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Food Processing and Preservation

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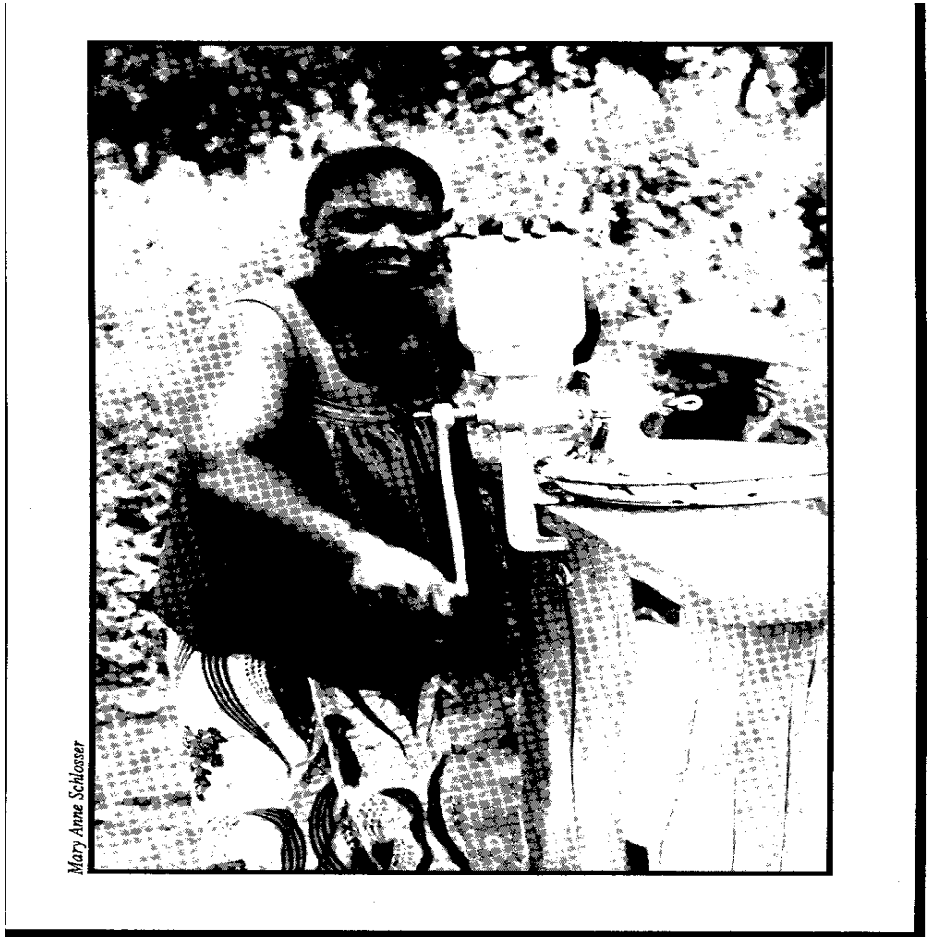

Storing Food at Home

You work hard when you grow food and prepare it to eat. Buying food takes money that you have worked hard to earn. You do not want to waste it. To keep food clean and safe in the home you must have good storage space, suitable containers, and a way to keep foods cool and dry.

IMPORTANT

Only water that is pure enough to drink should be used for washing or

cooking food. If the purity of water is in doubt, it should be boiled for 10 minutes or disinfected. See section on water purification, p. 138, for proper disinfection procedures.

HOW TO CARE FOR VARIOUS KINDS OF FOOD

Different kinds of food need special care. Treating each food properly will make it keep longer.

Dairy Foods <see figure 1>

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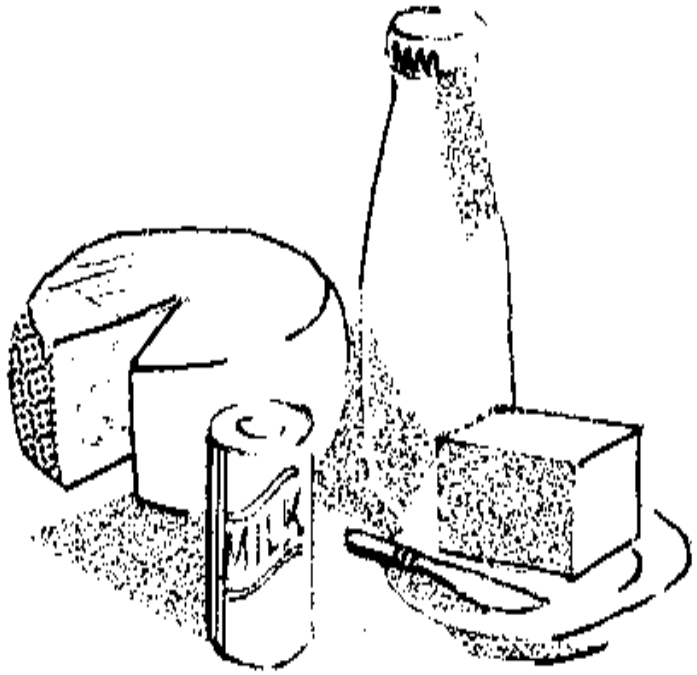

FIGURE 1

**Fresh milk is safe if it is boiled. If you do not have refrigeration, boiled milk
will keep longer than milk that has been pasteurized. Cream will keep longer if it
is boiled.**

**After milk and cream are boiled, then cooled, store them in clean containers. These foods will keep longer if stored in a refrigerator, ice chest (see p. 290), or
evaporative cooler (see p. 28). If
refrigeration is not available store**

them in the coolest place you can find.

Use boiled water to reconstitute canned, evaporated, condensed, or dried milk or add water and boil for 10 minutes. Unsafe milk should not be used for any purpose.

Cooked foods using milk or cream spoil very quickly. Use them immediately in hot climates. Do not store.

Dried milk in its original container will keep for several months in a cupboard or on open shelves. Close the container tightly after using. The milk will take up moisture and become lumpy if exposed to air. Then it is hard to mix with water and food. A glass jar with a tight lid, or a tin can with a press-in lid, are recommended to store dry milk powder after the package has been opened,.

After dried milk has had safe water added to it, store it the same as fresh fluid milk.

Canned evaporated milk may be stored at room temperature until opened. Before opening shake the can to mix thoroughly. After opening, cover tightly and store the same as fresh fluid milk.

Canned sweetened condensed milk may be stored in the cupboard or on open shelves. After the can has been opened it can be stored in the same place as the

**unopened can but it needs protection from ants and other insects. Sweetened condensed
milk does not require refrigeration unless it has been diluted with water.**

Butter should be kept in a cool place, in a covered container.

**Keep hard cheese in a cool place. Wrap tightly in a clean cloth or paper to keep out air. Put in a box or metal container if possible. Before using, trim away any
mold that forms on the surface.
Soft cheeses should be stored in a tightly covered container in a refrigerator or
other cool place.**

Fresh Meat, Fish, Poultry <see figure 2>

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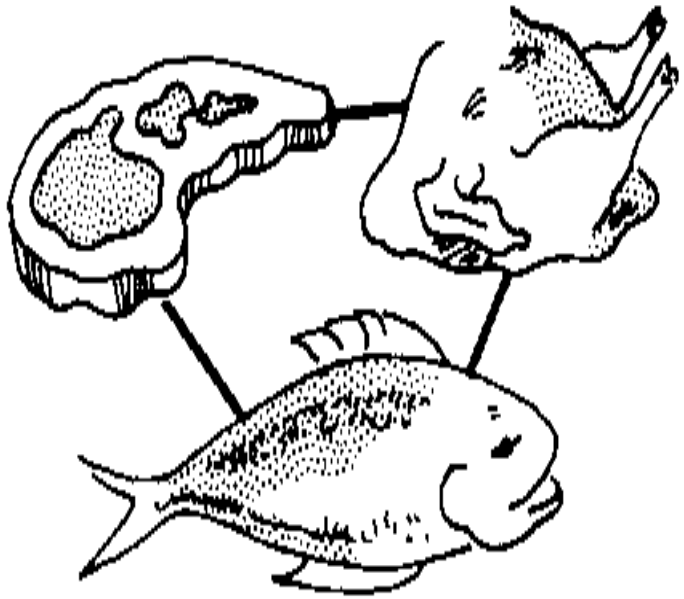

FIGURE 2

The moist surfaces of dressed meats, poultry, and fish attract bacteria that cause spoilage. Keep these foods clean, cold, and dry. They should be allowed some air when stored. Wrap loosely with a clean cloth or paper. Wipe or scrape off any dirt before wrapping.

These foods spoil very quickly. They should not be kept long in warm, moist climates.

Rubbing cured or smoked meats with dry baking soda may help prevent molding. If meat is attacked by insects or shows spoilage, cut out the bad part.

Eggs <see figure 3>

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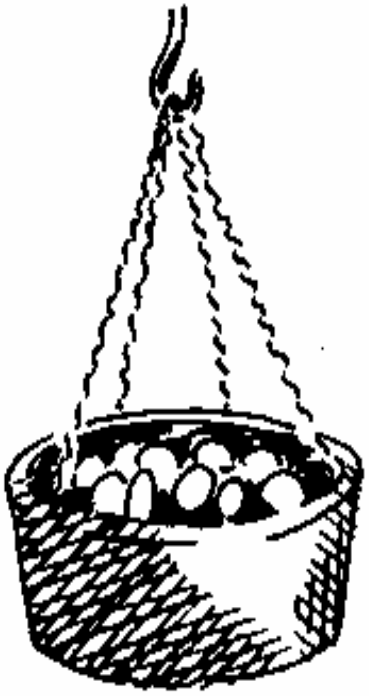

FIGURE 3

Sort eggs as soon as they are brought from the poultry yard or market. Cracked ones should be removed and cooked for immediate use. Spoiled eggs should be

thrown away. Rough handling and high temperatures shorten eggs' keeping quality.

Keep eggs in a covered container in a cool, dry, clean place. Eggs keep fresh longer if stored in an airtight container.

Don't wash the eggs unless you want to sell them. Water removes the thin film on the shell that protects the egg. This film helps to stop evaporation, the entrance of harmful bacteria, and the absorption of odors. Do wash eggs just before using them. Wash with cooled boiled water.

Fresh Fruits and Vegetables <see figure 4>

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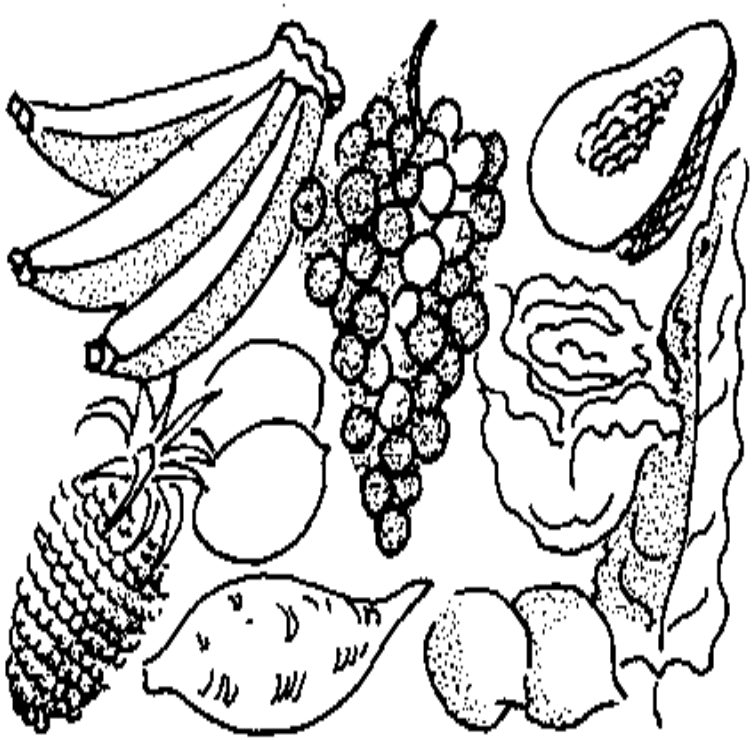

FIGURE 4

Fresh fruits and vegetables need to be kept clean and in a cool place with good air circulation and out of direct sunlight. Such conditions help to prevent spoilage. Avoid breaking or cutting the skin.

Sort fruits and vegetables before storing. Use bruised ones immediately, throw away decayed or spoiled ones. Ripe fruits and vegetables should be used in two or three days. Allow them to ripen in the open air out of the sun. Wash fruits and vegetables in clean water before using them.

**Fruits and vegetables stored in boxes, baskets, barrels, and bins should be sorted
frequently to remove decayed or spoiled ones. Some fruits such as oranges and apples may be wrapped in separate
papers. The wrappers help to keep
the fruit from bruising each other
and also help to prevent mold.**

**Soft fruits and vegetables such as
berries, peaches, papayas, figs,
tomatoes, and plums should be
spread out on clean wrapping paper
or in shallow pans or platters
rather than deep containers.**

**Potatoes and other starchy tubers should be sound, dry, and free from soil, cuts,
and bruises when put into storage. Wet tubers rot more quickly than dry tubers. Store potatoes in a dark place because light promotes the formation of green skin
and the poisonous glycoalkaloid called solanine in the potato.**

**Potatoes keep better if cured within 1-3 days after harvest. The easiest way to cure potatoes is to keep them in a container with restricted ventilation (to establish a high relative humidity of about 85 percent) for about 15 days at 15 [degrees]C
(60[degrees]F), or 10 days to 20[degrees]F, or 6 days at 25[degrees]F). After curing, fully**

open the container to allow free air movement and store in a cool, dark place.

Fats and Oils

Keep all fats cool, covered, and in lightproof containers. Heat, light, and air help to make fats rancid. Use no iron, copper, or copper alloy vessels or equipment to store or handle fats and oils because traces of iron or copper make them turn rancid quickly.

Fats and oils should be kept dry with no moisture mixed with them. Mold on the surface of fats shows moisture is present. Remove the mold carefully. If possible, heat the fat to drive off the moisture.

Foods like nuts and chocolate, which have some fat, may get rancid. Nuts keep best when left in shells. Keep these foods cool, clean, and dry in light-proof containers.

Peanuts that are much darker in color than the rest of the batch should be thrown out. They are probably contaminated with aflatoxin, which causes cancer of the liver.

Baked Goods <see figure 5>

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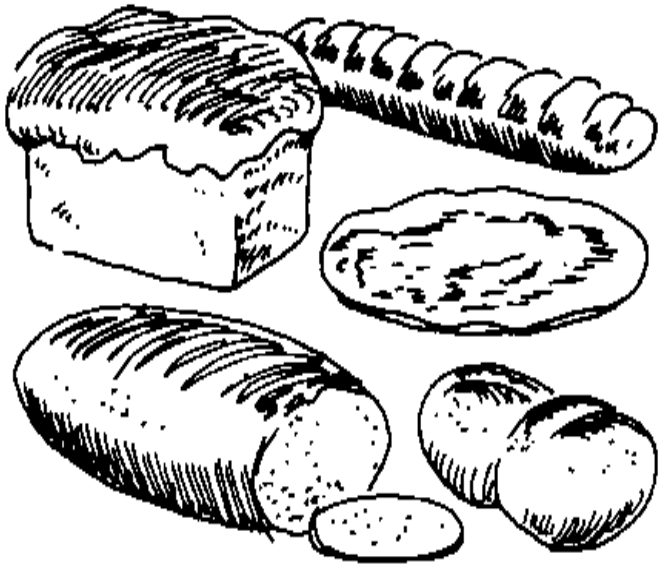

FIGURE 5

Cool bread, cakes, pies, cookies, and other baked goods rapidly after they are taken from the oven. Be sure the place is free from dust and insects. Wrap bread with a clean cloth or paper when cool.

Stored baked goods in a clean tin box or other suitable container off the floor.

Molds grow on bread. Scald and air

the bread box at least once a week. In hot humid weather do not shut the bread box tightly when it is filled with fresh bread.

Store crackers, crisp cookies, pretzels, and other crisp baked goods in airtight containers to retain crispness. A tin can with a press-in lid is ideal. If not available use a sealed plastic bag made from thick plastic.

Dried Foods

Dried meats and dried fruits and vegetables may be kept in closely woven cloth bags if the bags of food are kept in a cool, dry place. If these dried foods are hung in a damp place they are likely to mold.

Properly dried foods are best stored in airtight containers if you live in a humid climate. A tin can with a press-in lid or a large glass jar with a tightly fitting lid will prevent moisture pickup from the humid atmosphere. Look at the product occasionally and check that it is in good condition. If there is any sign of mold it means the food is not dry enough.

Open bags of dried foods should be kept in a pottery or metal container. Seal the container tightly to keep out insects and rodents.

Canned Goods <see figure 6>

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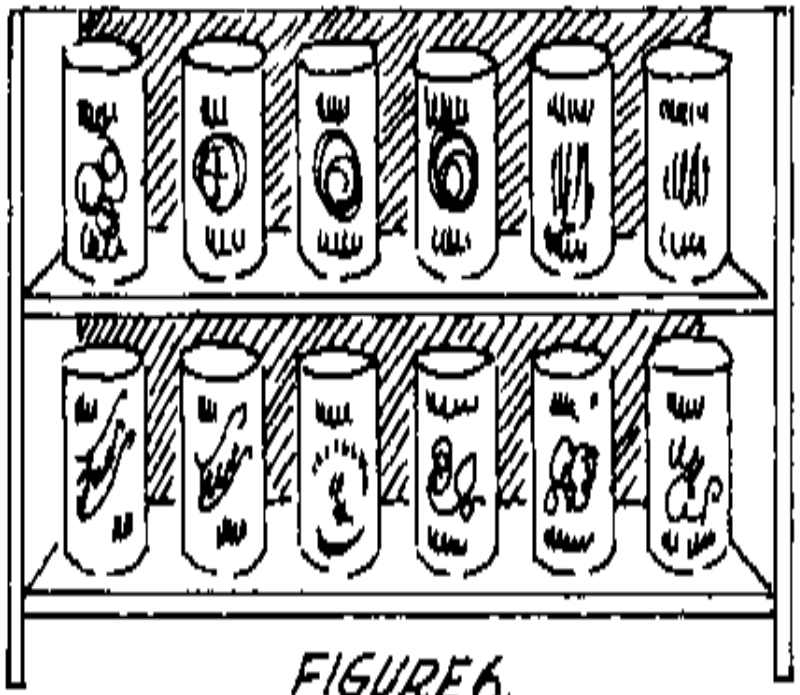

FIGURE 6.

**Canned foods should be kept in a clean, dry, cool place. Destroy any swelled or leaking cans. Do not eat or even taste the food in swelled or leaking cans. Don't
even open the can. Dispose of it.**

The outside of the cans will

become rusty if they are stored in a damp place or in humid atmosphere. The contents of rusty cans are safe to eat provided there are no holes, leaks, or bulges in the cans and the contents appear normal when can is opened.

Leftover Cooked Foods

Moist cooked foods, particularly those made with milk, eggs, meat, or fish, spoil easily. Leftover cooked foods should be cooled quickly. Store in refrigerator, ice chest, or evaporative cooler. Use at the next meal if not refrigerated.

FOOD SPOILAGE

When is Food Spoiled?

Food generally shows when it is spoiled. Check it often. It may have an unpleasant appearance, taste, or smell. Look for these signs of food spoilage:

- **slime on the surface of meats and other moist foods**
- **bad odors**
- **sour taste in bland foods**
- **gas bubbles, or foaming**
- **discoloration**

o liquid that has become cloudy, thick, or slimy
o texture becomes very soft
o signs of mold growth

It is important to destroy spoiled foods as soon as they are found. Throw away any food that has a bad smell. Chopped meat, eggs, and sea food usually spoil rapidly. Watch grains for signs of weevils. Look for insects and mold in dried foods. Destroy the part that has insects or mold at once.

Why Food Spoils

Foods may be spoiled by

o bacteria, molds, and yeasts
o parasites of meat animals
o insects and rodents
o warm air, freezing temperatures, light
o too little or too much moisture
o storing too long

Dirt and careless handling increase food spoilage. Good care of food in the home can help avoid waste. Keep food in a clean and safe place. Bacteria are living things so small you can't seem them. Many are harmful. They live almost everywhere.
Sometimes food is made unsafe because bacteria causing disease have gotten into it. Food can carry these and many other diseases:

o amoebic dysenteries o tuberculosis
o typhoid o diphtheria

o botulism o salmonellosis

People may appear healthy and still carry these disease bacteria in their bodies.
When they handle food, the bacteria may be passed on to the food. Then the food is unsafe for others.

Bacteria need water to live. Removing water prevents their growth. Foods are dried to preserve them. Then they are kept dry. Some foods that are dried are meat, fish, beans, peas, grapes, figs, currants, cereal grains, flour, spaghetti,
noodles and other pasta products, dates. They are dried in the sun or smoked over a fire.

Bacteria, molds, and yeast in foods may be destroyed by heating and some chemical preservatives. They cannot grow in properly dried foods. They grow more slowly at refrigerator temperature than at room temperature.

Molds can he harmful. They grow where it is damp. Molds look like delicate velvety or powdery growths of various colors spread through food.

If meat, cheese, or jam have mold on the surface, cut away the moldy part. The food that is left may be eaten.

Parasites, such as tapeworm and trichina, live in meat animals. The tiny larvae of
these parasites may be in the lean meat. They are waiting to complete their development in the human body or some other place.

Thorough cooking of meat is the best way to destroy these parasites. Preservatives such as salt and smoke do not destroy them. There is great danger in eating uncooked or lightly cooked sausages, for example, even though they have been smoked.

Many chemical substances either destroy certain harmful bacteria or prevent their growth. For food, two of the simplest to use are common salt and sugar. Salt is used for meat and vegetables. Sugar is used to preserve fruits. Sugar and salt have to be used at a high level to be effective.

Insects and rodents eat some food and damage several times as much as they eat with urine, feces, and hairs. They may also leave dangerous bacteria on them.

The house fly spreads typhoid fever, cholera, dysentery, tuberculosis, and many other diseases. Keep flies away from foods. A cloth net fastened to a simple wire frame keeps flies out of contact with food (Figure 7).

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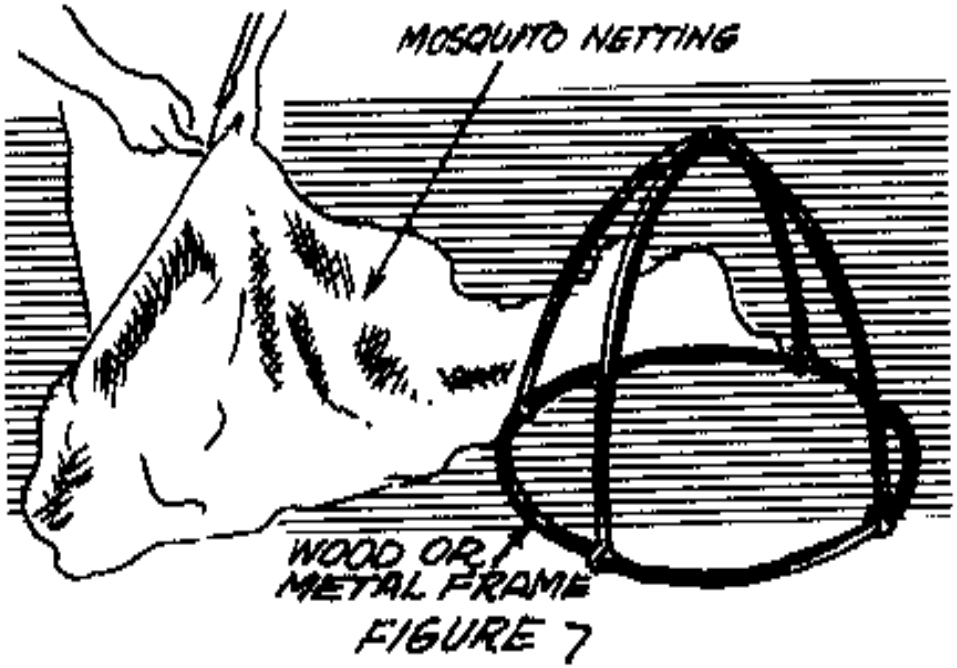

FIGURE 7

The "fly specks" often found on food or dishes may have disease

germs and mice destroy many types of food.

To help keep insect and rodent pests out of food:

o keep food covered or in closed containers
o get rid of garbage and trash
o keep the storage area clean

Poisoned bait, powders, or sprays may be necessary to rid storage areas of household insects and rodents. Ask your health department, sanitation, or other official what pesticide to use, where to get it, and how to use it. These people have special training on how to control household pests. They can help you.

Use pesticides with care. They are POISONOUS to people and animals. Keep them out of reach of children. Never store insecticides in the same place you store food. Always wash off any dust, spray, or solution that gets on you. When spraying, remove dishes, pots and pans, other cooking utensils, and food from the room. If you have a cupboard with solid, tight fitting doors store the dishes and cooking equipment there while spraying. Never use oil spray or solutions near a fire.

Rats and mice can be caught in traps or killed with poison bait. Destroy or block up all places where they are likely to nest and breed. Rodents cannot chew through metal, glass, or pottery containers so try to use containers made from

these materials for storage of food.

Temperature affects food. Fruits ripen more quickly, vegetables become old and wilt more quickly, and nuts, fats, and oils become rancid more quickly as the temperature increases. Insects, bacteria, molds, and yeasts grow more quickly at higher temperature. Therefore, store food in a cool place. Do not store food near a hot stove.

Food in direct sunlight gets hotter and spoils more quickly than food in the shade. Food should never be left in direct sunlight unless it has been put there for a limited time to dry it or to drive out insects.

Freezing temperatures can ruin the texture and flavor of some foods. Frozen potatoes, for example, are watery and have an unpleasant flavor. Frozen and thawed foods are safe to eat but may have an off flavor or bad texture.

Moisture in the air is necessary where green leafy vegetables are stored. If there is not enough moisture in the air, the moisture from these vegetables will evaporate into the air. Then they become wilted or limp and look bad even though they are still safe to eat. These vegetables keep best when stored in a sealed plastic bag or box and kept in a refrigerator, ice chest, or evaporative cooler.

CONTAINERS FOR FOOD

It is very important to have good containers for storing food. Some foods must

**be
stored in containers with tight fitting covers. Generally each food is best stored
in a separate container. Label food containers to save time and avoid mistakes.**

Types of Containers <see figure 8>

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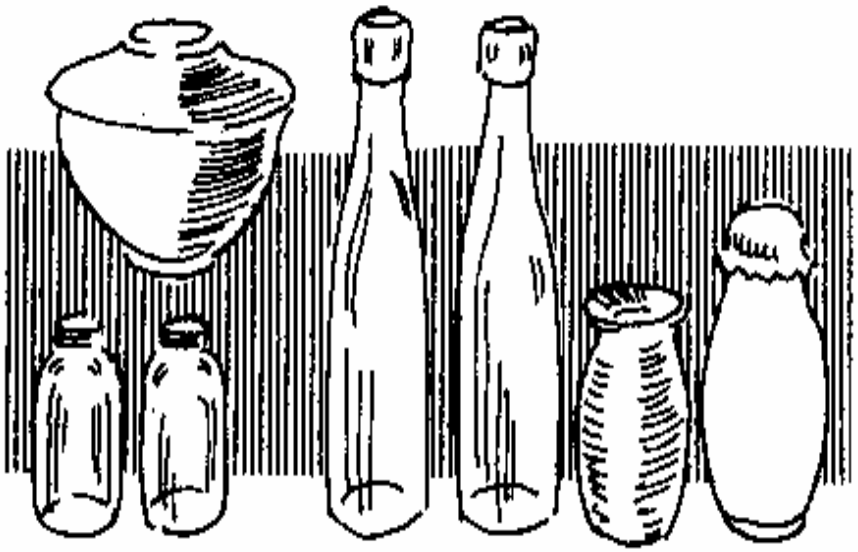

FIGURE 8

Dry foods should be stored in glass, pottery, wooden, or tin or other metal containers. The type of container will depend on the food to be stored and whether the container can be washed. Dry tin quickly to avoid rust.

For moist and watery foods the choice of containers is more limited. Leakage must be avoided You must consider the effect acids in watery foods have on the container, especially metals. A container that can be washed and aired before fresh supplies are stored in it is best.

Pottery jars are good for storing many kinds of food. Jars that are glazed on the inside are best. They can be washed easily. If the jars do not have a tight fitting cover, make one. Use a plate, saucer, or piece of metal. A good cover helps to keep out insects and rodents.

Glass jars with tight lids are also good for storing many foods. Foods that are affected by light should not be stored in glass jars unless the jars can be stored in a dark place. Glass jars can be used again. Wash them in hot soapy water. Rinse them with hot water that has been boiled for 10 minutes. Dry them in the sun if possible.

Bottles are good for storing liquids and some dry foods. In many countries people preserve fruit and vegetable juices in bottles.

Coconuts, gourds, and calabashes may be used for storing some dry foods for a short time. Covers can be made of closely woven materials. Insects tend to eat

away the soft lining of these containers, so they are not good for storing meal and flour for long. Wash these containers often to keep out weevils. Dry in the sun.

A simple cupboard can be made from a wooden box with shelves. The door is made of chicken wire so air can circulate. Use it to store root vegetables and some fruits.

Tin cans of all sizes are good for storing foods. Sometimes the lids of cans containing food have been removed with a hand or mechanical can opener. Then the lid does not fit. If you use these cans to store food, make a cover out of a plate, saucer, or a piece of metal.

Use a food cover to keep out flies and other insects when you store food on a table in an uncovered container. You can make a food cover out of mosquito netting and a metal or wooden frame (see Figure 7). Store foods this way for a short time only.

A bread box may be made of metal or wood. Punch holes in each end for air circulation.

**Open baskets are good for storing fresh fruits and vegetables for short periods. A
light cover is not needed for these foods. <see figure 9>**

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FIGURE 9. IN ETHIOPIA COVERED BASKETS ARE HUNG FROM THE RAFTERS TO STORE DRIED FRUITS AND VEGETABLES AND BREAD.

Care of Food Containers

Food containers must be kept clean. Wash and dry containers before fresh supplies are stored in them.

Water for washing containers should be clean and hot. Use soap or detergent. Rinse the containers carefully with clear clean water. Dry them in the sun if you can.

Do not store food in containers that have held kerosene, gasoline, heavy oil, chemicals, or pesticides.

Containers holding food that does not need to be kept cool may be stored on shelves or on a table.

THE STORAGE AREA

A good storage area is:

o clean and neat o well ventilated
o cool and dry o free of rodents and insects

You may store food in the kitchen in cupboards on open shelves, or in a closet with shelves. Sometimes a separate room next to the kitchen, called a pantry, is used for storing food. Also cellars, caves, and outdoor pits are used in some parts of the world for food storage. <see figure 10>

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FIGURE 10. IN THIS PHILIPPINE HOME SOME FOODS ARE STORED ON OPEN SHELVES. OTHER FOODS ARE STORED IN CUPBOARDS WITH VENTED DOORS SO AIR CAN CIRCULATE.

Good Ventilation

**Ventilation is important for good food storage. Good circulation is needed around
food to carry off odors and to keep the right temperature and the right amount of moisture.**

Keep the Storage Area Cool and Dry

Many fresh fruits soon spoil in a warm place. Then they are unsafe to eat. Cooking oils, table fats, and other foods with fat in them may get a stronger flavor if stored in a warm place. A dry storage area helps to prevent mold on foods such as bread, cheese, and berries. It also prevents rust on tin cans in which food may be canned or stored.

Keep the Storage Area Clean

**There is no substitute for cleanliness. Scrub shelves, cupboards, and floors often.
Paint, whitewash, or line shelves with clean paper. Clean the walls, then paint or
whitewash them. Keeping the storage area clean helps to keep away household pests.**

Remember, cleaning removes insecticides. Apply them again after you clean, not before.

Keeping Foods Cool

Some foods are quite perishable. They are:

o fresh meat, fish, poultry
o some fresh fruits and vegetables
o milk, butter, margarine, cream
o leftover cooked foods

In a warm climate it is best to buy these foods in small quantities and use them quickly rather than store them. If you have to store these foods, keep them as cool as possible. This is one way to keep them fresh and prevent spoilage.

There are several ways to keep foods cool. Some ways work better than others:

1. Mechanical refrigerators are the most effective in cooling and preserving foods, but are expensive and require an outside fuel source.

2. Ice chests come next; if ice is available they are quite effective.

3. Evaporative coolers follow ice chests.

4. Window boxes are the poorest devices.

5. In some situations, it is possible to enclose food in watertight containers and
place in a cool stream or spring.

6. Keep food in shade, out of the sun, if no other means is available to protect it.

Obviously there is direct relationship between effectiveness and price. Each

**family
should install the best cooling system it can afford; that is, option 1 is better
than option 2, but 2 is better than 3, etc.**

The information given in this section will help you to choose a practical way to keep foods cool given your particular situation.

EVAPORATIVE FOOD COOLER

The evaporative food cooler <see figure 1> is

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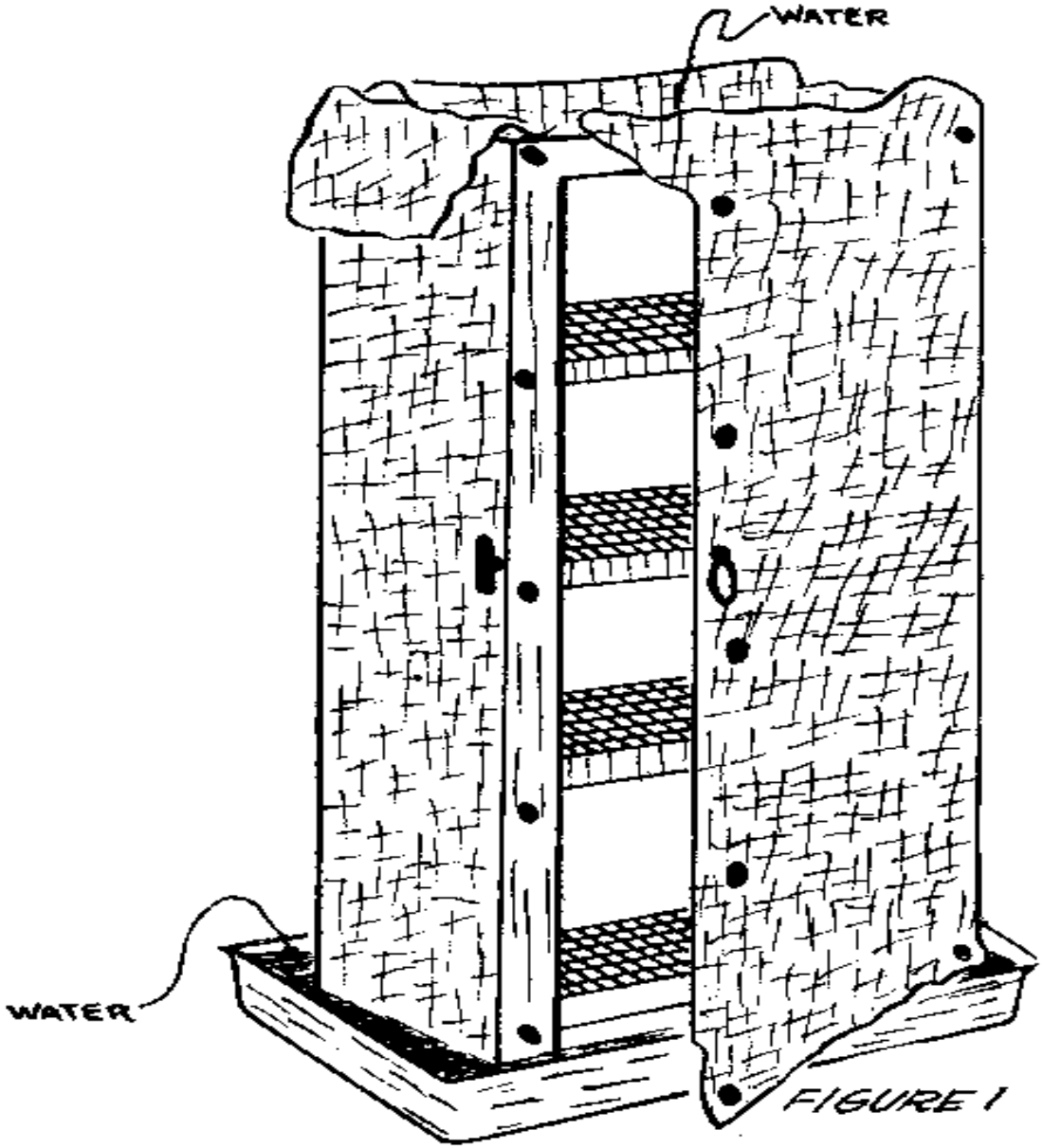

FIGURE 1

cooled by the evaporation of water from its cloth cover. The cloth is moistened as capillary action moves

water from the pans through it.

If the climate is dry and the cooler is kept in a breezy spot in the shade, it will cool food considerably below the prevailing temperature. To be safe, the cooler must be kept clean. The cooler's cloth cover keeps flying insects out. The water-filled lower pan discourages roaches and other crawling insects.

It should be emphasized that coolers based on the principle of evaporation of water need readily available water of reasonably good quality and a low humidity environment. These coolers do not cool in a humid climate.

Tools and Materials

Saw
Hammer
Nails, tacks
Burlap or other cloth: 2m x 2m (78 3/4' x 78 3/4')
Wood for frame: 3cm x 3cm x 13m (1 1/4, x 1 1/4" x 42.7')
Pan: 10cm (4") deep, 24cm x 30cm (9 7/16" x 11 13/16") for top
Screen, hardware cloth, or galvanized iron: 2m x 2m (78 3/4" x 78 3/4")

(nonrusting)
Hinges: 2 pair
Pan larger than 30cm x 36cm (11 13/16" x 14 3/16") for legs to stand in
Paint for wooden and metal parts
Buttons or lacing material for cover

Make the wooden frame to fit the upper pan (see Figure 2). This might be the

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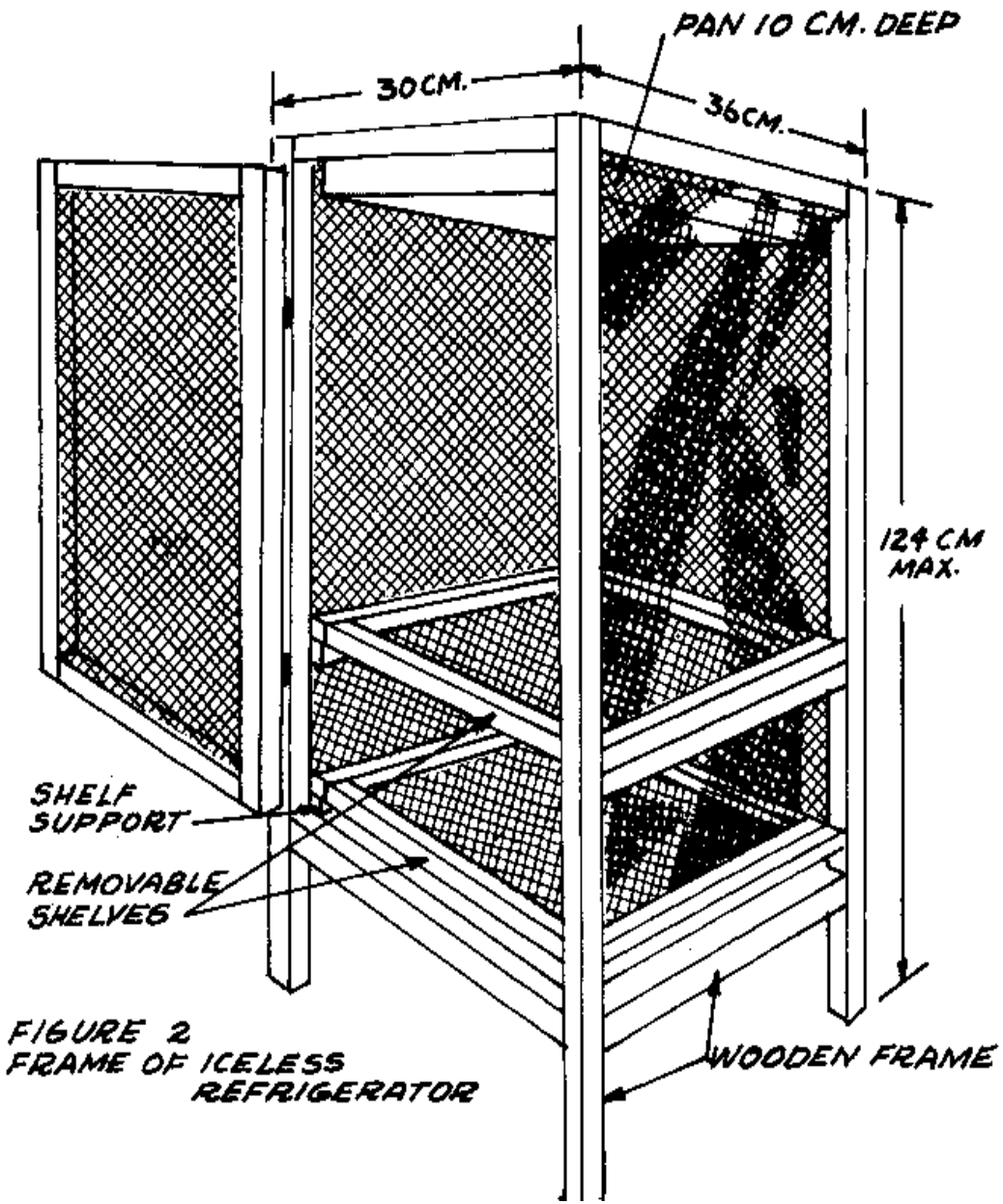

FIGURE 2
FRAME OF ICELESS REFRIGERATOR

**bottom of a discarded 20-liter (5-gallon) oil can. The lip of the pan fits over the
top of the frame to keep the pan from falling into the compartment. Hinge the**

door carefully so that it swings easily, and make a simple wooden or thong latch.

Paint or oil all the wooden parts. The upper and lower pans should also be painted to prevent rust. Cover the shelves (see Figure 3) and frame with screening

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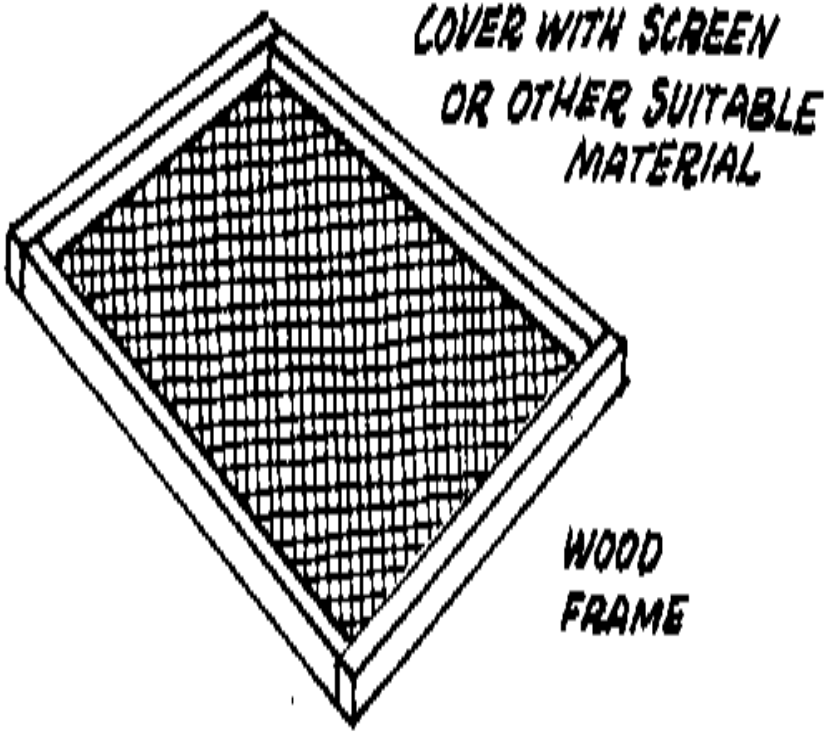

FIGURE 3 SHELF

or hardware cloth and tack it in place.

The frame can be strengthened by putting the screen on diagonally, although this will take more material than applying it with the wires parallel to the frame. Make the shelves adjustable by providing several shelf supports. Flatten the pointed ends of the nails slightly to keep the wood from splitting when it is fastened.

Make two covers of canton flannel, jute burlap (not sisal or henequin burlap), or heavy-grade absorbent coarse cloth to fit the frame. Wash and sun one cover while using the other. On the front, fasten the cover to the door instead of the frame. Allow a wide hem to overlap the door closing. To form wicks that will carry water from the pans into the cover, the top and bottom of the frame and door covers should extend into the upper and lower pans. If the cloth cover does not stay moist, extra pieces of cloth can be placed at the top of the frame to serve as additional wicks.

ICELESS COOLER

A second type of cooler may be made from a basket with a loose fitting cover. It may be made of bamboo or other slender wood with open weave. The size depends upon the family's needs. In addition to the basket, you will need a container to set the basket in. This may be square or round, of earthenware or metal. A clean oil drum could be used. This container should be about 30cm (12") high and wider than the basket. Other materials include bricks or stones and soft jute burlap. To build the cooler (see Figure 4):

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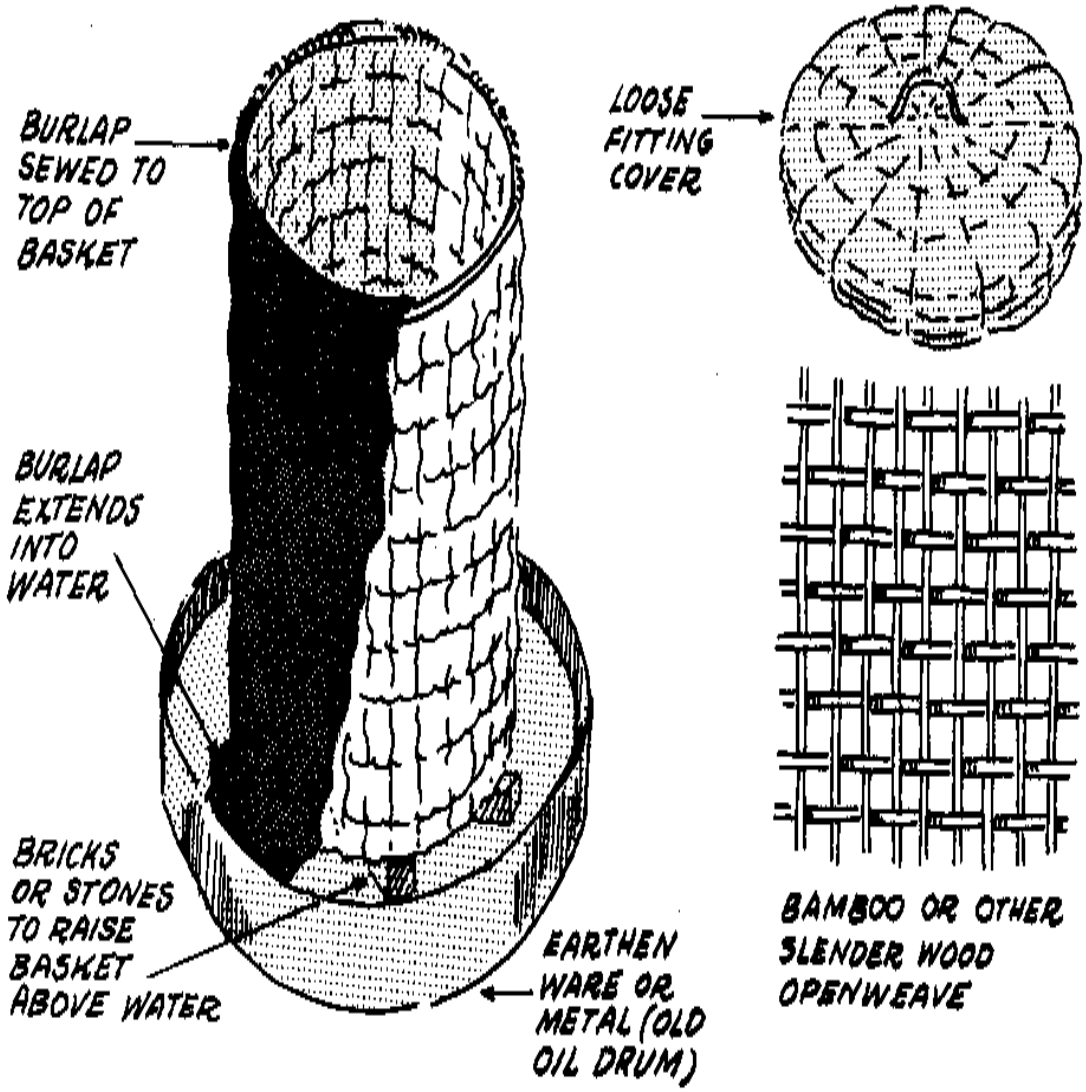

FIGURE 4

o Select a cool place in the kitchen away from the stove for your cooler.

o Place the outer container here.

o Arrange the bricks or stones in the container so the basket will balance evenly on them.

o Sew burlap around the rim of the basket. Let it hang loose around the bottom and extend into the earthenware or metal container.

o Sew burlap loosely over the cover of the basket.

**Set the basket on the bricks. Place food in the basket. Cover. Put water in the bottom of the container. Wet the cover of the basket the first time the basket is
used. Later do this just occasionally. The basket itself should not be in the water.
The burlap cover should hang down into the water.**

WINDOW BOX

**In some countries window boxes are used to store foods during the cool months of the year. They must have good ventilation and tight covers to keep out rain or
snow. An ordinary light wooden box may be used or you can make one. <see figure 5>**

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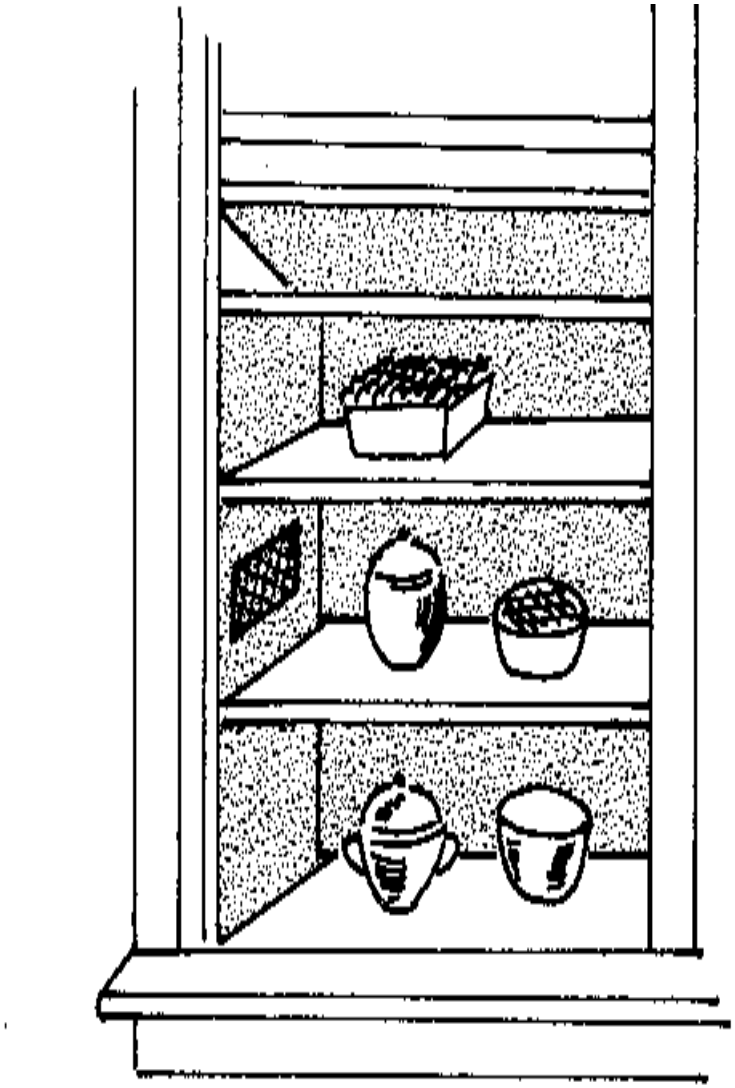

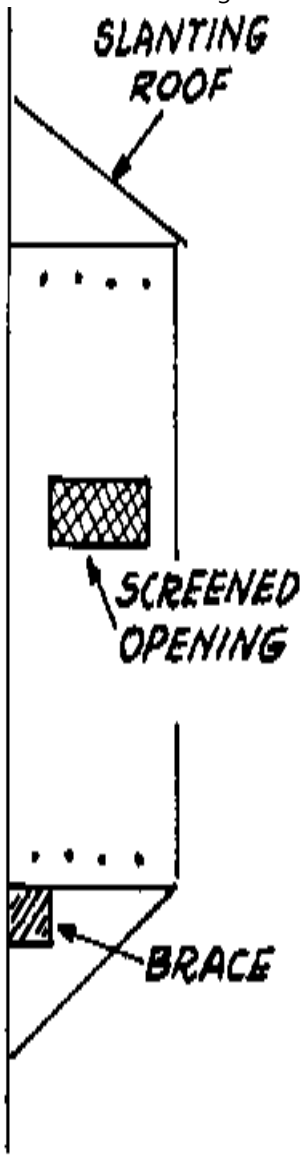

FIGURE 5

To install a window box

o Fit the box to the outside of the window. The window is the door. Select the window that is in the shade longest during the day. Keep the window closed when the box is not actually in use. This will keep the box from getting too warm and the room from getting too cold.

o Put a shelf on the window sill. Support the shelf with wooden braces.

o Set the box on the shelf. Fasten the box to the window case with screws or nails.

o Fit a sloping top over the box to shed the rain.

o Make holes in the end of the box so air can circulate. Screen the holes.

o Shelves may be made of heavy screening, poultry wire, or wood.

o Rest the shelves on cleats fastened to the sides of the box.

o Paint the box inside and out. It will be easier to keep clean. Wash the inside with soap and water from time to time.

o Food placed in the box should be in clean covered containers.

A similar food storage closet may also be built on the outside of the house. You can make it open into a room by a special door through the wall.

OTHER WAYS TO KEEP FOOD COOL

A mechanical refrigerator is ideal for storing perishable foods. However,

**refrigerators
are not available in all parts of the world and are often very expensive to buy and operate. Where a refrigerator is used, it needs special care.**

Clean and defrost it regularly. To do this, turn it off. Allow the ice to melt. Wash the inside of the refrigerator thoroughly, using warm water and soap. Pay special attention to the corners.

**An ice chest can be made at home. Line a wooden packing case with galvanized iron. You will need to put insulation between the wooden box and the iron to keep out heat. Use sawdust, cork, or similar material. Be sure to insulate the top
and bottom as well as the sides. Make a hole at the bottom for water to drain out as the ice melts. Keep the ice chest clean. Wash it with soap and water often.**

To pack the chest, allow at least one fourth to one third of the volume of the chest for the ice. Block ice lasts longer than chopped or crushed ice. Keep the packed chest out of the sun and away from sources of heat. Cool cooked foods to room temperature before placing them in the chest.

A wooden keg lined with cement makes a good food cooler. You may store leafy vegetables such as spinach and lettuce here. The vegetables can be kept in a strong paper or plastic bag. Hang the bags on a hook screwed into a cover of the keg. Fill the bottom with water.

On some farms cold water pumped from deep wells may first be used to cool foods, by running it through a suitable storage box. Also, a house or box may be built over a spring or brook to keep foods cool.

Special wells or caves are sometimes built for cool storage of foods. <see figure 6>

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FIGURE 6 THIS IS A SIMPLE COUNTRY ICELESS COOLER USED IN INDIA. YOU CAN MAKE IT EASILY WITH TWO DIFFERENT SIZED POTTERY JARS. PUT WATER BETWEEN THE JARS. COVER THE TOP WITH PALM, BANANA OR OTHER LARGE LEAVES.

Storing Vegetables and Fruits For Winter Use

In some countries the climate is too cold to grow foods the year around. Farmers and gardeners in many parts of the world have found good ways to store some vegetables and fruits.

Some of their methods may be ones you will want to study and tell others about. An agricultural adviser can help you decide which type of storage is best for your climate and the foods grown in your area. Storage methods described here are practical only in areas where outdoor winter temperatures average -1[degrees]C (30[degrees]F) or lower. They do not work when the climate is warm all year long.

Some vegetables, like tomatoes, can be planted late in the season so that they can be picked just before frost. If picked when white or turning red, tomatoes will ripen in a warm room. To store them for longer periods, they can be packed in boxes of sawdust; when they are to be used, the boxes are opened and the tomatoes are put in a warm room to ripen.

Dry bean seeds can be kept for winter use by picking the pods as soon as they are mature and spreading them in a warm, dry place until dry. The beans are then shelled, stored in bags, and hung in a cool, dry, ventilated place until needed. Cellars are usually too damp for storing dry beans. Dry beans of all kinds, soybeans, and peas can be stored this way. Keep the beans as dry as possible.

Root crops such as beets, carrots, celery, kohlrabi turnips, winter radish, and horseradish are not stored until late fall. When the soil is dry, the roots are pulled and the tops are removed. Cone-shaped pits make good storage places for root crops in areas where they can be kept from freezing. Turnips may be left in

the garden until later than most crops but are hurt by alternate thawing and freezing. Parsnips may be left in the ground until needed as freezing does not hurt them, but put a few in storage for use when the ground is frozen.

Sweet potatoes store best in a warm, moderately dry place. A small supply can be placed near a cooking stove of a warm chimney or some other place where the temperature will stay around 12[degrees]C to 15[degrees]C (55[degrees]F to 60[degrees]F).

Late maturing pumpkin and squash can be kept in rows out of doors until late winter. They can also be kept on shelves in an area with a temperature ranging from 12[degrees]C to 15[degrees]C (55[degrees]F to 60[degrees]F).

Some helpful pointers on storing fruits and vegetables:

o Different vegetables and fruits need different storage conditions and methods

o Anything showing decay or injury should not be stored.

o Vegetables and fruits will dry out unless the storage place is damp and the temperature low but not freezing.

o Ventilation not only changes air and removes odors, it also helps maintain desirable temperature and humidity.

o Windows and ventilators should be kept open when temperature is not freezing.

o Walls and ceilings should be insulated so moisture will not condense and drop on stored foods.

The following sections show how to build some kinds of storage facilities.

POST PLANK CELLAR

This type of storage cellar is low in cost, but does not last long because the wood will decay. (See Figure 1). If creosote or other waterproofing material is

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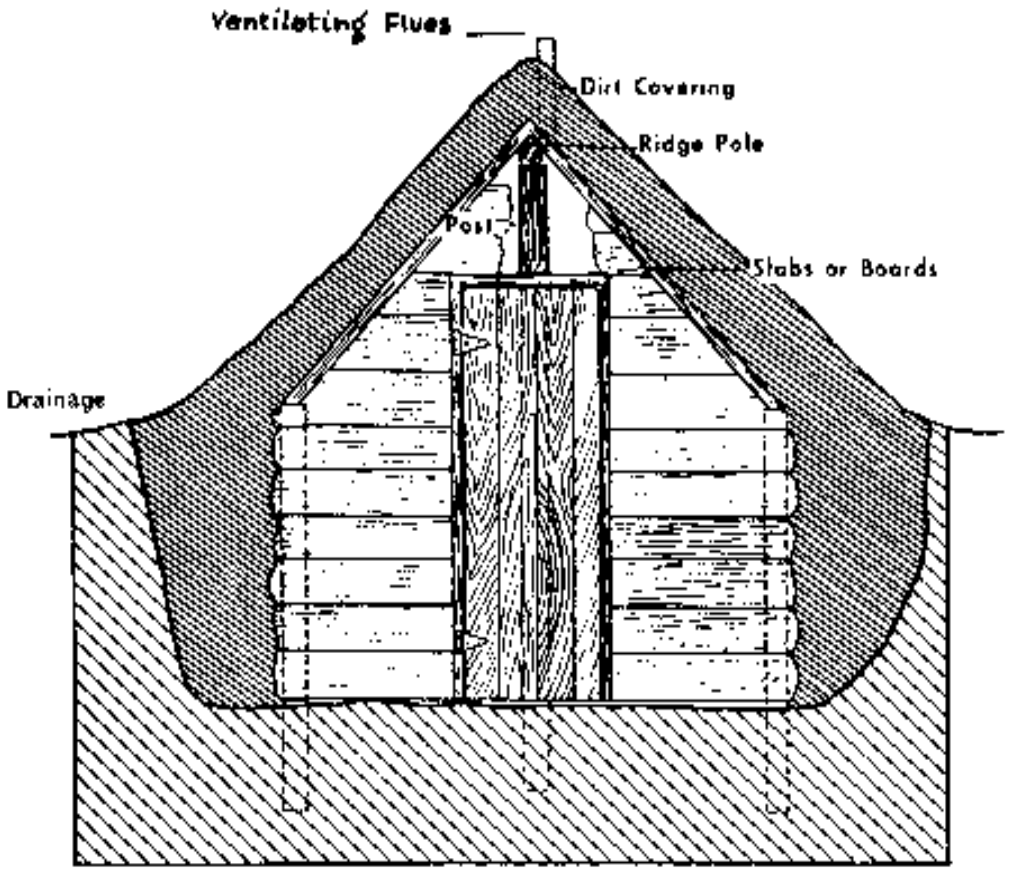

FIGURE 1

available, paint the wood with it to slow down decay.

o Dig a hole big enough to hold the foods to be stored and 120cm (4') deep.

o Keep the soil piled nearby to use to cover the roof and bank the sides.

o Set two rows of posts of the same height in the bottom of the pit near the side walls.

o Set a middle row of posts about 150cm (5') higher than the outside posts. Put a ridge pole on the center row. Lay planks on the two outside rows.

o Next place a roof of planks.

o Close the ends and cover the whole cellar except the door with soil. The door may be made of planks or other durable material. The thickness of the cover depends upon the climate.

o Be sure that water drains away from the cellar. Extend a pipe from the storage area up through the dirt for ventilation.

CABBAGE PITS

A good way to store cabbage, collards, and other greens is in a pit made of stakes and poles covered with straw (see Figure 2).

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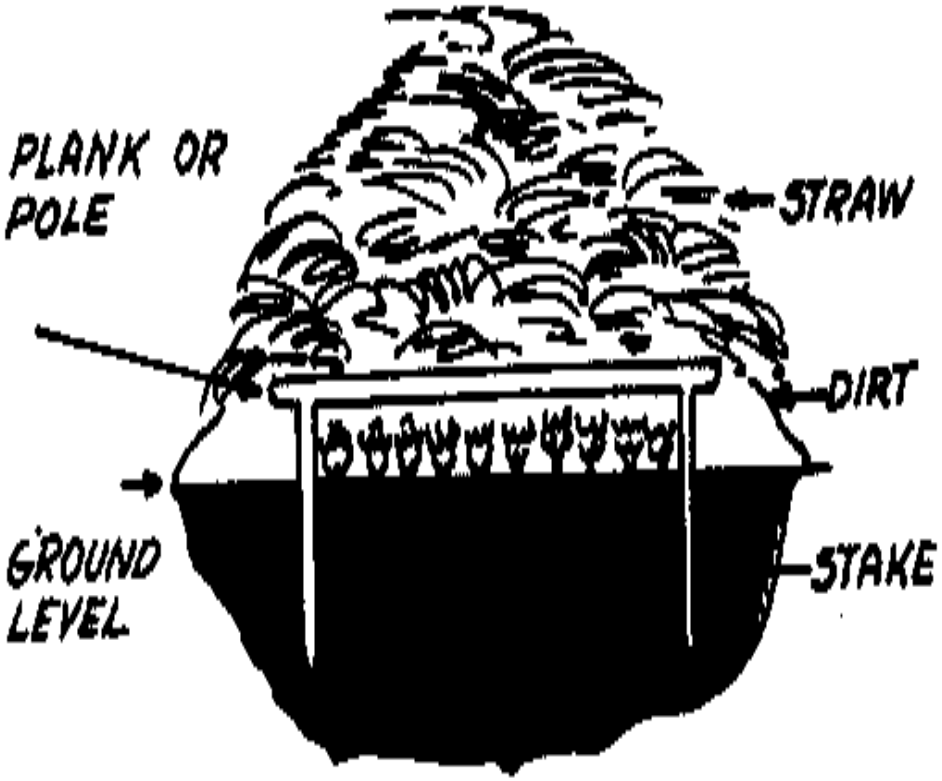

FIGURE 2

o Dig a trench long enough to hold the number of cabbages to be stored.

o Pull the plants by the roots and set them side by side in

the trench.

o Pack soil around the roots.

o Build a frame about 60cm (2') high around the bed. This may be of boards, poles, or stakes driven into the ground.

o Bank soil around the frame.

o Place poles across the top to hold a covering of straw, hay, leaves, or corn fodder.

Cabbages can also be stored above ground in an area protected by drains from excess moisture (see Figure 3). Cabbage plants are pulled out by the roots, placed

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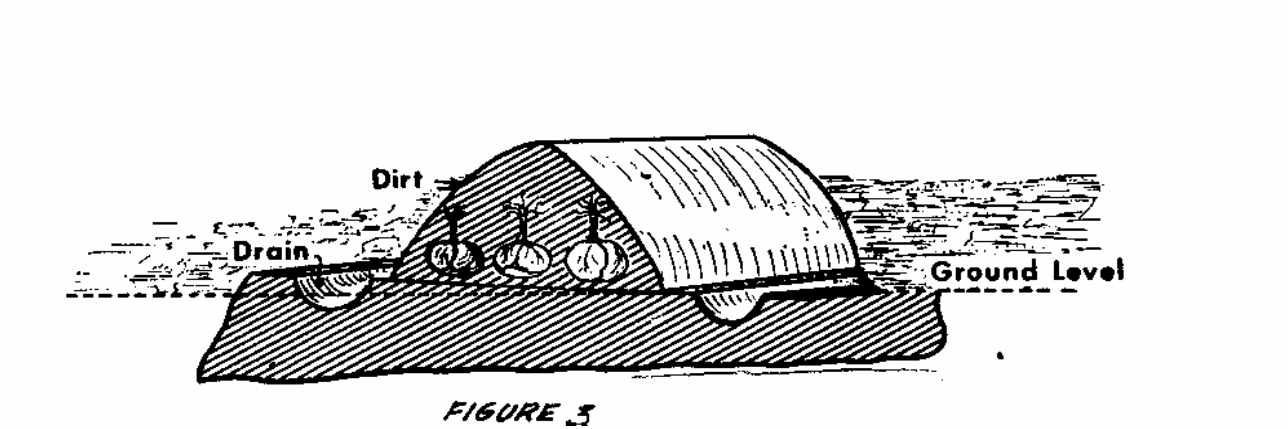

FIGURE 3

head down in the storage area and covered with soil. The advantage of this method of storage is that you can remove a few heads of cabbage without

disturbing the rest of the pit.

STORAGE CONES

o Build the cones either on the surface of the ground, or in a hole 15cm to 20cm (8" to 10") deep in a well-drained location.

o Spread a layer of clean straw, leaves, or similar material on the ground.

o Stack the food to be stored on the litter in a cone-shaped pile.

o Cover the food with more straw, leaves, etc.

o Cover the entire pile with 7cm to 10cm (3" to 4") of soil.

o Firm the soil with the back of a shovel to make it waterproof. More soil may be needed in very cold weather.

o Dig a shallow drainage ditch around the cone to carry away water.

o Ventilation or air circulation is necessary.

Small cones with 100 to 150 liters (a few bushels) of vegetables will get enough air if the straw between the vegetables and soil extends through the soil at the top opening. To keep out rain,

cover the top with a board or piece of sheet metal held with a stone. <see figure 4>

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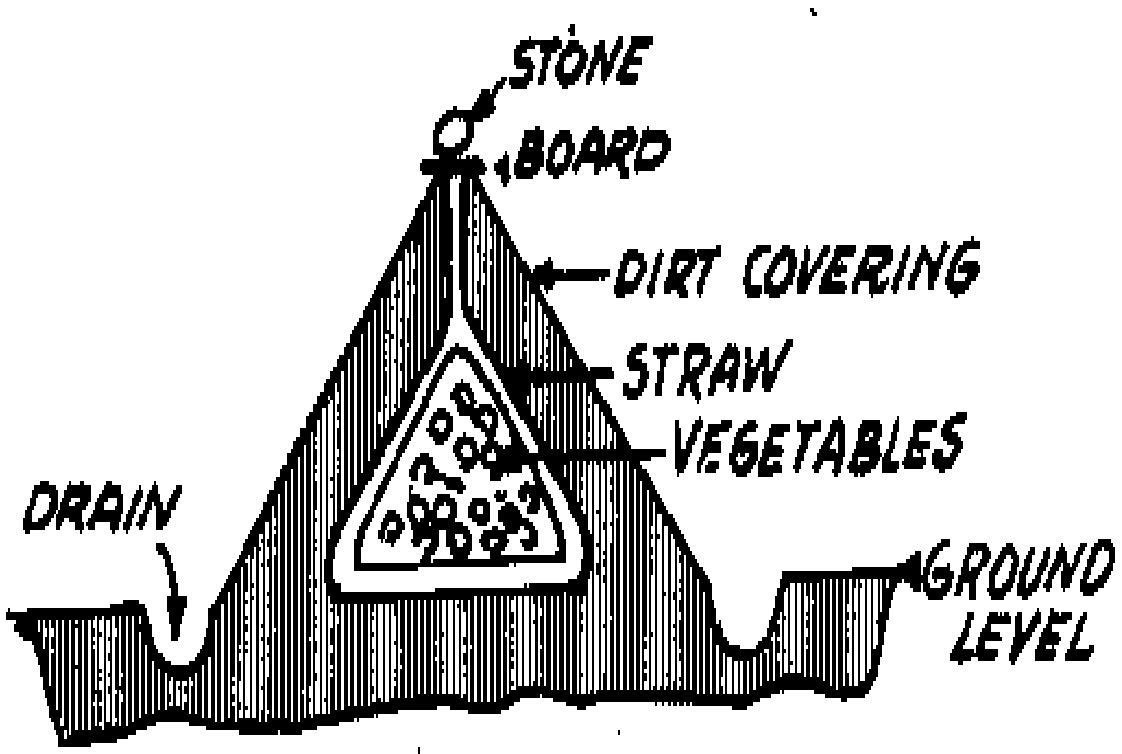

FIGURE 4

Large cones - Place two or three rough boards or stakes up through the center of the pile of vegetables to form a flue. Cap the flue with two boards nailed

together at right angles.

o Opening the cone - Once the cone is opened it is best to remove all the food at once. It is better to make several small cones rather than one large one, and place small amounts of vegetables in each cone. When several kinds of vegetables are stored in the same cone, separate them with straw or leaves.

o Cones should be made in a different place every year to avoid decay from spoiled food left in an old cone.

Fish Preservation

Fish can be an important source of protein, and more and more people are adding fish to their diets. Whether fish are caught from the sea or raised in a pond, a problem many people face is that they have more fish on hand at one time then they can eat or sell fresh.

If the proper equipment and a reliable supply of energy are available, fish can be kept for long periods by canning or freezing. Without these resources, salting and/or smoking are good low-cost choices for preserving fish.

Whichever method is chosen, quality and cleanliness are especially important:

o The quality of the fish to be preserved--the fish must be top quality, salting and smoking will not help poor quality, old, or rotting fish; and

o Cleanlines in all operations--all water used must be unpolluted; all waste

must be removed from working and drying areas; whatever comes in contact with the fish, including all the equipment, must be kept clean.

SALTING FISH

Salting, one of the oldest methods of preserving food, is an art as well as a science. The process of salting fish is influenced by weather, size and species of fish, and the quality of salt used. Therefore, experience is needed to adapt the process outlined here to your situation. Start by salting small lots of different varieties of the available fish. By salting small amounts of fish at first, you will learn how much time is required for each step. Salted fish, if properly packed to protect it from excessive moisture, will not spoil.

One word of caution: Start by salting non-fatty, white-meated varieties of fish. The salting of fatty fish brings up problems of rancidity, rusting, and spoilage that can be handled better after you have experience in salting.

The process of salting fish has four operations:

- **Preparing the fish**
- **Salting**
- **Washing and drying to remove excess salt**
- **Air drying**

IMPORTANT POINTS TO REMEMBER

o Use only top quality fish
o Work cleanly
o Work fast
o Keep the brine saturated--when in doubt, add more salt.
o Try to follow local custom in style and length of cure
o All water used must be unpolluted

Tools and Materials

A clean sharp knife

Salt: the amount varies with local conditions, but figure about 1 part salt (by weight) to 5 parts of raw, prepared fish. Use good quality salt. Salt that is dirty,
discolored, or has a bitter taste is unsuitable for salting fish.

Clean containers for washing fish

Clean, flat working surfaces; such as tables

Clean containers for removing waste

Waterproof vats: one or more, depending on the amount of fish to be salted. The dimensions are not too important; a good size is 183cm x 152cm and 91cm deep (6' x 5' x 3'). But fish can be salted in a container as small as a wide-mouthed glass jar. Metals other than stainless steel should not be used. Wooden boxes will
work because moisture will swell the wood and seal it effectively.

Clean boards and weights (for pressing).

Clean slats or lines for hanging fish (see Figures 3 and 4).

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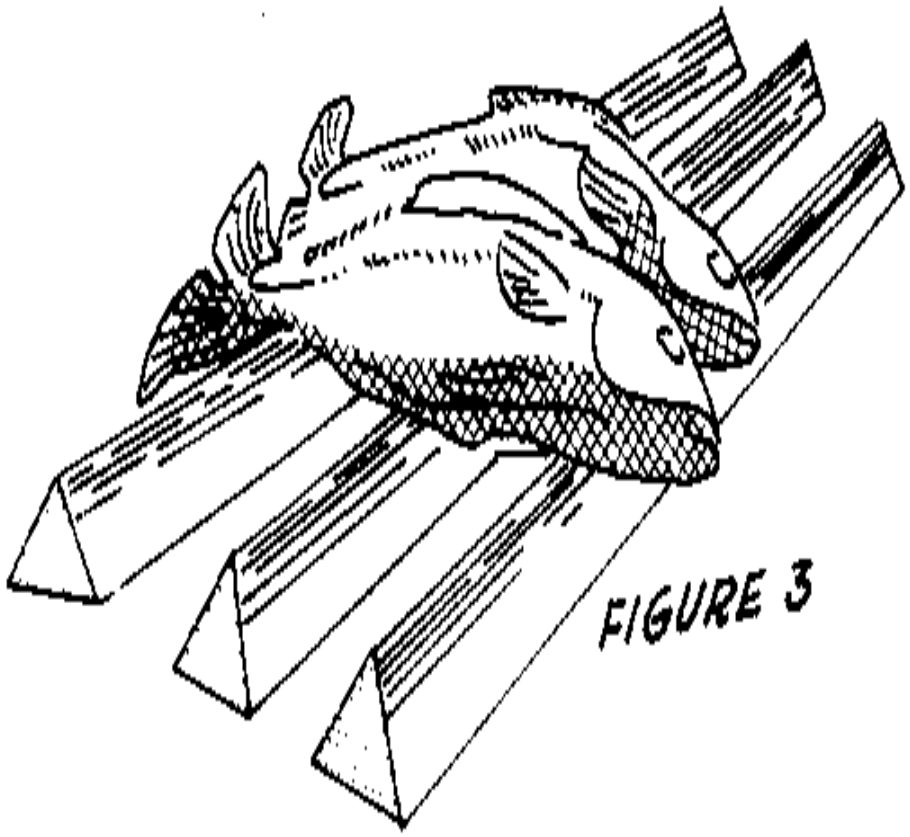

Portable thatch-roof shelters or small roofed sheds (see Figure 5).

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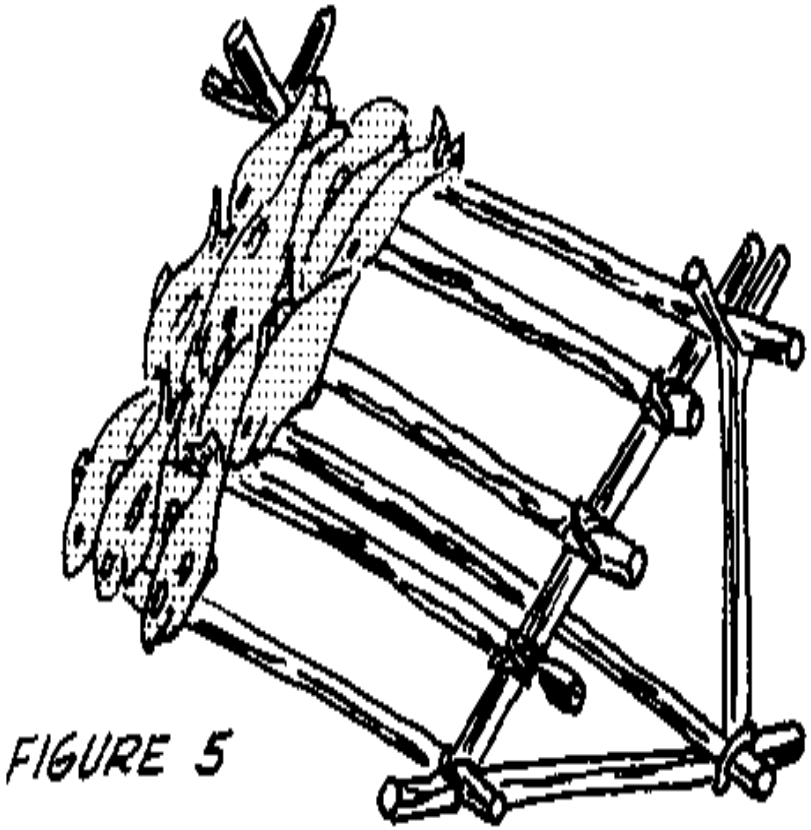

FIGURE 5

Preparing the Fish

Fish should be gutted and beheaded as soon as possible after catching.

Remove the head by cutting it off on a slanted line following the gills. Sharks can be beheaded at the last line of gill slits. (Only the "wings" of rays or skates

are usually considered edible.) Fish that weigh 250gm (1/2 pound) do not have to be beheaded but they should generally be gutted. Local custom will determine whether or not they should be beheaded.

In gutting a fish, cut from the gill cavity along the ventral fold to the anal vent (see Figure 1). All the

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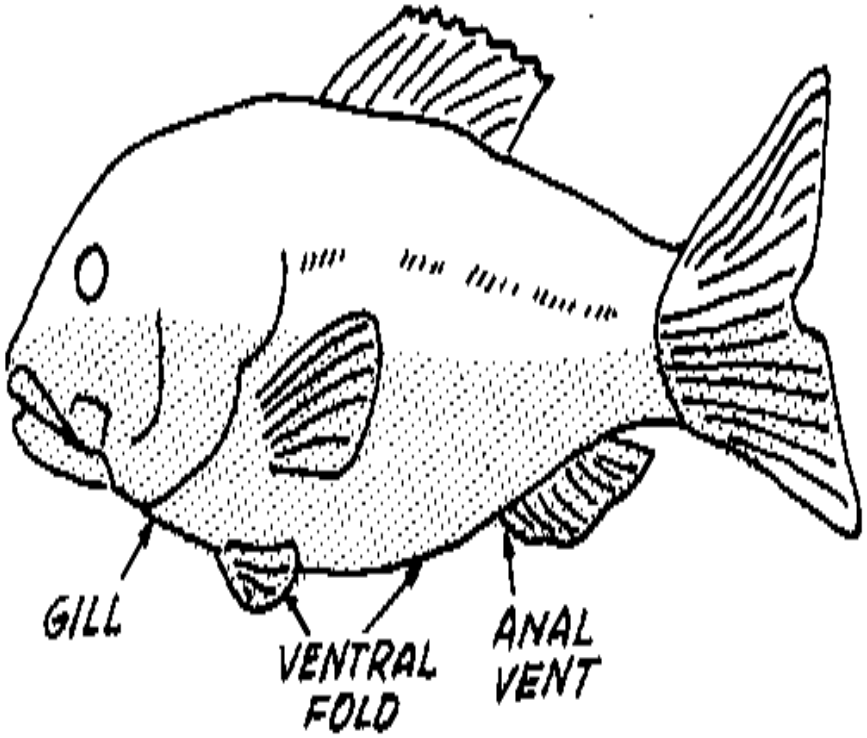

FIGURE 1

guts must be removed. It is also good commercial practice to remove the black membrane located in the visceral cavity (the hollow in the body of the fish which contains the guts) of many species.

The next step is to bleed the fish. All species of fish must be thoroughly bled: if the head has not been removed, cut the throat; remove the gills and all blood

vessels. Blood clots can cause discoloration, as well as bacterial infection that would make the fish unfit for eating.

Cut the fish according to local custom. As a rule of thumb: under 0.5kg (1 pound), the fish may be left whole; from 0.5kg to 5kg (1 to 10 pounds) it should be split in half from head to tail (see Figure 2);

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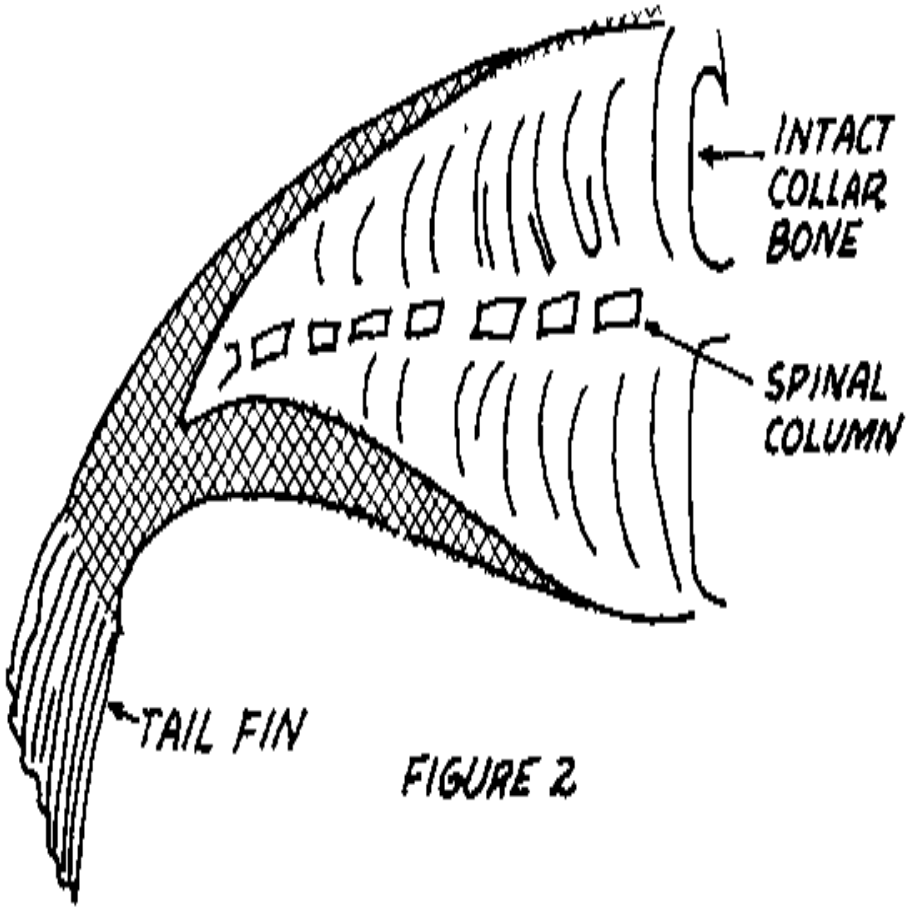

FIGURE 2

over 5kg (10 pounds), split the fish in two again from head to tail. The collarbone behind the gills should be left intact when a fish is split in half.

Salting

To salt fish, follow these steps carefully:

o Sprinkle a thin layer of salt in a waterproof vat. Use just enough to cover the bottom completely.

o Place a layer of fish, FLESH side up, with enough room for each fish to avoid overlapping. Try for a neat pattern, alternating head to tail and tail to head.

o Cover the fish with salt - a thin layer, but with no open spaces.

o Continue to layer the fish flesh side up, up to two or three layers from the top of the vat.

o Reverse the fish, packing them SKIN side up to the top of the vat, alternating with layers of salt. The top layer must be salt.

o The salt will extract moisture from the fish, forming a brine. Use boards and weights to keep all the fish under the salt.

o The brine must be kept saturated (90 on a Salinometer, or when no more salt can be dissolved) at all times. As moisture is extracted, more salt must be added to keep the brine saturated. With too little salt the fish will spoil.

**As moisture is extracted from the fish, the level of fish in the vat will fall. More
fish can be added, skin side up, alternating a layer of fish with a layer of salt,
the top layer always being salt. Continue to add salt to keep the brine saturated.
The fish are "struck through," or thoroughly salted, in 12 to 15 days in warm**

weather. In cold weather, the fish should stay in the brine for 21 days or more; in the tropics, 15 days may be a good limit. The higher the temperature, the quicker the fish will be struck through. When properly salted, the flesh of the fish is translucent but the eyes are opaque and no longer translucent. The flesh is
firm but yields to gentle pressure. It has a whitish salt cover. An odor of fish and brine should prevail. There should be no spoilage odors.

Washing and Drying to Remove Excess Salt

o When the fish are struck through, remove them from the vat and wash in unpolluted sea water or fresh brine to remove excess salt.

o Then place the fish on flat surfaces, using any arrangement of boards and weights to press them as flat as possible:

- to remove excess moisture; and

- to make the fish thinner, which will reduce the length of the air-drying process and improve the appearance of the fish for marketing.

Air Drying

The final drying can be done either by sunlight and natural air currents or by artificial heat and air currents generated by fans. In most areas, in the proper season, drying can be done outdoors in the sun and fresh air. Choose an open area to get the most sunlight and wind. Avoid swampy areas, locations near human or animal waste, and, especially, fly-breeding areas.

When freshly salted fish is first brought out to dry, there is danger of sunburn.
If fish is exposed at this stage to the direct rays of the sun, it may harden on the outside and turn yellow. This will keep the inside from drying properly. To avoid this, keep the fish under shade or semi-shade for the first day.

After the first day, expose the fish to as much sunlight and wind as possible. One
method is to lay the fish on triangular slats--so that the fish rests on the least
possible amount of surface--fresh
side facing the sun (see Figure 3).

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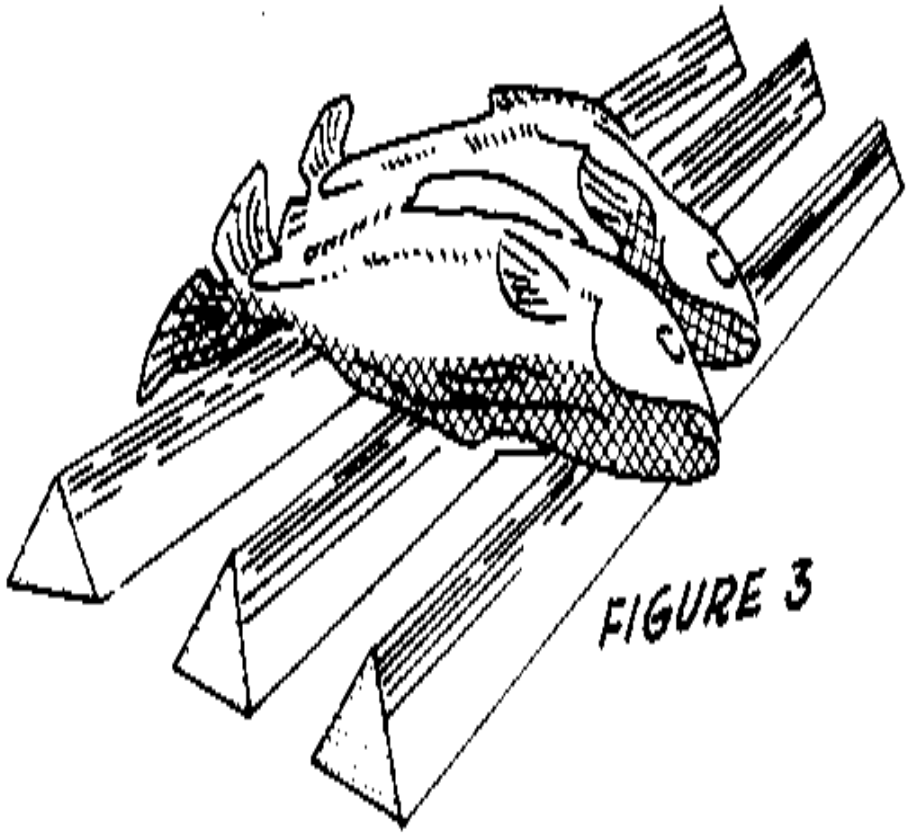

FIGURE 3

Another method is to hang the fish by the tail (see Figure 4).

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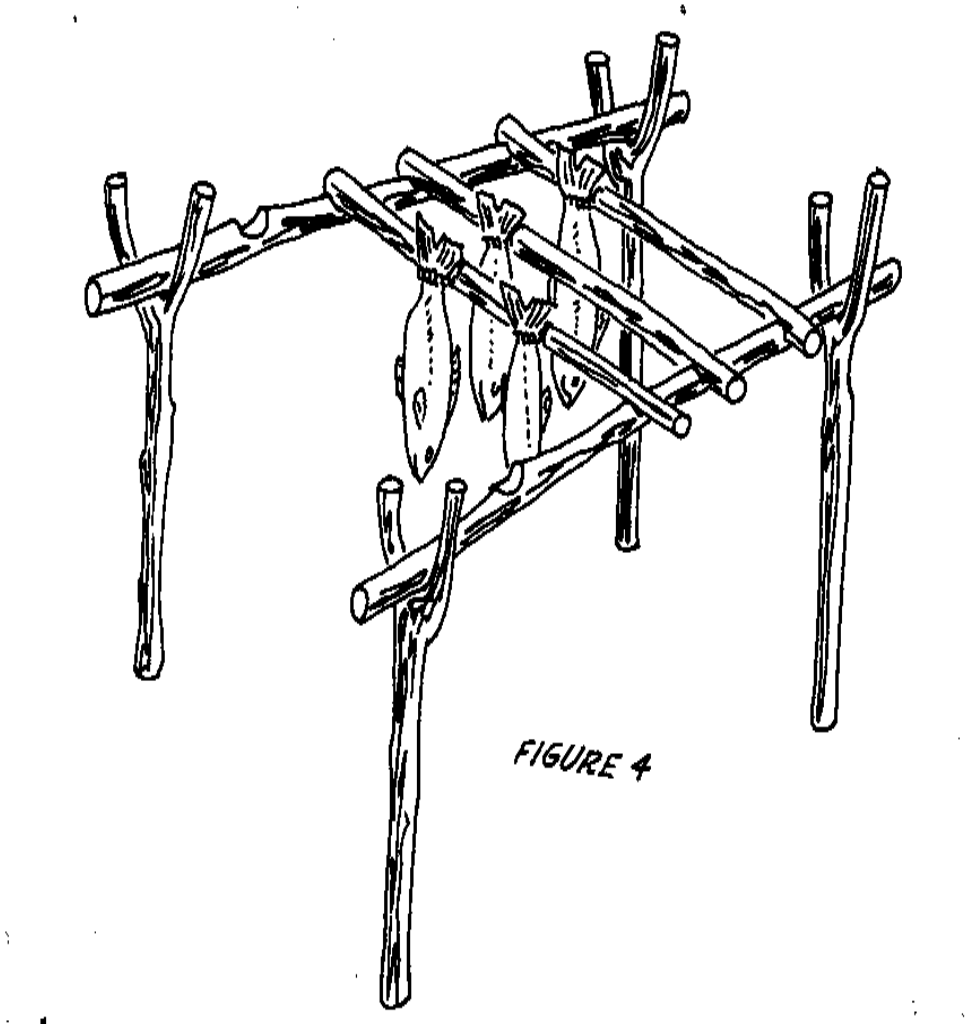

Protect the drying fish against dampness. The fish can be sheltered by portable thatch roofs (see Figure 5) or moved into small roofed sheds built nearby for

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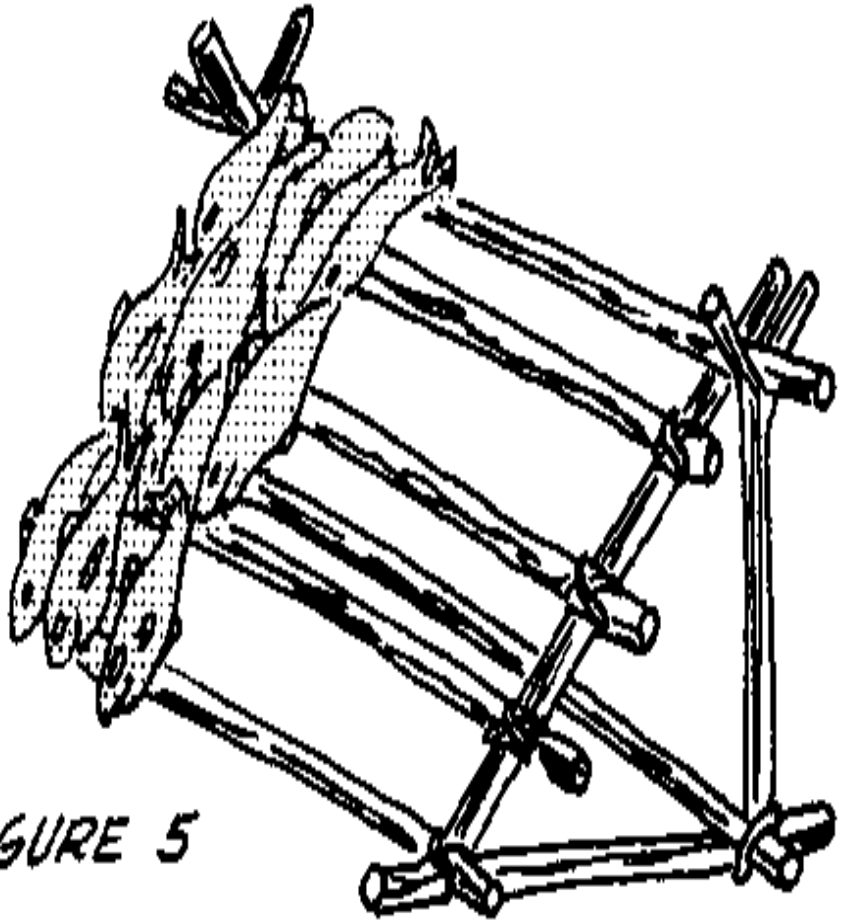

FIGURE 5

protection from rainfall and night-time dampness. The fish should be free of discoloration, mold, or other defects. Split fish should not have ragged edges.

Generally, six warm days with winds of more than 5km (3 miles)

per hour should dry the fish enough to prevent spoiling in storage or shipping, provided the fish is properly packed to protect it from excessive moisture.

Using Salted Fish

Salted fish is usually soaked overnight, with at least one change of water, to remove most of the salt before it is eaten. The longer it is soaked, the more salt is removed. Then it is used in the same way as fresh fish, except that it is not good for frying.

Source:

Daniel Casper, Product Manager, Seabrook Farms, Co., Seabrook, New Jersey

SMOKING FISH

Smoked fish does not last as long as salted fish, and must be refrigerated, frozen, or canned if it to be stored for any length of time. Smoked fish are prepared in a smokehouse, which is simply a shed or box over a fire that is controlled so that it produces smoke instead of flames. The fish are hung inside the smokehouse so that they are surrounded by smoke. It takes about six hours to smoke fish for eating or storage.

Prepare the fish as you would for salting. Bleed and gut the fish and split them from head to tail. Wash the fish in fresh, clean water. Place in a salt water brine for about one hour. Remove the fish from the brine and wash again in clean fresh water. Drain, and hang in a cool breezy place for about an hour.

Build a fire in the smokehouse. When the fire is burning properly--that is, producing lots of smoke-place the fish on hooks and hang or tie them in the top of the smokehouse. Make sure the fish are placed securely so they will not fall. Watch the fire carefully to make sure that it is smoking the fish and not burning them--and also to be sure that the smokehouse itself doesn't catch on fire.

After the fish are smoked for about six hours they can be eaten immediately, stored in jars (to be canned), or frozen or refrigerated until they are eaten.

Smoked fish do not last as long as salted fish, so do not smoke all of the fish unless it will be used soon after harvest. <see figure 6>

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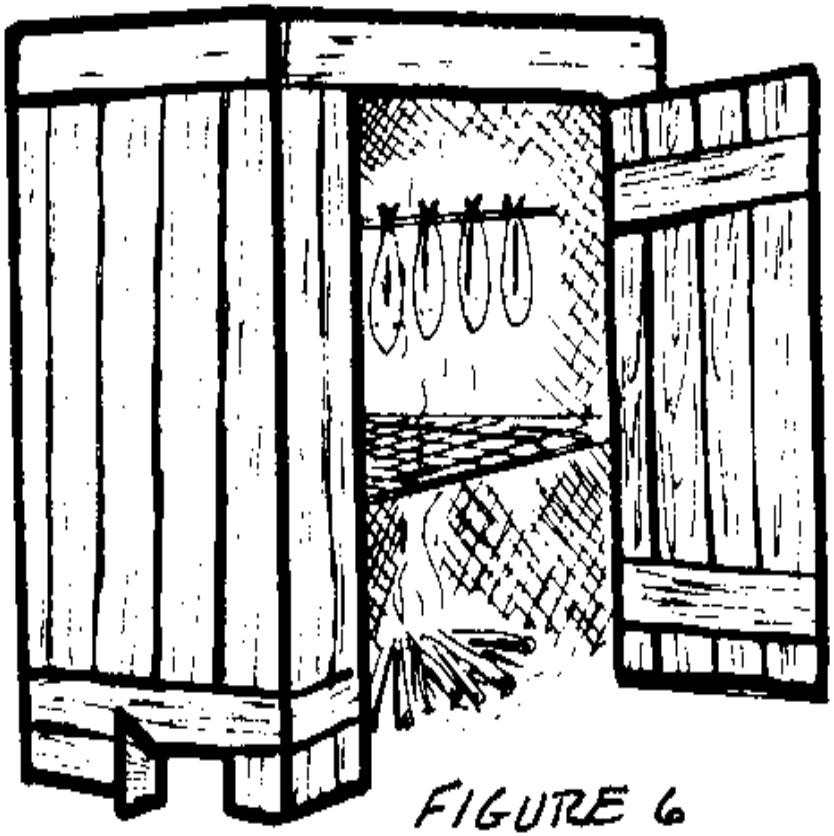

FIGURE 6

Source:

Chakroff, Marilyn. Freshwater Fish Pond Culture and Management. Arlington, Virginia: Volunteers in Technical Assistance, 1978.

**Carruthers, Richard T. Understanding Fish Processing and Preservation. Arlington,
Virginia: Volunteers in Technical Assistance, 1986.**