PHYSICS IN DAILY LIFE:

FEELING HOT, FEELING COLD

>>> DOI 10.1051/epn:2008406

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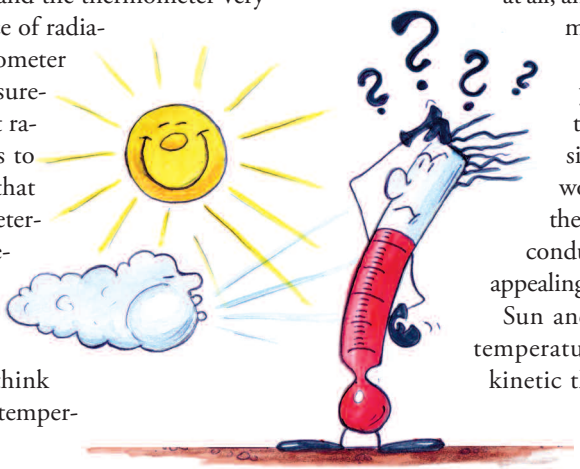
Even on a cold day, a bit of sunshine can make a tremendous difference. People will say things like 'It is supposed to be 15°C according to the forecast, but in the sun it's at least 25'. Although this may contain some truth in terms of heat balance, it is, strictly speaking, nonsense. There is no such thing as 'temperature in the sun'. How would one measure that? Different types of thermometers hanging in the sun would give widely different readings, depending on construction, optical properties and the like. The only decent definition of air temperature is derived from the mean kinetic energy of the molecules: $\frac{1}{2} m\langle v^2 \rangle = \frac{3}{2} kT$. Radiation has nothing to do with it.

But measuring the kinetic energy of the molecules in a gas directly is not exactly a piece of cake. Therefore we use an indirect way: the thermometer. It's easy to use, but not always reliable. The problem is the low thermal conductivity of air. This makes the thermal contact between the air and the thermometer very poor. As a consequence, the influence of radiation is hard to suppress. If the thermometer is in the sun, forget a reliable measurement. But even in the shade, indirect radiation will cause our thermometers to be slightly optimistic. No wonder that meteorologist have strict rules for determining the temperature: thermometers must be placed inside well-ventilated casings, which are painted white, placed 1,5 meter above the ground, etcetera. If you think about it, it's almost a miracle that air temperatures are accurately measured at all.



Wind is another source of misunderstanding, if it comes to temperature. Obviously, if the wind blows around our body (or, in fact, around *any* object that is heated above ambient temperature), the heat losses by conduction will increase. The reason is that the insulating layer of air – normally a few mm thick – will become thinner once the wind blows. The effect is the same as if the air temperature were lower. That seemingly lower temperature is often called the 'wind chill' factor. Although this is a widely known concept, many people are still missing the point. An example is the journalist who concluded, using the wind chill table, that the water in his car's radiator would freeze well above the freezing point, if only the wind would blow…..

If we think about it, wind chill is an ill-defined concept. For one thing, it depends upon the clothing that we wear. For example, in the limit of infinite insulation, wind would not bother us at all, and the wind chill factor would become meaningless. All we can say for sure is that any correction for wind must asymptotically reach a limiting value if the wind speed goes to infinity. Consider bare skin: eventually, our skin would assume the air temperature, and the heat losses would be limited only by conduction inside our own body. Not an appealing prospect, if it freezes outside.

Sun and wind: both make the concept of temperature a bit fuzzy. Thank heaven that kinetic theory provides us physicists with a reliable definition.

Come rain or shine. ■