
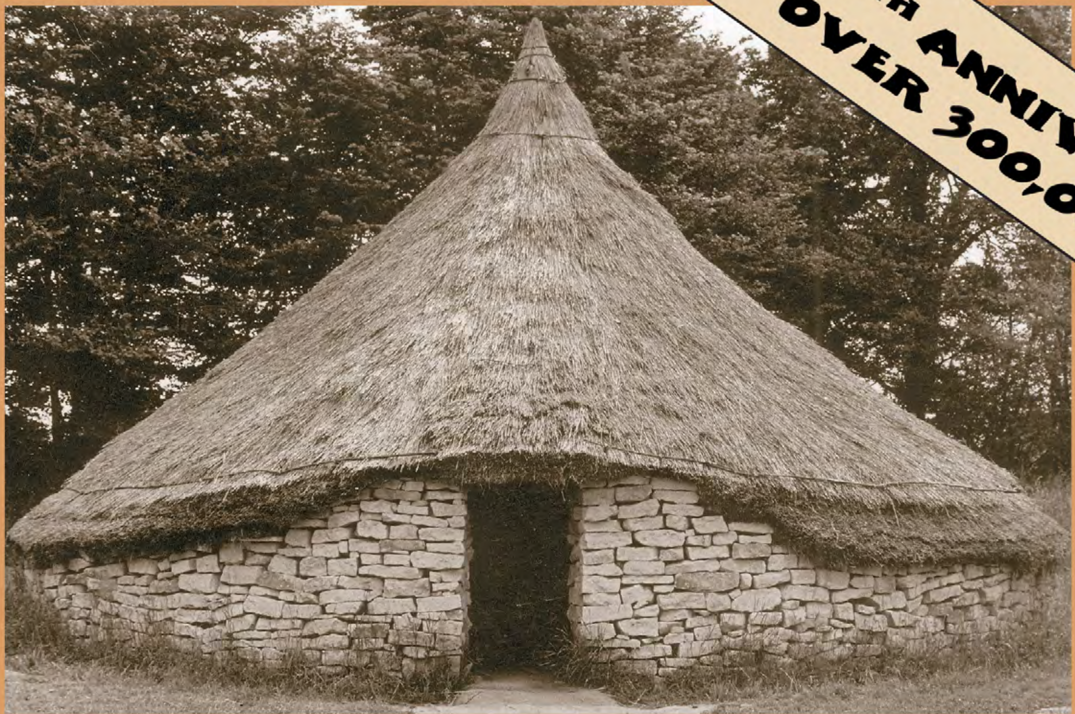


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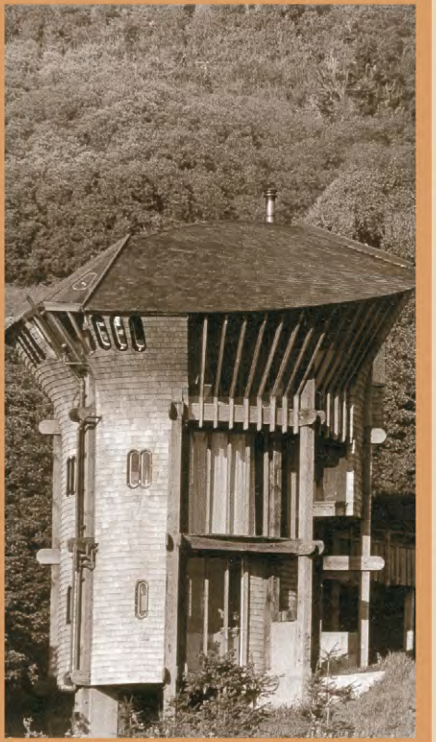
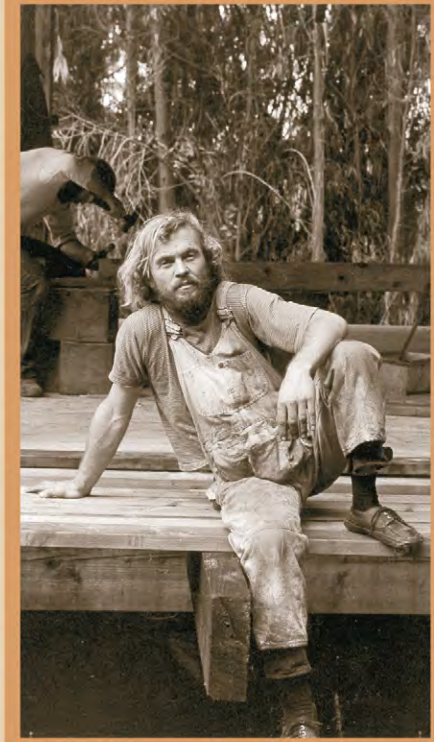
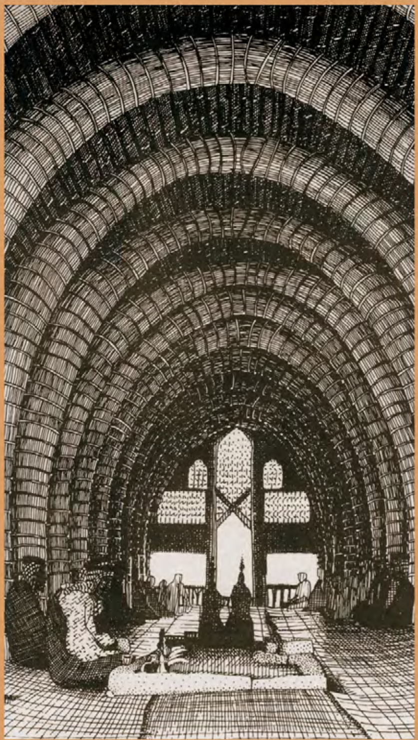



SHELTER

LLOYD KAHN • BOB EASTON





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SHELTER

Library of Congress Catalog Card Number: 90-60125
ISBN-13: 978-0-936070-70-4

Shelter was published in 1973, over 40 years ago. It was a celebration of handmade housing, of traditional building crafts and techniques, of natural materials and small homes. Its message: you can create your own shelter, with your own hands.

It caught on with young people who were seeking a different life, who were willing to take the time and learn the skills to build for themselves. It has been translated into French, Spanish, German, Korean, Japanese, and Chinese, and has gone on to sell over 300,000 copies worldwide.

These days, *Shelter* has become popular all over again, especially with 20 to 30-year-olds who need a place to live and don't want to get involved with banks and debt-saddling mortgages, or landlords and high rents. Now, some four decades later — even with all the changes in these years — the book is the same, and the message is the same:

Do what you can for yourself. Create your own shelter. With your own hands.

–Lloyd Kahn

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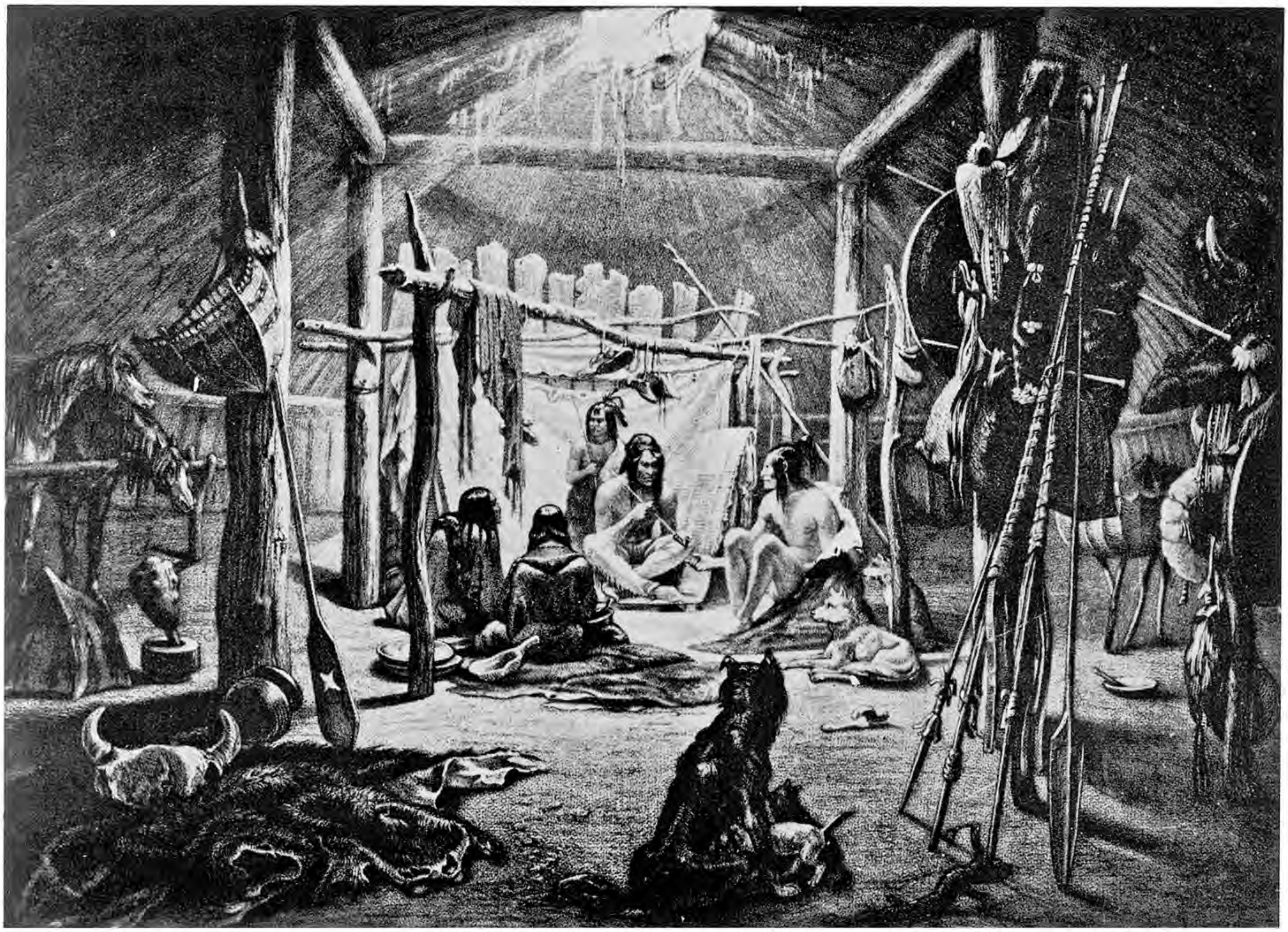
SHELTER



Interior of the lodge of a Mandan chief in the 1830's, a picture made on Prince Maximilian's expedition.

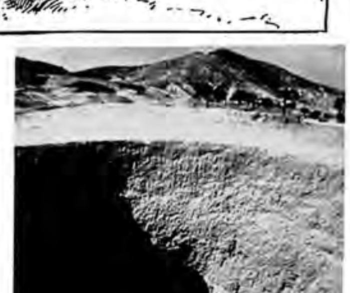
Early man lived under the trees and stars. At some time he found or improvised shelter.

...Hunters and fishermen in primeval times naturally sought shelter in rock caves and these were manifestly the earliest form of human dwellings; tillers of the soil took cover under arbours of trees, and from them fashioned huts of wattle and daub; while shepherds, who followed their flocks, would lie down under coverings of skins which only had to be raised on posts to form tents....

The first section of this book is our attempt to trace the evolution of these simple shelters — caves, huts, tents — to what we have now. By no means a complete history (we are not scholars or historians), it is rather an attempt to organize and understand cultural and structural concepts that appealed to our aesthetic senses.

Changing weather conditions, expanding agriculture and population, and the development of metal tools altered early man's shelter needs.Response to local materials, climate, and changing conditions has created an incredibly diverse number of structures: neolithic farmers who developed early rectangular wood frameworks from circular earth lodges; desert nomads with camel-packed, goat-skin tents; the Dogon tribes of Timbuktu whose mud cities reflect their view of the cosmos; American wood-stud palaces.

Sir Bannister Fletcher, quoted above and on pages 5, 6 and 11 was concerned with the history of architecture. What we are concerned with here is man and *shelter*.

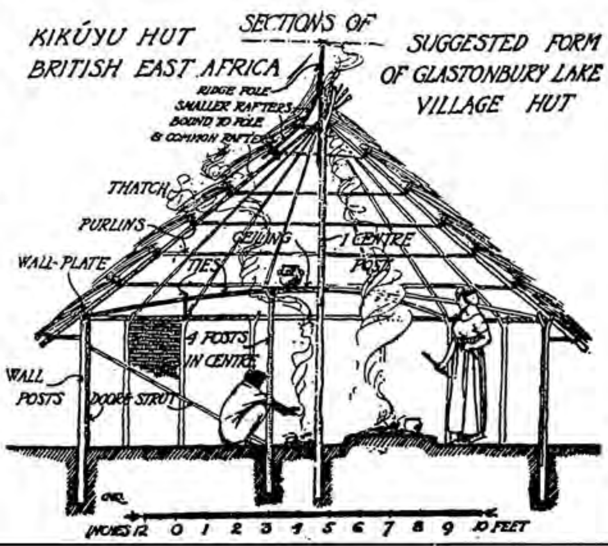


Looking into courtyard of Tunisian troglodyte dwelling.

IRON AGE HUTS

Charcoal burner's turf hut at Weald Open Air Museum, Sussex, England. In reconstruction a pole frame was covered with sacking, then branches with leaves, then turf stacked horizontally. This hut, used for sleeping, was constructed to specifications of Mrs. Arthur Langridge, whose family were traditional charcoal burners until the 1940's. Charcoal burning is an ancient craft, practised as early as 4,000 B.C. in Central Africa and unchanged until relatively recently with the introduction of metal kilns. Because charcoal gives off twice the heat of the equivalent weight in wood it was important in smelting iron.

Theoretical reconstruction of British Iron Age house at Avoncroft Museum of Buildings, Worcestershire, England. An excavation in 1959 revealed a circular wall over a meter thick and 10 meters in diameter, with no evidence of a center post; a pitch of 45° was chosen as the pitch necessary to shed water, and builders discovered two important facts during reconstruction: that the building has to have a wall plate so that the outward thrust of the roof rafters will not knock down the mortarless wall [this consists of notched and jointed poles set into the inside edge of the stone wall.] Secondly, it was necessary to include a ring beam in the roof apex lashing together all rafters with leather thongs. After frame erection, branches were interwoven among rafters and covered with hay before thatching....



Replica of Iron Age hut at Avoncroft Museum.

Ancient Latvian summer kitchen "Slietenis," Latvian Ethnographic Museum, Riga, USSR.

Theoretical reconstruction of Anglo-Saxon weavers hut, Weald Open Air Museum.

SOUTHERN

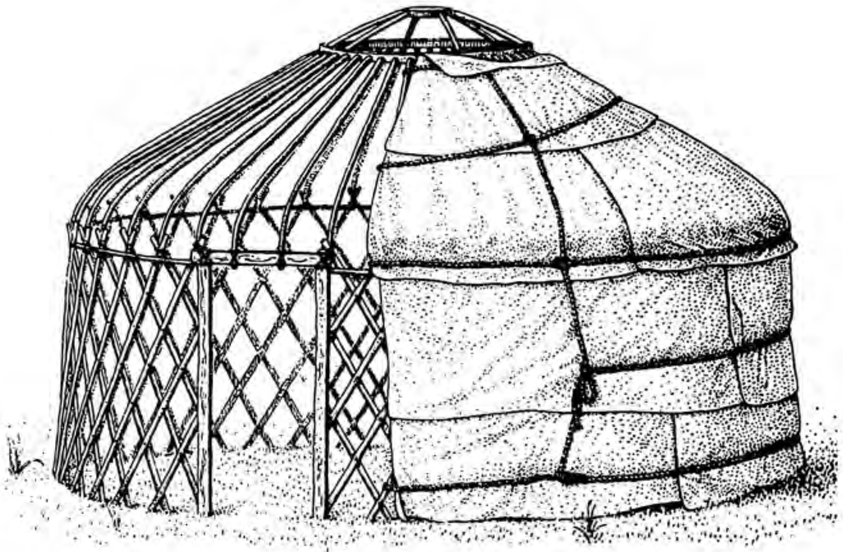
Made of mud, straw and clay mixture. Patted on by hand between lodge pole frame. Roof is bamboo thatch. All materials local Los Angeles county! The people who live in the apartments below complain that the hut is an eyesore.

Carey Smoot

CALIFORNIA

Court Johnson saw this twig framework in a dream and built it on a Santa Barbara mountain side. He wired together bent green eucalyptus branches set in a circular concrete and rock footing. Since this photo the frame has been plastered with adobe mud. Court's dream revealed to him an archetypal structure as used by various primitive cultures — thin saplings tied to achieve the strength of compound curves. The same frameworks are found in Ethiopia.

YURTS

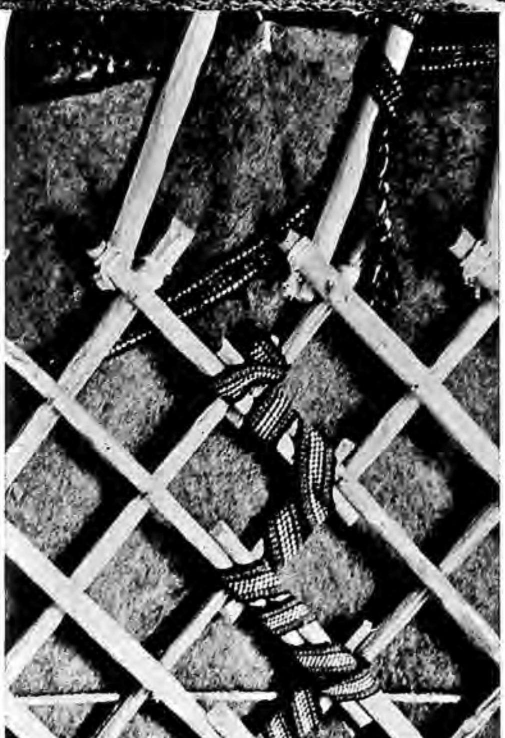


Several of the nomadic tribes of the Near East and Central Asia, from Iran to Mongolia, have for some several thousand years lived in a remarkable form of shelter: the yurt.

Yurts are particularly interesting shelters because they are so easily transported yet so solid in look and construction. The basic element is the expanding wall lattice: strips of wood are fastened together at intervals such that they can be expanded to form a larger wall section. Several of these sections are expanded and tied together with a door frame to form a circular wall. A compressive band/rope is then drawn around the top of the wall to help support the roof. Poles are then run from the top of the wall to a higher central compression ring. Sometimes there are two pillars helping hold up the central ring — and sometimes there are no pillars, the roof being self supporting like a truncated cone. The wood structure is then covered with various amounts of felt and canvas depending on the climate and weather.

The whole shelter is carried on one or two camels. It can be erected by several men in a half hour. After the outside covering is tied on and door shut it is astoundingly solid and sedentary looking.

Aron Faegre

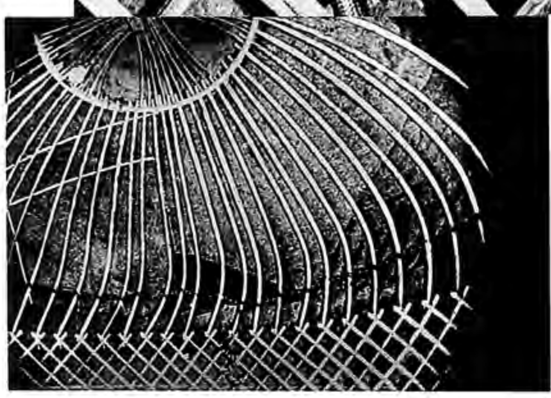


The tent is rather like a ship without bulkheads or lockers, for although the partitions do not exist they are nonetheless real; everything is stowed in its traditional position. The only exception is that if a bridal yurt cannot be provided for a newly-wed couple a be-ribboned curtain screens off a small part of the tent to give them some privacy.

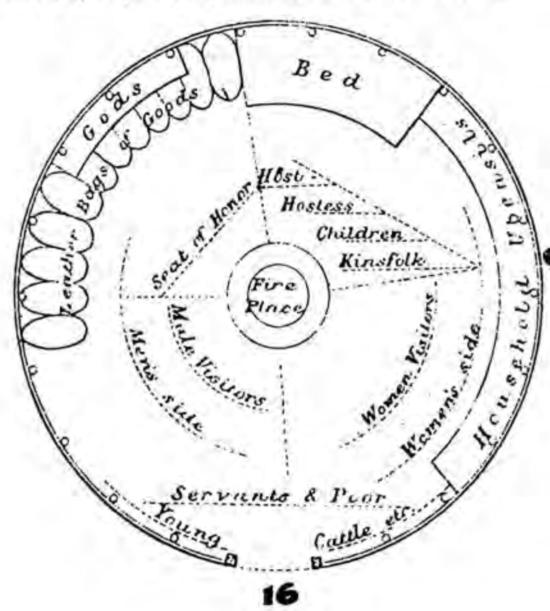
The yurt is always pitched facing south, so the pool of sunlight shining through the smoke hole in the roof acts as a clock. The area between the hearth and the door is the entrance hall; young animals may be tethered to the right of the door in winter. The rest is divided into thirds. To the west is the women's part; cooking-pots and maybe a samovar are kept on a shelf near the hearth; clothes storage, perhaps in chests but always also in large packs to protect it from the all-pervasive dust of the summer, is ranged along the wall; furthest in is the cradle, slung like a hammock. The east is basically the guests' side; sacks of dry goods like rice, barley and flour are also kept here. At the back of the tent two large bags hold the weaving equipment, and a gun may be hung between them. A mat is spread there where the men may sit and talk. At night the bedding is laid out on this mat.

On the Iranian side of the north-east border more and more Turkmen grazing is going under the plough. Now the yurts tend to be poor men's dwellings associated with villages, or they act as workshops for richer, settled tribesmen. Less than ten years ago it was a common enough sight to see groups of tents on the vast plain of the Gorgan; now it is a rare event.

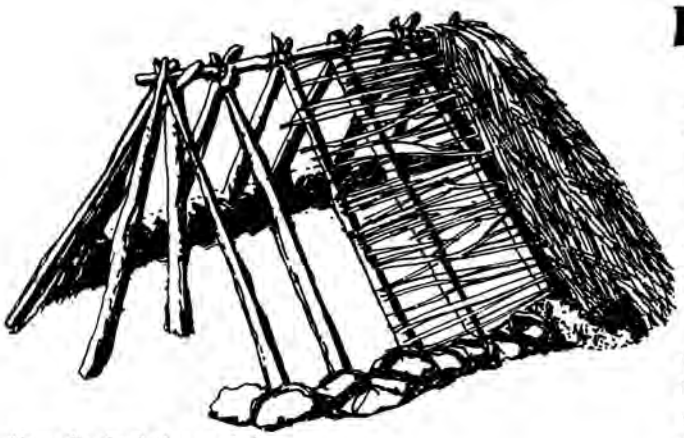
Elisabeth Beazley
Country Life, 2/3/73



The interior plan of an Altai Tartar's yurt was firmly established by rules of etiquette. These rules were adhered to from Mongol to Tibet, by emperors in palaces to Tartars in their tents.

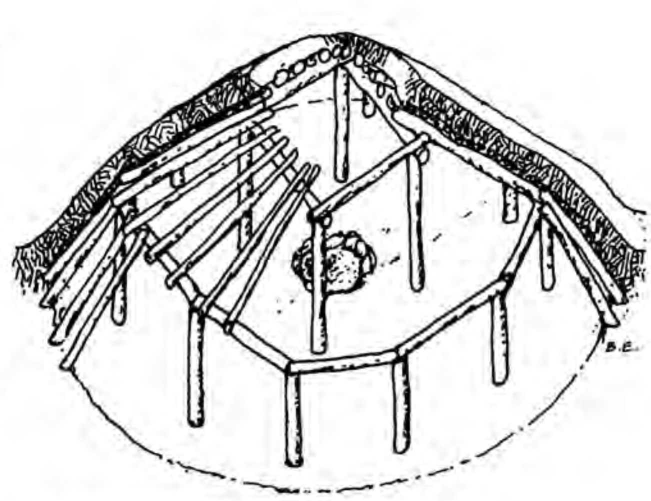


EARLY TIMBER



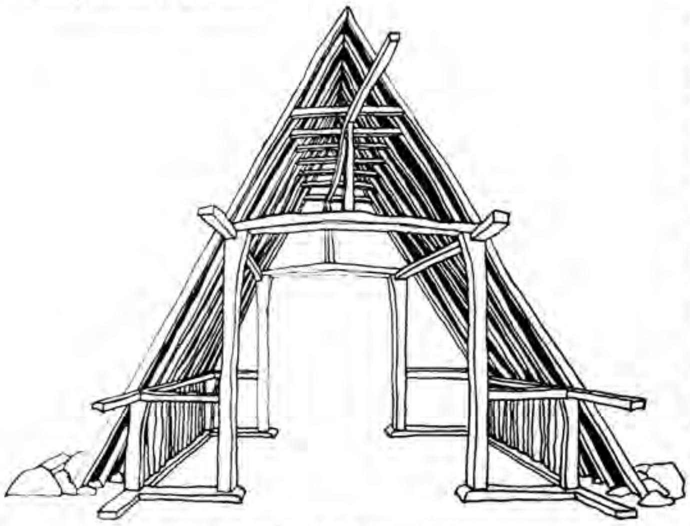
Nomadic Anglo-Saxon shelter. After drawing from The Family House in England.

Prehistoric man's wooden shelters were simple, crude, and suitable for his nomadic life. Generally round in shape and made of saplings lashed together, they did not require expert building skills. The transition from these early shelters to earth lodges, then elongated pole houses, then to mortise and tenon timber frames is covered in Medieval Structure: The Gothic Vault, *by James Acland. Following drawings (except as noted) and text are from this excellent book.*

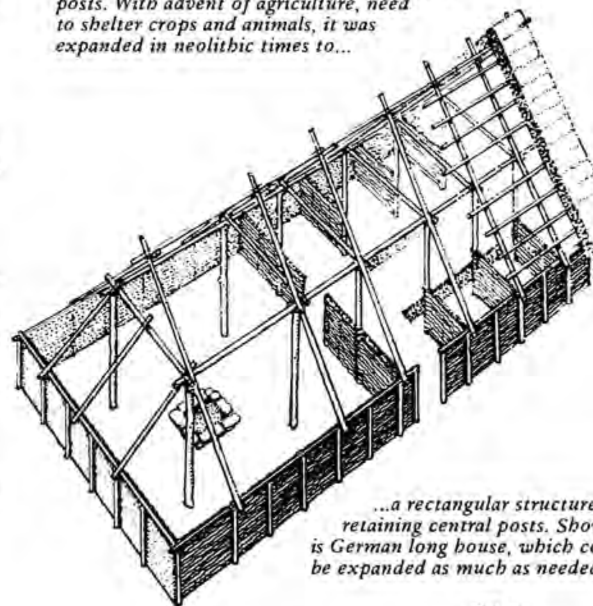


Circular earth lodge, with center supporting posts. With advent of agriculture, need to shelter crops and animals, it was expanded in neolithic times to...

When agricultural techniques and animal husbandry were introduced into Europe about 2500 BC, the early farmers soon found that they needed extra space to store grain and crops. Though the circular earth lodge sheltered animals as well as men, it was a form difficult to expand. Size was limited by the length of poles available for rafters. The Neolithic farmers met this new need by repeating the central square of supports used in the *earth lodge,* to create an elongated regular plan. The section through this long house of the north is identical to that through the earth lodge, but the repetitive bays allowed indefinite expansion for storage. The frame was, as in the past, made of lashed poles. Earth berms were banked up against the low walls of split logs or interwoven wattle. The builders set the butt ends of the long tapering poles into the berms and braced them over the two rows of posts. Over the rafters they placed a close mesh of light horizontal purlins to carry the thatch, turf or bark roof....

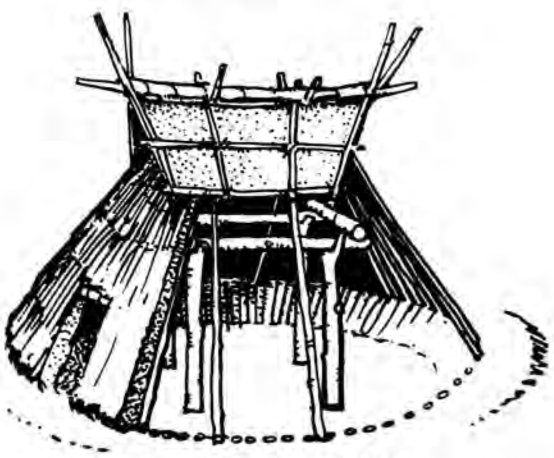


Early notched frame. From The Family House in England.



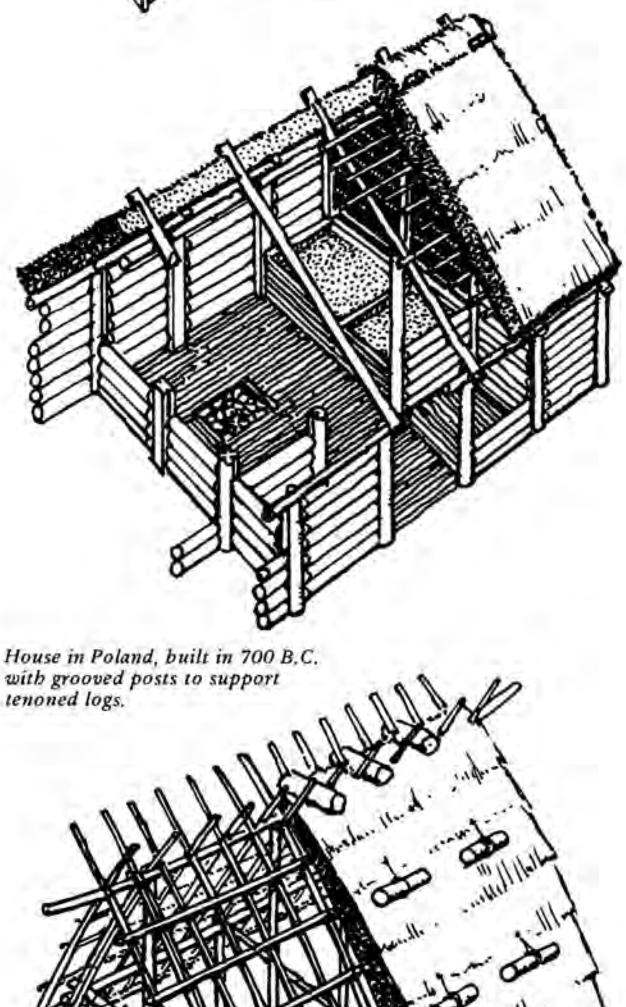
...a rectangular structure, retaining central posts. Shown is German long house, which could be expanded as much as needed.

The tightly lashed shell of poles carrying a protection of thatch or turf gave adequate insulation in the north but was subject to rapid decay. Moisture penetrated into the rafters, lashings rotted away, and the bark or sheathing became damp and mouldy in a short time. With only a central vent as a flue and one entry opening, the long house of the north tended to be dark, damp, smoky, and uncomfortable. The solution was to use the same basic plan but construct it of heavier timbers so that openings could be placed between the supports. To build a true frame of this type required better tools than the bronze axes and polished stone celts of the Neolithic. Only about 700 BC when iron tools became generally available in Europe, do we begin to see the emergence of carefully fitted framed structures in wood.



Neolithic northern Japanese shelter.

The peasant farmers exploited the new efficiency of iron axes and adzes to shape and model whole logs and develop a new form of structure. They set up vertical posts, cut with grooves into which were hammered tongued logs, and thus created a rigidly braced grid wall. No longer was it necessary to tie the building fabric together with complex and delicate lashings. Shaped timber connectors did the job better and were more lasting. Later builders learned to dispense with the heavy log or plank infills between the posts. They put up an open framed grid of timbers, mortised and tenoned at the joints to ensure rigidity. The apertures could then be left open as windows or doors or they could be filled with panels of woven wattle and daubed clay, effectively separating structural frame and sheathing skin....

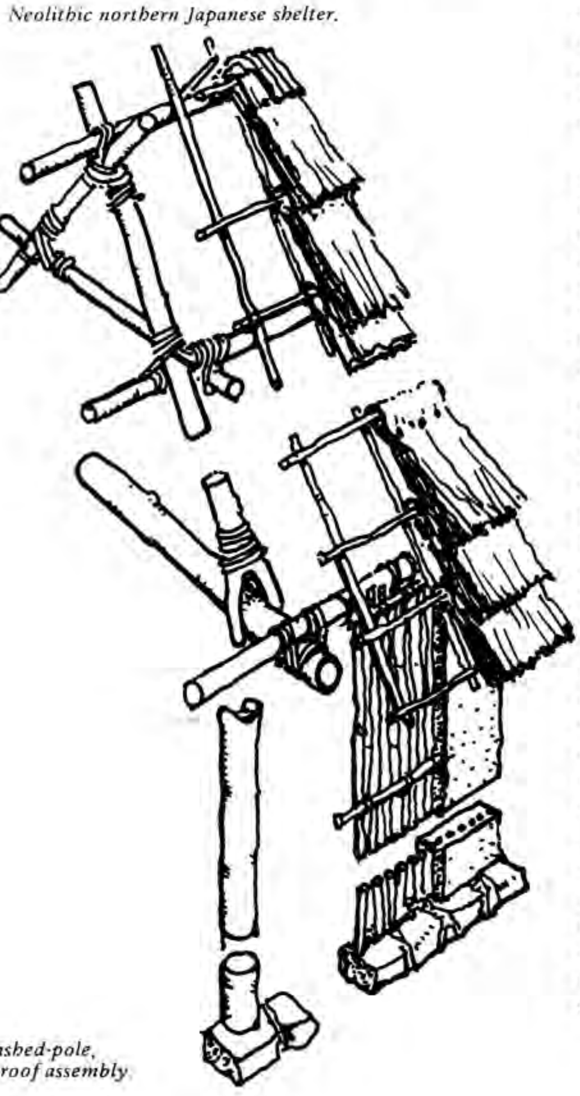


House in Poland, built in 700 B.C. with grooved posts to support tenoned logs.

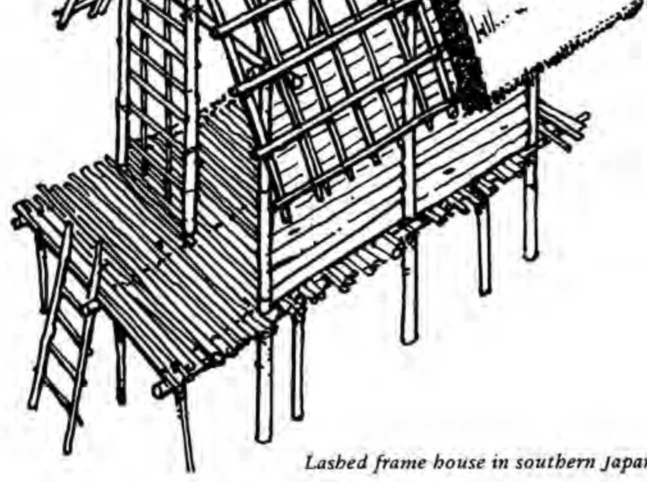
During the long slow centuries of the early Middle Ages in northern Europe, wood remained the dominant building material. As the broadleaf and coniferous forests were cut to make way for agriculture, the bulk of timber, the pole, the plank, and the peg were combined and recombined with growing skill and sophistication to solve a host of technical problems.

The peremptory demands of incessant warfare led to a refinement of Roman siege machinery, with mangonel and catapult increasing in range and weight of projectile. The need for metals dug from ever deeper mines forced the invention of geared assemblies for hoisting and pumping. Animal, wind, and water power sources were pressed into service to crush, grind, and carry material. At the waterfront port, improved derricks and hoists were devised to load the ships, while shipwrights embarked upon that long series of refinements and adjustments which converted the long boat of the north to a serviceable oceangoing merchant craft, the Hansa cog. In this dawn of European technology the carpenter was in the forefront of technical invention, using cordage, wooden poles, and timber gearing to control and manipulate energy in response to the demands of peace and war.

Before AD 1000 court and castle, monastery and abbey, town and fortified wall were rough timber constructions. After AD 1000 this new technical skill began to be reflected in the increasing scale and technical artistry of building. The timber-framed structure became a carefully interlocked rigid frame suitable for monumental structures....



Typical lashed-pole, thatched-roof assembly.



Lashed frame house in southern Japan.

BUILDING

Finished tacking down the tar-paper roof and sealed it.
Stacked up
the hay and the feed mash, and the seed
together in a warm corner, piled the tools and the loose hay,
hung the door.
Beat the rains

Lewis MacAdams

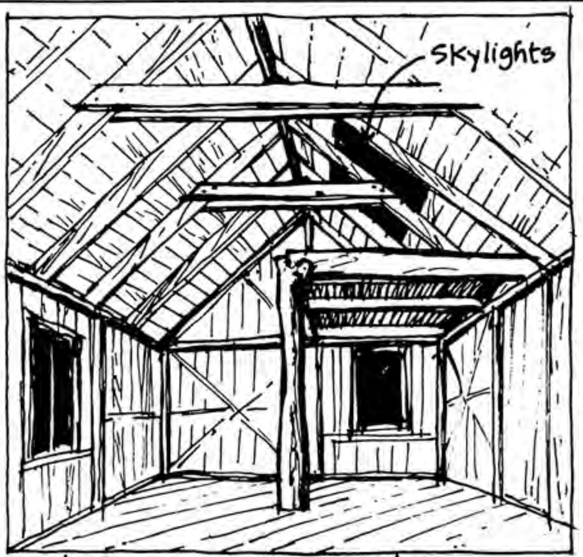
Small buildings are quick to build, adaptable to used materials (cheap), easy to heat, simple for the inexperienced builder, and can later be added on to.

The next section of the book, pages 37-59, is on small buildings, including six small basic structures drawn by Bob Easton, and suggestions on floors, details, doors, and windows. Siting advice is on page 40. Plumbing and wiring books are listed on page 50, insulation and heating information on page 169.

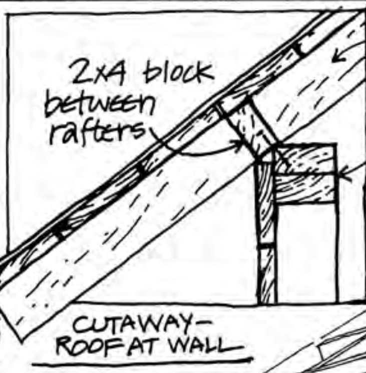
Building small to start will give you basic experience. A small shed can be a place to live in or store things while you study the land and decide what to do next. You can watch the rising and setting of sun and moon, study outlook and orientation, learn about seasonal temperatures and wind direction, vegetation, rainfall: the many considerations that should help you decide what kind of house will suit your needs and fit the site.

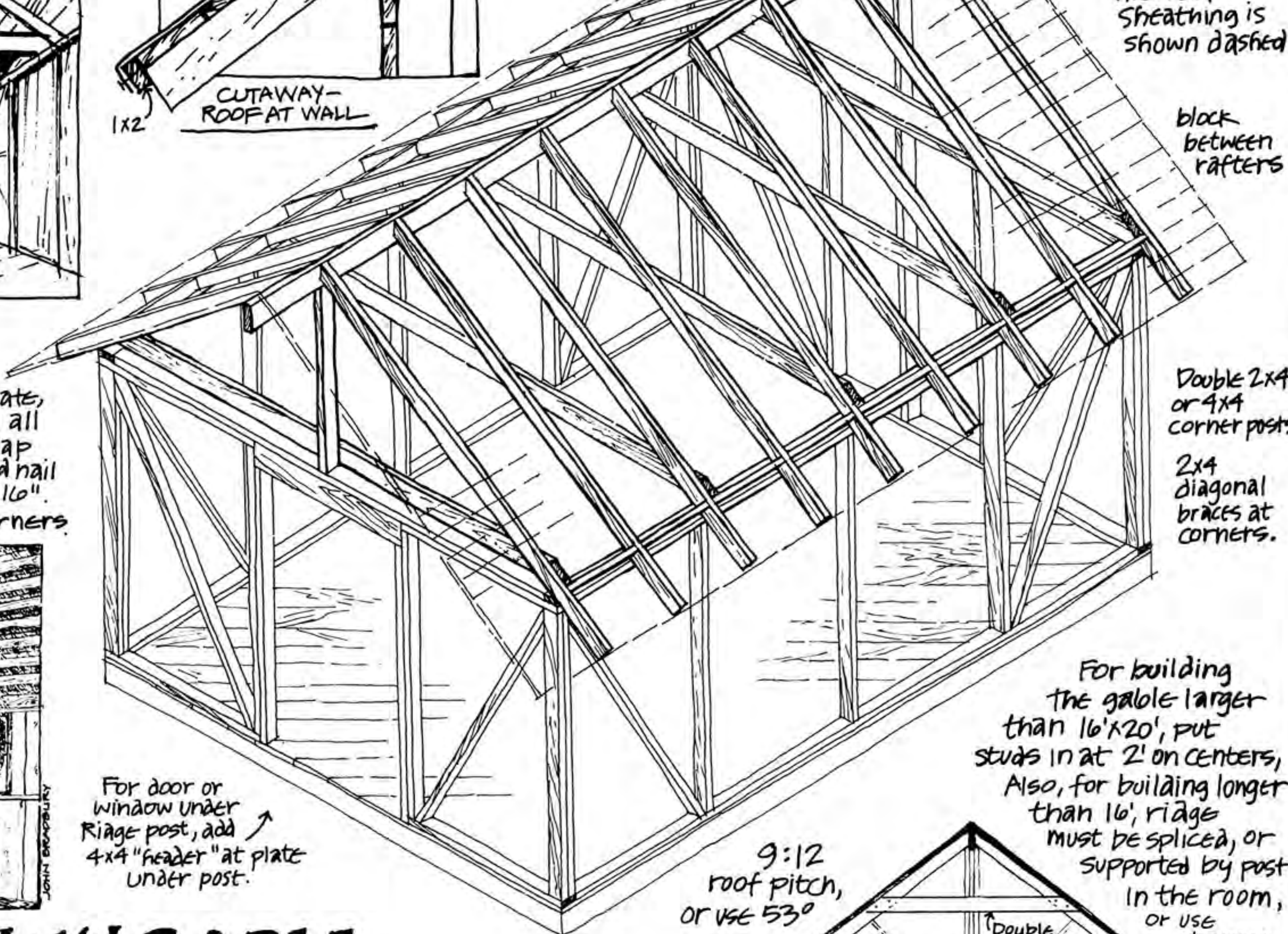
The small building can then be expanded as needed. *You* will change during the building process, and building in increments gives you flexibility and adaptability as you go.

Building is hard work, costly and relatively permanent. Unlike a painter or potter, the builder cannot throw away an unsatisfactory result. There it stands, for all to see, for many years. Thus there is wisdom, especially for a new builder, in starting small, simply, and heeding local advice.

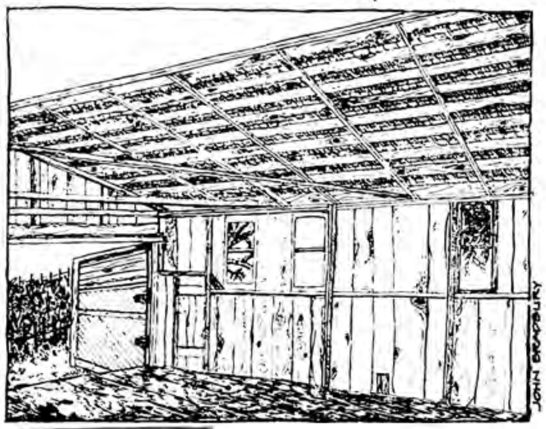


Loft- use a natural pole to support it.





Continuous 2x4 plate, build level around all 4 sides, always lap joints by 4', and nail together every 16". Lap at corners.

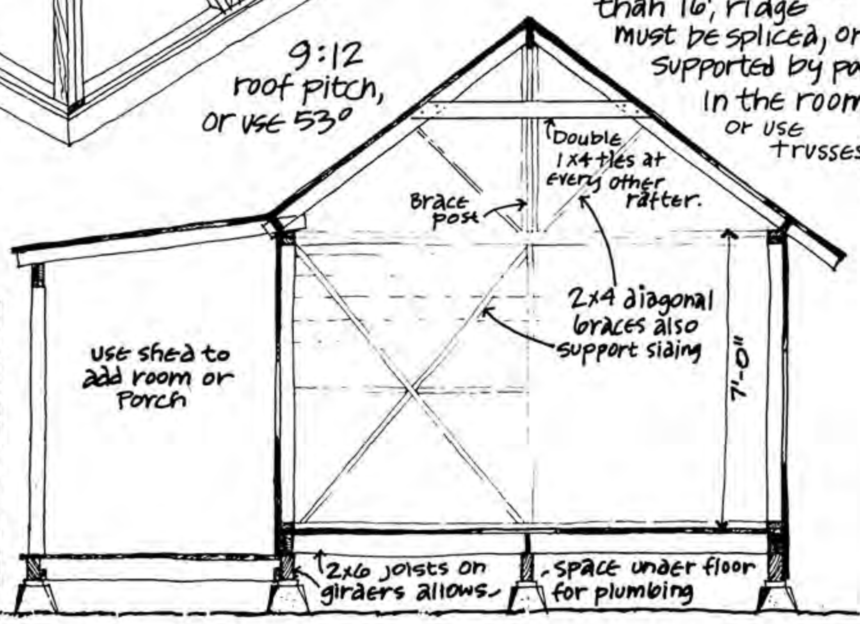


For building the gable larger than 16'x20', put studs in at 2' on centers, Also, for building longer than 16', ridge must be spliced, or supported by post in the room, or use trusses.

12'x16' GABLE

not to scale

- ALL USED 2x4'S EXCEPT FOR 2x6"x20' LONG RIDGE BOARD.



CUTAWAY THRU GABLE AND SHED

Whereas the shed roof is the simplest 2x4 structure, its size is limited. Still using 2x4's the small gable roof building is the easiest way to build a larger structure. It has the structural strength of the triangle and the tent shaped roof gives a sense of shelter. The pitch can be made steep for a shake roof or interior loft space, or shallow to conserve on materials and for cozy interior feeling. The gable and shed shapes fit together well in various combinations, as shown in sketches on these two pages.

Roof at Dutch Open Air Museum

Gabled room built by Bill Beckman

A 8'x13' Gabled building built with all used materials.

WINDOWS & DOORS

You can often pick up used wood frame windows and French doors (glass in a wood frame) from salvage yards and glass shops. They can be cleaned of old paint, oiled, and reputtied. Or, you can make them to the size you want. Shown below:

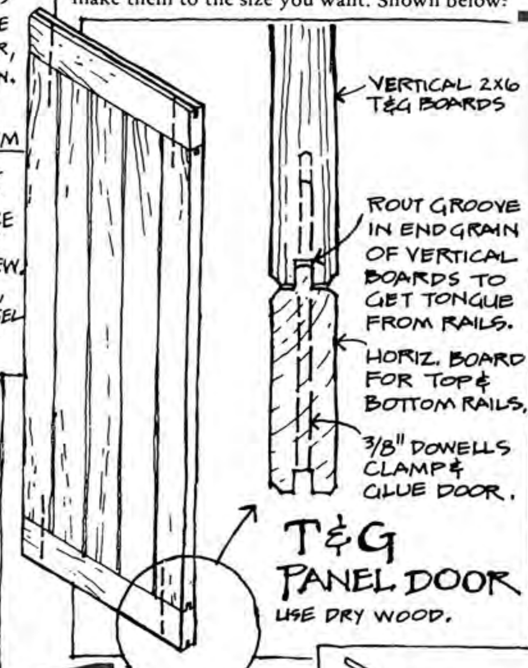
Robert Venable's window system uses ¾" thick wood; Lander Nicolait's technique uses 1½" stock and can also be used to make French doors. Always use *dry* wood.

SIMPLE, CRUDE WAY TO QUICKLY HANG A DOOR.

1. SCREW HINGES ON DOOR. (LEAVE HINGE TOGETHER, DON'T REMOVE PIN.
2. PROP UP DOOR IN OPENING, SHIM AND BRACE TIL DOOR IS PLUMB AND HINGES ARE IN RIGHT SPOT ON JAMB. SCREW. (FOR BETTER JOB, SCRIBE HINGE, CHISEL TO SET INTO DOOR AND JAMBS)

DOORS:

- FRAME FOR DOOR SIMILAR TO WINDOW FRAME, EXCEPT SILL – LET SILL BE SAME LEVEL WITH FLOOR ON OUTSIDE DOORS SO YOU CAN SWEEP OUT ACROSS SILL...
- ENTRANCE DOORS SHOULD SWING IN, DOORS FEEL BEST WHEN THEY SWING INTO ROOMS.



T&G PANEL DOOR
USE DRY WOOD.

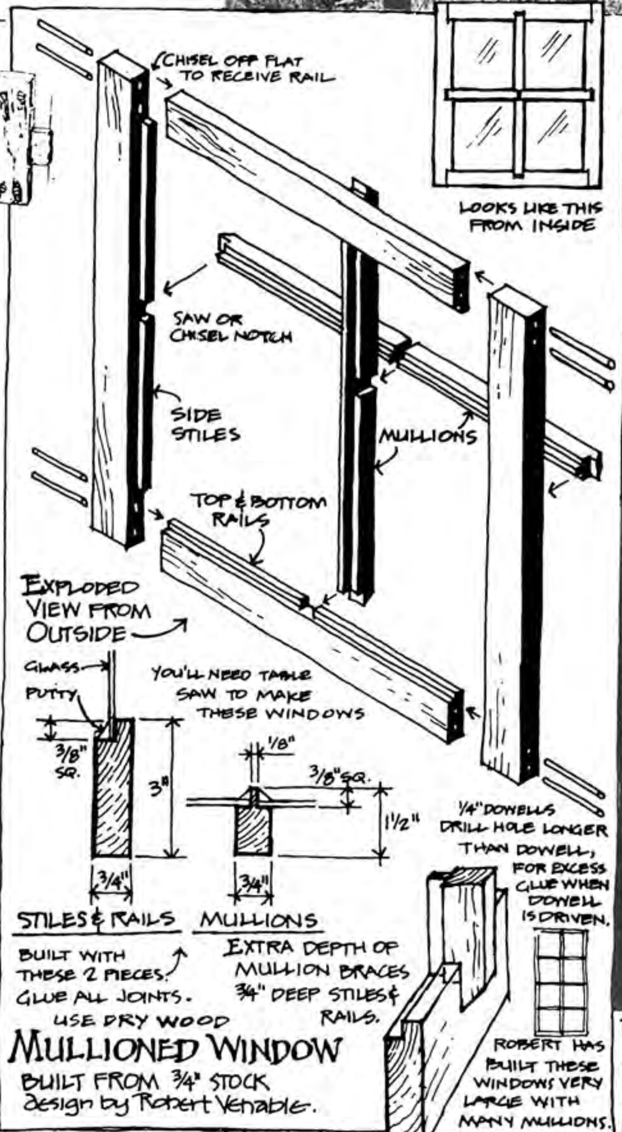
USED LEADED GLASS WINDOW REHUNG ON USED WOOD FRAME.

1X6 BOARDS ON EACH SIDE OF 2X2 FRAME. TARPAPER ON ONE SIDE OF 2X2'S. JOHN BRADBURY

1X10 BOARD DOOR WITH 3-2X4 CROSS BRACES. 1X4 BATTS ON OUTSIDE. (A VERY LIGHT DOOR)

NAIL TOGETHER DOORS

WOOD HANDLE FROM OLD CEMENT TROWEL



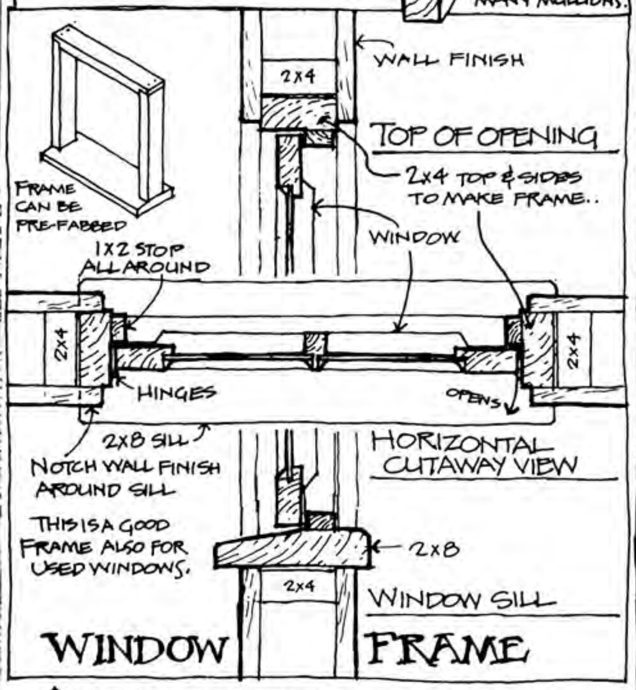
MULLIONED WINDOW
BUILT FROM ¾" STOCK
design by Robert Venable.

DUTCH FARMHOUSE WINDOW.

PEG LATCH ON IN-SWINGING WINDOW. HANGS ON THONG.

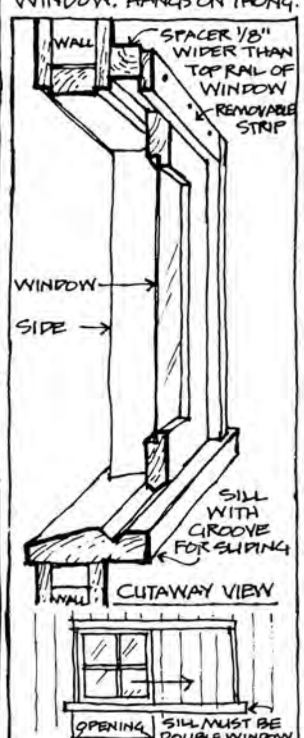
USED FRENCH DOOR REHUNG ON NEW USED WOOD FRAME.

WINDOW NEXT TO STONE. WILL WOOD



WINDOW FRAME

ALSO USE THIS FRAME FOR DOORS...



SLIDING WINDOW

PIVOT DOOR. JERRY THORMAN

TEMPLE DOOR. KATMANDU. G. WELLS.

FRAME ON ADOBE WALL

MATERIALS METHODS

When men built in pre-industrial times they had to use materials and knowledge that were at hand. Their dwellings were as ingenious and varied as their cultures: cottages built of stone gathered from cleared fields in Ireland, animal hair tents of the nomadic Bedouin herders, mud and adobe buildings of dry desert areas.

Bedouins

The most important part of building is the materials you use. Today, unlike our ancestors, we have a choice of building materials from the entire earth; oil from the Mid East makes polyurethane foam, aluminum from Venezuela clads mobile homes. But we now know that these resources are limited, they are becoming too expensive for the individual builder and soon may be available only to the corporate interests.

Highly processed materials of the industrial society — plywood, metals, plastics — are expensive because of the high costs in extracting, processing and transporting. It may be that there is a correlation between the cost of a material and the exploitive damage done to the earth in its creation. Highly processed materials also appear to have a short useful life span, especially plastics.

Zarch

We suggest you try to build with materials you find around you, close to your site. Use materials that are found on the earth, those that require a minimum of processing and transportation. Build with wood where it grows; wood is the only building material we can regenerate (part of the cost of lumber should go to reforestation). Use adobe or stabilized earth in dry climates, it is the earth's most abundant building material. Rock, bamboo, plaster, brick....

Latvian summer kitchen made from old boat.

Industrial society creates wastes. A challenge to the builder is to utilize this fallout, as has been done by making bricks from newspapers, from garbage, and from the sulphur refined out of crude oil. Another challenge is salvaging used materials, building with scavenged junk and scrap. The *Zarch* structure on P. 132 is shingled with scrap aluminum offset plates. Inventive builders have veneered plaster surfaces with pieces of broken plates, built walls of hard coal, constructed curving shapes with broken pieces of concrete and short scraps of 2x4.

Simon Rodia

Cutaway view of nautilus in its shell.

Using natural materials means a lot of work. Buildings that are pieced together with wood, dirt, rock, scrap, take time, but as the craftsman does it, he can choose to do it well, and shape the building with his imagination and changing perceptions. Use of local natural materials and hand labor results in a harmony of house and landscape. The character and warmth of less processed materials seem to make them easiest to live with over a period of time...a building is your skin extended.

Nature builds with what is available, and local, and can be studied, not copied. A nautilus secretes its shell. A swallow weaves its nest from mud, straw, horsehair and feathers.

scrap 2x4

> *You have leather?*
> *You have thread and nails and dye and tools?*
> *Then why don't you make yourself a pair of shoes?*
>
> *Mulla Nasrudin*

· MATERIALS & ANIMAL ENERGY ·

The three elaborations of shelter: Location, Transport & Processing

by Peter Warshall

The materials for non-human shelters are always elegantly simple and economical: the materials are easily available, require a minimum amount of transport from the source to the site of the shelter, and, except for the male bower birds of New Guinea who gorgeously advertise their boudoir, the materials are structurally crucial. Non-human animals are not interested in the baroque or fancy moldings.

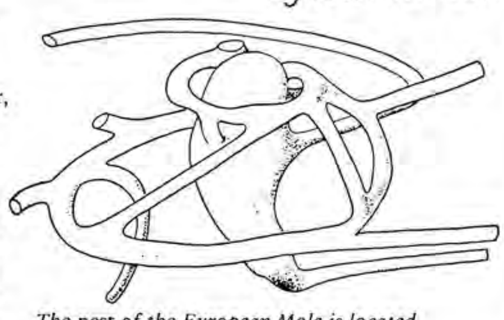
Hut of the brown gardener of New Guinea is built with central pole. The decorations on the display-ground are principally fruit and flowers.

Location

Most non-human animals are highly conservative about spending energy to construct shelters. Many never build shelters. Among mammals, all the ungulates (deer, zebra, gnu) never build any shelter. Neither do whales or dolphins. Like most living creatures, they rely on their senses and just use what's there. The Shelter Trip is simply finding the appropriate LOCATION. This is especially true for temporary shelters used for sleeping: the sea otter swims among algae and kelp, wraps itself among the seaweed to provide an anchor and floats asleep. More elaborately, certain tropical bats eat diagonal slits in palm leaves. The leaf droops and the bat sleeps in the "tent" formed by the droop. Many spiders, crickets, and other insects go to the extravagant limits of wrapping a leaf around themselves and tying the leaf into a cone with their body's silk. But most insects simply hide among the grasses and in the furrows of bark.

Excavate

Most rodents simply EXCAVATE their shelters and line them with soft grasses. Nothing is built. Insects, using the architecture of plant stems, tunnel into the stem's tube to rest or sleep or reproduce. Larger mammals, avoiding any strenuous labor, move in on already-made excavations. In Africa, I have seen warthogs use the abandoned burrows of aardvarks as sleeping quarters, retreats from danger and raising their young. Jackals, bat-eared fox, and spotted hyenas also use the burrows to raise their young. In North America, the interminably lazy coyote uses the burrows of badgers, skunks, or foxes.



The nest of the European Mole is located carefully under brambles or a tree trunk. The "dome" is about a foot below the surface in silica-clayey soil. The bottom of the "well" serves as an emergency escape route and a drainage outlet for excess water. The walls of the nest are compacted clay, smoothed, and sometimes plastered. Only the permanent galleries are shown. These permanent galleries extend out to the hunting galleries which are less permanent and altered daily. From The Natural History of Mammals.

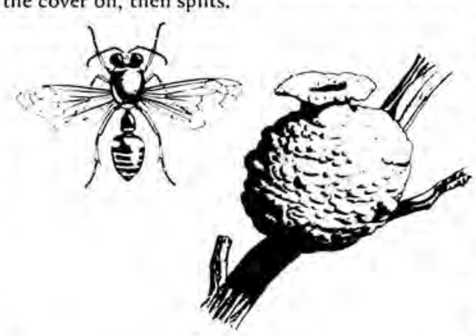
Coyotes limit themselves to enlarging, cleaning, and sometimes furnishing these burrows with an air hole. In short, most mammals use the self-support properties of the Earth itself. The only energy expended is finding the right spot and digging it out. The crustacean analog to using another's burrow is the hermit crab which uses another's shell. These crabs are totally dependent on the size and numbers of empty shells along the beach — something to be remembered by shell collectors. The avian analog is the owl who uses the woodpecker's excavations. All such re-use of another's burrow represents elementary re-cycling of shelters and energy conservation.

Some animals are partly passive agents in another animal's shelter trip. The malaria-causing protozoa is a fine example. It spends half its life in the belly of the malaria mosquito — subject only to the same problems as the mosquito. The other half of its life, the protozoa is injected into human blood. There, inside the red blood cells, the protozoa has the protection of the cell membrane and an ample food and oxygen supply to reproduce. When too many protozoa are living in one red blood cell, the cell bursts (causing fever in the human) and each protozoa enters another cell. Meanwhile, they receive all the sheltering benefits of being inside us. This protozoa and many other animals live in a *living shelter* and without even looking for a host, reap the benefits of an honored guest.

The extreme economy of non-human animal shelters is the chrysalis. Here, the very skin of the caterpillar turns into the shelter for metamorphosis. Only the thread from the caterpillar's mouth to the branch is added. The energy is daily eating.

Transport

In terms of energy and energy conservation, animals who use the immediate materials around them prosper. But, some animals have come to TRANSPORT materials from one location to another — requiring a new step in the transformation of materials to shelter. Transportation of materials usually occurs among animals when a *double-safety* situation arises: no adequate shelter is provided directly by the habitat and the young need protection *without the parents' presence.* The young go unattended because the parent may die before they are born or because the parents must forage for food at long distances from the shelter. A mud builder, the potter wasp, makes a little vase (with a cover). She fills the bottom of the vase with meat, then suspends the eggs from the cover so they dangle over the meat. She puts the cover on, then splits.



Potter wasp.

Unattended young are common among birds. Again, *location* is most important. But, additionally, carrying special materials to the location helps the young. Weaver finches (see *Thatching*) make shelters that will be somewhat safe from snakes and other predators. Carefully chosen long grasses are woven into a nest and then thatched. The extreme case is the mallee fowl whose shelter is a self-destructing compost heap. The eggs are large with lots of yolk and are buried under grasses covered by sand. The male returns to the compost heap-egg incubator and checks the temperature with his beak. He adds sand or takes it away to keep the eggs just warm enough. Finally, the young hatch and push their way out of the compost heap — never getting to know their parents.

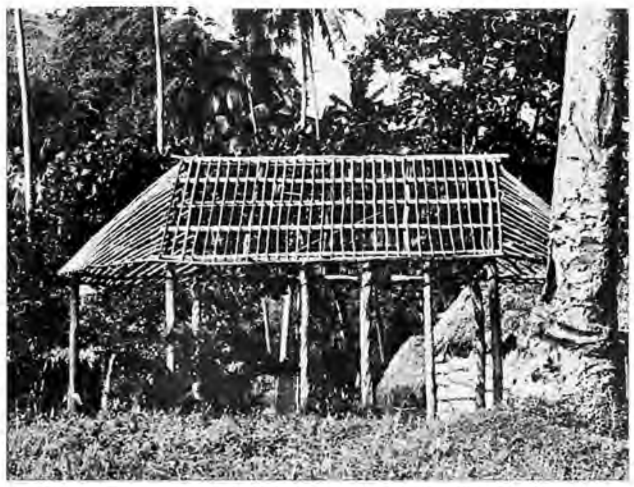
Hornet nest made from pulp.

Processing

The third elaboration of shelter, after *location* and *transport* of materials, is PROCESSING raw materials to make building materials. *Silk* is the most common bodily secretion used for homes and shelters. *Paper* is made by hornets by finding sawdust, rotted wood and discarded human litter and chewing it with their own saliva to form a liquid pulp. The pulp is spread to form the *carton* internal structure of the nest (brooding chambers, storage chambers, pillars between tiers) and spread out in sheets for the insulating layers around the "rooms" and "galleries". Bees process *resin* from wounds in pine trees into a substance called propolis. Propolis is one of the best sealers known on Earth. Bees use it to patch cracks in tree trunks, to cut down on drafts, to make doorways the right diameter, etc. Any rough object like unsanded wood that might harm a bee is covered with propolis. Any space that is too small to make a bee corridor or a bee honey comb (usually less than a quarter of an inch) is filled with propolis. This removes the shelters for harmful bacteria, molds and other insects that could ruin the bee hive. *Saliva* and *shit* and other excretions are used by termites in Africa in making their huge mounds. Almost all the clams, lobsters, and cephalopods (like the nautilus use secretions to form their shell-shelters.

THATCHING

NORFOLK REED ROOF ON BOAT SHED, NORFOLK, ENG.



SAMOAN ROOF FRAME LIFTED IN PLACE BY 4 MEN.

POLE ROOF FRAMES AT NETHERLANDS OPEN AIR MUSEUM, ARNHEM, HOLLAND

Thatching, perhaps the world's most common roofing material is virtually unknown in America. As with adobe, stone, and other un-processed materials, there is nothing to *sell,* therefore no entrepreneurs advertising the virtue of thatched roofs. Thatching *is* time-consuming, and it will burn, but when the western world begins running out of processed materials, we may discover that reeds, straw and fronds can provide a waterproof, insulated, and biodegradable roof.

The most elaborate, sophisticated thatching is practiced in England, where there are currently said to be about 800 thatchers still at work. There are three basic types of English thatch: Norfolk reed, which lasts 50-60 years; combed wheat reed, 25-40 years; and long straw, 10-20 years. An excellent book, with 500 photographs, is *The Thatchers Craft* (see bibliography.)

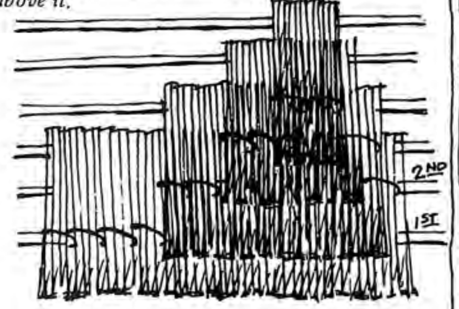
The thatching of Irish cottages is simpler, and requires less skill. Often a layer of sod is placed under the thatch for insulation. Much of the straw used in Irish thatching is what is left over after harvesting grain. A good description is in *Irish Folk Ways.*

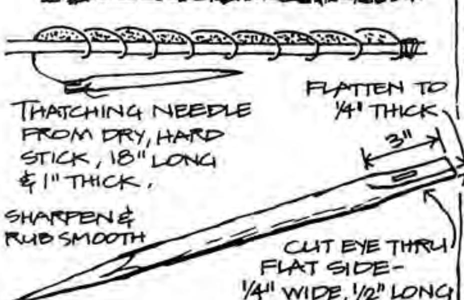
The best source of information for simple thatching is *Bushcraft,* a survival guide written by a WW II jungle rescue leader. (See bibliography.) Waterproof thatching requires a steep pitch, and the *overlap* principle. Suitable materials range from long reeds and grasses (best used dry), long stalk ferns (bracken), palm leaves, to straw.

SIMPLE THATCH
from Bushcraft.

SEWN THATCHING

Stitch at bottom of first thatch on lowest thatching batten. The second layer must overlay the stitching of the first row and include the top section of the underneath layer in the actual stitch. It is better to have each layer held by three rows of stitching. The stitching of every row must be completely covered by the free ends of the next layer above it.



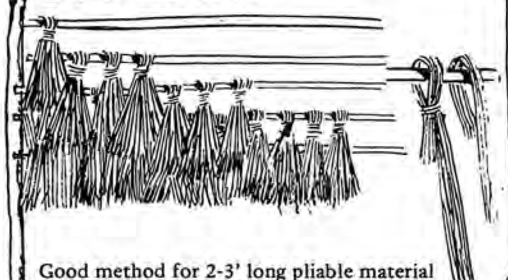


Lay the thatching material with the butts towards the roof and the lower end on the lowest batten. Secure one end of the sewing material with a timber hitch to the thatching batten, thread the other end through the eye of the thatching needle and sew in the ordinary manner to the thatching batten. To avoid holes where the sewing may tend to bunch the thatching together, pass the needle through the thatch at the angle indicated in the sketch and push thatch over the crossing of the stitches.

STICK THATCH

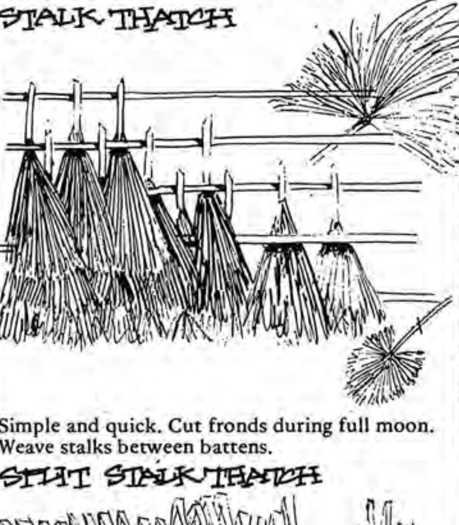
Tied 2' apart. Tie stick at one end, put thatch underneath, tie other end. Follow same principles as with *sewn thatching.*

TUFT THATCH



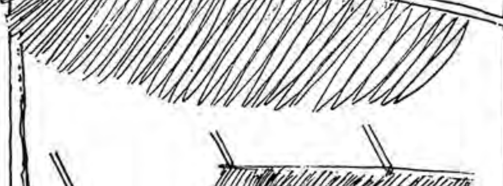
Good method for 2-3' long pliable material such as reeds. Gather into sheaves 1" thick. Bend butt end over batten, twist a few strands around the sheaf to hold tight. Slide along batten. This looks good from inside, is good weather protection. Important that long free ends overlap 2 or 3 rows below. Do not bunch tightly – leave ½" between bent-over ends.

STALK THATCH

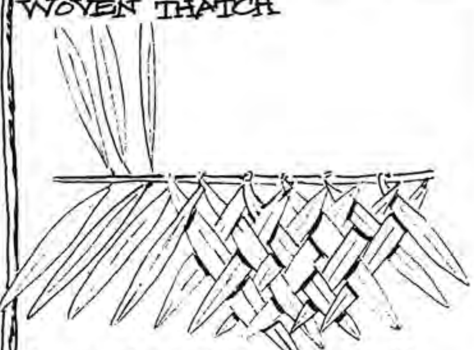


Simple and quick. Cut fronds during full moon. Weave stalks between battens.

SPLIT STALK THATCH

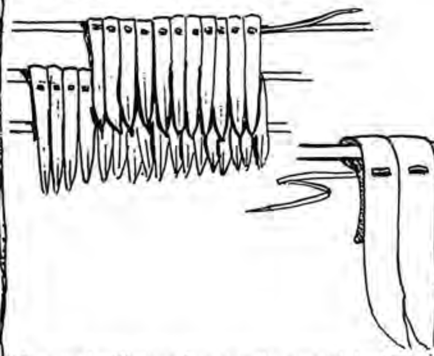


WOVEN THATCH



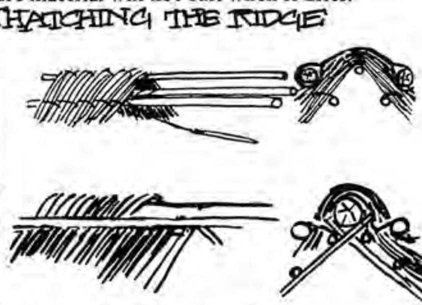
Weave together thusly, then overlap as with other methods.

SEWN BATTEN THATCH

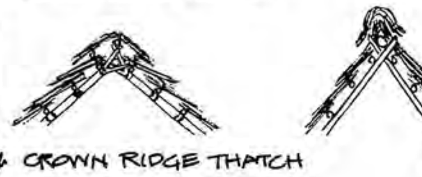


Neat and efficient for certain materials. Make sure material will not curl when it dries.

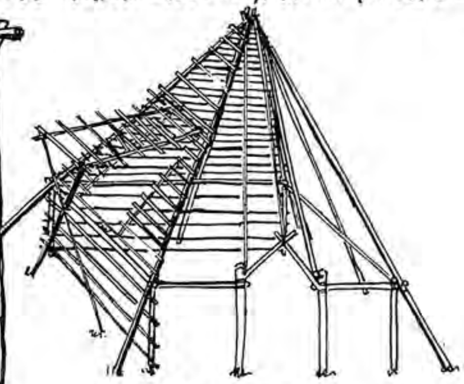
THATCHING THE RIDGE



SEWN RIDGE THATCH

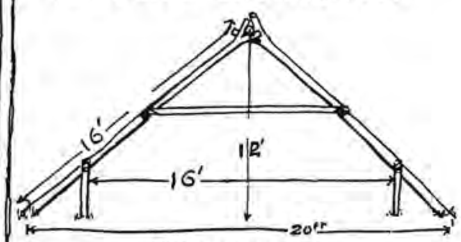


CROWN RIDGE THATCH

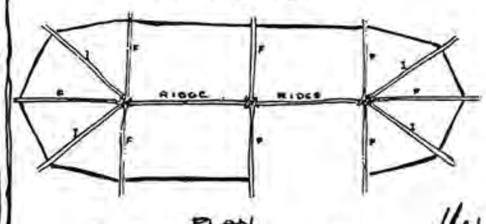


PYRAMIDAL HUT

NOTE X BRACE DORMER WINDOW



CUTAWAY VIEW



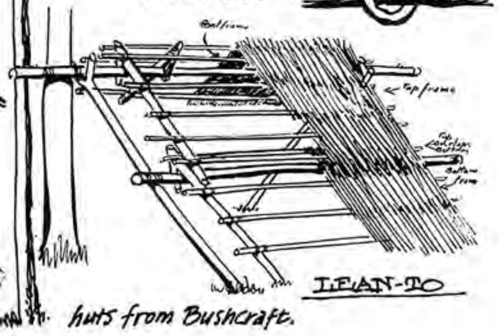
PLAN

MAXIMUM POLE SPAN IS 6'

LONG HUT

THE TIMBER HITCH

START LASHINGS WITH THIS KNOT



LEAN-TO

huts from Bushcraft.

ENERGY, WATER, FOOD, WASTE

Energy, water and food flow into a dwelling; waste flows out. All are resources and now that we understand that some are *finite*, such as the fossil fuels, we can study those that *aren't*: the sun's heat, the wind, tides, trees, the seed/life cycle. A dwelling could be tuned to this awareness: collection of solar heat, a garden with food grown from compost, electricity from the wind, energy from methane. The inhabitants of a house could survive from local energy, at a great savings and general benefit.

What is popularly known as the "energy crisis" is actually Americans becoming aware of the true price of wasteful and indulgent consumption. We now know that there is not enough easily-extractable oil and coal to support current growth rates and the current American standard of living. And rather than seriously consider any of the above alternatives, the oil companies, public utilities and present administration have laid awesome plans to strip-mine coal, extract oil shale, pump Alaskan oil, develop nuclear plants – in short to violate the earth in any manner, take any long range risk, to maintain profligate consumption. Technological futurists envision giant solar collectors and fusion but such solutions without an accompanying heavy price seem unlikely.

To change over to a solar, wind, methane powered economy would entail great ingenuity. "...had it not been for an abundance of fossil fuels...we might, today, have a solar energy economy just as effective and efficient as our fossil fuel economy."*

It would mean obviously much less consumption and more attunement with the forces of nature. The table saw that only runs when the wind blows. Hot water from the sun or a coil in the fireplace. Air conditioning from breeze catchers and rooftop water bags. Cargo carried again by clipper ships. Less instant energy from throwing a switch.

It might be the best thing in the world (for the world) if Americans had to learn patience, to slow down, to wait for the wind to blow.

*L.P. Gaucher, "The Solar Era: Part 1 – The Practical Promise," Mech. Eng. 94, 8. pp. 9-12, 1972.

Much independent work is now going on in exploring alternative energy sources, uses and life styles; they all show that the *future* is, in many respects, the *past*. The present rate of consumption cannot be supported by a wind and solar economy. With less available energy, life would inevitably become simpler.

What *would* life be like with less energy consumption? We'd make our own clothes, we'd again demand quality commercial products. We'd grow much of our food, and it would taste better. We would again make things with our hands; we would build and maintain our own houses. The air would be cleaner because we'd drive less, fly seldom, and life would be less hectic. Less centralized corporate production, more local cottage industry as in China. Less machine labor, more muscle-use, better health, rediscovery of dormant capabilities. We'd make our own music.

SOVIET SAILING SHIP TOVARISH.

ABANDONED WINDMILL IN SHADOW OF REFINERY, SPAIN.

COMMUNITY EFFORT TO FIGHT OIL SPILL.

HOT WATER HEATER.

COKE CARTON WATERWHEEL.

OILED ALK SCULPTURE.

A builder can take two very important steps to save energy: build small and insulate well.

I just remembered the "victory gardens" in San Francisco in the '40s. Our block's garden was on the lot next to our house. We had cabbage, artichokes, radishes, onions, lettuce, etc., in abundance. Fresh vegetables, it saved money, didn't take any one person too much time, and people felt good from working together and raising some of their own food.

Publications on energy and the environment:

Alternative Sources of Energy: a fine new bi-monthly magazine that has established and is maintaining a growing network of people interested in, and working on less-polluting energy sources. Solar heat, wind electricity, methane, salt water distillation, wave energy, etc. It's the first of its kind, and looks like it will be around a while. $5.00 per year from ASE, Rt. 1, Box 36 B, Minong, Wisc. 54859.

Undercurrents in Science and Technology: another peoples' information network, often carries good alternative energy information. $5.60 annually from Undercurrents Partnership, 34 Cholmley Gardens, Aldred Rd., London NW6, England.

Audubon: stunning color photography, perceptive articles on environmental issues. $2.00 per issue, (July '73 is outstanding) from Audubon, 950 Third Ave., New York, N.Y. 10022.

Citizens' Bulletin on the Environment: free monthly newsletter about governmental actions on pollution standards and control. From Office of Public Affairs, U.S. Environmental Protection Agency, Washington D.C. 20460.

EUCALYPTUS BOAT.

WINDWORKS

by Hans Meyer

Windmills, like a lot of other "new" discoveries, can appear to be some kind of panacea. Well, they probably are in their own way, but they don't come for nothing.

In the last three years, under the sponsorship of Bucky Fuller, we have built three different types of windmills. Each has its own advantages and disadvantages, strong points and weak points.

A cursory look at the research and literature that is available on windmills, coupled with a desire to look for oversights in the work that had already been done, led us to building a shrouded windmill. The increase in power output afforded by the shroud as well as the increased efficiency of the blades is appealing at first sight, but that "not so difficult to make" shroud, along with the structural problems of rotating it, quickly offsets the advantages in the 1 to 5 Kw range. Shrouded windmills may become practical when incorporated in the architecture of a house or building, for aesthetic or safety reasons, or in a production situation.

Two or three bladed, high speed windmills, usually with hard surfaced blades, are most readily suited to electrical generation. Their operation can be almost completely automated, with maintenance as infrequent as once every couple of years. The difficulty here is that we are dealing with a high speed piece of rotating equipment, which of itself requires a certain degree of sophistication before throwing in the aerodynamic and environmental onslaught tnat the machine is going to have to face.

For this type of windmill the blades need to be well built for aerodynamic cleanness, balance, and structural durability. Bearings must be long wearing and sufficiently strong to take gust loadings and gyroscopic forces, some type of transmission is usually required to get to generator speeds, the hub must have some type of feathering or coning to allow for blade protection and to avoid possible generator overspeeding, and, lastly, some type of slipring contrivance is pretty much a necessity to get the power down to the ground.

Despite these difficulties, the majority of the work that will be done with windmills in the next ten years will be with this basic configuration. NASA has begun a five year program to look at very large windmills for supplemental power, a number of production units will probably become available in this country in the next couple of years, and the best home building plans will run along these lines.

The last type of windmill that we have experimented with is the sail windmill of essentially the same design that the Greeks have used for hundreds of years. This mill, as opposed to the other two types, is slow speed, allowing much cruder construction and less demanding operating restrictions. This permissible roughness brings with it a proportionate decrease in efficiency, but this may or may not be significant. The fuel is essentially free, making the investment for a given power output relatively more important.

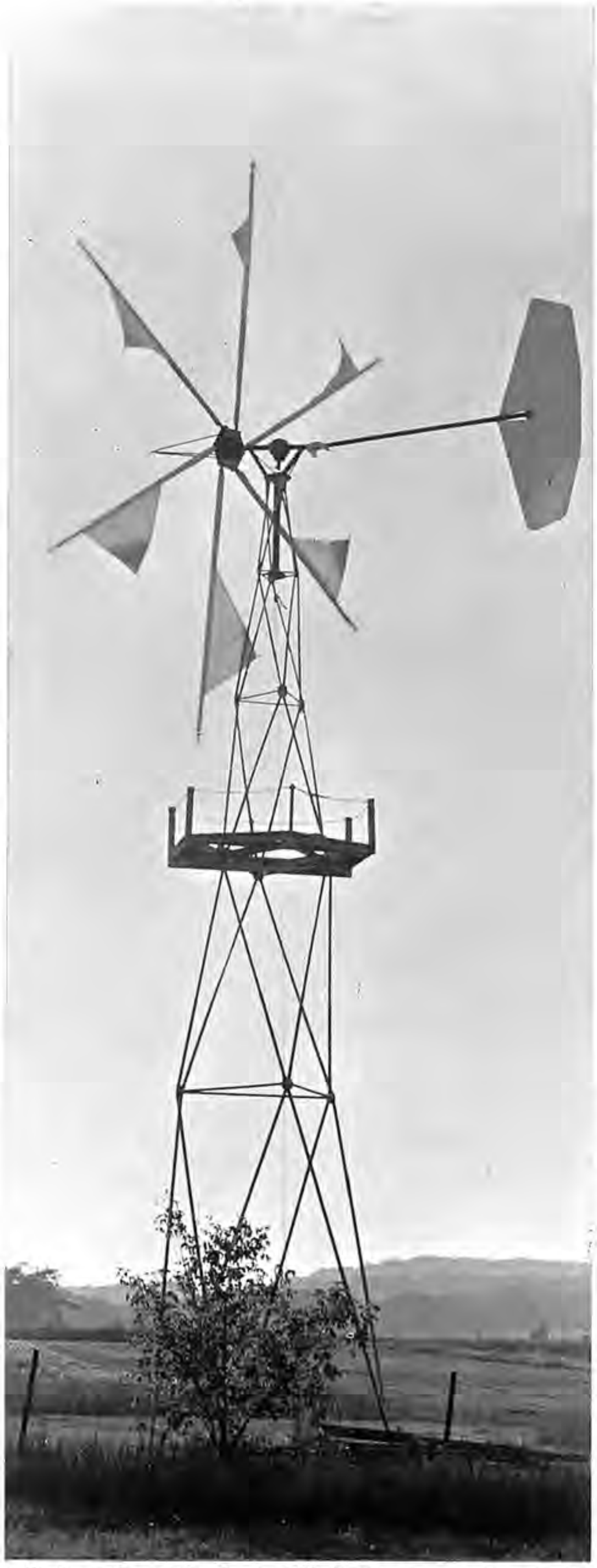
The sail windmills are the most suited to junk parts and home-made construction with a minimum of exotic components. Spars can be cedar saplings or laminated up with a hollow section. The hub can be wooden pillow blocks and a few pieces of metal. A differential can be used to transmit the power directly to the ground where any number of pieces of equipment can be hooked up. Sails can be home-sewn out of canvas, dacron, or cotton.

The difficulties with this type of windmill are pretty much the same as the advantages. In that it is slow speed, it is not easily adapted to electrical generation, at least not without a lot of gearing. Its slow speed results in good light wind operation and high starting torque, but then it operates at lower efficiency in all but the very lightest winds. Its efficiency in converting wind to mechanical power is about half that of the hard foils.

Sail windmills are self-regulating to the extent that they will accelerate until the sails start to luff. By changing the trim of the sails, the speed can be effectively regulated. This windmill though is the least automate-able. Changes in wind speed may require changes in sail trim, and heavy winds or storm conditions will require reefing.

Still other considerations and problems in using wind can be endless. Some of the problems are local and specific such as icing, lightning protection, UV degradation, and tower structures to suit the terrain; while others are more general such as static charge build-up on the blades, blade balancing, power conversion, and power storage.

We are, however, working with a proven technology and one that need not be harmful to any environment. The wind is a daily renewable, solar generated energy source, and our atmosphere is the largest energy storage system around. Our lifestyle is in every way related to our sources of energy. Windmills will be practical where they fit.



Windworks sail windmill, 1974. Since the photo, driveshaft to base has been added to drive buzz saw and electric generator.

Specifics

Here is a limited list of basic information sources on wind energy. We have over 50 pages of bibliography on different aspects of windmills. Let us know if you want something more specific.

—*New Sources of Energy*
Proceedings of the Conference,
Rome, 21-31 August, 1961,
Volume 7, Wind Power.

—Volunteers for International Technical Assistance (VITA)
College Campus,
Schenectady, New York
USA 12308

—Brace Research Institute
MacDonald College of McGill University
Ste. Anne de Bellevue 800
Quebec, Canada
(extensive list of publications on wind energy)

Henry Clews is a distributor of both the Swiss Electro and Quirk's wind generators and has a lot of practical experience running his farm on wind. Solar Wind Co. RFD 2, Happytown Road, East Holden, Maine 04429.

Dyna Technology, PO Box 3263, Sioux City, Iowa 51102 makes 6 and 12 volt wind chargers that have been known to disappear in high winds (not an uncommon problem). Automatic Power Division of the Pennwalt Corporation, 3213 Hutcheson Street, Houston, Texas 77003, sells Aerowatt wind generators that are reliable but extremely expensive.

A number of farm windmills are still available, but they are less than half as efficient as the high speed windmills. There are a lot in disuse, however, that could easily be rejuvenated.

Alternative Sources of Energy, Rt. 1, Box 36 B, Minong, Wisc. 54859, has a lending library of books and articles on wind energy, as well as other energy sources.

Plans for small high speed windmills are available from the following:
—Jim Sencenbaugh, 673 Chimalus Drive, Palo Alto, Ca. 94306.
—*Alternative Sources of Energy*, (address above), issue no. 8, article by Winnie Red Rocker.
—*Popular Science*, November, 1972.

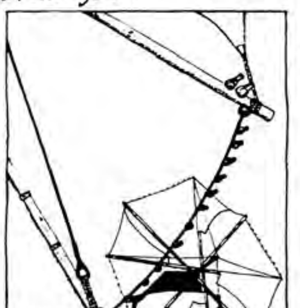
We have an updated version of the PS windmill in plan form that is slightly larger and a good deal simpler, using the same type of honeycomb blade construction. Plans for the sail windmill shown here are also available.

Martin Jopp, one of the years-ago windmill builders, seems to have an incredible knowledge of ways to do things that are considered difficult to impossible. Alan Sondak is working with him and should have something to say pretty soon.

Hans Meyer
Ben Wolff

Windworks
Box 329 Rt. 3
Mukwomago, W. 53149

Below: windmills in Torres Vedras, Portugal. Clay whistles on rigging signal farmers to reset sails when the wind changes.



1,250-kilowatt wind-powered generator built at Grandpa's Knob near Rutland, Vermont in 1941. Two-bladed propellor was 175 feet in diameter. There was a hook-in to the local utilities so there would be no interruption in power when the wind was not blowing. The mill generated for four years until a blade broke (in 1940 the threat of war priorities had caused engineers to rush having the spars forged and they made a mistake in design). The mill was never rebuilt. Very complete story on this mill and wind-powered generators in other countries in Jan./Feb. issue of Environment, *438 North Skinker Blvd., St. Louis, Mo. 63130.*

Thatched windmill on Mykonos.

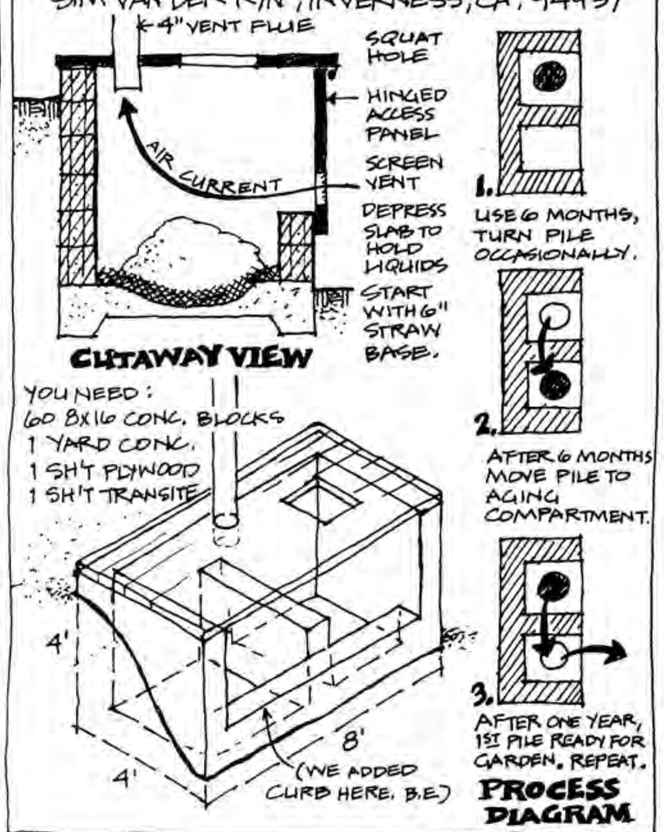
Greek windmill for pumping water. Large rudder keeps mill facing into wind. Rod attached to hub is bent like crankshaft, attaches to vertical rod that goes into ground, pumps up and down.

Bill Bullis

BATHROOM

SIM VAN DER RYN'S SANITARY AEROBIC COMPOST PRIVY •FOR ONE FAMILY•

☆ DOESN'T CONTAMINATE GROUND, SURFACE WATER.
☆ NO NOTICEABLE ODOR (TURN THE PILE, ADJUST MOISTURE CONTENT WITH WATER OR PEAT MOSS IF IT BEGINS TO SMELL; HOWEVER, IT'S VENTED, LIKE A NORMAL TOILET.
☆ FINISHED COMPOST IS PATHOGEN FREE AND SAFE TO BUILD THE SOIL (SEE PROCESS DIAGRAM: MATERIAL AGES A YEAR)
☆ MATERIAL COST: LESS THAN $100.
☆ CAN BE DETACHED OUTHOUSE OR INCORPORATED INTO HOUSE.
☆ FOR MORE INFO SEND $1.00:
SIM VAN DER RYN, INVERNESS, CA, 94937



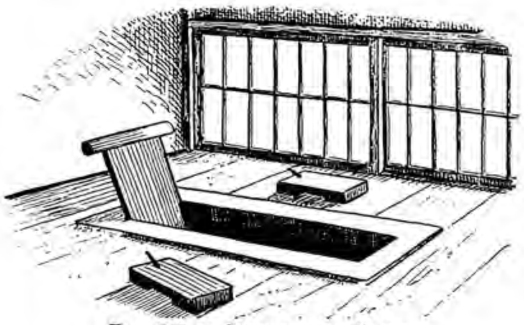


Fig. 217. — Interior of Privy.

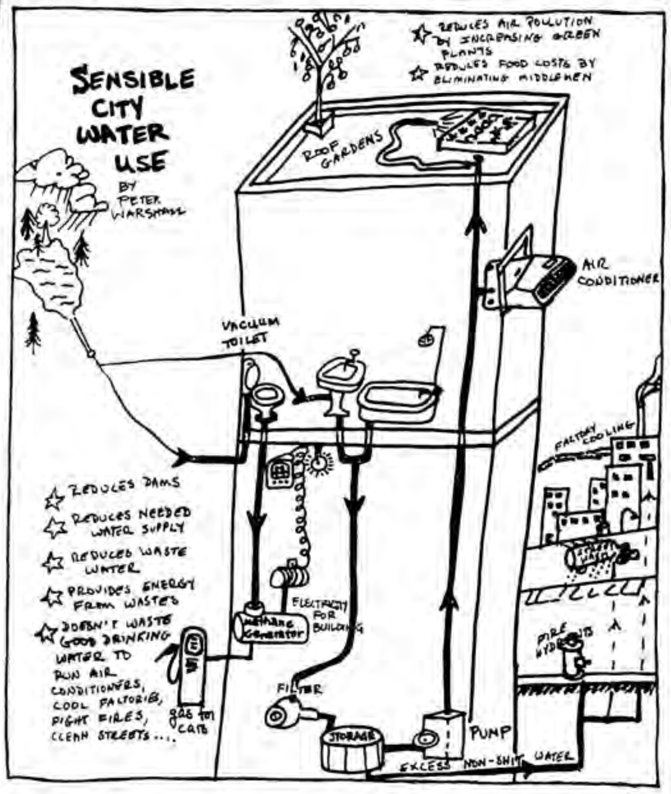
From *Japanese Homes and their Surroundings*

The Bathroom: Criteria for Design, Alexander Kira. 233 pp; 1966; $1.45 from Bantam Books, 271 Madison Ave., N.Y., N.Y. 10016.

Waste Water Treatment for Rural Communities; Commission on Rural Water, 1973; $13.00 from Information Clearing House, Demonstration water project. 221 No. LaSalle St., Chicago, Ill. 60601.
Best single source on septic tanks and why current standards have little scientific basis. Includes compendium of 50 alternative systems from mfr's, spec. sheets. *Sim Van der Ryn.*

Man's natural attitude during defaecation is a squatting one, such as may be observed amongst field workers or natives. Fashion, in the guise of the ordinary water closet, forbids the emptying of the lower bowel in the way Nature intended....It is no overstatement to say that the adoption of the squatting attitude would in itself help in no small measure to remedy the greatest physical vice of the white race, the constipation that has become a contentment.

From *The Bathroom.*



Portions of a chart on toilets prepared by Ed Allen:

A FIELD GUIDE TO THE TOILETS

Type	Picture	Manufacturer or Distributor	Hookups Required	Principle of Operation	Approximate Initial Cost 1973	Approximate Monthly Operating Cost, Family Use	Water Consumed Per Use	Liquid Waste Generated Per Use	Advantages	Disadvantages
OUTHOUSE		Homemade	none	Wastes biodegrade in pit and seep into soil. Pit gradually fills and outhouse must be moved.	$0 - $75	$0	none	Less than one pint	Easy, inexpensive, no pipes, no water required, no moving parts.	Unpleasant odors, cold in winter, inconvenient of access, can contaminate water sources
CONVENTIONAL FLUSH TOILET		Ubiquitous	3/8" water 3" waste	Wastes are siphoned through a trap by a sudden rush of water	$25 and up	Depends on cost of water; family of 4 would use about 4000 gallons per month for flushing.	5 - 7 gallons	5 - 7 gallons	Clean, odorless, relatively easy to repair, relatively cheap to buy	Uses enormous quantities of water to dilute small quantities of wastes. Ultimate disposal of sewage is a problem.
SLIDING VALVE TOILET--FIXED		Thetford Mansfield	3/8" water 3" waste	Pedal opens valve in bottom of bowl and actuates swirl of fresh water to rinse bowl	$100 - 125	Depends on cost of water; family of 4 would use about 100 gallons per month for flushing.	Approx. 1 pint (quantity used depends on how long pedal is depressed)	Approx. 1 pint	Fresh-water flush but very low water use. No chemicals or recirculating. Can be used as mobile unit with holding tank.	More expensive and more complicated than flush toilet. Sewer lines clog more easily due to weaker flush.
CHEMICAL TOILET		Sears Wards	Vent only	Wastes drop directly into bucket of deodorizing chemical. Bucket is dumped and recharged periodically.	$30 - 40	Varies, but is low	negligible	Less than 1 pint	Cheap, simple	Little more than an indoor outhouse. Disposal of wastes is problematical.
DIGESTING TOILET		Hawkeye	2" vent hose, Small effluent hose, 115V elect.	Microorganisms digest wastes aerobically. Hand pump uses effluent for flush. Small outflow of harmless, clear effluent.	$230 - 695 depending on level of expected use	About $1 for electricity (to run aerator) and $1 for microorganism cultures.	negligible	negligible; much is evaporated through vent.	Uses no water, produces little effluent. Relatively easy hookup. Some models can be used as mobile units.	Requires weekly addition of microorganism cultures.
COMPOSTING TOILET		Clivus	6" vent	Garbage and human wastes are digested by microorganisms, producing fertilizer.	About $1000	None; some value created in fertilizer.	none	none (liquids evaporate)	Puts the nutrients back on the land. No moving parts. Little maintenance. No water or sewer hookups.	High initial investment. Unit is very large, requiring considerable basement space.

ADDRESSES OF MANUFACTURERS AND DISTRIBUTORS

AB Clivus, Tonstigen 6, S-135 00 Tyreso, Sweden

Corlon Mfg. Corp., 1711 Floradale, S. El Monte, California 91733

Hawkeye Purification, Ltd., 1827-E State St., Bettendorf, Ia. 52722

LaMere Industries, Inc., Walworth, Wis. 53184

Mansfield Sanitary, Inc., Perrysville, Ohio 44864

Monogram Industries, Inc., 6357 Arizona Cir., Los Angeles, California 90045

Research Products Mfg. Co., 2639 Andjon St., Dallas, Texas 75220

Sears, Roebuck and Company, Minneapolis, Minn. 55407

Thetford Corp., P.O. Box 1285, Ann Arbor, Mich. 48106

Montgomery Ward and Co., Chicago, Illinois

HEATING & INSULATION

An extremely important consideration in building a home, often overlooked by the inexperienced builder, is *insulation*, as well as *siting* and *design* considerations that minimize heat loss in winter, heat gain in summer.

Before building anything, we urge you to get available local climatological information, and read sections of books that explain insulation. (Check the library.) In Ken Kern's *The Owner Built Home* there is excellent information on siting, heating, cooling, planting design and building climatology. In *Wood Frame House Construction* there is a good chapter on thermal insulation and vapor barriers. (See bibliography.)

We cannot cover the subject adequately here, and there is no substitute for local knowledge, but following are a few principles that may be helpful:

House orientation is very important. If windows face the hot summer sun there will be high heat gain. (In one dome with a great quantity of windows facing the sun, temperatures got over 140°, and several phonograph records actually melted—one of them was *It's a Beautiful Day*.) Conversely, windows on a wall facing cold winter winds will admit cold. And doors and windows should be sealed well (felt strips) to keep out winds.

There are three principles of heat transfer: *convection, conduction,* and *radiation.* Convection refers to the currents in the air that transfer heat through unsealed spaces; conduction is heat transferring through solid surfaces; radiation is direct transfer of heat through the air. All three of these principles play a part in heat loss and gain in buildings, and the different methods of insulating involve one or more of the three.

An example of stopping loss via convection would be fire blocking in stud walls that stops drafts (and fire danger), or fill insulation. An example of dealing with conduction would be layer(s) of insulation with air spaces in between. Finally, radiation heat loss is best stopped by a bright metal surface.

In double wall construction (studs with exterior, interior sheathing) the most common and cheapest insulation is the flexible fiberglass with aluminum backing and built-in vapor barrier. This is stapled in between the studs; the aluminum facing in, to be effective with an air space between the aluminum and interior wall surface.

A compromise between an airtight stove which burns less wood and an open fireplace is a Franklin Stove (invented by Ben) with doors that open so you can see the fire, close to conserve fuel. Some airtight wood stoves:

Ashley Automatic Heater Co., P.O. Box 630, Sheffield, Ala.
Reeves-Bowman Airtight Wood Heaters, Dover, Ohio 44622.
Shenandoah Wood & Coal Brooders, Box 839, Harrisonburg, Va. 22801.

Grow your own firewood: See Ken Kern's article "Woodlands" on page 160 and article "Heating Your Home without Harming Nature" in March, 1973 *Organic Gardening and Farming* magazine.

(A principle to remember with aluminum is that for it to reflect heat by radiation there must be an air space; otherwise it will transfer heat by conduction.)

Floors can also be insulated with roll fiberglass. Exposed ceilings can be insulated by rigid insulation on top of the roof sheathing. (¾" rigid insulation is twice as effective as the half-inch.)

In colder climates sprayed polyurethane foam is a consideration. It is the best insulation, but expensive and extremely dangerous if it catches fire, as it burns explosively and emits poisonous gases. If used, it should be protected with a fireproof wall inside, such as sheet rock or plaster.

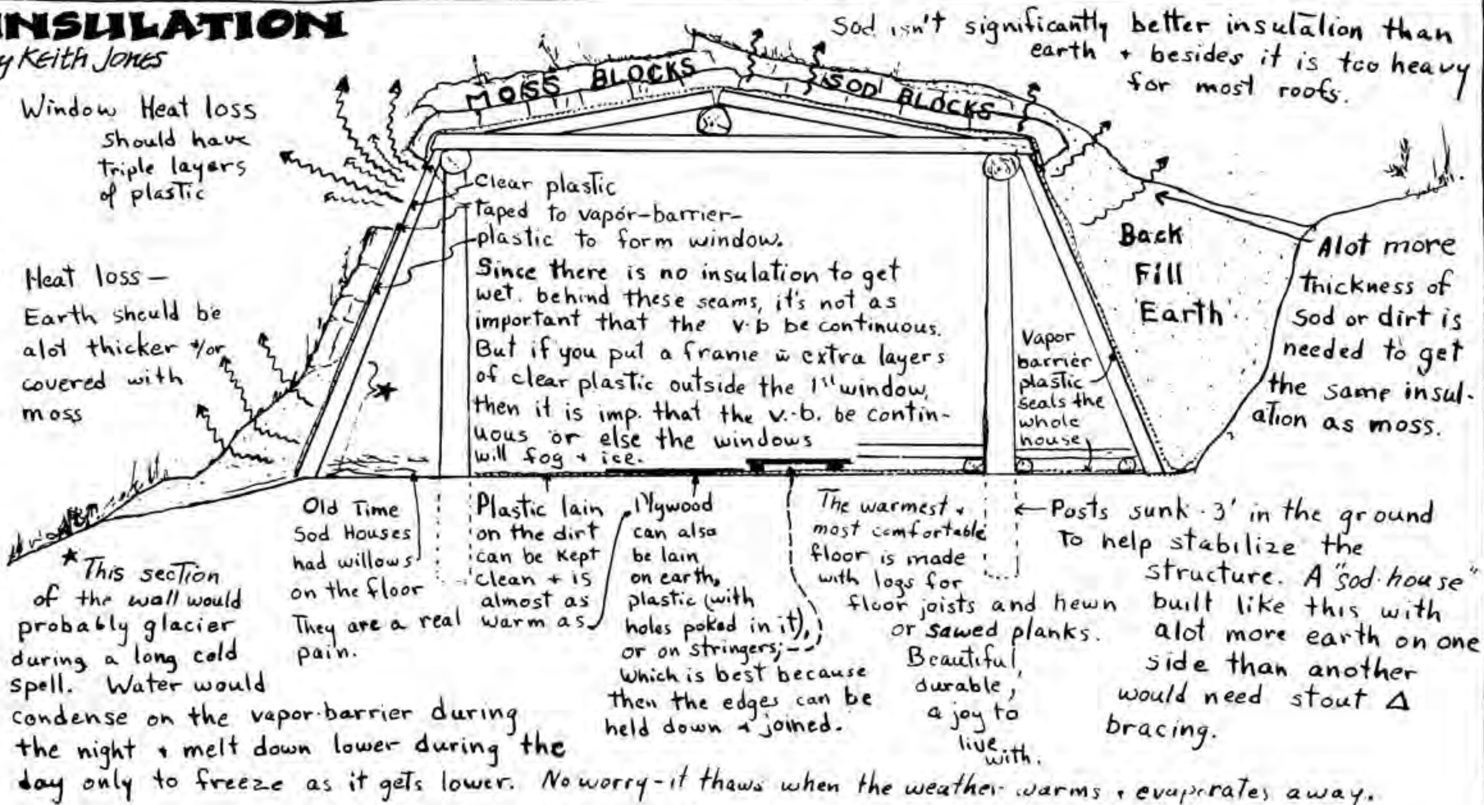
Another source of heat loss is imperfect combustion in the burner of the house heater. A brick or stone fireplace loses a great deal of the heat, although a *heatilator* unit will improve this considerably. If a metal flue is used, the more of it that is inside, the more heat will remain inside, rather than being lost outside. (See *The Last Whole Earth Catalog* for fireplace info.)

Low ceilinged rooms are obviously easier to heat. In cold climates, double glazing (must be sealed) is used to insulate windows.

In 1973, it took an average of $90 worth of propane to heat a three-bedroom house in a cold area in Northern California, and many people in the area were switching to diesel heating. Fuel is going to get scarcer, so if you are building, insulate well; the extra money you spend will be paid back within a few winters.

ARCTIC CIRCLE INSULATION

by Keith Jones



• Sod House showing different aspects of insulation •

Snow: Use blocks of wind-compacted snow, and build walls or domes. (See Stefansson's *Arctic Manual*). Snow as insulation comes into its own at sub zero temperatures. It too easily becomes ice or water at warmer temperatures. If interior temperatures are to be above freezing the snow needs to be insulated itself from the warmth. In soft snow areas a canvas tent can be banked with spruce boughs, brush, and soft snow thrown on the brush. Snow stops convection heat loss and because of its reflectivity it should cut down radiant heat loss.

Earth: According to the engineers, (Cooperative Extension Service, Univ. of Alaska, Publication no. 258) it takes about 30 inches of dry, loose-packed earth to equal an inch of urethane foam. In practice though earth wins out in several applications. The most obvious use of earth is for floor insulation. In dry, well-drained sites put floor structure directly on earth beginning with a plastic vapor barrier. (See illustration.)

If climate and site permit, a shelter sunk to any depth is cheaply insulated. A *strongly* built surface structure can be banked to any level or over completely as the Mandan earth lodge (see p. 18).

Sod: A variation on the earth insulation theme. Raw earth will erode away through the years but sod insulation will renew itself and even increase its thickness — if you can build a structure that will last that long. Sod has structural strength of its own and is commonly used in block form just as bricks. We have used a sod layer over banked earth in many of our shelters. Since any shelter is ultimately expendable and transient (hopefully recycleable) the abandoned shelter should be considered. The sod covered shelter returns quickly to nature — perhaps it never altogether leaves nature. If care is taken when stripping sod it can more easily replace itself in a few years.

Moss: The traditional insulation of many of northern Alaska's native people has been several different species of moss which are cut in block form from the forest floor or from dry lake beds. The moss from the lakes seems to be the better since it has a peat-like uniform density and resists compression. The forest moss has more initial loft but is more compressible and hence must be replaced or added to every year or two. Beware of species of sphagnum moss, usually found in marshy areas; if not protected from rain and melting snow it can soak up enough water to cause an otherwise strong framework to collapse. (The old-time Eskimo people of this region used sphagnum for diaper filler because of its absorbent qualities.) The stripping of lake bed moss seems environmentally more kind than the stripping of the forest floor.

Grass: Good possibilities — we've used it mostly for roof insulation sandwiched between 2 layers of polyethylene plastic film. Fire hazard is great as with many other indigenous materials.

Vapor barriers: The bubble of air trapped in our shelters for our personal comfort and survival is not only warm but is usually quite wet when compared to the outside air. This moisture in the form of invisible water vapor establishes a vapor pressure differential between the inside and the outside air. In winter in cold climates there is a constant drain of water vapor from inside to outside. This vapor passes through most porous materials such as logs and lumber and is little noticed. However, if the water vapor contacts cooler non-porous materials it will condense and saturate with water or ice anything in contact with the condenser. (See illustration.) A vapor barrier provides a more comfortable human environment and probably a more healthy one too — fewer dry, stuffy noses and other respiratory problems.

Wood: This is the most popular insulating material of the north European invaders of North America as in the log cabin. Nearly 5 inches of soft wood is required to equal an inch of urethane foam, (*op. cit.*). Although 3 or 4 inches of urethane foam is considered to be adequate insulation for interior Alaska I have yet to see a solid wood structure with wall thickness overall of 15 to 20 inches. Insulating with wood is most easily done with rough sawmilled timbers of the desired dimensions. Other easily used wood insulation is in the form of sawdust or shavings. Sawdust is a little better than shavings. Because of settling, these insulators work best in floors and ceilings, but can be used in vertical cavities if some provision is made for adding more sawdust the following year. These insulators are nearly as good as fiberglass, taking around 2½ inches to equal an inch of urethane foam.

Fiberglass: Takes a little less than 2 inches per inch of urethane. Greatest thing going for it is its fire resistance. Itchingly uncomfortable to work with and probably hazardous to health when one considers the small airborne slivers of glass entering the lungs and penetrating the skin. Don't trust the built-on vapor barriers on roll fiberglass. Use polyethylene continuous skin.

Plastic foam: In our experience and under our working conditions — primarily extreme cold — do-it-yourself — pour type urethane foam has too many bugs that outweigh its superior insulative value. Temperatures of chemicals, air, and forms are critical. Warping and expansion — contraction of finished product are serious enough to make some applications impossible. Forces generated by the rise of the chemicals will rend or/and bulge sturdily made forms. The noxious fumes of the chemicals have caused respiratory complications for some of us. The endless amount of labor and time wasted in one of a kind application is just too expensive. On the other hand several friends have had very good results from spray foam applications on domes, yurts, and roofs in interior Alaska — done by experienced commercial operators. Factory made board stock insulation in both urethane and polystyrene have useful applications but are extremely expensive to ship in our area. They are charged on a volume basis rather than by weight. I have heard unconfirmed reports that styrofoam's k factor improves as the temperature decreases and that urethane's does the opposite. The implications being that urethane is the best insulation to keep things cool — refrigerators, etc., and styrofoam is the best for extremely cold temperatures.

Layers: Multiple layers of aluminum foil with dead air spaces between as described by Rex Roberts in *Your Engineered House*, seems to hold interesting possibilities for cheap easy to ship insulation. We have no personal experience. We do use multiple layers of plastic and glass for windows and dome panels. On the theoretical level it might take 7 layers of window material with dead air spaces between (optimum spacing supposedly is 7/8 in.) to equal that inch of urethane. Have never used more than 4 and usually use only 3 layers so that we pay dearly for our light and visibility in this cold climate above the Arctic Circle. However we cut down considerably on our heat loss by putting shutters of urethane or caribou skin on our windows at night. We have our coldest weather, down to -70°, during the darkest part of the year. It is easier to fool around with shutters every evening than to cut and haul extra firewood. Three or four layers of vinyl plastic are also necessary to prevent window condensation at 50% relative humidity when outside temperatures are low.

Fur: Farley Mowat maintains in *People of the Deer* that the people have such poor housing because they have such excellent clothing. Fur makes the warmest cold weather clothing and caribou fur-hair is the warmest fur. Although caribou hair is not hollow like a grass stem, it is composed mostly of air in the form of small longitudinal cells. Consequently caribou skin clothing is so warm that it must be either clipped short or worn only in the coldest weather. Caribou skins are used today in our area primarily for winter mukluks and for sleeping pads while camping. The old-time people used one or two layer caribou skin tents, usually dome shaped. We have used a single layer of caribou skins sewn together to insulate our camp dome and also to temporarily insulate our winter house while suffering through the home manufacture of urethane foam. In both cases the caribou skins were surprisingly good insulation, especially with plastic to keep the snow from melting and wetting the skins. (Layering effect.)

Down: Waterfowl down is inadequate insulation in very cold temperatures when you are outside all day or living where it is difficult to dry clothing. The reason is that all the day's accumulation of invisible perspiration collects inside the down under the outer covering and gradually replaces the dead air with ice and water. Upon entering a warm shelter all the ice melts and you have wet down which is a problem to dry. If hung up to dry overnite it is usually dry enough to go through the same process the next day. The same goes for down-filled sleeping bags that are used constantly in below freezing temperatures. Light down garments for cool weather are very serviceable — as any waterfowl would most likely agree.

Baker Roshi, of the San Francisco Zen Center contrasted the Japanese style of heating by carrying around a hibachi (they put it underneath robes, making a warm tent) or hot baths, with the western Victorian house, with central heating of high rooms. Heat the person, not the house.

Tibetans heat themselves with tea.

Most of this book is about individual shelter. There is also the community. *The most typical type of community allowing individual participation and guidance in local policy is the small town. In 1971, a California town of about 2500 people decided to call a halt to unlimited growth. In a recall election it turned out that a majority of people disagreed with the prevailing government. What brought about the recall was a plan to handle the town's wastes by building a huge chlorinated ocean outfall sewage plant, which would have allowed for tremendous development and population expansion. The newly-elected utilities board changed the plan to a land retention system where all wastes are utilized, pumped into a series of five ponds with effluent used for spray irrigation rather than chemical treatment and mechanized stirring and shredding.*

If you can't fight city hall perhaps you can become it; the same thing could happen in many other small towns in America. Lewis MacAdams describes what happened:

COMMUNITY WATER

by Lewis MacAdams

YUGOSLAVIA.

Carrying anaerobic gunk from a fifty gallon garbage can to slop over deer shit to hex the deer's ass right out of my garden I started thinking about shit and water. Richard Brautigan suggested that a good way to keep deer out of your vegetable garden was to dump lion shit along the perimeters. As for water, in November of 1971 the Public Utility District of our town of about 2500 people was turned over and people committed, in varying degrees, to changing standard American water use practices were elected to four out of five seats on the water board. Two of the four votes involved recalling incumbent board members, two staunch members of the community, including one whose father had planned and built most of the local water system fifty years earlier. It was necessary to do this to stop the construction of a large sewerage system for the major part of the town that was already employing septic tanks, a sewerage system that climaxed with a so-called "secondary" treatment plant on a cliff over the ocean and a cement pipe to carry the so-called "treated waste" a half mile out into the Pacific. That the new system was planned to allow many more sewerage hook-ups than were previously possible with septic tanks in the low-permeability clay soils was dug quickly by many people in the town and the new board came to power with a mandate to somehow slow house construction as well as construct a more sensible solution for the downtown sewer, constructed in 1905, which was spilling, and still is spilling, about fifty thousand gallons of "raw" sewage a day into the lagoon by downtown.

In California, Public Utilities Districts are granted tremendously broad powers by the state – power to deal, directly or indirectly, with water, sewerage, transportation, electricity and natural gas, public lands and buildings, septic tanks, roads, and more. The local utilities district has moved in many areas – most notably roads, where the district has pulled control of the many dirt roads away from the county in order to keep them from being widened and paved. But basically in the last two years the District has dealt with water, and how water governs.

One of the first things the new water board did when they took office in November '71 was to vote a halt, to stop selling new connections to the water system. Then they scrapped the original sewer plan (the town had to buy its way out of the contract with the sewer engineers – *328,000 Dollars to Kennedy Engineers!* Twenty months later the water moratorium is still in effect. New housing construction is, after 20 months, tapering off. Yet every builder I know is employed, I think, because the price of houses had skyrocketed since the moratorium and families are buying smaller houses and adding on what rooms they need. For the last two summers we've had to use pumps on a near-by creek to fill up our water tanks when the water behind our dams went down. But nobody seems to feel very urgent towards an end to the water moratorium. The town's population has tripled in the last five years and everybody I see feels glad to let things settle down for a while. Work is about to start on the resource ponds of the sewerage system and that's probably going to take the most of the town energy for the next year and a half, and the town money too.

At the same time the water board has cut its portion of the county property tax by nearly half since taking office, from 1.87 per hundred dollars assessed valuation to 1.16. The people who actually use the water system pay for it, the "cost of water." This has encouraged a lot of people to install Rube Goldberg machinery and so-called "mexican-drains" to save as much water, to re-use as much water as possible. Our kitchen sink drains into a blackberry brambles, our bathroom sink and toilet into the septic tank and our clotheswasher and bathtub drain into the aforementioned fifty gallon can, which then flows through a hose into Phoebe's spice garden. Which is ok with the water district. They're not trying to sell water.

What I'm trying to get at is that each man and woman is the center of his or her own community, which can, in effect, be what Blake called Jerusalem. Politics is the eye looking out of the wish of its citizens, born and unborn. Whaletown, Woodville and Dogtown, if you don't draw your own water from the well who does? If you don't bury your own shit who takes it, and where does it go? The vision of the body politic includes it all, and is rooted in the world.

Note: Other uses of sewage ponds, in addition to spray irrigation: fresh water mussels, which can be dried and ground for chicken feed. Crayfish ($4.50 per lb.), or carp can be raised. More information: New Alchemy Inst., Box 432, Woods Hole, Mass. 02543 or *Organic Gardening & Farming* and *Compost Science*, both from Rodale Press, 33 East Minor St., Emmaus, Penna. 18049.

Countries in Europe and Russia use a system of purifying water with ozone, which leaves no bad taste in the water, and is being used to purify water from polluted rivers. Although ozonization has been proved to eliminate viruses, foul smells and bad-tasting pollutants, the U.S. is reluctant to use the process. As a French water company official put it, "There is a long chlorine tradition in the U.S. As everyone knows, chlorine leaves a strong taste that probably gives Americans a feeling of security...."

Water information: *A Study of Flow Reduction and Treatment of Waste Water From Households.* 1969. 154 pp. $1.25, from Sup't. of Documents, U.S. Gov't. Printing Office, Washington D.C. 20402. This is an excellent book on ways to reduce water use by such methods as aereators on faucets (aereator on shower can save six gallons per day), re-use of non-shit water to fill toilet bowl, and distillation and reuse of water. A chart in the book on household water use shows 45% for toilet flush, 5% for drinking.

•

Since, except during the sayf, the nomadic way of life necessitates moving camp every two or three weeks, and probably more often, the Bedouin possesses nothing that cannot be moved by two people, and virtually nothing that is not necessary to his way of life. He has one set of clothes that are worn until there is often hardly sufficient cloth to cover the loins. Water is so precious that these clothes are rarely washed, it being considered wasteful to clean clothes except at a waterhole....

Shelter in Africa

CHINA

by Bob Willmott

China's policy in agriculture, as in all fields is to prevent waste in any form. Although China today has a booming fertilizer industry, pig, sheep and human excrement is still used for fertilizer by China's 600 million peasants. In the city of Peking where we live and work the night-soil is collected by trucks with pumps, horse-drawn carts with tanks on the back and sometimes just three-wheel bicycle carts with large drums to collect the sewerage from underground wells. All this material is transported to the communes. At the communes the excrement is mixed with straw and animal manure and left in covered concrete pits for 14 days. There are 3 different pits and the raw material in this state is moved from one to another until heat combustion has killed all germs and the manure is ready to use on the crops.

In the streets which are scrupulously clean, peasants tie hessian bags under the cart oxen, donkeys and horses to catch the precious manure. Kids in the street where we live collect paper, bones, old iron and any household waste and sell it for ice-cream money to the municipal waste collection stalls by the side of the road. These stalls are staffed by women in neat aprons and cloth caps all helping to contribute to socialist construction in China.

Peasants today work hard to accumulate fertilizer while the chemical fertilizer industry is developing and more efforts are going into increasing barnyard manure. Production teams are raising more pigs and sheep. Peasant families are encouraged to raise pigs. Other sources of fertilizer are green manure, duckweed, river silt and grass. All water surfaces in the Hangchow, Chiahsing, Ningpo and Shaohsing counties are completely covered with green water plants raised for this purpose except for a central clearway for boat traffic. The peasants of Lungchiao did not ask the state for an ounce of fertilizer but tapped their own resources. They grew over 120 mu (1 mu = $\frac{1}{6}$ acre) of green manure in a nearby river, dragged up riversilt, cut grass and raised more sheep and pigs for their manure.

In the Tanlingtou area which had low yield soil, the brigade climbed 5 kilometres to the mountain reservoir to get silt for fertilizer. Others cut tall grass for compost. They dug deep ditches around the local swamp to drain off the water and lower the underground water level. They dumped tons of sand into the swamp to fill it up. They worked large quantities of green manure and sand into the clay soil to break it up and make it more fertile. The peasants added mud fertilizer to sandy soil. Two winters and springs of such battle improved the land and in 1964 the harvest for this area increased by 30%.

Acting according to Chairman Mao's call to be self-reliant the policy of "walking on two legs" (a policy for the development of all of China's industry – ie. developing local government-run industry at the same time as central government-run industry) has been developed all over China. In Kiangsu Province small nitrogenous fertilizer plants were set up. These small rural plants produce fertilizes that are cheaper, quicker in effect and do not harden the soil; qualities which greatly satisfy the peasants. The investment per ton of synthetic ammonia produced is only ½ the sum needed for a big plant. Synthetic ammonia is a middle product of the nitrogenous fertilizer plant. Its output is often the measure of the output of chemical fertilizers. In Kiangsu province alone, 37 small rural plants went into production in the past decade. As part of the drive to turn all waste products into useful chemicals, called "multi-purpose utilization", the workers of the East Wind Paper Mill in Chekiang province have turned waste water into fertilizer.

Under Lui Shao-chi's revisionist line in industry, some leaders of industrial enterprises insisted that their plants concentrate on one product. Fuller use of our raw materials, they said, is not our business. They emphasized division of labour and specialization of products, and ignored the cooperative relationship that should exist between factories in a socialist society. This had two bad results: huge amounts of waste were allowed to pollute the environment and damage fields, crops, fishing and health, while products which could be made from such waste materials, urgently needed for national construction, remained in short supply or had to be imported.

As the cultural revolution began to expose the damage Lui Shao-chi's capitalist line was causing in the country, workers studied Mao's line on socialist construction and put it into practice. The old idea that plants should produce only one item and not diversify came under attack. The move to use all waste and fight pollution got under way. The government by relying on the masses has in Kiangsu province seen many changes in the move to convert waste into valuable products. Many small chemical plants have been built in the rural areas to use "waste" materials such as cotton-seed hulls, corn cobs, chaff, sugarcane residue to make alcohol, furfural, acetic acid, acetone, glucose and even antibiotics.

The Wuchin Chemical Fertilizer Plant, with a capacity of 3,000 tons of synthetic ammonia per year, was started in January 1966 and was turning out fertilizer just eight months later. Running the plant with diligence and thrift, the workers kept improving management and lowering costs so that within a year a sizeable surplus fund was accumulated. This, plus a small sum contributed by the state, was used to expand production in the same year to 5,000 tons per annum. At the end of 1969, 80% of China's counties had their own fertilizer plants or were building them. Every county has had an operating plant since 1970.

About half the cost of building the Wuchin plant came from communes in the area. They all got their money back by 1969. In terms of benefit to the communes' rice paddies, the investment was less than 2 yuan per mu, while each mu received 25Kg of fertilizer. This figure does not include the plant's daily by-product, huge amounts of ammonia water, or waste water containing chemicals of fertilizing value. This "waste" water, regularly used to irrigate, makes it unnecessary to use additional chemical fertilizer on a further 5,000 mu. Most of the small plants are in the open countryside away from the county towns, which makes it easier to sell directly to the local communes. Thus, not only are fertilizer prices lower, but the communes save on transport costs (Kiangsu province has many canals and waterways) and avoid delays in getting it to their crops. Often fertilizer leaving the plant in the morning is spread on the fields the same afternoon.

In the cities soiled toilet paper (collected in boxes in the lavatory) is collected each day and taken by carts back to the communes to be burnt in big pits, the ash being used as fertilizer. As well as the obvious health advantage this method of paper disposal prevents pipe blockages. The ash from coal brickettes used for cooking and heating in homes makes very good fertilizer. Many houses grow corn and sunflower plants in their backyards. When a new method of extensive planting of sugar cane in the hills in Fengkai county Kwangtung province was first tried, they had trouble with white ants. They overcame this problem by using "ammonia water" made by mixing cow urine with crude salt and pouring the solution in and around the pits where the cane sections were planted. When the aphides attacked the cane leaves, instead of waiting for the insecticide to arrive, they made an insecticide from several kinds of wild plants grown in the hills. This killed the aphides and allowed the plants to grow properly.

As part of the drive for frugality and diligence the gases from cooking ovens, furnace plants and other industry are also being utilized. For instance, over a hundred chemical materials are now recovered from coke oven gas alone. In the past, factories and plants poured waste gases into the air, dumped slag, cinders and ashes into ravines and ditches and let waste water flow into streams and rivers. But now the workers convert these into useful products such as synthetic fibres, rubber, plastics, detergents, insecticides, drugs, fertilizers and dyes. The Fushun No. 3 Petroleum Plant pumps all its waste gas into bottles which serves as fuel for home cooking. We have one of these in our flat and they are very cheap and very effective (costs us about 5 yuan till next Jan.)

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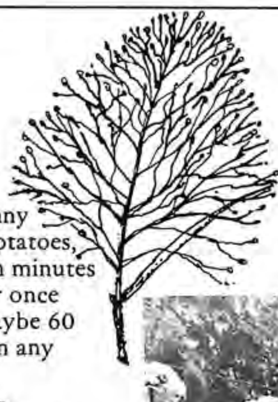
A small Garden...



Last night I had a meal of rock cod caught by Danny and Richard in their eucalyptus boat, fresh new potatoes, a salad of lettuce, parsley, cress, carrots all just ten minutes from the garden. A tomato from the store that for once didn't taste like soap, glass of white wine. Cost maybe 60 cents and fresher, tastier, and more energizing than any $10 restaurant offering.

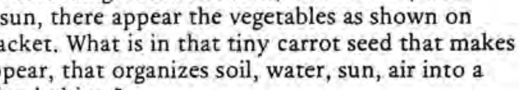
Remember what a tomato used to taste like before mechanized agriculture? Crispness of apples that weren't sprayed and waxed? As machines replace farmers and as fields and crops are chemically stimulated and dusted with insecticides, fruit and vegetables become tasteless, perhaps poisonous, increasingly expensive. The alternative, whether you're in a city or country is to raise your own. You can start with a small garden and easily have fresh vegetables each day. It needn't take a great deal of time. Although it took some time and work to get it going, our garden takes only 10 minutes a day maintenance, everything heavily mulched. A small California garden:

- —potatoes: pick only as many as needed just before cooking. They grow with no tending.
- —pea pods growing on the fence.
- —black seeded Simpson and romaine lettuce; never pick entire head, just keep taking outer leaves off each night.
- —garden cress for salads (tastes just like water cress, grows very fast.)
- —carrots: keep planting new ones as space opens up.
- —parsley.
- —artichokes; once started they take care of themselves (Pacific coast only).
- —20' of strawberries, mulched heavily so they need little water or weeding.
- —onions, to be picked as needed.
- —a few zuchini, crooked neck squash (Italians fry zuchini blossoms lightly in butter after dipping in egg and bread crumbs).
- —sunflowers.
- —daisies.
- —New Zealand spinach: perennial, once started grows wild.

That's a simple California garden. It'd be different in other climates. If you have a long hot summer you might be more inclined to raise a lot of vegetables — including corn — and freeze them. Or if you wanted to get some income from produce you'd have to do it on a larger scale and seriously. Hard work.

One of the most important parts of a garden is the compost bucket. (Here's a good use for plastic.) Keep it under the sink. All food, vegetable matter, scraps go into it. I don't take the time to compost it, just dig it into the ground for next year's garden. The natural next step is to segregate glass, metal, newspaper and somehow get it back into the manufacturing cycle. Recycle on aesthetic grounds, if for no other reason; a garbage can full of food, glass, plastic, metal *looks* bad.

Paul Wingate turned me on to the idea of planting wherever you move, without worrying about whether you'll be around at harvest time. Now wherever we live, I try to plant as soon as possible. It's easy to prepare soil for next year's vegetables: get horse or chicken manure, fish guts, any food scraps and dig them in, when you get the chance.



Trees in cities provide shade, greenery for the eyes, moisture, softness amidst the harsh surfaces. The London plane tree combats smog and has roots that don't buckle pavement. If you wanted to leave something behind, you could plant trees where they're needed most. St. Luke's Place in New York City is beautiful in the spring, trees lining both sides: life and a bit of hope amongst concrete and pavement.

I've always been amazed at the fact that you buy seeds, plant them according to instructions, and in time, with water and sun, there appear the vegetables as shown on the seed packet. What is in that tiny carrot seed that makes a carrot appear, that organizes soil, water, sun, air into a beautiful food object?

You can plant fruit trees wherever you live. Find out which do best in the area. Think how much you'd leave behind if you planted 2 fruit trees each year.

Next house I build I'll have the kitchen at ground level (or one step above) with easy opening french doors to the garden.

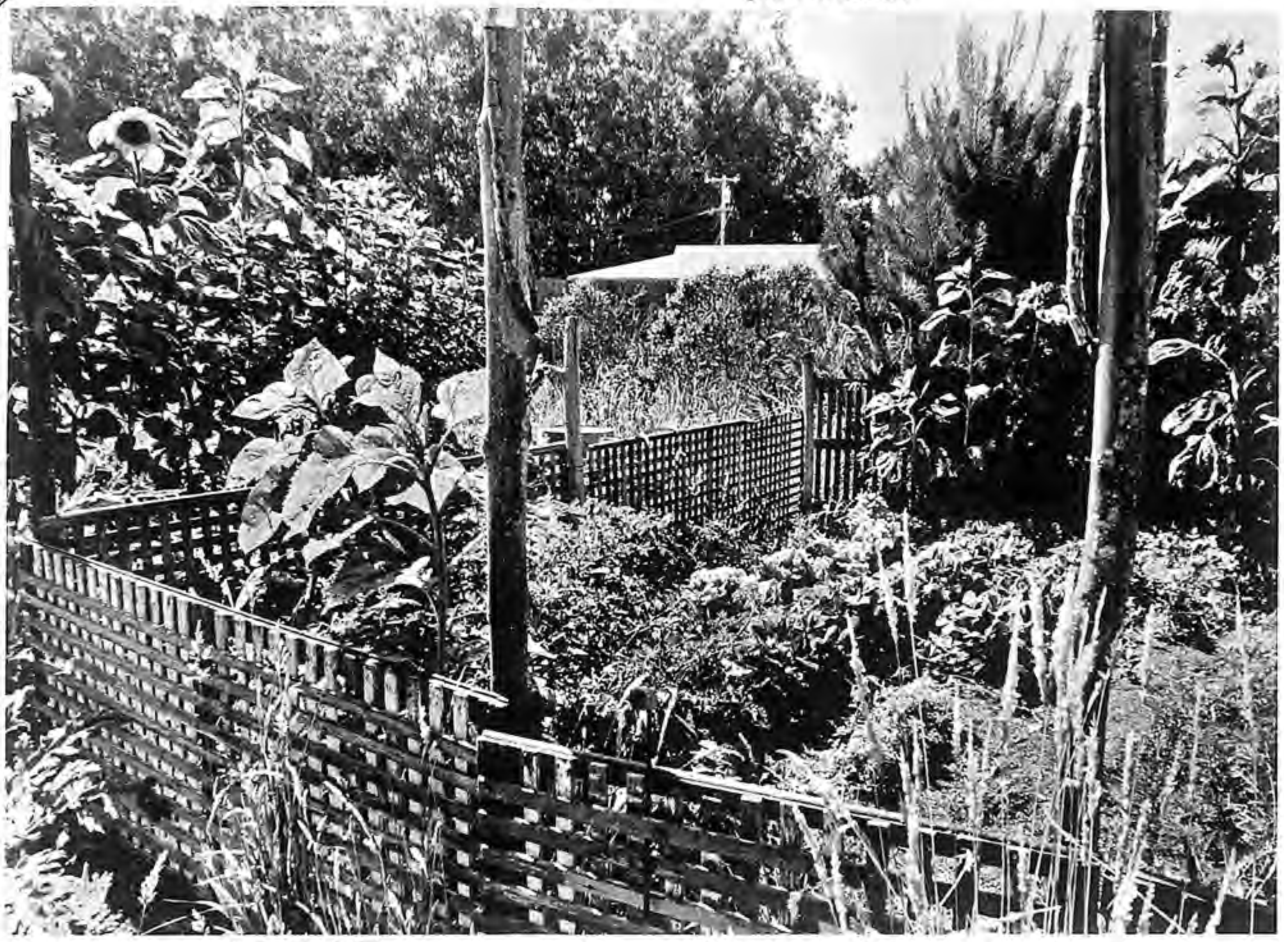
Great thrill of returning to a tree planted years earlier and eating a pear.

Plant bamboo!

Daisies grow fast, are hardy, do well in most soils, are lovely in garden, and provide continuous fresh flowers for the kitchen table.

As celebration of a child's birth, the parents could plant enough trees to provide timber for a small house for a future grandchild. Pine is a good wood, and needs no tending past seedling stage. You could also plant at least three kinds of fruit trees for each child born.

Jeanine Easton



In the June 1972 Organic Gardening and Farming Magazine, *Elias T. Manos describes his Chicago roof top garden. He screened off the roof with a basketweave fence, then cleared the gravel and covered it with slate so they could put chairs and table on it. They now have over 100 annual plants in pots, a rose tree, juniper, a strawberry barrel, tomato plants and flowers. Here are some extracts from his article:*

Weight is also a factor in our garden. Don't forget that all materials had to be transported to the roof by hand. The total weight of all soil and containers also had to be kept to a minimum in order to preclude any structural problem.

All of these considerations combined caused us to use styrofoam pots for most of our plants and to incorporate horticultural perlite, a lightweight mineral aggregate, into the soil mix.

Plant containers come in an unlimited variety of sizes, shapes and materials, including plastic and clay pots, wooden tubs, kettles, pails, jugs, crocks, barrels, kegs and any type of home-built planter that the imagination can conceive. Those that were not made to contain plants need only to have a drain hole drilled at the bottom.

One of our purposes was to create a free-flowing landscaped effect by which one would not notice that the flowers were growing out of containers. That was accomplished by terracing. The tallest, large-flowering plants go into the boxes at the rear. Then come two rows of eight-inch pots with the medium height plants, followed by the low-growers for edging across the front.

One of the natural principles we have discovered through our garden is that life is attracted to life. Nature can be attracted to the city by creating natural surroundings. We have a summer-long parade of butterflies and honey bees and you wonder, "Who gave them the message about our plants on the roof?" The blue jays, robins, cardinals and sparrows in our neighborhood often look in on us from atop the fence, while in the evening, night hawks circle overhead.

At the rear of our apartment and overlooking the roof garden is a dinette, arranged that way so that even on rainy days we can enjoy the plants through large windows at our table. It was a pleasant surprise last summer when a hummingbird came to investigate our impatiens under the window. Its tiny wings blurred as it hovered in space to extract goodness from the flowers, and all within an arm's length of us.

Building the roof garden has been one of our most fulfilling experiences. It taught us again that we can create a better environment for ourselves, valuable not only to body but to the spirit. Instead of condemning the ugliness of the cities, look around wherever you may be and you will find a place that you can beautify. You may also find that growing plants under unusual circumstances can be "strong medicine" for the heart and mind.

Gardening books: See pp. 50-51 of *The Last Whole Earth Catalog*. As a starter: *The Basic Book of Organic Gardening*, Robert Rodale, 1971, 377 pp. $1.25 from Ballantine Books, Inc., 101 Fifth Ave., New York, N.Y. 10003.

Handiest reference book: *The Encyclopedia of Organic Gardening*, J.I. Rodale, 1961, 1145 pp., $12.19 from Rodale Books, Inc., 33 E. Minor St., Emmaus, Penna. 18049.

Organic Gardening and Farming magazine, $5.85 per year from Rodale Books, Inc.

Control Garden Pests Without Poison Sprays, $1.00, from Rodale Books, Inc.

Good article on herbal and vegetable companions. Which crops can be grown next to each other, which should not be; herbs that repel various insects, beneficial weeds and flowers: February, 1972 *Organic Gardening and Farming*.

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