SOLAR RADIATION 7

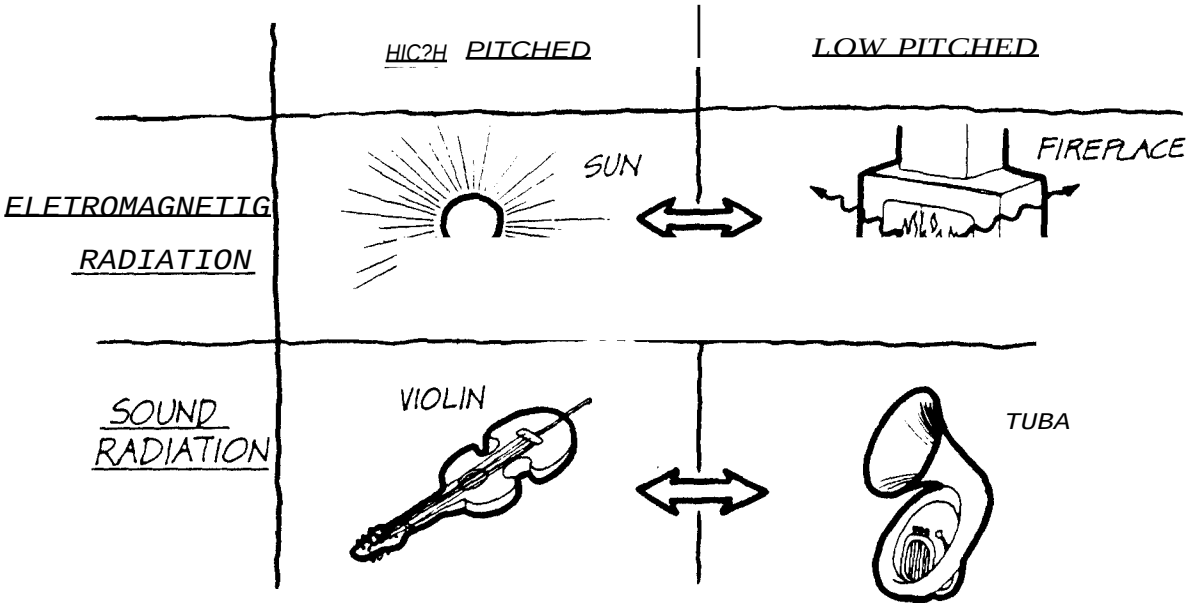
Now you've seen how houses lose heat. But how can the sun help to provide house heat? Can the same kind of system be used for hot-water heating or swimming-pool heating? To answer these questions, first we have to know something about solar radiation.

Remember that radiation heat flow (already discussed in Chapter 5) is a form of heat flow that needs no medium-such as air, water, or metal-to flow through. Solar radiation is like radiation heat flow, but it differs in important ways from the radiation heat flow already discussed. The distinctions between the two kinds of radiation are critical ones, especially with regard to solar heating.

Solar radiation and radiation heat flow belong to a class of radiation called *electromagnetic* radiation. X-rays, light waves, microwaves, television waves, and radio waves also belong to this class. Sound is another ciass of radiation. Sound radiation is subdivided into various pitches. Kettledrums and tubas are designed to handle low pitches, whereas flutes and violins can handle high pitches. Even different species of animals have ears that can hear different pitches. A dog's ear or a bat's ear can hear high pitches that human beings can't hear. Solar radiation and radiation heat flow differ in the same way as sounds of different pitch do. In fact, you could think of solar radiation as *high-pitched* radiation heat flow.

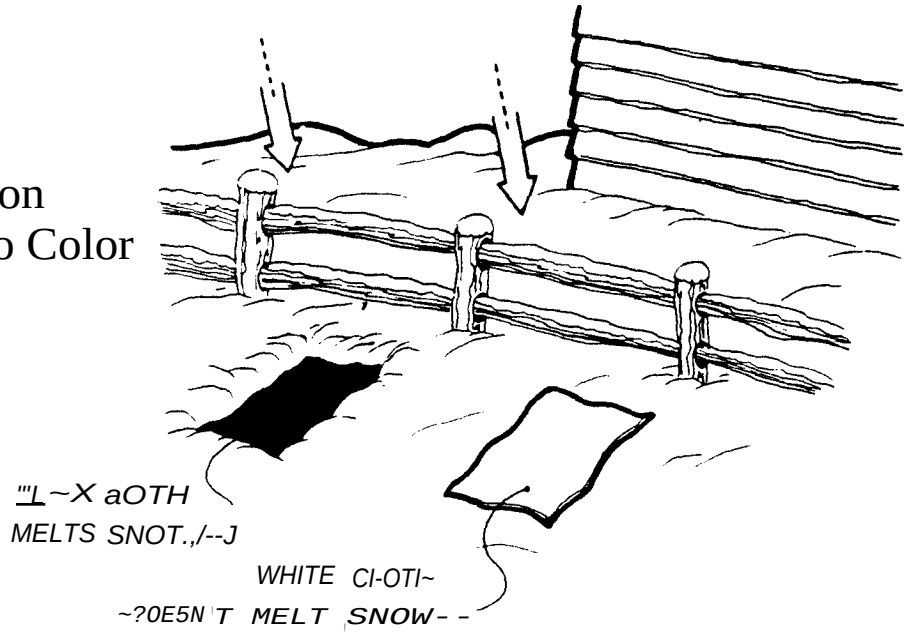
In terms of solar heating, radiation heat flow and solar radiation differ in two important ways. First, color is a very important factor in solar radiation but Is not too important in radiation heat flow. If a surface is exposed to the sun it will get very hot if it's painted black or a dark color, but it won't get very hot if it's painted white or a light color. Benjamin Franklin reportedly discovered this fact by laying a black cloth and a white

Radiation Comes in Different Pitches



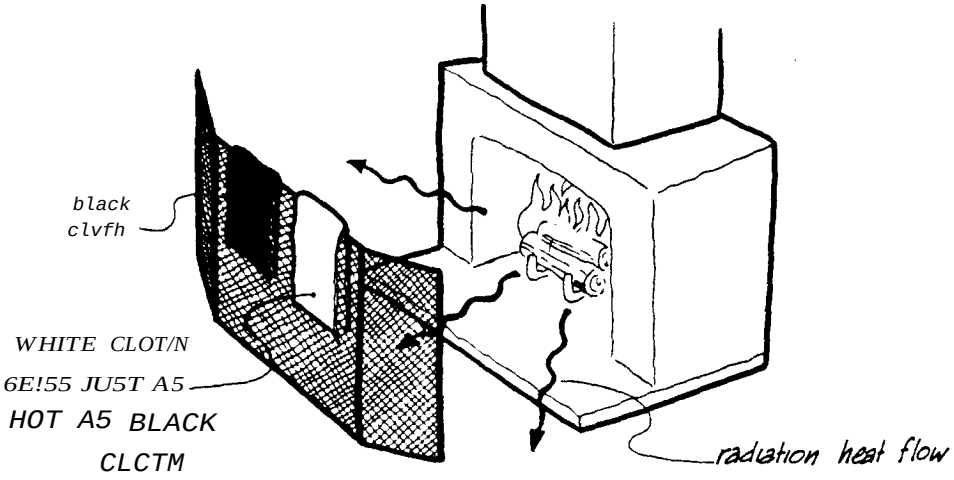
cloth on the snow on a sunny winter day. The snow melted much more quickly under the black cloth than under the white one because the black one absorbed more solar radiation. The white cloth reflected the sunlight away, so it didn't absorb as much solar radiation and didn't melt as much snow. We will use a hollow arrow (=====) to denote solar radiation to distinquish it from the other kinds of heat flow.

Solar Radiation is Sensitive to Color

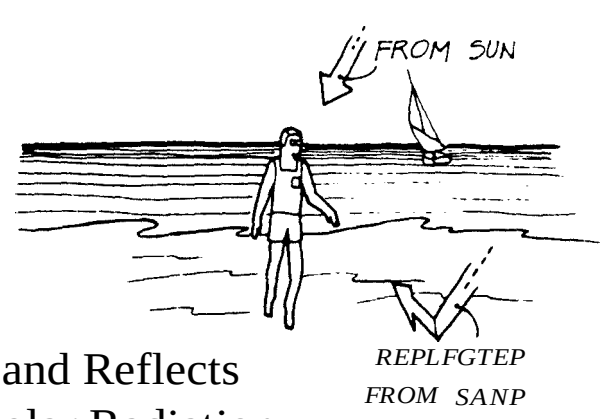


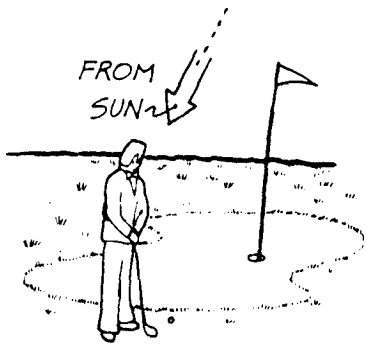
Unlike solar radiation, radiation heat flow reacts in the same way to different colors. If we held a black cloth and a white cloth in front of a fireplace, both would get just as hot.

Radiation Heat Flow is not Sensitive to Color



Recall that with radiation heat flow, the only way we could reflect the radiation was with a shiny surface. But with solar radiation both shiny surfaces and white or light-colored surfaces reflect the radiation. For example, you can get a worse sunburn on the beach than you can get on a golf course. On the beach you are exposed to solar radiation both directly from the sun and indirectly from the sun reflecting from the sand, but on a golf course lawn, you get the radiation only directly from the sun.

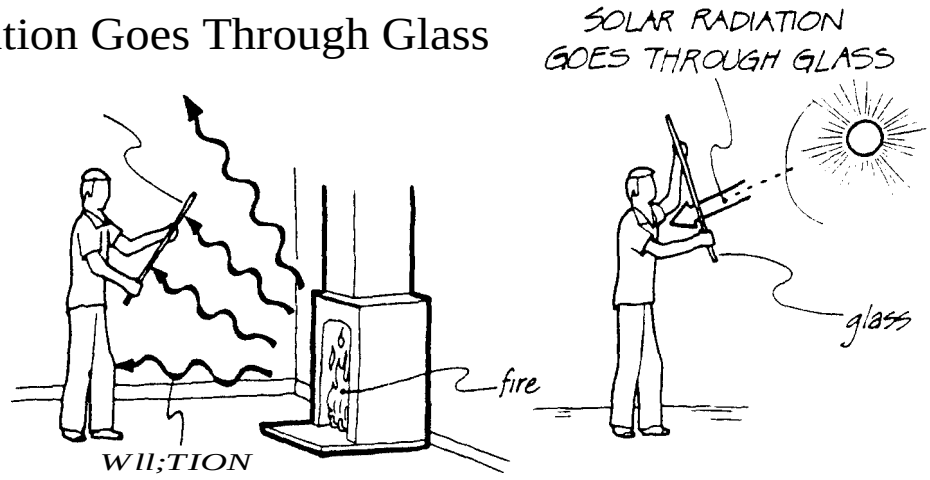




Sand Reflects Solar Radiation

Solar radiation and radiation heat flow differ in a second important way. Solar radiation can go through transparent materials like glass that radiation heat flow cannot go through. If you held a piece of glass in front of you, it would block the radiation heat flow from a fireplace; but it wouldn't stop solar radiation from coming through. The tendency for solar radiation, but not radiation heat flow, to pass through glass is sometimes called the *greenhouse effect.* Heat can enter a greenhouse through its glass roof, but the same glass acts like a solid wall to heat trying to leave the greenhouse by means of radiation. Plastic materials behave a little differently. Although both glass and plastic let solar radiation pass through them, some plastic materials also let radiation heat flow through.

Solar Radiation Goes Through Glass



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Other than the solar radiation's color sensitivity and its ability to pass through transparent materials, it behaves very much like radiation heat flow. It travels in straight lines, and it can be blocked by even thin material. To get out of the sun you get in the shade-the shade is simply anyplace where the solar radiation has been blocked. A tree can provide shade even though its leaves are very thin.