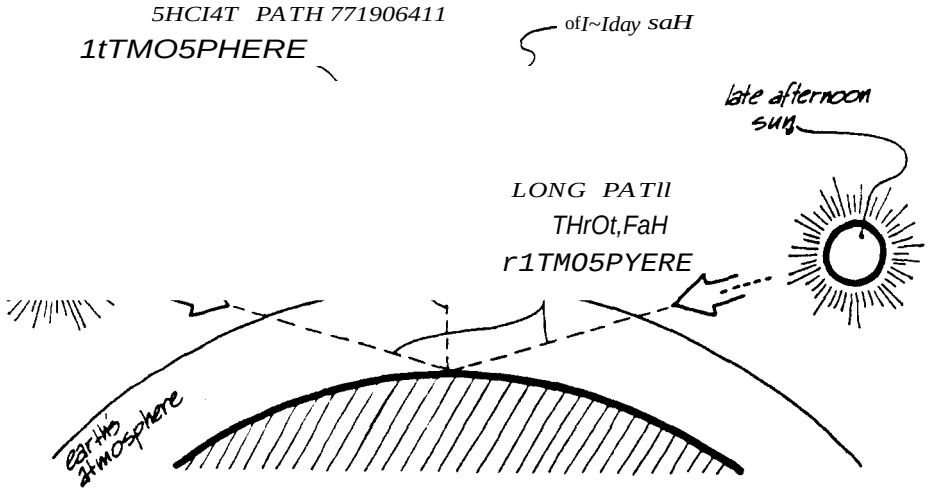
A TYPICAL DAY: '~ ~J
AFTERNOON 1/

The midday hours (10:00 A.M. through 2:00 P.M.) are the most important for solar collecting. During these hours the sun faces the collector almost head-on. A large fraction of the solar heat collected in a day occurs during these midday hours. By contrast, the early morning sun doesn't face the collector squarely, and the same is true in the late afternoon. In addition, the early morning and late afternoon sunlight has to pass through more of the atmosphere on its way to the collector.

More Solar Radiation Near Mid-Day

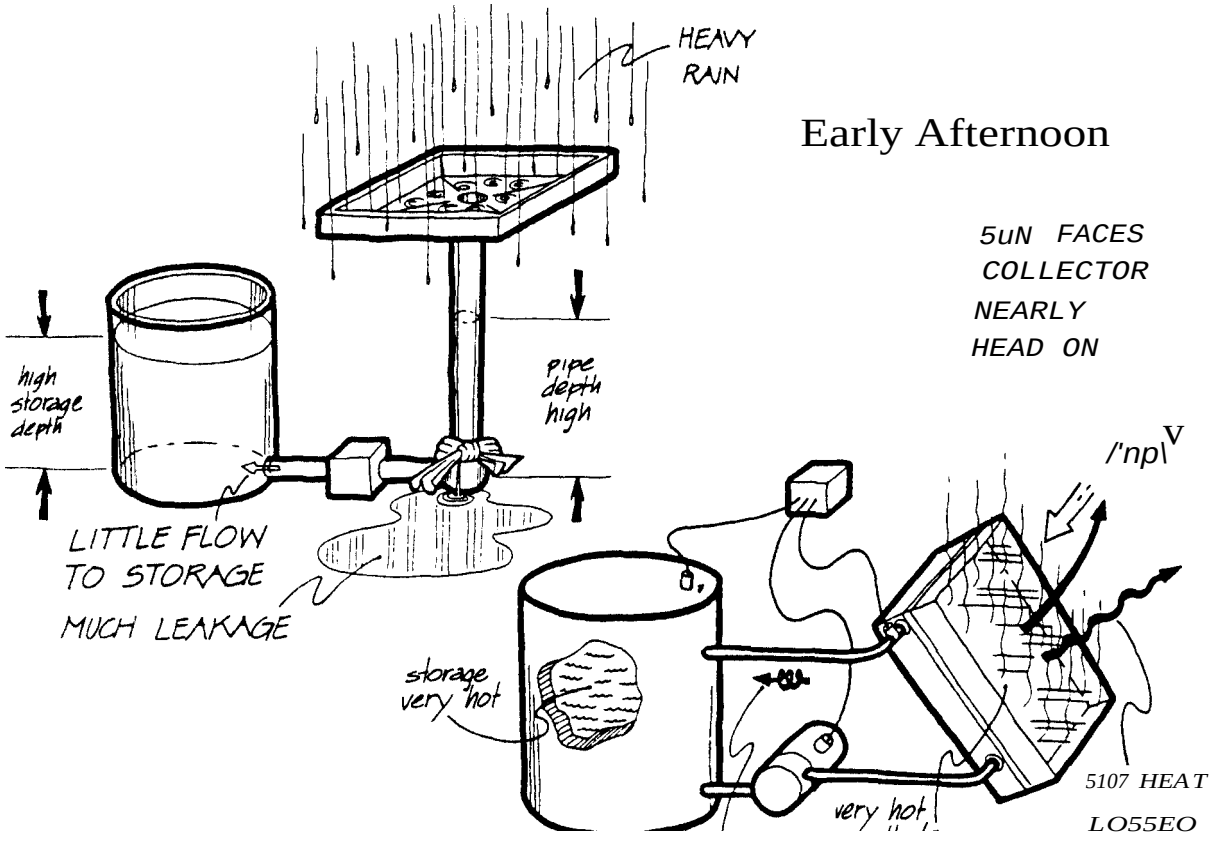


Solar radiation is diminished as it goes through the atmosphere, so less of it reaches the collector during the early morning and late afternoon. During the midday hours the sun angle Is better, and the sunlight passes through less atmos-

phere as well. In fact, In winter, a flat-plate collector can collect almost as much heat as a *tracking* collector, which has a tracking mechanism to keep the collector always pointed at the sun. Even though the tracking collector can face the early morning and the late afternoon sun, there Isn't much solar radiation to be collected then anyway. One that doesn't move at all can collect almost as much heat, yet be simpler and cost less.

A few hours past noon, most of the solar heat to be stored during the day has been moved by transport heat flow to the storage tank. The water in storage won't get much hotter, since little more heat will be added. Enough solar radiation is still present to heat the collector so that It is slightly hotter than the storage tank. But efficiency has fallen off: the collector is much hotter than the outdoors, making losses high. High losses mean little heat collected and lower efficiency.

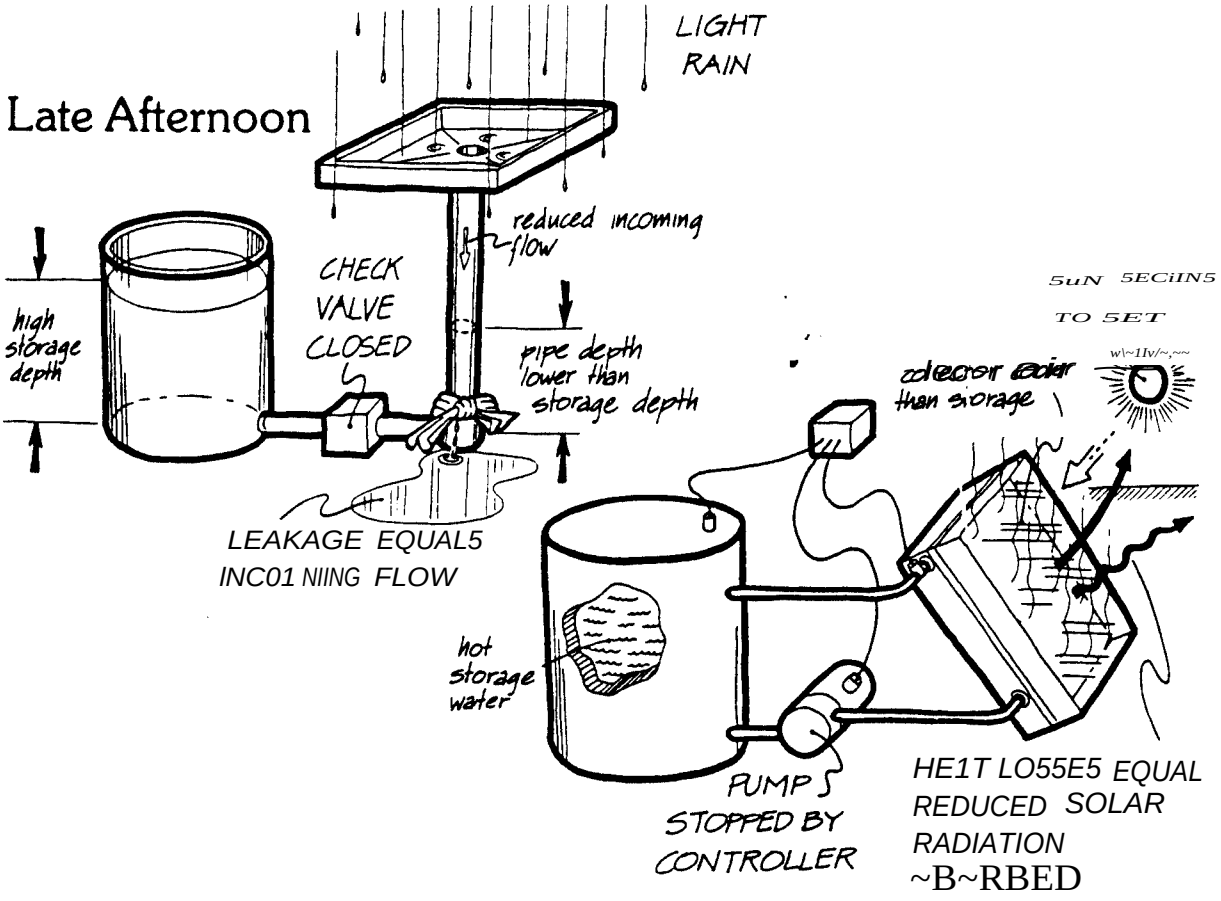
In the rainwater system, a heavy rain is still falling-analogous to the sun being nearly square to the solar collector. But after heavy rain for a long time, the storage water depth and the water depth of the pipe are much higher. The pipe's water depth



Is high enough to force much of the rainwater out of the leak. High leakage leaves little of the incoming flow to go to storage, so efficiency is lower.

Late in the afternoon the sun faces the collector less squarely, and less solar radiation is transmitted through the atmosphere, as we discussed earlier. The net effect of these factors is that the solar radiation absorbed by the collector falls off rapidly. But losses are still high, since they are determined by how hot the water coming from storage is. Eventually the collector can't absorb enough heat to stay hotter than the storage tank. When the collector gets cooler than the storage tank, the controller shuts off the pump. Of course, efficiency is zero when the pump Is off. Any Incoming solar radiation that is absorbed Is lost completely through the glazing.

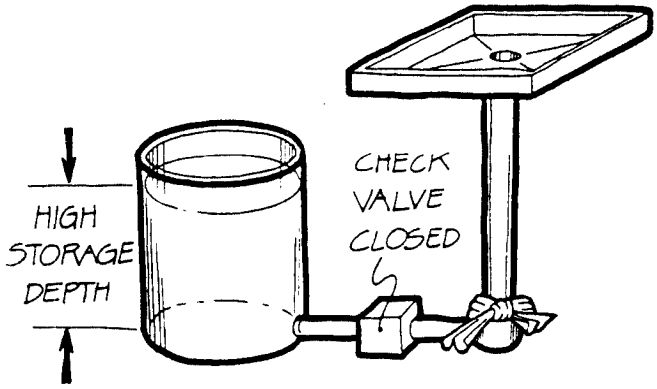
Let's suppose that the heavy rain falling on our rainwater tray diminishes, just as the solar radiation absorbed by the solar collector in the late afternoon is reduced. Less rainwater flows down the pipe, but there's still a lot of leakage since the pipe's water depth is so high. The reduced inflow can't maintain as



high a stagnation depth in the pipe because so much is leaking out. When the pipe's water depth drops below the storage water depth the check valve closes, preventing loss of our carefully stored rainwater out through the pipe's leak. As soon as the check valve closes, efficiency drops to zero: all the rainwater flowing down the pipe leaks away.

Finally the sun sets. The solar collecting system appears from the outside just as it did before the sun rose that same morning. The collector, exposed to the cold night air, is much colder than the heat storage tank. No water is pumped from storage to collector because the controller has long since sensed that the storage is hotter. Only the temperature of the storage water has changed. Whereas before dawn It was only warm, after sunset It is much hotter.

,timilarly, when the rain stops falling on the rainwater collector, the only difference is the amount of stored rainwater. The water in the pipe has long since leaked out and the check valve is closed, preventing loss of the stored rainwater. The net effect of the rain falling has been simply to store some portion of the rain caught by the collecting tray. Although some rainwater leaked away, the storage water depth after the rainstorm is much higher than it was before.



After the Sun Sets