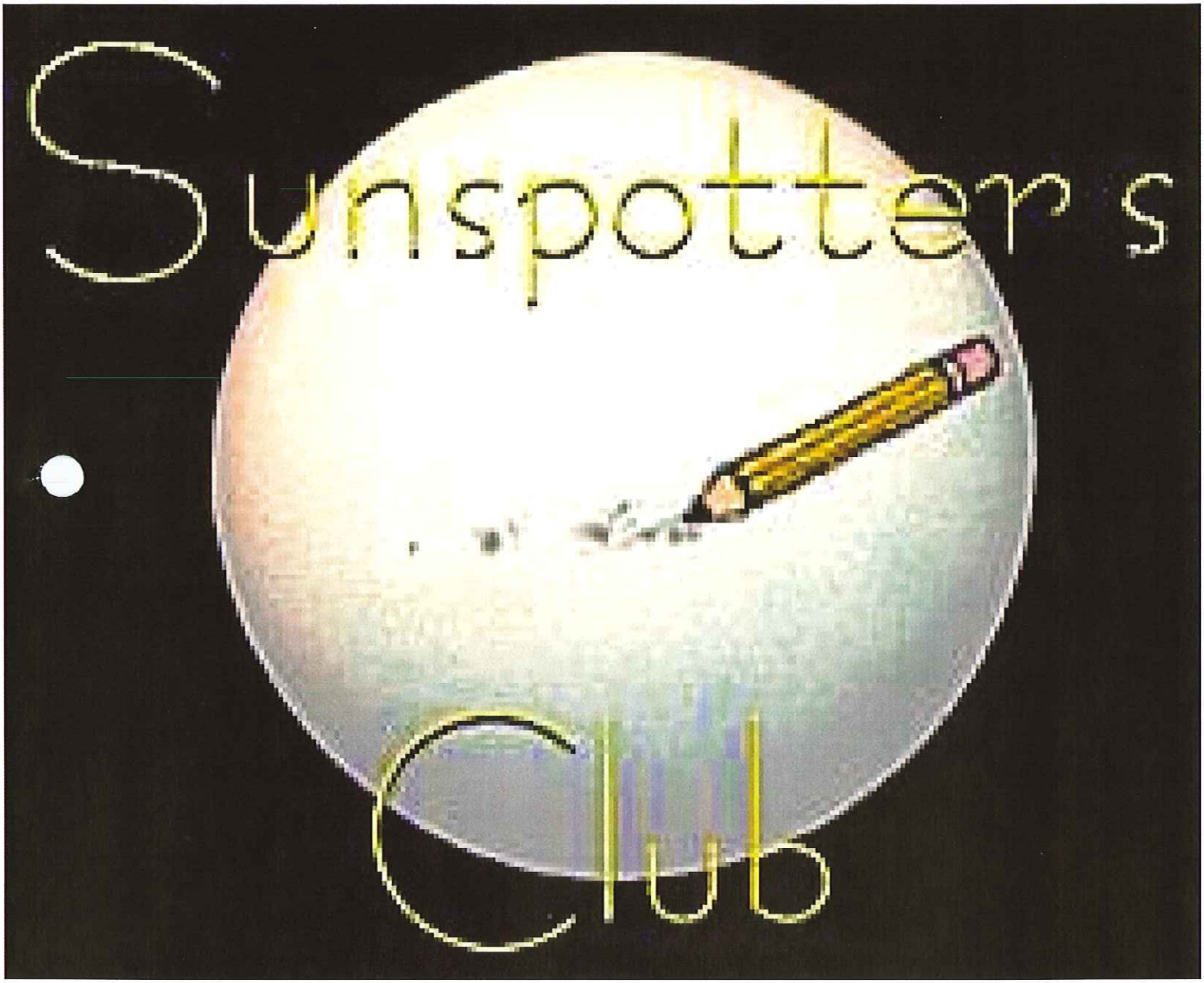
Sunspotter's
Club

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The Astronomical League
The World's Largest Federation of Amateur Astronomers

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- Introduction
- Awardees

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- Our Regions
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Astronomical League Sunspotters Club Certificate

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Raymore, MO 64083-9181
(816) 331-5796
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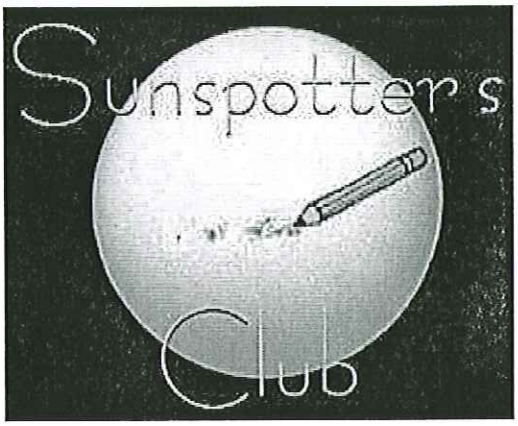
mailto:s.kranz1@comcast.net



Introduction.

The purpose of this program is to encourage solar observing with an eye toward educating the amateur astronomer on solar features and their evolution. By following this regimen the observer will learn the various features of solar activity, learn how these change during their passage across the disk, and learn how to develop a regular observing program.

Rules:

Before you start any solar observing program, make absolutely certain that you have safe filters and a safe set-up.

Only use filters from reputable sources, and never use a "solar filter" that screws into an eyepiece. As Richard Hill states in *Observe and Understand the Sun*:
"Observing the sun is the only inherently dangerous observing an amateur astronomer can do. Be aware of this at all times and take all necessary precautions. If you do not know a filter or procedure is safe then do not use it! Always err on the side of safety. An eye once damaged is forever damaged. Filters that let too much INFRARED light through can burn an eye if used visually. There is NO PAIN when this happens. Burned retinas can not be repaired. Excessive ULTRAVIOLET light has been shown to cause cataracts. So be very careful."

In the League's Sunspotter program, you will make two sets of drawings. The first set is five detailed sketches of sunspot groups. The second set is 20 or more sketches of the whole solar disk during two solar rotations (one rotation is about 30 days).

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- Astro-Books
- MarsWatch 1999

Awards:

- We Present

Navigation:

- Site Map
- External Links

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Artistic skill is not a requirement! Just diagram what you see as well as your skills allow. Use a number 2A lead pencil for best results.

Your five sunspot sketches must be done on five different days. These sunspot group drawings must be accurately labeled as to time, observing conditions, equipment used, and sunspot class. On each drawing, several features must be identified. The attached Sunspot Drawing Form shows the features you need to sketch and label. In order to see and identify all of the items, you will need to observe a rather complex sunspot group of Modified Zurich class D, E, or F. You may need to observe the sunspot group close to the limb to pick out all the details.

In the second set of drawings, you will sketch the whole disk of the sun throughout the passage of large sunspot groups during two different solar rotations. On the Solar Disk Drawing Form, outline the sunspot penumbrae and shade in the umbrae on the large circle. Classify all the sunspot groups on the disk and show the McIntosh classification letters on the small circle. Do a sunspot count, compute the Wolf Number, and fill out all the other blanks on the form. One of your sketches (in either the first or second set of drawings) should show the "Wilson effect". We realize that weather conditions may prevent daily observing, but at least half of the days for any given rotation should be observable. You should have a minimum of 20 whole disk drawings for the two rotations.

To qualify for the League Sunspotter Club, you must be a member of the Astronomical League, either as a member of a club affiliated with the League, or as a Member-at-Large of the League.

When your observations and drawings are completed, have them examined by an officer of your society, or a qualified, experienced second party if you do not belong to a Society. Have this person write a note verifying the work. Send this note and copies of the observations to the Astronomical League Observing Awards coordinator referred to above. The Sunspotters Club Certificate will be forwarded to your club officer for formal presentation, and your name will appear in the *Reflector*. Members-at-Large should send copies of their observations directly to the Astronomical League Observing Awards coordinator.

The Sunspotters Club is based on the League publication *Observe and Understand the Sun*. This manual includes material on sunspot classification and heliographic coordinates, as well as solar observing, telescopes, filters, and photography. It is available through the Astronomical League Sales Office. Check the most recent issue of the League's newsletter *The Reflector* for the League Sale's address and the price of the Observe Guide.

Terms and definitions you may need to know:

Faculae: relatively large (greater than an arc minute) irregularly shaped light area; sometimes serpentine in shape. Sunspots are usually located in Facula.

Granulation: fine grain structure of the solar photosphere. Grains appear to be one to two arc-seconds in diameter.

Light bridge: a bright ribbon or band that may appear to connect two sunspots.

Limb darkening: the effect of perspective where the edge of the solar disk appears darker than the center because it is a sphere.

McIntosh Sunspot Classification System: Adds classes for the type of the largest sunspot and sunspot distribution to the Modified Zurich Class. Pages 7-11 of the Observe the Sun has a good discussion and figures to help you classify groups by this three-letter system. (For example, a small lone sunspot with a penumbra might be coded as Hsx. A very large complex group might be Fkc.)

Modified Zurich Sunspot Class: A seven class (A-F, H) system of describing a sunspot group. The size of the group and distribution of penumbrae, if any, are factors.

Penumbra: a gray area which frequently, but not always, appears around an individual sunspot or group of sunspots.

Penumbral fibril: fiber like lines that may appear to radiate out from an umbra into the surrounding penumbra.

Penumbral fragment: a penumbra without a sunspot.

Penumbral grain: granular or small patchy structure that may be visible in the penumbra.

Pores: tiny, less than one arc-second, dark areas which are not as dark as a sunspot.

Solar north: Solar north is not the same as terrestrial north. During the course of an earth year, the sun's axis tilts over 26 degrees east and west of the earth's axis, and about 7 degrees toward and away from earth. These variations are due to a combination of the axial tilts of the Earth and Sun. Diagrams such as those on pages 13 and 14 of the Observe the Sun manual will help you estimate Solar north for the day of your observation.

Solar rotation: the sun does not rotate as a solid body. The equator rotates in about 25 days, the polar area in about 30 days. Use about 28 days for a solar rotation at typical sunspot latitudes.

Sunspot Group: A group may be anything from a single isolated sunspot to a complex elongated cluster of spots.

Umbra: The dark black area of a Sunspot.

Wilson effect: This effect of perspective is seen when a sunspot is near the solar limb. The umbra appears displaced within the penumbra, usually toward the center of the sun.

Wolf Sunspot number (R): a traditional method of counting sunspots. Count the individual sunspots. Count the number of groups. (An individual sunspot can count as a group if it is sufficiently separated from other spots or groups.) The Wolf number is ten times the number of sunspot groups plus the number of spots.

About the September, 1997 revision:

The revised Sunspotter award requirements consolidate the former two-part program into one program and one certificate. The sketching and required data have been simplified, some definitions have been added, and new sample forms have been provided.

Enjoy your daytime observing!

View the Astronomical League Sunspotters Club Sunspot Drawing Form;

View the Astronomical League Sunspotters Club Solar Disk Drawing Form;

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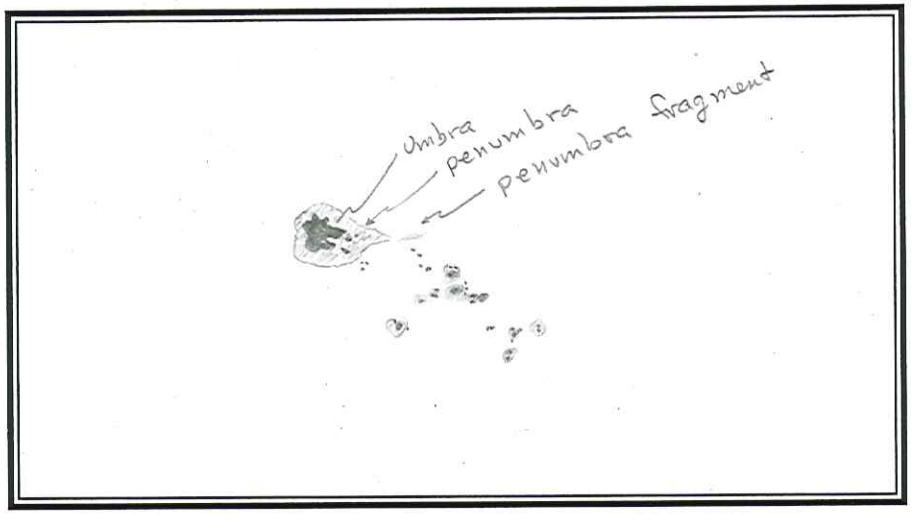
This page is maintained by David Knighton for the Astronomical League. Comments, corrections, and suggestions can be addressed to webmaster@astroleague.org. This page last updated January 14, 2001.

Sunspot Drawing

Observer Mike Hotlca
Location: Front Yard Broomfield, CO
Universal date/time: 2/22/04 12:20P MST
Telescope effective aperture: 8"
Sky quality: fair
Telescope focal length: f/8
(Excellent, good, fair, poor)
Eyepiece focal length: 10mm
Seeing in arc seconds: 3+
Magnification: 162x
(smallest detail seen where a photospheric granule is 1.5-2 arc seconds)
Filter type: Baader
McIntosh Sunspot Classification: Ehi



Label the following on your sunspot drawing:

- Umbra
- Penumbra
- Facula
- Light bridge (if present)
- Penumbril fibril (if visible)
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

- Is granulation visible? Yes: barely ✓ No: ____
- Is penumbral grain visible? Yes: ___ No: ✓
- Does the drawing show the Wilson effect? Yes: ___ No: ✓

A THREE DIMENSIONAL SUNSPOT CLASSIFICATION SYSTEM

by
Richard E. Hill
Coordinator - A.L.P.O. Solar Section

In 1938, M. Waldmeir devised what is now known as the Zurich Sunspot Classification System of sunspot groups. [Waldmeir 1955] It consists of nine steps or classes (A through J, omitting I) that delineate characteristic evolutionary stages of sunspot groups, though not all groups go through all classes. Most groups only go part way through the sequence and then either reverse their trend or skip ahead to one of the later classes. In general, the greater the area of a group the more asymmetrical will be its growth curve. A large group will tend to have an asymmetrical growth curve, rising rapidly from class A to E and then decaying more slowly as it goes from classes G to J. [Bray & Loughhead 1964]

It has been known for some time that groups of classes D, E and F are the flare producing classes. But not all such groups produce flares. This was a problem for those whose job it was to predict flares. Even in the most active class, F, a forecaster had little chance of success in predicting flare probability in any 24 hour period based on Zurich Class alone. A new system was needed that took in additional parameters.

Flares are the most energetic events in our solar system. They are eruptions that take place in and around sunspot groups releasing large amounts of energy across most of the electromagnetic spectrum. Often they are accompanied by the ejection of subatomic particles at various speeds that may impact the Earth's upper atmosphere. The electromagnetic emissions and subatomic particles can cause disruption of radio communications and aurorae. Typically, flares last from a few minutes to as much as four hours, though the majority are from ten to twenty minutes in duration. The more energetic flares tend to be of longer duration especially when observed in x-rays. In white light and H-alpha, the relationship is not quite as good. Flares are best seen in monochromatic light such as H-alpha or in the H & K lines of calcium light (blue and near UV at 3968.492 and 3933.682 angstroms respectively). Some are bright enough to be seen even in the combined light of the whole visible spectrum, white light.

But in order for flares to be observed and studied by the astronomer, a more predictive system for classifying sunspot groups was needed. This was most true for the detection of white light flares. An observer would have to spend inordinate amounts of time at the telescope observing nearly every well developed sunspot group all the time in hopes of seeing these elusive events. It would be highly advantageous to be able, on the basis of a few parameters, to weed out many of the less productive groups.

In 1966, Patrick McIntosh of the Space Environment Services Center of the National Oceanic and Atmospheric Administration introduced a sunspot classification system that improved the older Zurich system. The new classifications consist of three letters. First is the Modified Zurich Class. It basically retains the old Zurich Class, but G and J were removed as being redundant. A Modified Zurich Class was used rather than a totally new system, making it easier for observers to switch to the new system. The second letter represents an assessment of the largest spot of the group. This is not necessarily the leading spot, but rather the LARGEST. The third letter represents an assessment of the spot distribution within the group. It takes only slightly longer than the old system to classify all the groups on the Sun for a given day using the McIntosh System, but the information returned and its usefulness makes it worth the added effort.

In order to understand the McIntosh Classification system better, two terms have to be defined:

Unipolar Sunspot Group

This is a single spot or compact cluster of spots with the greatest separation between spots being less than 3 heliographic degrees (degrees on the Sun's surface). With a Class H group the separation is taken to be the distance between the outer border of the main sunspot penumbra and the most distant attendant umbra.

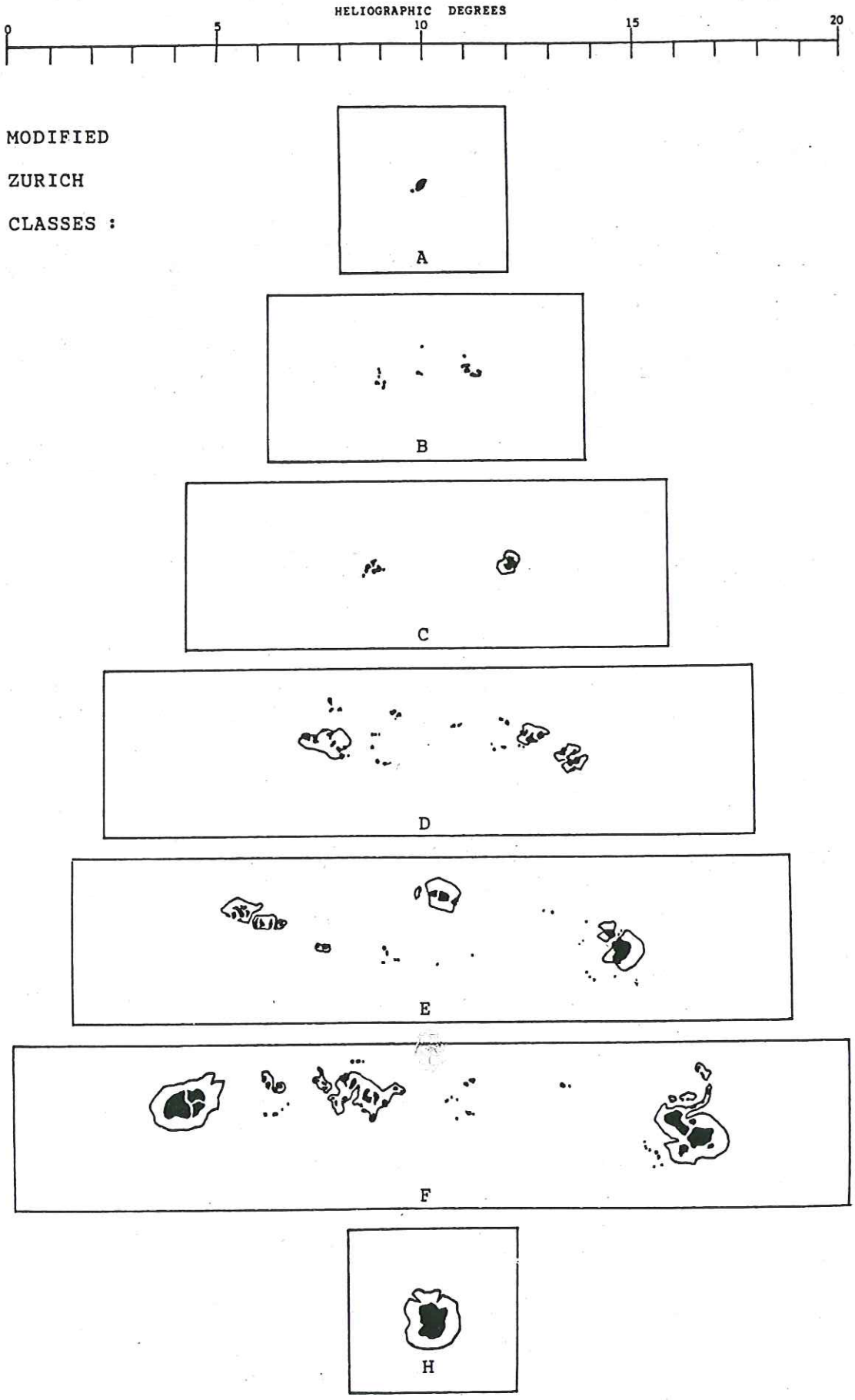

HELIOGRAPHIC DEGREES
0
5
10
15
20
MODIFIED
ZURICH
CLASSES :
A
B
C
D
E
F
H

Figure 2-1

Bipolar Sunspot Group

This is two or more spots forming an elongated cluster with a length of 3 or more heliographic degrees. If there is a large principal spot, then the cluster should be greater than 5 degrees in extent.

Now that we have these defined, below are the descriptive text that define the various classes in the McIntosh System. (All degrees are heliographic.)

For the Modified Zurich Classes: (for visual representations of these letters, see accompanying figures.)

A - A unipolar group with no penumbra. This can be either the early or final stage in the evolution of the group.
B - A bipolar group with no penumbrae on any spots.
C - A bipolar group with penumbra on one end of the group, usually surrounding the largest leader umbra.
D - A bipolar group with penumbrae on spots at both ends of the group and a length of less than 10 degrees.
E - A bipolar group with penumbrae on spots at both ends of the group with a length of 10-15 degrees.
F - A bipolar group with penumbrae on spots at both ends of the group and a length greater than 15 degrees.
H - A unipolar group with penumbra—usually the remains of a bipolar group

For the Largest Spot:

(North-south diameters are used since they suffer no foreshortening during rotation.)

x - No penumbra (for groups with classes A & B)

r - Rudimentary penumbra that usually only partially surround the largest spot. Such a penumbra will likely be granular rather than filamentary, making it appear brighter than a mature penumbra. The width of the penumbra will only be a few granules (of the photospheric granulation) and may be either forming or dissolving.

s - Small, symmetric spot (similar to Zurich Class J) and the spot will have a mature, dark, filamentary penumbra of circular or elliptical shape with a clean sharp border. If there are several umbrae in the penumbra they will form a tight cluster mimicking the symmetry of the penumbra with a north-south diameter of 2.5 degrees or less.

a - Small, asymmetric spot with irregular surrounding penumbra, and the umbrae within separated. North-south diameter of 2.5 degrees or less.

h - A large symmetric spot. Like type "s" but the north-south diameter is greater than 2.5 degrees.

k - A large asymmetric spot. Like type "a" but the north-south diameter is greater than 2.5 degrees.

For Sunspot Distribution:

x - Unipolar group of Modified Zurich Classes A or H (i.e. a solitary spot).

o - Open distribution with a leader and follower spot and few or none between. Any spots between should be very small umbral spots.

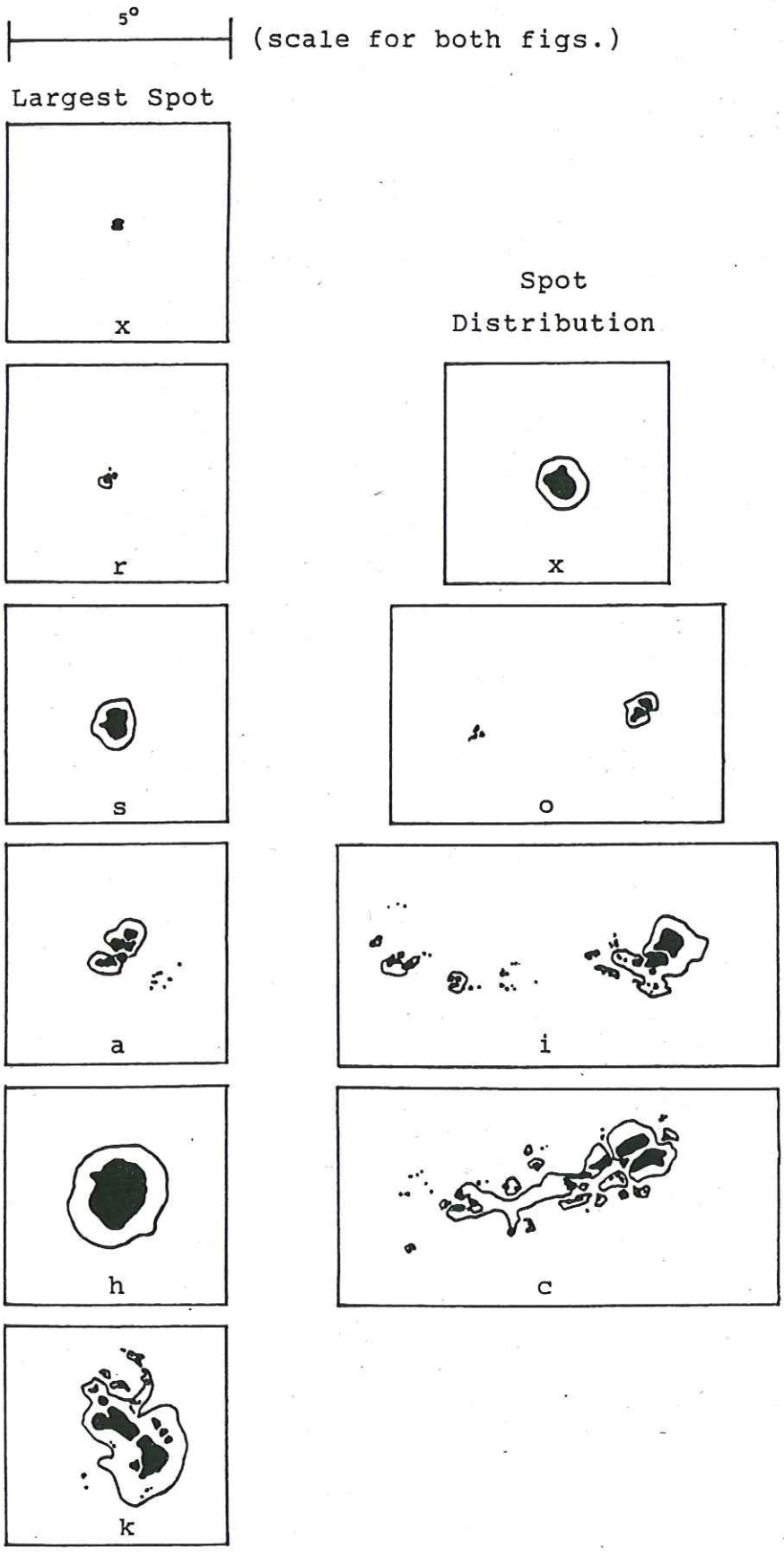

5°
(scale for both figs.)
Largest Spot
Spot
Distribution
x
r
x
s
o
a
i
h
c
k

Figure 2-2

i - Intermediate distribution where numerous umbral spots lie between the leader and follower spots.

c - Compact distribution where the area between the leader and follower spots contains many spots with at least one having penumbra. In extreme cases the whole group may be enveloped into one complex penumbra.

This system has proven a more accurate predictor of flares in the thirty years of its use. Indeed, it has helped solar astronomers understand better the relationship between flares and sunspots. Sunspot groups that produce flares are relatively rare. Because of this it has taken several solar cycles of observations to demonstrate the effectiveness of the new system.

With the old Zurich system it was found that groups of class F were most likely to produce flares. But only a 40% flare probability in a 24 hour period could be predicted using this parameter alone. With the McIntosh System, using Modified Zurich Class F, the probability improved to 60%. With just the largest spot class of "k" the probability in 24 hours was 40-50%. If just spot distribution category "c" were used, flare probability went up to about 70%. But, when all three dimensions of this system were used, classes Fsi, Fki and Fkc showed a probability of up to 100% for production of M flares in a 24 hour period and the McIntosh Class of Fkc had a further probability of up to 50% in X flares (x-ray) production! This surpasses any former method of flare prediction used, including sunspot area. [McIntosh 1984]

Observers of the A.L.P.O. Solar Section have been using the McIntosh Classification System for many years now, especially those involved in the detection of flares. Those doing whole disk drawings are most strongly encouraged to do so. Of course, other standard procedures need to be followed as well. These procedures are designed to make observations of the Section most closely match those being done at NOAA/SEC and can be found on the A.L.P.O. Solar Section webpages at: http://www.lpl.arizona.edu/~rhill/alpo/solar.html. Any amateur solar astronomer would benefit by using this system, and by trying to observe white light flares. The same groups that are most likely to produce flares also exhibit sudden changes (especially when flares occur) and rapid internal motions, on time scales of minutes!

The McIntosh Sunspot Classification System has demonstrated its effectiveness as a tool in the search for solar flares and in understanding the build up, storage and dissipation of energy in a flare. For amateur astronomers it can be used as a guide when deciding which solar features deserve further study. Amateurs that want to make their observations of the most use to science should adopt this system as soon as possible. In this way the amateur can enjoy observing the ever changing solar features while making a lasting and valuable contribution to science.

(See Figures 2-1 and 2-2 for visual representations of modified Zurich Classes. Figure 2-3 is a photograph showing some of the features described in this chapter.)

References:

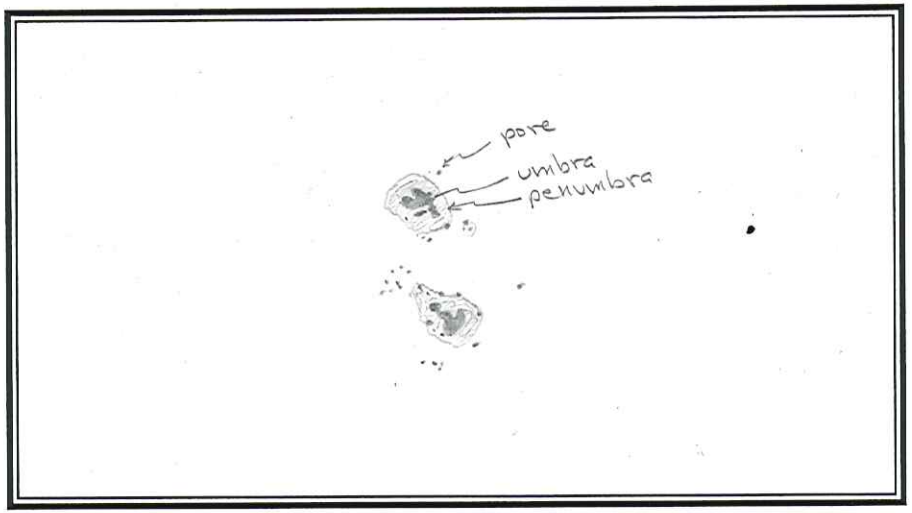
Bray, R.J., and Loughhead, R.E., [1964] **SUNSPOTS**, New York, Dover.

McIntosh, P.S., [1984], **"Flare Forecasting Based On Sunspot Classification"**, in Solar-Terrestrial Predictions: Proceedings of a Workshop at Meudon, France, June 18-22, 1984. Published by NOAA and Air Force Geophysics Laboratory.

Waldmeir, M., [1955] **THE SUNSPOT ACTIVITY IN THE YEARS 1610-1960**, Zurich, Schulthess & Co.

Sunspot Drawing

Observer Mike Hubbe
Location: Boulder, CO
Universal date/time: 2/23/04 2:24 P
Telescope effective aperture: 8"
Sky quality: Good
Telescope focal length: f/8
(Excellent, good, fair, poor)
Eyepiece focal length: 10mm
Seeing in arc seconds: 3
Magnification: 162x
(smallest detail seen where a photospheric granule is 1.5-2 arc seconds)
Filter type: Baader
McIntosh Sunspot Classification: Fki



Label the following on your sunspot drawing:

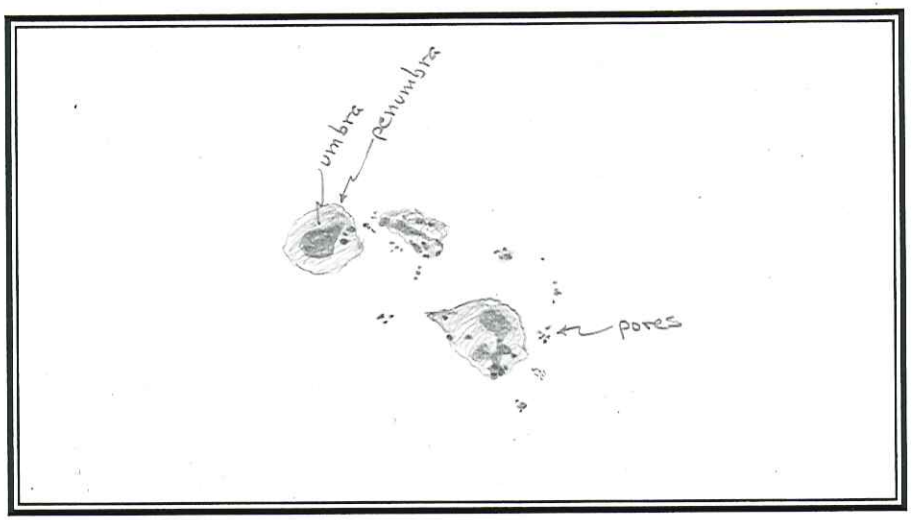
- Umbra
- Penumbra
- Facula
- Light bridge (if present)
- Penumbril fibril (if visible)
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

- Is granulation visible? Yes: ✓ No: ____
- Is penumbral grain visible? Yes: ___ No: ✓
- Does the drawing show the Wilson effect? Yes: ___ No: ✓

Sunspot Drawing

Observer Mike Hotka
Location: Ball Parking lot Boulder, CO
Universal date/time: 2/24/04 1:50P MST
Telescope effective aperture: 8"
Sky quality: Good
Telescope focal length: f/8
(Excellent, good, fair, poor)
Eyepiece focal length: 10mm
Seeing in arc seconds: 1.0
Magnification: 162x
(smallest detail seen where a photospheric granule is 1.5-2 arc seconds)
Filter type: Baader
McIntosh Sunspot Classification: Fki



N

Label the following on your sunspot drawing:

- Umbra
- Penumbra
- Facula was seen
- Light bridge (if present)
- Penumbril fibril (if visible) yes, present
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

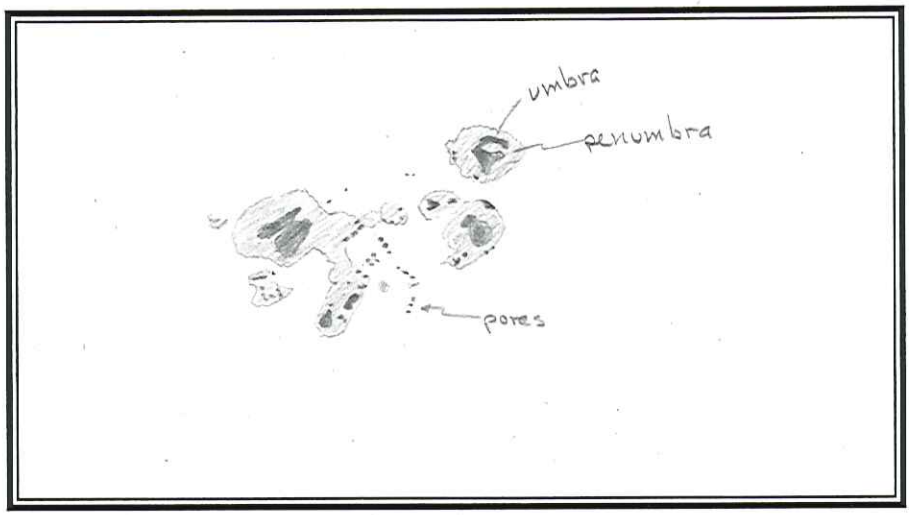
- Is granulation visible? Yes: ✓ No: ____
- Is penumbral grain visible? Yes: ✓ No: ___
- Does the drawing show the Wilson effect? Yes: ___ No: ✓

Sunspot Drawing

Observer Mike Hotka
Universal date/time: 2/25/04 11:45A
Sky quality: Good
(Excellent, good, fair, poor)
Seeing in arc seconds: 1.0
(smallest detail seen where a photospheric granule is 1.5-2 arc seconds)

Location: Ball Parking Lot Boulder, CO
Telescope effective aperture: 8"
Telescope focal length: f/8
Eyepiece focal length: 10mm
Magnification: 162x
Filter type: _____

McIntosh Sunspot Classification: Fkc



N

Label the following on your sunspot drawing:

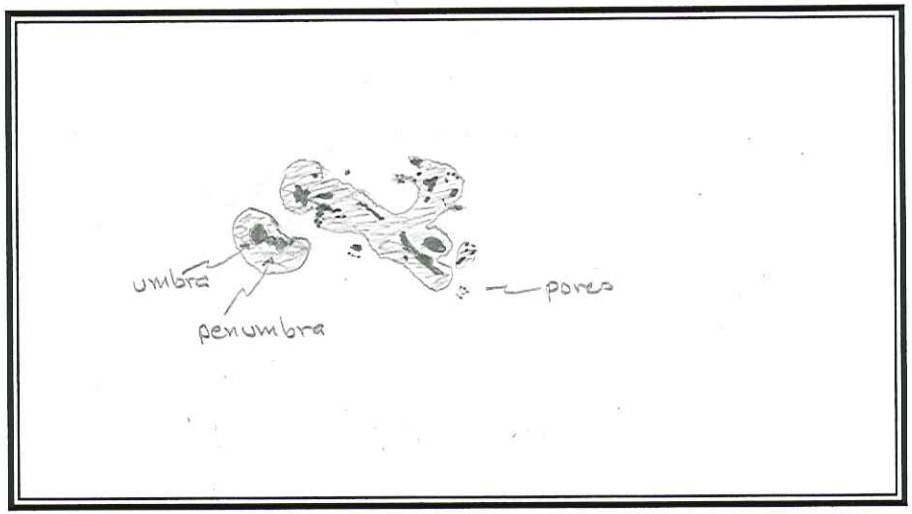
- Umbra
- Penumbra
- Facula was seen
- Light bridge (if present)
- Penumbril fibril (if visible) was seen
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

- Is granulation visible? Yes: ✓ No: ____
- Is penumbral grain visible? Yes: ✓ No: ____
- Does the drawing show the Wilson effect? Yes: ____ No: ✓

Sunspot Drawing

Observer Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Universal date/time: 2/26/04 12:08P
Telescope effective aperture: 8"
Sky quality: Good
Telescope focal length: f/8
(Excellent, good, fair, poor)
Eyepiece focal length: 10 mm
Seeing in arc seconds: 1.0
Magnification: 162x
(smallest detail seen where a photospheric granule is 1.5-2 arc seconds)
Filter type: Baader
McIntosh Sunspot Classification: Fkc



Label the following on your sunspot drawing:

- Umbra
- Penumbra
- Facula was seen
- Light bridge (if present)
- Penumbril fibril (if visible) present
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

- Is granulation visible? Yes: ✓ No: ____
- Is penumbral grain visible? Yes: ✓ No: ___
- Does the drawing show the Wilson effect? Yes: ___ No: ___

Sunspot Drawing

Observer_____ Location: _____

Universal date/time: 2/27/04 8:33A Telescope effective aperture: _____

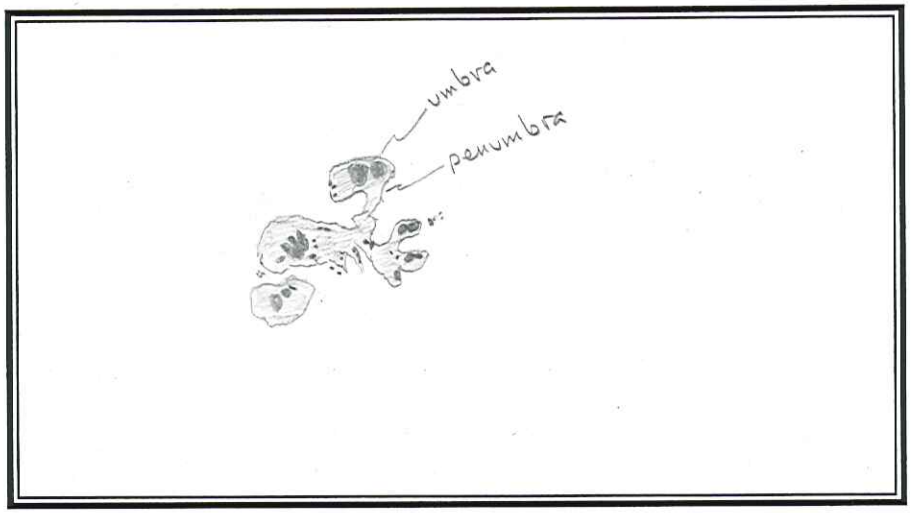
Sky quality: Fair - Good Telescope focal length: _____

(Excellent, good, fair, poor) Eyepiece focal length: _____

Seeing in arc seconds: _____ Magnification: _____

(smallest detail seen where a photospheric granule is 1.5-2 arc seconds) Filter type: _____

McIntosh Sunspot Classification: Hkc



Label the following on your sunspot drawing:

- Umbra
- Penumbra
- Facula was seen
- Light bridge (if present)
- Penumbril fibril (if visible) present
- Show *approximate* direction of **Solar** North with an arrow

Answer the Following:

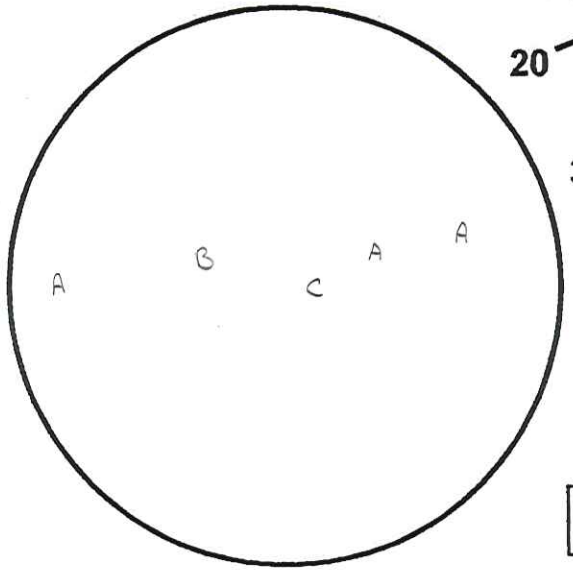
- Is granulation visible? Yes: ✓ No: ____
- Is penumbral grain visible? Yes: ✓ No: ___
- Does the drawing show the Wilson effect? Yes: ___ No: ✓

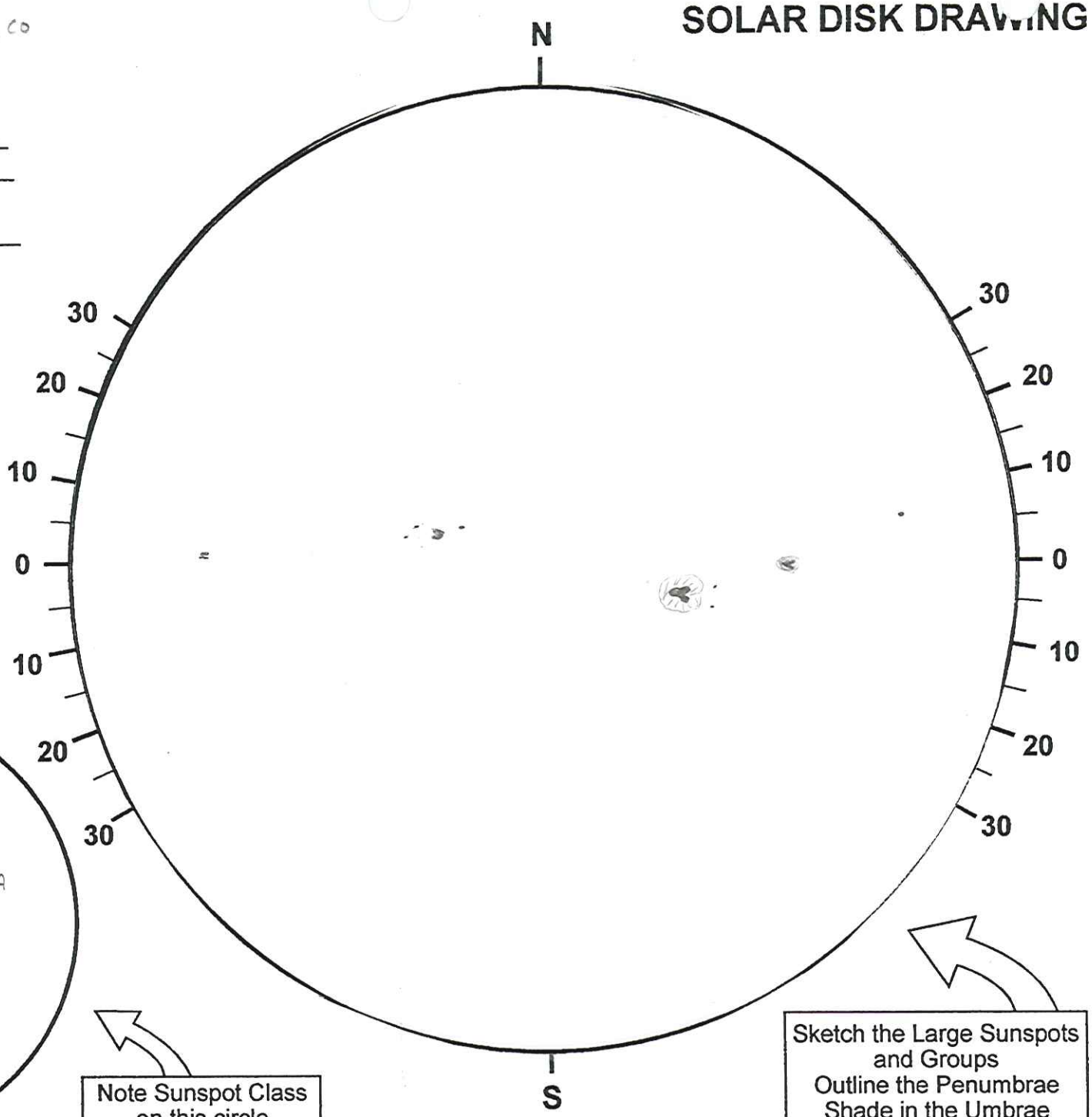
SOLAR DISK DRAWING

Observer: Mike Hatler
Location: Backyard Broomfield, CO
Date/Time 2/12/04 12:02P MST (UT)
Sky:
Seeing Good Clouds Clear Wind Calm
Telescope Reflector Type Newt.
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
(Direct) or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 3 +S 2 = 5
Spots: N 8 +S 4 = 12

Wolf Sunspot Number (R):
R= 10G + S = 62





Note Sunspot Class on this circle

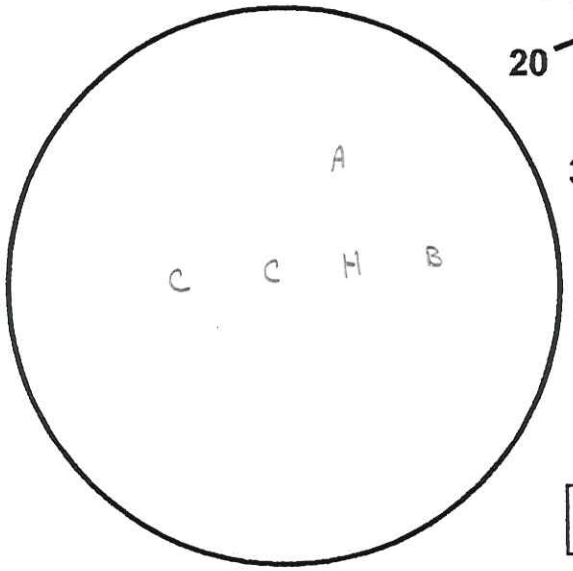
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

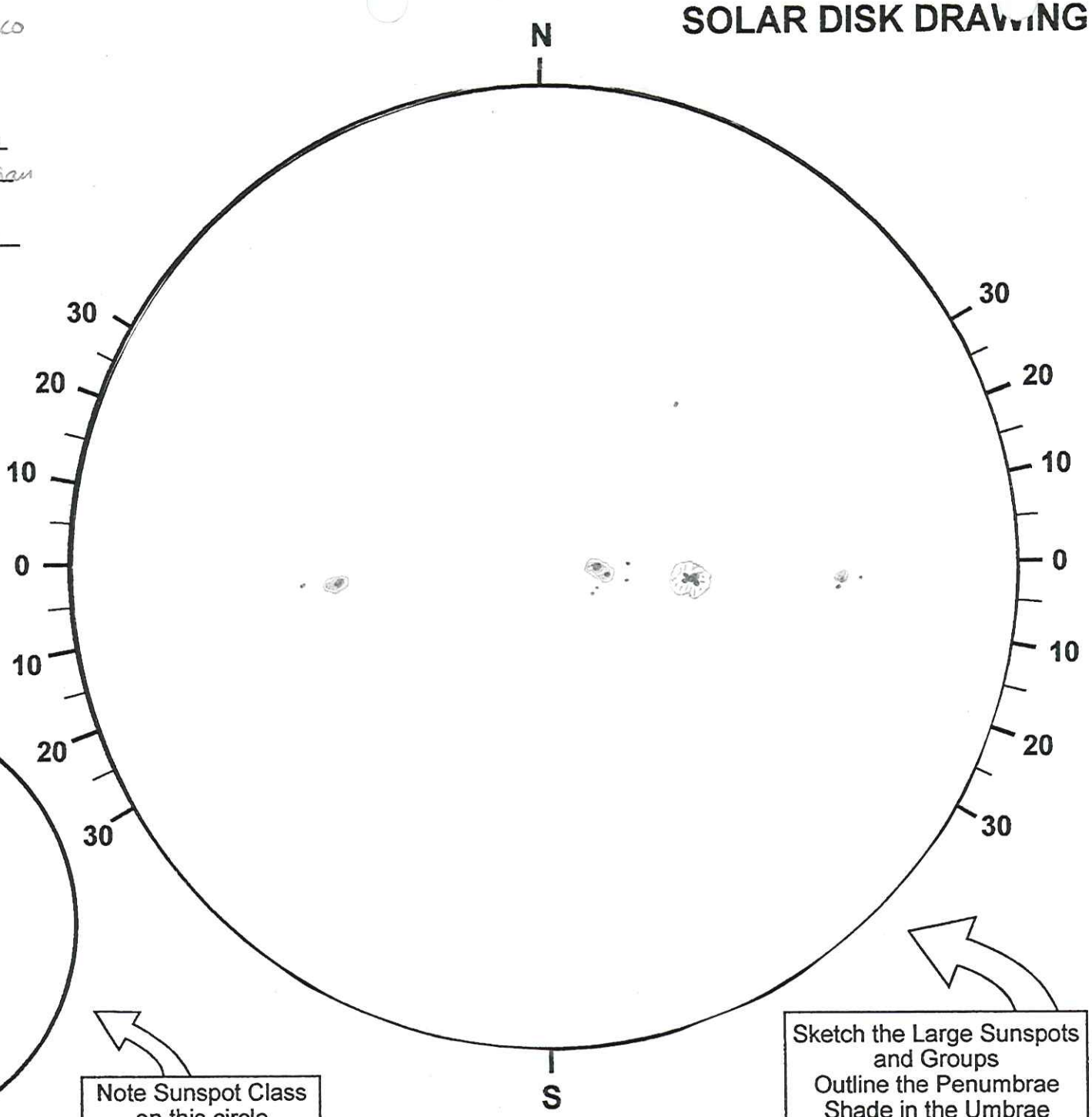
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Backyard - Broomfield, CO
Date/Time 2/13/04 4:49P MST (UT)
Sky:
Seeing Good Clouds Clear Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 4 = 5
Spots: N 1 +S 12 = 13

Wolf Sunspot Number (R):
R= 10G + S = 73





Note Sunspot Class on this circle

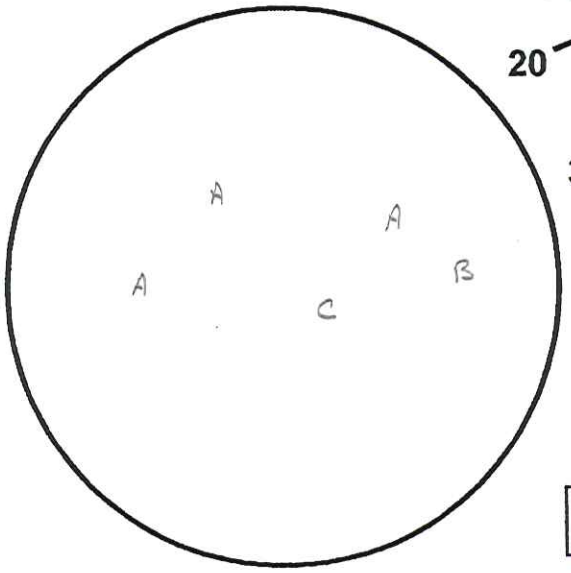
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

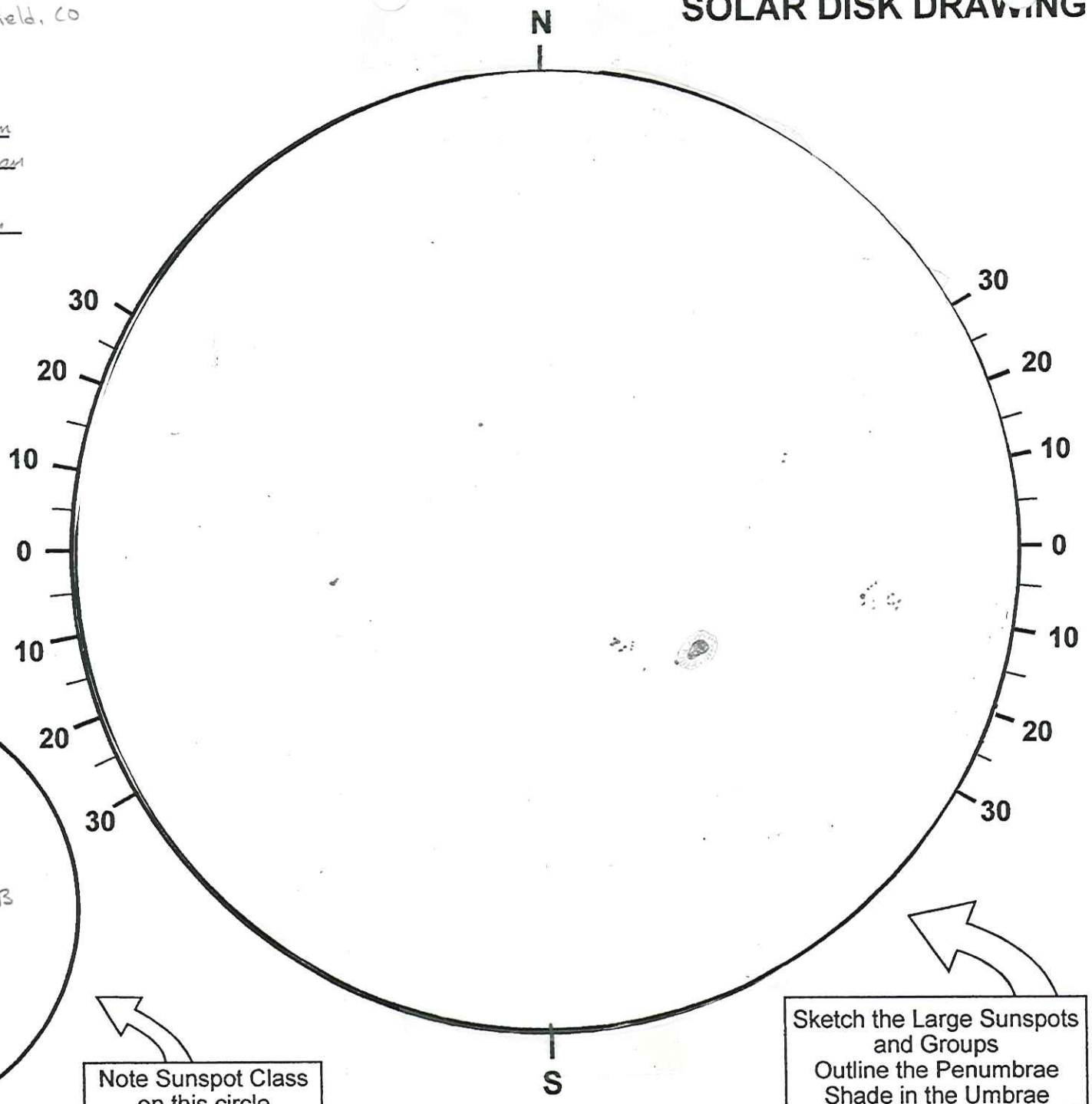
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Front Yard Broomfield, CO
Date/Time 2/14/04 10:15A (MST)
Sky:
Seeing Good Clouds High Cirrus Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 3 = 5
Spots: N 3 +S 26 = 29

Wolf Sunspot Number (R):
R= 10G + S = 79





Note Sunspot Class on this circle

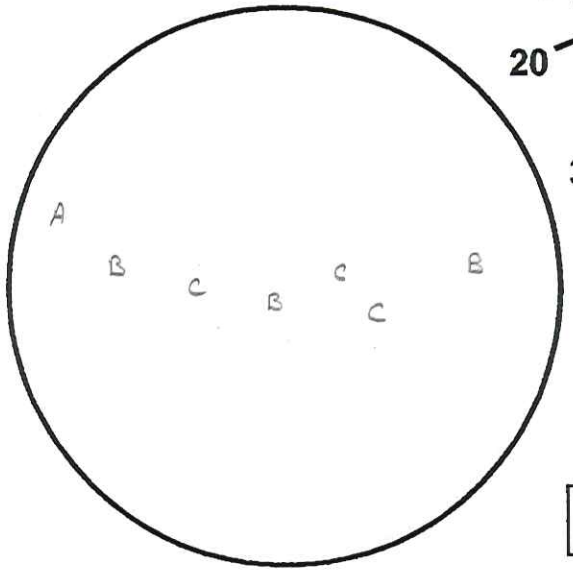
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

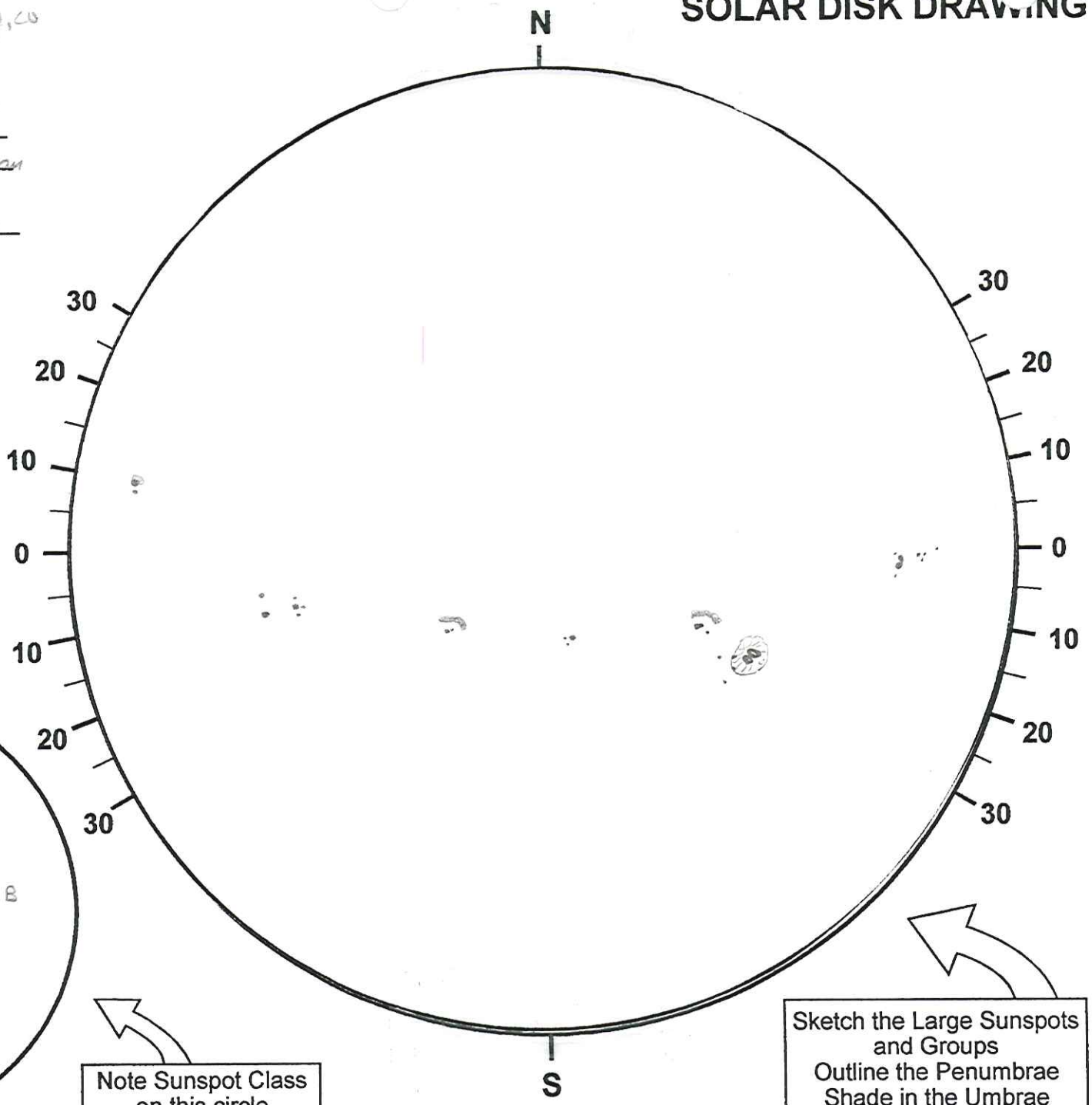
SOLAR DISK DRAWING

Observer: Mike Hotler
Location: Front Yard - Broomfield, CO
Date/Time 2/15/04 10:30A MST (UT)
Sky:
Seeing Good Clouds High Cirrus Wind Light NW
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 6 = 7
Spots: N 3 +S 28 = 31

Wolf Sunspot Number (R):
R= 10G + S = 101





Note Sunspot Class on this circle

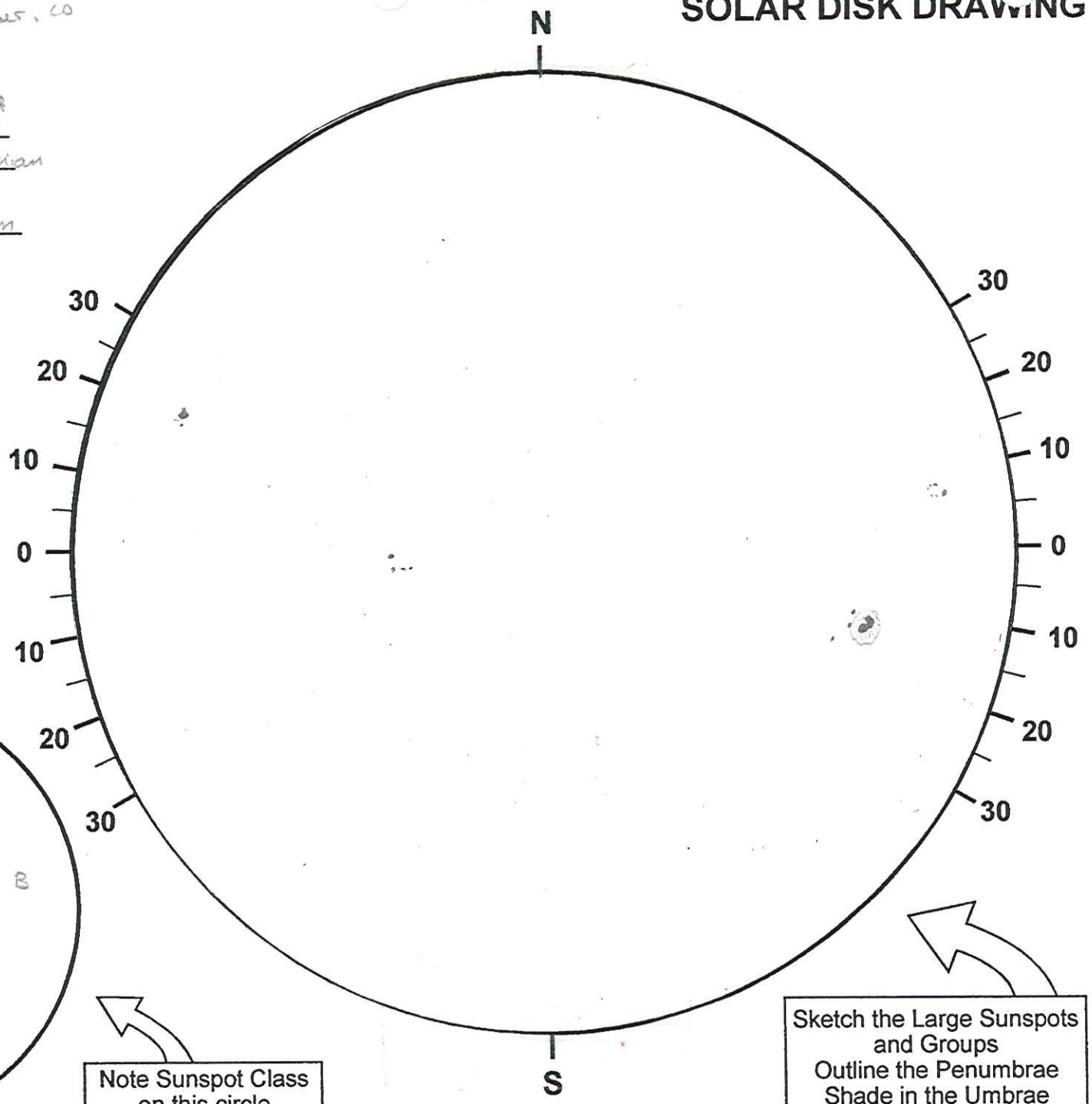
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

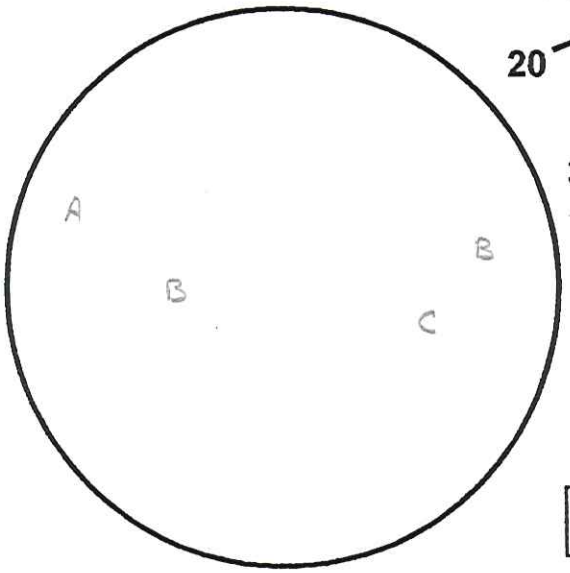
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/16/04 10:50A (MST / UT)
Sky:
Seeing OK Clouds High Cirrus Wind Stiff NW
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length F/8 Eyepiece 19 mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 2 = 4
Spots: N 9 +S 9 = 18

Wolf Sunspot Number (R):
R= 10G + S = 58





Note Sunspot Class on this circle

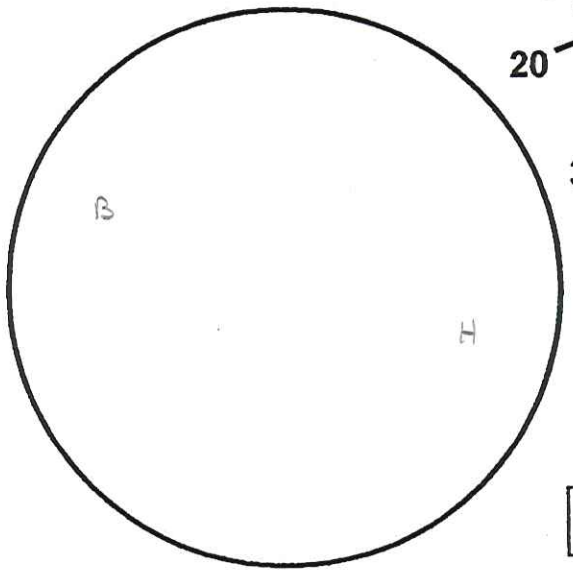
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

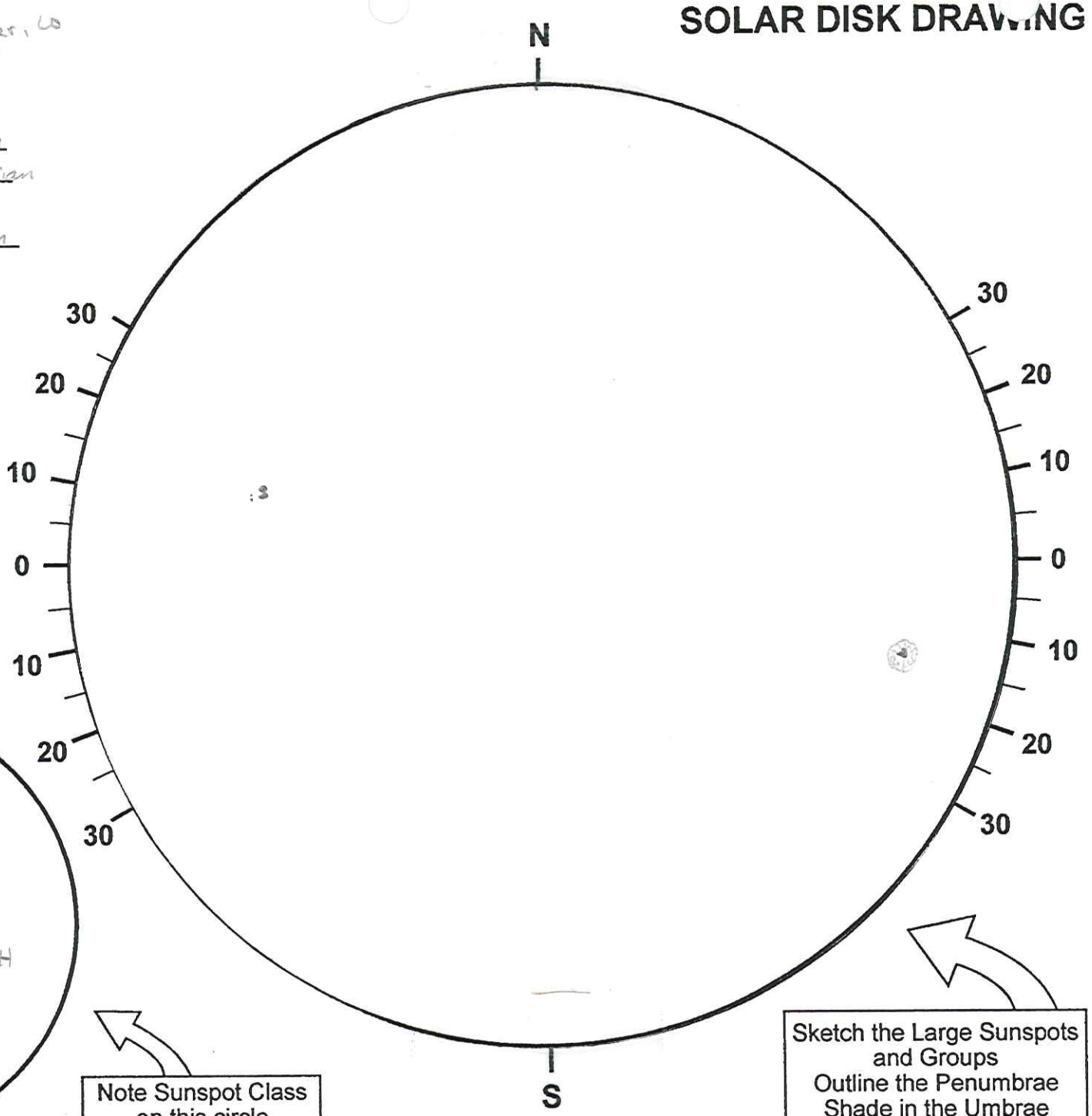
SOLAR DISK DRAWING

Observer: Mike Hotlen
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/17/04 1:30P MST (UT)
Sky:
Seeing OK Clouds High Thick Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19 mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 1 = 2
Spots: N 4 +S 1 = 5

Wolf Sunspot Number (R):
R= 10G + S = 25





Note Sunspot Class on this circle

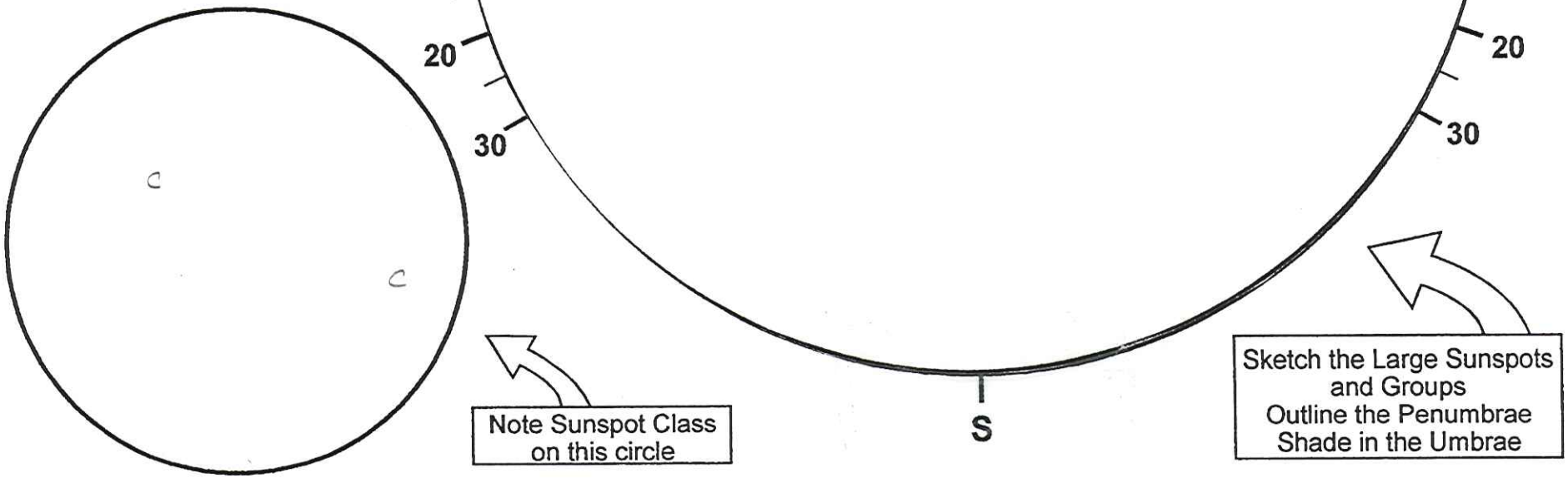
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

SOLAR DISK DRAWING

Observer: Mike Hotter
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/18/04 10:55A (MST) (UT)
Sky:
Seeing OK Clouds High Thick Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19 mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 1 = 2
Spots: N 5 +S 2 = 7

Wolf Sunspot Number (R):
R= 10G + S = 27

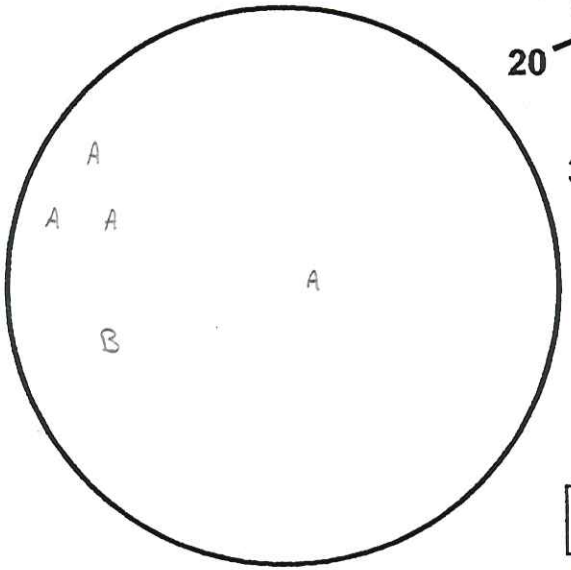


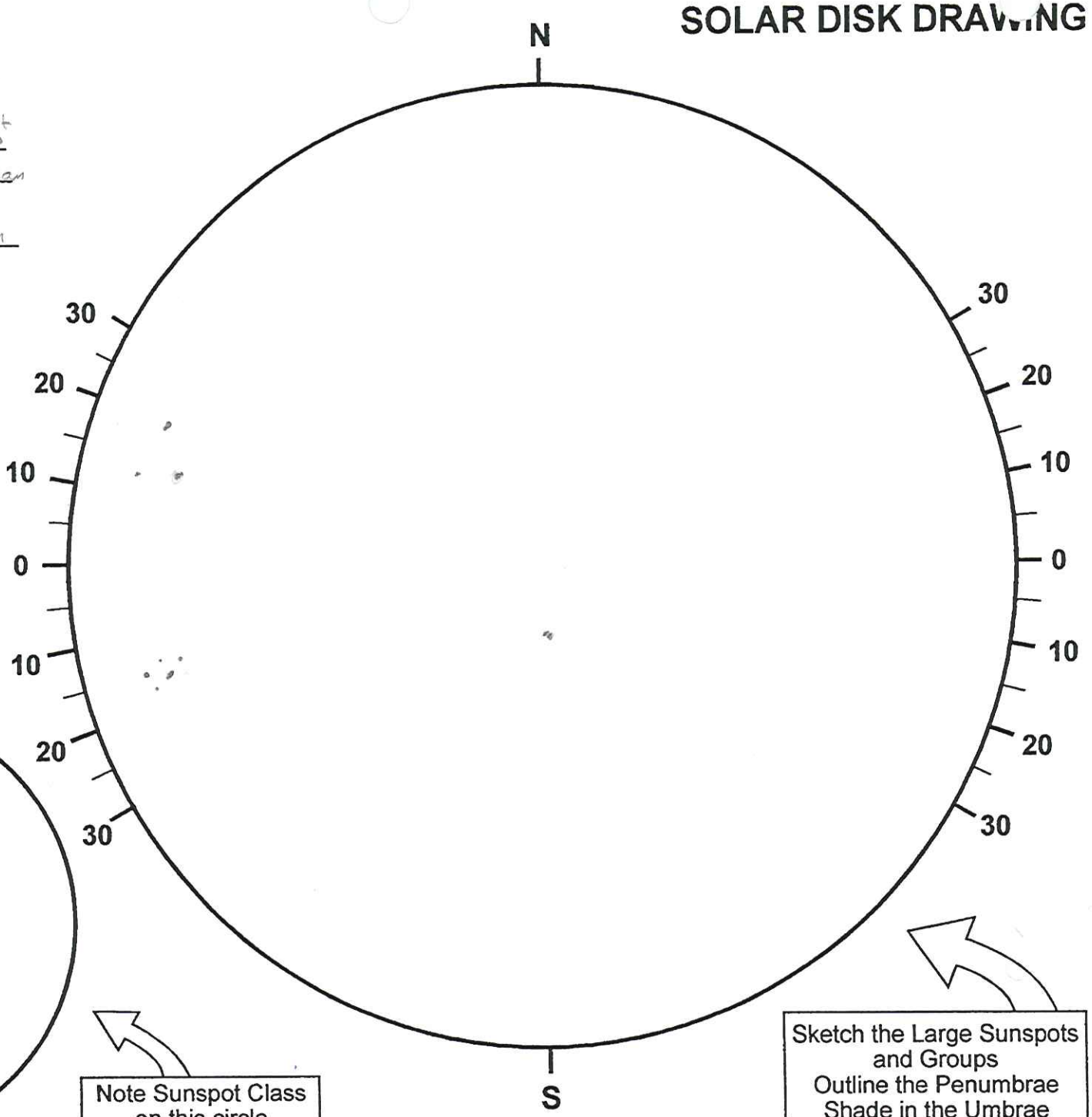
SOLAR DISK DRAWING

Observer: Mike Nottka
Location: Parmer - NE Colorado MST
Date/Time 2/20/04 3:45P (UT)
Sky:
Seeing Great Clouds P/C Wind Light NW
Telescope Reflector Type Newtonian
Aperture Used 12.5"
Focal Length f/8 Eyepiece 19mm
Filter
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 3 +S 2 = 5
Spots: N 5 +S 7 = 12

Wolf Sunspot Number (R):
R= 10G + S = 62





Note Sunspot Class on this circle

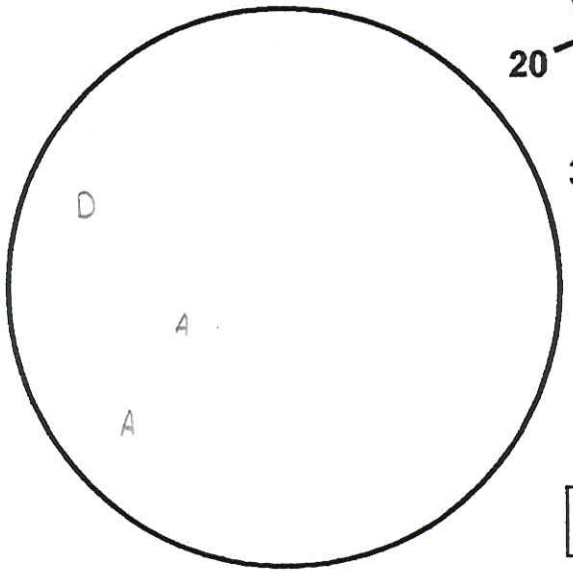
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

SOLAR DISK DRAWING

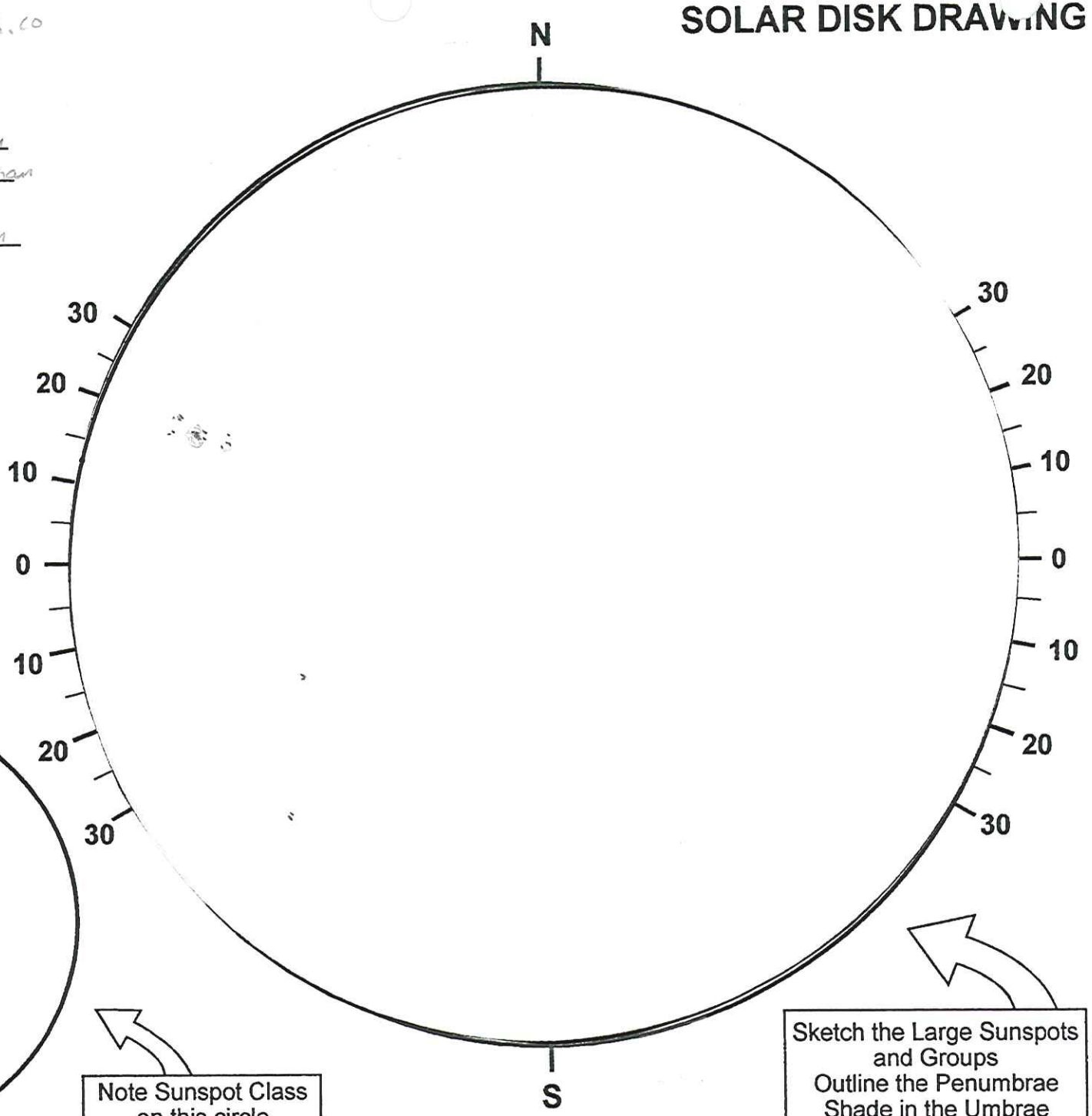
Observer: Mike Hotlen
Location: Front Yard - Broomfield, CO
Date/Time 2/21/04 1145P (MST) (UT)
Sky:
Seeing OK Clouds High Thick Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 2 = 3
Spots: N 12 +S 4 = 16

Wolf Sunspot Number (R):
R= 10G + S = 46



Note Sunspot Class on this circle



Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

Hotka, Michael

From: Crane, Jim
Sent: Wednesday, February 25, 2004 1:37 PM
To: Hotka, Michael
Subject: FW: Big Sunspot

Mike,
I just got this from Space Weather Alert.
Jim

-----Original Message-----
From: SpaceWeather.com [mailto:swlist@spaceweather.com]
Sent: Wednesday, February 25, 2004 11:19 AM
To: SpaceWeather.com
Subject: Big Sunspot

Space Weather News for Feb. 25, 2004
http://spaceweather.com

BIG SUNSPOT: There's a big spot on the sun today, sunspot 564. It first appeared only a few days ago, tiny and unremarkable. Since then it has grown wider than eight planet Earths. The active region can be seen without a telescope--but never look directly at the sun. Unfiltered sunlight can damage your eyes. Visit spaceweather.com for safe solar observing tips and a movie of the growing sunspot.

THE MOON AND MARS: Last August when Mars came historically close to Earth, the red planet was dazzling. Now it's merely one among many middling-bright stars in the evening sky. On Feb. 25th, once again, you can find it with ease. Just look for the crescent moon after sunset. Mars will be right beside it. Visit spaceweather.com for a sky map.

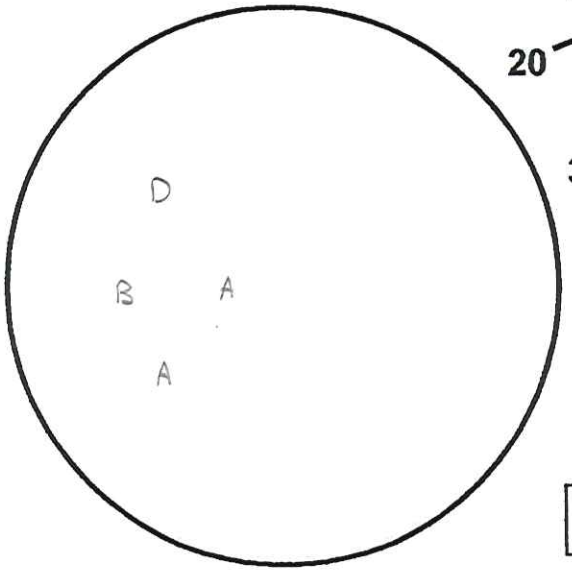
You are currently subscribed to spaceweather as: jcrane@ball.com
To unsubscribe send a blank email to leave-spaceweather-795703T@snglist.msfc.nasa.gov

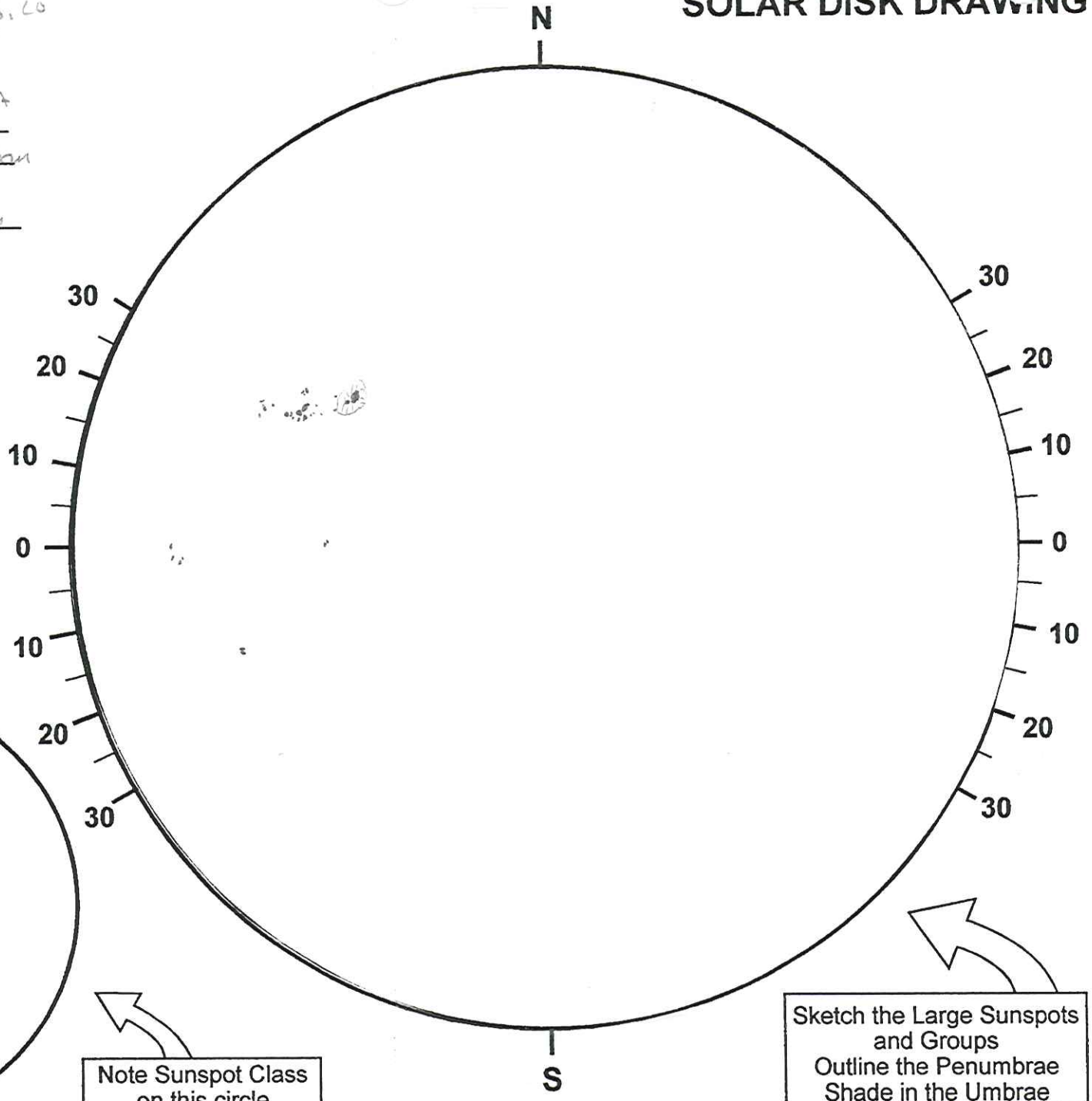
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Front Yard - Broomfield, CO
Date/Time 2/22/04 12:30P (MST)
Sky:
Seeing OK Clouds High Thick Wind Light N
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 3 = 4
Spots: N 22 +S 8 = 30

Wolf Sunspot Number (R):
R= 10G + S = 70





Note Sunspot Class on this circle

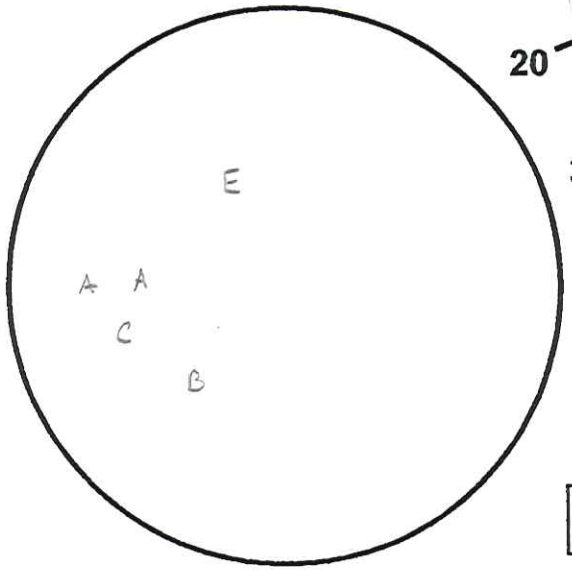
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

SOLAR DISK DRAWING

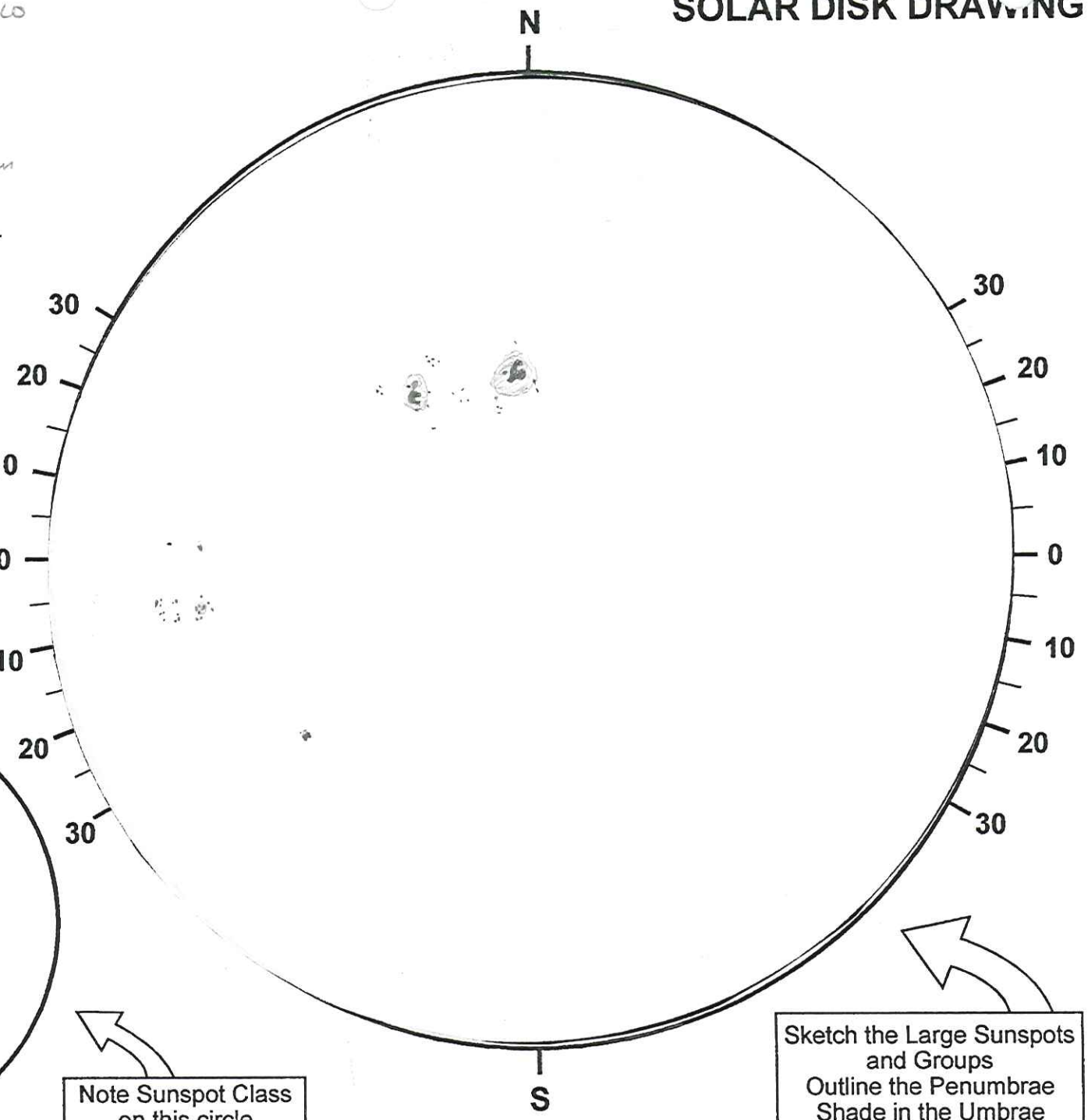
Observer: Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/23/04 2103 MST (UT)
Sky:
Seeing Good Clouds Some Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 3 +S 2 = 5
Spots: N 29 +S 24 = 53

Wolf Sunspot Number (R):
R= 10G + S = 103



Note Sunspot Class on this circle



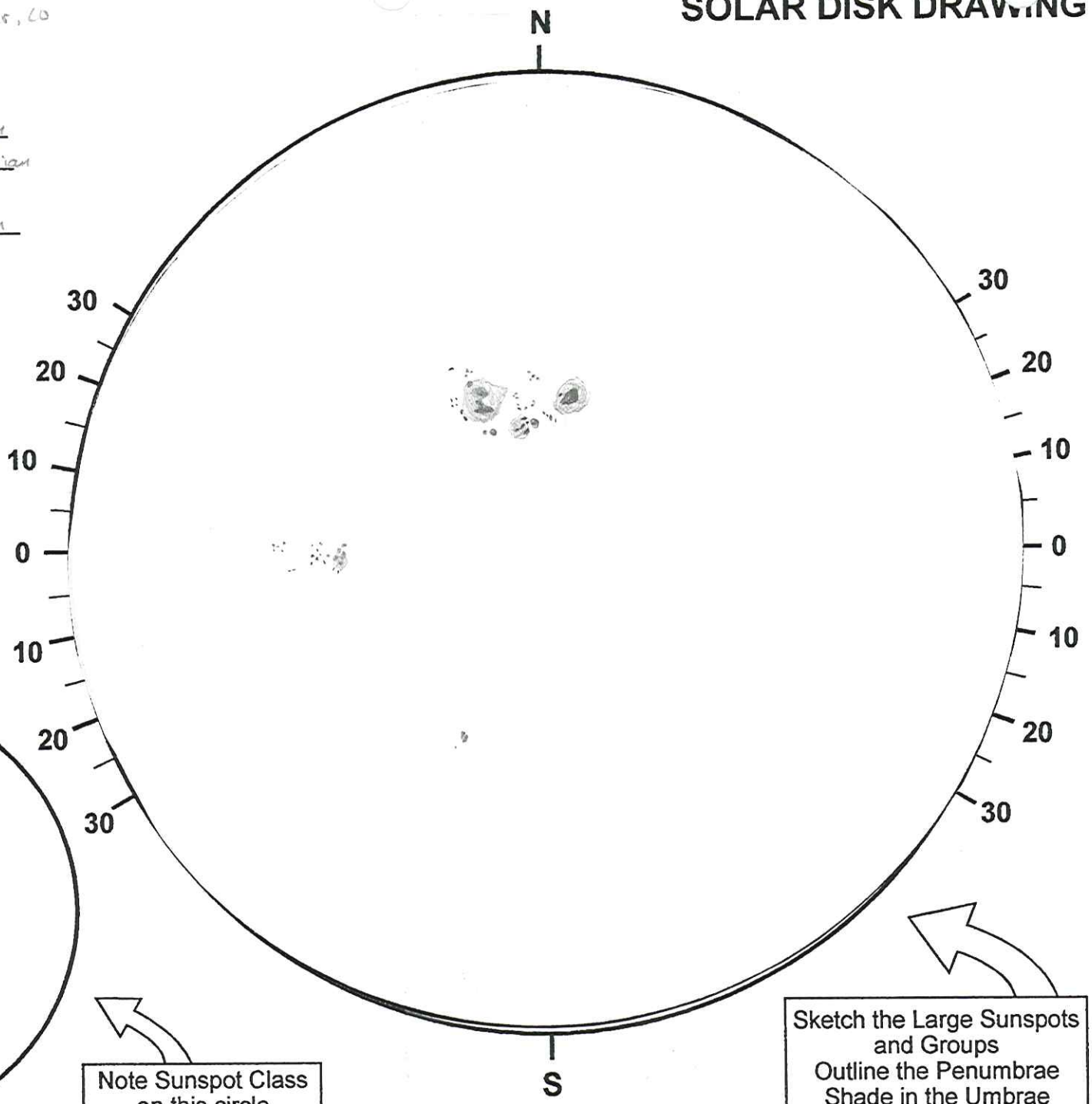
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

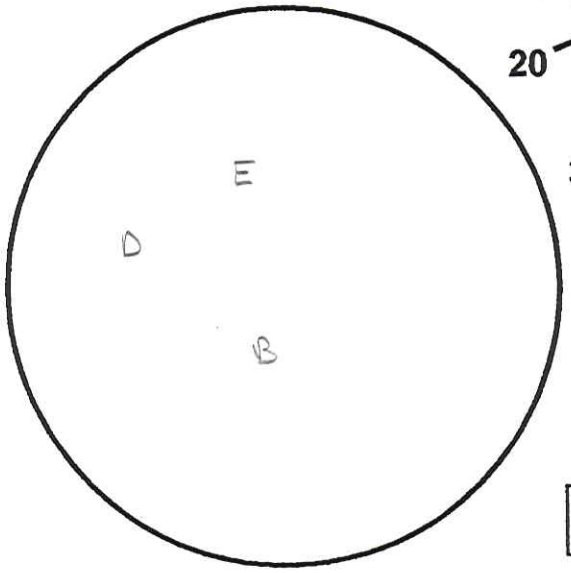
SOLAR DISK DRAWING

Observer: Mike Hotlen
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/24/04 1130P (MST) (UT)
Sky:
Seeing OK Clouds High Thick Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/9 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 2 = 4
Spots: N 54 +S 17 = 71

Wolf Sunspot Number (R):
R= 10G + S = 111





Note Sunspot Class on this circle

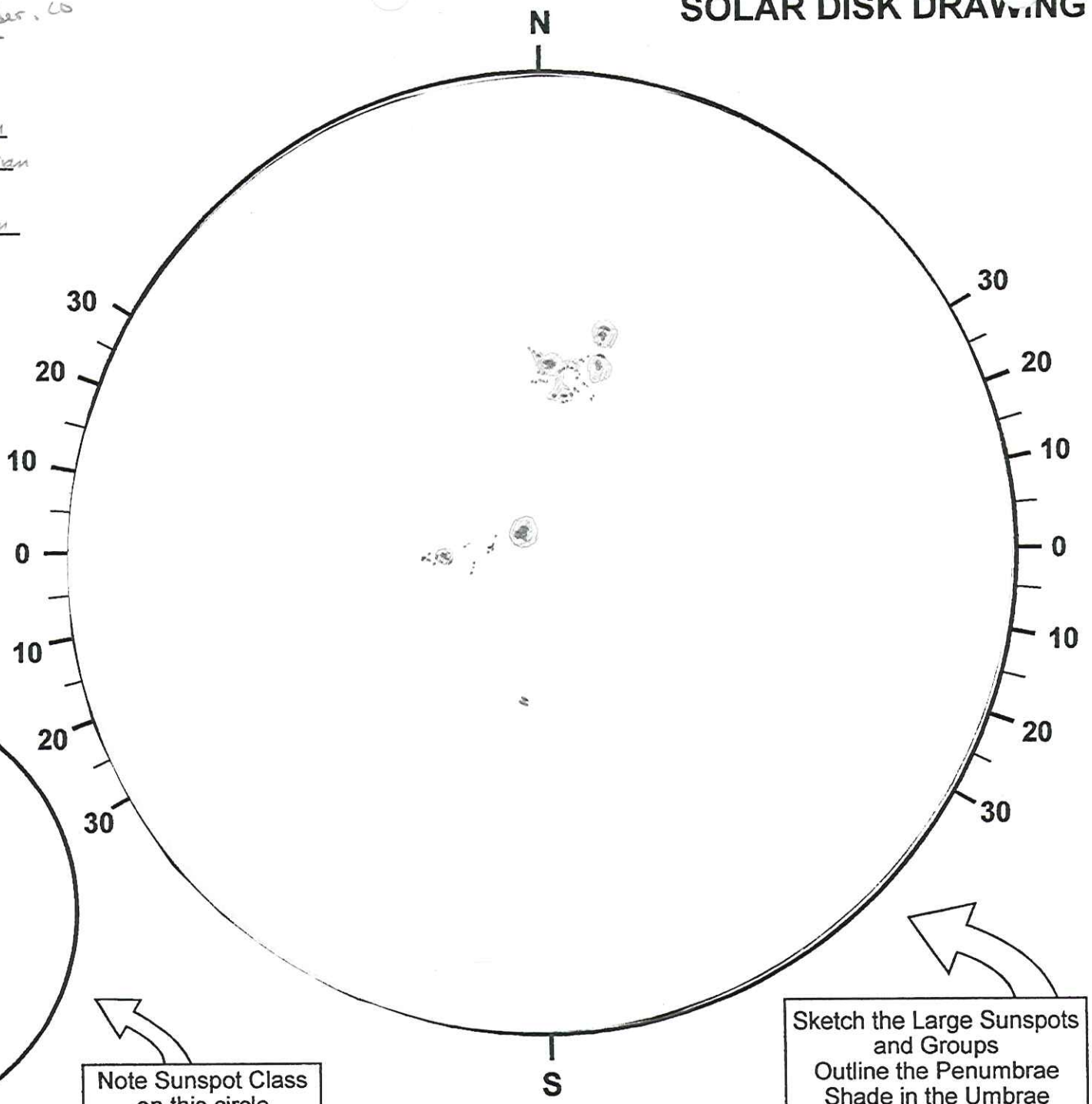
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

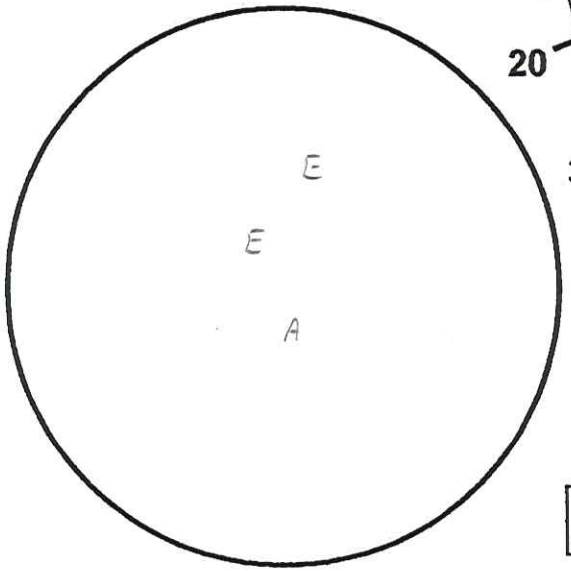
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Date/Time 2/25/04 1130A (MST / UT)
Sky:
Seeing Good Clouds P/C Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f18 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 2 = 4
Spots: N 47 +S 16 = 63

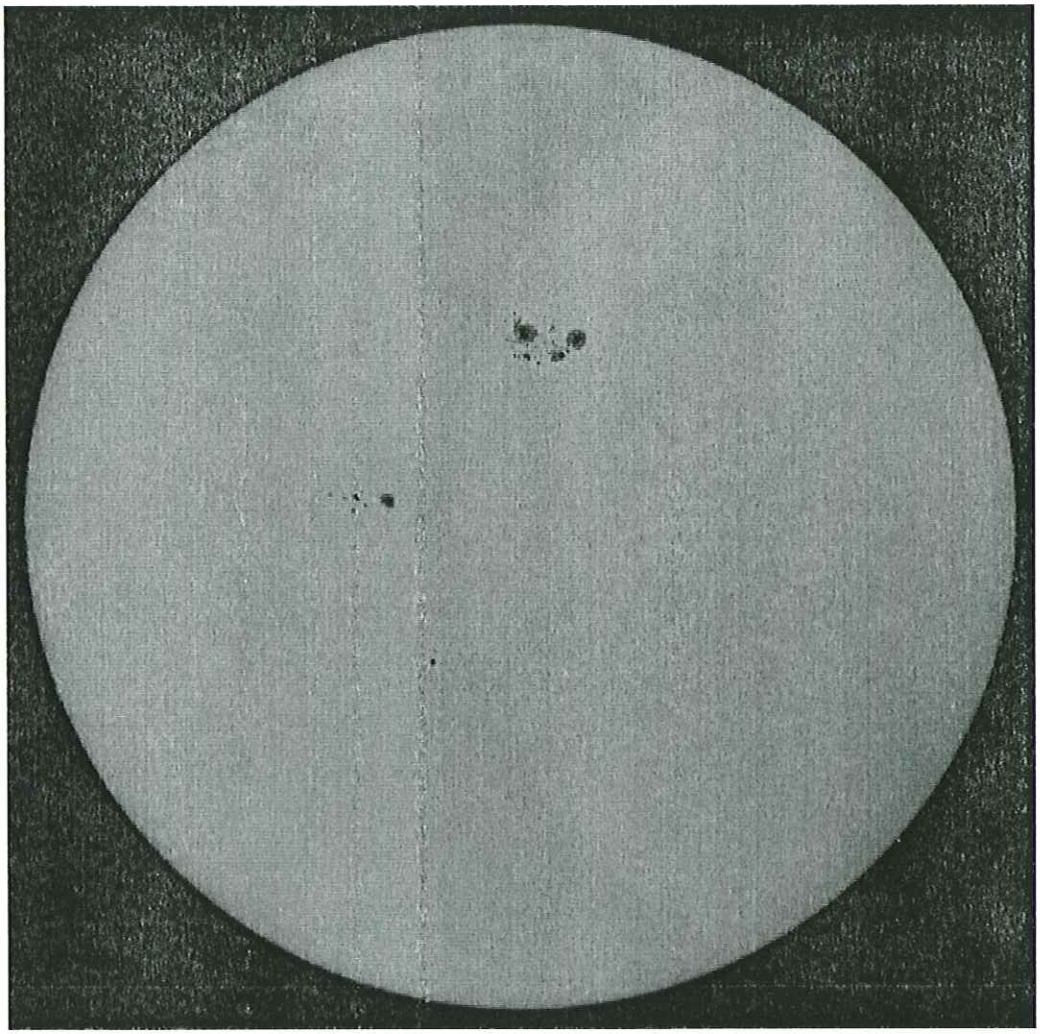
Wolf Sunspot Number (R):
R= 10G + S = 103





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

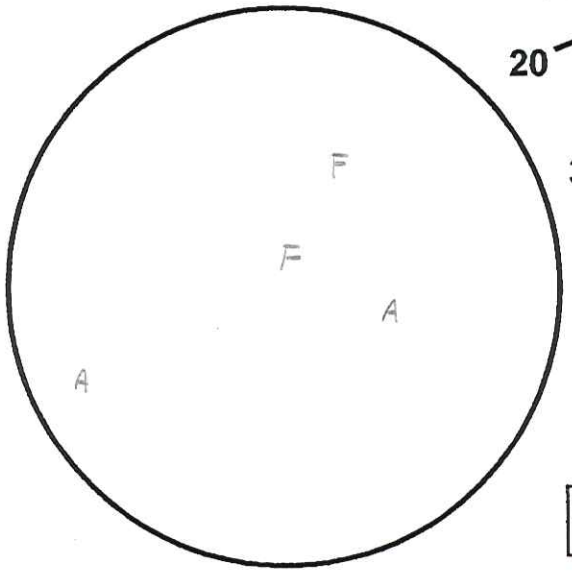

← 564
← 565
← 563

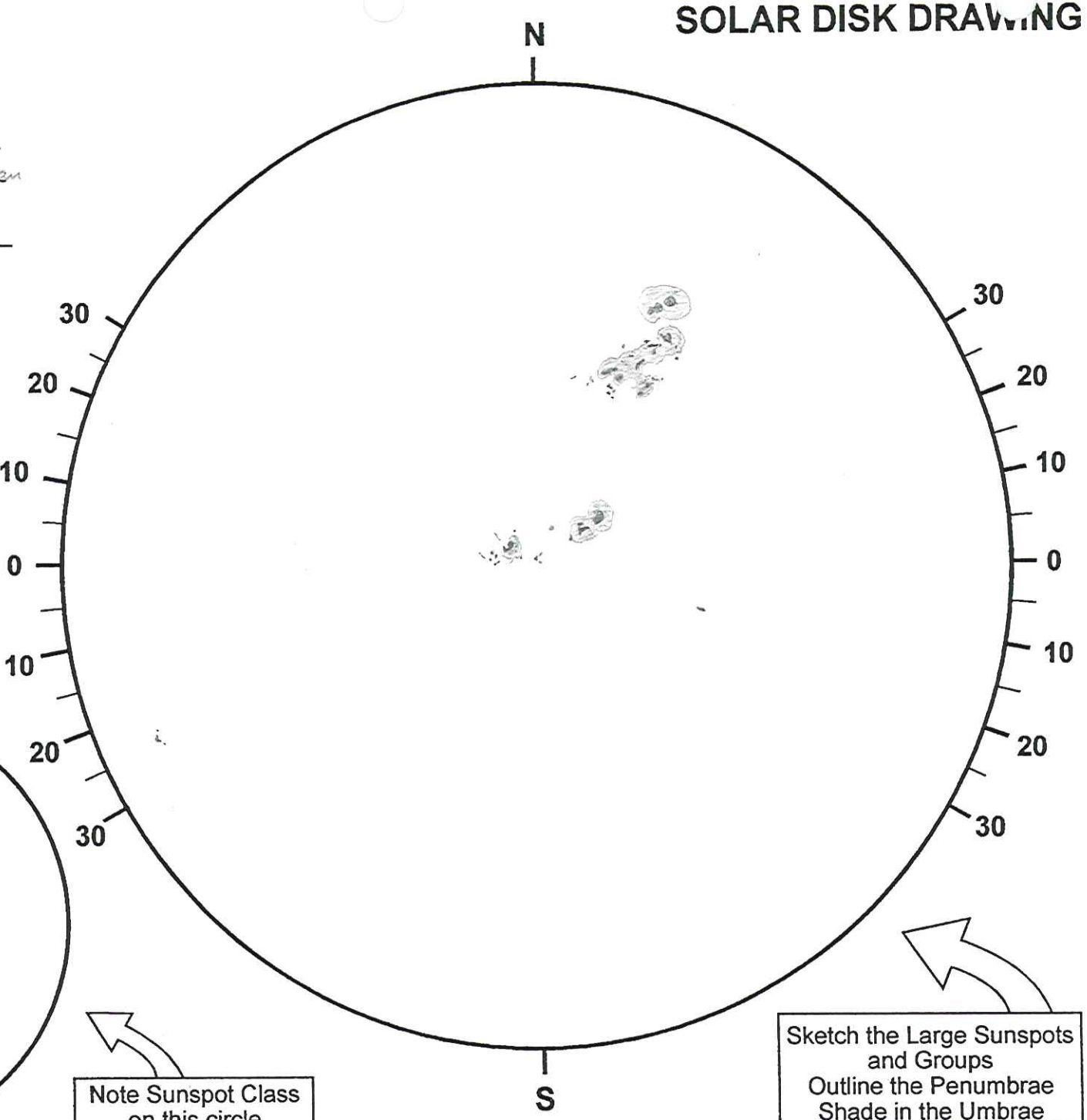
SOLAR DISK DRAWING

Observer: Mike Hatlee
Location: E. Airport I-70
Date/Time 2/26/04 11:45 (UT)
Sky:
Seeing Good Clouds High Thin Wind Strong SW
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
(Direct) or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 2 = 4
Spots: N 56 +S 5 = 61

Wolf Sunspot Number (R):
R= 10G + S = 101





Note Sunspot Class on this circle

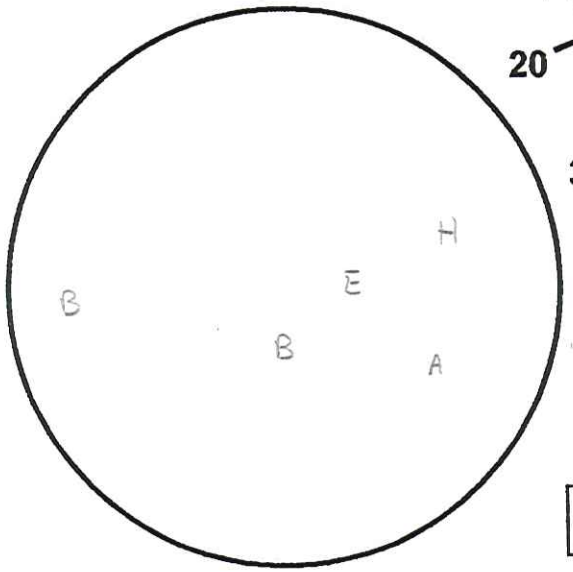
Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

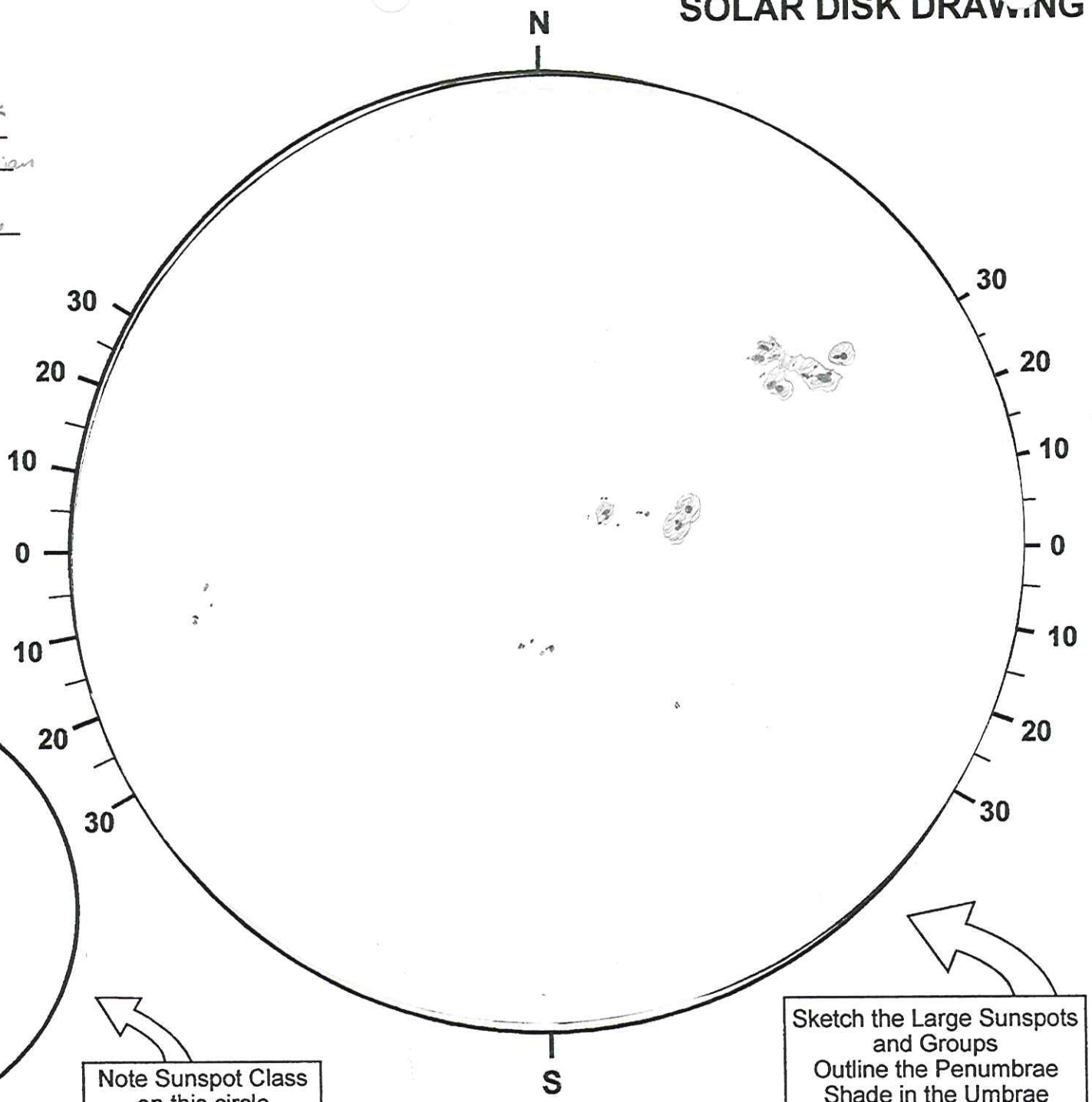
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Boulder, CO
Date/Time 2/27/04 8:23A (MST/UT)
Sky:
Seeing OK Clouds High Thin Wind Brisk E
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
(Direct) or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 3 = 5
Spots: N 37 +S 14 = _____

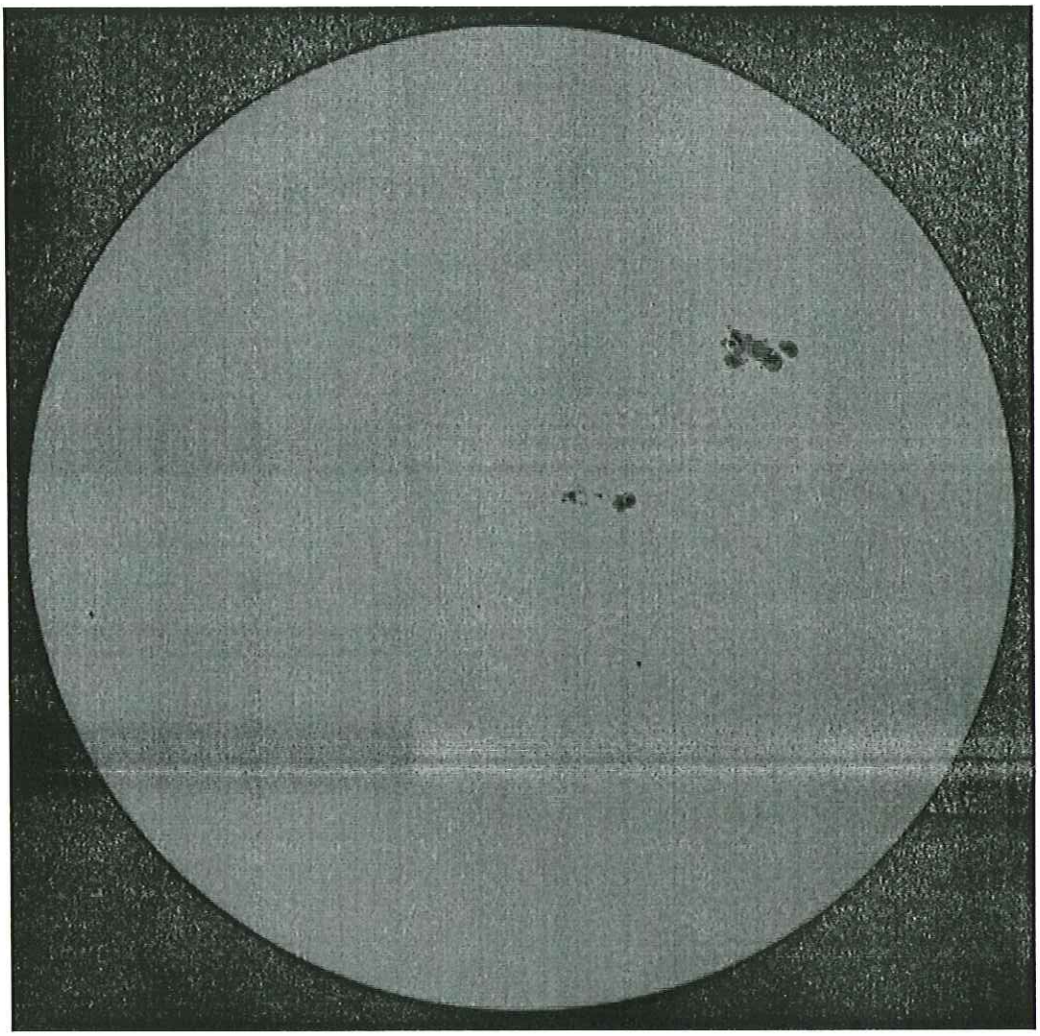
Wolf Sunspot Number (R):
R= 10G + S = 101





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

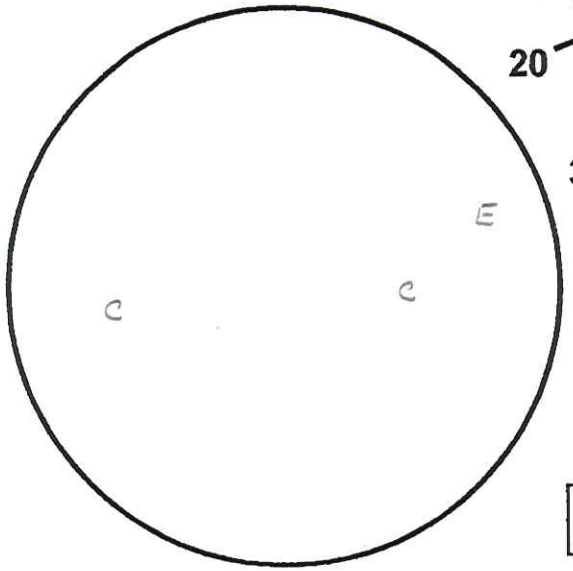


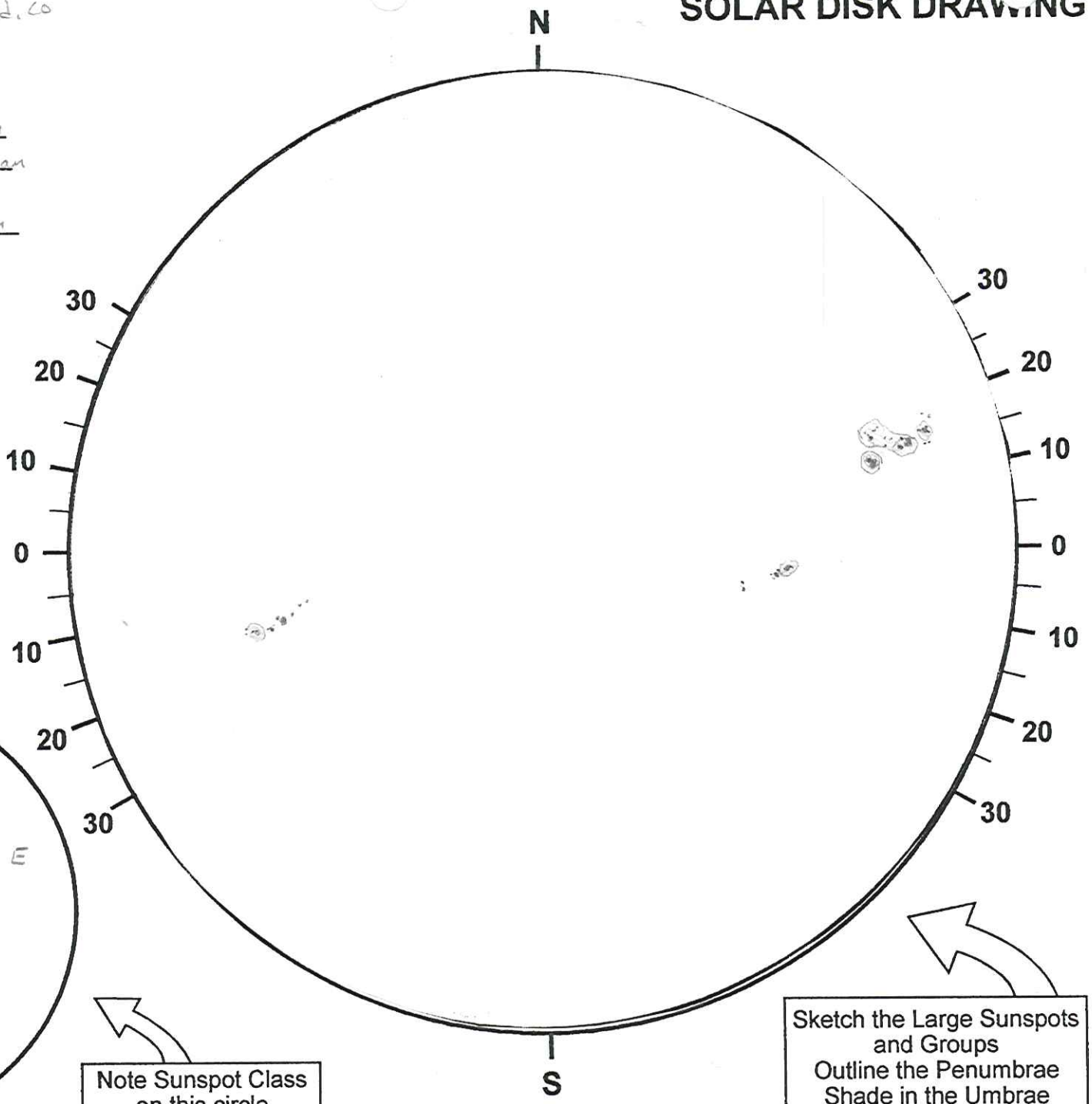
SOLAR DISK DRAWING

Observer: Mike Hotter
Location: Front Yard - Broomfield, CO
Date/Time 2/28/04 8:35A (MST)
Sky:
Seeing Very Poor Clouds High Thick Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19 mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 2 = 3
Spots: N 23 +S 19 = 42

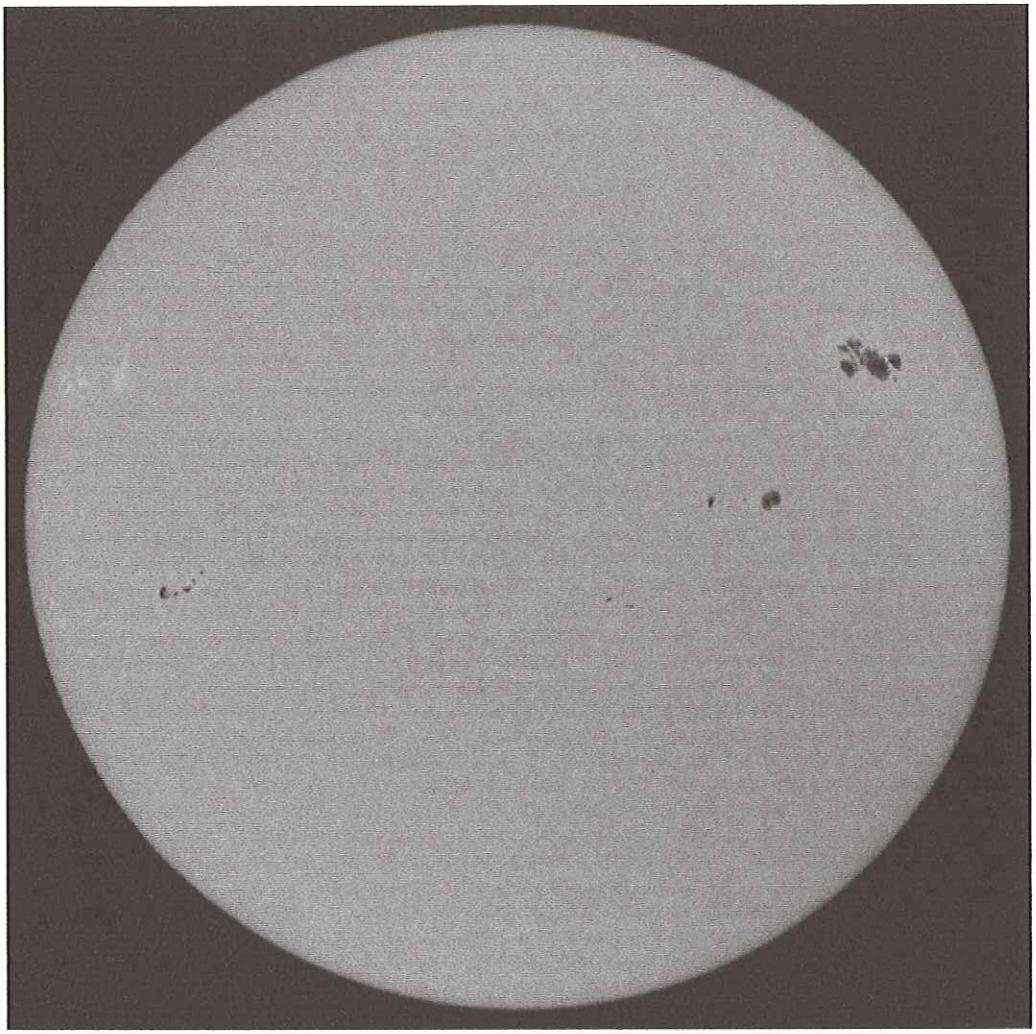
Wolf Sunspot Number (R):
R= 10G + S = 72





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

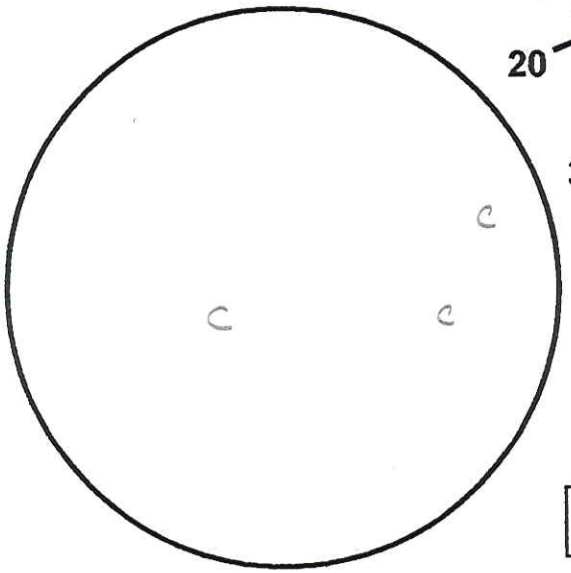


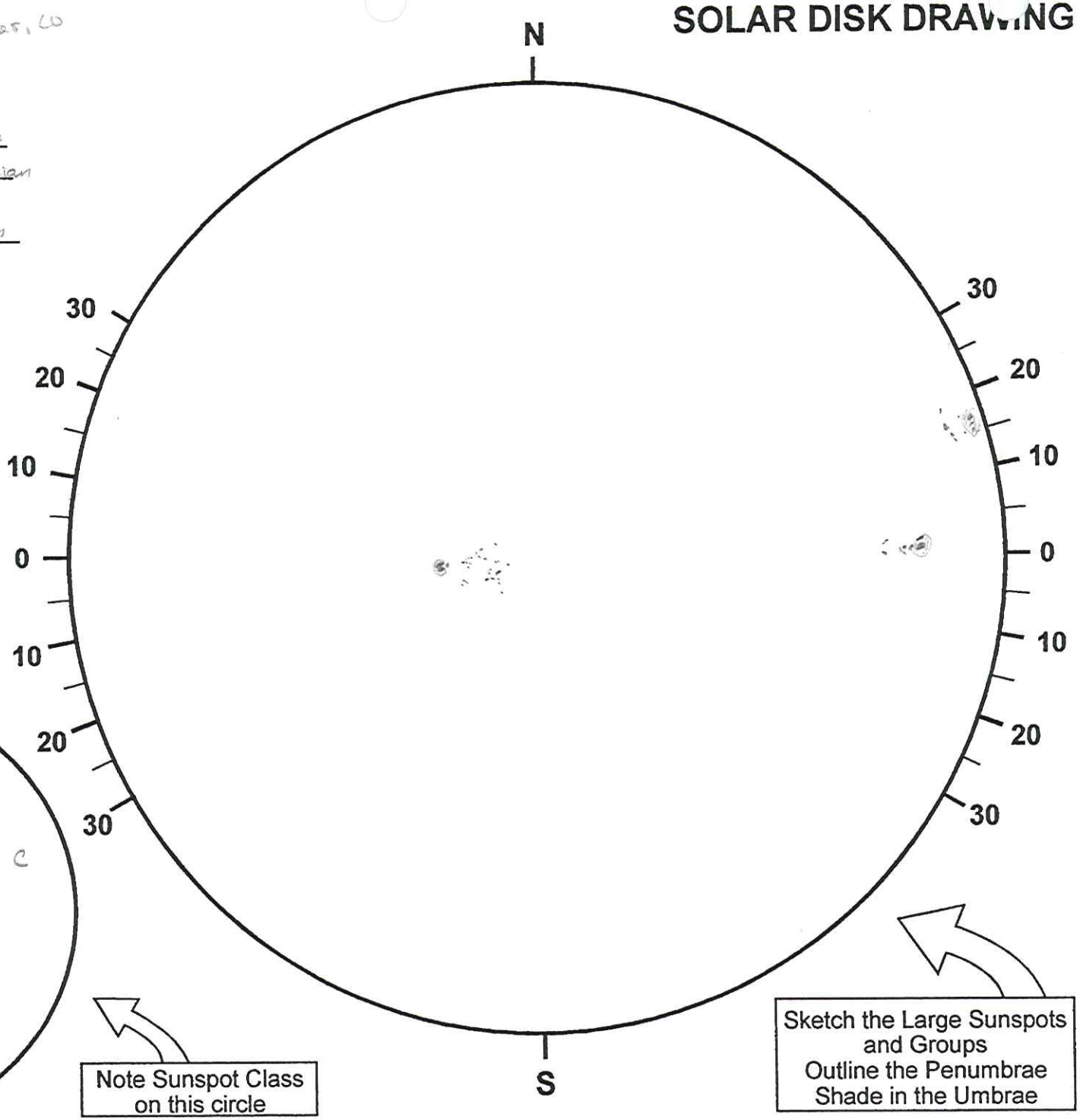
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Date/Time 3/1/04 11:16AM MST (UT)
Sky:
Seeing Good Clouds Very Thin Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 2 +S 1 = 3
Spots: N 24 +S 29 = 53

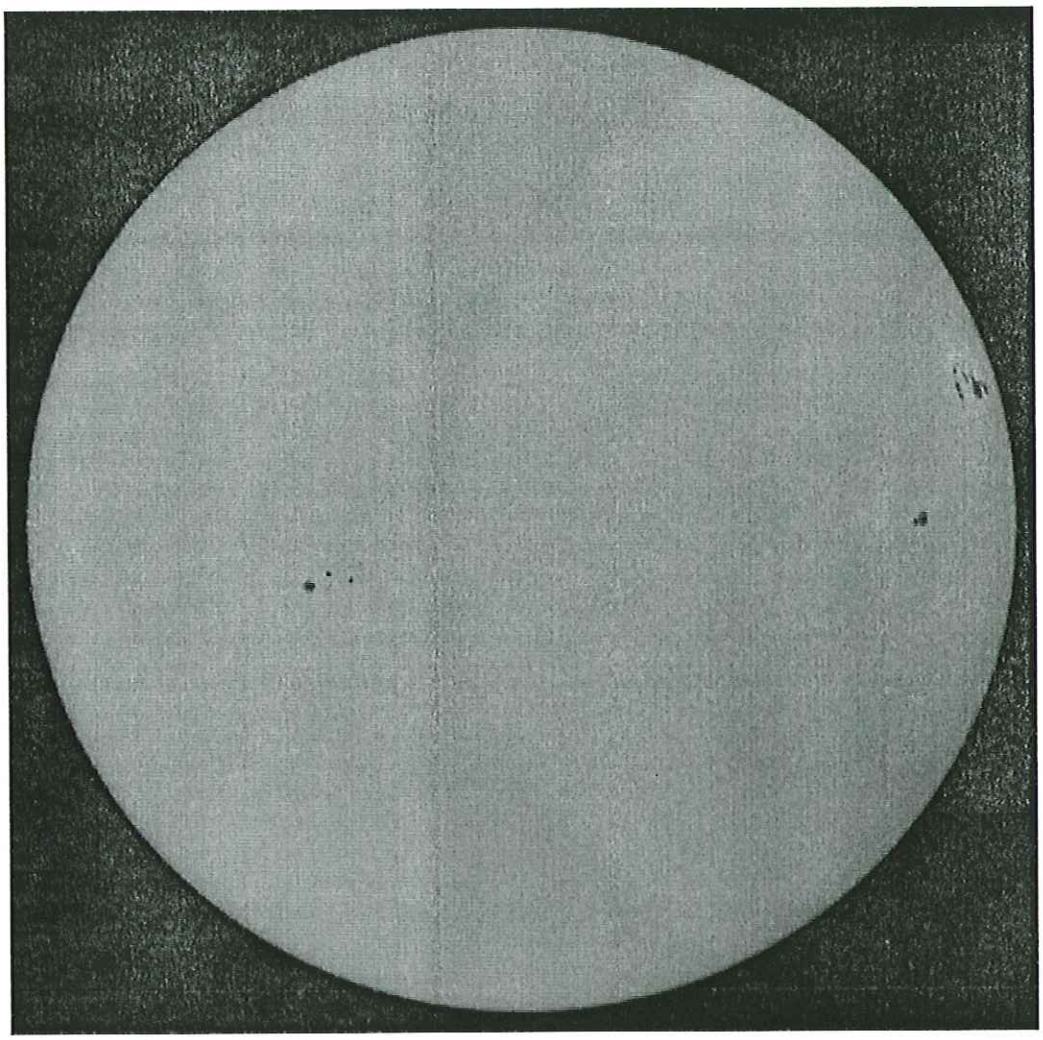
Wolf Sunspot Number (R):
R= 10G + S = 83





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

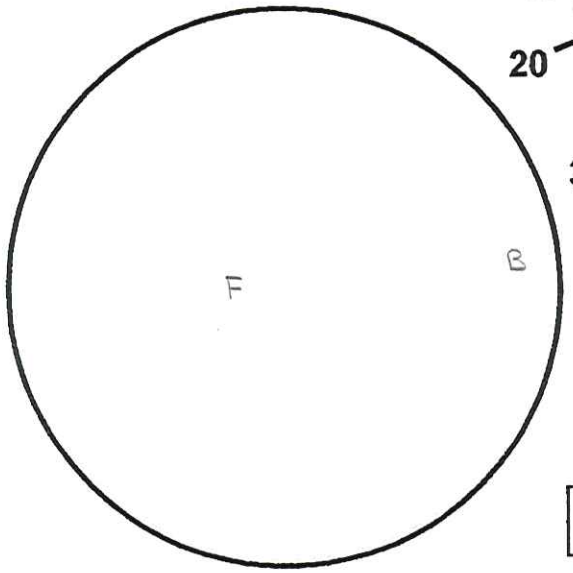


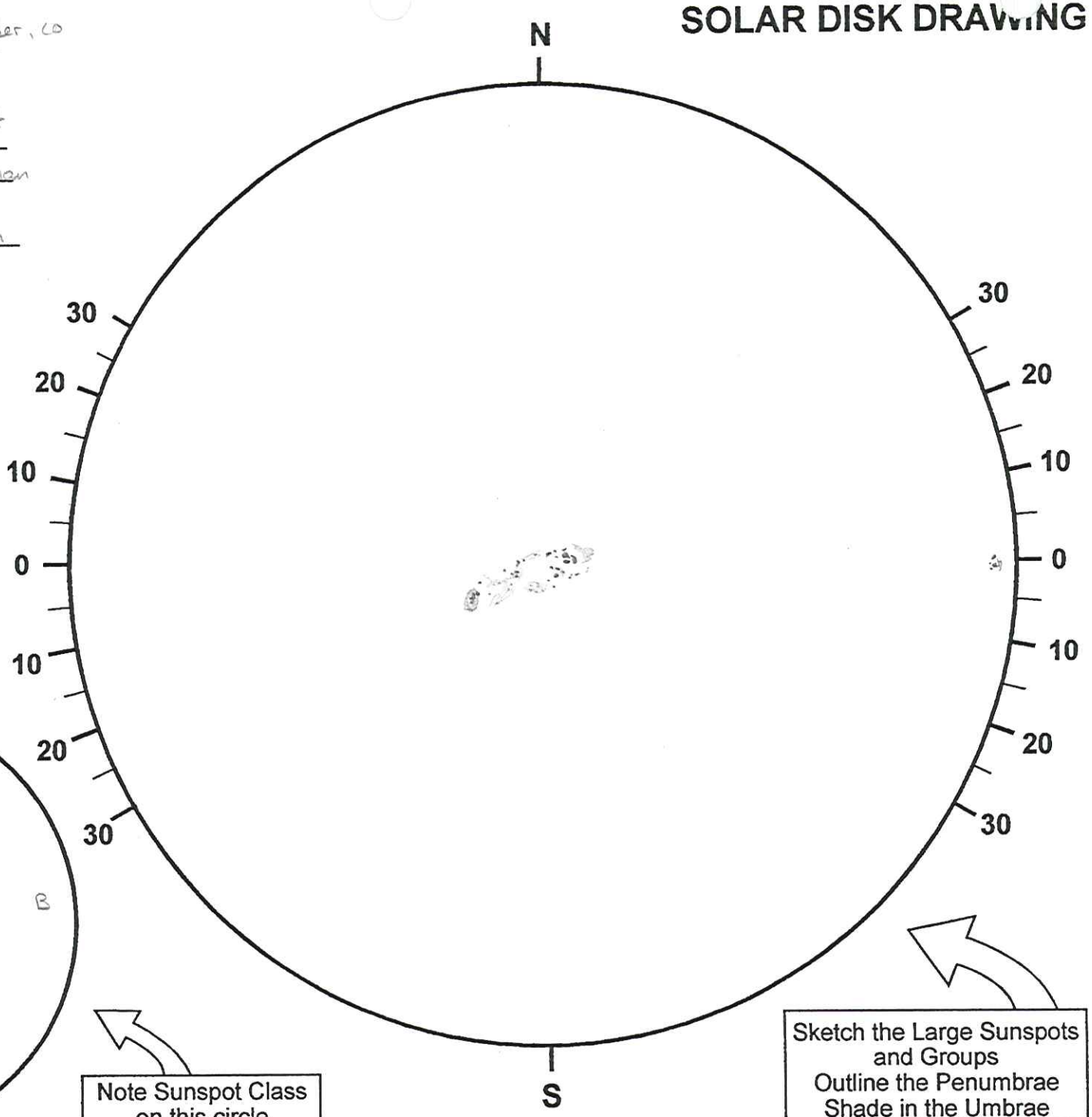
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Ball Parking Lot - Boulder, CO
Date/Time 3/2/04 11:37A (MST)
Sky:
Seeing Good Clouds Clear Wind Light NE
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 0 +S 2 = 2
Spots: N 10 +S 42 = 52

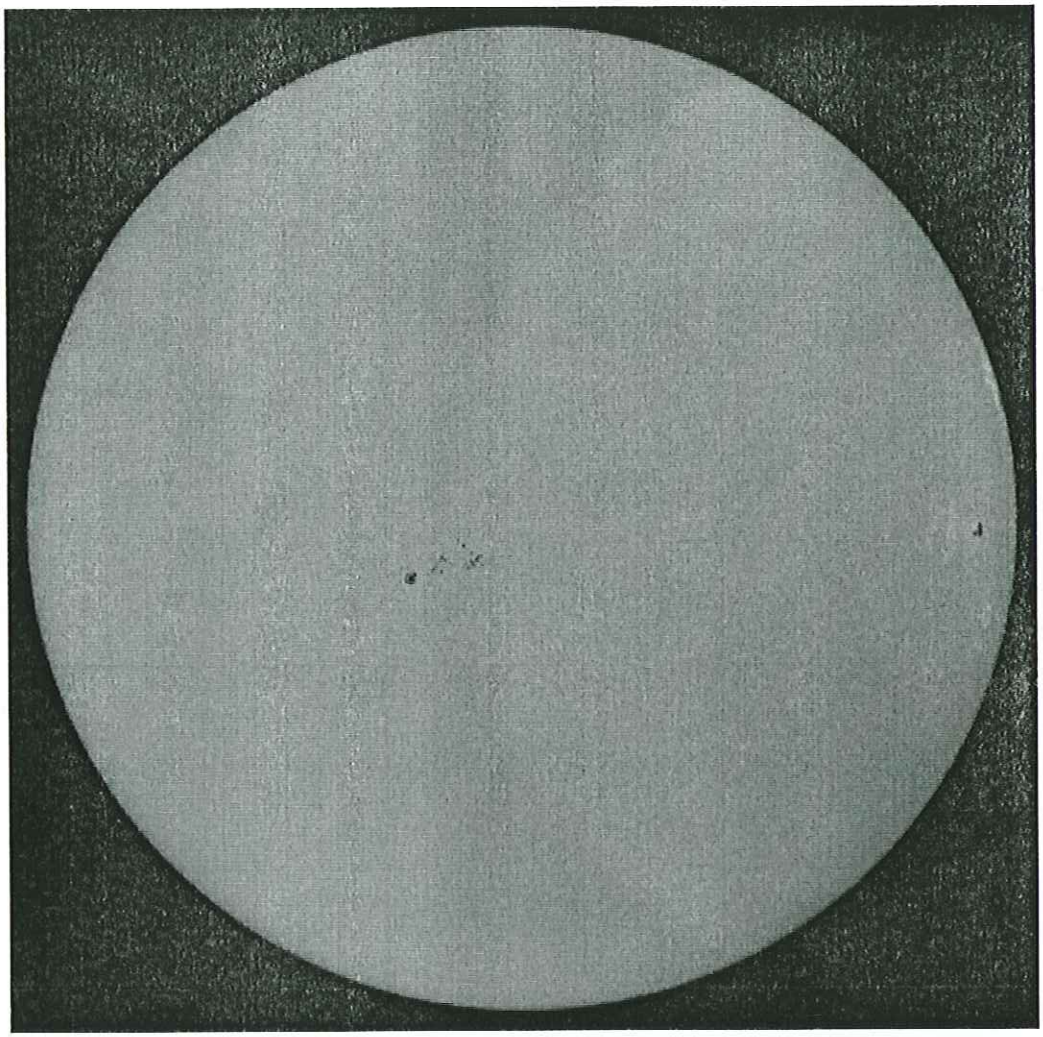
Wolf Sunspot Number (R):
R= 10G + S = 72





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

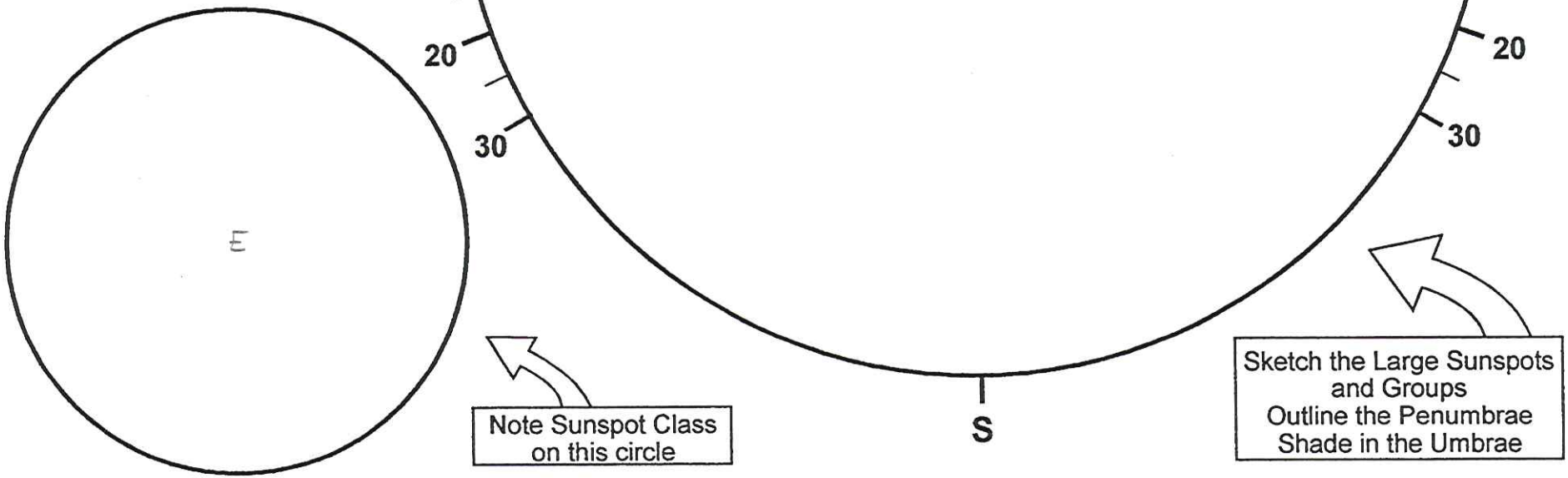


SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Boulder, CO MST
Date/Time 3/3/04 8:20 AM (UT)
Sky:
Seeing Good Clouds Clear Wind Calm
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

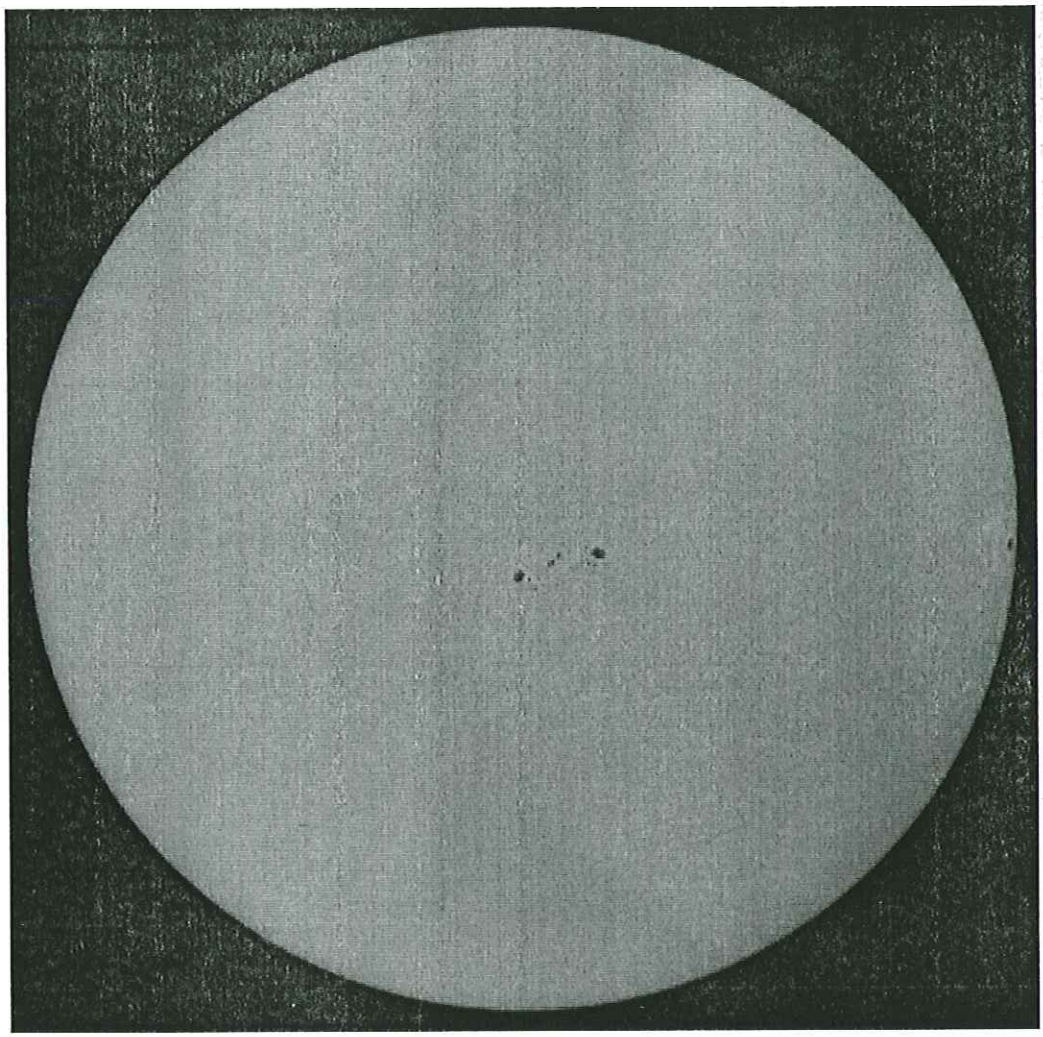
Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 0 +S 1 = 1
Spots: N 0 +S 27 = 27

Wolf Sunspot Number (R):
R= 10G + S = 37



Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

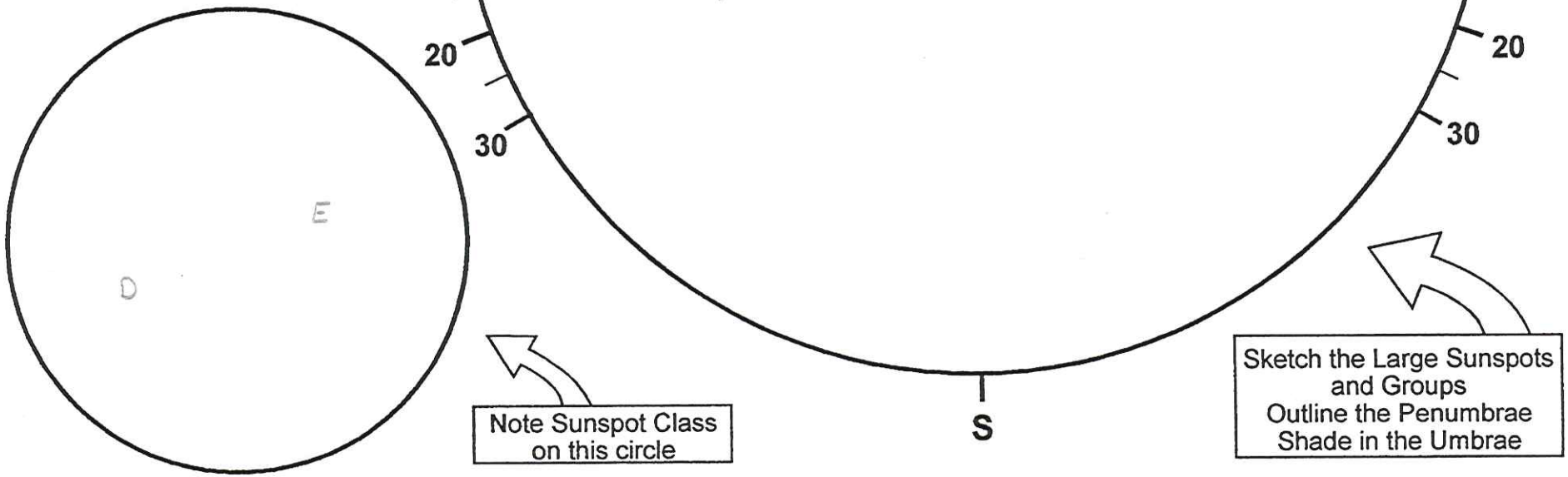


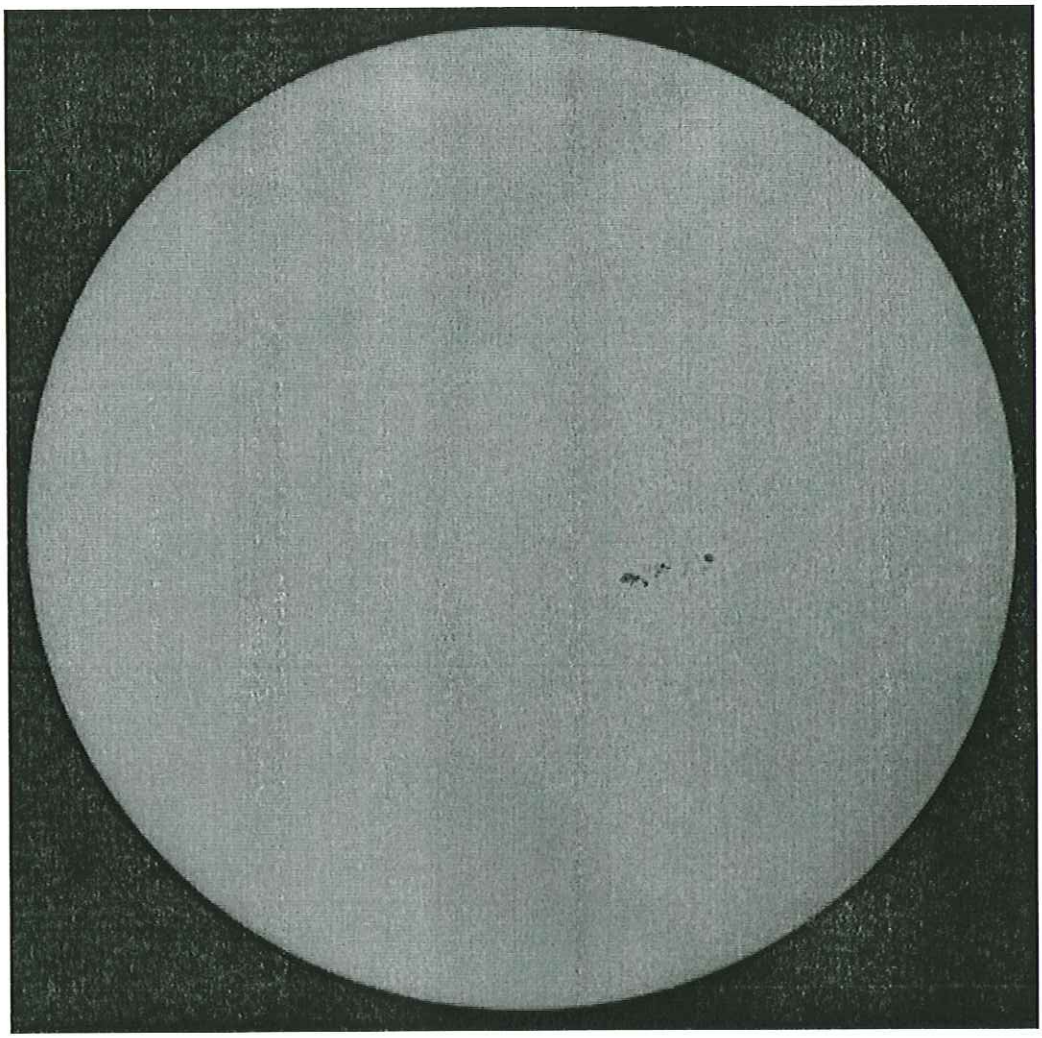
SOLAR DISK DRAWING

Observer: Mike Hotka
Location: Boulder CO
Date/Time 3/21/04 8:26A (MST) (~~UT~~)
Sky:
Seeing Good Clouds Clear Wind Calm
Telescope Rt Hector Type Newtonian
Aperture Used 8"
Focal Length 8'8" Eyepiece 19 mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 2 = 3
Spots: N 11 +S 32 = 43

Wolf Sunspot Number (R):
R= 10G + S = 73



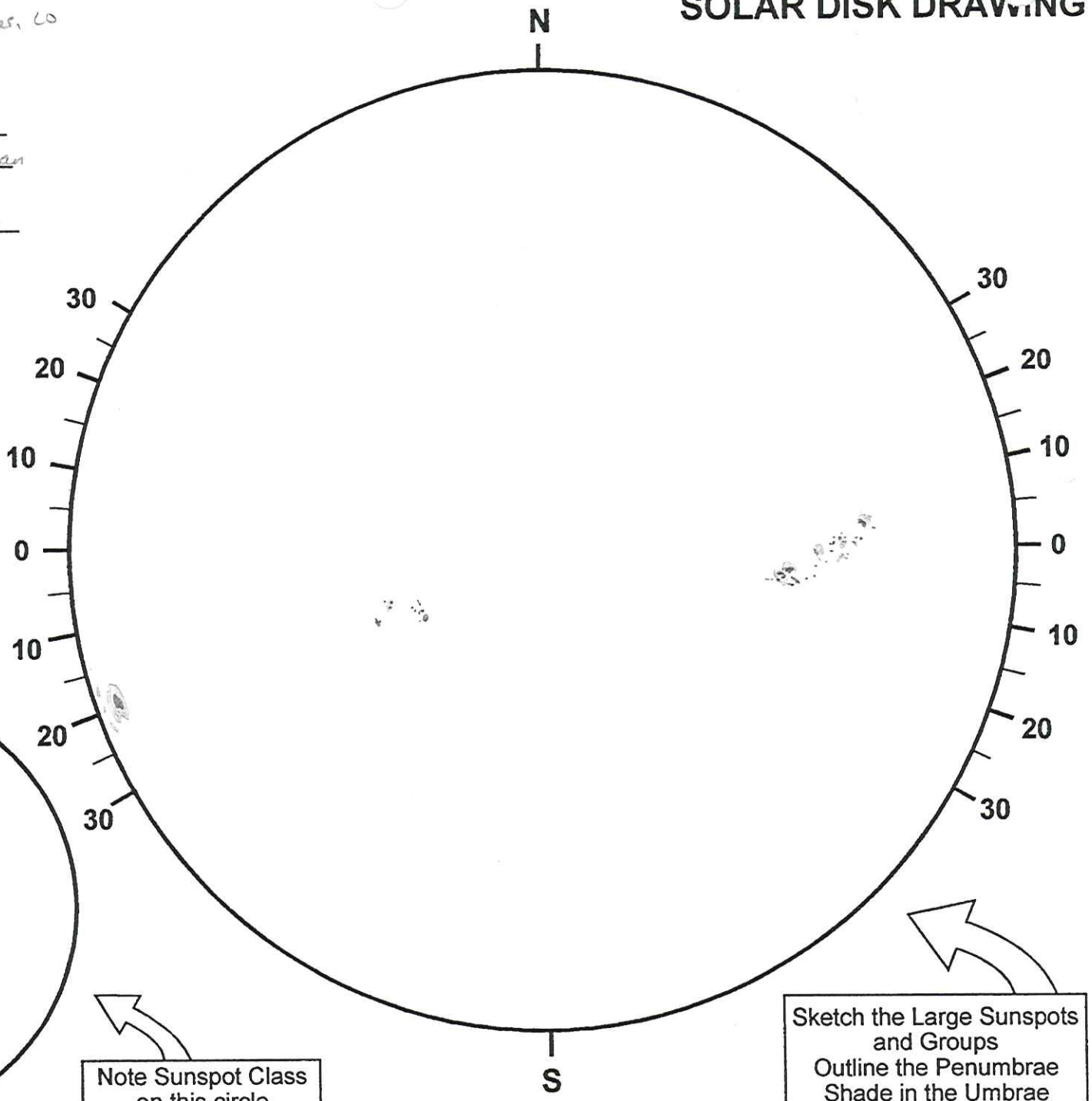


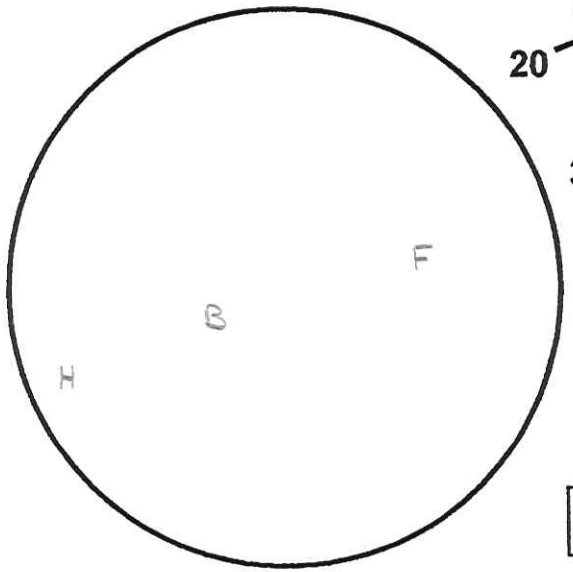
SOLAR DISK DRAWING

Observer: Mike Hattes
Location: Ball Parking Lot - Boulder, CO
Date/Time 3/5/04 12:36P (MST / UT)
Sky:
Seeing Good Clouds Clear Wind Some S
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 1 +S 3 = 4
Spots: N 13 +S 37 = 50

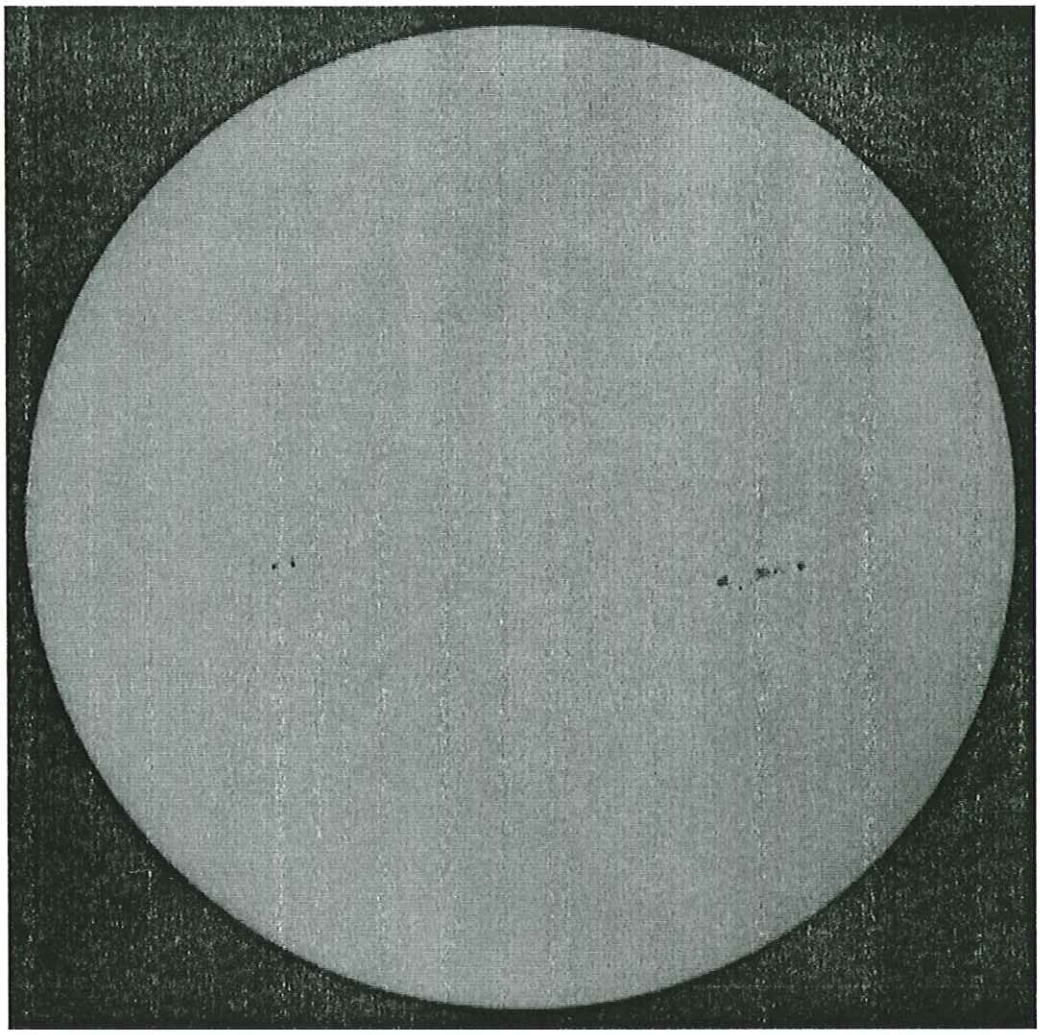
Wolf Sunspot Number (R):
R= 10G + S = 90





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae

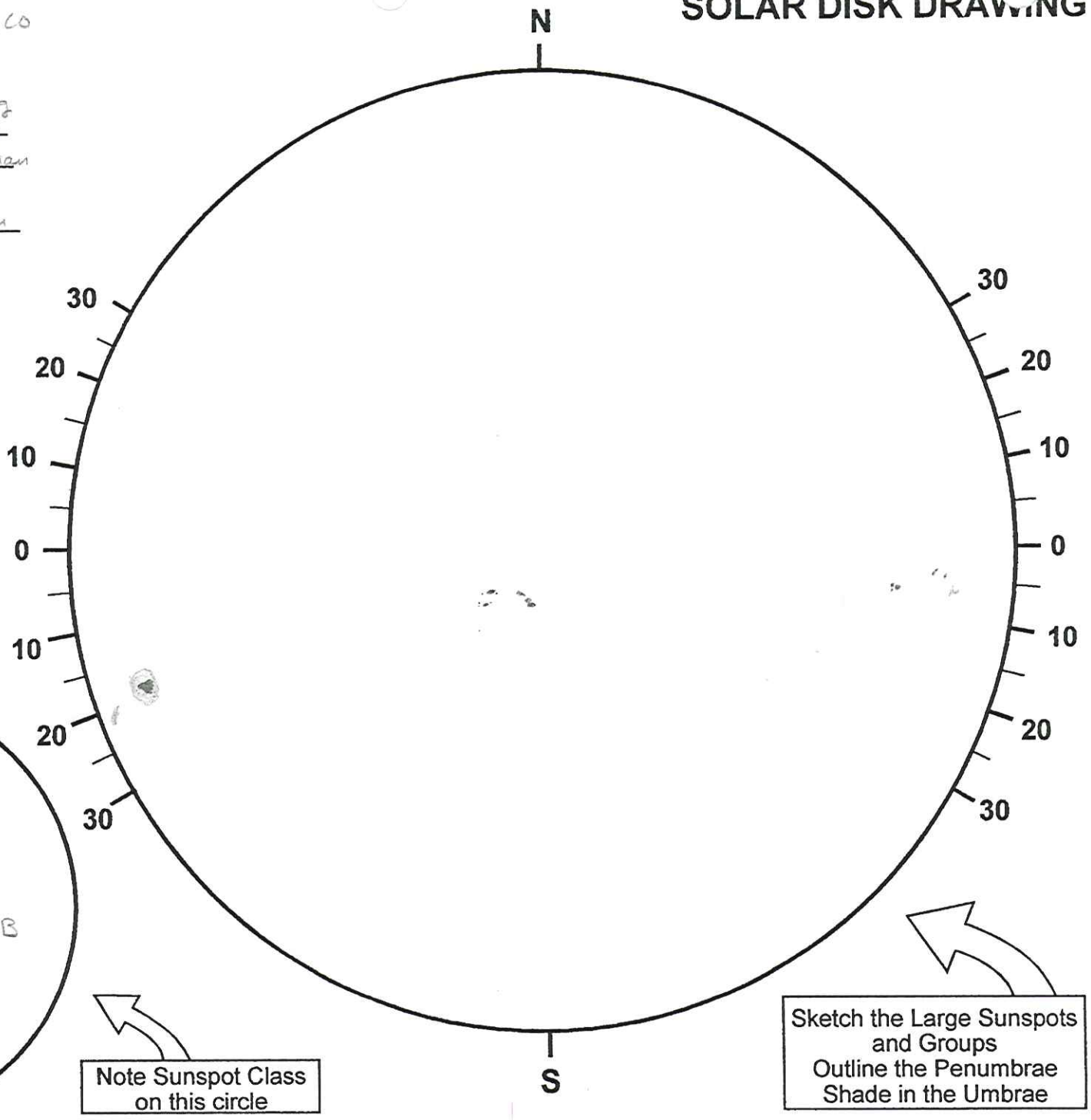


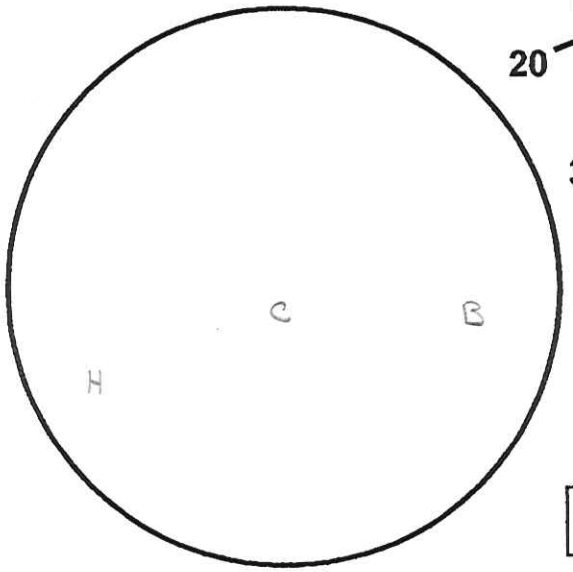
SOLAR DISK DRAWING

Observer: Mike Hottes
Location: Front Yard - Broomfield, CO
Date/Time 3/6/04 10:25A (MST) (UT)
Sky:
Seeing Fair Clouds High Thick Wind Strong NW
Telescope Reflector Type Newtonian
Aperture Used 8"
Focal Length f/8 Eyepiece 19mm
Filter Baader
Observations:
Direct or Projected (circle one)

Total Sunspot Count:
(N=north of solar equator, S=south)
Groups: N 0 +S 3 = 3
Spots: N 0 +S 19 = 19

Wolf Sunspot Number (R):
R= 10G + S = 49





Note Sunspot Class on this circle

Sketch the Large Sunspots and Groups
Outline the Penumbrae
Shade in the Umbrae