2. Aurorae

Aurorae, or polar lights, are a prime example of solar-terrestrial relationships. They also provide an interesting example of the development in geophysical research. And they are simply beautiful and, depending on his habitat, have fascinated or frightened mankind since historical times.

The aurora, also called the northern light, is a typical phenomenon of the high latitudes, where under suitable conditions (clear sky, no full moon), it can be observed almost constantly. Under normal conditions, the aurora is a colored arc extending roughly from east to west, changing its appearance in a typical pattern during the night. Under geomagnetically disturbed conditions, the aurora brightens, becomes highly structured, moves equatorwards across the sky, and changes its appearance fast. Typical auroral structures are shown in Fig. 3.2, with the arcs and bands more typical of geomagnetically quiet conditions and the draperies, rays, and corona more often observed during geomagnetic activity. The aurora is less bright than the full moon, and thus although even in mid-Europe some aurorae occur each year, often they are difficult to detect because of a city's counterglow in the sky.

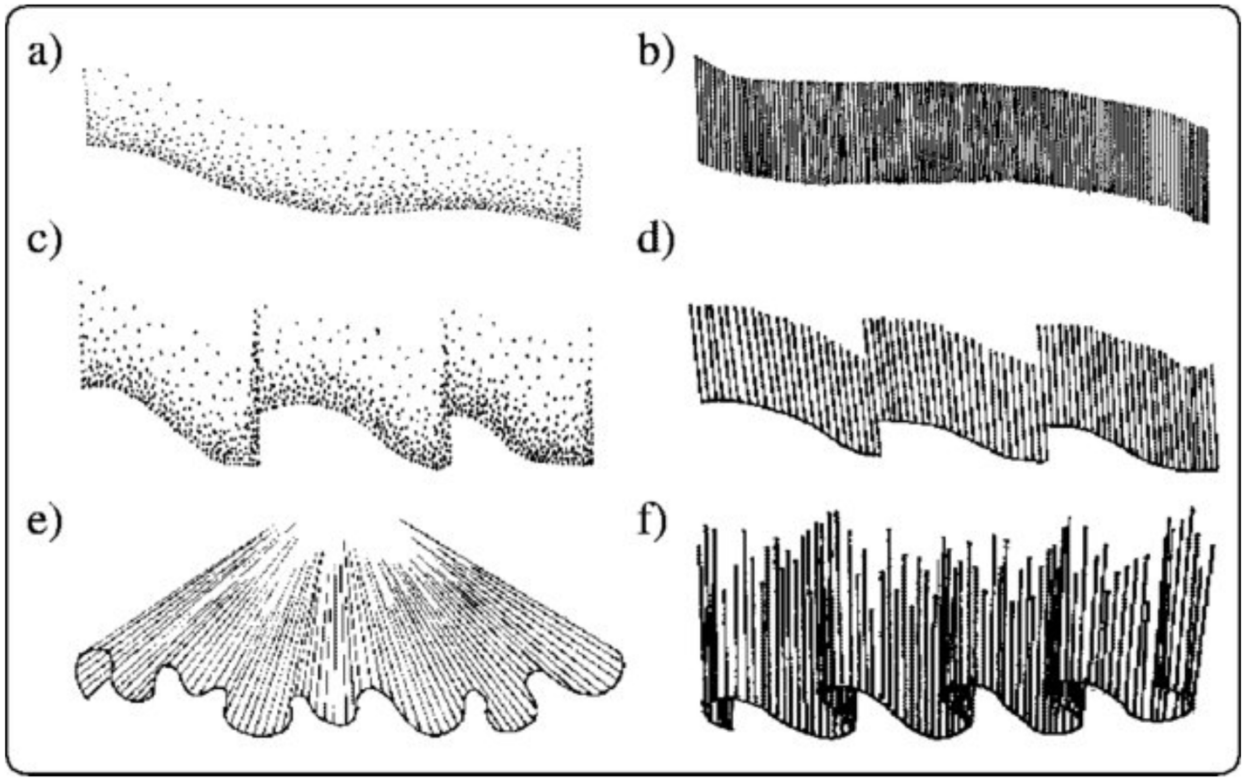
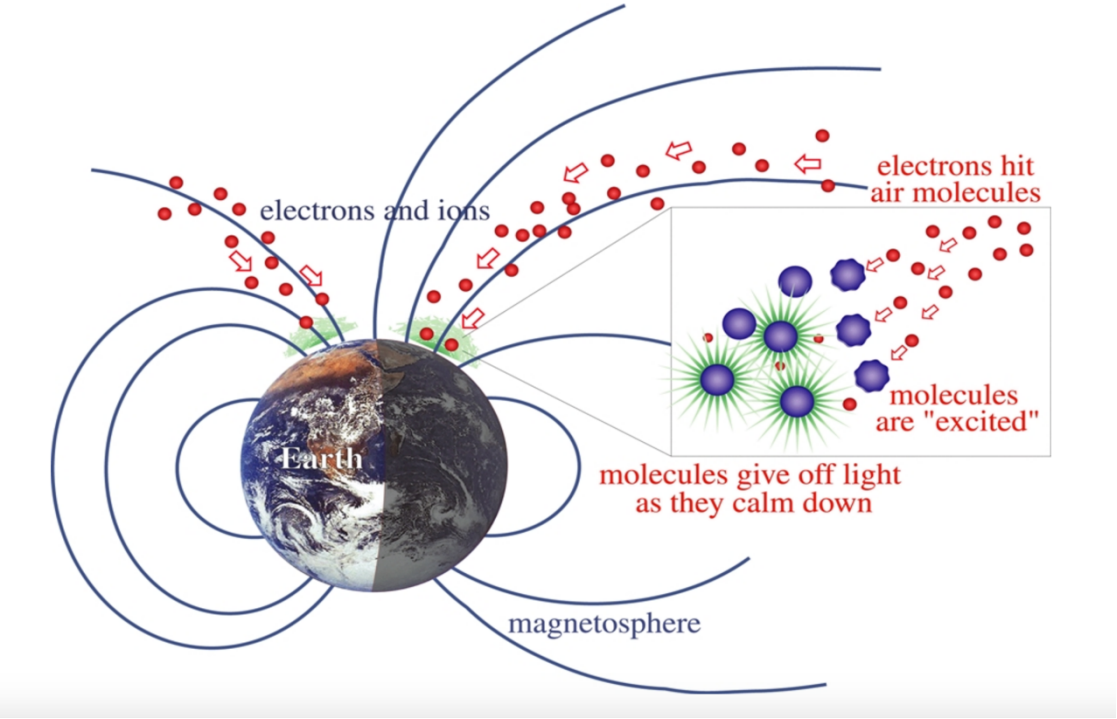


Figure 3.2. Artist's conception of some typical auroral forms: (a) homogeneous arc, (b) rayed arc, (c) homogeneous band, (d) rayed band, (e) corona and (f) drapery (courtesy of Adriane Elena Baranoski).

The "northern lights" are caused by collisions between fast-moving particles (electrons) from space and the oxygen and nitrogen gas in our atmosphere. These electrons originate in the magnetosphere, the region of space controlled by Earth's magnetic field. As they rain into the atmosphere, the electrons impart energy to oxygen and nitrogen molecules, making them excited. When the molecules return to their normal state, they release photons, small bursts of energy in the form of light. When billions of these collisions occur and enough photons are released, the oxygen and nitrogen in the atmosphere emit enough light for the eye to detect them. This ghostly glow can light up the night sky in a dance of colors. But since the aurora is much dimmer than sunlight, it cannot be seen from the ground in the daytime. The color of the aurora depends on which gas is being excited by the electrons and on how much energy is being exchanged. Oxygen emits either a greenish-yellow light (the most familiar color of the aurora) or a red light; nitrogen generally gives off a blue light. The oxygen and nitrogen molecules also emit ultraviolet light, which can only be detected by special cameras on satellites.


electrons and ions
electrons hit
air molecules
molecules
are "excited"
Earth
molecules give off light
as they calm down
magnetosphere