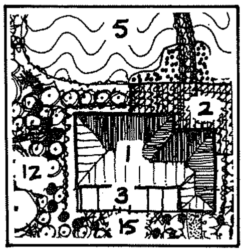


Chapter 3

METHODS OF DESIGN

3.1

INTRODUCTION

Any design is composed of concepts, materials, techniques, and strategies, as our bodies are composed of brain, bone, blood, muscles, and organs, and when completed functions as a whole assembly, with a unified purpose. As in the body, the parts function *in relation to each other*. Permaculture, as a design system, attempts to integrate fabricated, natural, spatial, temporal, social, and ethical parts (components) to achieve a whole. To do so, it concentrates not on the components themselves, but on the *relationships between them*, and on how they function to assist each other. For example, we can arrange any set of parts and design a system which may be self–destructive or which needs energy support. But by using the same parts in a different way, we can equally well create an harmonious system which nourishes life. It is in the *arrangement of parts* that design has its being and function, and it is the adoption of a purpose which decides the direction of the design.

Definition of Permaculture Design

Permaculture design is a system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth.

Functional design sets out to achieve specific ends, and the prime directive for function is:

Every component of a design should function in many ways. Every essential function should be supported by many components.

A flexible and conceptual design can accept progressive contributions from any direction, and be modified in the light of experience. Design is a continuous process, guided in its evolution by information and skills derived from earlier observations of that process. All designs that contain or involve life forms undergo a long–term process of change.

To understand design, we must differentiate it from its component parts, which are techniques, strategies, materials and assemblies:

- TECHNIQUE is "one–dimensional" in concept; a technique is *how* we do something. Almost all gardening and farming books (until 1950) were books on technique alone; design was largely overlooked.
- STRATEGIES, on the other hand, add the dimension of *time* to technique, thus expanding the conceptual dimensions. Any planting calendar is a "strategic" guide. Strategy is the use of technique to achieve a future goal, and is therefore more directly value–oriented.
- MATERIALS are those of, for instance, glass, mud, and wood. ASSEMBLIES are the putting together of technologies, buildings, and plants and animals.

There are many ways to develop a design on a particular site, some of them relying on observation, some on traditional skills usually learned in universities. I have outlined some methods as follows:

ANALYSIS: Design by listing the characteristics of components (**3.2**).

OBSERVATION: Design by expanding on direct observation of a site (**3.3**).

DEDUCTION FROM NATURE: Design by adopting the lessons learnt from nature (**3.4**).

OPTIONS AND DECISIONS: Design as a selection of options or pathways based on decisions (**3.5**).

DATA OVERLAY: Design by map overlays (**3.6**).

RANDOM ASSEMBLY: Design by assessing the results of random assemblies (**3.7**).

FLOW DIAGRAMS: Design for workplaces (**3.8**).

ZONE AND SECTOR ANALYSIS: Design by the application of a master pattern (**3.9**).

All these methods can be used to start on sensible and realistic design, with innovative characteristics. Each method is described below.

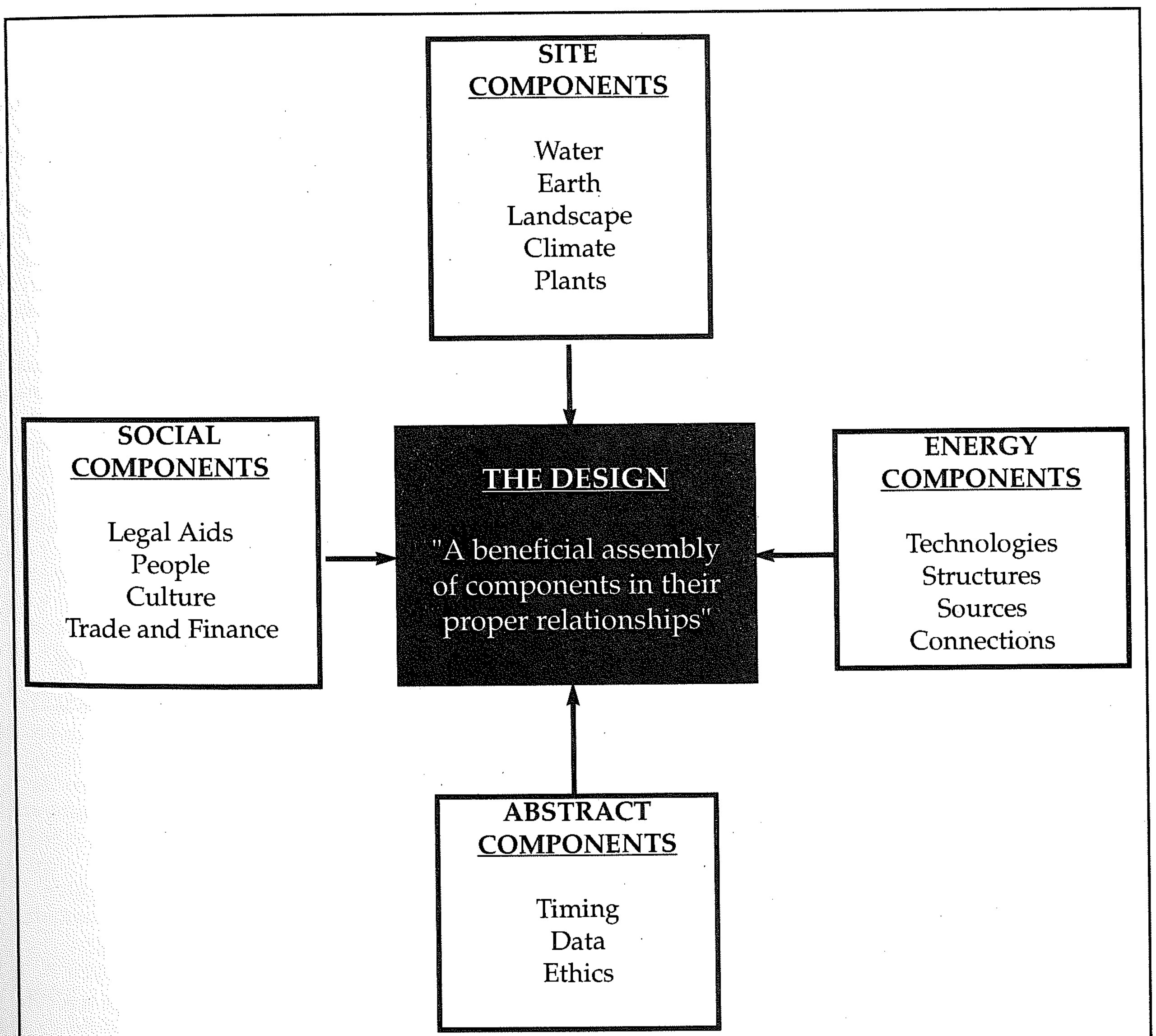
3.2
ANALYSIS
DESIGN BY LISTING THE CHARACTERISTICS OF COMPONENTS

The components of a total design for a site may range from simple technological elements to more complex economic and legal systems. How are we to make decisions about the patterning and placement of our components (systems, elements, or assemblies)? We can list what we know about the characteristics of any one component, and see where this leads us in terms of beneficial connections.

<u>Principle of Self–Regulation</u>
The purpose of a functional and self–regulating design is to place elements or components in such a way that each serves the needs, and accepts the products, of other elements.

To illustrate, we could select a homely and universally–known component, a chicken. What do we know about this hen? We can list its PRODUCTS (materials, behaviours, derived products), NEEDS (what the

TABLE 3.1
ELEMENTS OF A TOTAL DESIGN



chicken requires to lead a full life), and BREED CHARACTERISTICS (the characteristics of this special kind of chicken, whether it be a Rhode Island Red, Leghorn, Hamburg, etc). See **Figure 3.1**.

A broader classification would have only two categories: "outputs" and "inputs". Outputs are the yields of a chicken, inputs are its requirements in order to give those yields. Before we list either, we should reflect on these latter categories:

OUTPUTS, YIELDS or PRODUCTS are RESOURCES if they are used productively, or can become POLLUTANTS if not used in a constructive way by some other part of the system.

INPUTS, NEEDS, or DEMANDS have to be supplied, and if not supplied by other parts of the system, then EXTERNAL ENERGY or EXTRA WORK must be found to satisfy these demands. Thus:

A POLLUTANT is an output of any system component that is not being used productively by any other component of the system. EXTRA WORK is the result of an input not automatically provided by another component of the system.

As pollution and extra work are both unneccessary results of an incompletely designed or unnatural system, we must be able to connect our component, in this case the chicken, to other components. The essentials are:

- That the inputs needed by the chicken are supplied by other components in the system; and
- That the outputs of the chicken are used by other components (including people).

We can now list the characteristics of the chicken, as we know them. Later, we can see how these need to be linked to other components to achieve our self–regulated system, by a ground strategy of *relative placement* (putting components where they can serve each other).

1. Inputs (Needs) of the Chicken

Primary needs are food, warmth, shelter, water, grit, calcium, dust baths, and other chickens.

Secondary needs are for a tolerable social and physical environment, giving a healthy life of moderate stress.

2. Outputs (Products and Behaviours) of the Chicken

Primary products are, for instance: eggs, feathers, feather dust, manure, various exhaled or excreted gases, sound, and heat.

Derived products are many. From eggs we can make a variety of foods, and derive albumen. From feathers we can make dusters, insulation, bedding, rope, and special manures. Manure is used directly in the garden or combined with leaf and stem materials (carbon) to supply compost heat. Composted anaerobically, it supplies methane for a house. Heat and gases both have a use in enclosed glasshouses, and so on. Our list of derived products is limited only by lack of specific information and by local needs for the products.

Behaviours: chickens walk, fly, perch, scratch, preen, mate, hatch eggs, care for young, form flocks of 20–30 individuals, and forage. They also process food to form primary products and to maintain growth and body weight.

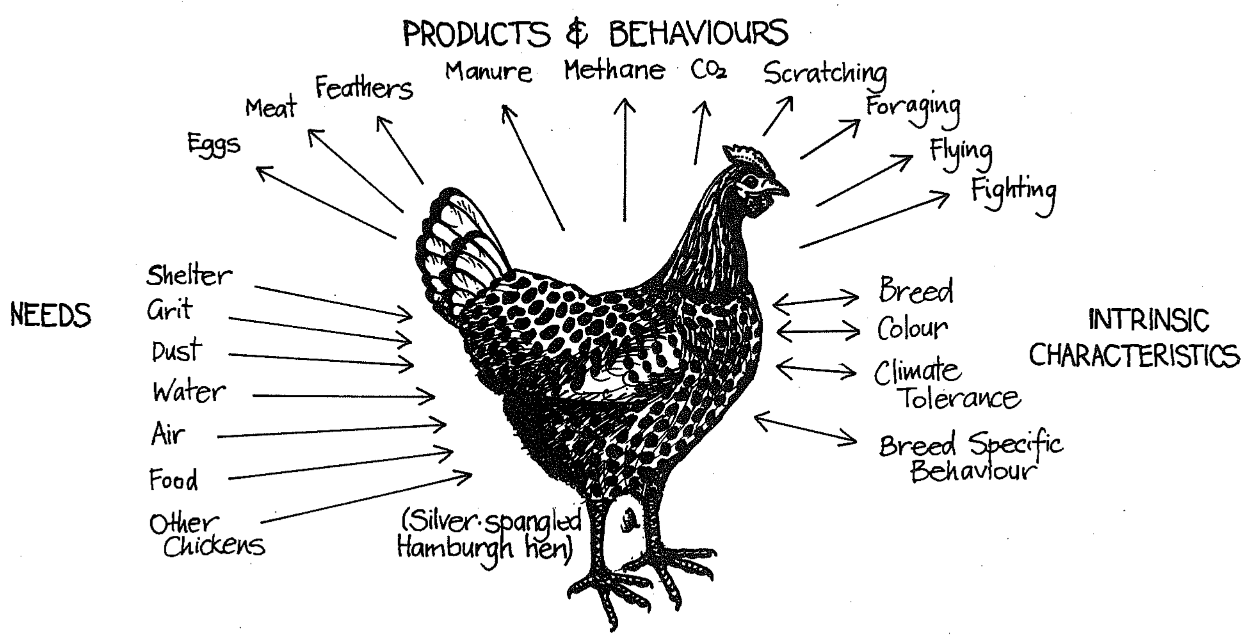


FIGURE 3.1
PRODUCTS AND BEHAVIOURS OF A HEN.
Analysis of these inputs and outputs are critical to self–governing design. A deficit in inputs creates *work*, whereas a deficit in output use creates *pollution*.

3. Intrinsics

Instrinsics are often defined as "breed characteristics". They are such factors as colour, form, weight, and how these affect behaviour, space needed, and metabolism; how climate and soil affect that chicken; or what its tolerances or limits are in relation to heat, cold, predation, and so on. For instance, white chickens survive extreme heat, while thickly–feathered large dark chickens survive extreme cold. Heavy breeds (Australorps) cannot fly over a 1.2 m fence, while lighter breeds (Leghorns) will clear it easily.

We can add much more to the above lists, but that will do to start with (you can add data to any component list as information comes in).

MAKING CONNECTIONS BETWEEN COMPONENTS.

To enable a design component to function, we must *put it in the right place*. This may be enough for a living component, e.g. ducks placed in a swamp may take care of themselves, producing eggs and meat and recycling seeds and frogs. For other components, we must also *arrange some connections*, especially for non–living components, e.g. a solar collector linked by pipes to a hot water storage. And we should *observe and regulate* what we have done. Regulation may involve confining or insulating the component or guiding it by fencing, hedging, or the use of one–way valves. Once all this is achieved, we can relax and let the system, or this part of the system, self–regulate.

Having listed all the information we have on our component, we can proceed to placement and linking strategies which may be posed as questions:

- Of what use are the products of this particular component (e.g. the chicken) to the needs of other components?
- What needs of this component are supplied by other components?
- Where is this component incompatible with other components?
- Where does this component benefit other parts of the system?

The answers will provide a plan of *relative placement* or assist the access of one component to the others.

We can choose our other components from some common elements of a small family farm where the family has stated their needs as a measure of self–reliance, not too much work, a lot of interest, and a product for trade (no millionaire could ask for more!) The components we can bring to the typical small farm are:

- Structures: House, barn, glasshouse, chicken–house.
- Constructs: Pond, hedgerow, trellis, fences.
- Domestic Animals: Chickens, cows, pigs, sheep, fish.
- Land Use: Orchard, pasture, crop, garden, woodlot.
- Context: Market, labour, finance, skills, people, land available, and cultural limits.
- Assemblies: Most technologies, machines, roads and water systems.

We will not list the characteristics of all of these elements here, but will proceed in more general terms.

In the light of linking strategies, we know where we *can't* put the chicken (in a pond, in the house of most societies, in the bank, and so on), but we *can* put the chicken in the barn, chicken–house, orchard, or with other components that either supply its needs or require its life products. Our criteria for placement is that, if possible, such placement enables the chicken to function naturally, in a place where its functions are beneficial to the whole system. If we want the chicken to work for us, we must list the energy and material needs of the other elements, and see if the chicken can help supply those needs. Thus:

THE HOUSE needs food, cooking fuel, heat in cold weather, hot water, lights, bedding, etc. It gives shelter and warmth for people. Even if the chicken is not allowed to enter, it can supply some of these needs (food, feathers, methane). It also consumes most food wastes coming from the house.

THE GLASSHOUSE needs carbon dioxide for plants, methane for germination, manure, heat, and water. It gives heat by day, and food for people, with some wastes for chickens. The chicken can obviously supply many of these needs, and utilise most of the wastes. It can also supply night heat to the glasshouse in the form of body heat.

THE ORCHARD needs weeding, pest control, manure, and some pruning. It gives food (as fruit and nuts), and provides insects for chicken forage. Thus, the orchard and the chickens seem to need each other, and to be in a beneficial and mutual exchange. They need only to be placed together.

THE WOODLOT needs management, fire control, perhaps pest control, some manure. It gives solid fuel, berries, seeds, insects, shelter, and some warmth. A beneficial interaction of chickens and woodlot is indicated.

THE CROPLAND needs ploughing, manuring, seeding, harvesting, and storage of crop. It gives food for chickens and people. Chickens obviously have a part to play in this area as manure providers and cultivators (a large number of chickens on a small area will effectively clear all vegetation and turn the soil over by scratching).

THEPASTURE needs cropping, manuring, and storage of hay or silage. It gives food for animals (worms and insects included).

THE POND needs some manure. It yields fish, water plants as food, and can reflect light and absorb heat.

In such a listing, it becomes clear that many components provide the needs and accept the products of others. However, there is a problem. On the traditional small farm the main characteristic is that *nothing is connected to anything else*, thus no component supplies

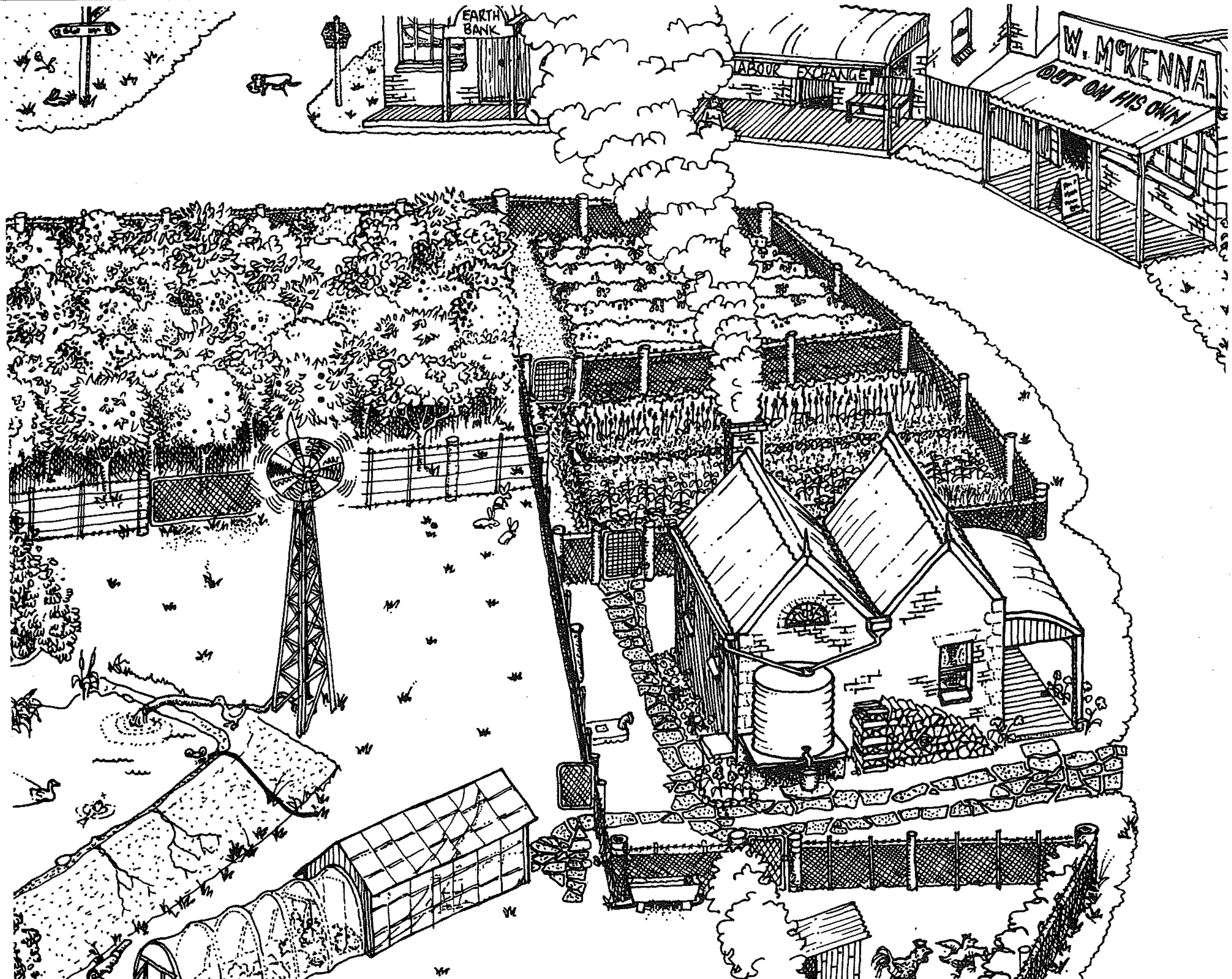


FIGURE 3.2
A TYPICAL SMALL FARM.
Villages and farms may contain all the components for self-governance but unless these components are placed in harmonious relationships to each other time, energy, and resources are wasted. In this figure unplanned and segregated systems all demand inputs.

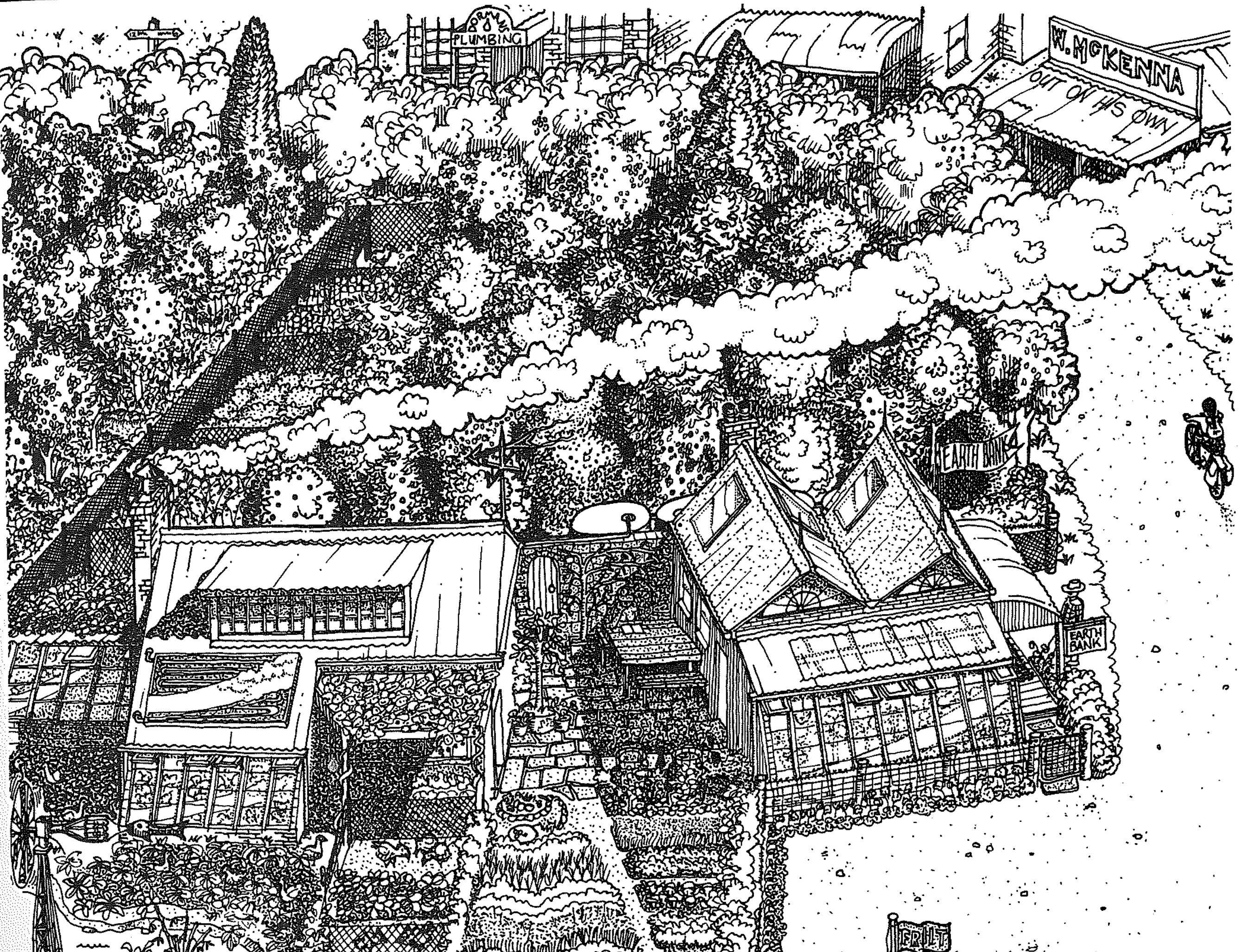


FIGURE 3.3
A RE–DESIGNED SMALL FARM.
In this figure many elements supply the energy inputs for others, and the system can be largely self–regulating.

the needs of others. In short, the average farm does not enjoy the multiple benefits of correct relative placement, or needful access of one system or component to another. This is why most farms are rightly regarded as places of hard work, and are energy–inefficient See **Figures** 3.2 and 3.3.

Now, *without inventing anything new,* we can *redesign* the existing components to make it possible for each to serve others. See **Figure 3.4– 3.5**.

Just by moving the same components into a beneficial design assembly, we can ensure that the chicken, glasshouse or orchard is working for us, not us working for it. If we place essential components carefully, in relation to each other, not only is our maintenance work minimised, but the need to import energies is greatly reduced, and we might expect a modest surplus for sale, trade, or export. Such surplus results from the conversion of "wastes" into products by appropriate use.

The chicken–house heats (and is heated by) the glasshouse, and both are heated by the chimney. The chickens range in the orchard, providing manure and getting a large part of their food from orchard wastes and pests, and from interplants of woodlot or forest components. A glasshouse also heats the house, and part of the woodlot is a forage system and a shelter–belt. Thus, sensible placements, minimising work, have been made. Market and investment control have been placed in the house, together with an information service using a computer, which can link us to the world.

Each part of this sort of design will be dealt with in greater detail in this book, but a simple transformation such as we made from **Figure 3.2** to **Figure 3.3** is enough to show what is meant by functional design.

A great part of this design can be achieved, as it was here, by analytical methods *unrelated to any real site conditions*. Note that before we actually implement anything, before we even leave our desk, we have developed a lot of good ideas about patterns and self–regulatory systems for a family farm. It only remains to see if these are feasible on the ground, and if the family can manage to achieve them. This is the benefit of the analytical design approach: it can operate without site experience! This is also its weakness. Until the chicken is actually heating the greenhouse, manuring the orchard, or helping to produce methane for the house, our system is just information, or potential. Until that chicken is actually in function, we have produced no real resources, nor have we solved any real problems on our family farm.

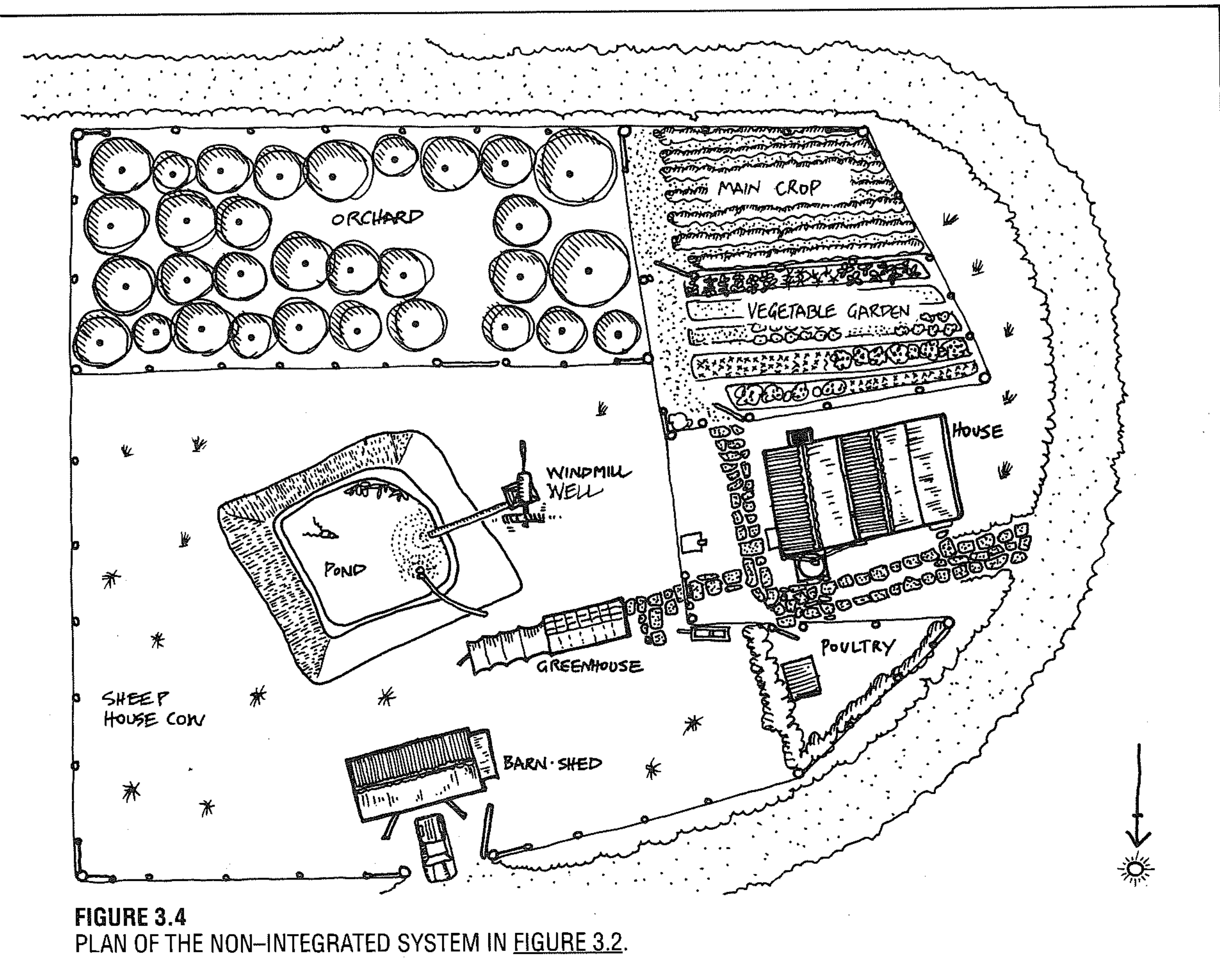


FIGURE 3.4
PLAN OF THE NON–INTEGRATED SYSTEM IN FIGURE 3.2.

Information as a Resource

RESOURCES are practical and useful energy storages, while INFORMATION is only a potential resource, until it is put to use.

We must never confuse the assembling of information with making a real resource difference. This is the academic fallacy: "I think, therefore I have acted."

Note also that we have arrived, analytically, at the need for *cooperation* within the system, and that any *competition* absorbs energy, hence consumes part of our slender resources. Our ideal is to allow the free expression of all the beneficial characteristics of the chicken, so that we avoid conflict and further regulate the system we have designed in light of real–life experience on the site.

3.3

OBSERVATION

DESIGN BY EXPANDING ON DIRECT OBSERVATION OF A SITE

Unlike the preceding analytic method, this way of arriving at design strategies starts on and around the site. Short practice at refining field observation as a design tool will convince you that no complex of map overlays, library, computer data, or remote analysis will ever supplant field observation for dependability and relevance.

Observation is not easily directed, and it is therefore regarded as largely unscientific and individualistic. Process and events, as we encounter them on a real site, are never revealed just by maps or other fixed data. Yet it is from the observation of processes and events (such as heavy rain and subsequent run–off) that we can devise strategies of "least change", and so save energy and time. No static method can reveal processes or dynamic interactions.

A camera and a notebook are great aids to observation, allowing a re–examination of information if necessary. A good memory for events helps. Video recorders are very useful to review processes.

How do we proceed? As we approach the problem, we can adopt any or all of these attitudes:

- A CHILD–LIKE AND NON–SELECTIVE APPROACH, in which "I wonder why..." may pre-face our actual observation.
- A THEMATIC APPROACH, where we try to observe a theme such as water, potential energy sources, or the conditions for natural regeneration.

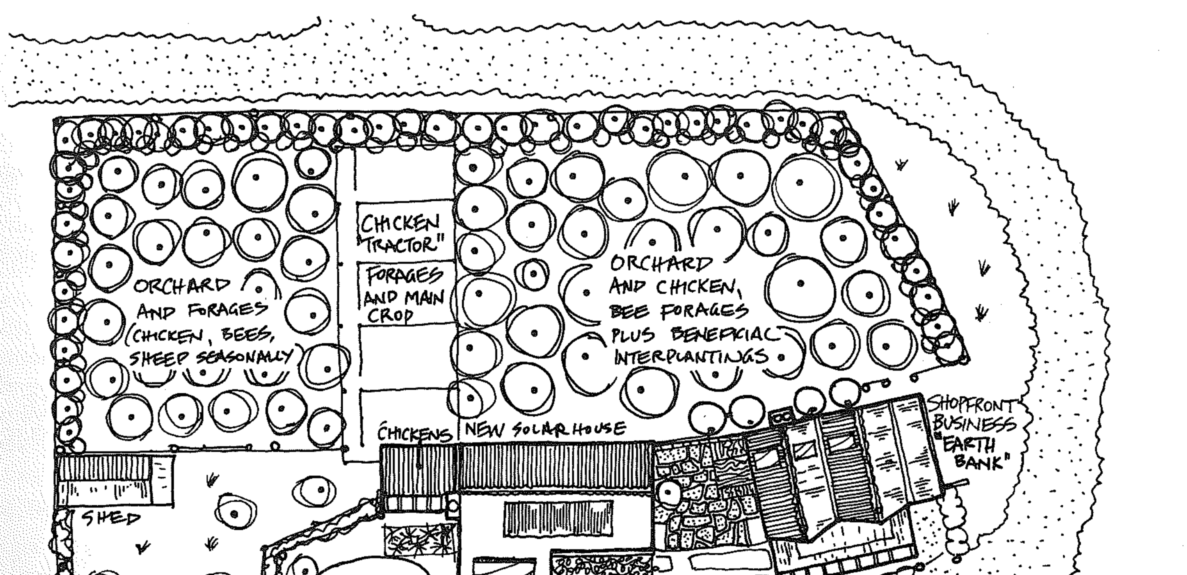


FIGURE 3.5
PLAN OF THE INTEGRATED SYSTEM IN FIGURE 3.3.

• AN INSTRUMENTAL APPROACH, where we measure, perhaps using equipment, a factor such as temperature gradients, wind, or reflection from trees.

• AN EXPERIENTIAL APPROACH, using all our senses as our instruments, trying to be fully conscious both of specific details, sensations, and the total ambience of the site.

In order to develop a design strategy, possible procedural stages are as follows:

1. Make value–free and non–interpretative notes about what is seen, measured, or experienced, e.g. that "moles have thrown up earth mounds on the field." Make no guesses or judgements at this stage (this takes some discipline but gets a lot of primary data listed).

2. Later, select some observations which interest you, and proceed to list under each of them a set of SPECULATIONS as to possible meanings, e.g. (on the moles):

- That molehills are only conspicuous on fields, and may actually occur elsewhere.
- Or that they occur only on fields.
- That fields are particularly attractive to moles.

And so on. Many speculations can arise from one observation! Speculations are a species of hypothesis, a guess about which you can obtain more information. To further examine these speculations, several strategies are open to the observer:

3. Confirm or deny speculations by any or all of these methods:

- Library research on moles, and even on allied burrowing species (e.g. gophers).
- Asking others about moles and their field behaviour.
- Devising more observations on one particular THEME just to test out your ideas.
- Recalling all you know about moles or allied species in other areas or circumstances.

This process will start to further elaborate your knowledge of an existing and *specific site characteristic*, and may already be leading you to the next step:

4. Examination of all the evidence now to hand. Have we evolved any patterns, any mode of operating? What *other* creatures burrow in fields and are predators, prey, or just good friends of moles? Now, for the last decisive step:

5. How can we find a USE for all this information? What design strategies does any of it suggest? For example, we may now have found a *lot* of data on burrowers and fields, and look upon the mole (if mole it is) as a fine soil aerator and seed–bed provider, and therefore to be encouraged—*or* the very opposite. We may have discovered places where moles are beneficial, and places where they could well be excluded. Or possibly they are best allowed to go their way as natural components in the system. Methods of mole–control or data on how to prepare moles for eating may have surfaced, and so on.

As the research and observation phase (plus others' observations) goes on, the mole will gradually be seen to be *already connected* in one or other way to worms, upturned soils, fields, lawns, gardens, pastures, water percolation, and even perhaps soil production. Dozens of useful strategies may have evolved from your first simple observations, and the site *begins to design itself*. You may begin sensible trials to test some of your hypotheses.

Some cautious trials and further observation will, in time, confirm the benefits (or otherwise) of moles in the total system or in specific parts of it. A great deal of practical information will be gathered, which will carry over to other sites and to allied observations. A study of earthworms may have co–evolved, and the interconnectedness of natural systems has become evident.

No analytic method can involve one in the world as much as observation, but observation and its methods need to be practised and developed, whereas analysis needs no prior practice and requires less field research or first–hand knowledge. As an observer, however, you are very likely to stumble on *unique and effective strategies*, and thus become an innovator!

The uses and strategies derived from observation, experience or experiments on site are the basic tools of aware, long–term residents. A set of reliable strategies can be built up, many of them transferable to other locations. Here, we have used nature itself as our teacher. That is the greatest value of nature, and it will in time supply answers to all our questions.

Thus, the end result of systematic observation is to have evolved strategies for application in design. A second and beneficial result is that we have come to know, in a personal and involved way, something of the totality of the interdependence of natural systems.

3.4

DEDUCTION FROM NATURE
DESIGN BY ADOPTING LESSONS LEARNT FROM NATURE

The impetus that started Masanobu Fukuoka[3,4] on his remarkable voyage to natural farming was the sight of healthy rice plants growing and yielding in untended and uncultivated road verges. If rice can do this naturally, he asked, why do we labour to cultivate the soil? In time he achieved high– yielding rice production on his farm without cultivation, without fertilisers or biocides, and without using machinery.

Via our senses (which include the sensations of the skin in relation to pressure, wind chill, and heat), and the organised, patterned, or measured information we extract from observation, we can discover a great deal about natural processes in the region we are examining. In order to put our observations about nature to use, we need to look at the following:

STRUCTURE

We can imitate the structure of natural systems. If we have palms, vines, large evergreen trees, an "edge" of herbaceous perennials, a groundcover of bulbs or tubers, and a rich bird fauna in the *natural* system of the region, then we can reconstruct or imitate such a system structure on our site, using some native species for pioneers, bird forage, or vine supports. We can add to this the palms, vines, trees, tubers, and poultry that are of great use to our settlement (over that broad range of uses that covers food, crafts, medicines, and fuels).

After studying the natural placement of woody legumes or windbreak in natural systems, we can imitate these in designed systems. We can improve on local species by finding out–of–region or exotic species even better suited to those roles than those of an impoverished or degraded native flora and fauna. Certainly, we can carefully select species of a wider range of use to settlements than the natural assembly.

PROCESS

Apart from the structure of natural systems, we need most of all to study process. Where does water run? How does it absorb? Why do trees grow in some special sites in deserts? Can we construct or use such processes to suit ourselves? Some of the processes we observe are processes "energised" by animals, wind, water, pioneer trees or forbs, and fire. How does a tree or herb propagate itself in this region? As every design is a continuous process, we should most of all try to create useful self–generating systems. Some examples would be:

• On Lake Chelan (Washington state, USA), walnuts self–generate from seed rolling downhill in the valleys of intermittent streams. Similar self– propagation systems work for palms in the tropics, *Aleurites* (candle–nut) in Hawaii, and asparagus along sandy irrigation channels. Thus, we save ourselves a lot of work by setting up headwater plantations and allowing these to self–propagate downstream (as for willows, Russian olive, and hundreds of water–plant species, including taro in unstable flood–water lowlands), as long as these are not a problem locally.

• Birds spread useful bird forages such as elderberries, *Coprosma*, *Lycium*, autumn olive, pioneer trees or herbs, and preferred grains such as *Chenopodium* species. If we place a few of these plants, and allow in free–ranging pigeons or pheasants, they will plant more. The same applies to dogs or foxes in the matter of loquats, bears for small fruits, and cattle for hard seeds such as honey locusts. Burrowers and hoarders such as gophers will carry bulbs and root cuttings into prairie, and jays and squirrels, choughs, or currawongs spread oaks when they bury acorns.

If, in grasslands or old pastures, we see that a "pioneer" such as tobacco bush, a pine, or an *Acacia* provides a site for birds to roost, initiating a soil change so that clumps or coppices of forest form there, we can use the same techniques and allied species to pioneer our food forests, but selecting species of more direct use to us. Many native peoples do just this, evolving scattered forest nucleii based on a set of pioneer trees, termite mounds, compost heaps, and so on. We can provide perches for birds to drop pioneer seeds, and so set up plant nucleii in degraded lands around simple perches placed on disturbed sites.

• We can provide nest holes so that owls may then move in to control rodents, purple martins to reduce mosquitoes, or woodpeckers to control codling moth. Many nurse plants allow insect predators to overwinter, feed, or shelter within our gardens, as do small ponds for frogs and rock piles for lizards. If we want these aids to pest control, we need to provide a place for them. Some of these natural workers are very effective (woodpeckers alone reduce codling moth by 40–60%).

• To limit a rampant plant, or to defeat invasive grasses, we need only to look to nature. Nature imposes successions and limits on every species, and once we know the rules, we can use this succession to limit or exclude our problem species. Many soft vines will smother prickly shrubs. Browsed or cut out, they allow trees to permanently shade out the shrub, or rot its seeds in mulch. Kikuyu grass is blocked from spreading by low hedges of comfrey, lemongrass, arrowroot (*Canna spp.*), or nasturtiums. We can use some or all of these species at tropical garden borders, or around young fruit trees. We can smother rampageous species such as *Lantana* by vines such as chayote (*Sechium edulis*) and succeed them with palm/legume forests, by cutting or rolling tracks and then planting legumes, palms, and vines of our choice. Where rampageous grasses smother the trees, we set our trees out in a protecting zone of "soft" barrier plants such as comfrey, nasturtium, or indeed any plant we locally observe to "beat the grass", and we surround our mulched gardens with belts of such plants.

There are hundreds of such botanical lessons about us. Look long enough, and the methodologies of nature become clear. This is design by analogy: we select analagous or botanically–allied species for trials. If thistles grow around a rabbit warren, then perhaps if we disturb the soil, supply urine and manure, and sow seed, we will get globe artichokes (and so I have!) Or we can pen goats or sheep on a place, then shut them out and plant it. It was by such thinking that the idea of chicken or pig "tractors" evoled to remove such stubborn weeds as nut–grass, *Convolvulus*, onion–weed, and twitch before planting a new succession of useful plants. Or we can provide fences or pits to trap wind–blown debris (dried leaves, rabbit and sheep manures, seagrasses), which can be gathered for garden use. And so on...

All these strategies can be derived from observing natural processes, and used consciously in design to achieve a great reduction in work, hence energy inputs.

itself. It is of value in assessing energy flows in the system, and is also a generator of creativity. Because it is based on a set of essentially random selections, it may reveal some very innovative designs.

The process is as follows: we select and list a set of design components, and with them a set of placement or connective strategies. If our components are arranged in a circle around these "connections", we can join them up at random, make a sketch of the results, and see what it is that we have achieved. This frees us from "rational" decisions, and forces us to consider unusual connections for their value; connections that would be inhibited from proposing by our limited education, by cultural restraints, or by normal usage. (See **Table 3.2**).

	House	
Windmill		Storage box
Glasshouse	**ATTACHED TO**	Yard or compound
Animal shelter	**BESIDE**	Caves
Trellis	**AROUND**	Trenches
Mounds	**OVER**	Swales
Compost heaps	**IN**	Ponds
Plants	**ON**	Chickens
Ducks	**UNDER**	Fish
Windbreak	**CONTAINING**	Barn
	Fence	

TABLE 3.2
RANDOM ASSEMBLY SELECTION

Having laid out a simple diagram, we can select any one component and connect it to others, creating images for further examination as to their particular uses and functions. Some simple examples are:

- Glasshouse OVER house
- Storage box IN glasshouse
- Raft ON pond
- Glasshouse ON raft
- House BESIDE pond

And, using more connections: glasshouse CONTAINING compost heap ATTACHED TO house BESIDE pond with cave UNDER, containing storages boxes with plants IN these.

We can sketch these, and see just what it is we have achieved in terms of energy savings, unique assemblies, special effects for climate, increased yield, compact design, or easier accessibility. As we do not usually think of these units *with respect to their connections*, this simple design strategy frees us to do so, and to achieve innovative results.

Having illustrated (by way of a diagram) random assemblies, we can then think out what would happen if we did in fact build them or model them. Rafts can, of course, be oriented quickly to suit seasons. Caves are cool and ponds in them almost immune from evaporation. Ducks are safe from predators on rafts. Glasshouses on rafts will warm contained water and create thermal storages and currents. Solar cells will light caves, and caves below houses supply storage and cool or warm air. Trees shade houses, and so on.

Thus, immune from ridicule and criticism, we can try various unlikely combinations and links of components (all of which probably exist somewhere), and try to assess what we have done *in terms of function*. This is, if you like, working backwards from assembly to function to benefits and system characteristics. The value of this approach is that it frees us to create novel assemblies and to assess them before trials.

Creative solutions may also be arrived at by constantly re-examining a problem, and by considering every form of solution, including that important strategy of doing nothing! (Fukuoka[3,4])

CREATIVE PROBLEM SOLVING
Restate a problem many ways, reverse the traditional approaches, and allow every solution to be considered. Simple solutions may be found by this process.

The art of thinking backwards, or in opposites, is often very effective in problem-solving. It is easier to drive an axle out of a wheel than to knock a wheel off an axle, easier to lower a potted vine down a dark shaft over a period of months than to grow it up from the bottom. So, if we worry away at problems in terms of restatements, turning things on their head and stating the opposite, we may find that real solutions lie in areas free from acquired knowledge and values.

3.8
FLOW DIAGRAMS
DESIGN FOR WORK PLACES

For designing any special work place, from a kitchen to a plant nursery, the preceding methods have limited uses. Here, we call in a different method—the "flow chart". We imagine how the process flows. In the kitchen we take from storage, prepare, cook, serve, and gather in the plates and food for waste disposal and return to storage.

Thus the processes follow a certain path. The best kitchens are U-shaped or compact, so that least movement is necessary. Storages are near the place where food, plates, or pots and pans are needed. Frequently-used items are to hand on benches, or in special niches. Strong blocks, bench tops, or tables are built to take the heavy work of chopping and the clamping on of grinders and flour mills. We can mark such designs out on the ground, and walk around these, preparing an imaginary meal, measuring the space taken up by trays, pots, and potato storages, and so creating an efficient work place. It should also involve the placement of traditional items, and agree with cultural uses.

It is advisable to involve an experienced worker in any such design, and to research prior designs or new aids to design, such as we find in office furniture which can be adjusted to the person. I have seen some excellent farm buidings such as shearing sheds and their associated yards built by worker–designers after years of observation and experience. Some people specialise in such design for schools, wineries, and golf courses. In general, it is mainly work–places which need such careful attention. Most other areas in buildings are of flexible use, and have the potential for multiple function.

The technique of flow charts is also applicable to traffic–ways and transport lines serving settlements, where loads or cargoes are to be received and sorted, and where schedules or time–place movements are integral to the activity.

3.9

ZONE AND SECTOR ANALYSIS DESIGN BY THE APPLICATION OF A MASTER PATTERN

Zone and sector analysis is a primary energy–conserving placement pattern for the whole site. When we come to an actual site design, we must pay close attention to locating components relative to the two energy sources of the site:

First, energy available *on site*: the people, machines, wastes, and fuels of the family or society. For these, we establish ZONES of use, of access, and of time available.

Second, energy entering or flowing *through the site*: wind, water, sunlight and fire may enter the site. To govern these energies we place intervening components in the SECTORS from which such energies arise, or can be expected to enter. We also define sectors for views, for wildlife, and for temperature (as air flow). To proceed to a discussion of the pattern in its parts:

ZONES

We can visualise zones as series of concentric circles, the innermost circle being the area we visit most frequently and which we manage most intensively. Zones of use are basic to conservation of energy and resources *on site*. We do not have endless time or energy, and the things we use most, or which need us often, must be close to hand. We plan our kitchens in this way, and we can plan our living sites with equal benefit to suit our natural movements.

We should not pretend that any real site will neatly accept this essentially conceptual conformation of pattern, which will usually be modified by access, site characteristics such as slope and soils, local wind patterns, and the technical problems of, for example, constructing curved fences in societies where title boundaries, materials, and even the education available is "straight".

In *zonation*, the village or dwelling itself is Zone 0, or the origin from which we work. The available energy in Zone 0 is human, animal, piped–in, or created on site. Whatever the sources, these energies can be thought of as *available* or *on–site energies*. In order to conserve them, and those other essential re-sources of work and time, we need to place components as follows:

Zone 0 (the house or the village).
In this zone belongs good house design, attached glasshouse or shadehouse, and the integration of living components as sod roof, vines, trellis, potplants, roof gardens, and companion animals. In some climates, many of these structures are formed of the natural environment, and will in time return to it (bamboo and rattan, wattle and daub, thatch, and earth–covered or sheltered structures).

Zone 1
Those components needing continual observation, frequent visits, work input, complex techniques (fully–mulched and pruned gardens, chicken laying boxes, parsley and culinary herbs) should be placed *very close to hand*, or we waste a great deal of time and energy visiting them. Within 6 m (20 feet) or so of a home, householders can produce most of the food necessary to existence, with some modest trade requirements. In this home garden are the seedlings, young trees for outer zone placement, perhaps "mother plants" for cuttings, rare and delicate species, the small domestic and quiet animals such as fish, rabbits, pigeons, guinea pigs, and the culinary herbs used in food preparation. Rainwater catchment tanks are also placed here. Techniques include complete mulching, intensive pruning of trees, annuals with fast replacement of crop, full land use, and nutrient recycling of household wastes. In this zone, we arrange nature to serve our needs.

Zone 2
This zone is less intensively managed with spot–mulched orchards, main–crop beds, and ranging domestic animals, whose shelters or sheds may nevertheless adjoin Zone 1 or, as in some cultures, be integrated with the house. Structures such as terraces, small ponds, hedges, and trellis are placed in this zone. Where winter forces all people and animals indoors, joint accommodation units are the normality, but in milder climates, forage ranges for such domestic stock as milk cows, goats, or poultry can be placed in Zone 2. Home orchards are established here, and less intensive pruning or care arranged. Water may be piped from Zone 3, or conserved by species selection.

Zone 3
This area is the "farm" zone of commercial crop and animals for sale or barter. It is managed by green manuring, spreading manure from Zone 2, and soil conditioning. It contains natural or little–pruned trees, broadscale farming systems, large water storages, soil absorption of water, feed–store or barns, and field shelters as hedgerow or windbreak.

Zone 4
This zone is an area bordering on forest or wilderness, but still managed for wild gathering, forest and fuel needs of the household, pasture or range, and is planted to hardy, unpruned, or volunteer trees. Where water is stored, it may be as dams only, with piped input to other zones. Wind energy may be used to lift water to other areas, or other dependable technology used.

Zone 5
We characterise this zone as the natural, unmanaged environment used for occasional foraging, recreation, or just let be. This is where we learn the rules that we try to apply elsewhere.

Now, any one component can be placed in its right zone, at the best distance from our camp, house, or village. As our very perfect "target" model does not fit on real sites, we need to deform it to fit the landscape, and we can in fact bring "wedges" of a wilderness zone right to our front door: a corridor for wildlife, birds, and nature (**Figure 3.7**). Or we can extend a more regularly used zone along a frequently used path (even make a loop track to place its components on).

Zoning (distance from centre) is decided on two factors:

1. The number of times you need to visit the plant, animal or structure; and
2. The number of times the plant, animal or structure needs you to visit it.

For example, on a yearly basis, we might visit the poultry shed:

- for eggs, 365 times;
- for manure, 20 times;
- for watering, 50 times;
- for culling, 5 times; and
- other, 20 times.

Total = 460 visits; whereas one might visit an oak tree twice only, to collect acorns. Thus the zones are "frequency zones for visits", or "time" zones, however

TABLE 3.3:
SOME FACTORS WHICH CHANGE IN ZONE PLANNING AS DISTANCE INCREASES.

Factor or Strategy	ZONE I	ZONE II	ZONE III	ZONE IV
Main design for:	House climate, domestic sufficiency.	Small domestic stock & orchard.	Main crop forage, stored.	Gathering, forage, forestry, pasture.
Establishment of plants	Complete sheet mulch.	Spot mulch and tree guards.	Soil condition-ing and green mulch.	Soil conditioning only.
Pruning and trees	Intensive cup or espallier trellis.	Pyramid and built trellis.	Unpruned and natural trellis.	Seedlings, thinned to selected varieites.
Selection of trees	Selected dwarf or multi-graft.	Grafted varieties and plants managed.	Selected seedlings for later grafts. by browse.	Thinned to selected varieties, or
Water provision	Rainwater tanks, bores wind pumps. reticulation.	Earth tank and wells, bores,	Water storage fire control.	Dams, rivers, in soils, dams.
Structures	House/green-house, storage integration.	Greenhouse and barns, poultry sheds.	Feed store, field shelter.	Field shelter grown as hedgerow and woodlot
Information	Stored or generated by people.	In part affected by other species.	As for II.	Arising from natural processes.

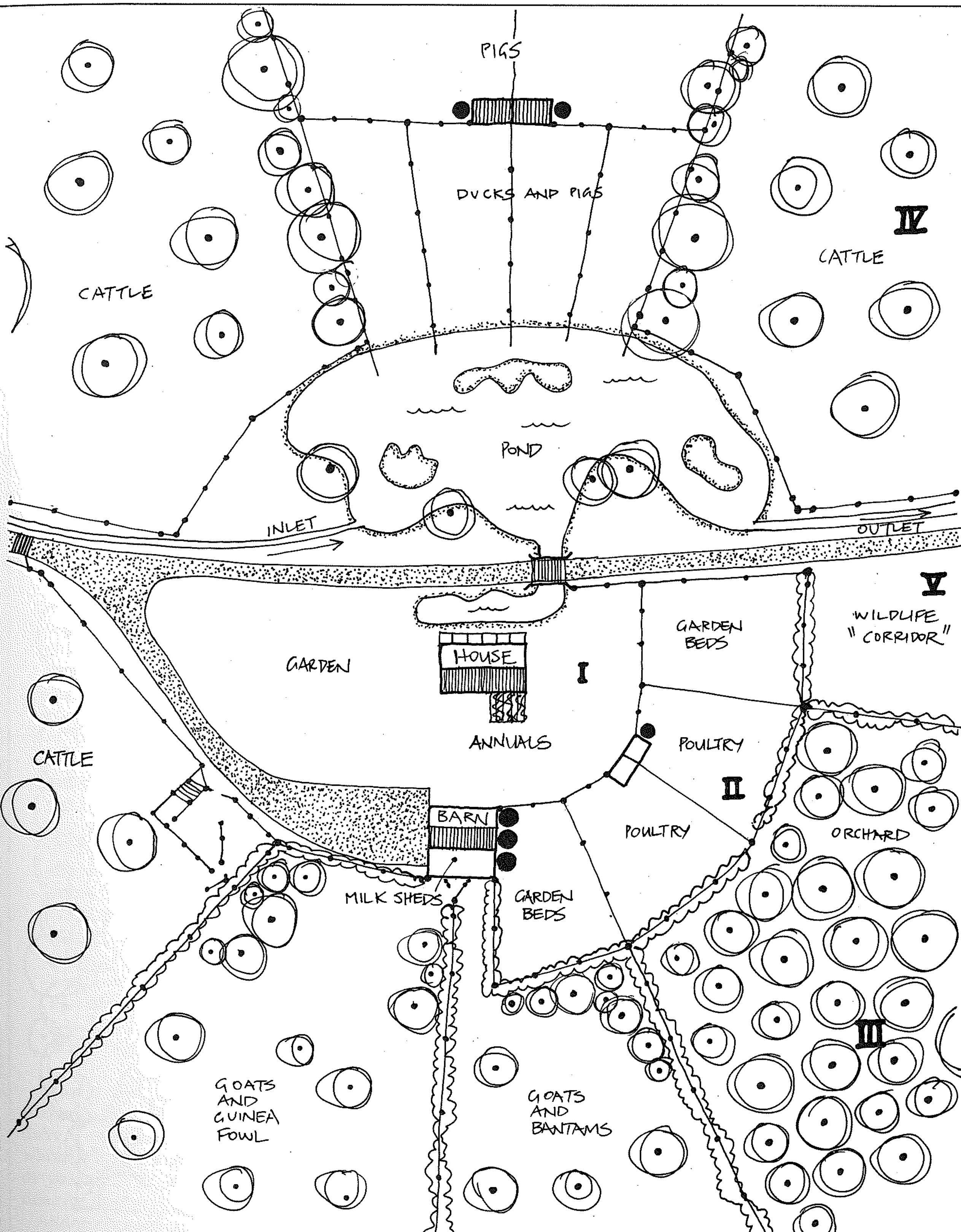


FIGURE 3.7
THE BASIC GROUNDPLAN FOR ZONE AND SECTOR ANALYSIS.
If this pattern only is carefully applied to a site great benefits result.

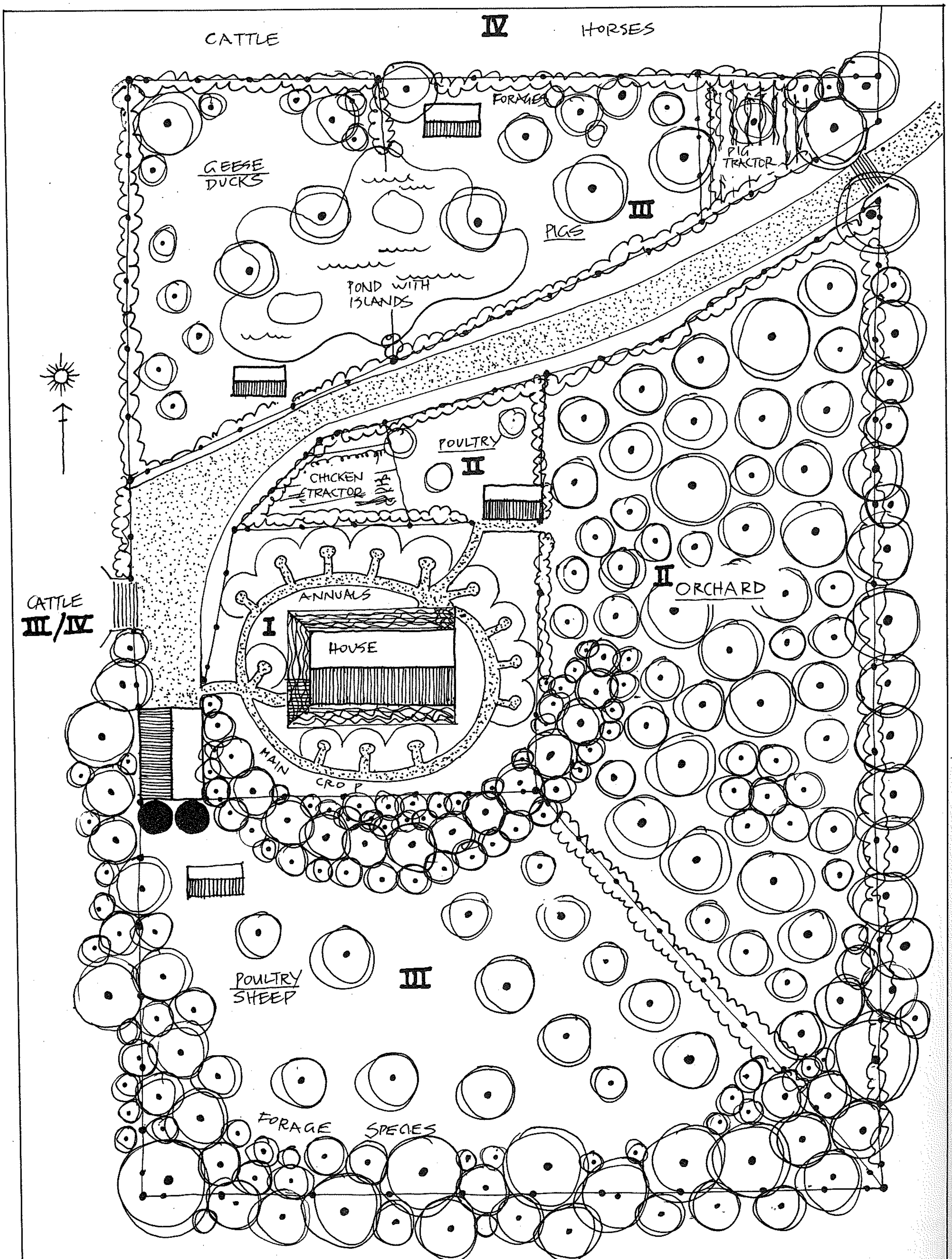


FIGURE 3.8
GROUND PLAN FOR A MIXED SMALL FARM.

you like to define them. The more visits needed, the closer the objects need to be. As another example, you need a fresh lemon 60–100 times a year, but the tree needs you only 6–12 times a year, a total of 66 to 112 times. For an apple tree, where gathering is less, the total may be 15 times visited. Thus, the components or species space themselves in zones according to the number of visits we make to them annually.

The golden rule is to develop the nearest area first, get it under control, and then expand the perimeter. A single perimeter will then enclose all your needs.

Too often, the novice selects a garden away from the house, and neither reaps the plants efficiently, nor cares for them well enough. Any soil, with effort and the compost from the recycling of wastes, will grow a good garden, so stay close to the home.

Let us think of our zones in a less ordered way, as was well described by Edgar Anderson for Central Honduras (Anderson, E., 1976):

> Close to the house and frequently more or less surrounding it is a compact garden–orchard several hundred square feet in extent. No two of these are exactly alike. There are neat plantations more or less grouped together. There are various fruit trees (nance, citrus, melias, a mango here and there, a thicket of coffee bushes in the shade of the larger trees)... There are tapioca plants of one or two varieties, grown more or less in rows at the edge of the trees. Frequently there are patches of taro; these are the framework of the garden– orchards. Here and there in rows or patches are corn and beans. Climbing and scrambling over all are vines of various squashes and their relatives; the chayote (choko) grown for the squashes, as well as its big starchy root. The luffa gourd, its skeleton used for dishrags and sponges. The cucurbits clamber over the eaves of the house and run along the ridgepole, climb high in the trees, or festoon the fence. Setting off the whole garden are flowers and various useful weeds (dahlias, gladioli, climbing roses, asparagus fern, cannas). Grain amaranth is a 'sort of encouraged weed that sows itself.'

Around the "dooryard gardens" described above, Anderson notes the fields (in Mexico) "dotted here and there with volunteer guavas and guamuchiele trees, whose fruit was carefully gathered. Were they orchards or pastures? What words are there in English to describe their groupings?"

Anderson is contrasting the strict, ordered, linear, segmented thinking of Europeans with the productive, more natural polyculture of the dry tropics. The order he describes is a semi–natural order of plants, in their right relationship to each other, but not rigorously separated into various artificial groups. More than that, the house and fence form essential trellis for the garden, so that it is no longer clear where orchards, field, house and garden have their boundaries, where annuals and perennials belong, or indeed where cultivation gives way to naturally–evolved systems.

Monoculture man (a pompous figure I often imagine to exist, sometimes fat and white like a consumer, sometimes stern and straight like a row–crop farmer) cannot abide this complexity in his garden or his life. His is the world of order and simplicity, and therefore chaos.

When thinking of placing components into zones, remember that intrinsic properties and species–specific yields are available from a component wherever it is placed (all trees give shade), so that we don't include these "intrinsics" in assessing function in design.

JUDGING ZONAL PLACEMENT

Place a component in relation to other components or functions, and for more efficient use of space or nutrient. Look for products that serve special needs not otherwise locally available.

The amount of management we must always provide in a cultivated ecosystem is characterised by conscious placement, establishment, guidance, and control energies, akin to the adjustments we normally make to our environment as we traverse it on our daily tasks.

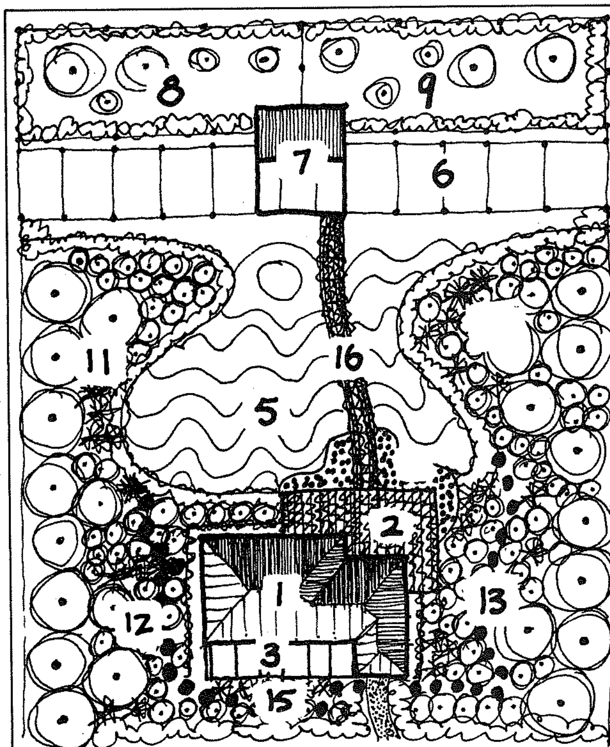


FIGURE 3.9
Design for a 1,000 square metre block. See text.

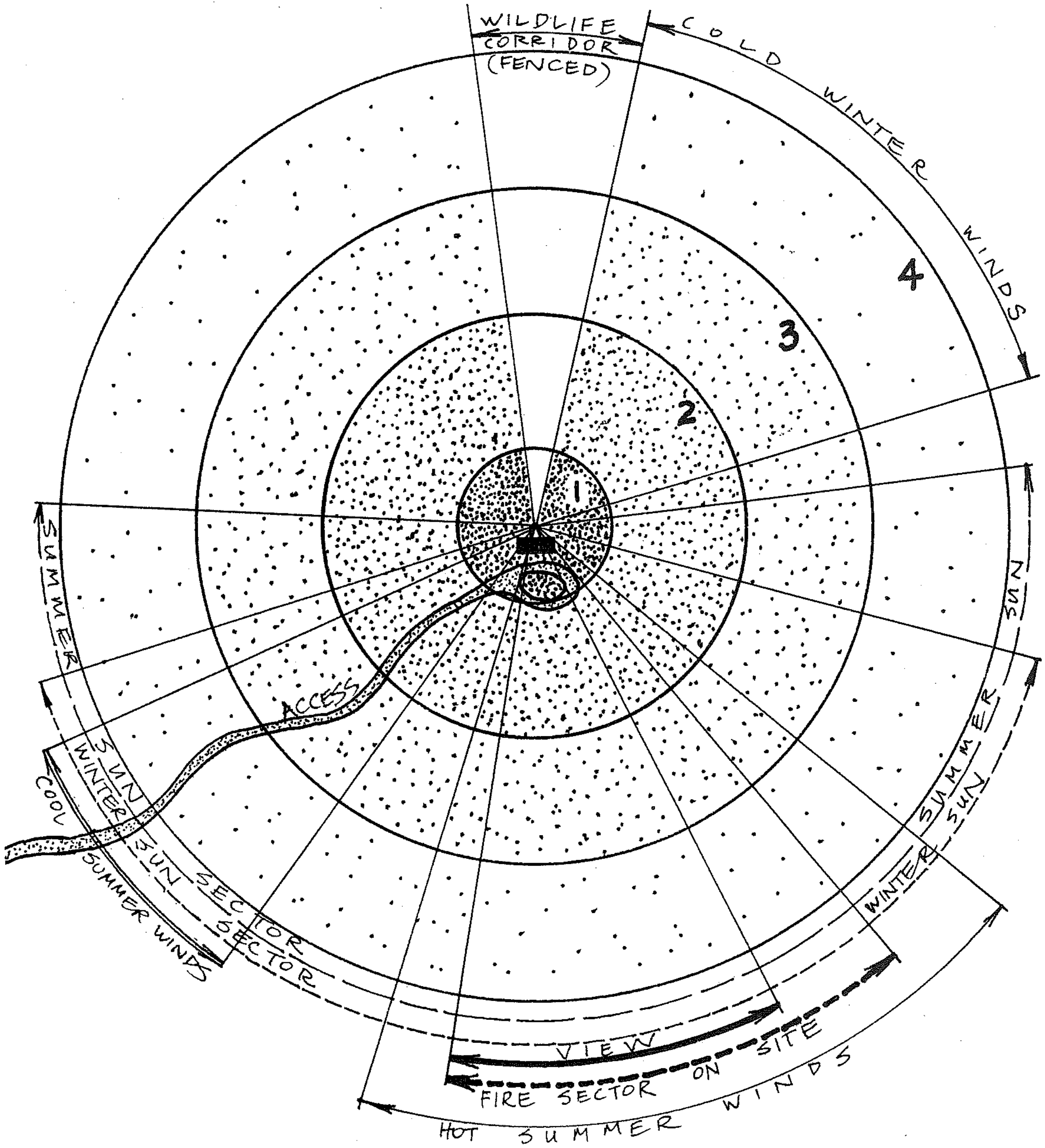


FIGURE 3.10
SECTOR ANALYSIS.

PLACEMENT IN SECTORS

Next in a permaculture design, we consider the wild energies, the "elements" of sun, light, wind, rain, wildfire, and water flow. These all come from *outside* our system and pass through it: a flow of energies generated elsewhere. For these, we plan a "sector" diagram based on the real site.

Our sectors are more site–specific than are the conceptualised zones. They outline the compass directions from which we can expect energy or other factors. Some factors we may invite in to our homes; we need sunlight for technologies and plant growth. Some we may exclude (such as an unpleasant view of a junkyard). More commonly, we plan to regulate such factors to our advantage, placing our zonal components to do so.

Whereas settlement or house is the ground zero for zones, it is the through point for sectors. Energies from outside can be thought of as so many arrows winging their way towards the home, carrying both destruc-tive and beneficial energies; we need to erect shields, deflectors, or collectors. Our choice in each and every sector is to block or screen out the incoming energy or distant view, to channel it for special uses, or to open out the sector to allow, for example, maximum sunlight. We guard against catastrophic fire, wind, or flood by protective embankments, dense trees, ponds, roads, fences, or stone walls, and we likewise invite in or exclude free-ranging or undomesticated wildlife by placements of forage systems, fences, nest boxes, and so on. Thus we place hedges, ponds, banks, walls, screens, trellises, hedgerows or any other component of design to *manage incoming energy*.

If you like, we place our components in each zone as though zones could be rotated about Zone 0. For any one component, it stops rotating when it is working to govern energies in the sector diagram. Thus, by "revolving" our zones, we find a place where our selected component (a tree, fence, pond, wall, or animal shed) works to govern sector factors. Given that we have both zone and sector energies controlled, then our component is well placed. Then we combine the two diagrams to make a spiderweb of placements, putting every main system in its right place in terms of energy analysed on the site (**Figure 3.10**).

To sum up, there should be no tree, plant, structure, or activity that is not placed according to these criteria and the ground plan. For instance, if we have a pine tree, it goes in Zone 4 (infrequent visits) AWAY from the fire danger sector (it accumulates fuel and burns like a tar barrel), TOWARDS the cold wind sector (pines are hardy windbreaks), and it should also bear edible nuts as forage.

Again, if we want to place a small structure such as a poultry shed, it should BORDER Zone 1 (for frequent visits), be AWAY from the fire sector, BORDER the annual garden (for easy manure collection), BACK ONTO the forage system, possibly ATTACH to a greenhouse, and form part of a windbreak system.

There is no mystery nor any great problem in such commonsense design systems. It is a matter of bringing to consciousness the essential factors of active planning. To restate:

<u>The Basic Energy–Conserving Rules</u>

Every element (plant, animal or structure) must be placed so that it serves at least two or more functions.
Every function (e.g. water collection, fire protection) is served in two or more ways.

With the foregoing rules, strategies, and criteria in mind, you can't go far wrong in design.

<u>Placement Principle</u>

If broad initial patterning is well analysed, and good placements made, many more advantages than we would have designed for become obvious.
Or, if we start well, other good things naturally follow on as an unplanned result.

This is the broad pattern approach. Given that the scene has been set, *observation* comes into play to evolve other pattern strategies. If we watch just how our animals move, how winds vary, or how water flows, we can evolve guiding patterns that achieve other desirable ends, e.g. making animals easy to muster, bringing them to sites where their manure is needed, steering cool winds to ameliorate excess heat input or to direct them to wind turbines, and directing water to where it is needed in our system.

SLOPE, ASPECT, ELEVATION, AND ORIENTATION.

No site is quite flat, and many have irregular configurations; thus our neat spider webs of zone and sector overlays are distorted by a more realistic landscape. To use these irregularities to our advantage, we need to further consider these factors:

With zones and sectors sketched in on the ground plan, slope analysis may proceed. High and low access roads, the former for heavy cargo or mulch, the latter for fire control, can now be placed. Provision for attached glasshouse, hot air collectors, reflection pond, solar pond, and shadehouse should be made at all homestead sites where climatic variation is experienced.

Slope determines the unpowered flow of water from source to use point, and slope and elevation will permit the placement of hot air or hot water collectors *below* their storages, where the **thermosiphon** effect can operate without external energy inputs. The simple physics of flow and thermal movements can be applied to the placement of technological equipment e.g. solar hot water panels, taking advantage of slope. Where no slope exists, towers for water tanks and hollows for heat collectors (or solar ponds) can be raised or excavated for the same effect.

However, in the normal humid landscape (where precipitation exceeds evaporation), hill profiles develop a flattened "S" curve that presents opportunities for placement analysis of components and systems, as per **Figure 3.11**.

The ancient occupied ridgeways of England testify to the commonsense of the megalithic peoples in landscape planning, but their present abandonment for industrial suburbs in flatlands does little credit to the palaeolithic planning of modern designers. The difference may be that the former planned for themselves, while the latter design for "other people".

Slope gives immense planning advantages. There is hardly a viable traditional human settlement that is not sited on those critical junctions of two natural ecologies, whether on the area between foothill forests and plains, or on the edge of plain and marsh, land and estuary, or some combination of all of these. Planners who place a housing settlement on a plain, or on a plateau, may have the "advantage" of plain planning, but abandon the inhabitants to failure if transport fuels dry up. They then have to depend on the natural environment for their varied needs but have only a monocultural landscape on which to do so. Successful and permanent settlements have always been able to draw from the resources of at least two environments.

Similarly, any settlement which fails to *preserve* natural benefits, and, for example, clears all forests, is bent on eventual extinction.

The descending slopes allow a variety of aspects, exposures, insolation, and shelter for people to manage. Midslope is our easiest environment, the shelter of forests at our back, the view over lake and plain, and the sun striking in on the tiers of productive trees above and below. **Figure 3.11** shows a broad landscape profile, typical of many humid tropical to cool climates, which we can use as a model to demonstrate some of the principles of landscape analysis.

On the high plateaus (A) or upper erosion surface, snow is stored, and trees and shrubs prevent quick water run–off. The headwaters of streams seek to make sense of a sometimes indefinite slope pattern, giving way to the steep upper slopes (B), rarely (or catastrophically) of use to agriculture, but unfortunately often cleared of protecting forest and subject to erosion because of this.

The lower slopes (C) are potentially very productive mixed agricultural areas, and well suited to the structures of people and their domestic animals and implements. Below this are the gently– descending foothills and plains (D) where cheap water storage is available as large shallow dams, and where extensive cropping can take place.

This simplified landscape should dictate several strategies for permanent use, and demands of us a careful analysis of techniques to be used on each area.

The main concern is water, as it is both the chief agent of erosion and the source of life for plants and animals. Thus the high plateau is a vast roof where rain and snow gather and winds carry saturated cloud to great heights. At night the saturated air deposits droplets on the myriad leaves of the ridge forests.

The gentle foothill country of area (C), brilliantly analysed for water conservation by Yeomans[5], supports the most viable agricultures, if the forest above is left uncut. Here, the high run–off can be led to midslope storage dams at the "Keypoint" indicated in **Figure 3.11** (examined in much more detail in Yeomans' books). Using the high slopes as a watershed, and a series of diversion catchment drains and dams, water is conserved at the keypoints for later frugal use in fields and buildings. The water is passed with its nutrients to low dams, and released as clean water from the site. (This is the ideal: the reality often falls far short of it.) The lower slopes—those safe to use tractors on at least—can be converted to immense soil–water storage systems in a very short time (a single summer often suffices). This is a matter of soil conditioning, afforestation, water interception, or a combination of these.

The plains of area (D) are the most open to wind erosion and the most resistant to water erosion. However, it is here that great damage can occur by salting. Red and dusty rains and plagues of locusts are a result of the delinquent use of the plough, heavy machinery, and clean tillage of these flattish lands, together with the removal of trees and hedgerows, and the conversion of the plains to monocultures of extensive grazing and grain cropping.

It is on the plains areas that water is most cheaply stored, in soil and in large surface dams, where no–tillage crops, **copses** and **hedgerows** are desperately needed. This is where broadscale revolutions in technique can be implemented to improve soil health, reduce wind and water losses, and produce healthy foods.

The forests on the high slopes, coupled with the thermal belt [Geiger[12]] of the house site make a

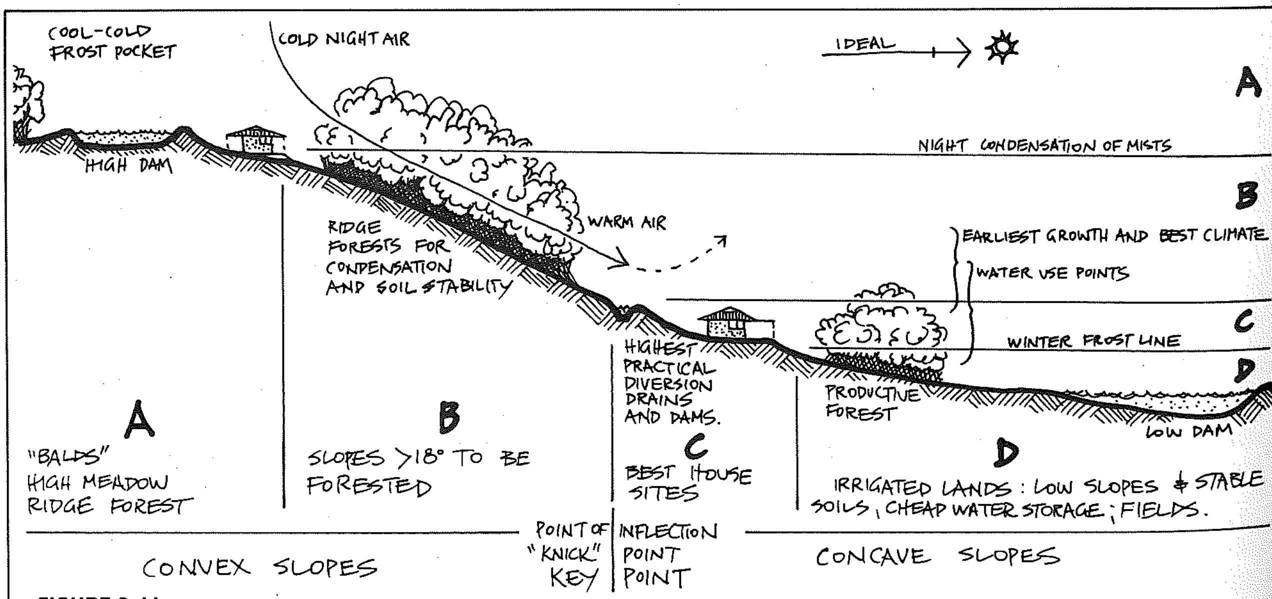


FIGURE 3.11
BROAD HUMID LANDSCAPE PROFILE.
Slope analysis and site planning in relation to aspect largely decide the placement of access, water supply, forests, and cropland. Here we supply such analysis to a cool, humid region.

remarkable difference to midslope climate and soil temperatures. Anyone who doubts this should walk towards an uphill forest on a frosty night, and measure or experience the warm down–draught from high forests. If these are above Zones 1 and 2, they present little or no fire danger. Their other functions of erosion control and water retention are well attested.

Downslope, reflection from dams adds to the warmth. Solar collectors placed here transmit heat, as air or water circulating by thermosiphoning alone, and assist house, glasshouse or garden to function more efficiently. Even very slight slopes of 1:150 function to collect water and heat if well used in the design.

The easy, rounded ridges of non–eroded lower slopes and their foothill pediments are a prime site for settlement. They allow filtration of wastes, inseparable from large populations, through lowland forest and lake, and the conversion of these wastes into useful timber, trees, fruits, and aquatic life.

If zone and sector are imposed in plan, sun angle and landscape slope are assessed in elevation. These determine the following placements:

SUN ANGLE describes the arc of the sun during summer and winter months, and so decides eave and sill placement of windows, areas of shade, and reflection or absorption angles of surfaces. Also, in *every* situation (even hot deserts), some part of the system should be left open to the sun for its energy potential.

ASPECT describes the orientation of the slope. A slope facing the sun will receive considerably more direct solar radiation than a slope facing the shade side (south in the southern hemisphere, north in the northern). The shaded side of hills may delay thaw and thus moderate frost effects in vegetation. In mid–latitudes, we seek the sunny aspect of slopes to achieve maximum sunlight absorption for our settlements and gardens.

The final act in site planning is to orient all buldings and structures or constructs correctly, to face **mid– sky**, the sun, or the wind systems they refer to, or to shelter them from detrimental factors e.g. cold winter winds or late afternoon sun.

In summary, if the elements of the design are carefully zoned, the sectors well analysed, the sun angle and slope benefits maximised for use, and the constructed environment oriented to function, then a better ground design results than most that now exist. As I reassure all would–be permaculture designers, *you can do no worse* than those prior designs you see about you, and by following the essentially simple outline above, you may well do much better. Incredible as it seems, these essential factors are the most frequently overlooked or ignored by designers to the present day, and **retrofit** is then the only remedy for ineffective design.

3.10

ZONING OF INFORMATION AND ETHICS

In this book, I am concentrating on people and their place in nature. Not to do so is to ignore the most destructive influence on all ecologies: the unthinking appetite of people—appetite for energy, newspaper, wrappings, "art", and "recreation". We can think of our zones in other than product terms and management, as a gradation between an ecosystem (the home garden) managed primarily for people, and the wilderness, where all things have their right to exist, and we are only supplicants or visitors. Only excessive energy (human or fuel) enables us to assert dominance over distant resources. When we speak of dominance, we really mean destruction.

What is proposed herein is that we have no right, nor any ethical justification, for clearing land or using wilderness while we tread over lawns, create erosion, and use land inefficiently. Our responsibility is *to put our house in order*. Should we do so, there will never be any need to destroy wilderness. Indeed, most farmers can become stewards of forest and wildlife, as they will have to become in any downturn in the energy economy. Unethical energy use is what is destroying distant resources for short–term use.

Our zones, then, represent zones of destruction, information, available energy, and human dependency. The "ecologist" with large lawns, or no food garden, is as hypocritical as the "environmentalist" drinking from from an aluminium beer can and buying newspapers to read of destructive exploits. Both occupations exploit wilderness and people.

In Zone 1 we are *information developers;* we tend species selected by, and dependent on, mankind. All animal species tend their "home gardens", and an interdependency arises that is not greatly different from the parasite–prey dependency.

In Zone 2, already nature is making our situation more complex, and we start to *learn* from species other than our people–dependent selections. As we progress outwards, we can lose our person–orientation and gain real understanding of the necessity for all life forms, as we do not "need" to exploit most species. We in fact need and use only a few species of the hundreds of thousands that exist.

In wilderness, we are visitors or strangers. We have neither need nor right to interfere or dominate. We should not settle there, and thus leave wastelands at our back. In wilderness we may learn lessons basic to good design, but we cannot improve on the information already available there. In wilderness, we learn of our little part in the scheme of all things.

<u>Understandings</u>

1. Everything is of use. It is not necessarily needed by people, but it is needed by the life complex of which we are a dependent part.

2. We cannot order complex functions. They must

evolve of themselves.
3. We cannot know a fraction of what exists. We will always be a minor part of the total information system.

Thus, we are *teachers* only in our home gardens, and *learners* elsewhere. Nowhere do we create. Everything we depend on we have evolved from *what is already created*, and that includes ourselves. Thoughtful people (those who get recreation from trying to understand) need wilderness as schools need teachers. Should we lose the wilderness, or suffer it to be destroyed, we will be recycled for more appropriate life in any number of ways, some very painful and protracted. We can also state our first "error" thesis here; such errors, once made, lead us into increasing problems.

Type 1 Error
When we settle into wilderness, we are in conflict with so many life forms that we have to destroy them to exist. Keep out of the bush. It is already in good order.

3.11 INCREMENTAL DESIGN

Almost all engineering design is based on small changes to existing designs, until some ultimate limit in efficiency or performance is reached. The whole process can take centuries, and the end result can be mass–produced if necessary. Kevin Lynch (1982) in his book *Site Planning* writes of site designing by incremental adaptation of already–existing designs: design by following physical systems that have been shown to work. He believes the best site planning of the past to be a result of this process, and that it in fact works very well unless some external and important condition (e.g. market or land ownership) changes. He maintains that this fine–tuning of *successful* design for a specific climate and purpose can be totally inappropriate if transferred out of culture, climate, or if applied to a different purpose.

It is, however, the most successful way to proceed *after* selective placement and energy conservation is paid sufficient attention. Known effective design units and specifications, whether of roads, culverts, houses, garden beds, or technologies have been subjected to long tests, and have evolved from trials (or prototypes) to working and reliable standards. Even if "old–fashioned" (like overshot water wheels), they may yet represent a simplicity and an efficiency hard to beat without a considerable increase in expense and complexity.

Such continual adaptation is the basis of feedback in systems undergoing establishment, where we make additions or changes to houses or plant systems. It is not the way, however, to satisfy the demands of a complex system which (like a private home and garden) has to satisfy a complex set of priorities. Nor does it cope with changing futures, new information and sets of values, or simply self–reliance and self–governance.

3.12 SUMMARY OF DESIGN METHODS

To sum up, in whole farm planning and in report writing, outlining areas of like soil, slope, or drainage will suggest sensible crops, treatments, fencelines and land use generally. If we accept what is there, ethical land use dictates conservative and appropriate usage. But (as may happen) if someone is determined to raise wheat on all that land regardless of variations, they can probably do so only if they command enough energy or resources. I am sure we can grow bananas in Antarctica if we are prepared to spend enough money, or can persuade penguins to heat a glasshouse!

Insofar as we enter into village design, we may have financial and space constraints on upper or lower sizes: a "break–even" point and an "optimum" number of houses per unit area. However, if we neglect a foray into the social effects of settlement size and into the needful local functions related to settlement size, we may be designing for human misery, the under–servicing of needs, and even for such sociopathologies as riot and crime. Such designs may be economic (in cash terms), efficient for one use only, and totally inhuman. But they are built every day. For example, it was found that rats subjected to breathing in the same airstream of their fellows experienced severe instability, physiological stress, and consequent pathologies akin to crowding stress. This is called the "Bruce effect" after the experimenter who discovered it, and this effect may apply equally well to people. Yet in almost all cities, one can see people crammed into 16–40 storey office buildings with no opening windows and only a single airstream!

Site designing needs not a specialist approach, but rather a multi–disciplinary and bio–social approach that takes into account the effects the environment has on its intended occupants.

Perhaps if we assembled all our considerable, diverse, and effective knowledge of both the parts and the whole order of design into a type of computer search or game–playing programme, we might advance the whole design process as a realm of continuing and additive human knowledge, available to everyone. Such programmes could deal with a great deal of the fussy detail that now slows design—from plant list specifications to home construction details—leaving the designer with those imponderables about the processes observed on the land, the likely trends of future societies, future needs, and a measure of human satisfaction.

In elaborating just some of the basic approaches to design, without including specialist solutions, I want to stress that all the approaches outlined are not only useful, but necessary. Only by some sensible combination of all the methods given can one select and assess all the elements that enter into a total design assembly, and so evolve a design that includes a large degree of self–management, takes account of details on site, suits the ethics and resources of people, locates ground features in an integrated way, and provides for natural systems and access routes to be properly located.

3.13

THE CONCEPT OF GUILDS IN NATURE AND DESIGN

The methodologies of polyculture design rely more on species interaction than on configuration, although both are necessary inputs to a design. Thus, in designing for best (or most beneficial) species assemblies, we need to know about, and use, the concepts of species guilds and the co–actions of species.

In the natural world, we may often notice assemblies of plants or animals of different species that never-

TABLE 3.4
IMPETUS TO DESIGN

PERMACULTURE	MOST PRESENT–DAY DESIGN
STIMULATED BY: A perceived social problem.	STIMULATED BY: A drive to erect monuments or make money.
SUBJECT TO: Values of energy conservation, self–reliance, and harmonious human occupancy.	SUBJECT TO: Economic (as cash) considerations and the desire for profit.
MEDIATED BY: Consideration of long–term biosocial factors.	MEDIATED BY: Purely functional values for short–term cost and material factors.
ACHIEVED BY: Research and consultation with clients, or assisting people to gain an education in design.	ACHIEVED BY: External funding, little consultation, little client/people education.
REFINED BY: Allowing space, finance, and feedback to adjust activity, and allowing for new or overlooked needs as they occur.	REFINED BY: Selling off and not taking responsibility for the results.
LEADING TO: A dynamic and healthy area inhabited by people with the power and understanding to make necessary changes.	LEADING TO: A dislocated populatio, powerless to effect change easily. Hence, dependency and anxiety.

RESULTS

THE STABILITY OF DYNAMIC LOCAL ADJUSTMENT.	**THE INSTABILITY OF PERCEIVED INDIVIDUAL POWERLESSNESS.**

theless occur together over their range. Closer examination of such mixed assemblies often reveals a set of mutual benefits that arise from such convivial togetherness. These benefits offer help or protection to the whole assembly (as when one bird species acts as "lookout" for another, or defends others from hawks). When we *design* plant guilds, as we always try to do in a polyculture, we try to maximise the benefits of each species to the others. We can also add factors of convenience to ourselves, or which save us inputs of fertiliser or pesticides, as in the "apple–centred" guild described below .

A **guild**, then, is an harmonious assembly of species clustered around a central element (plant or animal). This assembly acts in relation to the element to assist its health, aid our work in management, or buffer adverse environmental effects (see **Figure 3.12**). Let us list some of the reasons to place species in association:

<u>To benefit as selected species by:</u>

- Reducing root competition from (e.g.) invasive grasses. Almost all our cultivated food trees thrive in herbal ground covers, not grasses.
- Assisting pest control in various ways:
  — by providing **anti–feedants** (bitter or unpalatable browse or chemical deterrents), e.g. nasturtium roots provide root chemicals to tomatoes or gooseberries which deter whitefly. Many plants, fermented or in aqueous extraction, deter pests or act as anti–feedants when sprayed on leaves of the species we wish to protect.
  — by killing root parasites or predators, e.g. *Crotalaria* captures nematodes that damage citrus and solanaceous roots; *Tagetes* marigolds "fumigate" soils against grasses and nematodes.
  — by hosting predators, as almost all small–flowered plants [especially*Quillaja*, many *Acacia* species, tamarisk, *Compositae* (the daisy family) and *Umbelliferae* such as dill, fennel, carrot, and coriander] host robber–flies and predatory wasps.
- Creating open soil surface conditions, or providing mulch. For example, comfrey and globe artichokes allow tree roots to feed at the surface (unlike grasses, which competes with tree roots), while spring bulbs (daffodils) or winter–grown wild *Allium* species, whose tops die down in mid–spring do not compete with deciduous tree roots in summer dry periods, nor do they intercept light rains.
- Providing free nutrients: woody or herbaceous legumes fix nitrogen or other essential nutrients via root associates, stimulate soil bacteria or fungi, and benefit associated trees. Clovers; trees such as *Acacia*, *Casuarina*, and *Pultenaea*; sugar–providing grasses (sugar cane); and high humus producers (bananas) all assist orchard species. Many can be slashed or trimmed to give rich mulch below trees or between crop rows.
- Providing physical shelter from frost, sunburn, or the drying effects of wind. Many hardy windbreak species of equal or greater height, both as edge windbreak or in–crop crown cover exclude frost, nullify salty or hot winds, provide mulch, and moderate the environment towards protecting our selected species. Examples are borders of bamboo, cane grasses, *Casuarina*, hardy palms, and tamarisks. In–crop shade shelter of legumes are needed by such crops as avocado, citrus, and cocoa or coffee (or any crops needing partial shade). In–crop trees can eliminate frost effects in marginal frost areas.

<u>To assist us in gathering:</u>

- Culinary associates: it is of some small benefit in detailed planning to keep common culinary associates together (tomatoes with parsley and basil; potatoes with a tub of mint) so that we also gather them together for cooking, salads, or processing (dill with cucumbers). Thus we reduce work. Dill and apples also go well together, raw or cooked, and dill is one of the *Umbelliferae* that host predatory wasps below apple trees.

<u>Specific animal associates of a guild:</u>

We have made reference, in pest control, to host plants. These can be best specified by observing, researching, or selecing plants to host quite specific predatory wasps, lacewings, or ladybirds. Vertebrates that assist our selected crop species are:

- Ground foragers, e.g. pigs or poultry specifically used to clear up the fallen fruit that host fruit fly or larval forms of pests. Foragers can be run in orchards for that relatively short period of the year when fruit is falling and rotting, or they can be used to eat reject fruit and deposit manures.
- Insectivores: birds, in particular, that search bark crevices (woodpeckers, honey–eaters) for resting larvae and egg masses. To encourage these, plant a very few scattered flowering shrubs and herbaceous plants such as *Kniphofia*, *Banksia*, *Salvia*, *Buddleia*, and *Fuschia*. All of these provide insect and nectar foods for insectivorous birds.
- Mollusc control: snails and slugs are almost totally controlled by a duck flock on range, and several large lizards (*Tiliqua* spp.) also feed primarily on snails. Ducks can be ranged seasonally (autumn to spring) in plant systems, and in summer on marshlands. Ducks will eat seedlings, so that appropriate scheduling is essential.
- Guard dogs: for deer, rabbits, and other vertebrate pests. A small number of guard dogs, fed and kennelled in orchards, are sufficient control for fox predation on orchard poultry foragers. Such dogs, reared *with* domestic poultry, do not attack the flocks themselves.
- Hawk kites suspended over a berry crop, or flown as light model planes over an extensive grain crop deter all flock–bird predators of the crop, and are more dependable than natural hawks. They need to be removed when not needed, so that birds do not get

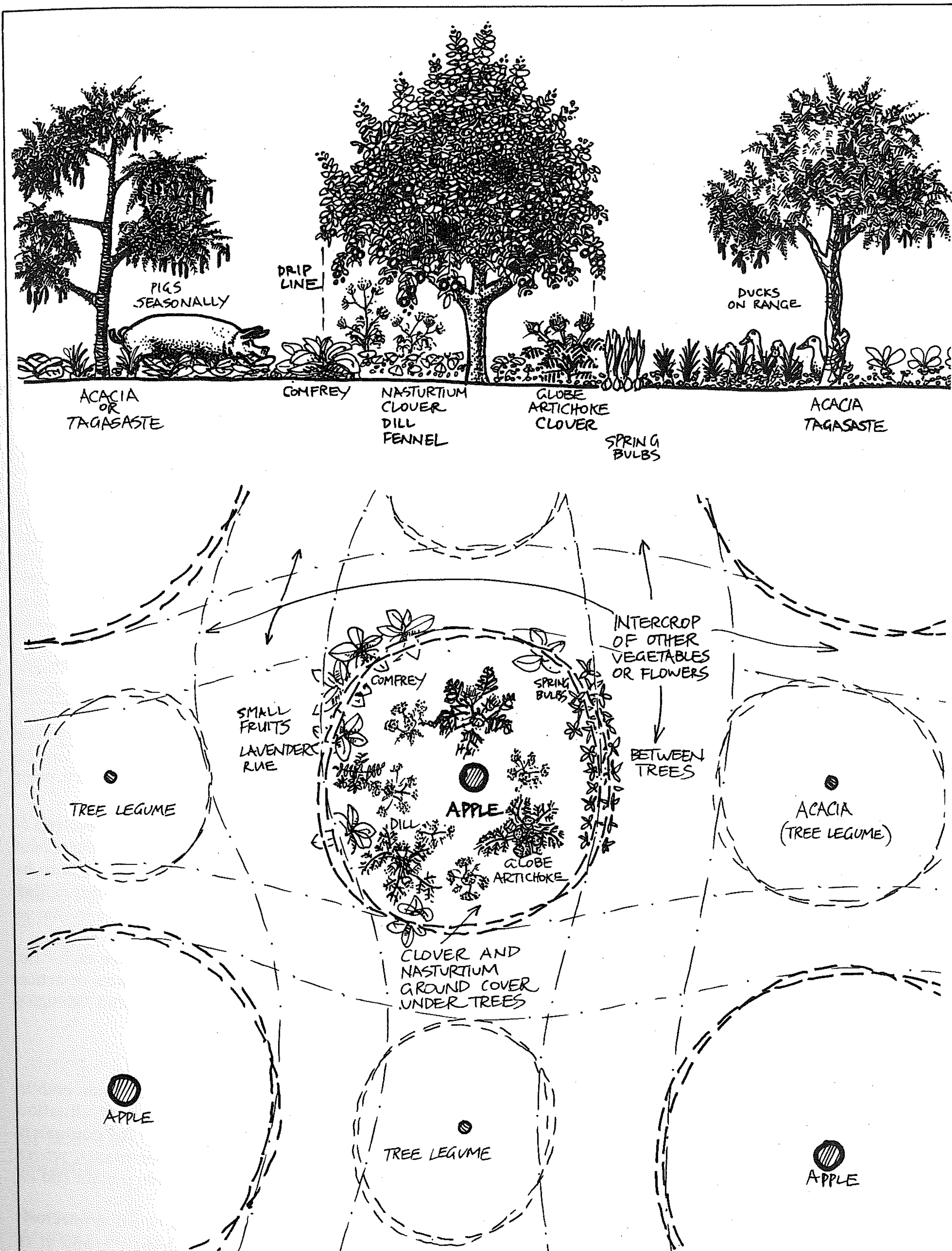


FIGURE 3.12
A GUILD ASSEMBLY FOR AN IDEALISED APPLE ORCHARD.
Most accessory species enhance the health and productivity of the apples. Floristic elements are maximised.

accustomed to them.

These are just part of the total guilds. Every designer, and every gardener, can plan such guilds for specific target species, specific pests and weed control, and specific garden beds or orchards.

ANALYTIC APPROACH TOWARDS SELECTING A GUILD

A guild of plants and animals is defined here as a species assembly that provides many benefits for resource production and self–management (more yields, but lower inputs). In general, the interactions between plant and animal species are thus:

- Most species get along fine; this is obvious from a study of any complex home garden or botanical garden; perhaps 80% of all plant species can co– mingle without ill effect.
- Some species greatly assist others in one or other of many ways. Positive benefits arise from placing such species together where they can interact (10–15% of all species).
- A minority of species show antagonistic behaviour towards one or more other species. This in itself can be a benefit (as in the case of biological pest control) or a nuisance (as in the case of rampancy or persistent weeds or pests). Perhaps as few as 5% of all species act in this way.

Now, to give the above classes of interaction a more useful analytic structure, we will allot symbols, as follows:

+ : this is used to indicate a *beneficial* result of interaction, with a yield above that of some base level (judged from a monoculture or control crop of the species).

o : this is used to indicate *"no change"* as a result of interaction, on the same basis.

–: this is used to indicate a *reduction* in yield or vigour as a result of interaction with another species.

Thus, for two useful species (each selected for a useful product), we have the simple tabulation of **Table 3.5**, which gives us all possible interactions.

The array is such that only three interactions benefit us, three are neutral, and three are antagonistic in effect effect. By grouping scores, we can analyse for beneficial effects in our interaction table, and act on these. However, because of the vagaries of weather in any given year, many times a peasant farmer may accept a (– +) effect just to ensure that he at least gets a crop, even if it is of the "losing" species. It is *always* safer to mix or complicate crop than to pin hopes on a single main crop. In fact, be guided by analyses but study reality!

STATES OF ACTION

In common usage, COACTION implies a force at work: one that restrains, impedes, compels, or even coerces another object. INTERACTION implies reciprocal action: two things acting on each other. This is an important distinction. A final category is INACTION, or an absence of any detectable action.

We cannot at this point guess which state applies, but when we put two species together, there are these possibilities:

- One acts on the other (co–action or unilateral action);
- Both act on each other (interaction or mutual action); and
- Neither act (inaction or neutrality).

TABLE 3.5
INTERACTION MATRIX OF TWO SPECIES (plant or animal).

		SPECIES A		
		+	**o**	**–**
	+	**++**	**+o**	**+–**
SPECIES B	**o**	**o+**	**oo**	**o–**
	–	**–+**	**–o**	**––**

It would seem probable that in the case of (++) and (––) we have mutual action or interaction. In the case of (–**o**), (**o**–), (+**o**), (**o**+), (+–), (–+) *one only* needs to be acting, a form of co–action. In the case of (**oo**) neither acts, no effects appear, and both are inactive insofar as our measures can detect.

We need to observe and perhaps analyse each case, but it does seem probable that such states of action apply. Some such states can be named and examples given, for instance:

A. Mutual Action States

++ This is called symbiosis, and is common both in nature and in society. It is a "win–win" situation ideally suited to guild development. An example is the mycorrhizal associates of higher plants, where mutualism or fair trade occurs between a plant and its root associate.

-- Haskell (1970) has coined the word synnecrosis (*The Science Teacher 37(9)* Supplement), and it is obviously uncommon. War is our best example of a "lose–lose" situation, but there are also battles between plants for light, nutrients, and space. There are forms of chemical warfare in both plants and animals.

B. Single Action States

–o Haskell calls this amensalism. It hurts the *actor*, not the other. A butterfly attacking a rhinocerous would fit, or a wasp parasite "glued" to a tree it attacks, as is the case with some pine trees and Sirex wasps.

o– Called allolimy by Haskell, it leaves the actor unaffected but hurts the other, e.g. a walnut tree beside an apple tree yields well, but the juglones secreted by its roots act to kill or weaken the apple. In the same way grasses act to weaken most deciduous fruit trees.

+o Termed commensalism. Even though the actor benefits, the other remains unaffected, e.g. an epiphyte attached to a sturdy tree, such as vanilla on a coconut trunk.

o+ Called allotrophy by Haskell. The actor is unaffected, the other benefits. Examples are a teacher and student relationship, or a charity where one hands on surplus goods to another person less fortunate.

+– Called parasitism, the actor benefits, the other loses *if* the actor is the parasite. All pathogens and parasites tend to weaken or take from the host.

–+ Self–sacrifice. The actor loses. This is the reverse of parasitism, and a better word might be self–deprivation to help others. This is often seen in nature, mostly as individuals helping members of the same family or species. Medals are awarded for this in human society, and we call it selflessness or even heroics.

oo Neither one acts. No one is hurt, no one wins. Neutrality pacts may achieve this result in society, or we observe it commonly in nature. There are critical areas in nature (water holes, salt licks, grooming stations) where antagonistic species agree on neutrality. In fact, many plant species appear to be basically neutral in behaviour.

Such analyses suit two–species interactions, but where we depart (in the designed system) from nature is that we may value (in the sense of obtaining a yield from) only one of these species. Let this be species A in **Table 3.6**. The other can be a weed or a species such as *Lantana*, which we might wish to eliminate. In this case, we can set up a matrix as diagrammed in **Table 3.6.**

TABLE 3.6
INTERACTION MATRIX OF TWO DIFFERENT SPECIES.

		SPECIES A (a palm)		
		+	o	–
SPECIES B (lantana)	+'	+'+	+'o	+'–
	o'	o'+	o'o	o'–
	–'	–'+	–'o	–'–

In order of benefit (increase in palms, less increase or decrease in lantana):
(–'+)>(o'+)>(–'o)>(+'+)>(o'o)>(–'–)>('–)>(o'–)>(+'o)
Best result..................>Neutral................>Worst result.

This is a very necessary type of analysis for selecting useful plants that will eliminate or weaken an unwanted weed species. All such analyses can be made using plant/plant, animal/animal, or plant/ animal pairs.

How do we *observe* co–action? This is quite simple in the field, *providing* there are plenty of examples to score, and we have set some criteria to score by. For example, take a town or area with a great many trees planted in the backyards. Select any one of these species for criteria, say an apple, then decide on how to score, e.g. (in compounds with apples and other species of plants growing):

+: apple tree healthy, bearing very well, not stunted or over–vigorous.
o: apple tree healthy, in fair order, bearing.
–: apple tree bearing poorly, sick or dying.
x: no apple tree in this yard.

TABLE 3.7
CO–ACTION MATRIX

	APPLE SCORE			
Other trees near, or in, yard.	+	o	–	x
WALNUTS	.	.	7	15
MULBERRY	5	5	1	3
ACACIA	7	5	.	3

Scoring can be of specific pairings:

		APPLE SCORE			
		+	o	–	x
WALNUT SCORE	+	.	.	.	5
	o	.	.	5	4
	-	.	.	.	.
	x	.	.	.	.

Then, we draw up a co-action matrix on a piece of paper, with the "apple" score at the top and "other trees" down the left side (**Table 3.7**). Tally the scores **by** walking from yard to yard.

We quickly see that where there are walnuts, apples are sick or absent (**o–**). However, healthy apple trees coexist with both mulberries and *Acacias* (**+o**) and (**oo**). Ideally, we use a similar score for *each species* of other tree, so that our co-action results score the same criteria for walnut, mulberry, and *Acacia* that we score for apple.

Additional field notes are useful. Healthy, untended apple trees often have quite a specific understory of spring bulbs, comfrey, clover, iris, nasturtium, etc. This too should be noted as we go. I have, in fact, carried out such analyses, and some of the results will be used as a real example in the next section.

BUILDING UP GUILDS FROM CO-ACTION ANALYSIS.

If we wish to construct a guild, then we need to bring two or more species into close proximity where we can judge the effects of one on the other. If we have a () result *anywhere*, we might be able to intervene with a third or fourth party which we can call an arbitrator, a buffer, or an intervenor.

- Apple next to walnut produces (**–o**): *not* desirable; the apple sickens or dies.
- Apple next to mulberry produces (**+o**): a good result.
- Mulberry next to walnut produces (**oo**): mutual inaction.

Thus, apple *then* mulberry *then* walnut gives us (**+oo**). By this *intervention strategy*, we have, in effect, cancelled out the (––) and have a *nett benefit* in a three– three–species array. That is, we can use several two–species results to achieve a better result with three species, which goes beyond accepting (fatalistically) the primary conflict. Here, a mulberry is the *intervenor* or critical species or element in conflict resolution. We can take this further again by examining yet other co–actions:

- *Acacia* next to walnut gives (**o+**)
- *Acacia* next to mulberry gives (**o+**)

Now, apple–mulberry–*Acacia*–walnut gives us (**++o+**), which is much better again. So we proceed to isolating and *arranging* guilds to maximise benefits and eliminate conflicts. This is part of the skill of planning strip or zone placements of mixed species.

THE ROLE OF CONFIGURATIONS IN GUILDS

Here, we have to consider *placement* of interactive elements. Obviously, there is a commonsense close spacing for many plants and machine components, but as the distance between *living* components widens, we can never be quite sure that chemical or behavioural interaction ceases. Consider the case of two territorial birds, displaying or calling a mile or more apart. To us, they appear as individuals; to each bird, the other is in clear interaction. There is distant interaction, too, via pollen or spores in plants, and perhaps even by gaseous or chemical "messengers". This is certainly true of some mammals, so that effects of one on the other can be passed on by a sense of smell, even though they are not nearby at that time, e.g. urine marking territory. The great whales may well be communicating by sound around the whole globe.

Configuration in planning a guild with *intervening* species between hostile () species, comes in assessing the distance across the interaction boundary that the effect takes place, and in then arranging the guild species to obtain a maximum of (++), (**o+**), or (**+o**) effects. For example, we find a (++) condition with legume/grain or fruit–tree/tree legume interplants. We know that the effect, for grains, extends from 1.5–2 m into the crop; thus for a configurational design, we can spiral or strip–plant these two species for a *total positive edge interaction effect in crop*. Such careful guild analyses and configurations are the basis of species planning in permaculture.

For more critical geometric analyses, see such texts as Rolfe A. Leary's *Interaction Geometry: An Ecological Perspective* , USDA Forest Service, General Technical Report NC–22, 1976. This text has a useful reference list and is issued by the North Central Forest Experimental Station, Fulwell Ave, St. Paul, MN, 55108, USA.

3.14
SUCCESSION: EVOLUTION OF A SYSTEM

Nature shows us that a *sequence of processes* arise in the establishment of "new" systems on such devastated landscapes as basalt flows and ice–planed or flood–swept sites. The first living components are hardy *pioneer species*, which establish on these damaged or impoverished environments. Thus we see "weeds" (thistles, *Lantana*) occupying overgrazed, eroded, or fired areas. These pioneer species assist the area by stabilising water flow in the landscape, and later they give shelter, provide mulch, or improve soil quality for their successors (the longer–term forest or tree crop species).

To enable a cultivated system to evolve towards a long–term stable state, we can construct a system of mixed tree, shrub, and vegetable crop, utilising live-stock to act as foragers, and carefully planning the succession of plants and animals so that we receive short–, medium–, and long–term benefits. For example, a forest will yield first coppice, then pole timbers, and eventually honey, fruit, nuts, bark, and plank timber as it evolves from a pioneer and young, or crowded, plantation to a well–spaced mature stand over a period of 15–50 years.

Unlike the processes of nature, however, we can place most of the elements of such a succession *in one planting*, so that the pioneers, ground covers, under–story species, tree legumes, herbage crop, mulch species, the long–term windbreak and the tree crop are all set out at once. So many species and individuals of each species are needed to do this that it is usually necessary to first create a small plant nursery to supply the 4,000–8,000 plants that can be placed on a hectare. While these are growing in their pots, we can fence and prepare the soil, and then plant them out to a carefully–designed long–term plan.

Where this approach is used, as it has been by many permaculturalists on their properties, quite remarkable changes occur over two to three years. Mulch is produced on site for the long–term crop, while weed competition, wind, and frost effects are nullified or moderated. Cropping can be continuous as the annuals or herbaceous perennials effectively control unwanted grasses and weed species. For instance, radish or turnip planted with tree seedlings control grasses until the small tree provides its own grass control by shading. **Figure 3.13** gives an indication of how a system can accept different species of plants and of animal browsers as it evolves.

3.15 THE ESTABLISHMENT AND MAINTENANCE OF SYSTEMS

Every design is an assembly of components. The first priority is to locate and cost those components. Where our resources are few, we look closely at the site itself, thinking of everything as a potential resource (clay, rock, weeds, animals, insects). We can think of labour, skill, time, cash, and site resources as our interchangeable energies: what we lack in one we can make up for by exchange for another (e.g. clothes–making in exchange for roof tiles). The best source of seed and plants is always neighbours, public nurseries, or forestry departments. From the early planning stages, it pays to collect seed, pots, and hardy cuttings for the site, just as it pays to forage for second–hand bricks, wood, and roofing.

The planning stage is critical. As we draw up plans, we need to take the evolution in *stages*, to break up the job into easily–achieved parts, and to place components in these parts that will be needed *early in development* (access ways, shelter, plant nursery, water supply, perhaps an energy source). Thus, we *design*, assess resources, locate components, decide priorities, and place critical systems. Because impulsive sidetracks are usually expensive, it is best to fully plan the site and its development, changing plans and designs only if the site and subsequent information forces us to do so.

On a rural (and sometimes urban) site, FENCING or hedgerow, SOIL REHABILITATION by mulch (or loosening by tools), EROSION CONTROL, and WATER SUPPLY are *the* essential precursors to successful plant establishment, for we can waste time and money putting out scattered plants in compacted, impractical, and dry sites. Any soil shaping for roads, dams, swales, terraces, or paths needs to be finalised before planting commences.

For priority in *location*, we need to first attend to Zone 1 and Zone 2; these support the household and save the most expense. What is perhaps of greatest importance, and cannot be too highly stressed, is the need to develop *very compact systems*. In the Philippines, people are encouraged to plant $4m^2$ of vegetables—a tiny plot—and from this garden they get 40–60% of their food! We can all make a very good four metres square garden, where we may fail to do so in 40 square metres.

Similarly, we plant and care for ten critical trees (for oils, citrus, nuts, and storable fruit). We can take good care of these, whereas if we plant one hundred or one thousand, we can lose up to 60% of the trees from lack of site preparation and care. Thus, ten trees and four metres square , well protected, manured, and watered, will start the Zone 1 system.

Starting with a *nucleus* and expanding outwards is the most successful, morale–building, and easily–achieved way to proceed. Broadscale systems have broadscale losses and inefficiencies. As I have made every possible mistake in my long life, the advice above is based on real–life experience. To sum up:

- Design the site thoroughly on paper.
- Set priorities based on economic reality.
- Locate and trade for components locally or cheaply.
- Develop a *nucleus* completely.
- Expand on information and area using species proved to be suited to site.

Precisely the same sort of planning (nucleus development) applies to any system of erosion control, rehabilitation of wildlife or plants, writing books, and creating nations. Break up the job into small, easily achieved, basic stages and complete these one at a time. Never draw up long lists of tasks, just the next stage. It is only in the design phase that we plan the system as a whole, so that our smaller nucleus plans are always in relation to a larger plan.

Instead of leaping towards some imaginary end point, we need to prepare the groundwork, to make modest trials, and to evolve from small beginnings. A process of constant transition from the present to the future state is an inevitable process, modest in its local effect and impressive only if widespread. Thus, we seek first to gain a foothold, next to stabilise a small area, then to develop self–reliance, and only after this is achieved to look for exportable yields or commercial gain.

Even in a commercial planting it is wise to restrict the total commercial species to 3–10 reliable plants and trees, so that easier harvesting and marketing is achievable, although the home garden and orchard can maintain far greater diversity of from 25–75 species or

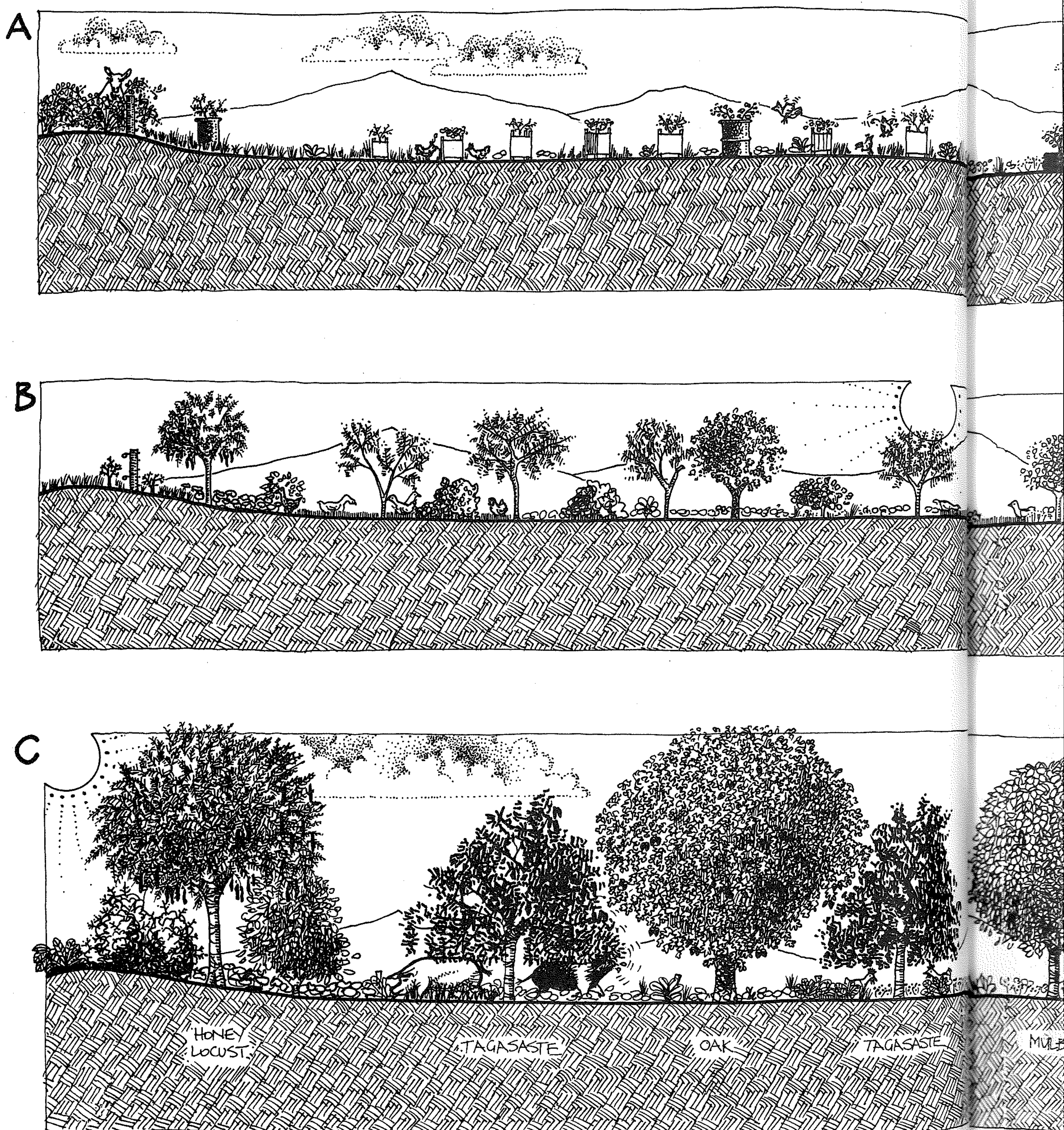
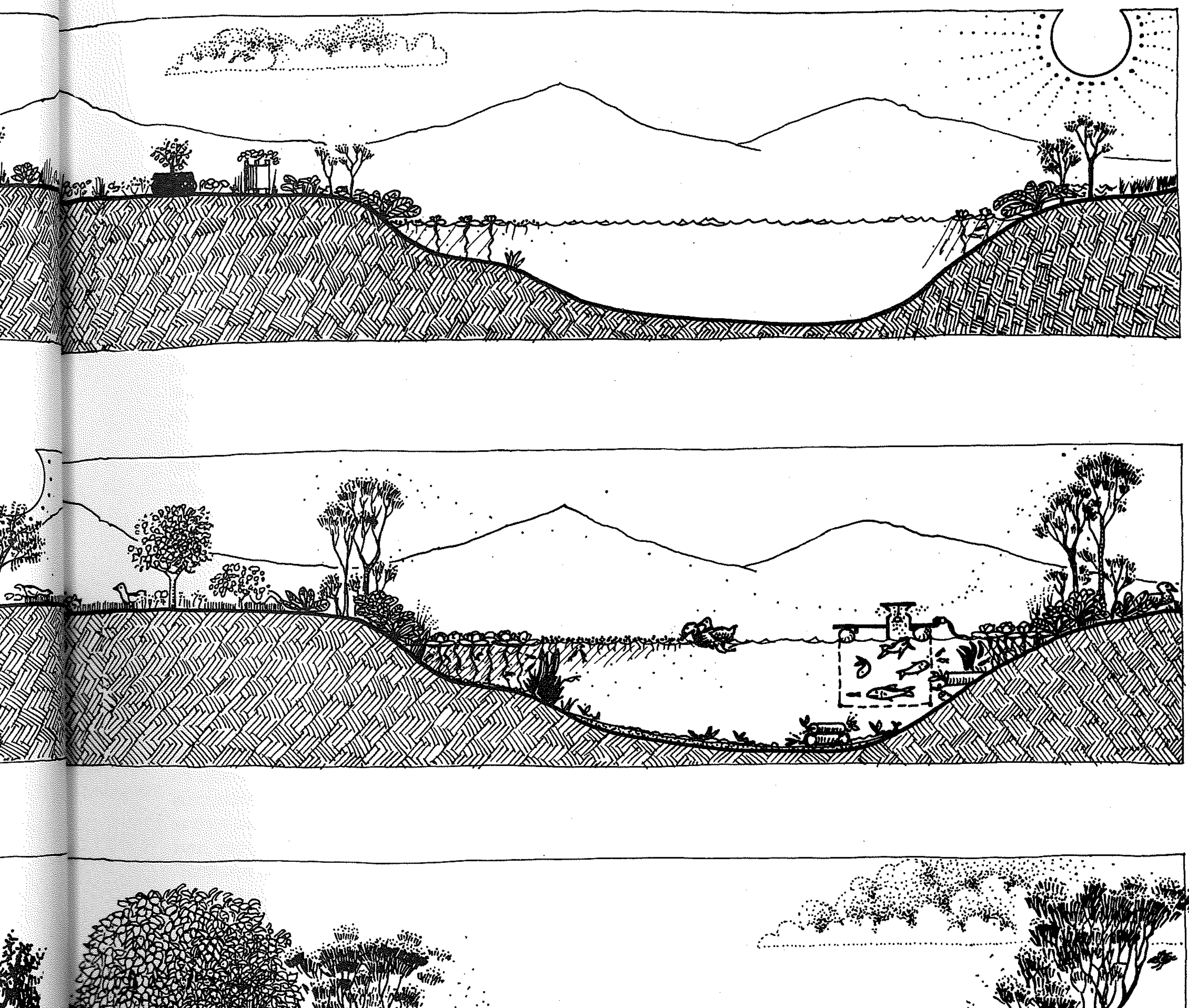


FIGURE 3.13
EVOLUTION IN A DESIGNED SYSTEM.
Pioneer species prepare for long–term evolution to a stable and productive system over a period of from 5 – 15 years.

A. System establishment; an area is fenced and a complex of species planted and protected from grazers by fencing and tree guards. Ponds are established. Only small livestock (chickens) and some annual crops can be harvested.



B. The system evolves to a semi–hardy stage. Geese, fish, and shellfish are introduced, and crops include some aquatic plant species.

C. An evolved system provides forage, firewood, aquatic and animal products. Larger foragers (sheep, pigs) can be grown seasonally. The system provides its own mulch and fertilizers. The mature system requires management rather than energy input, and has a variety of marketable yields (including information).

more.

Thus, our design methodologies seek to take into account all known intervening factors. But in the end it comes down to flexibility in management, to steering a path based on the results of trials, to acting on new information, and to continuing to observe and to be open or non–discriminatory in our techniques.

The success of any design comes down to how it is accepted and implemented by the people on the ground, and this factor alone explains why grand centralised schemes more often result in ruins and monuments than in stable, occupied, and well–maintained ecologies.

We can design any expensive, uncomfortable, or ruinous system as long as we do not have to live in it, or fund it ourselves. Responsible design arises from recommending to others the way you have found it possible to work or to live in a similar situation. It is much more effective to educate people to plan for themselves than to pay for a permanent and expensive corps of "planners" who lead lives unrelated to those conditions or people for whom they are employed to design.

3.16 GENERAL PRACTICAL PROCEDURES IN PROPERTY DESIGN

Except for the complex subject of village design, a property design from one–fourth to 50 ha needs firstly a clear assessment of "client or occupier needs", and stated aims or ideas from *all* potential occupiers (including children). A clear idea of the financial and skill resources of occupants is necessary so that the plan can be financially viable.

With a base map, aerial photograph, or a person as a guide, the designer can proceed to observe the site, making notes and selecting places for:

- Access ways and other earthworks;
- Housing and buildings;
- Water supply and purification, irrigation;
- Energy systems; and
- Specific forest, crop, and animal system placement.

All the above are in relation to slope, soil suitability and existing landforms. By inspection, some priorities may be obvious (fire control, access, erosion prevention). Other factors need to be tackled in stages as time, money, and species permit. At the end of each stage, trial, or project, both past performance and future stage evolution should be assessed, so that a guide to future adjustments, additions, or extension is assembled as a process. In all of this, design methodologies *plus* management is involved, and it is therefore far better to train an owner–designer who can apply long–term residential management than to evolve a roving designer, except as an aide to initial placements, procedures, and resource listings.

The restrictions on site use must first be ascertained before a plan is prepared or approved. In the matter of buildings, easements, health and sewage requirements, permits, and access there will probably be a local authority to consult. If water (stream) diversions are foreseen, state or federal authorities may need to be consulted.

The homely, but probably essential process of building up real friendship between residents, designers, officials, and neighbours should be a conscious part of new initiatives. Small local seminars help a lot, as district skills and resources can be assessed. There is no better guide to plant selection than to note district successes, or native species and exotics that usually accompany a recommended plant. Nearby towns, in gardens and parks, often reveal a rich plant resource.

As every situation is *unique*, the skill of design (and often of market success) is to select a few unique aspects for every design. These can vary from unique combinations of energy systems, sometimes with surplus for sale, to social income from recreational or accommodation uses of the property. This unique aspect may lie in special conditions of existing buildings, vegetation, soil type, or in the social and market contact of the region. Wherever occupants have special skills, a good design can use these to good effect, e.g. a good chemist can process plant oils easily.

A design is a marriage of landscape, people, and skills in the context of a regional society. If a design ended at the physical and human aspects, it would be still incomplete. Careful financial and legal advice, plus an introduction to resources in these areas, and a clear idea for marketing or income from services and products (with an eye to future trends) is also essential.

Over a relatively short evolution of three to six years, a sound design might well achieve:

- Reduction in the need to earn (conservation of food and energy costs).
- Repair and conservation of degraded landscapes, buildings, soils, and species at risk.
- Sustainable product in short–, medium–, and long–terms.
- A unique, preferably essential, service or product for the region.
- Right livelihood (good work) for occupants in services or goods.
- Sound and safe legal status for the occupiers.
- An harmonious and productive landscape without wastes or poisons.
- A cooperative and information–rich part of a regional society.

These then, or factors allied to them, are the test of good design over the long term. For many regions, a designer or occupant can provide species (as nursery), resources (as education), services (as food processing or lease), or simply an example of sustainable future occupations. Pioneer designers in a region should seek to capitalise on that pioneer aspect, and provide resources for newcomers to the region.

3.17
PRINCIPLE SUMMARY

Definition of Permaculture Design: Permaculture design is a system of assembling conceptual, material, and strategic components in a pattern which functions to benefit life in all its forms. It seeks to provide a sustainable and secure place for living things on this earth.

Functional Design: Every component of a design should function in many ways. Every essential function should be supported by many components.

Principle of Self–Regulation: The purpose of a functional and self–regulating design is to place elements or components in such a way that each serves the needs, and accepts the products, of other elements.