural societies, the natural environment provided all material needs, with human effort mainly required for harvesting. In pre-industrial societies with high population densities, agricultural productivity depended on large and continuous input of human labour.[ix]

Industrial society depends on large and continuous inputs of fossil fuel energy to provide its food and other goods and services. Permaculture designers use careful observation and thoughtful interaction to make more effective use of human capabilities, and reduce dependence on non-renewable energy and high technology.

Within more conservative and socially bonded agrarian communities, the ability of some individuals to stand back from, observe and interpret both traditional and modern methods of land use, is a powerful tool in evolving new and more appropriate systems. While complete change within communities is always more difficult for a host of reasons, the presence of locally evolved models, with its roots in the best of traditional and modern ecological design, is more likely to be successful than a pre-designed system introduced from outside. Further, a diversity of such local models would naturally generate innovative elements which can cross-fertilise similar innovations elsewhere.

Facilitating the generation of independent, even heretical, long-term thinking needed to design new solutions is more the focus of this principle than the adoption and replication of proven solutions. In the past it has been the academy and urban affluence that have tolerated and even supported such thinking, while traditional agrarian culture has ruthlessly suppressed it. In the final chaotic stages of post-modern affluent society the systems of authority of knowledge are less clear, and the opportunities for such independent and more systemic thinking are more diffusely spread across the social and geographic hierarchy. In this context we cannot rely on labels and demeanour as signs of authority and value when assessing any prospective design solutions. Thus at every level we must rely more and more on skills in observation and sensitive interaction to find the best path forward.

The proverb *beauty is in the eye of the beholder* reminds us that the process of observing influences reality, and that we must always be circumspect about absolute truths and values.

Principle 2: CATCH AND STORE ENERGY

'Make hay while the sun shines'

We live in a world of unprecedented wealth resulting from the harvesting of the enormous storages of fossil fuels created by the earth over billions of years. We have used some of this wealth to increase our harvest of the Earth's renewable resources to an unsustainable degree. Most of the adverse impacts of this over-harvesting will show up as available fossil fuels decline. In financial language, we have been living by consuming global capital in a reckless manner that would send any business bankrupt.

We need to learn how to save and reinvest most of the wealth that we are currently consuming or wasting, so that our children and descendants might have a reasonable life. The ethical foundation for this principle could hardly be clearer. Unfortunately, conventional notions of value, capital, investment and wealth are not useful in this task.

Inappropriate concepts of wealth have led us to ignore opportunities to capture local flows of both renewable and non-renewable forms of energy. Identifying and acting on these opportunities can provide the energy with which we can rebuild capital, as well as provide us with an "income" for our immediate needs.

Some of the sources of energy include:

- Sun, wind and runoff water flows
- Wasted resources from agricultural, industrial and commercial activities

The most important storages of future value include:

- Fertile soil with high humus content
- Perennial vegetation systems, especially trees, yield food and other useful resources
- Water bodies and tanks
- Passive solar buildings

Designed ecological restoration is one of the most common expressions of environmental thinking in affluent countries, and is a valid element in permaculture design when it considers people as an integral part of the restored systems. Ironically, the abandonment of more marginal rural landscapes in many affluent and developing countries due to falling commodity prices, and substitution by intensive fossil fuel subsidised systems, has created "modern wildernesses" on a far larger scale than designed ecological restoration. This abandonment has some negative effects, such as the collapse of traditional water management and erosion control systems as well as an increase in wildfire, but in other places it has allowed nature to rebuild the biological capital of soil, forests and wildlife without input of non-renewable resources.

While low-cost and fossil fuel subsidised models for rebuilding natural capital are important expressions of this principle, we can also think of the collective experience, know-how and technology and software deriving from generations of industrial affluence, as a huge store of wealth which can be redeployed to help create new forms of capital appropriate for energy descent. Much of the optimism about sustainability relates to the application of technology and innovation. Permaculture strategies make use of these opportunities while maintaining a healthy scepticism based on the premise that technological innovation is often a "Trojan horse", recreating the problems in new forms. Apart from the need to discriminate in the use of technology to build new capital assets, technological innovation is itself a storage of wealth that will progressively depreciate during energy descent, albeit at a slower rate than physical assets and infrastructure.

The proverb '*make hay while the sun shines'* reminds us that we have limited time to catch and store energy before seasonal or episodic abundance dissipates.

Principle 3: OBTAIN A YIELD

'You can't work on an empty stomach'

The previous principle focused our attention on the need to use existing wealth to make long-term investments in natural capital. But there is no point in attempting to plant a forest for the grandchildren if we haven't got enough to eat today.

This principle reminds us that we should design any system to provide for self-reliance at all levels (including ourselves), by using captured and stored energy effectively to maintain the system and capture more energy. More broadly, flexibility and creativity in finding new ways to obtain a yield will be critical in the transition from growth to descent.

Without immediate and truly useful yields, whatever we design and develop will tend to wither while elements that do generate immediate yield will proliferate. Whether we attribute it to nature, market forces or human greed, systems that most effectively obtain a yield, and use it most effectively to meet the needs of survival, tend to prevail over alternatives.[x]

A yield, profit, or income functions as a reward that encourages, maintains and/or replicates the system that generated the yield. In this way, successful systems spread. In systems language these rewards are called 'positive feedback loops' that amplify the original process or signal. If we are serious about sustainable design solutions, then we must be aiming for rewards that encourage success, growth and replication of those solutions.

While this may be self-evident to farmers and businesspersons, there is a consistent cross-cultural pattern where rising affluence leads to dysfunction and cosmetic environments replacing functional and productive ones. The original permaculture vision promoted by Bill Mollison of urban landscapes full of food and other useful plants rather than useless ornamentals, provides an antidote to this dysfunctional aspect of our culture. Even in poorer countries, the unexamined

aim of the majority of development projects is to enable people to escape the need to maintain functional and productive environments, by full participation in the monetary economy where 'Obtaining a Yield' becomes a narrow and destructive process dictated by the forces of the global economy. The *nouveau riche* model of success, in which the functional and practical are banished, needs to be replaced with honest acknowledgement of sources of affluence and real measures of success. Generations of wage and salary culture in more developed countries under both capitalist and socialist models have led to an extraordinary dislocation between productive activity and the sources of our sustenance. In assisting middle class urban Australian's facing the challenge of a more self-reliant rural lifestyle I have explained that it's like becoming a businessperson. One of the fortuitous spin-offs of the largely dysfunctional and cynical "Economic Rationalism" of recent decades has been a partial revival of awareness about the need for all systems to be designed to be productive in some way.

Principle 4: APPLY SELF-REGULATION and ACCEPT FEEDBACK

'The sins of the fathers are visited on the children unto the seventh generation'

This principle deals with self-regulatory aspects of permaculture design that limit or discourage inappropriate growth or behaviour. With better understanding of how positive and negative feedbacks work in nature, we can design systems that are more self-regulating, thus reducing the work involved in repeated and harsh corrective management.

Feedback[xi] is a systems concept that came into common use through electronic engineering. *Principle 3: Obtain a yield* described the feedback of energy from storages to help get more energy, an example of positive feedback. This can be thought of as an accelerator to push the system towards freely available energy. Similarly, negative feedback is the brake that prevents the system falling into holes of scarcity and instability from overuse or misuse of energy.

Self-maintaining and regulating systems might be said to be the 'Holy Grail' of permaculture: an ideal that we strive for but might never fully achieve. Much of this is achieved by application of the Integration and Diversity (Permaculture design principles 8 & 10) but it is also fostered by making each element within a system as self-reliant as is energy efficient. A system composed of self-reliant elements is more robust to disturbance. Use of tough, semi-wild and self-reproducing crop varieties and livestock breeds, instead of highly bred and dependent ones is a classic permaculture strategy that exemplifies this principle. On a larger scale, self-reliant farmers were once recognised as the basis of a strong and independent country. Today's globalised economies make for greater instability where effects cascade around the world. Rebuilding self-reliance at both the element and system level increases resilience. In the energy descent world, self-reliance will become more valued as capacity for high and continuous input declines and economies of scale and specialisation reduce.

Organisms and individuals also adapt to the negative feedback from large-scale systems of nature and community by developing self-regulation to pre-empt and avoid the harsher consequence of external negative feedback. Kangaroos and other marsupials abort the development of embryos if seasonal conditions appear unfavourable. This reduces the later stress on the population and the environment.

Traditional societies recognised that the effects of external negative feedback controls are often slow to emerge. People needed explanations and warnings, such as *the sins of the fathers are visited on the children unto the seventh generation* and *laws of karma* which operate in a world of reincarnated souls.

In modern society, we take for granted an enormous degree of dependence on large-scale, often remote, systems for provision of our needs, while expecting a huge degree of freedom in what we do without external control. In a sense, our whole society is like a teenager who wants to

have it all, have it now, without consequences. Even in more traditional communities, older taboos and controls have lost much of their power, or are no longer ecologically functional due to changes in the environment, population density and technology.

The development of behaviour and culture that is more attuned to the feedback signals from nature to prevent overexploitation is one of the challenges of environmentalism. Negative feedback needs to be well targeted and strong enough to bring about corrective change, but not so strong that it damages further development of the system. For example, rainwater collection and use in a house brings awareness of limits to both yield and quality. If a wood stove flue produces a smoky taste to water, this negative feedback encourages corrective action. The common aim of designing sustainable systems with zero hazard from negative feedback is like trying to raise children without exposure to immunological and accident hazards; it leads to more serious hazards in the future. Clearly the open acceptance of hazards from negative feedback must be constrained by ethical principles and primarily applied to ourselves, families and communities (in that order), rather than externalised as is more typical through large-scale industrial economies.

The Gaia hypothesis[xii] of the earth as a self-regulating system, analogous to a living organism, makes the Whole Earth a suitable image to represent this principle. Scientific evidence of the Earth's remarkable homeostasis over hundreds of millions of years highlights the Earth as the archetypical self-regulating whole system, which stimulated the evolution, and nurtures the continuity, of its constituent lifeforms and subsystems.

Principle 5: USE AND VALUE RENEWABLE RESOURCES & SERVICES

'Let nature take its course'

Renewable resources are those that are renewed and replaced by natural processes over reasonable periods, without the need for major non-renewable inputs. In the language of business, renewable resources should be seen as our sources of income, while non-renewable resources can be thought of as capital assets. Spending our capital assets for day-to-day living is unsustainable in anyone's language. Permaculture design should aim to make best use of renewable natural resources to manage and maintain yields, even if some use of non-renewable resources is needed in establishing systems.

The joke about the washing line being a solar clothes dryer is humorous because we recognise that we have been conned into using unnecessary and complex gadgets for simple tasks. While anyone would recognise line drying of clothes as miles ahead in the sustainability stakes compared to using an electric tumble drier, fewer people acknowledge wood as an environmentally appropriate fuel. All forests generate surplus low-value wood as a by-product of sustainable management which, when properly seasoned (more solar drying) can be used as a local source of heating and cooking in well designed stoves. In the same way that wood does not meet all criteria we might want from a fuel, herbal medicine might not provide a complete pharmacopeia, but we can, to a very great extent, successfully treat many ailments with locally grown and processed botanical medicines. By doing so, we avoid many adverse side effects both internal and external from centralised drug production, increase our respect for nature, and feel more confident in maintaining our own health.

Renewable services (or passive functions) are those we gain from plants, animals and living soil and water, without them being consumed. For example, when we use a tree for wood we are using a renewable resource, but when we use a tree for shade and shelter, we gain benefits from the living tree that are non-consuming and require no harvesting energy. This simple understanding is obvious and yet powerful in redesigning systems where many simple functions

have become dependent on non-renewable and unsustainable resource use.

Classic permaculture designs using chickens or pigs to prepare ground for planting bypass the use of tractors and rotary hoes, as well as artificial fertiliser and pesticides. In these systems, a modicum of management and fencing allows a more sophisticated use of livestock for multiple functions.

Permaculture design should make best use of non-consuming natural services to minimise our consumptive demands on resources, and emphasise the harmonious possibilities of interaction between humans and nature. There is no more important example in history of human prosperity derived from non-consuming use of nature's services than our domestication and use of the horse and other animals for transport, soil cultivation and general power for a myriad of uses. Intimate relationships to domestic animals such as the horse also provide an empathetic context for the extension of human ethical concerns to include nature. On the other hand in cultures where livestock are still prevailing symbols of meaning and wealth, the more fundamental renewable services provided by plants and soil life need to be recognised, valued and used. In both rich and poor communities realising the value of human waste as a renewable source of fertility made safe by the ecological service of microbes in a compost toilet is one of the important and universal applications of this principle.

The proverb *Let nature take its course* reminds us of another aspect of this principle - that the pursuit of total control over nature through use of resources and technology is not only expensive, but can also lead to a spiral of intervention and degradation in biological systems and processes which already represent the best balance between productivity and diversity.

Principle 6: PRODUCE NO WASTE

'Waste not, want not'
'A stitch in time saves nine'

This principle brings together traditional values of frugality and care for material goods, the modern concern about pollution, and the more radical perspective that sees wastes as resources and opportunities. The earthworm is a suitable icon for this principle because it lives by consuming plant litter (wastes), which it converts into humus that improves the soil environment for itself, for soil micro-organisms, and for the plants. Thus the earthworm, like all living things, is a part of a web where the outputs of one are the inputs for another.

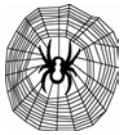
The industrial processes that support modern life can be characterised by an input-output model, in which the inputs are natural materials and energy, while the outputs are useful things and services. However, when we step back from this process and take a long-term view, we can see all these useful things end up as wastes (mostly in rubbish tips) and that even the most ethereal of services required the degradation of energy and resources to wastes. This model might therefore be better characterised as "consume/excrete". The view of people as simply consumers and excreters might be biological, but it is not ecological.

The proverb *waste not, want not* reminds us that it is easy to be wasteful when there is an abundance, but that this waste can be the cause of later hardship. This is highly relevant in a context of energy descent. The opportunities to reduce waste, and in fact live from waste, are historically unprecedented. In the past only the most destitute made a living from waste. Today we should acknowledge those who creatively reuse waste as the very essence of living lightly on the earth. Apart from household and industrial wastes, modernity has created new classes of living wastes (unwanted pest plants and animals) which proliferate in our minds as much as across the landscapes of the affluent nations.

Bill Mollison defined a pollutant as '*an output of any system component that is not being used*

productively by any other component of the system.'[xiii] This definition encourages us to look for ways to minimise pollution and waste through designing systems to make use of all outputs. In response to a question about plagues of snails in gardens dominated by perennials, Mollison was in the habit of replying that there was not an excess of snails but a deficiency of ducks. Similarly plagues of grass and forest trees lead to devastation by bushfire of some regions, while plagues of herbivores overgraze others. Innovative and creative ways to use these upwellings of abundance is one of the characteristics of permaculture design.

A stitch in time saves nine, reminds us of the value of timely maintenance in preventing waste and work involved in major repair and restoration efforts. Although far less exciting than creative ways to use unwanted abundance, maintenance of what we already have is set to be a huge and ongoing issue in an energy descent world. All structures and systems depreciate in value and all ecological and sustainable human systems devote resources to timely maintenance.



Principle 7: DESIGN FROM PATTERNS TO DETAILS

'Can't see the wood for the trees'

The first six principles tend to consider systems from the bottom-up perspective of elements, organisms, and individuals. The second six principles tend to emphasise the top-down perspective of the patterns and relationships that tend to emerge by system self-organisation and co-evolution. The commonality of patterns observable in nature and society allows us to not only make sense of what we see, but to use a pattern from one context and scale, to design in another. Pattern recognition is an outcome of the application of *Principle 1: Observe and interact*, and is the necessary precursor to the process of design.

The spider on its web, with its concentric and radial design shows a clear pattern even though the details always vary. This icon evokes zone and sector site planning - the best known and perhaps most widely applied aspect of permaculture design.

Modernity has tended to scramble any systemic common sense or intuition that can order the jumble of design possibilities and options that confront us in all fields. This problem of focus on detail complexity leads to the design of white elephants that are large and impressive but do not work, or juggernauts that consume all our energy and resources while always threatening to run out of control. Complex systems that work tend to evolve from simple ones that work, so finding the appropriate pattern for that design is more important than understanding all the details of the elements in the system.

The idea which initiated permaculture was the forest as a model for agriculture. While not new, its lack of application and development across many bioregions and cultures was an opportunity to apply one of the most common ecosystem models to human landuse. Although many critiques and limitations to the forest model need to be acknowledged, it remains a powerful example of pattern thinking which continues to inform permaculture and related concepts, such as forest gardening, agroforestry and analogue forestry.

The use of zones of intensity of use around an activity centre such as a farmhouse to help in the placement of elements and subsystems is an example of working from pattern to details. Similarly environmental factors of sun, wind, flood, and fire can be arranged in sectors around the same focal point. These sectors have both a bioregional and a site specific character which

the permaculture designer carries in their head to make sense of a site and help organize appropriate design elements into a workable system.

The use of swales and other earthworks to distribute and direct runoff water must be based on primary land patterns. In turn these earthworks then create moisture productivity zones that define planting and management systems.

While traditional land use systems provide many models of whole system design, people embedded in cultures of place often need experience which allows them to view their landscape and communities in new ways. In some of the pioneering Landcare projects in Australia in the 1980's, aerial over flights of their farms gave landholders both the picture and the motivation to begin serious work to address tree decline and associated land degradation problems. From the air, the patterns of land ownership were less visible, while the catchment patterns of nature stood out. Similarly the larger social and community context, rather than technical factors, can often determine whether a particular solution is a success. The list of overseas development projects that have failed due to ignorance of these larger-scale factors is extensive.

The proverb '*Can't see the wood (forest) for the trees'* reminds us that the details tend to distract our awareness of the nature of the system; the closer we get the less we are able to comprehend the larger picture.

Principle 8: INTEGRATE RATHER THAN SEGREGATE

'Many hands make light work'

In every aspect of nature, from the internal workings of organisms to whole ecosystems, we find the connections between things are as important as the things themselves. Thus *the purpose of a functional and self-regulating design is to place elements in such a way that each serves the needs and accepts the products of other elements.*[xiv]

Our cultural bias toward focus on the complexity of details tends to ignore the complexity of relationships. We tend to opt for segregation of elements as a default design strategy for reducing relationship complexity. These solutions arise partly from our reductionist scientific method that separates elements to study them in isolation. Any consideration of how they work as parts of an integrated system is based on their nature in isolation.

This principle focuses more closely on the different types of relationships that draw elements together in more closely integrated systems, and on improved methods of designing communities of plants, animals and people to gain benefits from these relationships.

The ability of the designer to create systems that are closely integrated depends on a broad view of the range of jigsaw-like lock-and-key relationships that characterise ecological and social communities. As well as deliberate design, we need to foresee, and allow for, effective ecological and social relationships that develop from self-organisation and growth.

The icon of this principle can be seen as a top-down view of a circle of people or elements forming an integrated system. The apparently empty hole represents the abstract whole system that both arises from the organisation of the elements and also gives them form and character.

By correct placement of plants, animals, earthworks and other infrastructure it is possible to develop a higher degree of integration and self-regulation without the need for constant human input in corrective management. For example, the scratching of poultry under forage forests can be used to harvest litter to down slope garden systems by appropriate location. Herbaceous and woody weed species in animal pasture systems often contribute to soil improvement, biodiversity, medicinal and other special uses. Appropriate rotationally grazed livestock can

often control these weedy species without eliminating them and their values completely.

In developing an awareness of the importance of relationships in the design of self-reliant systems, two statements in permaculture literature and teaching have been central:

- Each element performs many functions.
- Each important function is supported by many elements.

The connections or relationships between elements of an integrated system can vary greatly. Some may be predatory or competitive; others are co-operative, or even symbiotic. All these types of relationships can be beneficial in building a strong integrated system or community, but permaculture strongly emphasises building mutually beneficial and symbiotic relationships. This is based on two beliefs:

- We have a cultural disposition to see and believe in predatory and competitive relationships, and discount co-operative and symbiotic relationships, in nature and culture.[xv]
- Co-operative and symbiotic relationships will be more adaptive in a future of declining energy.

Permaculture can be seen as part of a long tradition of concepts that emphasise mutualistic and symbiotic relationships over competitive and predatory ones.

Declining energy availability will shift the general perception of these concepts from romantic idealism to practical necessity.

Principle 9: USE SMALL AND SLOW SOLUTIONS

'The bigger they are, the harder they fall'
'Slow and steady wins the race'

Systems should be designed to perform functions at the smallest scale that is practical and energy-efficient for that function. Human scale and capacity should be the yardstick for a humane, democratic and sustainable society. This principle is reasonably well understood as a result of the pioneering work of E. F. Schumacher[xvi]. Whenever we do anything of a self-reliant nature - growing food, fixing a broken appliance, maintaining our health, we are making very powerful and effective use of this principle. Whenever we purchase from small, local businesses or contribute to local community and environmental issues, we are also applying this principle. Despite the successes of intermediate and appropriate technology in addressing local needs in development projects, cheap energy has continued to provide a subsidy to large-scale systems in recent decades. The end of cheap energy will shift the natural economies of scale in favour of small systems, while relative differences in economies of scale between different functions will continue.

On the other hand, the idea that movement of materials, people (and other living things) should be a minor aspect of any system is a new idea to modernity. The convenience and power from increased mobility and information technology has been a "Trojan horse", destroying community and increasing energy demands. Mobility and speed in affluent countries has become so dysfunctional that the 'Slow Food' and 'Slow Cities' movements are gaining much support. The communications and computer revolution has given new impetus to the ideas that speed is good, but again characteristic downsides are emerging such as the storms of spam which threaten the amenity of email.

Many practical examples provide a more balanced view to counter the natural attraction of both fast moving processes and large-scale systems. For instance, the fast response of crops to soluble fertilisers is often short lived. Manures, compost and natural rock minerals generally

provide more sustained and balanced plant nutrition. A good result from a little fertilizer does not mean better results from more.

In forestry, fast grown trees are often short lived, while some apparently slow growing but more valuable species accelerate and even surpass the fast species in their second and third decades. A small plantation of thinned and pruned trees can yield more total value than a large plantation without management.

In animal nutrition, rapidly grown livestock fed concentrated nutrients are often subject to more disease and have a lower life expectancy than more naturally raised animals. Overstocking is one of the most widespread causes of land degradation, and yet small numbers of managed livestock are beneficial if not essential to sustainable agriculture.

In crowded cities the apparent speed and convenience of cars stalls movement and destroys amenity, while much smaller, slower, more energy efficient bicycles allow freer movement, without pollution and noise. Bicycles can also be more efficiently manufactured and assembled in smaller and more local factories than the economies of scale necessary for the automotive industry.

The proverb *'the bigger they are, the harder they fall'* is a reminder of one of the disadvantages of size and excessive growth. While the proverb *'slow and steady wins the race'* is one of many that encourages patience while reflecting a common truth in nature and society.

Principle 10: USE AND VALUE DIVERSITY

'Don't put all your eggs in one basket'

The spinebill and the humming bird both have long beaks and the capacity to hover - perfect for sipping nectar from long, narrow flowers. This remarkable co-evolutionary adaptation symbolises the specialisation of form and function in nature.

The great diversity of forms, functions and interactions in nature and humanity are the source of evolved systemic complexity. The role and value of diversity in nature, culture and permaculture is itself complex, dynamic, and at times apparently contradictory. Diversity needs to be seen as a result of the balance and tension in nature between variety and possibility on the one hand, and productivity and power on the other.

It is now widely recognised that monoculture is a major cause of vulnerability to pests and diseases, and therefore of the widespread use of toxic chemicals and energy to control these. Polyculture[xvii] is one of the most important and widely recognised applications of the use of diversity to reduce vulnerability to pests, adverse seasons and market fluctuations. Polyculture also reduces reliance on market systems, and bolsters household and community self-reliance by providing a wider range of goods and services.

However polyculture is by no means the only application of this principle.

Diversity of different cultivated systems reflects the unique nature of site, situation and cultural context. Diversity of structures, both living and built, is an important aspect of this principle, as is the diversity within species and populations, including human communities. The conservation of at least some of the great diversity of languages and cultures on the planet is arguably as important as the conservation of biodiversity. While inappropriate and destructive responses to energy descent will have knock on impacts on both human and biodiversity, in the longer-term, energy descent will slow the economic engine of diversity destruction, and stimulate new local and bioregional diversity. While many environmental and social movements only recognise prior biological and cultural diversity, permaculture is just as actively engaged in how to create new

bioregional diversity from the melting pot of nature and culture we have inherited

The proverb *'don't put all your eggs in one basket'* embodies the common sense understanding that diversity provides insurance against the vagaries of nature and everyday life.

Principle 11: USE EDGES AND VALUE THE MARGINAL

'Don't think you are on the right track just because it is a well-beaten path'

The icon of the sun coming up over the horizon with a river in the foreground shows us a world composed of edges.

Tidal estuaries are a complex interface between land and sea that can be seen as a great ecological trade market between these two great domains of life. The shallow water allows penetration of sunlight for algae and plant growth, as well as providing forage areas for wading and other birds. The fresh water from catchment streams rides over the heavier saline water that pulses back and forth with the daily tides, redistributing nutrients and food for the teeming life.

Within every terrestrial ecosystem, the living soil, which may only be a few centimetres deep, is an edge or interface between non-living mineral earth and the atmosphere. For all terrestrial life, including humanity, this is the most important edge of all. Only a limited number of hardy species can thrive in shallow, compacted and poorly drained soil, which has insufficient interface. Deep, well-drained and aerated soil is like a sponge, a great interface that supports productive and healthy plant life.

Eastern spiritual traditions and martial arts regard peripheral vision as a critical sense that connects us to the world quite differently to focused vision. Whatever is the object of our attention, we need to remember that it is at the edge of anything - system or medium, that the most interesting events take place; design that sees edge as an opportunity rather than a problem is more likely to be successful and adaptable. In the process, we discard the negative connotations associated with the word "marginal" in order to see the value in elements that only peripherally contribute to a function or system.

In rural development work, the focus on staple crops, prime agricultural land and clearly articulated aims and values within communities frequently leads to undervaluing, ignorance and destruction of wild species, marginal spaces, along with the less visible needs of women, the disadvantaged and landless. Similarly, in economic policy the focus of big business and thriving cities ignores the fact that these systems apply the fruits of past innovation, and that small business and smaller and less affluent places and systems are the sources of future innovation.

This principle works from the premise that the value and contribution of edges, and the marginal and invisible aspects of any system should not only be recognised and conserved, but that expansion of these aspects can increase system productivity and stability. For example, increasing the edge between field and pond can increase the productivity of both. Alley farming and shelterbelt forestry can be seen as systems where increasing edge between field and forest has contributed to productivity.

The proverb *'don't think you are on the right track just because it is a well-beaten path'* reminds us that the most common, obvious and popular is not necessarily the most significant or influential.

Principle 12: CREATIVELY USE AND RESPOND TO CHANGE

'Vision is not seeing things as they are but as they will be'

This principle has two threads: designing to make use of change in a deliberate and co-operative way, and creatively responding or adapting to large-scale system change which is beyond our control or influence. The acceleration of ecological succession within cultivated systems is the most common expression of this principle in permaculture literature and practice, and illustrates the first thread. For example, the use of fast growing nitrogen fixing trees to improve soil, and to provide shelter and shade for more valuable slow growing food trees, reflects an ecological succession process from pioneers to climax. The progressive removal of some or all of the nitrogen fixers for fodder and fuel as the tree crop system matures shows the success. The seed in the soil capable of regeneration after natural disaster or land use change (e.g. to an annual crop phase) provides the insurance to re-establish the system in the future.

These concepts have also been applied to understand how organisational and social change can be creatively encouraged. As well as using a broader range of ecological models to show how we might make use of succession, I now see this in the wider context of our use of, and response to, change.

The adoption of successful innovation in communities often follows a pattern similar to ecological succession in nature. Visionary and obsessive individuals often pioneer the solutions, but it generally requires more influential and established leaders to take up the innovation before it is widely seen as appropriate and desirable. Generational change is sometimes necessary for radical ideas to be adopted but this can be accelerated through the influence of school education on the home environment. For example, children bringing home trees they have grown in school nurseries can lead to successful establishment and care of valuable and long-lived trees, which might otherwise be neglected or eaten by livestock.

Permaculture is about the durability of natural living systems and human culture, but this durability paradoxically depends in large measure on flexibility and change. Many stories and traditions have the theme that within the greatest stability lie the seeds of change. Science has shown us that the apparently solid and permanent is, at the cellular and atomic level, a seething mass of energy and change, similar to the descriptions in various spiritual traditions.

The butterfly, which is the transformation of a caterpillar, is a symbol for the idea of adaptive change that is uplifting rather than threatening.

While it is important to integrate this understanding of impermanence and continuous change into our daily consciousness, the apparent illusion of stability, permanence and sustainability is resolved by recognising the scale-dependent nature of change. In any particular system, the small-scale, fast, short-lived changes of the elements actually contribute to higher-order system stability. We live and design in a historical context of turnover and change in systems at multiple larger scales, and this generates a new illusion of endless change with no possibility of stability or sustainability. A contextual and systemic sense of the dynamic balance between stability and change contributes to design that is evolutionary rather than random.

The proverb *'vision is not seeing things as they are but as they will be'* emphasises that understanding change is much more than the projection of statistical trend lines. It also makes a cyclical link between this last design principle about change and the first about observation.

Conclusion

Sustainable development to provide for human needs, within ecological limits, requires a cultural revolution greater than any of the tumultuous changes of the last century. Permaculture design and action over the last quarter century, has shown that revolution to be complex and multi-facited. While we continue to grapple with the lessons of past successes and failures, the emerging energy descent world will adopt many permaculture strategies and techniques as natural and obvious ways to live within ecological limits, once real wealth declines.

On the other hand, energy descent will demand real-time response to novel situations and incremental adaption of existing inappropriate systems, as well as the best of creative innovation applied to the most ordinary and small design problems. All this needs to be done without the big budgets and cudos associated with current industrial design innovation.

Permaculture design principles can never be a substitute for relevant practical experience and technical knowledge. However, they may provide a framework for continuous generation and evaluation of the site and situation specific solutions necessary to move beyond the limited successes of sustainable development to a reunion of culture and nature.

---

[i] B. Mollison, & D. Holmgren, *Permaculture One,* Corgi 1978 and since published in 5 languages (now out of print).

[ii] H.T. Odum, *Environment, Power & Society,* John Wiley 1971 was a book which influenced many key environmental thinkers in the 1970s and was the first listed reference in *Permaculture One*. Odum's prodigious published output over the three decades since, as well as the work of his students and colleagues, has continued to inform my work.

[iii] *David Holmgren: Collected Writings 1978-2000*, (e-book) Holmgren Design Services 2002. Article 10 *The Development of The Permaculture Concept* and Article 22 *Energy and EMERGY: Revaluing Our World* are especially relevant in explaining the influence of Howard Odum's work on permaculture. For a recent evaluation and comparison of Odum's Emergy concept to other sustainability tools see *Ecosystem Properties and Principles of Living Systems As Foundation for Sustainable Agriculture: Critical reviews of environmental assessment tools, key findings and questions from a course process* by Steven Doherty and Torbjörn Rydberg (editors) Jan 2002.

[iv] Richard Heinberg *The Party's Over: Oil, War and the Fate of Industrial Societies* New Society Publishers 2003.

[v] For an exploration of the evolutionary limitations of tribalism in the modern world see Article 26 *Tribal Conflict: Proven Pattern, Dysfunctional Inheritance* in David Holmgren: Collected Writings 1978-2000.

[vi] For a current articulation of the value of indigenous culture and value in a eco-spiritual response to energy descent see *Last Hours of Ancient Sunlight: Waking up to personsal and global transformation* by Thom Hartmann 1999 Harmony Books.

[vii] Best known for coining the term "lateral thinking".

[viii] Norbert Wiener, *Cybernetics: Control and Communication in the Animal and the Machine*, 1948, is the foundation text. John Gall, *General Systematics*, Harper & Row 1977, provides an accessible and useful guide for permaculture designers.

[ix] See F. H. King, *Farmers of Forty Centuries* for a description of Chinese agriculture at the turn of the 20th century as an example of a sustainable society dependent on maximum use of human labour.

[x] This is a rephrasing of Lotka's Maximum Power Principle. Howard Odum has suggested the Maximum Power Principle (or at least his EMERGY-based version of it) should be recognised as the fourth Energy Law.

[xi] The return of part of an output of a circuit to the input in a way that affects its performance.

[xii] See J. Lovelock, *Gaia: A New Look At Life*, Oxford University Press 1979.

[xiii] B. Mollison, Permaculture: A Designer's Manual, Tagari 1988.

[xiv] B. Mollison, Permaculture: A Designer's Manual, Tagari 1988.

[xv] Charles Darwin's emphasis on competitive and predatory relationships in driving evolution was based on some excellent observations of wild nature, but he was also influenced by his observations of the society around him. Early industrial England was a rapidly changing society tapping new energy sources. Predatory and competitive economic relationships were overturning previous social norms and conventions. The social Darwinists used Darwin's work to explain and justify industrial capitalism and the free market. Peter Kropotkin was one of the first ecological critics of the social Darwinists. He provided extensive evidence from both nature and human history that co-operative and symbiotic relationships were at least as important as competition and predation. Kropotkin's work had a strong influence on my early thinking in developing the permaculture concept. See P. Kropotkin, *Mutual Aid*, 1902.

[xvi] See E. F. Schumacher, *Small is Beautiful: A study of economics as if people mattered*. 1973

[xvii] Polyculture is the cultivation of many plant and/or animal species and varieties within an integrated system.

Holmgren Design Services
The source of permaculture vision and innovation

16 Fourteenth Street
Hepburn
Victoria 3461
Australia
Tel: +61 (0)3 53483636
Email: info@holmgren.com.au

www.holmgren.com.au