IV, V, & VI

PERMACULTURE ON LOW ISLANDS
PERMACULTURE ON HIGH ISLANDS
PERMACULTURE ON GRANITIC LANDSCAPES

BY BILL MOLLISON

Pamphlets IV, V, & VI in the Permaculture Design Course Series

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These are the fourth, fifth and sixth in a series of 15 pamphlets based on the 1981 Permaculture Design Course given by Bill Mollison at The Rural Education Center, Wilton, New Hampshire, USA. Elizabeth Beyor, without compensation, undertook the transcription of tape recordings of the course and subsequent editing of the transcripts into 15 pamphlets. Later, Thelma Snell produced the typescript for all pamphlets and produced the drawings for these three pamphlets, again without compensation. Lisa Barnes laid out and made mechanicals of the original editions. More recently, Meara Culligan entered all 15 pamphlets onto computer disk. In the last few editions, I have added some further light editing to increase the readability of the pamphlets. In deference to the monumental task of love represented by Bill's assembly of the Permaculture Design Course, and by the subsequent volunteer efforts leading to these pamphlets, Yankee Permaculture has placed them in the public domain. Their reproduction is free to all and highly encouraged. The pamphlets are now available on computer disk, individually or as a set. See our order form for details.

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For Mother Earth
Dan Hemenway, Sparr, Florida, June, 2001.

Fifth edition

Edited from the Transcript of the Permaculture Design Course
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Permaculture on Low Islands - IV

A special arid condition exists on low islands. This is because islands, small islands in particular, even the islands in Boston Harbor, have very little water catchment and finite water storage. Of course, all water storage is finite, but some storages are more limited than others.

There are two classes of islands. These are low islands and high islands. Their origins are totally different. The low islands are residual islands. The high islands are volcanic islands or they are granitic islands, either resulting from recent volcanic activity or from folding of the ocean bed, bringing up granites.

All islands are in process of development and change. Often volcanoes come up, making new islands, islands marching off down the slopes and back into the sea again. Islands are appearing and disappearing in those volcanic areas. Many people have actually seen islands appear and disappear. It has happened in recent times Islands are temporary events, and for a variety of reasons. But some islands have more permanence than others.

Inasmuch as islands have a limited catchment, what really happens in the low islands is that the fresh water sits on top of a salt-water base. You can actually measure the available fresh water. The top level of the water is often only three to five feet below the surface, and its bottom level only four or five feet below that. If you know the area of the island, you can work out the actual number of gallons of fresh water coming in, and the storage within the water table. Islands can be tropical paradises if a lot of people don't go piling in on them. If they do, it will soon be necessary to use seawater to drink, or start bringing in water. And the plants will die if the fresh water within the water table is drawn off and the water table is allowed to fill up with salt water.

You must not pollute this water table. Here, the dry toilet becomes a real necessity. You can't run even two or three septic tanks into that water table on a small island.

Conditions of aridity exist mainly on the low islands with a finite water storage. There, one must be very efficient about using water. You must employ a whole set of strategies. I have worked as a designer in these particular conditions. The demand for designers in the atoll marine islands is very, very high. We can't begin to fill that demand.

Fig. 1-IV. "The atoll is basically a series of small islands around a closed lagoon, and the cay, which may be right beside it, is a small island surrounded by ocean"

The atoll is basically a series of small islands around a closed lagoon; and the cay, which may be right beside it, is a small island surrounded by ocean. The atolls are circular islands and a few little sand patches, just starting to be islands.

Atolls are composed of coral and sand, with an accumulation of biomass brought in by sea birds and migratory animals. The sea makes the island, really. These are calcareous islands, these islands are mined for phosphates In fact, all phosphates, no matter in what mineral structure they occur, have this derivation. They are accumulations of the manure of sea birds that have been feeding on sea animals.

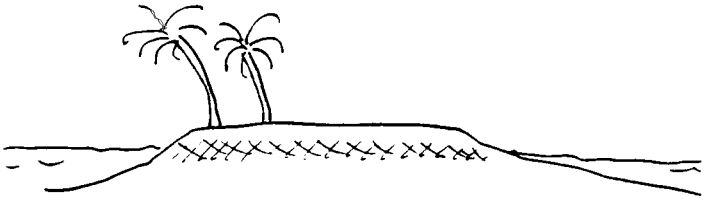

Fig. 2-IV. "The combination of phosphates and calcareous sands results in the formation in the soil of a layer of concrete about 18 inches down."

The combination of those phosphates and the calcareous sands forms the soil, which is free sand, and somewhat of a layer of "concrete" about 18 inches down. This concrete (calcium triphosphate) layer has various names. We will call it platen to differentiate it from another layer we will be discussing later in our study of tropical areas. This layer of platen varies in depth from maybe nine inches to two or three feet thick. It is often quite level on top, but of variable depth below. This has an effect on the water table Rain penetrates very little. The rain tends to follow this platen layer out and run off, and is thereby lost to storage on the island. Thus,only a very shallow-rooted agriculture is possible.

So how did all these low islands get these big trees, like coconut, growing on them? The answer is, almost exclusively, by human intervention. The coconuts have no trouble establishing on the high islands, which often lack platen because they do not have the calcium build-up that the low islands have. But, nearly always, whenever these trees appear on the low islands, they get there by human agency. Both the ancient and the modern Polynesian sagas document this well.

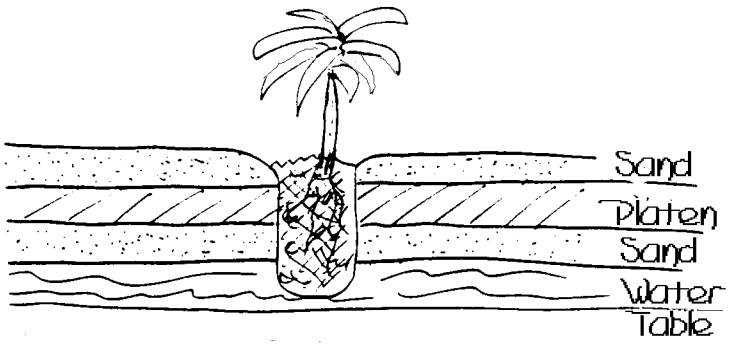

Fig. 3-IV. "The tree keeps the platen open."

To start getting a foothold on these islands, it is necessary to shovel away the layer of sand and break up the platen below it, getting through to what is a rather brackish groundwater. Then, everything you can get in the way of humus, you put in that hole. When your hole is filling up, you put a tree in, preferably a coconut. The tree keeps the platen open. So, down from the tree trunk and around it's circumference, the platen is cracked and permeable to rain. The tree sets up its own little ground water system. Then, to establish more trees, you go about this again and again.

Start the process of vegetation on these islands in this way. A lot of vegetation occurs naturally, such as various grasses, and queer little twisted plants, which can sometimes be peculiar to the island. However, to get a productive forest started, you are in for this platen smashing.

Now we will move to the magical ring garden. You all know that circles, like pyramids, have tremendous life forces and surges of energy. Here is the ideal place to use them. Break up the platen and take it away. Heap up the sand around the edge. Fill up your circle with mulch and plant your vegetable crop in the mulch, putting a single drip system into the center. This makes a very successful island garden -- circle gardening. The fairies can dance around it.

Because drip-water normally will extend laterally about two to two and a half feet, you would probably have a maximum effective diameter of about four to five feet. If we make our hole deep enough -- and it need not be a deep hole -- it is also touching the water table at the base of the humus, and there is a "wick watering" system as well.

It is no good removing all the top sand, smashing up the platen and throwing it away, replacing the platen with mulch, and putting sand back over the mulch. A new layer of platen will reform above the mulch within twelve months. If you want to make a lot of concrete, that would be the way. You could smash it up every 12 months, take it away and make stone walls out of it.

Once you have started these drainage holes through the platen, the water rapidly turns quite fresh. When you first come on a calcareous island that has never been inhabited, then it is your trees and your first few plants that start the fresh water process. It will pay to put a lot of effort into those. Make some quite large holes, bring in canoe loads of mulch. The whole process, once you have started it off, will continue on its own.

We plant the inner edge of our ring garden with cabbages and peas and beans. We might put in a few more arid plants just on the outside or, we would put a circle of reinforcing wire into it, and grow cucumbers and beans up on this.

If we look at the geometry of what we have done, we may find that we have been pretty clever. Within a four foot circle we may have put twelve running feet of row crop within reach of a single drip point. That would be smart work, very efficient use of space.

What we don't want to do on an arid coral atoll is to set up a system of sprinklers. Before the water hit the ground, we would lose much of it to the hot wind We would also lose water in surface evaporation. In addition, this would accelerate the formation of platen below the surface. So instead of using sprinkler systems, we make what is basically a large wick, composed of fibrous organic material. Then we start a small pipe or tap just going drip, drip, drip into our wick at the top. And we drip, drip at the center. By adjusting the drip rate, we can get this area fairly saturated. That water reaches out to the roots of the plants.

The center of your little ring garden is a very pleasant place to sit, so leave a few empty spots. You can sit surrounded by plants. Nobody can see you, and you are eating well.

Then it is up to you, for I have never really analyzed this -- I don't know whether you would go on making circle patterns, or whether you would make some linear patterns. The main thing, though, is to decrease the area of pathway, and concentrate the number of linear feet you are going to get in around the least number of drip points. It may be a matter of hose efficiency. I don't know; It is a subject that might require spending a couple of hours just working out a pattern.

However you design it, it is a garden that still needs application of mulch, and it needs watering. So, look at the linear efficiencies, and look at the fairies running around the edge of your rings, and the power surges going on around there!

Whether we are looking at an island in the bay out here, or at a calcareous island, we can't use septic tanks. The reason is that we are dealing with a very small water catchment system. We can't pump industrial wastes into an island water table. You have to govern the use of the surface with respect for the storages. On atoll systems, you have to store water as surface water.

It is possible to make small gley ponds, lined with leaves of papaw, grapes, banana -- anything that ferments very fast. Then pump it full of water from the ground well. You can thus double the amount of water that you have in that particular profile.

To keep sandy banks from collapsing, take coconut logs and line the banks with them. Once you have vegetation in this system, you are not so worried about instability of the banks.

A question that intrigued me was, "What would you ever grow in a pond on a coral atoll?" Because here is your fringing reef. You already have crayfish, fish - any amount of good seafood. I think probably the best thing to grow would be some aquatic plant food, something not common to the islands, also some rather exotic fresh water food such as prawns. Raise some ducks to feed the prawns via the algae cycle. If you are going to recommend water holes to seashore people who are already eating a lot of fish food, they probably don't want to grow fish in that area. I think if there are plenty of fish and plenty of shell fish, perhaps I would like some prawns and some of the very many varieties of tropical water crop that are high nutrient.

We can do something else. We can take the water out of our water hole. Go down very close to the water table, and you can grow semi-aquatics here, while growing plants of different root penetration just off the banks. That looks good and works well. Put some tubers up there on the bank, and other plants of different water demand down here.

It is quite possible for a pond to grow its own gley. Then allow it to fill gradually and grade the banks up, so that you turn it from a dry hole to a sealed pond by the, process of a crop, which you grow within the pond and roll down.

Another obvious and very plentiful source of water is any and all small roofs. Some of the water can be stored high up off the ground in above-ground tanks.

If your client insists on having septic tanks, the best thing to do is to put them right at the perimeter of the island. The general flow of water is outward, unless your water usage is exceeding the fresh water fall.

Arrange your settlement on the periphery of the island, and draw water from central areas. Even so, if you use an excessive amount of water, the sea enters the edges, quickly signified by the death of trees from the effects of salt. You will also have a reverse flow of those pollutants. If there are too many people on an island, then the beaches become unusable because of the pollutants dashing up in the sparkling green waters.

So for these low islands, you have grow-hole technology: there is a pit, wick-watering gardening technology; there is gley technology for collecting free surface water, and for creating a growing situation. There is a roof catchment, and surface storage in tanks. And with this peripheral housing idea, you will be keeping your waste from the main water lanes. But to build up a large village at the center of your island could be a disastrous technique. You have to think your way through these situations all the time.

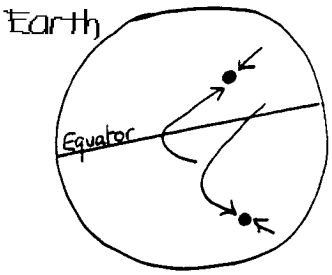

Fig. 4-IV. "On all oceanic islands we have two sets of winds."

On all oceanic islands, whether low islands or high islands, we have two sets of wind, and two periods of calm. We have spring-autumn periods of calm, and we have winter-summer winds. For the most part, these winds are either northeast-southwest, or northwest-southeast. Winds of many land situations don't differ a great deal, but islands are usually of this nature. So you have wind-break problems and erosion problems.

You have to be careful not to lose your island to erosion. It is quite possible to lose islands in this way. From the air, I have observed in these bays out here that waves are in the process of wiping out islands. Waves never cease to attack. Where the winds sweep on shore with waves, the process of erosion proceeds very rapidly. We can lose these islands because we let this wind attack directly.

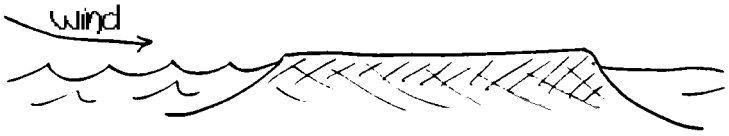

Fig. 5-IV. "It is quite possible to lose islands to erosion."

This process can be diverted by some change, like a little tree on the shoreline deflecting the winds upward. As the number of trees increases, the wind deflects and the trees begin to win out against the sea. A whole set of plants can become established along the shoreline, actually stopping the force of wave erosion.

The highest that vegetation can build an island is to about six feet -- vegetation alone -- so don't tamper with this shoreline vegetation. Or, if you tamper with it, you better have other defenses ready. You could deliberately tamper with this vegetation, let the sea come inside your island, create a harbor effect, but then you should have very good, previously-built defenses around your harbor area. If you remove a strip of this deflecting vegetation, you have much broader wave running inland and coming with much greater force, because it is in a streamlined wind. Whenever the force of the wind lifts over vegetation, you get a low pressure coming in and the waves break further out and run much less up the beach. Don't muck around on these two very critical shorelines.

Remove the trees to make an airstrip, and you will have the sea come marching in across your airstrip, cutting it to pieces. Disaster. It will be hard to put that island back again. Contain an airstrip within vegetation, preferably at an angle to the winds. It is good to have trees alongside the airstrip and to keep your coastline intact. Then, when you drop below your tree level, you can land. The main thing is to preserve coastline vegetation at the ends of the air strip.

Atolls mainly need windbreaks on the outside areas. Atolls and cays have very different conditions of sea surrounding them. Cays have fairly turbulent seas around them; while the atolls have very quiet and shallow seas within them. Large regions of the internal lagoons are shallow, and are revealed at high tide. These are very rich growing areas; they have some land nutrient input from rainfall. So they are very productive. They have large fish -- sharks, rays, barracuda, schools of fish, mullet. Some atolls are really in a fish farm situation.

Mangroves occur within those atolls, though in some they are absent, because they have been utilized as firewood, or perhaps they just never got established there. But you can bring them in and they will quickly carry out the island into the lagoon. You can accomplish this in two ways. You can either put mangroves along raised barriers, which you make from logs and sand, forming further fish-trap enclosures, which may increase the fish population. There are plants that stand right here on the shoreline on which the waves break. Basically, there are three genera -- *Pemphis, Tournefortia*, and *Scaevola*. These are plants that will stand there in the sea, maybe growing about fifteen feet high. Behind them, you put a set of very tall plants. Where climate permits, you would use one of the palms. And it is possible to use the date palm. You don't ordinarily think of the date palm as being an island palm, but rather an oasis palm. But when you re-think the matter, you will see the basic conditions are very similar. We should be trying a lot more things, such as mangroves inland in the deserts. We should try many of our coastal species in the desert, and a lot more of our desert species on the coast.

It was an accidental occurrence that started some date palms growing on the Hawaiian coast. A Catholic priest on the Hawaiian Islands was eating a package of dates sent by a supporter. He discarded the pits, which sprouted and grew and took off along the coast just as well as the coconut palm.

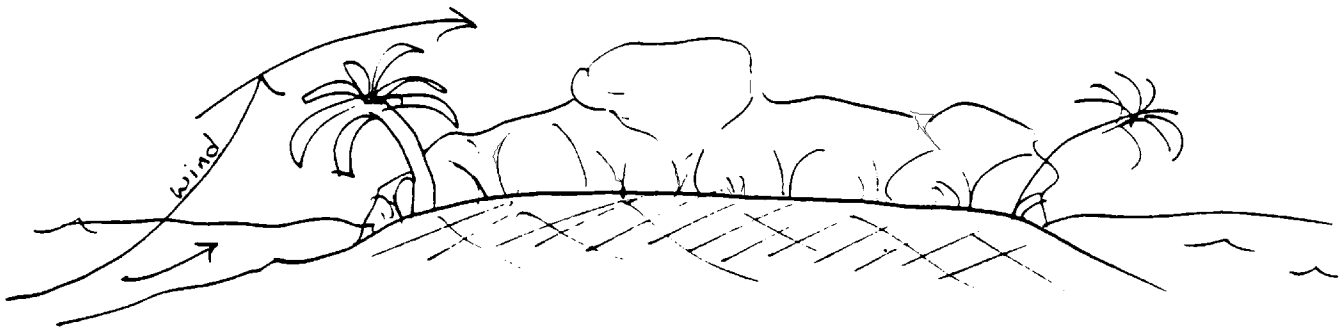

Fig. 6-IV. "As the number of trees increases, the wind is deflected and the trees begin to win over the sea."

You are not going to get much bearing from the front line trees on an island coast. They are principally useful as a windbreak. The next line will give some yield; and from the third line of trees -- that's within fifty feet -- you will start to get a normal yield. The palms are very good along the coastline.

In cold climates, you may be setting out *Coprosma*. They will stand right on the coast. *Coprosma repens,* bayberries, will stand well towards the forefront, but not quite as far forward as these others. The New Zealand mirrorbush is another one. There is the beach plum, *Prunus maritima*. There are others such as *Prunus catalonica, Rosa rugosa*. They grow right on the beach. Just make sure, though, that the trees you bring in are growing on oceanic beaches. Many things will grow on the coastline of sheltered water, but will not take that front-line oceanic assault.

Now there is another set of front line plants that are for the main part needle-leaf plants. There is the whole group of *Casuarina,* tamarix, Monterey pine, and a great plant with wide climatic range, the Norfolk Island pine, and the Monterey cypress.

You are not looking for yield here. You are looking more to the mulch potential of this set of trees, because these trees stand front on the ocean, the first to receive the winds from the sea. They are the front-line species. Of course, you can mix them up. You can put a row of palms and needle leafs and broad leaves. There are a very few thick-leafed plants. The sea grape is one.

There is a very small group of plants that will not take any salt at all on their leaves. Some of these seem to be large nut trees. Chestnut does not like salt at all; and I don't think walnuts are real fond of salt on their leaves. Almonds, peaches, apricots, apples, have to be somewhat sheltered. The pistachio doesn't want salt at all.

Of all the vegetables I know of, none of them suffer badly from salt. Many grow near the sea.

So you put in a coastal defense system and maybe extend your island into your lagoon system. You might as well use these extensions for other reasons. They might incidentally be fish traps, rearing systems. Warn your client of the drastic results of hacking off the foreshore vegetation to get a better view. Re-establishing a coastline is very difficult once erosion has started. Watch your water balances. Recommend minimal use, and see that you get maximum surface storage. Maintain potential surface storage at all times.

Islands can be interesting experimental stations. Some weird animals have developed on island, such as the giant tortoises, the big ones that you can sit on. They are great lawn mowers, and very good at converting table scraps into fertilizer. A herd of giant tortoises is an excellent thing to have lumbering about in the undergrowth, cleaning up the old fallen coconuts. There is a whole series of land crabs that do quite a lot of work on islands as compost shredders and insectivores. They find insect larvae and consume them. They lessen wood beetle infestation. Pigs can be useful on islands, and they are fairly easily controlled. Ducks do well, and chickens.

You have to look at your nitrogen turnover on islands. Put in some nitrogenous species. There are many island legumes. Some of them are vines, ground vines; some are little trees; some are tall trees.

You can eat the leaves, the flowers, and the pods.of the horseradish tree, the *Moringa.* It is nice to have in the garden -- a vegetable hedge. It is quite a tall little tree. It grows to 20 or 30 feet.

So you look after the nutrients within the garden systems, you look after the windbreaks. You set out central gardening, and, on low islands, peripheral occupational zones to decrease the risk of contamination of the water table.

We would probably have to bring in worms, and bring in a handful of compost to get all our little bacterial and fungal and algae forms onto the island, because we can be starting from a sterile environment. We should bring in a handful of soil with almost every plant we bring in. These plants have soil associates. The nitrogen-fixing bacteria for legumes are not necessarily going to be there. There are also some varieties of trees that won't grow from seed unless started in their own soil.

Finally, a further word on mangroves with respect to their importance for the whole global nutrient cycle… Mangrove is a generic term for estuarial forest plants and the genera are drawn for the main part from sub-tropical and tropical rain plants, such as *Sonnerata, Rhizopodia, Aegiceras* and *Nipa,* in the palms. The Nipa palms are mangroves. *Avicenna* is another mangrove -- one that comes all the way to latitude forty. All of these have twisty stems and leathery leaves, and they stand out in these quiet tidal waters. As a system, they are very productive. I think perhaps the mangroves have the highest biomass turnover of any system. *Aegicera* is a superb honey plant, responsible for most of the tropical honey of good quality.

They all lay a very thick leaf mulch in the sea amongst their roots, which turns into a nice loose mud which people detest. So they cut down the mangroves, and get washed away when they do it. You can always put little walkways out into the mangroves, two planks wide, you know, if you have to walk through there.

You say that the bald cypress will tolerate tidal water? Well, then, there you have another mangrove. More species come in as you go up river in mixtures of sea and fresh water.

They all lay down this really rich leaf mulch, which goes through several animals like shrimps, little anthropoids, diatoms. That leaf is really used. The whole food chain starts within these seas. It is an area that is responsible for most of the offshore shrimp fisheries. The mangrove jacks and quite specific fish are associated with the mangrove stands. Mangroves are very enriching systems. They should be heavily encouraged and widely distributed. Instead, they are everywhere being degraded and filled in and drained and chopped. Then everyone wonders why fish are getting scarce.

The mangrove palms are useful, too. They have either some useful fruits, some honey yields, or some stem products. Some of the mangroves have very durable woods and timbers. Some have edible, if not particularly delicious, fruits. However, their real value is in the enormous life-turnover in the system. The mangroves are great places for crocodiles. There is nothing quite comparable to moving through the mangroves in a canoe at two miles an hour, with a 40 foot crocodile bellowing behind, who can touch 30 miles an hour if he speeds up. There are alligators in mangroves, and little fish that spit at you and bug their eyes. There are whole hosts of organisms ripping around in there, all of enormous value to the nutrient cycle.

And there we will leave the low islands, the atoll with its quiet lagoon, and the sun sinking slowly in the West.

Permaculture on High Islands - V

Fig. 1. "High islands have a wet slope and a dry slope."

Islands, whether or not they are volcanic, if they are over a thousand feet high, often have clouds. They will have a very humid top on them, and sub-humid slopes. There will be a wet slope and a dry slope, because seasonally you get winds -- summer winds and winter winds.

If the island is more than five degrees off the equator, it will have a dry and a wet side. The wet side will be pretty wet, so that the humid area comes down slope on one side, while the dry side may be quite dry. The water table is high; the catchment potentially good.

Fresh water often travels out beyond the island and bubbles up in the sea. Typically, around the island and off the coasts, there are fresh water springs below sea level. They are quite visible; they look like sort of shimmer in the water as it bubbles out of crevices, and you can drink from these springs. They are known to the peoples who do much diving.

We will take a look now at a high island in Hawaii. This island is half volcano. The other half blew up. Because of the high humidity of the air passing across all islands, there is quite a heavy rainfall over this area where winds rise, peak and fall. As the winds pass across and come down the opposite side of the island, they assist in the drying-out of that side. The winds, lose moisture as they entered the wet side of the island, heat up as they descend, and then have greater evaporative power. They are also working on a lower pressure system.

Back to the wet side, this is a wet area, and will be rain forest. If we do not intervene, the rain forest will slowly extend down, and so will the clouds, to lower and lower levels, in some cases, extend to the water line, even on the dry side. The whole island then becomes totally wet. What really happens is the wetness descends in the trees at ground level.

I have a little book, given to me by someone as I left Hawaii, called "Memories of Molokai", written by one of the descendants of the missionaries. This man grew up there. He says that fields that were dry grasslands when he was a boy are now wet and marshy forested areas. People now alive can remember the descent of the mists as the forest has extended. They remember when the mist was one thousand feet high, higher than it is today. You really observe a positive, fast response when forests take over. The amount of water generated on high islands is relevant to the amount of forest on those islands. Historically, springs have either dried up, or recommenced to flow, depending on whether the forest is extending, or being removed.

You can play around with the water, play around with forests, on these high islands. High islands lend to high-ridge storage of water, following the model we studied in the keyline system. We can direct water from catchment to catchment to catchment.

High islands are also good sources of wind and sun and water power. The ancient Hawaiians applied these principles.

Now we will look at the ancient Hawaiian land division. As we look down on the island, we can see that there are natural volcanic run-off patterns, and river systems. The Hawaiian land subdivision followed the ridges between the valleys. It followed the natural division of the island, which was from the mountain ridge to the surrounding reef, including the section of lagoon between the shoreline and the river, and, in fact, extending over the reef. This was the Ohana division of the islands. It was a good division, arrived at, no doubt, after a whole series of extinctions and reinvasions, over some thousands of years. These very logical districts imparted control of the entire watershed from its origins to its discharge into the sea and beyond.

The Hawaiians independently invented the keyline system. They put a massive stonewall at the keyline and led the water from the upper valleys out to the ridges. They took it back to the valleys and out to the ridges at a lower level, then back to the valleys, and that was their taro lands. These keyline systems still exist. You can walk out the keyline and examine those terraces, sometimes cyclopean, built of enormous stones.

They are forested from keyline up, and they confined foot traffic to the ridge tops -- very sensible people.

Forests were taboo areas, because they were the source of water. They were used very carefully for essential purposes. Where the human and forest nutrient eventually reached the sea, they enclosed the area with rock wall. Within this enclosure, in three days' time, the sea will grab all nutrients and somehow fix them. In that case, it is the form of algae. In those enclosed ponds they raised millions of pounds of mullet. So they turned run-off nutrients into fish and ate the fish. Then, back up on the hillside, in the paddy field, the process started all over again. Real good. That quite stable ecology supported many thousands of people.

Well, we soon fixed that. A few missionaries and a few cattle, a touch of disease -- we set it all to rights, cutting up the system, building condominiums. The whole nutrient flow now goes into the sea. All the fish traps filled and became solid earth systems. There may be fewer people living on the islands now, and the islands themselves are far less able to afford them a living. Production is starting to decline rapidly. Righteous, but not smart.

We could re-institute the Ohana division, except that Ohana is a word in which the people are an integral part of the division. If you belonged to an Ohana, you belonged to a valley and a set of fields and a fish pond and a reef section. They guarded right out to the reef and over the reef by building underwater structures. Thus they created reef structures for additional fish shelter. The people were an integral part of this whole system. The Ohana is a totality. I think it to be a nice concept. Its watershed, its people, its nutrient flow, its animals, everything, is a single, indivisible unit. Perhaps we could seize the headwaters here and start Ohanaing downhill.

That is a very nice system. You can go and examine what remains of it. Amazingly, there are those taro patches right on the nose of the ridges because they keylined right out to there. They keylined a little steeper than we do, because they did it by hand, and their little gutters were often stone lined. These gutters run out to quite amazingly steep ridges, right out to the points of the ridges where it was flatter. They grew taro in the paddy fields on

those ridge points. You really can't better their system. You might change the elements of it. Taro is not for all of us. Poi is not an ideal food. It is pink and gluey, and tastes frankly of acid. But I have friends who dearly love it.

They did extraordinarily well in establishing the integrity and the nutrient flow in that system. It is all there, just waiting to be revived. On very exposed dry sites, they used tiny rock walls, little rock mulch walls in amazingly intricate cross-wind patterns, sometimes only ten feet apart. Behind those they grew dryland crop, like sweet potato. They also grew a dryland fern out there for mulch.

You can do no better than to study the ancient technology of the Hawaiian gardener. For what limited species he had at his command, he was a superb technician and an excellent designer. I wonder at and admire his works, which are totally ignored by the current population. This patterning is all over the landscape. When you look at it with a permaculture eye, it doesn't take you long to work out what they are up to.

Not that the modern Hawaiian can reinterpret that. While some of the old Hawaiians still use it, they are very old. If we could have really looked at the culture before we converted it, we could have learned a lot. There is only one bit of hope. The Hawaiians are buying back the islands. I think they might win if we keep marijuana illegal.

Now this is your technique in the high islands. Keep your upland slopes forested. Your island dictates the sort of forest. If your island is high enough -- two thousand feet high -- you have gained (in latitude) maybe seven to twelve degrees. So you can descend from plum and deciduous species, which have sufficient chilling up there, to ultra-tropical, equatorial species at sea level. You can play all sorts of climate games downhill. Low light tolerance trees go up here, too, because they are almost always mists around the higher area.

Mist often curiously reproduces the whole shape of the island in the air above it. This is typical of all islands. Often, coming from the sea, you can see the cloud that belongs to your island; you can recognize that cloud straight-away. That is the island you are approaching. After a while, you come upon its solid counterpart. The Maori described New Zealand as the land of the long white cloud. It is a long island.

In certain of the Hawaiian Islands, and many other high islands, it is quite typical to find valleys that have no sunlight all day. Those valleys are in eternal shadow. There is no solar evaporation in there, only transpiration by plants. The vegetation on that side, away from the sun, steeply descends to sea level as a rain forest. It is not much good fighting that. You might as well turn it into the sort of rain forest that you approve of. The rain forest works its way down the hillside by means of soil storage of water. It creates really wet soil conditions. As the forest comes down, it creates additional precipitation. The forest really sends its own water down at ground level, regardless of transpiration. The forest condensation and its protection of the soil from evaporation win over transpiration. Given that we have constant humidity, the forest always beats rainfall in terms of water storage.

But when the loggers headed into these forests for sandalwood, when the graziers came and burned up to the ridges, the clouds were pushed right up those ridges. Then they attacked the growth on the ridges for charcoal, and the ridges are drying up. They further propose to attack the higher levels, to clear the area off for their electric generators!

There are special problems related to the placement of housing on islands. These problems are currently, but temporarily, overlooked by the new island people. Opposite to streams, on tropical islands, fringing coral reefs will disappear, because the coral won't stand fresh water. Therefore, these openings in the fringing reef are normal entries for vessels into the harbors. They occur naturally. Or you can blast some out, if you feel brave enough to see what happens after that.

Oceanic islands, inevitably, at some period in their history, experience tidal waves. If the tidal wave doesn't slow up on the reef, the valley with no reef offshore acts as a funnel, and the tidal wave sweeps into it with ever-increasing velocity and ever increasing bore. These are particularly dangerous valleys for settlement in the lower parts of the valley, and the Hawaiians treated them as not even cultivation areas. They grew tree crop in them, mainly coconut. The coconut trees did a lot to decrease the wave velocity up the valley. So you must keep your client out of there.

Unfortunately, Sheraton Hotels and a few other people don't know about that. They are sitting right there. The periodicity of tidal waves is about twelve to fifteen years. So we will see a lot of disappearance of white America on the Hawaiian Islands before too long.

Going inland from the shoreline, you are safe enough at the first elevation, if you have a sub-ridge within the major valley. It is usual for a tidal wave to penetrate more than a half mile inshore. The Hawaiians also perch themselves up off the valley floor, on the sides of the valleys in case of reawakening volcanism. Volcanism is always accompanied by torrential rains and enormous and very rapid mud flows. People don't want to be in the path of that flow, which may descend with a speed of four hundred miles an hour. So they build their homes up here off the valley floor, and in from the valley mouth. Where there is a fringing reef, you can creep closer to the coast. You just might get a twelve foot wave instead of a hundred foot wave. Europeans settled tightly on the coast. They are just in between two tidal wave episodes. One happened not long back, and very probably there will be another one soon.

Ash flows, mud flows, flows down wadis, landslides, which come down these volcanic hillsides, dictate that you get on a point of a lower ridge. While this is a nice place in any locality, it is almost dictated by necessity on oceanic islands.

The other factor to be considered on oceanic islands is the cyclone. Therefore wind shelter becomes important, and particular attention must be paid to house construction. Earthquakes and mud slides, but particularly earthquakes, dictate that you reduce the mass of your house to the minimal. It would be best, particularly in tropical islands, if the house were made out of paper or light matting.

As a designer, the last thing you check out before you leave is to be certain that you haven't left some unfortunate client to a certain death. The paths of mud flows, the paths of tidal waves, the paths of cyclone damage, are all known if you make local inquiries. Look for traces and effects that show you where not to be when these events occur. So, having done all the rest of your planning, you had best be sure that you have put your client where he will have a maximum chance of getting out of any of these situations.

Permaculture on Granitic Landscapes - VI

Granitic landscapes are somewhat like the residual desert -- slab landscapes with a lot of rocks. This landscape presents peculiar problems. Typically, there may be a hundred feet of permeable sand. Your chances of any significant storage of water anywhere in that landscape is very slight.

Yet millions of people live on those landscapes. The entire Perth plain of Australia is of this nature. It has about a two hundred foot depth of clean sand. You can't keep water on it. You may water it forever and the water just goes down and down. You can mulch it and the mulch is gone. A thick mulch is gone in six months. It just gets washed down into the sand. There is nothing to stop it. Mulch just breaks down into little particles and acids and flows on down between sand. It washes right down to wherever the water table happens to be at the time. All organic materials are washed down.

Near ancient rivers you will find people living on these plains -- plains extending out from large granitic areas, not subject to glaciation, and along major rivers that have receded, drying up a bit.

The water source is often bored wells. But that water is finite, and the usual story applies. Once you might have needed to bore to a depth of 20 feet. Now it is necessary to make a 2,000-foot bore, while the water is getting saltier and saltier the further you go down, because there is a natural stratification. There are different salt layers that have hard alkali.The ground water, the fresh water is flowing over the top of saltier water. As the fresh water is pumped off, the bore must go ever deeper and the water gets more expensive and saltier.

So small gley ponds, tanks, and very modest bore water use are requirements for the survival situation. Your garden area should probably be completely lined with plastic sheeting. You then can mulch, and humic acid at least will reach the roots of your plants. Your garden will then be sort of an underground tank.

It is necessary to treat the granitic landscape very much like the desert situation, even though the area may be reasonably humid.

Trees do well in this landscape, though I don't quite know why. So place a big accent on tree crop as a replacement for annual crop.

There can be no lawns. Lawns are total disasters. It takes 90 inches of water a year to maintain a lawn on siliceous sands. You may put on eight feet of water to keep your lawn alive, but there will be huge evaporative loss of water.

Around these rocks and dunes there may be numerous microclimates. You may be able to go from dates to strawberries.

Because of the reflectivity of granite, there are light and heat benefits. Incorporating the mass of these granite rocks into buildings is good strategy. It can be either under glass, or just incorporated under shade houses and used as evaporative cooling systems. It is sometimes possible to dig a rock out and incorporate that rock in the house.

There was a woman in Sydney who got sick of builders, and she set about designing her own house -- typical woman. So she headed for the rocks. What she has is nice rocks coming out in the bedroom, rock coming up through the walls into the living room. She has good evaporating cooling systems, little keylines running all over, covered with moss and ferns -- good permaculture design. It is a good idea, you see, to accept these natural features as part of the house. Glassed in, rocks are amazingly efficient heat stores, very cheap.

"You can mulch right on top of rocks."

Working your way around this rocky landscape, you come upon all kinds of run-offs. You can put little blocks on the shelving areas and mulch there, right on the rock. You can mulch right on top of rocks and right beside the rock below, and get good little run-off systems going into those pockets. In the crevices, granite flakes off, and you find large sheets of that which you can lay out with a bit of assistance from a crowbar, and you can fill that area with mulch and make a growing area there.

You can grow on both sides of your rock in the shade, and in the semi-shade, in the morning sun and in the afternoon sun. Morning sun is the sun for the production of leaf; afternoon sun ripens. These are really interestingly detailed habitats, and you can almost sense what plants will grow in any of these pockets of mulch on rock, just by moving around in the system.

I have a friend who had about four acres of this granitic soil and four acres of dirt that he started to play with. His granitic area is slowly becoming far more productive than the other four acres of promising agricultural soil. He was using the stones for ripening and all sorts of things.

By playing around in there, you can have a lot of fun, and create a really attractive environment. You see a pile of rocks down here, a lot of niches in there, good tomato and cucumber spots, places for vines to grow and climb on rock instead of fencing. There are banks and little shaded areas for strawberries, and on and on and on and on.

But it is hard to deal with that area out where there is no rock base. A modest gley pond, run-off tanks, bores, windmills. Deep siliceous sands are hard to deal with, and shouldn't be crowded up and settled. Tree crops are a vital factor in sustaining agriculture on siliceous sands. Nearly all the palms, many of the fruits, figs, grapes -- all those do quite well there with minimal work.

I have often wondered about the potential of a below-garden gley system. Dig off the earth, put a green mat layer in, and then return the earth. I don't know whether it would work. It might.

I'm not saying exactly what you can do around a situation of this sort. When you walk in there, you should be able to work out quite a lot that you can do. I would stick in little olives and date palms and grapes and raspberries and strawberries and marigolds all around in amongst these rocks, and direct little runnels to places -- lots of detail work. Nice! There is nothing like an old rocky river bed or a pile of stones to work in! A pile of logs is great -- big logs, I mean, a huge amount of niches, and a great potential. Just start people cleaning up the country.