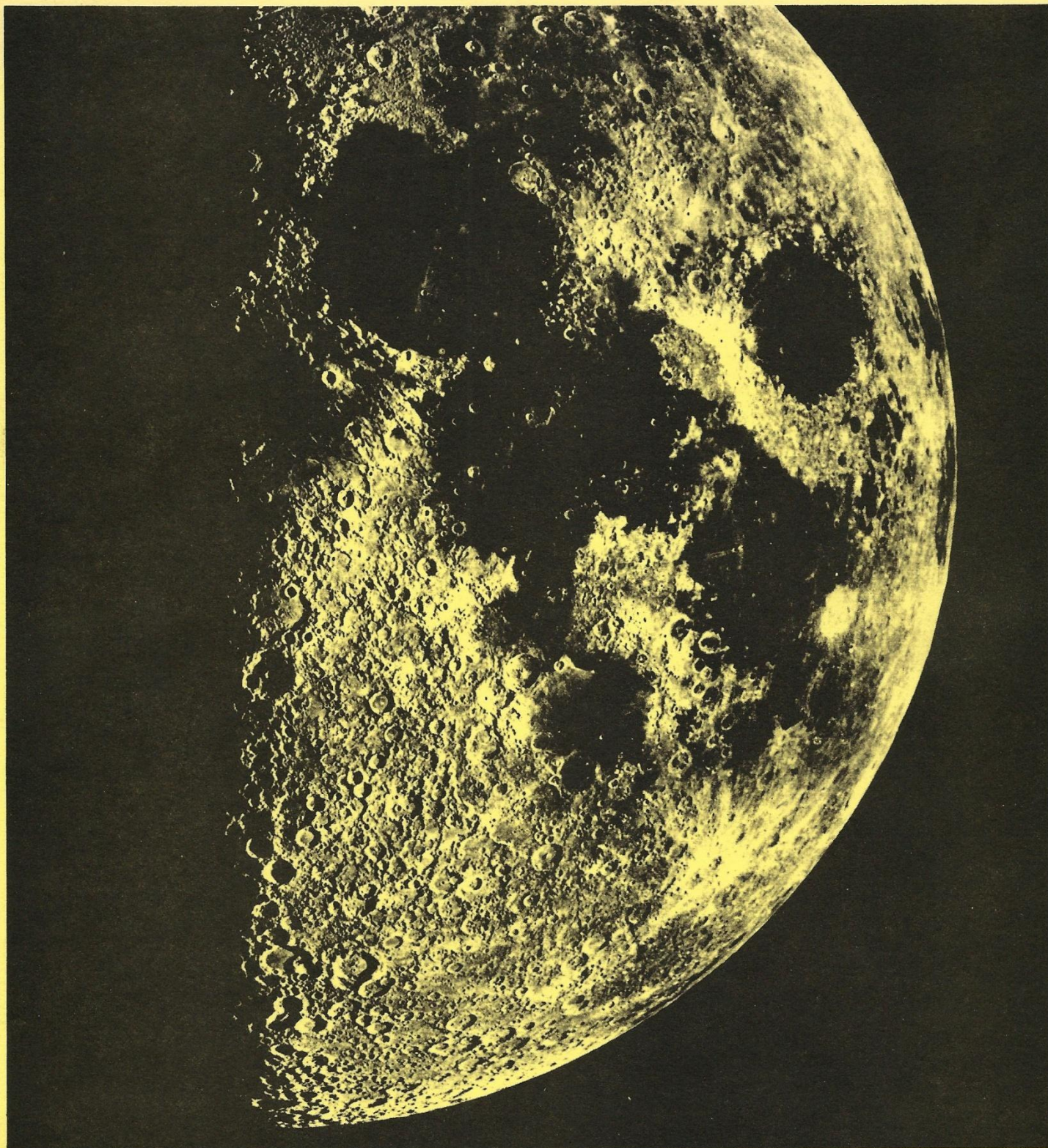




THE WASP

THE JOURNAL OF THE WARREN ASTRONOMICAL SOCIETY



MAY 1978



The Warren Astronomical Society
P.O. Box 474
East Detroit, Michigan 48021

Club News

The Warren Astronomical Society (W.A.S.) is a local nonprofit organization of amateur astronomers. Membership is open to all interested persons. Annual dues are as follows; Student- \$11.00, College- \$13.00, Senior Citizen- \$15.50, Individual- \$18.00, Family- 23.00, the membership fees listed here include a one year subscription to Sky & Telescope Magazine.

Meetings are held on the first Thursday of each month at Cranbrook, and the third Thursday of each month at Macomb County Comm. College.

The EDITOR: Roger A. Civic, 26335 Beaconsfield
Roseville Michigan, 48066- call 776-8735

OBSERVATORY SCHEDULE

Dennis Joswick..Chairman

Lectures for the coming month are listed below.

May .5/6 ...Dave Dobrzelewski ... 778-9715

May. 12/13 .Jon Root

May. 19/20 .Louis Faix 781-3338

May. 26/29 .David Harrington 879-6765

The lecturer may select either the Friday or Saturday, depending on the Weather and their personal schedule.

Star Bowl Victory!!

The mighty W.A.S. team has again taken on all comers and again won out against seemingly overwhelming odds. Six teams tried but they all in turn were struck down. The defending champs, DOAA, did not show. I wonder why??? The date was April 8, 1978, the place, Abrams Planetarium, the host was the M.S.U. Astronomy Club. The members of this great team were: Ken Kelly, Frank McCullough, Don Hisson, and Doug Bock.

•buy – sell – trade•

FOR SALE...Projector Table, brand new...\$30.00.- 30"X40" wood drawing table, \$15.00.- Folk Guitar w/pick, 6 string, \$10.00. - TI-50 Scientific calculator, rechargeable .. \$30.00. Call Larry Kalinowski 776-9720.

FOR SALE...Celestron 8 with: wedge, tripod, 3 eyepieces, aluminum dewcap, counterweights, prism diagonal, piggyback camera mount, off axis guider, illuminated eyepiece, telecompressor, teleextender, and 'T' mount and ring for Cannon body. New cost-\$1571.00, selling for-\$1150.00. Write Richard Hill, 3932 Todd, Midland, Mich. 48640 Or call 1-517-835-5548.

For sale...Tasco 60 mm telescope (tube only) 2 eye pieces and a 24 mm finder ..\$25.00. Also, Jagers 4½" reflector (tube only)with a 10X30 mm finder. Contact Joe Munau, 681-2006.

For Sale...10" f/6 reflector with Optic Craft mount (pipe), asking \$300.00 Also, Celestron photographic accessories- A.C.-D.C. drive corrector and off axis guiding assembly. F. B. Bruner, 643 Washington, Hope In. 47246

For Sale...8" f/6 reflector, with 2.14 diagonal, mounted in 10" tube-50" long no eyepiece focusing mount. \$125.00. Also 4" O.D.-24" long, black iron stand that is ready to accept 3 legs and Equatorial head (Pacific) \$15.00. plus, a 22½ lb. counter weight with 1" hole & screw clamp. \$15.00 Contact Roger Civic, 776-8735.

MINUTES ...

The Warren Astronomical Society met March 16, 1978 in the Cafeteria of Macomb Community College at 8:20 p.m. President Lou Faix called for a treasurer's report which listed \$342.56 as the current balance. It was made known that the regional convention for amateur astronomers will be held in Dayton, Ohio on June 9, 10 and 11. June 28 to July 1st are the dates for the National Convention in Racine, Wisc. Rates each night for single is \$18. Lou has all information regarding the submitting of papers and photos for the Convention. John Searles of the Toledo Astronomical Society told of a Great Lakes Symposium to be held in that city May 19 and 20. Doug Bock gave April 8 as the date for the MSU Invitational which will feature a Messier Contest. Diane McCullough took the floor to explain about the Easter week-end Star Party. Arrangements have been made with Park officials for anyone who wishes to stay overnight. Members were cautioned to drive slowly.

In the interest of security, all keys to the Camp Rotary Observatory have been turned in. Dennis Jozwik, observatory chairman, explained that the dome will be repaired this week-end. He favored expanding the Observatory but felt that funding will be a problem.

Pete Kwentus volunteered to develop a fund raising program. Incorporation of our Society will be investigated. Carl Noble offered his support and help. Larry Kalinowski questioned the various aspects, pro and con, of incorporation. Lou said that an annual financial report of the Society is mandatory.

Gary Morin brought in by-laws of the Great Lakes Regional. He requested that all members study them and make recommendations. A Roster of our group will be put together for May by Gary Morin and Loretta Caulley. Members were asked to update their dues. Elections in May will be handled by Pete Kwentus. Election for National officers will be held at the April meeting. A letter of appreciation from the Cranbrook Science Institute for their December award was then read to members.

Larry Kalinowski reported on his telescope making Group. He asked for four telescopes for the April 13 and 14 Star Show at Warren Woods High School. Robin Bock spoke in defense of spectators at public Star Parties. Pete Kwentus then sold tickets for Astronomy books donated to the Society. Roger Civic acknowledged articles written by Rick Carter and Jeff Stanek. Lou Faix spoke on a book about space colonization and also announced that there will be a Variable Star Observers Convention at U. of M. this June 2nd. Dave Harrington announced the dates of forthcoming Lunar Occultations. Frank McCullough disclosed that the April program will have Jerry Persha, Doug Smith, Dr. Paul Strong and Mike Newberry as speakers. Chuck Meyers told of travel arrangements for the Solar Eclipse in Feb. 1979. \$300 is the tab and \$50 is needed as a deposit.

After intermission, Doug Bock, Diane McCullough, Louis Faix, Ray Bullock, Gary Morin, Jim Paulausky, John Root, Mark Ropes, Jeff Stanek and Pete Kwentus finished the program with their competent exhibitions of their own telescopes and photographs.

The meeting closed at 11:08 p.m.

Respectfully submitted,



Loretta D. Caulley, Secretary

GEMINI

The Great Twin Brethren

The two bright stars in this mid-winter and early spring constellation have been known as "The Twins" from earliest days. However, in classic and modern times the twin stars have been known as CASTOR and POLLUX. Gemini, meaning "twins" in Latin, is the third sign of our Zodiac and lies west of Taurus and northwest of Orion.

In pre-classic times old stories and folklore tell of the adventures of the twin heroes. They have figured prominently in Greek, Roman, Persian, Egyptian, Phoenician folklore and doubtless the beginnings could go back to still earlier pairs.

CASTOR and POLLUX were said to be the sons of Jupiter and Leda. CASTOR excelled in horsemanship, while POLLUX was famous as a soldier and boxer.

According to legend, they were educated by great teachers and were renowned for their strength and daring. The Twins were among the Argonauts who set sail with Jason in his quest for the Golden Fleece. It was an incident during this voyage which gave them their reputation as patrons of sailors. A sudden storm came up while the Argo was at sea and the great ship was in peril. While the fury of the seas was at its height, Orpheus took up his harp and began to play and pray for the gods to save them. The storm then suddenly died while at the same time twin stars appeared shining over the heads of the twins CASTOR and POLLUX.

CASTOR and POLLUX were also great warriors and are celebrated in Macaulay's "Battle of Lake Regillus." He retells an old legend:

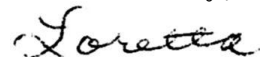
"... was aware of a stately pair,
That rode by his right hand
So like were they no man
Might one from other know
White as snow their armour was,
Their steeds were white as snow."

Romans built a temple in their honor. Their likenesses appeared on silver coins and statues showing them on horseback with stars shining above the head of each are still to be seen.

The stars CASTOR and POLLUX are interesting in that they have quite recently altered in appearance. POLLUX is now a first magnitude star and CASTOR is second. They mark the heads of the two figures. Two definite lines of fainter stars outline the bodies and another pair of stars shows their feet which appear to be on the brink of the Milky Way.

There is a record of a lunar occultation in Gemini that was observed about the middle of the 4th Century B. C.

Submitted by,



Loretta D. Caulley

FROM THE I.A.U. CIRCULARS

By Ken Kelly

PERIODIC COMET WILD 2 (1978b)

This comet was discovered by Paul Wild of Berne University on January 6 with a 40 cm Schmidt telescope at Zirnmerwald. It will come to perihelion on June 15 at 20H 35M, UT. It is in an elliptical orbit of eccentricity 0.556823, with a period of 6.171 years. It has a semi-major axis of 3.364398 AU and a perihelion distance of 1~491025 AU. The inclination is 3.2753 degrees, the ascending node is at longitude 136.1115 degrees, the argument of perihelion is 39.8757 degrees, and the mean daily motion is 0.159714 degrees. The following predicted positions were given on IAU Circular # 3177:

	H	M	°	'	Δ	r	mag
April 22	6	59.57	+23	00.0	1.578	1.596	11.0
May 2	7	25.44	+22	34.6			
12	7	52.97	+21	48.3	1.647	1.535	10.9
22	8	21.74	+20	39.3			
June 1	8	51.33	+19	07.2	1.717	1.499	10.9

These positions are for OH UT on the given dates and are for equinox 1950. The comet is reported as extremely well condensed, with a suggestion of a tail in PA 80 on Feb. 10 (B. Manning, IAUC # 3193).

NOVA SERPENTIS 1978

This object was discovered by Y. Kozai at Tokyo on Mar. 1. It is located at 17H 48M 59.74S, -14° 43' 08.2" (equinox 1950). On March 4.82, it had a visual magnitude of 8.3. It has been getting dimmer slowly since then, although it is fluctuating. The last reported magnitude was 10.0 on April 3.51.

APPARENT DISTANCE (") AND POSITION ANGLES (°)
OF SATURN'S SATELLITES FOR 10 P.M. E.S.T.
(11 P.M. E.D.T.) Computed by Ken Kelly

DATE	TETHYS		DIONE		RHEA		TITAN		IAPETUS	
	AD	PA	AD	PA	AD	PA	AD	PA	AD	PA
Apr. 20	46	83	55	268	81	267	81	237	544	92
21	46	261	23	111	36	239	39	177	529	92
22	44	79	30	63	69	91	84	109	511	92
23	40	256	57	261	58	72	134	96	489	92
24	36	73	49	92	50	279	174	89	465	92
25	28	248	13	327	74	258	188	84	438	92
26	24	62	40	251	26	120	175	80	708	92
27	17	230	59	84	81	83	136	73	376	93
28	11	24	40	277	18	19	78	58	342	93
29	10	158	14	207	78	267	37	349	305	93
30	14	302	49	76	38	241	85	286	267	93
May 1	21	106	57	267	66	92	141	274	227	93
2	27	279	29	105	60	73	178	268	186	94
3	33	94	24	56	45	281	188	263	143	94
4	38	270	55	259	75	259	171	258	100	96
5	42	87	52	90	23	126	130	251	60	117
6	44	265	17	347	80	84	75	236	29	189
7	45	83	35	248	20	30	38	171	20	261
8	44	261	58	82	76	269	84	108	61	274
9	42	78	44	274	41	244	133	95	118	271
10	39	255	12	180	63	93	170	89	160	272
11	34	72	45	74	62	74	183	84	200	270
12	27	248	57	265	42	283	169	79	239	271
13	22	61	33	100	75	260	130	73	277	271
14	15	228	18	46	20	135	73	57	312	271
15	10	18	51	258	79	84	36	344	345	271
16	10	151	53	88	22	39	85	285	375	271
17	14	300	22	293	73	269	239	273	403	271
18	21	106	29	2444	44	246	174	267	428	272
19	27	278	55	81	59	94	182	263	450	272
20	33	93	46	272	63	75	164	258	469	272
21	37	270	12	148	38	285	124	251	484	272
22	41	87	19	71	75	261	71	234	497	272
23	43	265	56	264	18	148	38	166	506	272
24	44	83	37	97	78	85	84	107	512	272
25	43	260	14	29	25	46	132	95	514	273
26	41	78	47	256	71	269	167	89	513	272
27	37	255	53	87	46	248	178	84	508	272
28	33	72	25	285	55	96	164	79	500	272
29	25	247	23	237	65	76	125	73	488	272
30	21	60	52	80	34	288	69	56	474	272
31	14	226	48	270	75	261	36	341	457	272

- NIGHT WATCH -
RIK HILL

One planet that is usually overlooked telescopically is Venus. It seems that there is this myth that there are no features of interest to see, so why bother? Those who consider themselves devotees at least make note of the phase changes. But one should not sell this object too short. There is plenty to do and see which will require the best of amateur skills.

As Venus enters the evening sky it is seen to be gibbous, being on the opposite side of the sun as we see it. As it nears greatest eastern elongation it will head for a quarter phase and then turn into the beautiful crescent that is usually pictured in most books on astronomy. It will be about 31 weeks from superior conjunction (when Venus is on the opposite side of the sun) to reach greatest eastern elongation, but from that point to the next conjunction (inferior) it will only take 10 weeks. This means that those beautiful crescent phases will be short lived for the evening observers among us. During those few weeks Venus will grow from some 15 seconds of arc in diameter to near 60! This will almost bring Venus into naked eye resolution range.

At its most dazzling this year Venus will attain a -4.3 magnitude, on Tuesday, October 3rd. It should be easily visible by day for a week either side of this date. On Wednesday, October 4 the moon and Venus will be close in the sky. So if you can locate the moon you will find Venus nearby. In fact, in the beginning of October Mars, Uranus, Venus, and Neptune will all be rather close together in the evening skies.

Many amateurs, most notable those in the Assoc. of Lunar and Planetary Observers (ALPO) have been sketching markings seen on the disc of Venus. Anyone can do this but it will take some practice. First I will go through the features usually seen:

CUSP-CAPS . . . These are the areas near the visual poles of the planet. It is here that the greatest contrasts result. At times the caps themselves appear to be of a greater brightness than the body of the planet and often they present an irregular appearance in comparison with the curve of the terminator. I have seen them protrude past the terminator pole and at other times appear to attenuate the cusp. These will be the changes most easily visible. One should be especially on the watch for inequalities in the cusp-caps. It is not at all unusual for one cap to extend beyond the apparent pole while the other is attenuated. Remember that the caps are bright separate features of Venus and not just the horn or cusp. If there is difference in the brightness of the horns then there are probably cusp-caps, if there is no brightness difference then these are just the cusps or horns.

TERMINATOR IRREGULARITIES - These exhibit themselves as notches streaks, and occasionally (if one is very lucky and observant) a 'Y' shape on its side with the base of the 'Y' perpendicular to and touching the terminator. These are the famous clouds of Venus. Some authorities claim poor concordance between these observed visual light features and those seen by the Mariner 10 spacecraft. This is not too surprising. Many objects have entirely different appearances in two different wavelengths so widely spaced in the spectrum. Also

remember that this is a gas we are observing and at such spacing we could be seeing much different aspects of it. At any rate these irregularities are usually the clouds. They are seen better if a deep blue or violet filter is used. I use a small filter (a cheap surplus interference filter) centered on 450 nm (4500 Å) with a 20 nm half bandwidth (200 Å). Even so it will by no means be easy to see these features at first. It takes training and patience. Just as you did not see the belts and spots on Jupiter the first time you may have looked so too here, you will not see any detail on Venus the first time you try. The best method is to spend a long time behind the eyepiece without moving and just keep looking until the eye gets used to the low contrast of the features. The contrasts involved are commonly around 5-10% This is equivalent to the differences seen in brightness within Saturn's rings. They are there but some effort is needed to see them.

The 'Y' shaped feature has been often photographed in earth based telescopes in the UV. About the only time this is seen is when the terminator bisects the planet, or at about greatest elongation. This is because the fork in the 'Y' is a feature the Mariner 10 scientists called the "eye of Venus". It is caused by the sun, but no one seems to know the mechanism, only the effect. It just so happens that at the noon point on Venus there is created a disturbance around which all the clouds must pass. In the eye the clouds are of a cumulus nature. So as the clouds pass around this spot they cause these streams and then they rejoin into their characteristic spiraling bands on the other side. A few amateurs have reported seeing this feature.

BRIGHT LIMB BAND - This band is very bright, in fact the brightest region of the visible disc. It runs along the limb (opposite the terminator) from pole to pole. It is not always consistent in its brightness and can even seem detached from the cusp-caps. Sometimes bright spots can occur or even breaks, both of which have also been photographed in visual light. If one is to see anything in this feature a filter should be employed to reduce the dazzling brightness of the limb.

ASHEN LIGHT - This is without a doubt the most controversial of all the observed features of Venus. If one is to see it the planet must be occulted by some mechanism. One way is to put the bright portion of the planet out of the field of view. But, this puts the desired portion in a poor part of the eyepiece. The best method is to find an eyepiece where the focal plane lies at or very near the end of the barrel. All that needs to be done then is to draw a piece of rather opaque tape across the end and that will suffice. Once the planet is hidden behind the occulting device the Ashen Light may appear as a diffuse glow filling in the un-illuminated portion of the planet. It appears much like earthshine but its cause may be much different. There is a possible cause in the upper atmosphere of Venus. During one of the Russian Venera flights a spectrum was obtained of the night side of the cloud tops. After correcting for an error in the calibration in the Russian equipment, some U.S. scientists found that the spectrum showed oxygen emission lines were present in that spectrum. The present theory for this emission is as follows: The UV light from the sun breaks down the CO₂ (the most abundant molecule in the Venerian atmosphere) on the daylight side of Venus into CO and free single O. Single oxygen is very reactive but not with CO. So that CO and O that is formed on the evening terminator is carried

into the night atmosphere by the 200-300 mph winds where it reunites with other single oxygen atoms at a much greater rate than it ever can with CO. This recombination causes an emission of light. That light measured by the Venera spacecraft was not enough to cause an airglow that could be seen as far away as earth, but there is one more factor to consider. It seems that the Ashen Light visibility roughly corresponds to the solar cycle. This would make some sense for during solar maximum the solar wind is stronger and there is an abundance of flares which emit a great deal of UV as well as other radiations. The upshot of this is to try to see if there is a good agreement with the numbers of solar flares and the appearance of the Ashen Light. This work can easily be taken on by the amateur astronomer.

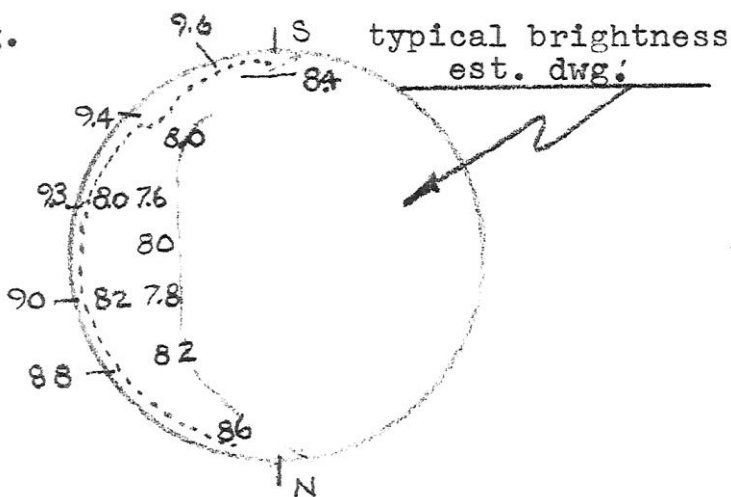
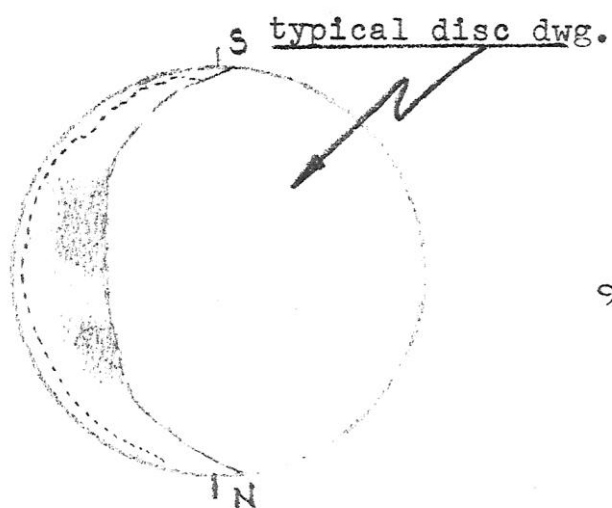
In drawing Venus most authorities agree that the standard disc size that should be used is a 2" disc. I would recommend that an off-white or even grey paper be used. This will allow the accentuation of the brightest regions with a chalk or pastel. The drawings can be done in pencil or better yet, pastels (mostly yellows and whites.) Be patient as I said before for the markings and details of Venus are elusive. Unlike Jupiter drawings, there is no rush to capture the detail at Venus. The rotation is much slower and any particular detail is likely to remain for some time. For records of intensity estimates a scale of 1 to 10 with decimals should be used.

If the work is taken seriously then much useful scientific data can be gathered and work done. If you wish further information on Venus observing/recording and would be interested in joining a coordinated effort then I would refer you to the address below.

Pleasant Peering ...

RIK

Julius L. Benton Jr.
ALPO Venus Recorder
Director; Thornwell Museum
P.O.Box 60
Clinton, S.C. 29325



THE OUTER PLANETS

Neptune

By: Jeff Stanek

The Blue Planet

Neptune is very similar to Uranus in many aspects. They are nearly the same size, and are similar in terms of density and albedo. Neptune is 30 A.U. away from the Sun and is the eighth planet from the Sun. Because of the long distance from the Sun, Neptune has a orbital period of 165 years. Neptune's discovery was a triumph of the modern era of Newtonian astronomy. It had not been known until mathematicians analyzed the deviations from an elliptical orbit shown by Uranus. These deviations are small, but were detectable, and could have been caused by gravitational interaction with another, as yet undetected, planet.

The denouement is one of astronomy's most famous anecdotes. John C. Adams in England predicted positions for the new planet in 1845, but the astronomy professor at Cambridge did not bother to try to observe this prediction of a recent college graduate. The Astronomer Royal's butler put off Adams from interrupting the dinner of the A.R. so Adams never saw the A.R. in person. Though Adams left a copy of his calculations, when the A.R. requested further information, partly to test Adam's abilities, Adams did not take the request seriously and did not respond at first. The very "proper" Astronomer Royal took offense and did not choose to have further dealings with Adams. The story then continues in France, where a year later Urbain Leverrier was independently working on predicting the position of the undetected planet.

When the Astronomer Royal saw in the scientific journals that Leverrier's work was progressing well for nationalistic reasons he began to be more responsive to Adam's calculations. But the search for the new planet, though begun in Cambridge, was carried out half-heartedly. Neither did French observers take up the search. By this time it was 1846. Leverrier sent his predictions to a friend at Berlin, who very excitedly began observing and discovered Neptune within hours. Years of heavy debate followed over who (and which country) should receive the credit for the discovery. We now tend to credit both Adams and Leverrier for the discovery of Neptune.

We now have the benefit of hindsight, and can examine the calculations of Adams and Leverrier more carefully. One assumption was necessary for them to make their calculations: they had to guess a radius for the orbit of Neptune in order to calculate its expected direction in the sky. They used the value from Bode's law. This value was 39 A.U., substantially larger than the value we have since measured for Neptune. The error happened not to be of importance for the configuration of the planets at the time they were working, but at other times their calculations would not have given the right position. So there certainly was an element of luck in their successful prediction.

Neptune's orbit is so large that it takes a very long time to travel around the Sun, and it has not yet made a full orbit since it was discovered. It never appears larger than 2 seconds of arc across in our sky, so it is always very difficult to study. Even measuring its diameter accurately is hard. In 1968, Neptune occulted an eighth magnitude star, a star about as bright as Neptune itself. This occultation was visible only from Japan, Australia, and New Zealand. From the fact that the star is known only by its catalogue number, it was only a humdrum star. However, when it was occulted by Neptune it became very important. From observations of the rate at which the star dimmed, astronomers could deduce information about Neptune's upper atmosphere and eventually the atmosphere's temperature and pressure structure. Further, from the length of time that the star was hidden by the disk of Neptune, they deduced that Neptune's diameter is 2.3 seconds of arc, equal to about 49,200 km. The astronomers could calculate the diameter from the occultation because they knew how fast Neptune moves across the sky with respect to the fixed stars. The longer the star was hidden from view, the greater the diameter of Neptune must be.

Neptune, like Uranus, appears greenish in small telescopes. Only in much larger telescopes does Neptune's blue color come out. Only hydrogen and methane have yet been detected with spectrographs. Neptune has two moons: Triton (a sea god, son of Poseidon) is large, perhaps 6000 km across, A second moon, Nereid (a sea nymph), is small. Nereid is perhaps only 500 kilometers across, and is in a very eccentric orbit with an average radius of 5.5 million km. Triton's orbit is about 350,000 km in diameter. The orbits of Triton and Nereid are inclined 160 and 28 degrees respectively, with respect to the ecliptic plane. Nereid never gets brighter than 20th magnitude, which is near the limit of our observational capabilities even with the largest telescopes.

According to its celestial position, Neptune is at Right Ascension 17 hours 9 minutes and at Declination minus 21-26 also it is at 7.7 magnitude. Neptune is now in the constellation Ophiuchus.

NEXT MONTH:
PLUTO
THE LAST PLANET?

From the Realm of Known Space

By Gary M. Morin

James Harwood Jeans

Sir James Jeans was born in Southport England, September 11, 1877. The son of a parliamentary journalist, Jeans was educated at Trinity College, Cambridge and continued to lecture on mathematics there until 1904. From Cambridge he came to America to become professor of applied mathematics at Princeton. While at Princeton Jeans began to concern himself with the problems of gas dynamics. These studies led him into the study of interstellar gas clouds. His calculations convinced him that the direct condensation of planetary bodies from such a gas cloud was impossible. This left wide open the question of how the Solar system was formed. Jeans became a proponent of the Chamberlain theory which says that the solar system was formed by the tidal forces generated by a star which had passed close to the sun. Jeans went on to prove that such a near collision would produce the necessary material for planetary formation.

Jeans returned to Cambridge in 1910 but was forced to resign in 1912 due to ill health. He was offered a post as research associate at the Mt. Wilson Observatory in 1923. He stayed at Mt. Wilson until his death in 1946. At Mt. Wilson Jeans became involved in the controversy surrounding the most volatile of modern astronomical findings, Hubble's calculation of the distance to M31. Originally Jeans' calculations of the movements of material in spiral nebulae seemed to support the theory that these objects were within our own galaxy. However in 1925 using Eddington's mass-luminosity relationship Jeans recalculated his distance estimate for M31 and M81 and confirmed Hubble's estimate.

Sir James Jeans was knighted in 1928 for his contributions to physics and astronomy. He was the author of a number of very popular books on general astronomy and cosmology. He was also an accomplished organist and wrote Science and Music in 1938.

Since Jeans is a rather contemporary figure, and many of his theories unconventional, his impact on the science must be judged by future generations.

The Apprentice Astronomers Notebook

Lou Faix

Last month we started our discussion of daytime astronomy by noting the types and growth patterns of sunspots as well as their cyclic nature. This edition of the "Notebook" will discuss observational techniques which the amateur can use in charting the positions and movements of the spots. Accurate positional, as well as frequency and size, data is needed to keep track of each eleven year solar cycle. At the beginning of a cycle the spots are at high latitudes and gradually migrate towards the Sun's equator (See last month's butterfly diagram).

The Sun's axis of rotation is inclined $7\frac{1}{4}^{\circ}$ to the plane of the ecliptic while the Earth's axis of rotation is tilted $23\frac{1}{2}^{\circ}$. To complicate the viewing problem, the two axii are not parallel but displaced from each other by $75^{\circ}26'$ as shown in Figure 1. On September 8th, the Sun's North Pole points straight towards the Earth while its Southern Pole does likewise on March 6th. Because of the Earth's tilt, the Sun axis may appear to lean as much as $26\frac{1}{2}^{\circ}$ east or west of our meridian. As a result of all this, sunspots do not appear to travel in straight lines across the face of the solar disc. Rather, they follow curved paths inclined to the observer's meridian. (See Figure 2) Since the Sun's average rotation time is $27\frac{1}{4}$ days, individual spots can be observed for a period of about two weeks although they are difficult to observe when they are near the limb.

Plotting of sunspot tracks requires proper polar alignment of the telescope. Since that task is mostly readily performed at night using known star positions, users of portable telescopes have to do a little improvising. I picked a good viewing spot on a sidewalk and drilled shallow holes ($\frac{1}{4}$ " deep) in the concrete to line up with the legs of my telescope mount. At night, the equatorial head was aligned for the proper azimuth and elevation angles and permanently locked to the pedestal. Thereafter, I only need to reposition the mount over the same holes for daytime viewing. Once again the amateur must be cautioned about safe observing practices. Any error or accident in solar viewing can result in instant and permanent blindness. Objective filters are the safest system and eyepiece filters should never be used. Remove any guide scopes and finder scopes which cannot be capped.

Use a reticule eyepiece which will give the largest full diameter image of the Sun. Orient the cross hairs to north-south/east-west and position the Sun as if in a gun sight. The N-S cross hair will then act as a meridian line through the Sun. I find it convenient to have a prepared sketch sheet like the one shown in Figure 3. If you make your own, be sure the circle which represents the Sun is exactly 6" in diameter. Estimate the positions of the spots in each quadrant as accurately as possible. A little practice with a reticule eyepiece will allow you to sketch what you see with good fidelity. It's fairly easy to visually divide each quadrant into quarters. Try to include the penumbral grey zone around the larger spots in your sketches. Work methodically and strive for visual accuracy. Drawing is a skill that improves with practice. Be sure to note which side is the northern end of the meridian. To determine the exact latitude and longitude of the sunspots we must use a Stonyhurst chart like the one seen in Figure 4. These come in a set of eight (one for each one degree of solar declination tilt, 0° through 7°) and can be obtained from:

American Association of Variable Star Observers
 187 Concord Avenue
 Cambridge, Massachusetts 02138

Before overlaying your sketch on the Stonyhurst chart, there are two things you must determine; the position angle and latitude tilt of the Sun on the day of observation. This information can be obtained from the American Ephemeris and Nautical Almanac. If you can't borrow an old issue, it can be purchased from:

Superintendent of Documents
 Government Printing Office
 Washington, D.C. 20402

Less exact data is published in the 16th edition of Norton's Star Atlas and is reprinted below. As an example, on May 19th the sun is leaning 20° west of the meridian and is tilted with its south pole 2° towards the Earth.

TABLE 27 VARIATIONS OF THE POSITION ANGLE
 OF THE SUN'S AXIS DURING THE YEAR

Jan.	5, July	7:	0°	July	7, Jan.	5:	0°
Jan.	16, June	26:	5° W	July	19, Dec.	26:	5° E
Jan.	27, June	15:	10° W	July	30, Dec.	16:	10° E
Feb.	8, June	5:	14° W	Aug.	13, Dec.	7:	14° E
Feb.	23, May	19:	20° W	Aug.	28, Nov.	20:	20° E
Mar.	7, May	8:	23° W	Sept.	8, Nov.	9:	23° E
Mar.	18, Apr.	26:	25° W	Sept.	21, Oct.	30:	25° E
Apr.	8:		25° W	Oct.	11:		26.3° E

TABLE 28 VARIATIONS OF THE HELIOCENTRIC
 LATITUDE OF THE CENTRE OF THE SUN'S DISK
 DURING THE YEAR

Dec.	7, June	6:	0°	June	6, Dec.	7:	0°
Dec.	15, May	28:	$1^\circ 0'$ S	June	14, Nov.	24:	$1^\circ 0'$ N
Dec.	23, May	20:	$2^\circ 0'$ S	June	22, Nov.	21:	$2^\circ 0'$ N
Jan.	1, May	11:	$3^\circ 0'$ S	July	1, Nov.	13:	$3^\circ 0'$ N
Jan.	10, May	2:	$4^\circ 0'$ S	July	11, Nov.	4:	$4^\circ 0'$ N
Jan.	19, Apr.	21:	$5^\circ 0'$ S	July	21, Oct.	27:	$5^\circ 0'$ N
Feb.	1, Apr.	8:	$6^\circ 0'$ S	Aug.	3, Oct.	12:	$6^\circ 0'$ N
Feb.	18, Mar.	21:	$7^\circ 0'$ S	Aug.	24, Sept.	22:	$7^\circ 0'$ N
Mar.	7:		7.3° S	Sept.	9:		7.3° N

You would pick the Stonyhurst chart for $D = -2^\circ$ and position it under your sketch so that 200 latitude lines align with the east/west reticule line in the drawing. Now trace the solar equator and the latitude and longitude lines which enclose the sunspots. (See Figure 5) This process will allow you to define the sunspot position to an accuracy of a degree or two. It will also allow you to forecast where the spot should be on your next observing session. Its latitude won't change but its longitude will advance 13.20 per day. A little arithmetic will allow you to decide if the sunspot you're observing now is the same one you saw last month before it disappeared behind the edge limb. Some spots last several months.

Keeping track of sunspots is a fascinating hobby that doesn't require an out-of-town viewing location or a big telescope. We're now coming into a period of increasing Solar activity and this would be a good time to start your daytime astronomy program. Have fun but ----

BE CAREFUL - WHEN IN DOUBT - DON'T LOOK.

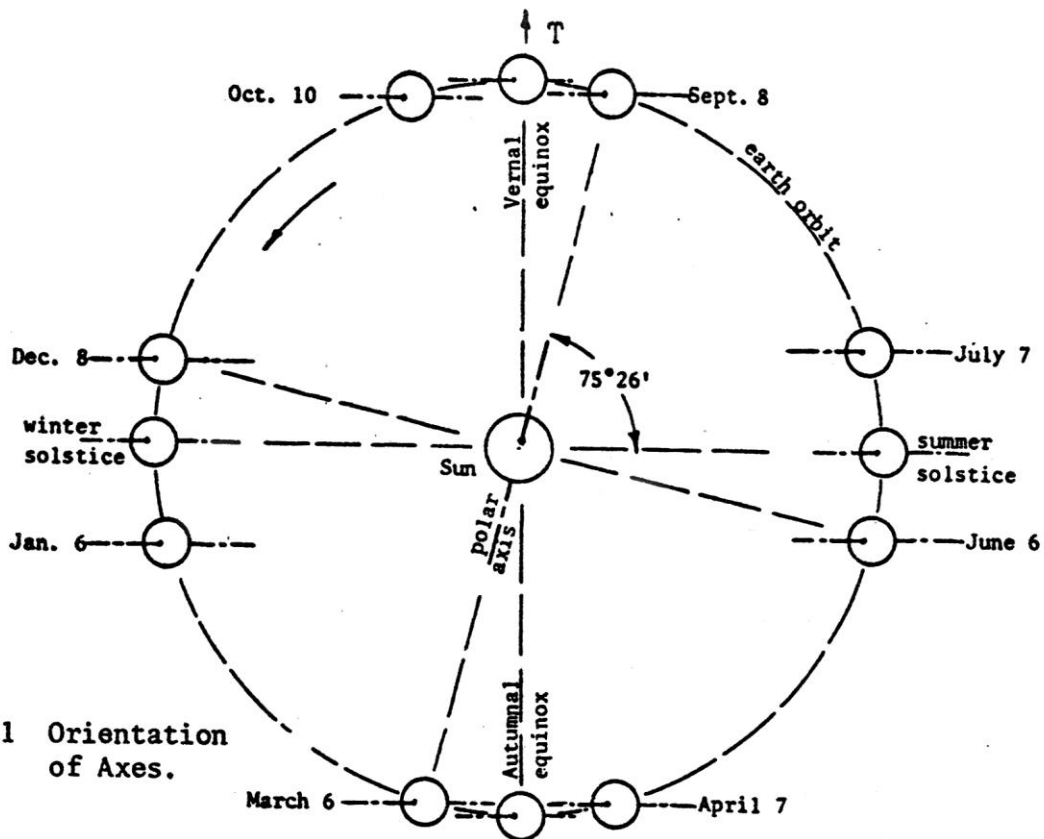


Fig. 1 Orientation of Axes.

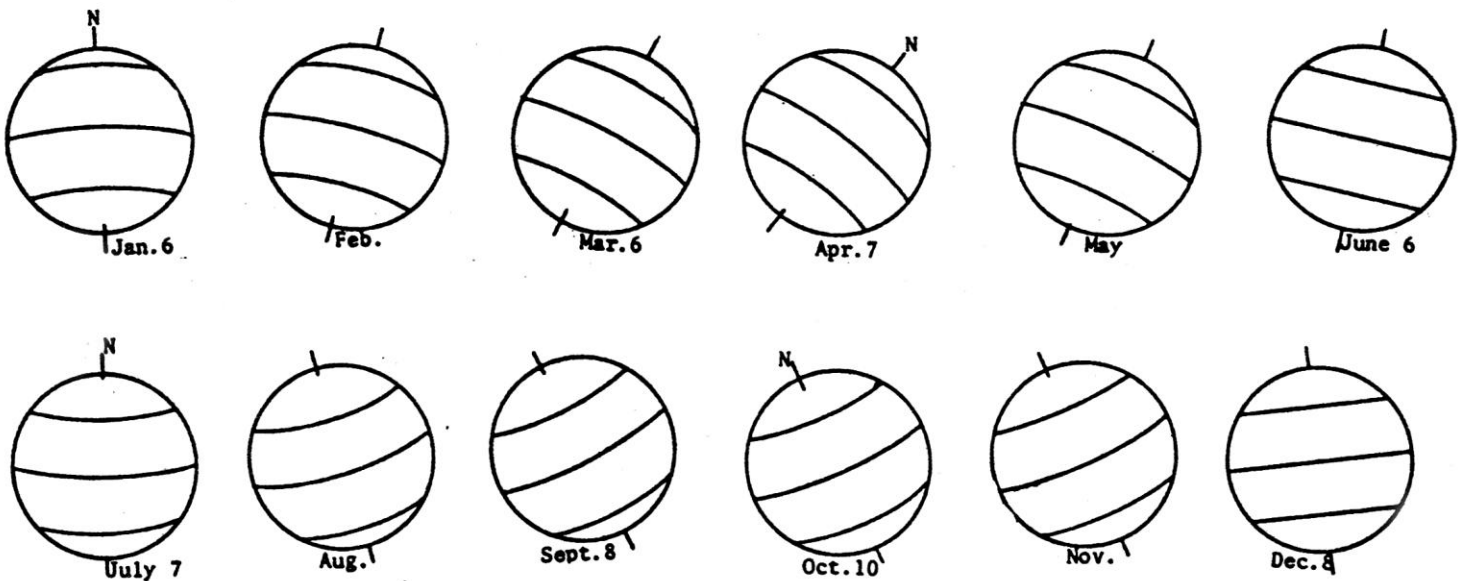
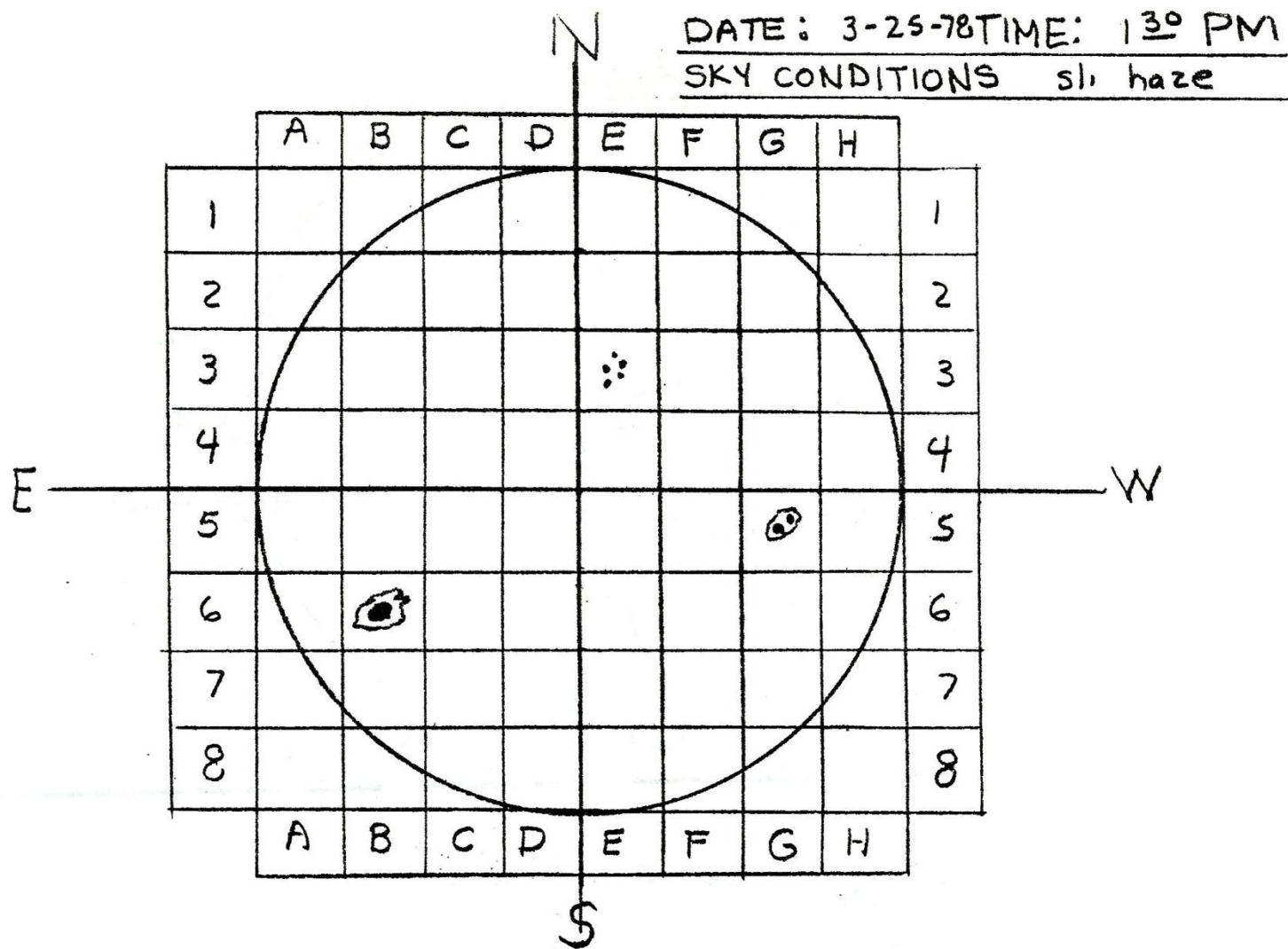


Fig. 2 The monthly positions of the disk of the sun during the year (The earth's axis is straight up and down).



LOC	No	CLASS	NOTES
E3	5	A	
B6	1	H	
G5	2	D	

Figure 3 - Sunspot Observing Chart

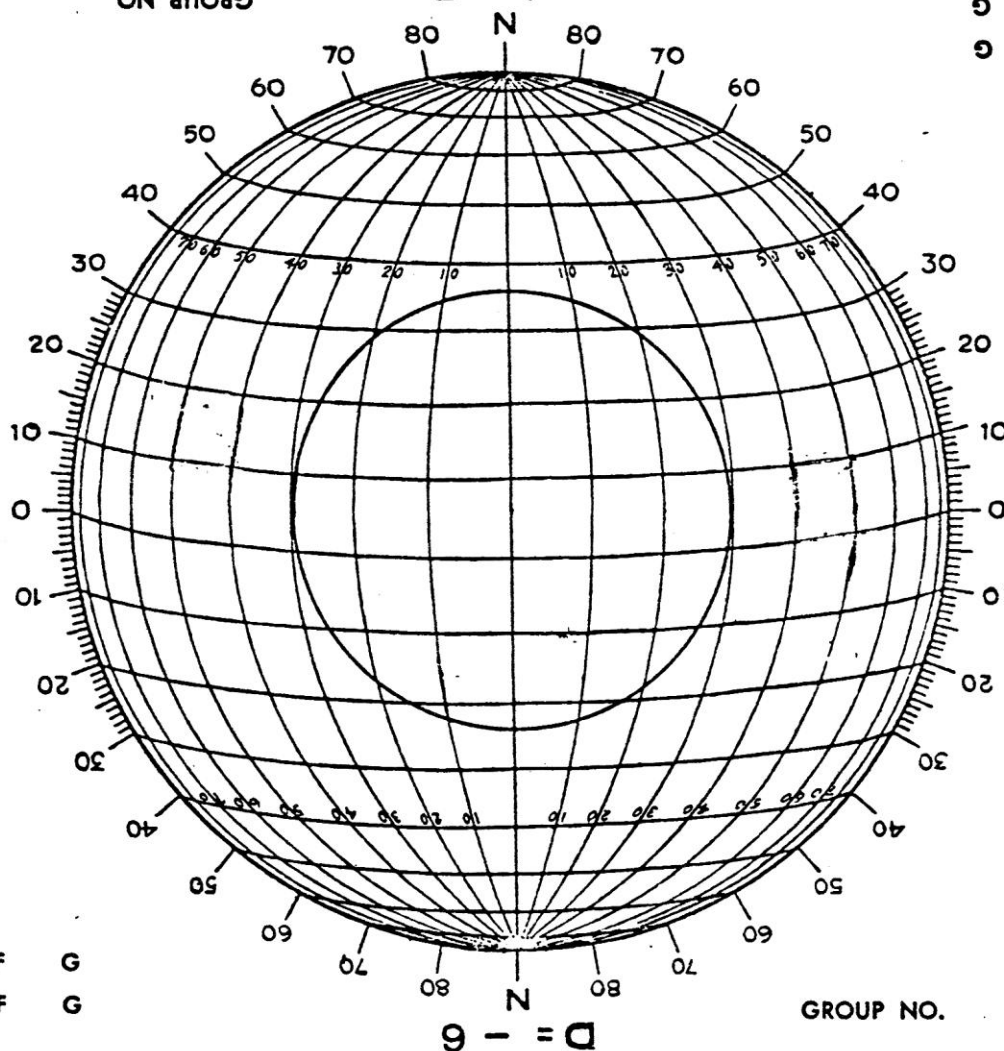
10F +G -R

Wind Direction

EXPLANATION of Seeing

GROUP NO.

D = + 6



GROUP NO. _____

METEOROLOGY

EXPLANATION of Seeing

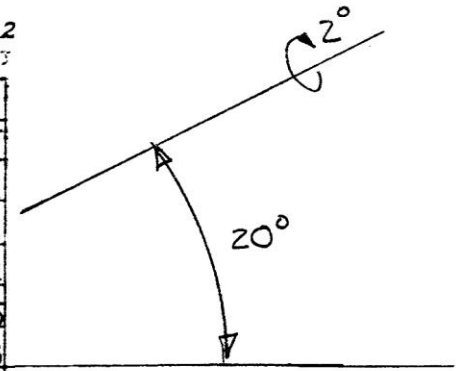
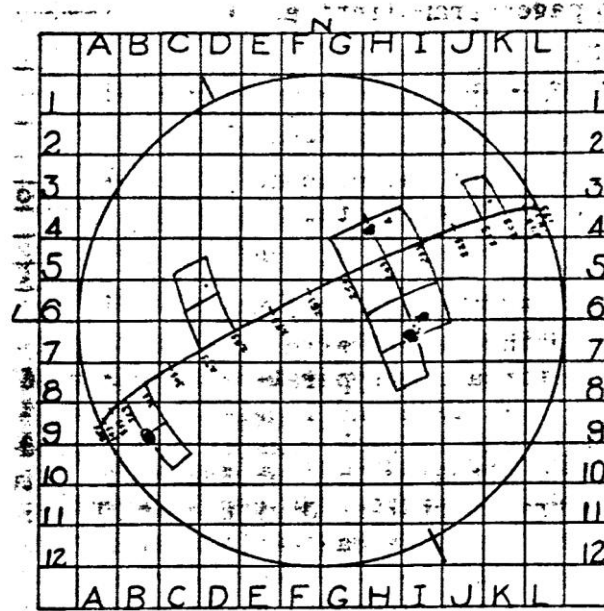
Wind Direction
Velocity
Barometer
Temperature
No Clouds
Cumulus clouds
Cirrus Thin Stratus
Thick Stratus

E	All detail clearly seen
G	Good detail at times
F	Course detail only
P	Only large groups visible no detail
VP	Muck boiling around limb

10F +G -R

Figure 4 - Stoneyhurst Chart

DATE: 3-25-75 U.T. 1730 SUNSPOT NO. 67 SEEING: G-2



LOC	NO	CLASS	LOC	NO	CLASS	NOTES
88	1	H	K4	1	A	
89	1	A				
84	6	C				
167	8	D				

SUMMARY N-3-B

S-2-9

DATE: 3-25-75 1730 SUNSPOT NO. 67

Figure 5 - Solar Latitude & Longitude Lines Traced on Observing Chart

ANNOUNCEMENT

NINTH ANNUAL GREAT LAKES ASTRONOMY SYMPOSIUM

Friday and Saturday, May 19-20, 1978

Co-hosted by

The University of Toledo' Astronomy Department
The Adams Astronomical Society of Rogers High School

INVITED SPEAKERS

KEYNOTE: Dr. John O'Keefe
Stellar and Cosmic Astronomy Branch
Goddard Space Flight Center
Tektites

Banquet: Dr. Armond Delsemme
Ritter Observatory
The University of Toledo

Dr. Mirjana Gearhart
Ohio State University Radio Observatory
Ohio State University
QSOS

Dr. Robert Maringer
Battelle Memorial Institute
Columbus, OH
Meteorites

Dr. Frazier Owen
National Radio Astronomy Observatory
Charlottesville, VA
Radio Sources in Clusters

ITEMS OF INTEREST

SECOND ANNUAL KENNETH E. CHILTON AWARD: To the most outstanding amateur astronomer. Please submit the name of your nomination with sufficient documentation for judges to make the proper choice.

BEST AMATEUR TELESCOPE AND INSTRUMENT AWARD: Trophies and cash awards for the most outstanding displayed instruments. Notify the chairperson if you are planning to display your work.

Planetarium programs, slide show, observing session, etc.

Beautiful weather guaranteed-

Laura Dent, President
Adams Astronomical Society
% Rogers High School
5539 Nebraska Ave.
Toledo, OH 43615

* Submitted papers welcome by May 1, 1978