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A Cookbook for Building a Solar Food Dryer

by Arnold and Maria Valdez

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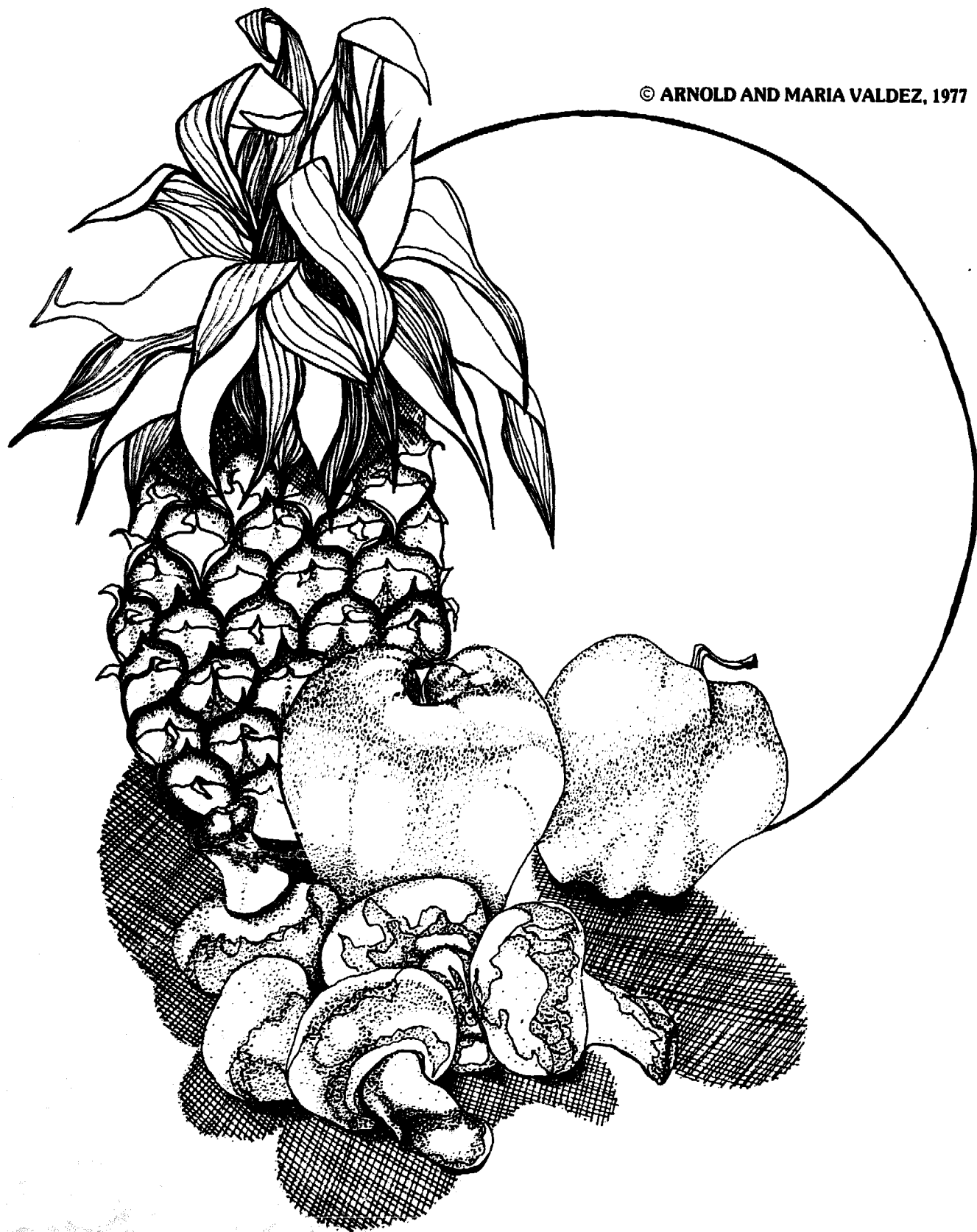
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A Cookbook for Building A Solar Food Dryer

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a cookbook for building a solar food dryer



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Printed by O&V Printing, Inc.
623 4th Street, Alamosa, Colorado 81101

Selecting, Drying and Storing Dehydrated Foodstuffs

WHY DRY: AN INTRODUCTION

Food drying as food gathering has been one of mankind's basic instincts for survival. When the first frosts began to bring the coolness of winter closer, the necessity to keep warm and store of the harvest became the prime concern for continuing existence. The burden of providing grains, vegetables, fruits and game for the winter table, as well as seeds for the next planting season, usually fell to the woman. She found ways to preserve by cooking, boiling, bottling, juicing, jellifying and drying. Of these methods, the oldest, simplest, most natural and economical is drying. Sun drying for the American Indian and other early pioneers was as standard as canning is today. For these migrators who moved from hunting ground to hunting ground the constant problem of preserving any surplus foodstuffs was done by drying. Dry foods were light weight, less bulky, and could be preserved longer; a truly precious commodity by which whole communities survived. With hot water and processing equipment belonging to another distant time space, these early women adapted their food preserving needs in harmony with nature providing by drying with sunpower in their open space kitchens.

IT'S YOUR CHOICE: TRY DRYING WITH IMAGINATION

Just about anything can be dried. My first drying experiences were totally motivated by the survival instinct, some imagination, and the need to preserve simply, a harvest surplus. Without running water, conventional power, or the proper canning equipment, the necessity for food preservation focused on drying.

That first season I did some limited air drying above our wood stove, making salt jerky and apples. My second attempt combined two natural principles of the previous season: heat, and air - but not without bug or dust problems. An evolution had taken place, and I was aided by "Hilda", a recycled solar space heater built by Arnie. "Hilda" was a discarded grain bin with a face lift. Double glazed and insulated, she has a small fan, 230 aluminum beer cans for an absorber, and storage area filled with river rocks. During the harvest we converted the rock storage to a space which accommodated three levels of trays. I solar dried about one-half of my harvest, producing everything from carrots to a squash, chili, and tomato soup mix---apples with limes, to bananas and pumpkins. Dehydrating enhances and draws out new flavors and sweetnesses, as those who sampled my dried "carrots" or "bananas" can testify. Dried onions, celery, carrots, and zucchini can be used instead of chips for dips, or powdered in a blender to produce a vegetable salt. Combined with cabbage and tomatoes, etc....dried vegetables can become soup, and salad croutons. Fruits such as apples, peaches, pears, pineapple, bananas, etc. are an alternative to sweeteners, and a must for travel with little ones. Mixed with whole wheat, oats, pumpkin seeds and honey, dried fruits become a high protein snack. We have included a detailed bibliography containing references for many old stand by's, as well as recent creative ways for serving dehydrated foodstuffs. I highly recommend those books specially marked (*) as good reference reading, my favorites being *Dry It, You'll Like It*, *The Homestead Kitchen and Cellar*, and *Manna, Foods of the Frontier*.

A FEW FINAL REMINDERS FOR SELECTION:

- 1) Try to use fresh and somewhat undamaged produce. Black bananas in the mushy stage will only stick when dry, and if pried will pick up wood slats off trays. The same goes for any other fruit or vegetable. The taste of over-ripe dry produce is not as flavorful or chewable as when fresh produce is used.
- 2) Try to plan your drying with each month's harvest as you would canning. Cherries and apricots in July. Fruits in August. Apples and greens in September. Herb and root crops in October. Chili, cabbage and other garden produce or game in November. The remainder of the year can be planned according to bargain surpluses or at the end of safe winter storage for apples and bananas.
- 3) Try drying with your imagination.

Preparation, Processing and Storing Dry Food Stuffs

In comparison to canning, solar food drying is a very safe and economical way to process foods. Since my first experiences with food drying I have continued to increase the use of dehydrating. I produce half of my family's table needs via dry fruits and vegetables. An average season will produce two bushels of apples, one bushel each of pears, peaches and plums, as well as my

entire harvest yield of zucchini, squash, pumpkin green tomato, carrots, dill, mint, rosehip, chili and a hind quarter of elk. In between seasons I manage bananas, more apples, or plums. The other half of what I store is raw packed, and hot bathed fruit and pickles.

Solar food drying needs only one-fourth of the space canned foods do, and have a "shelf-life" four or five times greater. There are no stoves, pans, pressure gauges, jars, lids, syrups or spices. You need not pressure or suffer your foods of their vitamins. Drying foods, skins and all, help keep food nutrition values high. When completely dehydrated, produce will lose 90 to 99 per cent of their water content. Food spoilers such as molds and yeasts cannot function without the presence of large amounts of moisture. According to U.S.D.A. Research, dry food usually contains about 2.5 to 4 per cent of water content depending on the produce. Safe moisture contents range from 10 per cent for fruits to 20 per cent for vegetables. Most reference sources I consulted are opinionated in different directions as to the need for treatment by sulfering, blanching and oven pasteurization. Two new references "Dry It, You'll Like It" and "The Homestead, Kitchen and Cellar" encourage a return to the natural unpeeled, thin sliced and untreated method. I personally have tested successfully this natural approach, and find that produce two or three years old is still preserved and tastes good.

I am in agreement that sulfering is a needless and unnatural process, and food keeps just as well without this procedure which is used to preserve color and vitamin content. The same effect can be achieved by: 1) Juice or honey-dipping produce to retain color. 2) If you maintain a temperature of not more than 110° your vitamin retention of "C" remains high - most charts including the one listed in this text, call for much higher temperature ranges. It is safe to say that thinly sliced produce in an efficient solar dryer between 90° and 110° will achieve a safe medium. 3) The skins on your produce will prevent your foods from suffering the "second biggest nutritive loss", according to Adell Davis. Examples of vitamin losses suffered by peeling the skins off root crops is cited in "Let's Cook It Right". Vegetables such as carrots, turnips, etc. have their mineral content under their skins. I dry all my produce, which is thinly sliced, in their skins and find that even bitter tasting pumpkin and squash lose their pungent flavors and become sweet. Although your solar dried produce will not resemble in color or softness canned or commercially sulfur dioxide treated food stuffs, yours will be higher in vitamin content, more healthful, and a lot more economical per pound than any other method.

A FEW GENERAL RULES OF THUMB TO FOLLOW:

- 1) As previously stated, select firm and ripe produce. Remember: Dry produce will only be as good as the quality of the fresh product you processed.
- 2) Wash and dry, but do not peel your produce. The thinner you slice your fruits and vegetables, the quicker they dry.
- 3) Use only wood or nylon mesh for trays, as illustrated. (Picture A). Cheese cloth leaves its fibers on bananas and apples, so I don't recommend its use. Cedar, redwood or green pine will leave its odor, resin, or stain your foods. I have found a good, sturdy and recycled material for tray bottoms can be old bamboo curtains. They are easily cleaned and have enough air space needed.
- 4) Spread your produce so that they do not cluster and stop the air flow process. Check your produce once every two days and re-arrange dry and not so dry produce. Some foods require dark or light dry conditions as is recommended in the table reference. You can, with this particular dryer, arrange top trays for light and bottom trays for darker drying as illustrated (See Picture B). By keeping some produce to the rear end of the tray in the shadows, the same effect can result. I have dropped an old gauze curtain over the front end to achieve both light and heat control.
- 5) Keep a record on each batch, its before and after weight and temperature range (See Data Sheet). It is important to have a small household thermometer inside someplace to check the critical 110° limit. At the sun's high point, or when that limit is endangered, simply drape your collector with white gauze.
- 6) If night temperatures seem very cold as in early winter, remove your trays and store inside. Freeze drying is okay, but produce becomes very brittle and not as tasty. (Picture C).

Storage

Your fruits and vegetables are considered dry when no water content can be detected from cut pieces. If the middle feels or looks moist, dry a bit longer. Fruits are considered dry when "tough", leathery and pliable. Vegetables should be brittle or crisp as in a chip.

You can weigh your produce before and after. If it has lost half of its original weight it is 2/3 dry. An example of weight loss comparison is given by Ester Dicky in Passport For Survival. She says roughly 1 oz. dried equals 1 lb. An example shows that 16 fresh apricots can equal approximately one pound while 175 dried apricots equal 1 lb. Four pounds of fresh meat equals 1 lb. of dried.

You can use both these general tests, but with experience you will be able to determine by texture, etc. as to what is dry and what is not.

It is best to store for ten days to two weeks produce that has just been dried. A large bottle with gauze cover over the lid will do. All remaining moisture can then be air dried. Study your product, looking for any pieces that may not be completely dry. If you feel your product needs a bit more drying, it is better to pop them back into your dryer for a day then to let them develop a mold.

You can store your finished product in paper sacks, plastic bags or old chipped canning jars. They should keep for up to five years, but are better used within two years.

ENJOY!

Maria Mondragon Valdez

My experiences are in my climate, which is basically mountain desert. In more humid climates and less sunny environments, one must take extra care during drying and storage. Use your head: dry only during long, sunny periods. If you get caught by a wet period or a cloudy week, finish your drying in an oven at low temperatures or over the kitchen stove. Take care with storage and rotate your supply.

Try These Recipes:

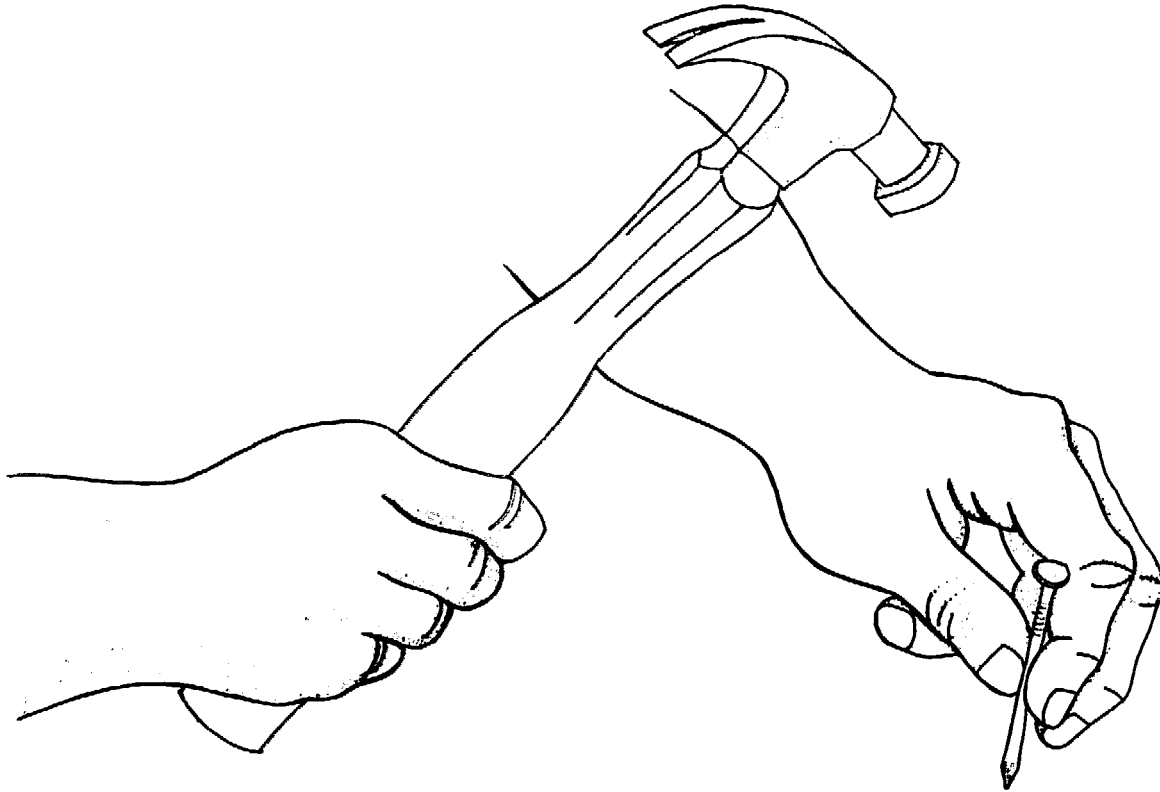
***GARDEN SOUP MIX:** (Prepared in bulk but used in portions depending on your personal taste). Dehydrate separately, mix and store in large jar - carrots, celery, onions, tomatoes, parsley, rosemary, thyme. Use in pinches or by cupfull, depending on your taste. Add just a few minutes before serving. Good for stews, broth, or as croutons. Blend or crust some of the mixture and use as a seasoning salt. You can add any other vegetables or greens you have available.

***SEASONING SALT MIX:** Dehydrate separately, mix, crush or blend and store in jars - lettuce, cabbage, turnips, carrots, onions, garlic, dill, and other herbs. Use like table salt to season foods.

***FRUIT MIX** (Dehydrate separately) - cherries, apricots, pears, apples, etc. Either dry or purchase coconut, seeds, and nuts. Mix and store. Great for traveling snacks.

***HOT GREEN CHILI MIX** (Dehydrate separately, mix whole or blend into powder) - green chili in skins (deseeded), garlic, onions, oregano and/or cumin. Add to stews in dry state or add a small amount of water and blend into puree for soups, beans, hominy, or meat broth.

***HOT RED CHILI MIX** (Dehydrate red chili pods and garlic separately, deseed red chili after drying and store whole pods) - Puree chili and garlic with water to reconstitute. Use sparingly and refrigerate after reconstituting. Great for hominy, beans, or meat broth to make red chili.



The authors assume no responsibility, either expressed or implied, for the performance, longevity, or reliability of systems constructed from these plans, or injury or damage to persons, materials, or property during the construction or operation of said systems.

Building The Solar Food Dryer

The construction of the solar food dryer will require some basic carpentry skills and a few common household tools. Following is a list of the essential tools:

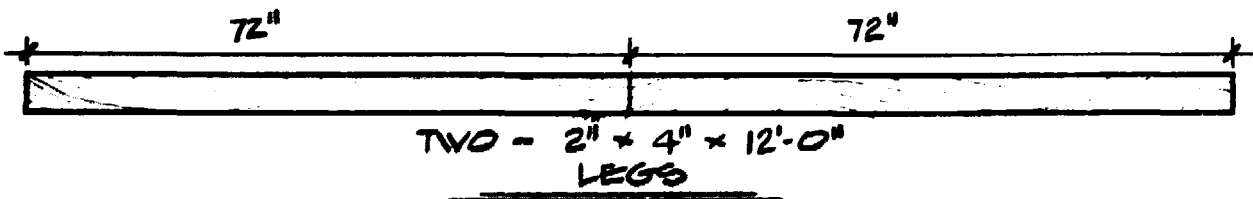
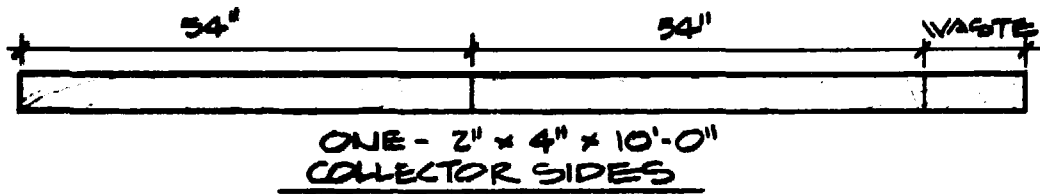
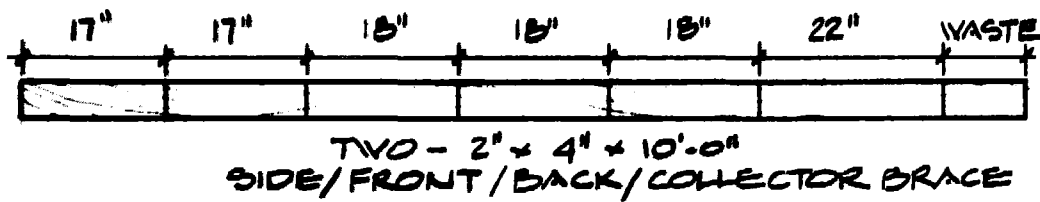
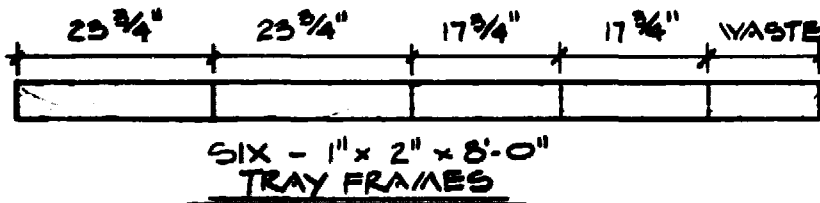
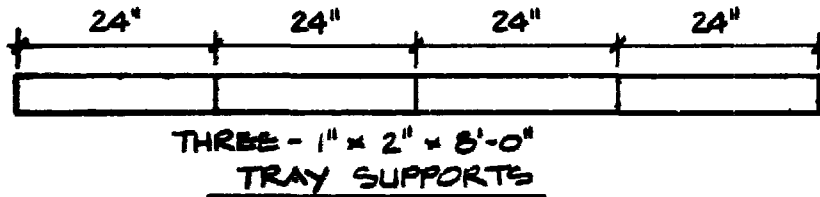
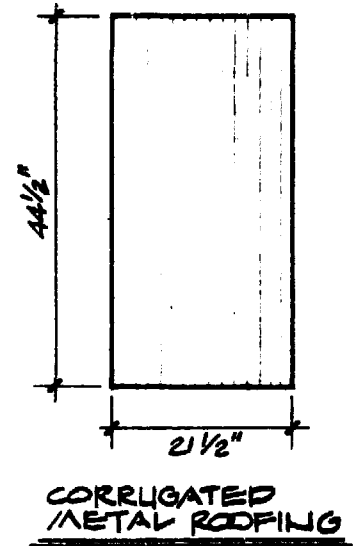
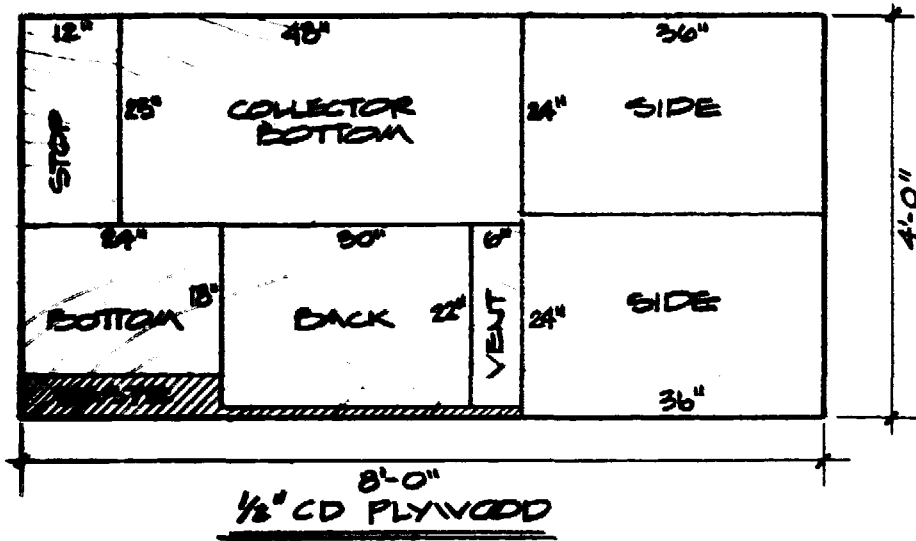
- Hand saw or skill saw, if available
- Hammer
- Tape measure
- Framing square or tri-square
- Wood rasp
- Screwdriver
- Tin snips
- Staple gun
- Brace and 1", 1/2" auger bits
- Keyhole saw
- Paint brush
- Chalking gun
- Scissors
- Pencils
- Soaking pan

Materials for the food dryer can be new, scrounged, or recycled. If purchased locally, the cost should be about \$50. The following list contains the materials which, when used skillfully, should result with a loss of less than ten percent.

- 3 - 2" x 4" x 10'
- 2 - 2" x 4" x 12'
- 1 - 4' x 8' x 1/2" exterior grade plywood
- 9 - 1" x 2" x 8' wood furring strips
- 20' - 1" x 1/4" molding
- 1 - 2' x 8' sheet of plastering metal lath
- 1 - 2' x 4' piece of 1/2" celotex insulating sheathing or equal amount of 1" insulation
- 24 sq. ft. nylon mesh for food trays
- 1 - 2' x 4' piece of corrugated roofing metal
- 1 - 2' x 4' sheet or strips of aluminum foil
- 1 - heat resistant flat black spray paint or stove polish
- 1 - 1" x 4" x 2' or equivalent for air intake vent
- 16' sq. ft. of clear fiberglass (greenhouse grade) or glass equivalent. Plastic may be used but has a limited life time of a year or less
- 6" x 22" screen (for insect protection)
- 6 - 2" utility hinges/screws
- 1/2 - lb. no. 16 cement coated nails
- 1/2 - lb. 1 1/2" galvanized nails
- 2 - 4 1/2" x 1/2" bolts, nuts and washers
- 1 - quart exterior grade paint or water seal
- 1 - tube chalking compound (silicone)
- 2 - screen door latches (hooks and eyes)
- 1/2 - lb. 6D box nails
- 1/2 - lb. 4D box nails

CUTTING DESCRIPTION

SCALE $\frac{1}{2}'' = 1'-0''$



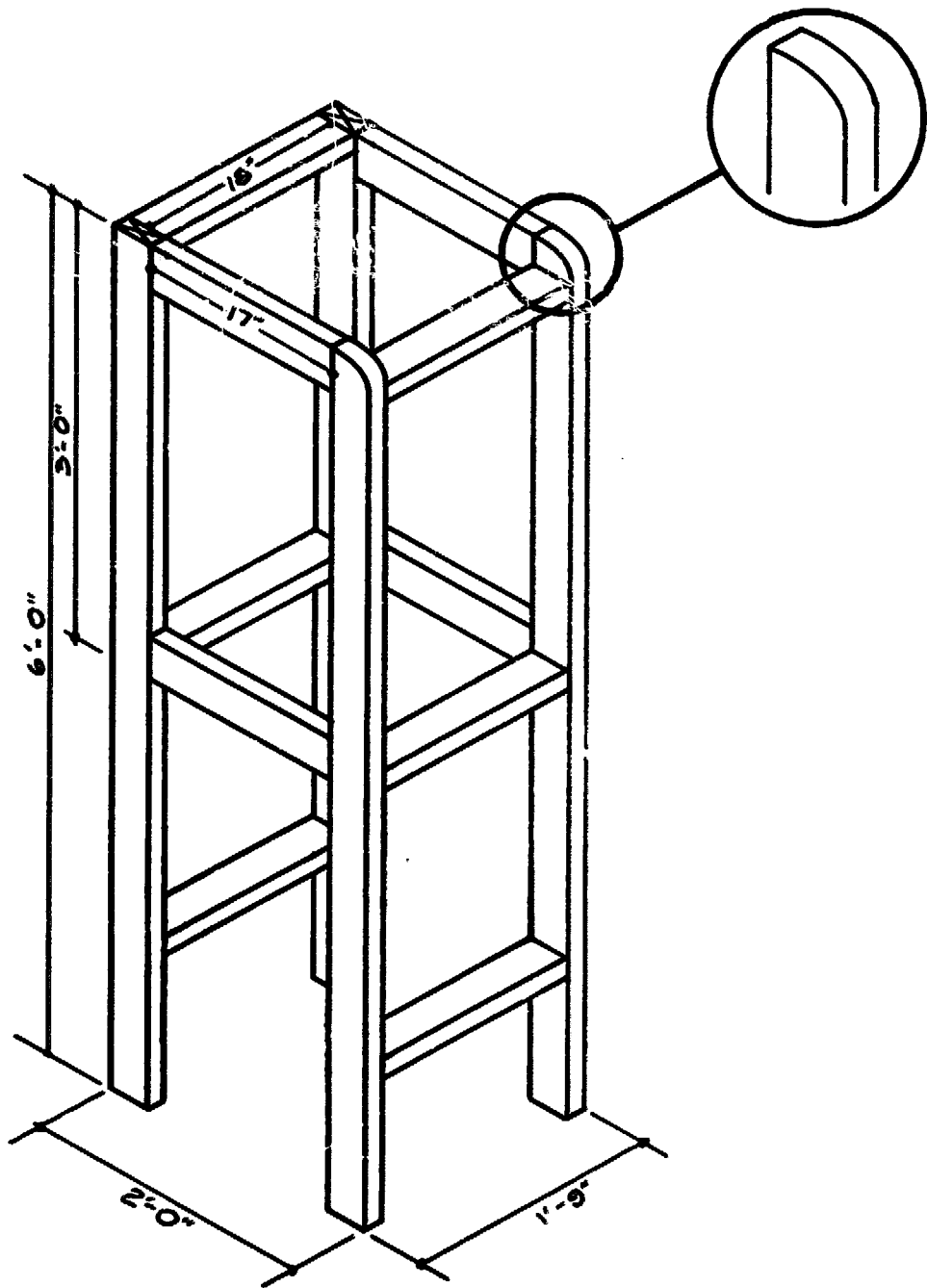


FIGURE 1 — FRAMING FOR FOOD DRYER BOX

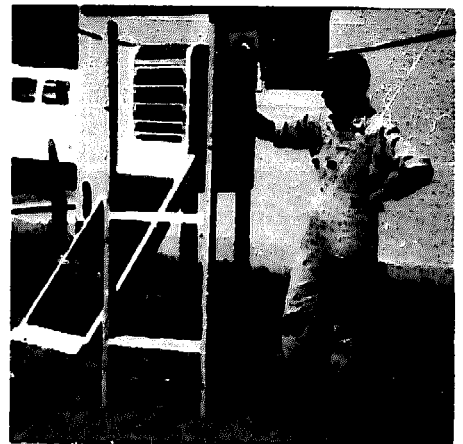


ILLUSTRATION #1



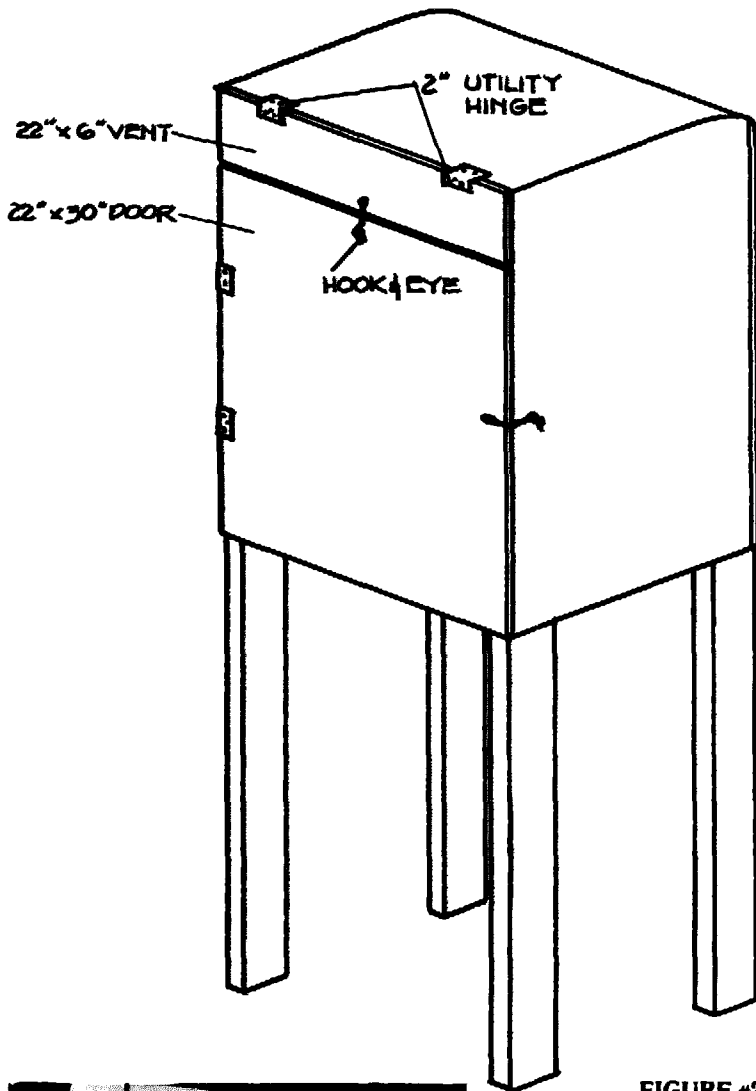
ILLUSTRATION #4



ILLUSTRATION #2

The construction of the solar food dryer begins by cutting 4 - 2'' x 4'' x 6' pieces of wood — these will form the main structural members for the box. The two front pieces can be rounded as shown in the detail enlargement; this gives the dryer a more streamline look. However, the corners can be square if desired. The next step is to nail the 17'' braces, two for each section as shown in the drawing. These are toenailed with #16 nails. The finished section should resemble Illustration #1.

After these sections are finished, they may now be aligned and joined with the 18'' braces, 3 for each side spaced as shown in the drawing. (Illustration 2.) These main structural elements now compose the frame to which the sides and bottom are attached. Two 3' x 2' pieces of 1/2'' plywood are cut for nailing onto the sides with the 1 1/2'' galvanized nails. (Illustration #4) The box can be placed in the ground or flat surface (Illustration #5) to ease fabrication. Once the sides are nailed, the box becomes sturdy and is now solid enough to stand upright (Illustration #6) The inside will look like Illustration #7. A piece of plywood 18'' x 24'' is cut and nailed on the bottom forming the cover. (Illustration #8) The door and vent are cut from a piece of plywood to a size of 22'' x 3'. The vent is 6'' x 22'' while the door is 30'' x 22''. (Figure #2) The figure below shows how the door and vent are attached.



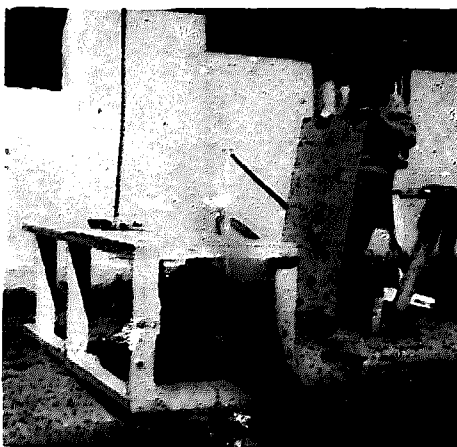
Top vent is designed to open upward to release hot air, inside vent area is screened for insects.

The door can be designed to open either way. The hooks & eyes are the latches for securing the doors.

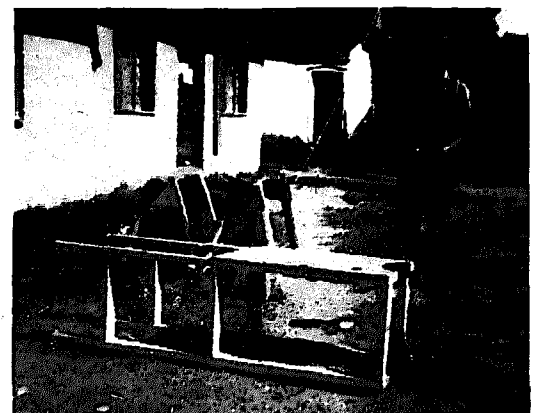


ILLUSTRATION #8

FIGURE #2
VENT AND DOOR
DIMENSION



← ILLUSTRATION #5 →



The molding for supporting the food trays is cut from 1" x 2" furring strip. These are cut to a length of 24"; a total of 12 pieces are needed to form the slides for the 6 food trays. (Figure 3). The strips are spaced evenly and nailed to the sides as shown.

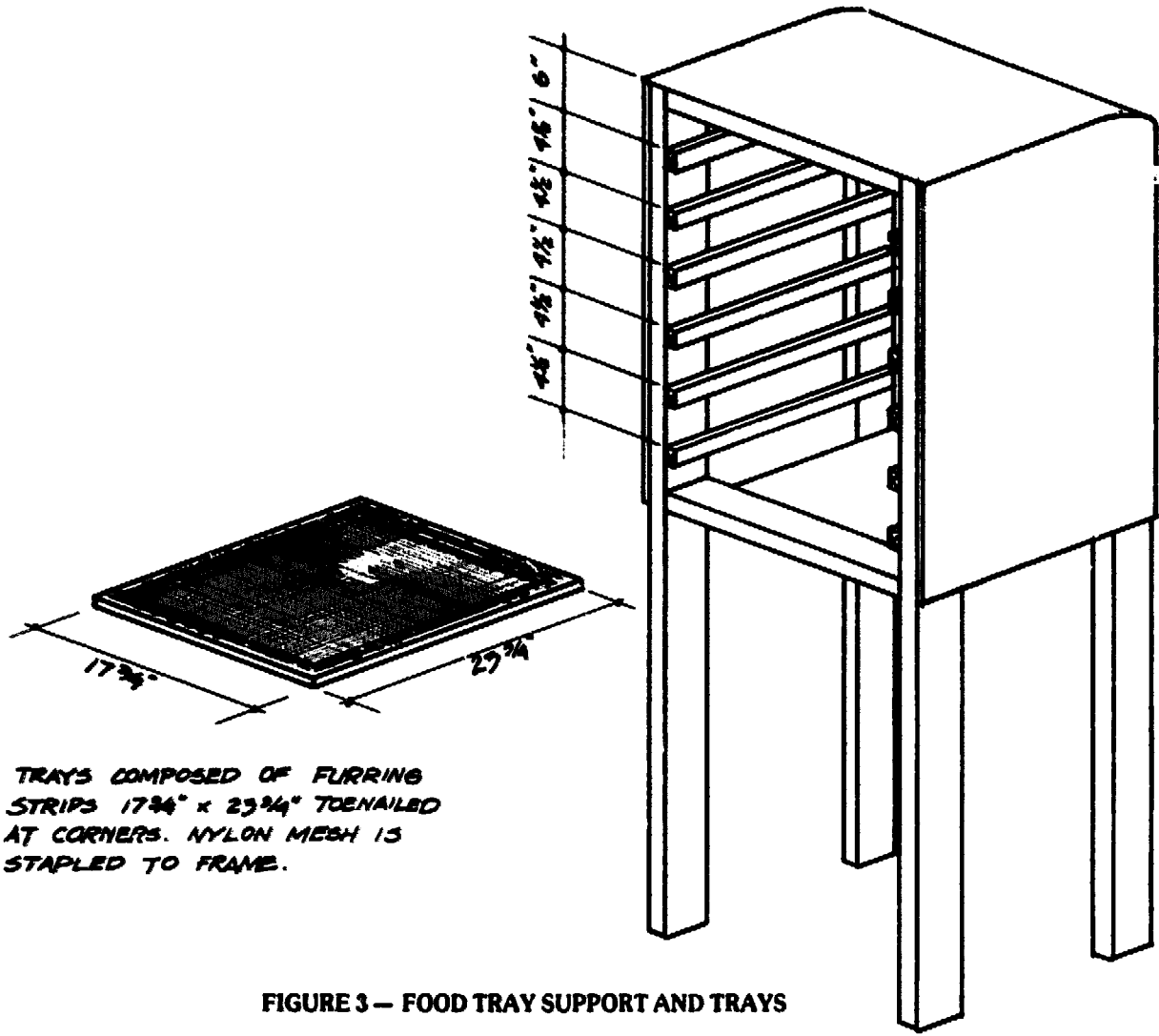


FIGURE 3 — FOOD TRAY SUPPORT AND TRAYS

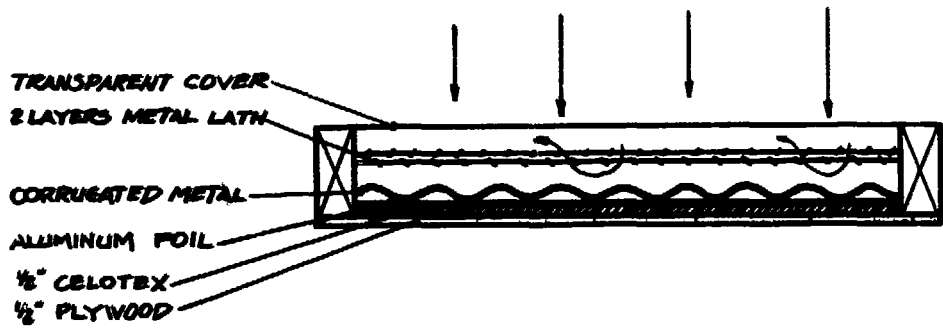


← ILLUSTRATION #7

ILLUSTRATION #6 →



The second phase of construction involves the building of the solar collector — the heat source for the dryer. The collector is designed to trap the solar energy via the greenhouse effect which is created within the transparent cover:



Incoming solar energy is trapped by the transparent cover and is absorbed by the lath and corrugated metal thus raising the temperature of the air within the collector.

FIGURE 4 — THE GREENHOUSE EFFECT AND COLLECTOR CROSS-SECTION

The solar collector will be heating air which enters the bottom vent and flows upward through natural connection. The following illustration shows the dimensions and how the air circulates:

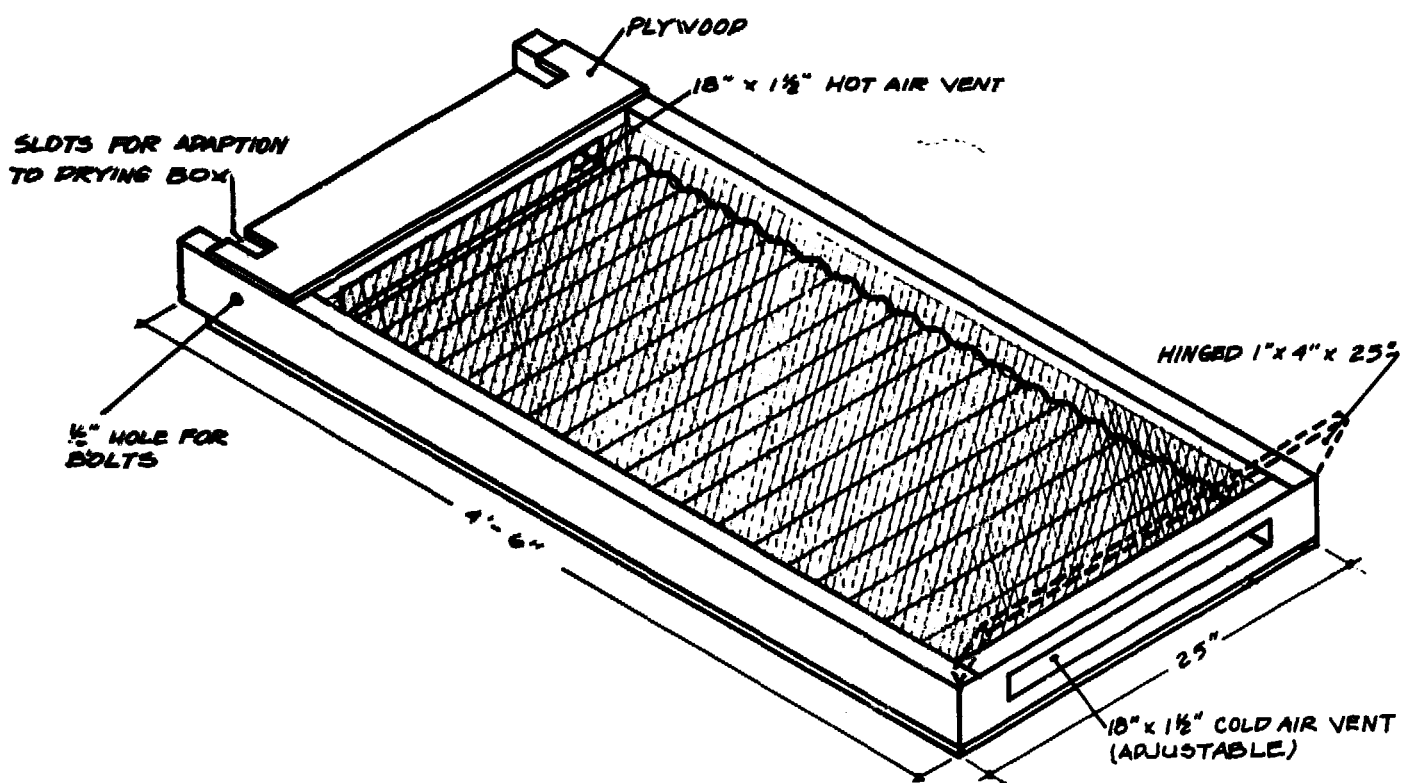


FIGURE 5 — FOOD DRYER SOLAR COLLECTOR

The solar collector is capable of producing air temperatures up to 150° F. In order to control the temperature the bottom hinged vent can be opened or closed to either slow or speed up the air flow. A fast flow will produce lower temperatures while a slow flow will raise the temperature. With a little practice, the dryer can be "tuned" to achieve the desired temperature.

We can also adapt the collector for use as a window-box heater by modifying the design:

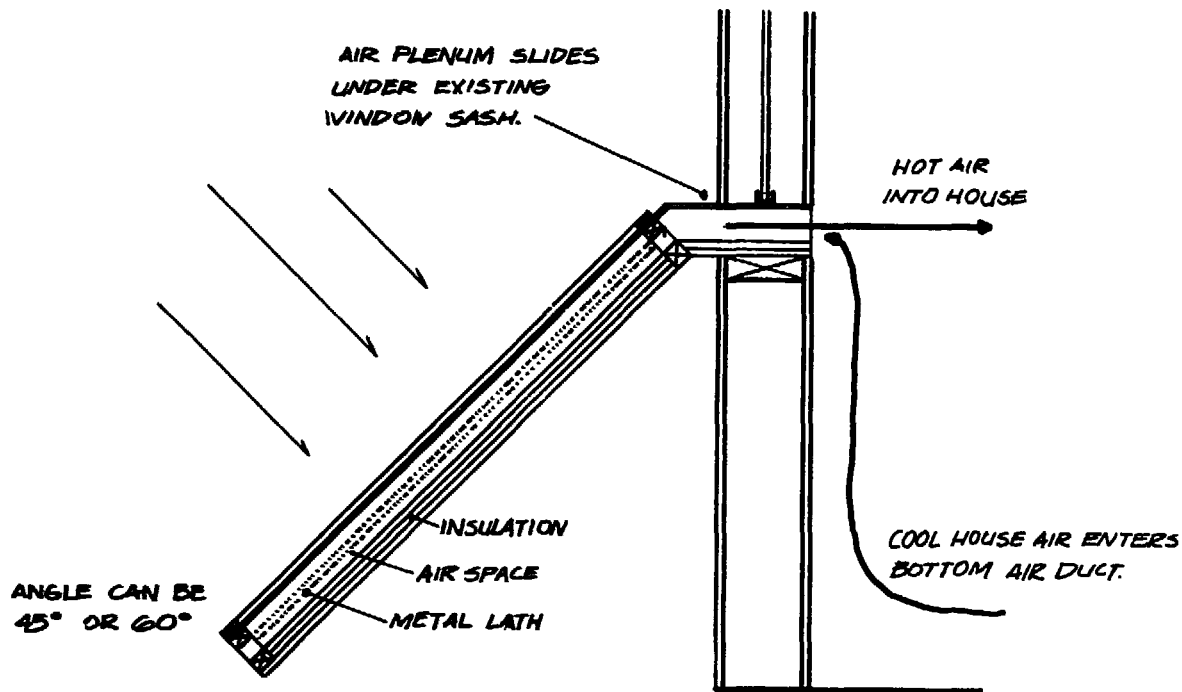
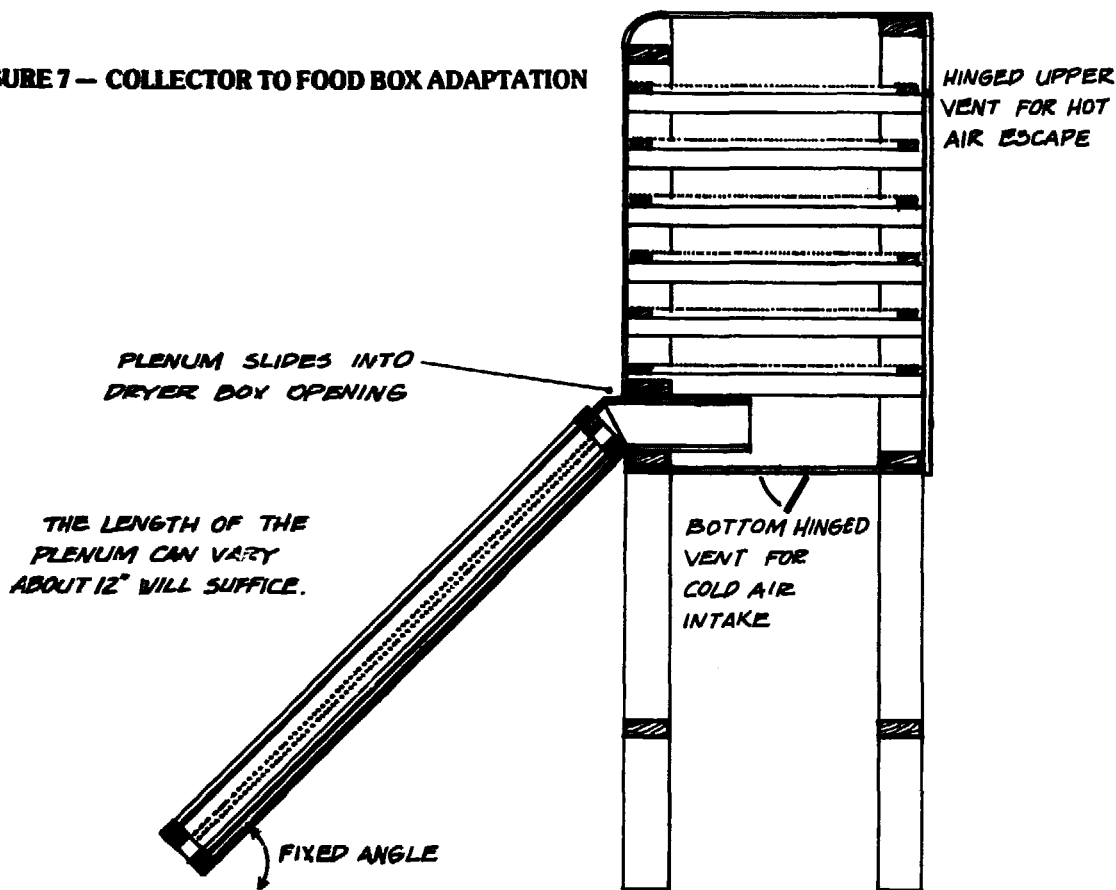


FIGURE 6 — SOLAR COLLECTOR ADAPTED AS WINDOW BOX HEATER

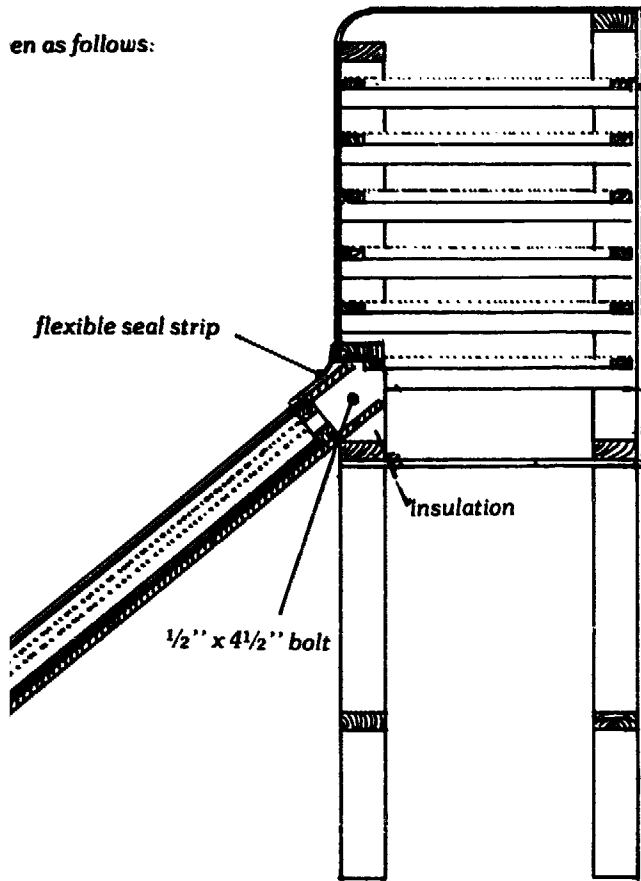
If this design is desired, the collector will have to remain stationary at the chosen angle. With the previous design, the collector can be seasonally adjusted at a variety of angles. A steeper angle functions well during the winter, while a less inclined angle gives maximum summer heat gain. The collector also functions as an automatic valve; when the air is cool or there is no sun, the cool air will settle to the bottom of the collector, thus stopping the flow.

The window box heater will require a little more fabrication, but can fulfill two functions — food drying and space heating. The illustration below shows construction details and adaption to food dryer box.

FIGURE 7 — COLLECTOR TO FOOD BOX ADAPTATION



en as follows:



advantage of maximum adjustment seasonally and also can be detached for ease in portability
adjustment the seal between the collector and the box must be checked and sealed for air leaks

SOLAR COLLECTOR CONSTRUCTION

This section will describe the building of the collector as designed for food drying only. We will begin by cutting 2 - 4' x 6" pieces of 2" x 4" for use as the collector sides. Two 22" pieces of 2" x 4" are nailed as follows:

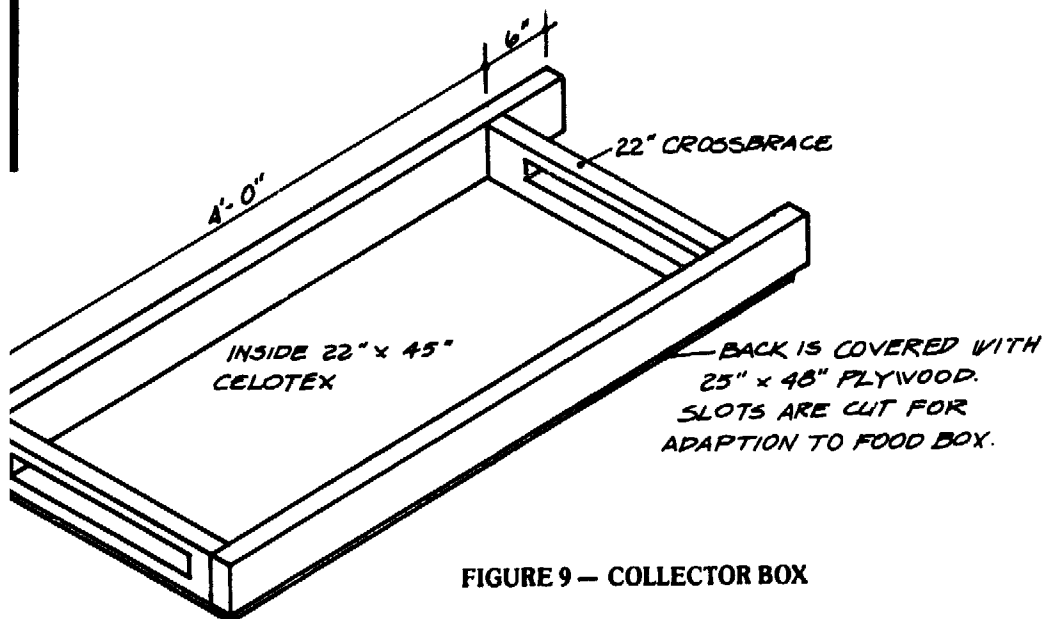


FIGURE 9 - COLLECTOR BOX

Once the two braces are nailed the plywood can be cut to a size of 25" x 48". This can now be nailed and the celotex cut to 22" x 45" for the inside. The top and bottom vents can be cut by drilling a hole and using the keyhole saw. Aluminum foil is shaped to the celotex with the shiny side up towards the absorber or corrugated metal. The foil serves to reflect heat up towards the plate. We can now cut a piece of corrugated roofing metal to 22" x 45". This plate is fastened over the aluminum foil. If new metal is used, it must be scrubbed with vinegar to remove shiny surface so the paint will stick. After the metal is scrubbed and washed with water, the plate can now be painted with a flat black heat resistant paint or stove polish (Illustration #9). A sheet of metal lath is folded over forming two layers. The lath is stapled or nailed to the box sides about 1" above corrugated metal, and is also painted flat black. (Illustration #10). The collector can now be fitted onto the box, once the collector is aligned at maximum winter angle, the corresponding holes on the food box are drilled to accept the 4 1/2" bolts. (Illustration #11). A 2" x 4" x 18" brace is nailed over the top collector plenum to function as a stop and nailer for the fiberglass or transparent cover (See Figure #9 detail). The bolts are now inserted in the holes attaching the collector to the food box.

After the paint is dried, we can begin to "glaze", or cover the collector. A piece of fiberglass is cut to fit the collector, the side and top of the food box. The fiberglass or glass, plastic, etc., is fitted over the 2" x 4" perimeter edges. Wood molding (1 1/2" x 1/4") is placed over the cover and can be either nailed with galvanized nails or wood screws. (Illustration #12). After this is done, all the edges around the glazed areas are chalked to create a seal for air leaks and weather.

The bottom collector vent and upper hot air vent and door are hinged (Figure #2). Once all the vents are complete, a finish coat of paint or water sealer is applied over all areas and molding exposed to the weather. The food trays are inserted in the box making it ready for the solar food drying process that follows (Illustration #12).



ILLUSTRATION #9

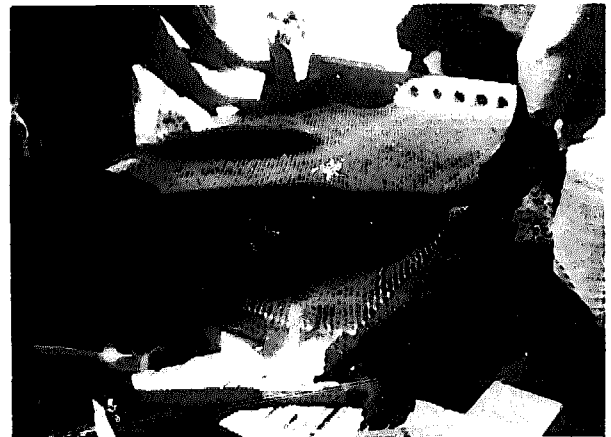


ILLUSTRATION #10

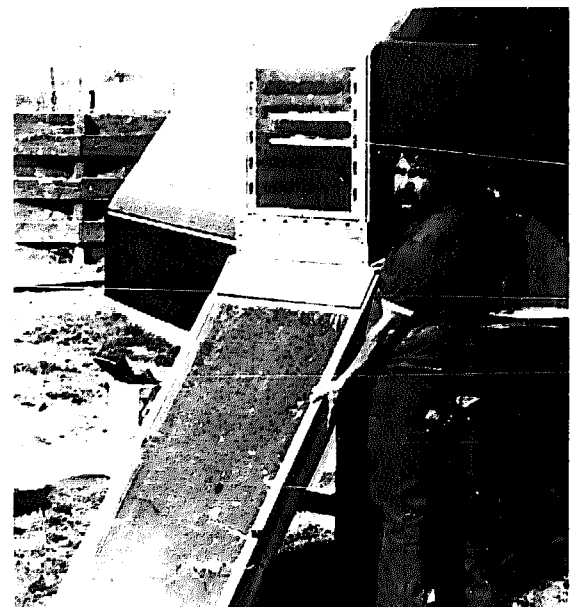


ILLUSTRATION # 12

The Multipurpose Food Dryer

If a more permanent food dryer is desired, then there is the option of building it right into the home. A south-facing orientation is the basic site requirement for the construction. This food dryer can also be used as a space heater providing the shelter with daytime heating while drying food at the same time. A design by the author shows how a multi-purpose "solar collector" can fulfill the functions of drying, space heating, and spring cold frame for plant starters. The following illustrations provide a look of such an evolution:

FIGURE 1 - Framing for the attached food-dryer, an angle of about 60° was chosen for maximum winter heat gain. The frame extends 30" from the house and consists of 2" x 4" spaced at 2 foot centers for fiberglass supports.

FIGURE 2 - Front view of dryer showing bottom and top air ducts.

FIGURE 3 - Outside cold air vent allows outdoor air to circulate through dryer and exhaust through hinged upper vent - a relief valve when hot air is not wanted in the house.

FIGURE 4 - Results of the dryers efficiency. Side doors provide access to food trays.



FIGURE #1



FIGURE #2



FIGURE #3



FIGURE #4

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- *Detailed References Recommended.***

**TABLE I. SOLAR FOOD DRYING
SOME BASIC STEPS**

(ADAPTED FROM DOMESTIC
TECHNOLOGY CO. DEHYDRATOR)

PRODUCE	DRYING TIME PER LB OF PRODUCE	DRYING TEMP : OPTIMUM	COLLECTOR TEMP : MAX	LIGHT CONDITIONS
GRAPES	12.6 LBS PER 4 DAYS	120 F	160 F	LIGHT
GRAINS	5 LBS PER 3DAYS	150 F	160 F	DARK
CARROTS	5 LBS PER 3 DAYS	112 F	120 F	DARK
HERBS (GARLIC INCLUDED)	5.7 LBS PER 2 DAYS	110 F	140 F	DARK
MUSHROOM	6.6 LBS PER 2 DAYS	100 F	160 F	DARK
VEGETABLE (ONIONS & OKRA ETC	6.6 LBS PER 2 DAYS	120 F	150 F	LIGHT
FRUITS	5.7 LBS PER 2 DAYS	110 F	140 F	LIGHT
GREENS	3.3 LBS PER 2 DAYS	115 F	130 F	LIGHT

