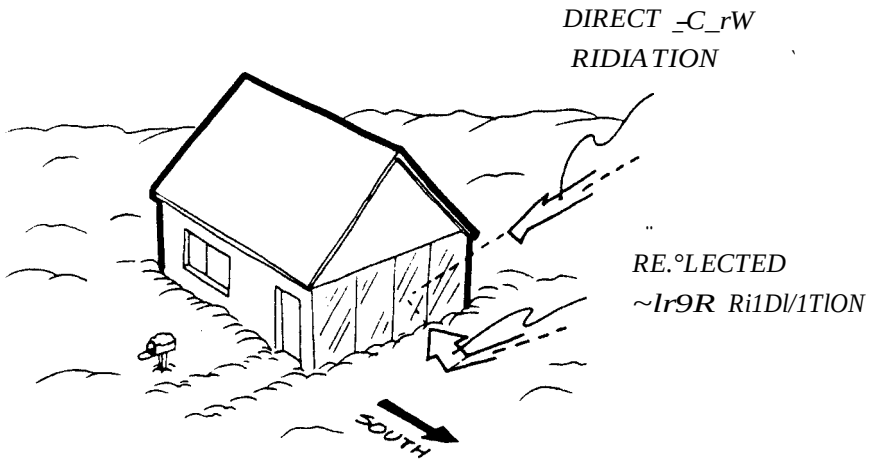
REFLECTING SOLAR RADIATION Lr

When we learned about solar radiation we found that it could be reflected by mirrors or light-colored surfaces. If we can reflect solar radiation in our solar collector, we can capture more sunlight. The more sunlight we capture, the more heat we can get out of the collector. This is true whether we are using an active or a passive solar heater.

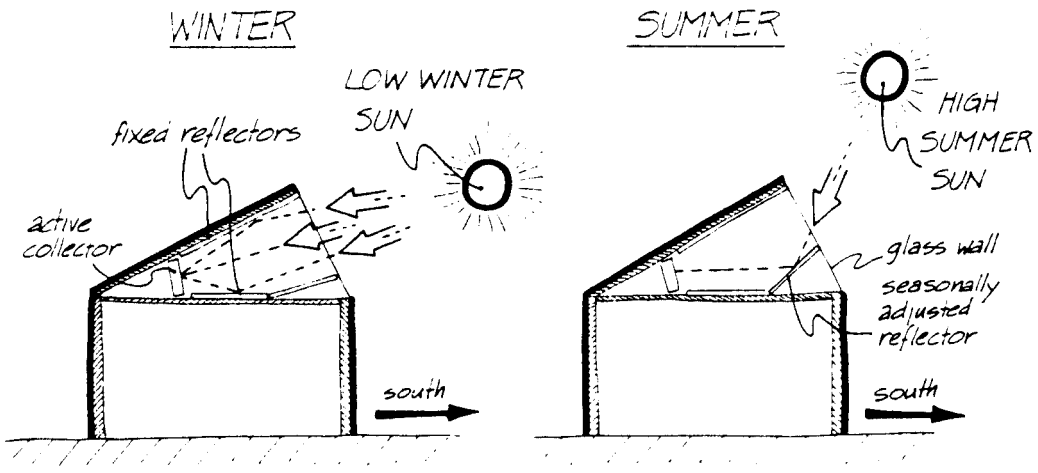
The simplest way to reflect sunlight into a collector is from the ground. White or light-colored pebbles in front of a Trombe wall system can add one-third more heat. In cold climates, snow on the ground has the same effect, especially in winter when the sun is low in the sky.



Snow Reflects Solar Radiation

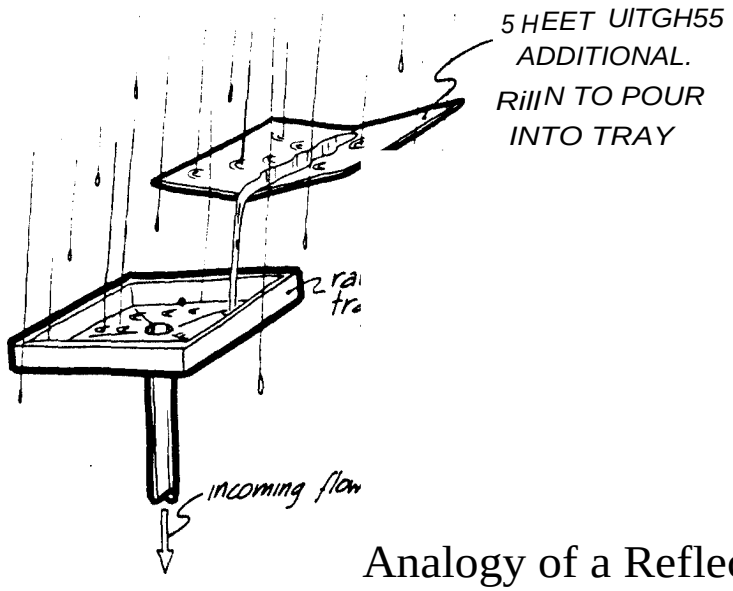
Ground reflection isn't too important in roof-mounted collectors, especially those with a low tilt angle. Reflectors-mirrorlike surfaces often made of plastic film with a shiny coating-are used to increase the solar radiation that normally falls on a roof-mounted collector. Reflectors are cheaper than collectors, so there's a cost advantage in adding reflectors to a system. A disadvantage is that the reflectors need to be adjusted regularly, though perhaps only from month to month. One system, called *Pyramidal Optic Condenser,* uses the roof peak of a house to hold reflectors. One of the reflectors is adjusted to capture both the low winter sun and the high summer sun.

ReflectomCapture More Sunlight



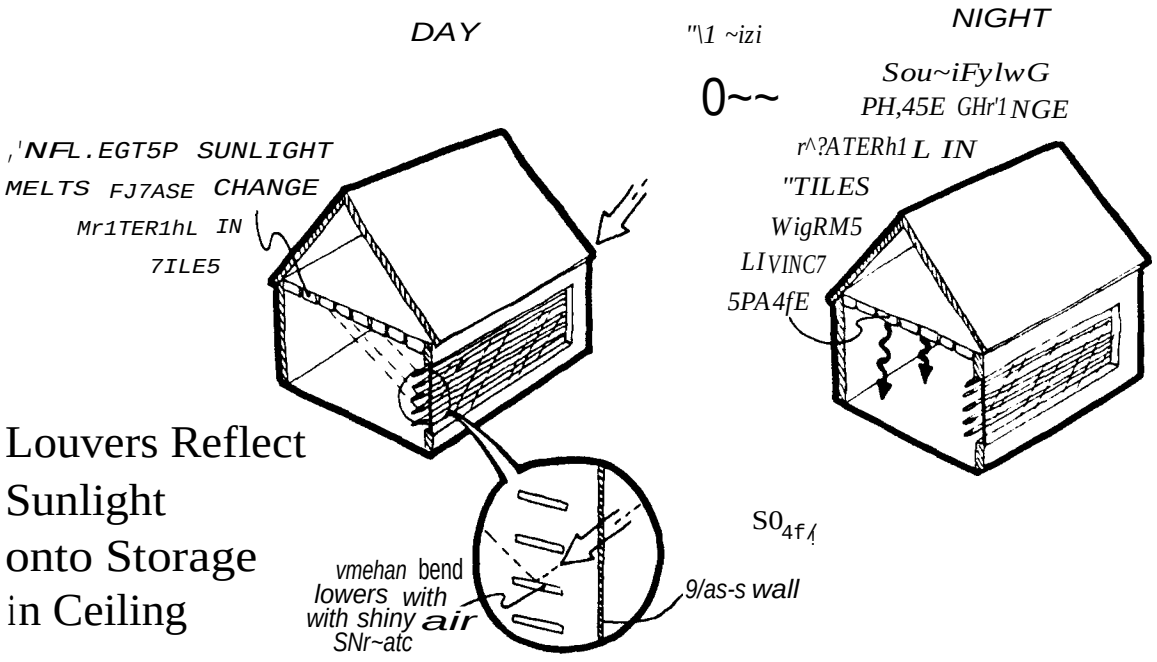
The rainwater analogy to a reflector is a sheet which catches some extra rain and lets it pour into the rainwater tray. Since more rain is captured, more will flow down the pipe. But even though we're capturing more rainwater, the leak doesn't get any bigger. Losses are the same with or without the "reflected" rainwater. Similarly, reflectors *add* heat (via solar radiation), but only collectors *lose* heat. In the system just discussed, the collectors cover only about half of the area normally needed to heat a house. Heat loss from the collectors is cut by half, yet the reflectors insure that the same amount of solar radiation is absorbed by the collectors.

Passive systems can also use reflectors. One method, called Sun *Louvers,* uses venetian blind louvers with a shiny upper surface to reflect sunlight onto the ceiling of a house or apartment. Ceiling tiles filled with phase change material absorb



Analogy of a Reflector

the reflected solar radiation. As you may recall, phase change materials store heat without getting hot, so overheating is less of a problem. The phase change material melts as it absorbs solar radiation. Later at night, the melted phase change material solidifies and gives off heat.



Louvers Reflect Sunlight onto Storage in Ceiling

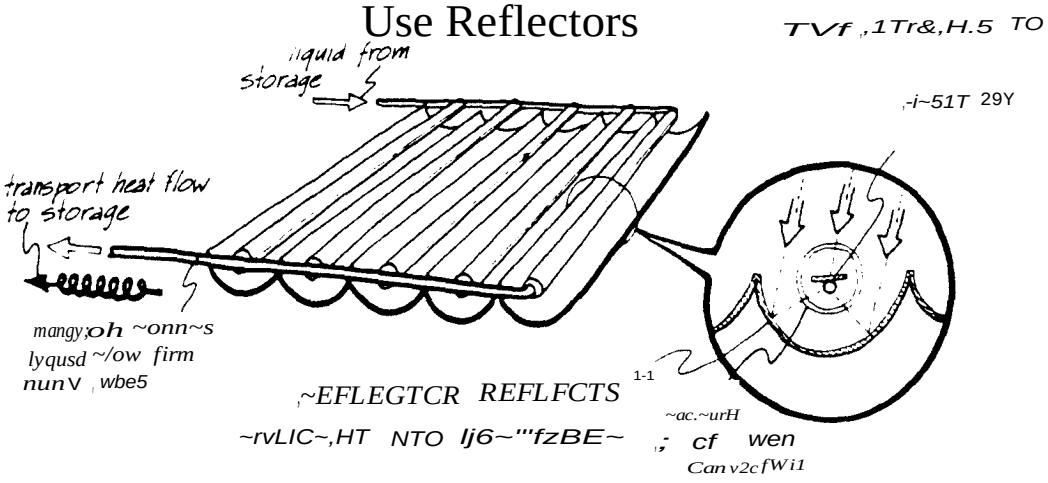
Reflectors are also important in solar air-conditioning. It may seem strange that solar *heat* can be used for cooling. However, using thermodynamic principles, heat can be used to condense a vapor into a liquid. When the liquid evaporates again into a vapor it extracts heat-that is, it cools. You feel cold when you get out of the shower because the water evaporating from your skin has a cooling effect.

Most of the *thermodynamic cycles* used for cooling need heat at a very high temperature-200° F or more. The collectors we've discussed so far may get that hot, bLA their efficiency is very low. Ordinary glazing isn't good enough to yield high efficiency at these high temperatures; heat losses must be further reduced.

The collectors for solar air-conditioning, called *evacu*ated-tube collectors, cut heat loss in two ways. First, the absorbing surfaces are surrounded by a tube-shaped vacuum jacket similar to a fluorescent light bulb. The vacuum jacket completely eliminates convection heat loss, since no air surrounds the absorbing surface. Second, the absorbing surfaces are made very small to reduce radiation heat loss-small areas lose less heat than large ones. Reflectors are placed behind the evacuated tubes, letting the smaller absorbing surfaces receive as much solar radiation as a larger surface would.

Heat is removed from the absorbing surfaces by conduction to tubes *through which* a liquid is pumped. The liquid often must be a special one that won't boil at a high temperature. So little heat is lost that these collectors achieve reasonably high efficiency even though they operate at very high temperatures; they are well suited to operating air-conditioning equipment.

Evacuated-Tube Collectors Use Reflectors



Using solar heat for air-conditioning should be a good match. The cooling is needed only when the sun is out; storing heat for nighttime use isn't necessary. However, the extra complication of reflectors, vacuum-jacketed collectors, and heat-driven air conditioners can offset the cost of storage. Nevertheless, evacuated-tube collectors can help cool buildings in many hot climates such as the Southwest; they are also effective in cooling many larger buildings such as stores in shopping centers.