



SUNSPOTS AND SUNSPOT GROUPS

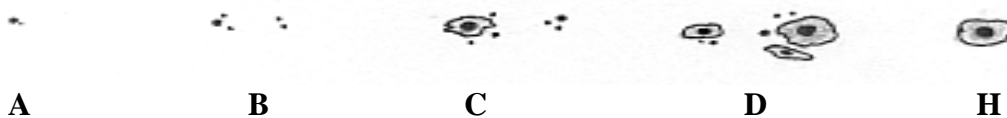
Sunspots are dark areas that grow and decay on the lowest level of the sun that is visible from the Earth - the photosphere. We often refer to this level as the Sun's surface, even though the density there is only one-hundredth that of the Earth's atmosphere at sea-level. Sunspots are the most well-known and easily observed feature of the Sun which show its dynamic nature through their change in number and area.

Sunspots are darker than their surrounding area because they are cooler than the average temperature of the solar surface (about 6000 degrees). The appearance and disappearance of sunspots is due to underlying changes in the magnetic fields that exist throughout the sun. Because the sun shows differential rotation (ie, the equator rotates faster than the poles), the magnetic flux lines become wound up inside. Instabilities in the process create some regions of intense magnetic field. These regions tend to exclude material from within them, become buoyant (because they are less dense) and rise to the surface. Thus is how a sunspot region is born.

A sunspot is first observed as a tiny dark spot called a pore. Not all pores develop into fully-fledged sunspot regions, but those that do undergo an interesting evolution over a period of hours to days. First of all the pore becomes darker and larger, but with no distinguishable internal features. Other spots may break out around the first one. Any significant size sunspot region can be observed to form as a double-ended group, and with an instrument known as a solar magnetograph it can be determined that spots at opposite ends of the group have opposite magnetic polarity (one end being a north pole and the other a south pole). This is in agreement with the idea of magnetic flux lines emerging through the photosphere. A sunspot group is thus defined as that collection of sunspots that belong to the same outcropping of magnetic flux. This is not always an easy matter to determine.

When a spot becomes large it often looks a bit like a fried egg. In the middle there is a very dark area, called the umbra, and around this is a lighter or grey area called the penumbra. In very large and complex groups, some of the large spots may consist of a penumbra that encloses two or even more penumbra (maybe the equivalent of a double yolker!). It is often regions containing these type of spots that show significant flare activity.

The growth of sunspot groups is described by the letters A,B,C,D,E,F and H. A through D describe different development phases. E and F represent further increases in size after the D phase. Phase H is the aged sunspot group, and represents the final decay phase of a large group.



Not all sunspot groups follow the same sequence. In some cases pores barely make it to an A group before disappearing back into the convective turbulence of the sun's outer layers after just a few hours. Sometimes a collection of sunspots may grow into a C group and then decay back through the B and A phases within a few days. In a few cases a large region may rapidly grow to the D phase, increase in size through E and F, remain around for as long as a few months, and then decay to the H phase before final extinction into obscurity.

Material Prepared by John Kennewell and Andrew McDonald. © Copyright IPS - Radio and Space Services. Comments or suggestions can be directed to education@ips.gov.au