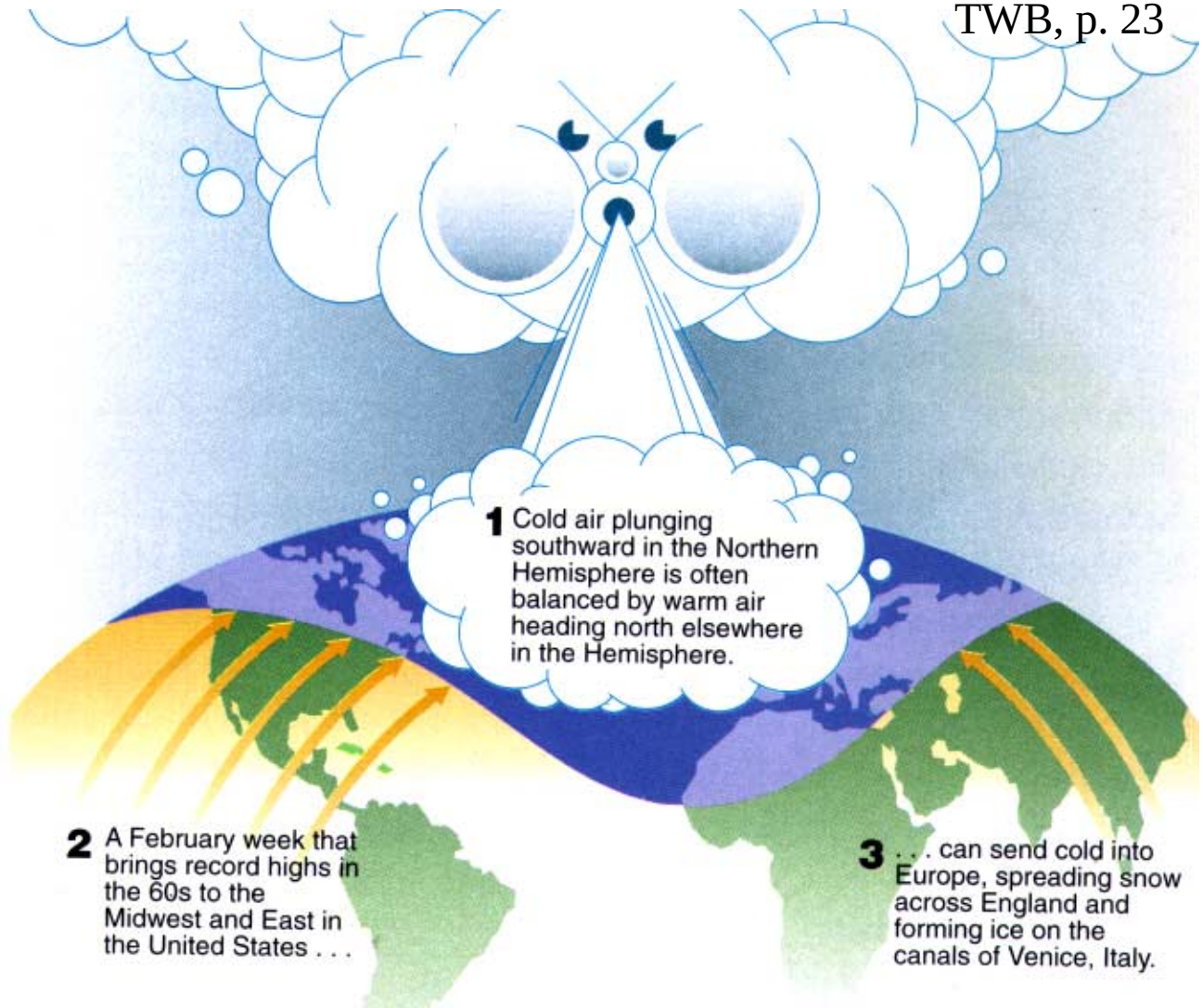
Lecture 6. Air Masses

- 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.

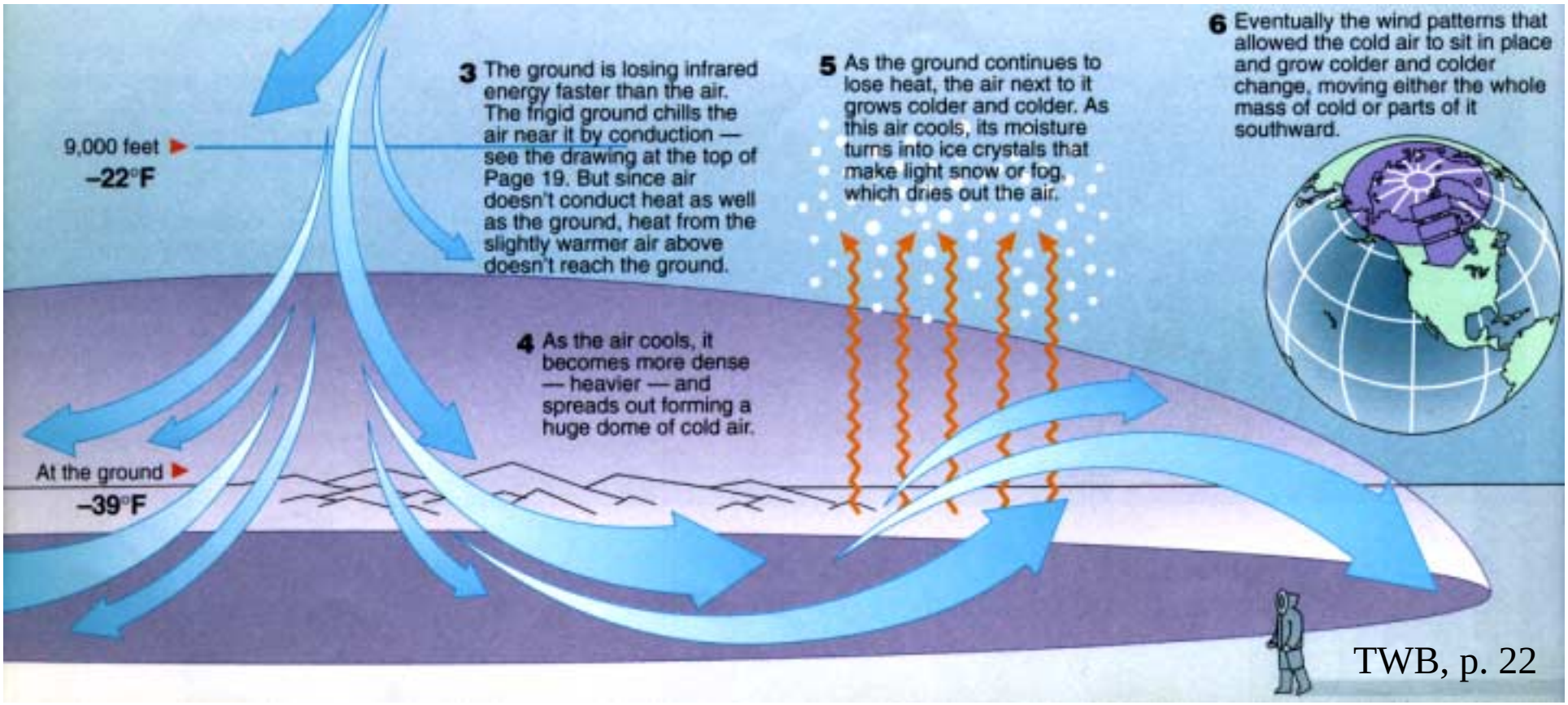
Mid-latitude Weather: Battle of the Air Masses

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.

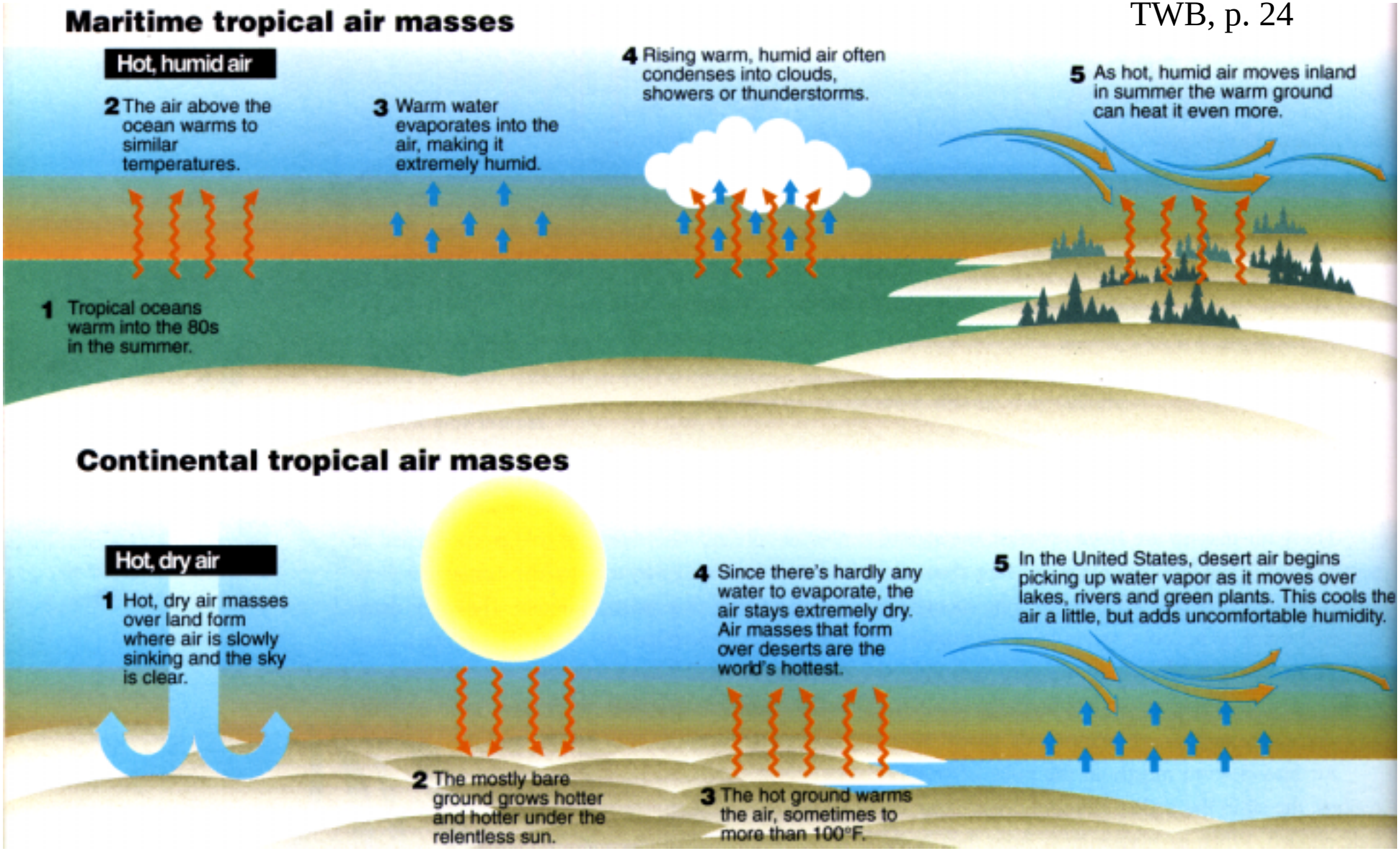
Formation of Polar Airmasses



- 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.

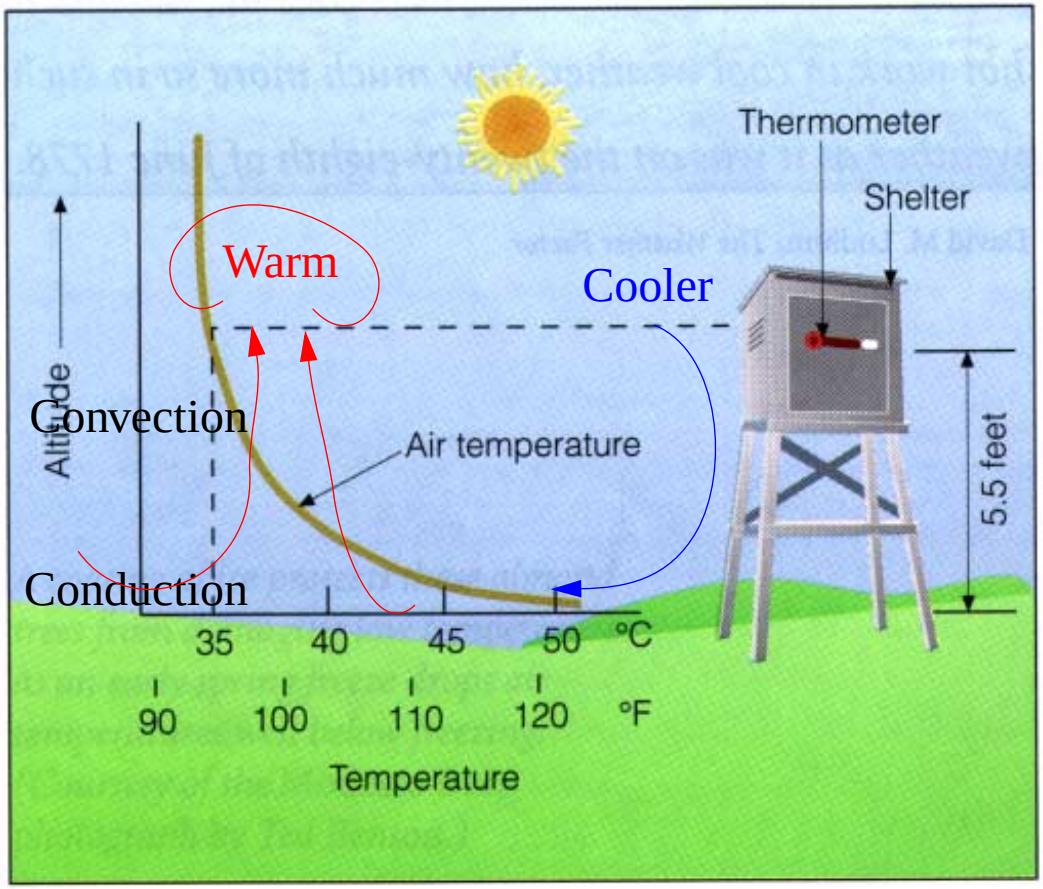
Formation of Tropical Airmasses

TWB, p. 24



Daytime Heating

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



(EOM)

FIGURE 3.1
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.

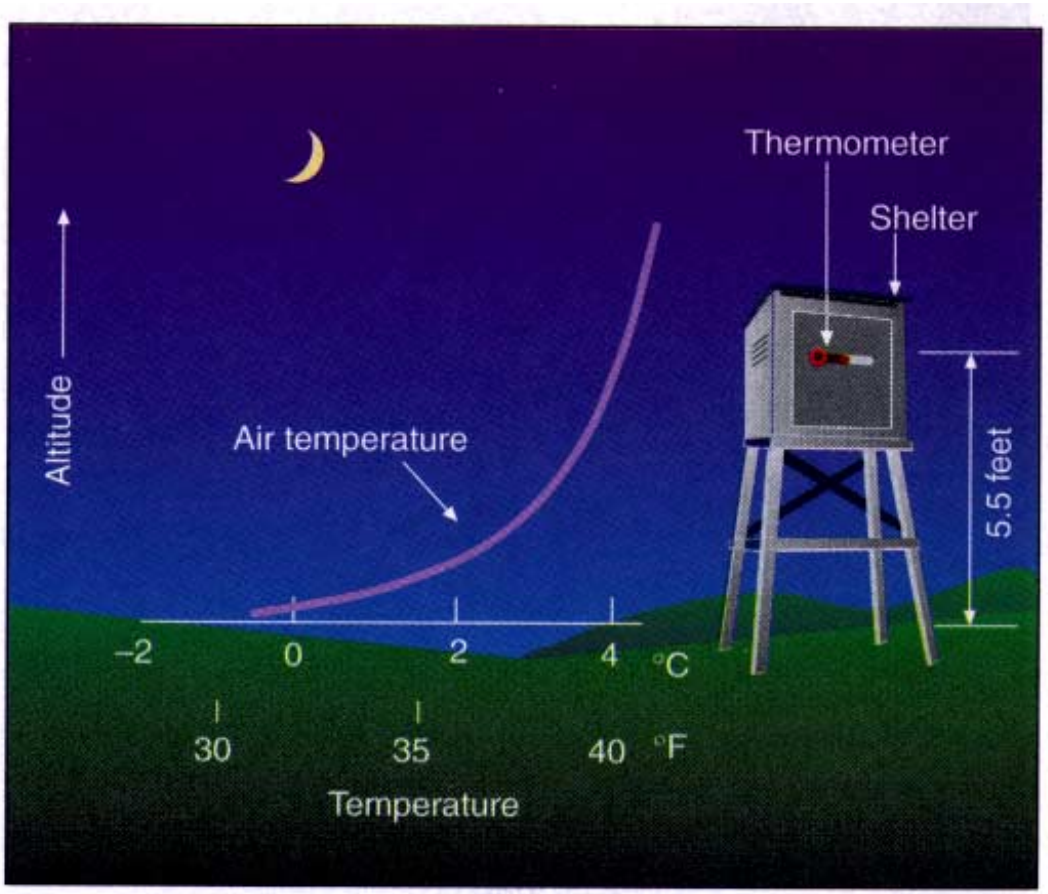


FIGURE 3.3 (EOM)

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

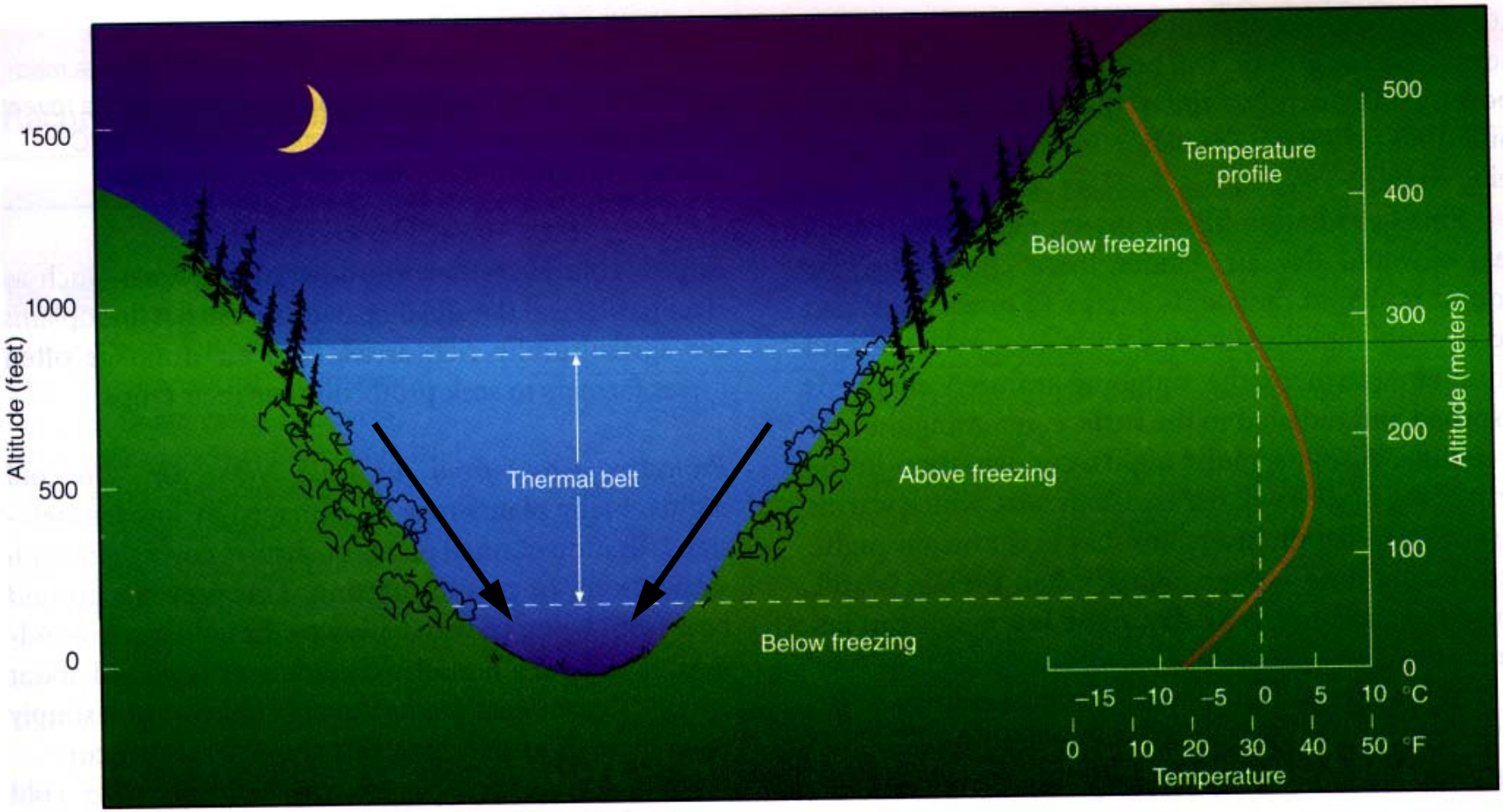


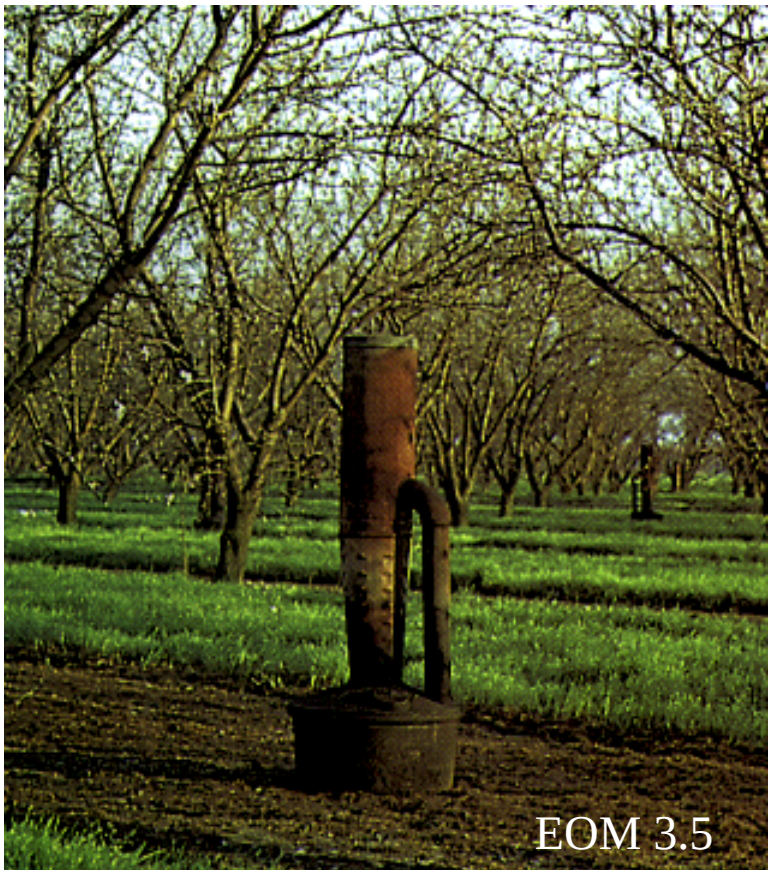
FIGURE 3.4
On cold, clear nights, the settling of cold air into valleys makes them colder than surrounding hillsides. The region where the air temperature is above freezing is known as a thermal belt.

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



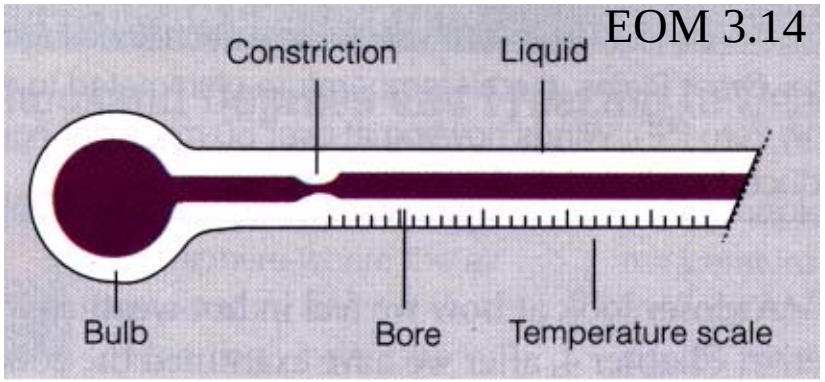
Wind Machine

- 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.

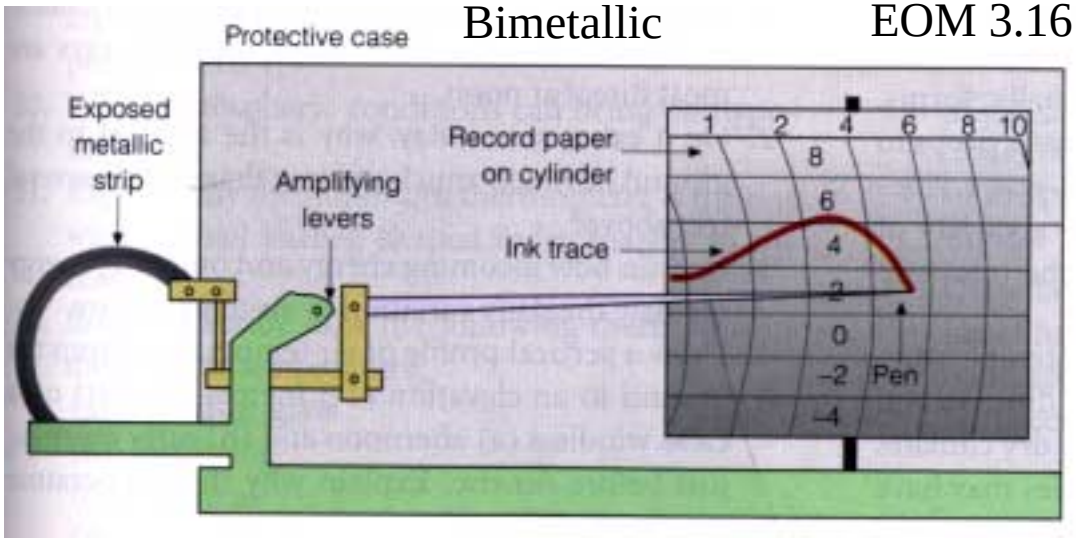
EOM 3.14



- 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.

Bimetallic

EOM 3.16



- Radiometers - based on brightness of emitted radiation (brighter = hotter). Used on satellites.