

LIVING ENVIRONMENTS

David Gale draws inspiration from complex and self-perpetuating natural systems

DURING the recession in 1992, Gale & Snowden was formed specifically to design ecological buildings and landscapes. Coming from a biological and ecology background I was interested in ways of designing environments for people that integrated them into their surroundings in a manner that would not only reduce the negative impact on the environment by human occupation but would provide a positive contribution to the locality and habitat.

As can be seen in the articles in this edition of *EcoDesign*, there are ways of approaching design that can help us integrate into our environment. The key is in understanding how natural systems

work, and once we have learnt the principles of biological processes and their interaction with each other, we can make use of this knowledge to design living environments for people and nature.

Take for example how a natural woodland system functions. Over millions of years a complex web of interaction between plants and animals with their environment has resulted in a balanced ecosystem. This ecosystem is in a state of constant change but held within an equilibrium, a community of organisms that co-habit in a beneficial way for all the life-forms. The system is robust, resilient and self-perpetuating, each animal and plant having its own niche in the system, performing its own unique functions. The woodland or forest is the result of natural succession; what nature, when it is left alone will eventually achieve.

We can learn from this woodland system and by placing certain plants and animals together that are compatible with each other and their environment, we can design similar ecosystems which have the robustness, resilience and can be as self-perpetuating as a natural woodland. By selecting compatible plant and animal species that have a specific use, for example as food for people or livestock, we can re-create a woodland-type ecosystem, which is edible.

■ *Fig 1* shows the principles of how a Woodland Garden can be structured to reflect the organisation of a natural woodland.

Taking nature as a model or guide a stage further, we can design larger, more complex systems that begin to integrate people into the ecology of a plot of land or into a bioregional area. In order to do this we need to define what requirements we need to live and see how these can be met in an ecological way. Our requirements for living are relatively basic and can be classified as food/water, energy, shelter and good relationships. These 'needs' have been encapsulated in the Principles of Permaculture – recognised by Bill Mollison as he studied the interrelationships of natural systems, and translated into a practical methodology that enables anyone to mimic natural systems in their own environment.

We are not necessarily talking about total self-sufficiency as this is not readily achievable at present for most of us, but we are talking about altering our lifestyles to become more in tune with how nature works. Designing with nat-

The Edible Woodland Garden

A Woodland Garden is an ecosystem that reflects the seven layers of a natural woodland:

Canopy: the tallest trees, which are standard fruit and nut trees.

Lower trees: fruit and nut trees on dwarfing rootstocks.

Shrub layer: fruit bushes, gooseberries, currants and other berries.

Herbaceous layer: herbs, perennial vegetables and self-seeding annuals.

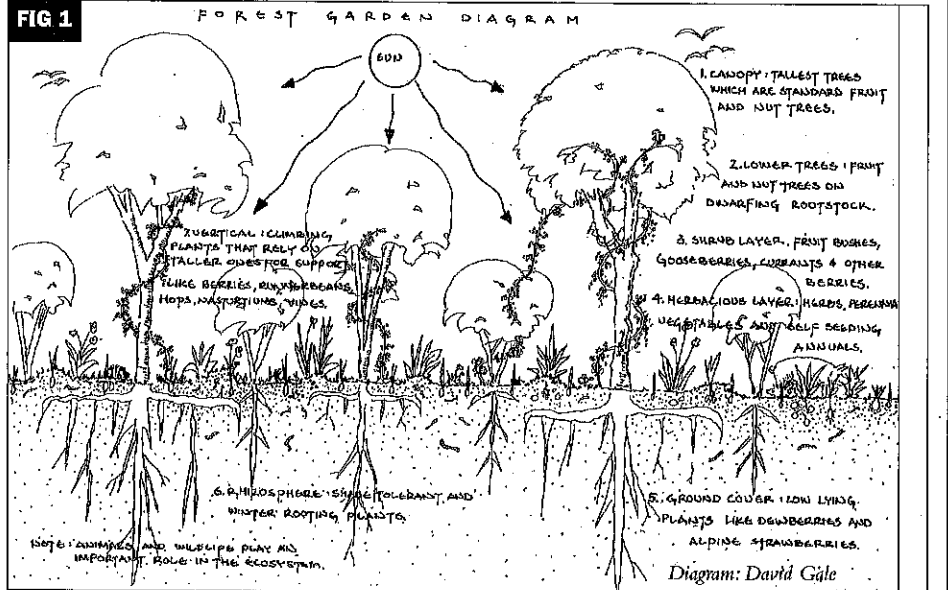
Ground cover: low lying plants like dewberries and alpine strawberries.

Rhizosphere: shade tolerant and winter root plants.

Vertical: climbing plants that rely on taller ones for support, like berries, vines, runner beans and hops.

All the plants in a Woodland Garden are companion planted. Each meets the requirement of something else, be it support, distributing water or nutrients from deep in the soil for other shallower rooted plants, providing mulch material to suppress weeds or to protect other plants from pests by

FIG 1



excreting substances or providing habitats for predators. The root systems also inhabit different levels of the soil just as trees and plants grow at different heights in the open. The ecosystem created is as resilient and self-

perpetuating as a natural ecosystem. It requires minimum human intervention and because the system is three-dimensional and operating at the height of the succession chain, it produces large quantities of biomass and food.



Crippets Woodland Garden

'Crippets' is a listed 17th century fishing cottage on the North Devon coast. The design, undertaken by Gale & Snowden, includes the integration of building and landscape to provide the occupants with an ecological and energy efficient building with a landscape design that provides their water and a large proportion of their food in an environmentally sensitive manner. The plot has been designed along permaculture principles and is a mature example of a woodland garden system. The various strategies in the garden include: edible woodland garden, which has been adopted by the native woodland and its wildlife; perennial and self-seeding annual vegetables; salad and fruit; several stone raised beds; composting areas; herbs and various hedge species; fungi. The woodland garden produces a large proportion of the household's herbs, salads, fruits, nuts and vegetables.



perpetuating as a natural ecosystem. It requires minimum human intervention and because the system is three-dimensional and operating at the height of the succession chain, it produces large quantities of biomass and food.

ural systems allows us to develop strategies where our needs, or the 'inputs' we require and the 'outputs' that we produce, are part of the same cycle – creating living systems with no waste products.

If we look at our water needs as an example, at present the majority of us obtain our water from the mains, a costly, inefficient system that requires high levels of energy and chemicals, using large reservoirs, pumping apparatus and a large distribution system, resulting in dubious water quality. At some point in this linear throughput, water is contaminated with our waste, and as a consequence, we pollute our watercourses, ground water and coastal areas.

Yet with simple measures such as water saving devices, separation of potable and non-potable water, collection of water at a more local source, such as rainwater collection or key point collection, black water and grey water separation, treatment and nutrient reclamation, we can obtain our water in a less environmentally damaging way. We can also cycle water within well designed natural systems to more than double resource use, without contaminating it with pollution.

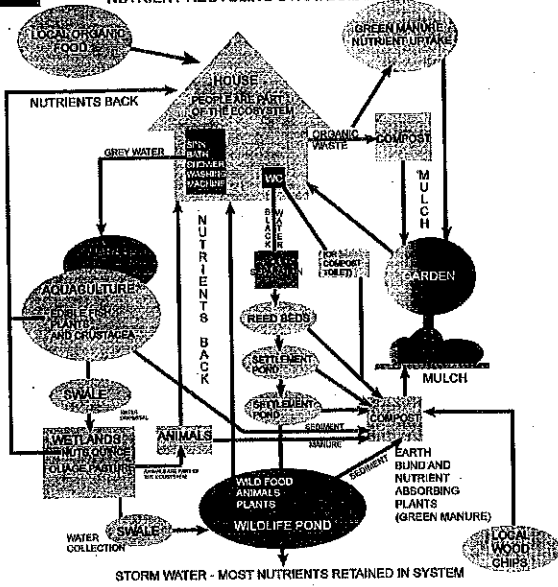
■ Fig 2 shows alternative ways of managing water to a building

By designing water systems into our habitat we can turn what currently is an environmentally damaging system into a system that is environmentally enhancing. Water plays an important role in any ecosystem and by understanding its function, again we can use the principle to design our own habitats.

Amongst other things, water is a nutrient carrier and this is why plants are able to grow more quickly in water based habitats than in land

FIG 2

NUTRIENT RECYCLING STRATEGIES



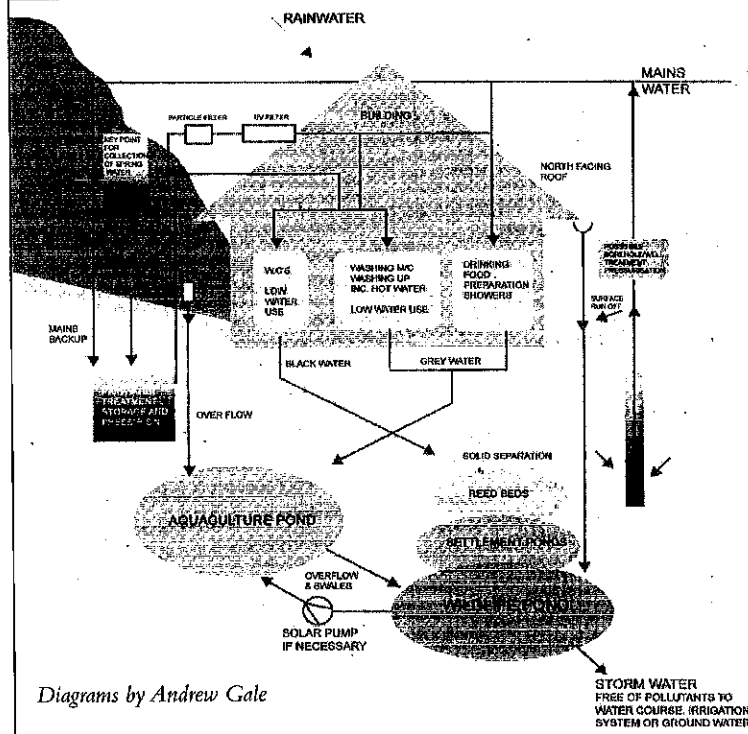
Water strategies

Fig 2 shows alternative ways of managing water to a building. Three alternative sources for water include rainwater, key point spring water and bore-hole/well water. Rainwater collection: best achieved from the south facing roof to avoid algae and moss growths on the north slope. Water can be primary filtered and taken to a water storage contained either underground or in the basement of a building. Water can then be pumped, filtered and treated as necessary for non-potable uses. Key point water collection: a key point is a location on a slope of a hill where spring water can be found. Many villages were situated to take advantage of these points not only for drinking water but also for gravity fed irrigation and for power. Spring water is often relatively pure

and can be used directly into buildings. If there is sediment or any coliform present a series of simple cost effective particle and Ultra Violet filters would in many cases render the water potable. Bore hole/wells were traditionally used in flatter locations where spring water was not present. Water in small quantities can be pumped, filtered and treated as necessary. Low water appliances such as water-saving tap heads and showerheads can be used to reduce the quantity of water required and of course a compost toilet is waterless. The overflow of the rainwater collection system can be used as part of the water management in the landscape and water-based WC's can also be directed into water-based reed beds for natural treatment.

FIG 3

ALTERNATIVE WATER STRATEGIES



Nutrient recycling strategy

Fig 3 shows an example of how people can begin to be better integrated into the landscape by recycling organic wastes. Kitchen waste can be composted to provide mulch for plant such as in a woodland garden system. Grey water nutrients can be used in an aquaculture pond and/or irrigation system. Plants and animals are able to use the nutrients, some of which can be eaten. Black water (solids and urine) can be composted directly with carbon (eg: wood chippings or straw) or diverted to a reed bed system for

treatment. Sediment can be collected and used for growing green manure. The green manure can then be used back on the land as mulch in a woodland garden or similar. With woodland garden systems and other Permaculture techniques, some of our food can be produced in relatively small spaces. By supplementing what we can grow with local organic produce we can significantly reduce energy and chemical consumption as food grown in a monoculture system travels vast distances and requires large amounts of energy and chemicals to produce.

based ones, readily absorbing trace elements and nutrients, willows and reeds being typical examples.

We can design systems that take into account our food requirements and instead of producing waste – something that does not occur in nature – systems can be introduced that allow our outputs to be recycled in various ways back into the landscape and back into the food web.

Fig 3 shows a nutrient recycling strategy and Photograph 3 shows a reed bed sewerage system integrated into the landscape.

In nature, at the junction between different ecosystems, eg land and water or woodland and field, a unique habitat is formed, constituting some characteristics of each ecosystem but also exhibiting its own characteristics which includes its own unique microclimate and organisms. This is known as the 'edge effect' and designs can incorporate this effect by increasing the edge where different habitats meet.

Photograph 4 shows an aquaculture system designed as part of an overall strategy to manage water in a landscape and provide food. The aquaculture pond has been designed with a large surface area to increase the pond's edge, and by placing edible and wildlife – attracting vegetation in this location we can make use of the increased bioactivity around the pond's perimeter.

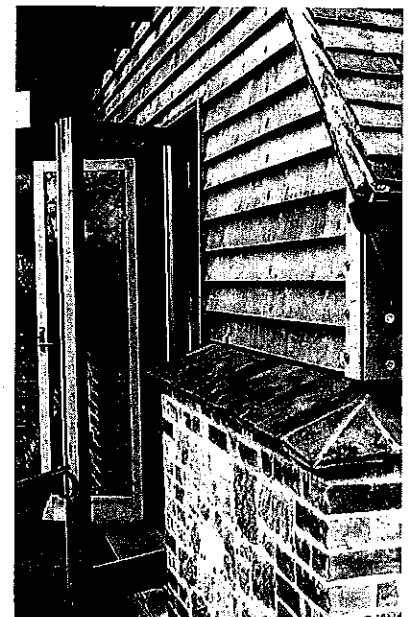
We can adopt this principle for all locations where one habitat encounters another and through sensitive design we can transform an energy intensive land-



Malthouse Cottage (photos 5-7)

Malthouse Cottage is a heavily insulated timber frame addition to a 17th century house in Hampshire designed by Gale & Snowden. Features include super-insulation using recycled newsprint, green oak weather boarding, reused stone and brick plinth, organic paints and stains, triple glazed timber windows and doors. Features include:

- Breathing superinsulated timber frame



construction: 150mm timber studs with recycled newsprint insulation to walls and roof.

- Timber construction throughout (including Glulam beams and posts)
- Thermal mass to ground floor construction to even out temperature fluctuations and absorb passive solar gain in winter
- Triple glazed, low E windows and doors
- Green Oak weather boarding (non treated)

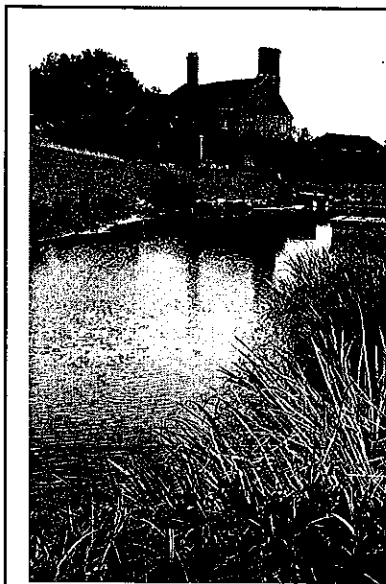
- Passive ventilation (non mechanical throughout)
 - Organic paints, stains and waxes throughout
 - Reclaimed clay roof tiles
 - Reclaimed stone plinth from site
 - Local materials and labour
 - Pergola to south façade
- The building is an airy modern timber framed construction with exposed softwood floor and roof beams. The large French windows catch the heat from the low evening sun in the spring and autumn.

scape, such as a lawned garden, into an abundant healthy ecosystem richly inhabited by wildlife.

When it comes to designing shelter for people, it can be relatively easy to design cost effective ecological buildings. The technology does not need to be complicated and the careful selection of low embodied energy and non-toxic materials combined with energy and water efficient design, making use of available renewable resources, should contribute to a building that has a rela-

tively low impact on the environment and is also healthy for its occupants.

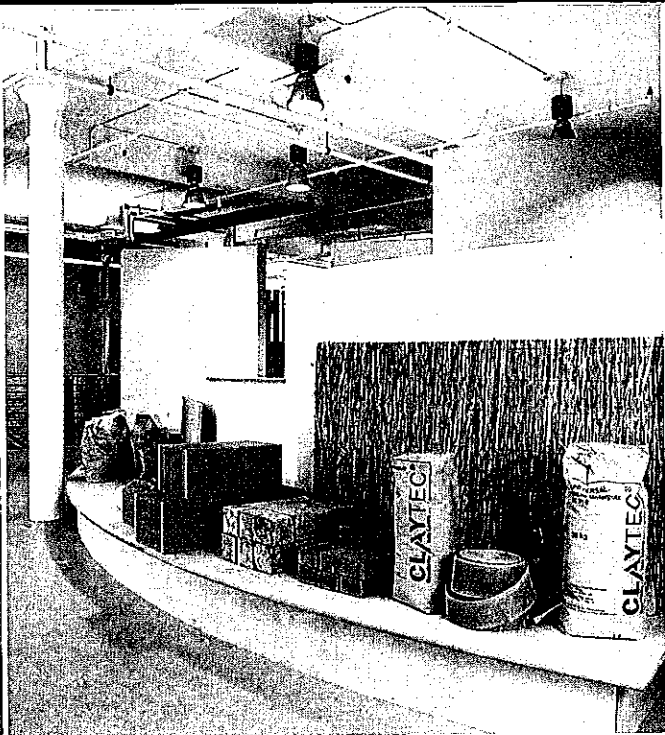
The use of local materials and labour will also contribute to reducing transportation and provide employment in the area, helping maintain or creating new crafts and skills and strengthening communities. Simple measures to orientate the building properly with the sun and away from the wind and frost pockets, with the correct glazing ratios and inclusion of thermal mass to reduce temperature fluctuations will also con-



Photograph 4 shows an aquaculture pond designed as part of the integrated landscape design. An aquaculture pond functions in principle in a similar way to the woodland garden. The design is based on a natural water-based ecosystem. Aquatic plants and animals are chosen for their compatibility and usefulness and are placed together in a three dimensional assembly. Grey water from showers, sinks etc can be diverted into the pond after being screened by an edge reed grease filter providing a small amount of nutrients into the system which would otherwise be waste from people. Rainwater can also be diverted into the pond to provide a constant input of water. The pond perimeter has been maximised to take advantage of the increase in biological activity known as the 'edge effect'.

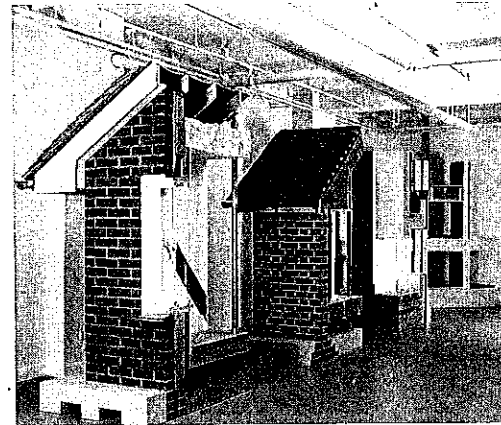


Photograph 3 shows a reed bed sewerage system as part of an integrated landscape design, including food production, nutrient collection and habitat creation. Situated in Surrey, designed by David Leigh (aquaculture specialist) with Gale & Snowden. Solids from black water are separated and sediment from the reed ponds is channelled to bunds planted with nutrient absorbing plants such as meadowsweet, valerian, comfrey and nettles. The plants can be harvested and used as green manure on food producing crops nearby.



Earth pavilion & mock up constructions (photos 8&9)

Gale & Snowden designed the interior fit out and the technical displays for the UK's first ecological building centre – Construction Resources, London. This centre was designed to display and advise professionals, contractors, builders and the general public on the best available environmental building products and systems, and provide information on the many benefits of using ecologically sustainable materials and techniques. The technical



displays include an Earth Pavilion built entirely of earth bricks and renders. Life size constructions demonstrate ecological renovation and new build techniques. High performance windows and doors, water saving systems and energy generation systems are also displayed. The interior design included a feature staircase, timber and earth counters and purpose made display furniture.

Photos: Nigel Rigden

tribute to provide a comfortable place to live and work. Further integration of the building can be achieved by such methods as placing ponds on the south side of the building where the sun can be reflected onto the building or conservatory and growing plants on or around the building to provide shade or to act as wind breaks.

Photographs 5-7 show a superinsulated moisture-breathing timber frame construction designed by Gale & Snowden in Hampshire.

To achieve an energy efficient building, care is also needed both in the detailing of the building and during its

construction. Energy efficiency can be greatly reduced by poor construction and such factors as air infiltration through the structure of a building can render the building ineffective.

As approximately only one per cent of the total building stock each year is new build, the need to increase the efficiency of the existing building stock is evident. It is also relatively straightforward to renovate existing buildings in an environmentally responsible way including selection of appropriate materials and reducing energy demand, and of course reusing existing buildings which requires fewer resources than

building anew.

Photographs 8&9 show the earth pavilion at Construction Resources.

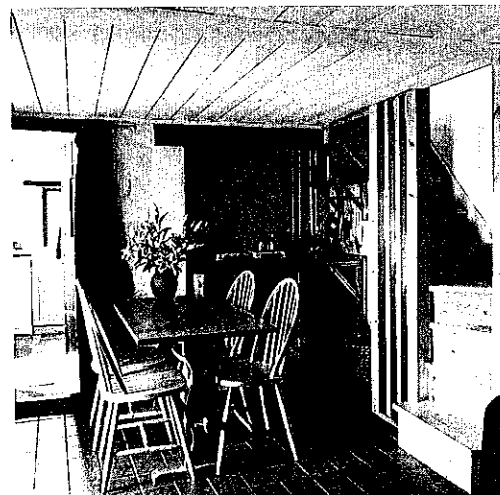
Gale & Snowden designed the interior fit out of the UK's first ecological building centre, Construction Resources, situated in a disused Metal Box factory in London. Using full size construction mock-ups, various materials and methods of constructing new and renovating existing buildings it demonstrates how we can build and renovate in an environmentally responsible way

Photographs 10 & 11 show an ecological renovation of a 17th century cottage in Devon.



Crippets (Photos 10 & 11)

The building work included significant sympathetic renovation works including structural works to the foundation, walls, floors and roof. There is also a new timber staircase, woodburner for cooking, space heating & hot water (ensuring a CO² neutral building for all heating), a key point gravity-fed spring



water collection system including UV and particle filtration. Local labour and craftsmen carried out all building work. Building products are from reclaimed or renewable/local sources, low in embodied energy and non-toxic eg: plant-based paints and waxes used throughout.

Designing living environments where natural systems interlink and create new and unique habitats is fascinating work. Observation of nature is key to successful design, but so too is the ability to underpin these observations with technological innovation. No one is suggesting that we revert to a bygone 'rural idyll' – our needs at the end of the 20th century preclude this. But with the advent of technology to harness renewable energies, and with a greater understanding of humanity's part within natural systems, it is possible to design ecosystems which do not destroy or deplete the earth, but which nourish and complement natural systems; which give back more than they take from the environment and which provide healthful and aesthetically pleasing living spaces. This is the challenge for humankind in the 21st century. ☐