Name: ______________________________

Exercise Fifteen: Outdoor (Daytime)

Observing with the Telescope, Part IV: Visual Observations of the Sun

The sun is too bright for us to see surface features with the naked eye. It is safe, however, to view the sun through special filters placed over a telescope's objective (objective filters), through the combination of a dense filter and a Herschel wedge, which reflects only a small fraction of the sunlight into the eyepiece, or by projecting its image onto a white screen. *Never* look at the sun through an unfiltered telescope. This lab will acquaint you with the various aspects of the sun's surface as seen in visible light.

I. Solar Features

Using a low-power eyepiece, look at the entire sun. (It may be colored by the filters used to block out much of the sunlight.) Concentrate on trying to see the following features:

- *Limb darkening*: nonuniform brightness of the solar image.
- *Sunspots*: dark spots that move with the solar image when the sun is moved about in the telescope field. (Other spots are probably specks of dust on the telescope optics.)
- *Faculae:* light, patchy areas usually most visible near the edge of the sun.
- *Granulation:* fine structure (grainy appearance) all over the rest of the sun's disk. This is usually visible only when seeing conditions are very good.

1. Quickly sketch the entire solar disk, identifying approximately where these features are most noticeable.

2. Why does the sun appear darker at the edge than at the center? In other words, explain limb darkening. (Hint—hotter areas appear brighter, and the deeper one can see into the sun, the hotter it is.)

3. Draw a close-up of a large sunspot (or group) as seen through a high-power eyepiece. Look for a group featuring two very close, large spots or for a large single spot.

4. Why do large spots occur in pairs or singly with a light "bridge" across the middle? (Hint—consider the sun's magnetic field.)

II. Solar Rotation

If you watch a particular sunspot group for a number of days, you see that the group moves across the disk of the sun. This motion indicates that the sun is rotating. By following the motion of sunspot, you can determine the rotation period of the sun. However, there is a complication, called the projection factor, which would cause you to overestimate the sun's rotation period if you do not use the correct procedure. Figure 15.1 is the polar view of the sun showing the northern hemisphere of the sun divided up into 10° segments of longitude. (In the figure the Earth would be in the direction of the bottom of the page.)

Figure 15.3 is an equatorial view of the sun. It is divided up into 10° segments both in apparent longitude and in latitude. (Notice that the 45° nearest the edge appears only 1/3 of the way from the solar rim; this is an example of the projection factor.) By using Figures 15.1, 15.2, and 15.3 you can compensate for the projection factor and obtain a more accurate value for the sun's rotation period.

1. On top of Figure 15.2, draw as carefully as you can the positions of as many spots as possible. You should locate at least six groups, three of which are at different latitudes.

2. After at least two days have passed, reobserve the sunspots and plot their new positions using a different color to distinguish these from the other positions. Be sure to use the same orientation of Figure 15.2 when plotting the positions for the two different days. (Why?)

3. Now, overlay Figure 15.3 with Figure 15.2, aligning the lines of solar latitude with the apparent movements of the spots on Figure 15.3.

4. Record in a table the two positions (longitude) and times of observation for each spot.

5. For each spot calculate the time necessary for the spot to rotate 360°. Average the values you get from spots at about the same latitude. Keep separate the values for spots at different latitudes. (How do your results compare with the accepted values, 25 days at the solar equator and 34 days at the poles?)

6. Plot a graph of spot rotation period versus solar latitude, using the graph paper provided at the end of the exercise.

7. What does this graph tell you about the surface of the sun?

III. The Solar Spectrum

1. Using a hand-held spectroscope, look at a white card held in bright sunlight, and draw in the observable features of the solar spectrum in the space provided.

Blue end

Red end

2. What information about the sun does such a spectrum give us?

Figure 15.1
Polar view of the sun.

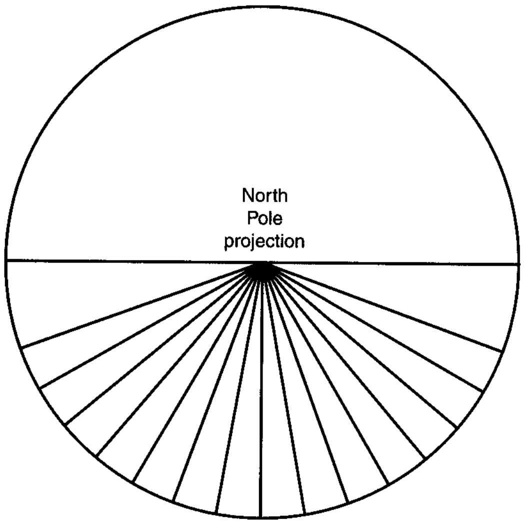


Figure 15.2

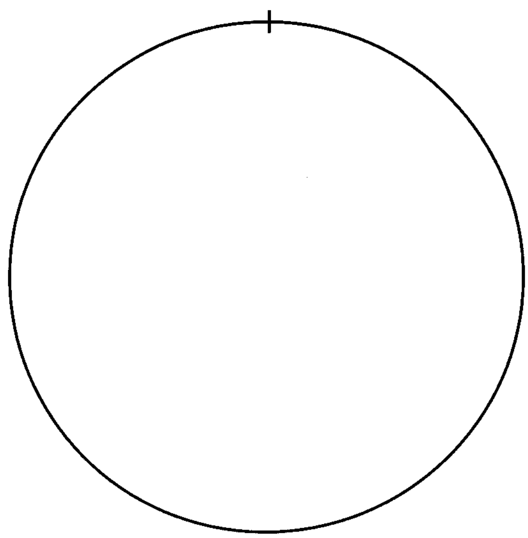
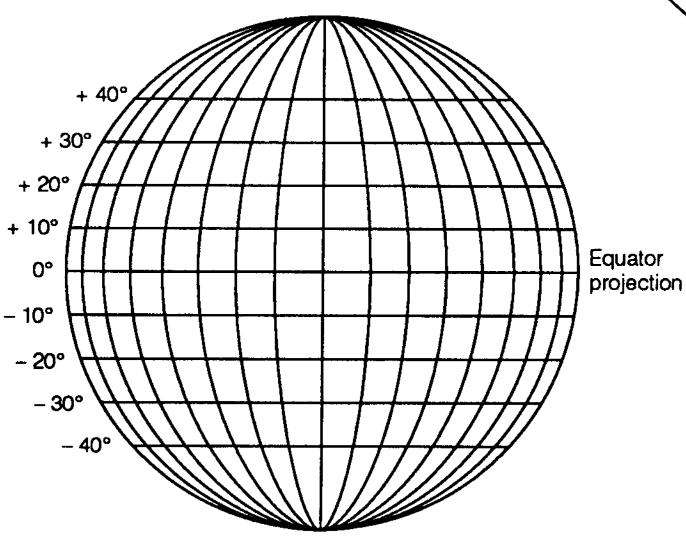
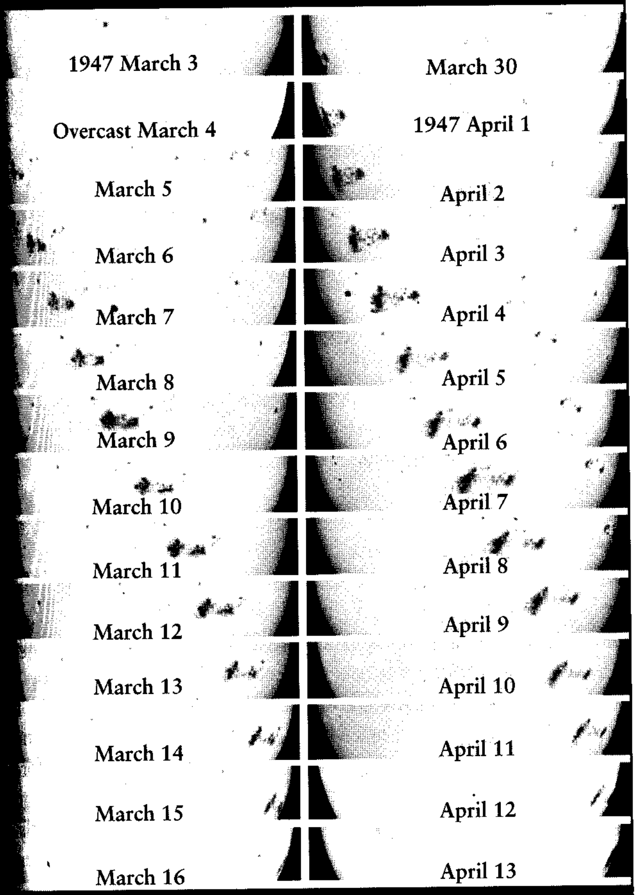
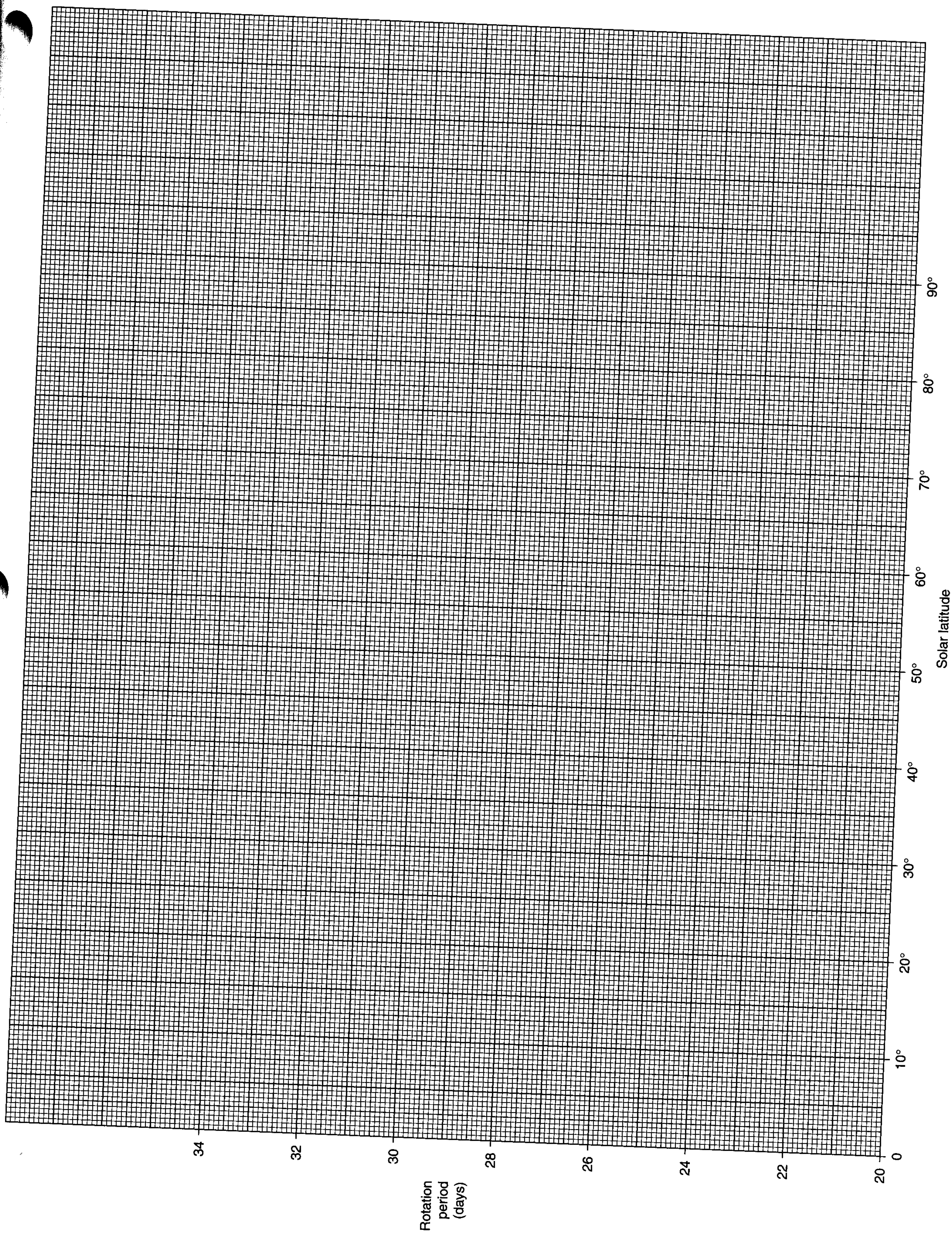


Figure 15.3
Equatorial view of the sun.




1947 March 3
Overcast March 4
March 5
March 6
March 7
March 8
March 9
March 10
March 11
March 12
March 13
March 14
March 15
March 16
March 30
1947 April 1
April 2
April 3
April 4
April 5
April 6
April 7
April 8
April 9
April 10
April 11
April 12
April 13


Solar latitude
0
10°
20°
30°
40°
50°
60°
70°
80°
90°
Rotation period (days)
20
22
24
26
28
30
32
34