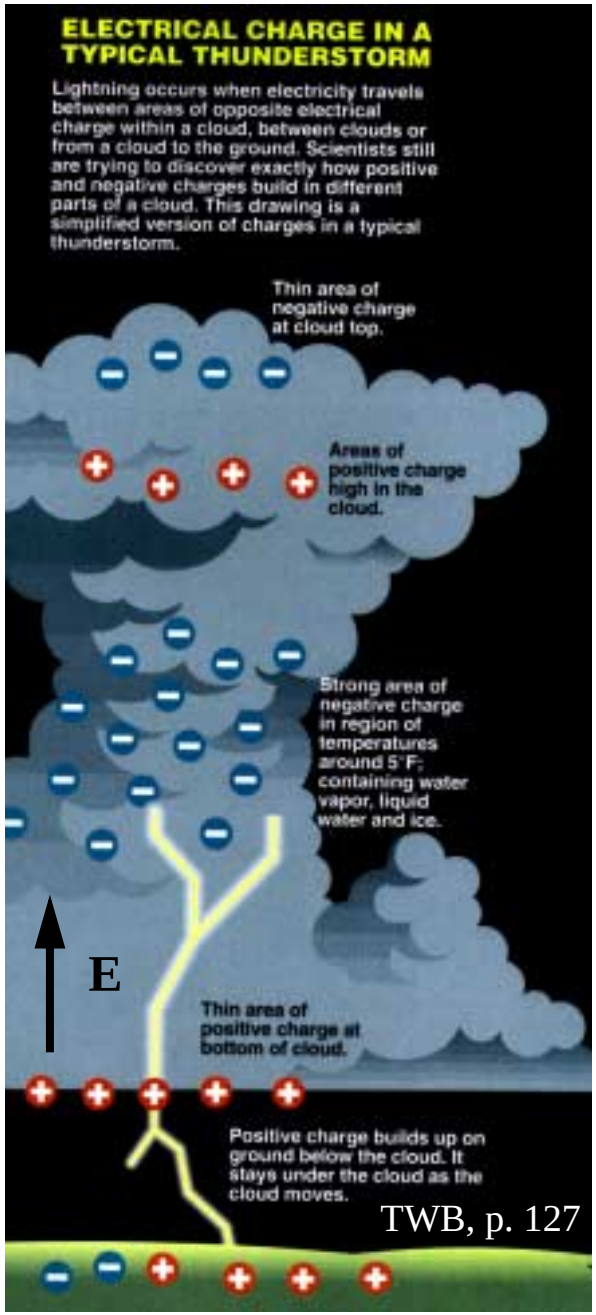
## Lecture 27 Cloud Electrification

- Lightning forms because different charges build up in parts of cloud.
- Supercooled water and small ice particles rising in the updraft attract electrons (negative charge) when they collide with larger ice particles.
- If electric field **E** exceeds 1 million volts per meter, electrons are torn off air molecules, *ionizing* the air. Charge can now flow freely.



TWB, p. 127

## Facts about Lightning

- Cloud-to-cloud (80%) or cloud to ground (20%)
- A short channel of air in the cloud ionizes.
- Electrons migrate downward, attracted by the positive charge below.
- One or more channels roughly 50 m long ionizes underneath, continuing the downward march of electrons in the *stepped leader.*
- As stepped leader nears ground, one or more *streamers* of positive charge also ionize a channel.
- When a streamer meets the leader, a powerful wave of current moves up the ionized channel at 1/3 the speed of light...a lightning stroke.
- Several strokes usually occur in quick succession to make a lightning flash.
- The glow of the ionized air, heated up to 30,000 C, makes lightning visible. The rapid thermal expansion and contraction of air create sound waves, which spread 1 mile every 5 secs to make thunder.
- Lightning starts 10,000 fires a year over the US. Most drier western forest ecosystems need occasional lightning-set forest fires to remain healthy.

*Film: Lightning - Electric Skies (35 min)*