The Operative Bald Spot

by Lawrence Drake
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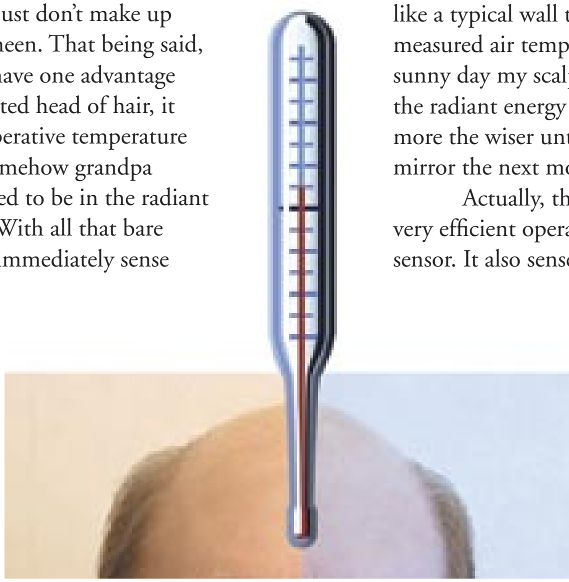
I have always been just a little perturbed that my maternal grandfather passed on his lack of hair to me through his gene pool. Those of us who are follicly challenged know that baldness has few advantages. Cheaper haircuts just don't make up for the blinding sheen. That being said, a bald head does have one advantage over a well populated head of hair, it is the ultimate "operative temperature sensor"! Maybe somehow grandpa knew I was destined to be in the radiant heating business. With all that bare skin up top I can immediately sense the smallest changes in air temperature or radiant heat transfer. The combination of the two is what defines "operative temperature" and the comfort equation that drives the radiant industry.



On the extreme, when I walk outside on a cold cloudy day my head quickly informs my brain that a warm cap is in order lest all my body heat escape directly through my shiny dome like hot air rising up a chimney. That cold air hits my warm scalp and convective heat exchange is immediate. An infrared photo would light up my head like a beacon and show waves of heat traveling skyward. When the day is cool and sunny, that same patch of skin sends a different signal but with a similar message, "put on a cap". This time the sun is beating down on my sensitive bare spot and threatening to cook it to a sunset red if not acted upon in short order.

Operative temperature is that temperature which combines both the air temperature and the radiant temperature effect. Unfortunately, conventional heating (and cooling) systems measure only the air temperature. If my biological sensor was like a typical wall thermostat and only measured air temperature, on a cool sunny day my scalp would cook from the radiant energy and I would be no more the wiser until I looked in the mirror the next morning.

Actually, the human body is a very efficient operative temperature sensor. It also senses humidity and heat conduction (walk across a cold tile floor barefoot). The task of any space heating or cooling system is to create an environment which satisfies all the operative temperature requirements of the occupants. If that is done, then the occupant is comfortable. If one temperature is out of whack, the others must make up the difference. It is a balancing act. As technology advances and consumers are demanding more comfort, this balancing act becomes a great challenge.

In the good old days of stone castles, mud huts, or log cabins, people would sit in front of roaring fireplaces and cook one side of their bodies with radiant heat and chill the other with the cool drafty air coming in through the cracks and crannies. At just the right distance and frequent turning they could get an average temperature. This was acceptable

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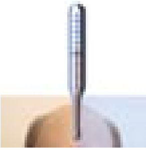

because it was better than the only alternative, no heat at all.

Fast forward a few centuries and people have learned how to "can" hot air and radiant heat and move it to where it is needed. For some reason, Europeans and Asians chose to move primarily radiant heat and the Americans elected to move hot air. Europeans used the fire to heat water and then moved the water to a radiator. Americans heat air with fire and blow the heated air it into the room. *(barely 5% of heating in the United States is hot water heat)*

Now it seems reasonable that if my body requires a balance of radiant, conduction and convective heat transfer, I should look for a heating system that will satisfy all three of these criteria. Enter the modern radiant heating system. Now, even though it is called a "radiant" heating system, it also heats the air. In fact, a typical radiant floor heating system delivers almost half of its heat by natural convection; cool air coming in contact with the floor, being heated and rising. The big difference between convection from a radiant floor and forced convection from a hot air system is air temperature and velocity. A radiant floor produces air temperature just a few degrees over the floor surface temperature and only a degree or two above the average room temperature. This air gently rises and dissipates its' heat in the first few feet above the floor until it reaches room temperature. There is virtually no hot air rising to the ceiling. In fact, the temperature at the ceiling is slightly cooler than at shoulder height. This "half radiant/half convection" makes the body smile because that is almost precisely the ratio which the body loses heat. It also makes my head happy because it senses a well balanced environment.

The combined heat transfer of a radiant system is also quite different than produced by the typical baseboard convector. Baseboard convectors are designed to primarily heat air, not radiate heat. Warm air rises from the baseboard up the wall, across the ceiling, down to the floor and back to the baseboard as it cools. Its operation is dependent on air temperature stratification. While significantly better than forced air convection, it cannot produce the balanced comfort of a radiant system.

A person's biological operative temperature sensor will sense comfort changes as we move about a room. Large widows feel "drafty" as you move closer to them on a cold winter day. You feel the air that is cooled by the window as it falls to the floor, but most of that chilly feeling comes from the radiant heat transfer of your warm body giving up its heat to the cold window.

When faced with a cold surface like a window, once again radiant heating systems come to the rescue. This can be in the form of concentrated tubes or electric elements in the floor area adjacent to the cold surface, a wall mounted radiator or even ceiling radiant panels. The

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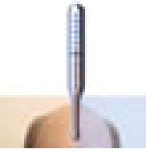

beauty of radiant heat transfer is that it travels in any direction and is self regulating. The larger the temperature difference between the heated surface and the cold surface, the greater the heat transfer. You just have to make sure that there is enough heat delivered to the radiant surface to supply the heat transfer process. As the temperature of the cold surface drops, the temperature difference between it and the heated surface increases, increasing the output of the heated surface. That is why radiant tubing or electric elements are often spaced closer together near outside walls. The water or electric element carries the heat so, where more heat is required, more heat energy is needed. This does not increase the "temperature" of the radiant surface, it only increases its heating capacity and allows it to compensate for cold surfaces naturally.

Outside of the comfort benefits of radiant systems, there are energy savings as well.

In a typical forced air heated house, my biological operative sensor tells me that the radiant portion of my comfort status is lacking so I should increase the air temperature or put on some more clothes. I opt for the former and turn up the thermostat on the wall to compensate for the cold walls, windows, ceilings and floors. In fact, the colder it is outside, the more I turn up the thermostat. Of course most of that hot air immediately rises to the ceiling where it doesn't do me any good and proceeds to transfer heat to the cold attic. On its way to the ceiling it washes over cold walls and frigid windows...more heat transferred to the outside. The hotter the air, the faster the heat transfer.

Now compare that to a radiant heated house where the radiantly heated surfaces are only a few degrees above average room temperature and the radiant heat transfer part of the comfort factor is being satisfied. My biological operative sensor is satisfied at lower air temperatures and there is no hot air rising to the ceiling or wiping the walls. The result is less heat loss through walls, windows and ceilings. Not only that, but my feet are just as comfortable as my head. No cool moving air at the floor to slow down the blood flow in my toes and no hot air at the ceiling to make my head sweat. I don't turn up the thermostat as it gets colder outside. In fact the radiant heat transfer increases automatically as outdoor temperatures decrease and my little abode gets even more comfortable without touching a thing!

Balance... it is all about balance. A good balance between radiant, convective and conductive heat transfer makes my operative sensor more comfortable and my pocketbook healthier. Only a radiant heating systems can do all that. Maybe bald people are a little more sensitive to operative temperature, but everyone benefits when it is in balance, even those with thick, flowing, curly locks.

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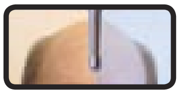
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