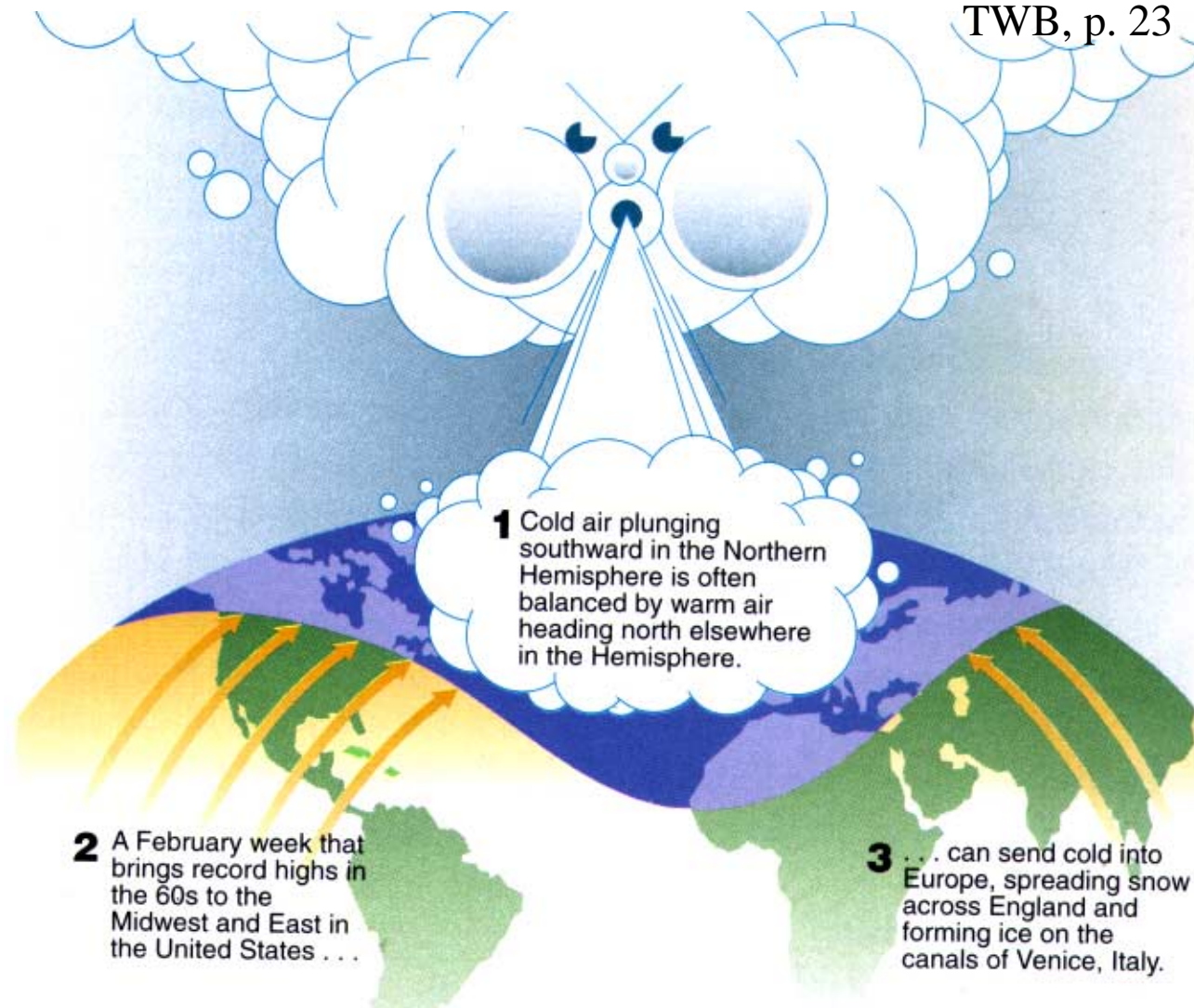


## Lecture 6. Air Masses

- If the same air stays over a region for many days, it warms or cools (and moistens or dries) into balance with the underlying surface to form an *air mass*.
- Fairly uniform air masses may extend 1000's km across.
- When air masses blow over us from their formation region, they bring us heat waves and cold snaps.
- Air mass types (and formation regions):
  - Continental polar (AK, Canada, winter)
  - Maritime polar (N Pacific)
  - Maritime tropical (Gulf of Mexico, Hawaii)
  - Continental tropical (SW deserts, summer)
- Polar and tropical air masses are rapidly modified after they blow out their regions of origin and don't make it to Seattle in pure form.

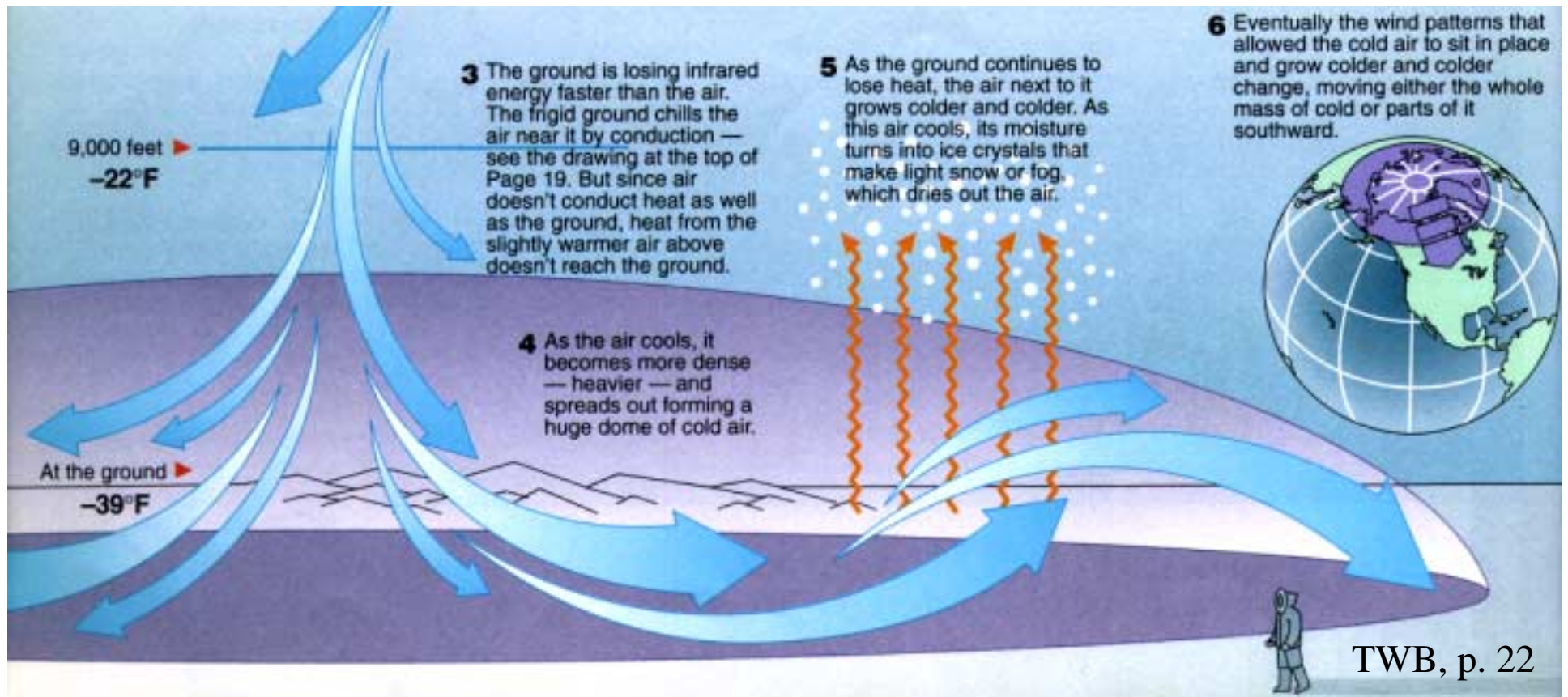
# Mid-latitude Weather: Battle of the Air Masses

TWB, p. 23



- Storms and fronts form near contrasts between warm and cold airmasses, then blow these airmasses around to make day-to-day temperature changes.

## Formation of Polar Airmasses



- Polar airmasses form in winter, because the ground and air are emitting infrared radiation, but there is little sunlight to heat them up, so they cool.
- In these airmasses, air cools as it gently sinks, and temperatures are coldest at the ground (an 'inversion').
- The cold dense air spreads southward like pancake batter.



# Formation of Tropical Airmasses

TWB, p. 24

## Maritime tropical air masses

### Hot, humid air

- 1 Tropical oceans warm into the 80s in the summer.
- 2 The air above the ocean warms to similar temperatures.
- 3 Warm water evaporates into the air, making it extremely humid.
- 4 Rising warm, humid air often condenses into clouds, showers or thunderstorms.
- 5 As hot, humid air moves inland in summer the warm ground can heat it even more.

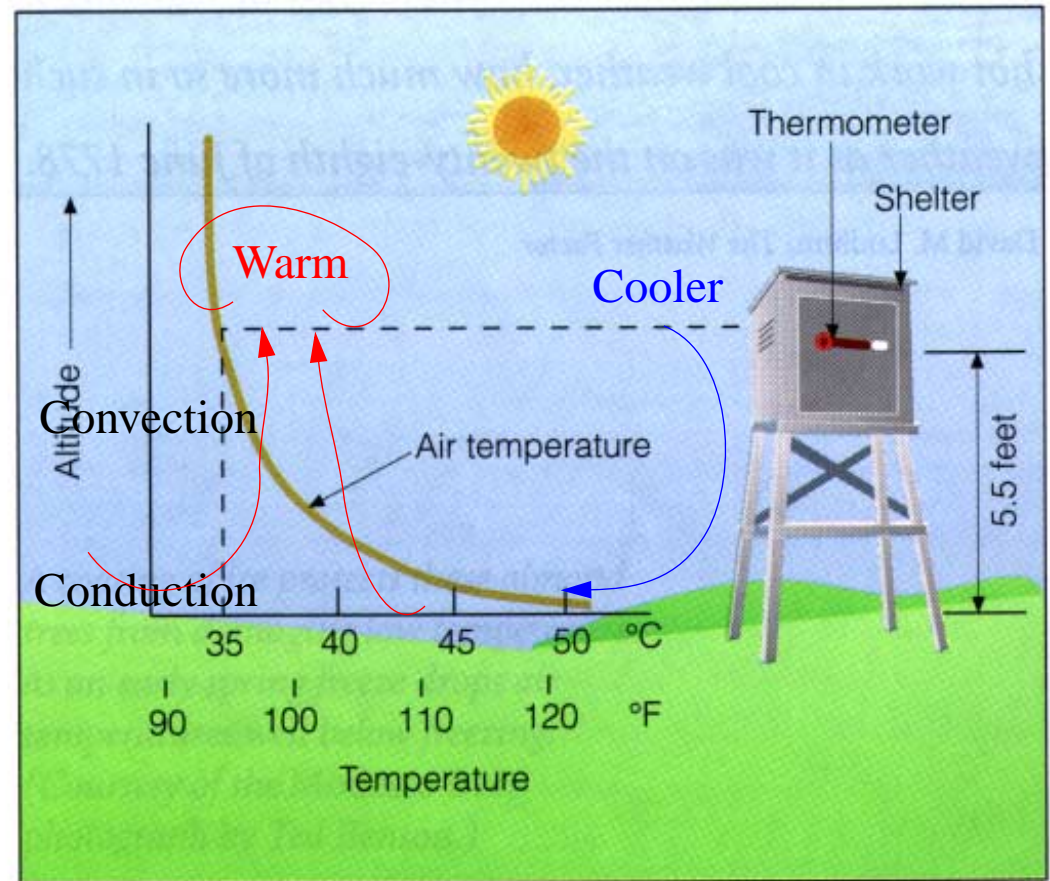
## Continental tropical air masses

### Hot, dry air

- 1 Hot, dry air masses over land form where air is slowly sinking and the sky is clear.
- 2 The mostly bare ground grows hotter and hotter under the relentless sun.
- 3 The hot ground warms the air, sometimes to more than 100°F.
- 4 Since there's hardly any water to evaporate, the air stays extremely dry. Air masses that form over deserts are the world's hottest.
- 5 In the United States, desert air begins picking up water vapor as it moves over lakes, rivers and green plants. This cools the air a little, but adds uncomfortable humidity.

## Daytime Heating

- Heat goes from ground to lowest inch of air by conduction, mixed upward by turbulent convection. Wind promotes enhanced turbulence, mixing.



**FIGURE 3.1**

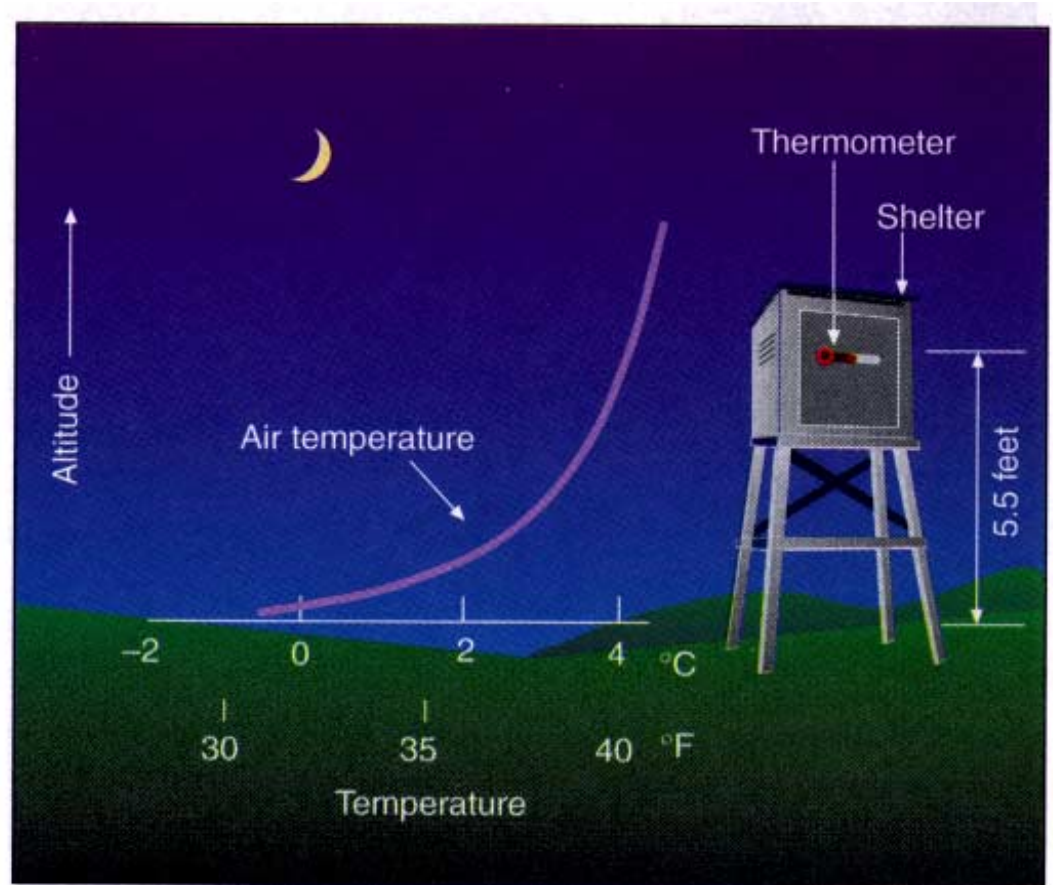
(EOM)

*On a sunny, calm day, the air near the surface can be substantially warmer than the air several feet above the surface.*



## Nighttime Radiation Temperature Inversions

- Ground radiates more efficiently, cools faster than air. Radiative cooling fastest on cold, clear night.
- Wind, turbulence mixes air, weakens inversion.

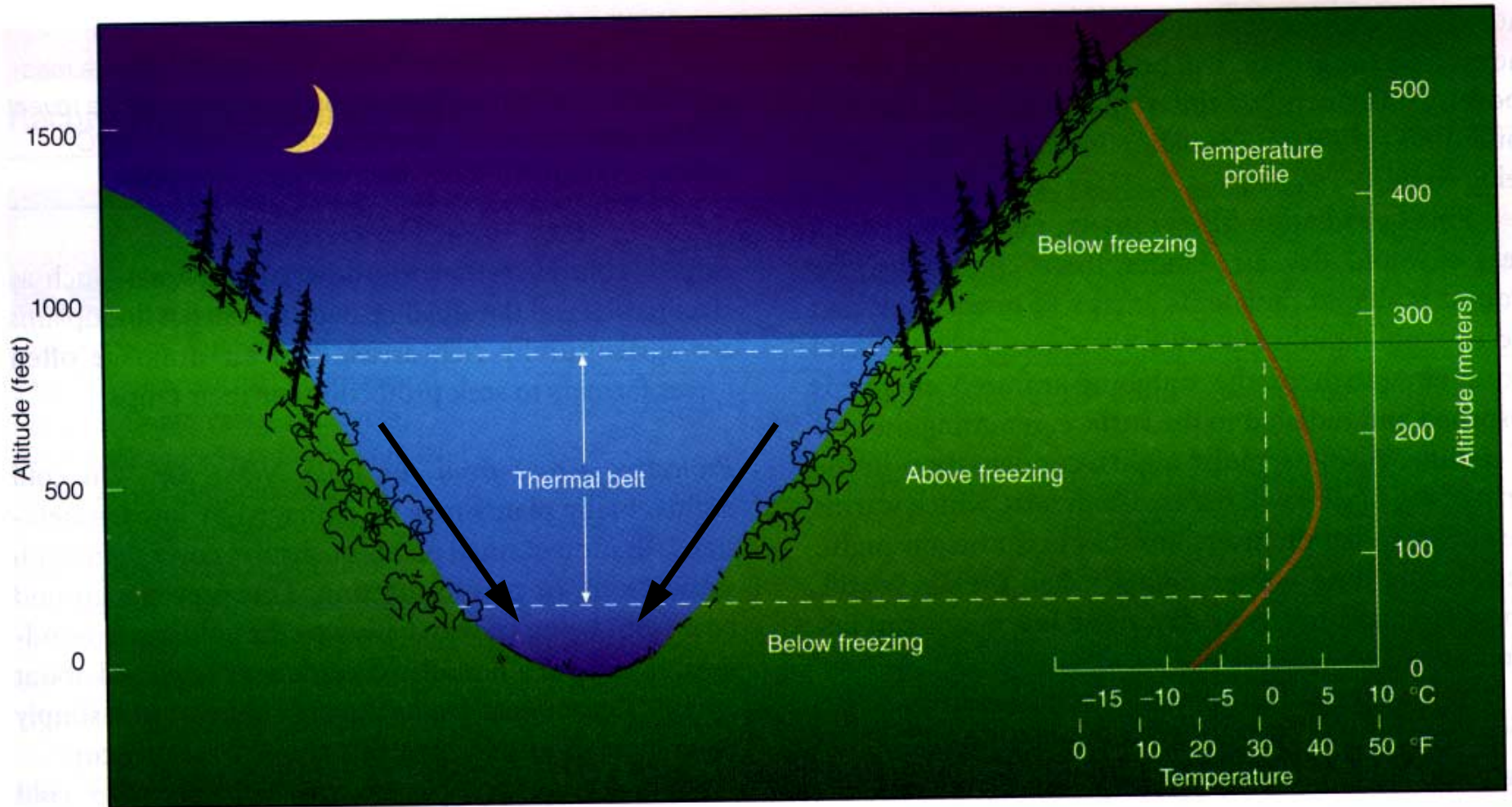


**FIGURE 3.3**

(EOM)

*On a clear, calm night, the air near the surface can be much colder than the air several feet above. The increase in air temperature with increasing height above the surface is called a radiation temperature inversion.*

## Thermal Belts on Hillsides



**FIGURE 3.4**

*On cold, clear nights, the settling of cold air into valleys makes them colder than surrounding hillsides. The region where the air temperature is above freezing is known as a thermal belt.*

The cold air currents blowing down hillsides are called **katabatic** winds.



## Protecting the Orange Crop Against Frost

- If air is subfreezing only near ground (radiation inversion), heat or mix it up.

Orchard heater



Wind Machine

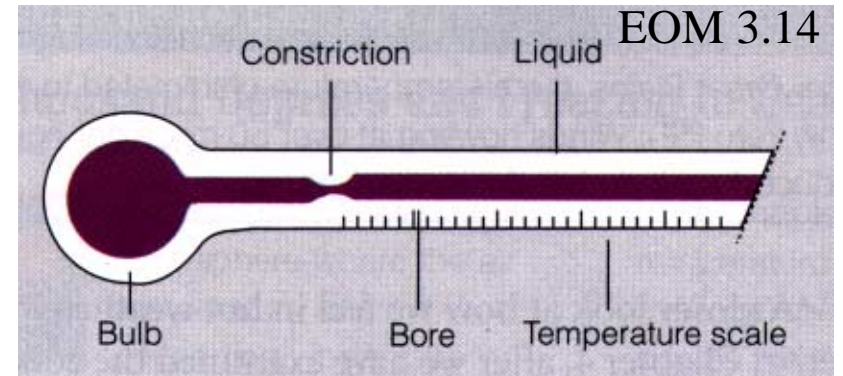


- If air is subfreezing above tree-tops too, spray water (freezes around oranges, releasing latent heat and insulating them).



## Thermometers

- Liquid thermometer - liquid with low freezing point (e. g. mercury) in bulb expands with temperature, forcing some liquid up the narrow bore.



- Bimetallic thermograph - strip bends when heated since one metal expands faster than the other.
- Electrical resistance thermometer - based on resistance change with temperature; used on airplanes.
- Radiometers - based on brightness of emitted radiation (brighter = hotter). Used on satellites.

