

Lunar Occultations – The Amateur's Opportunity

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Agenda For The Evening

1. Introduction to lunar occultations
2. Lunar movement exercise
3. What you can observe
4. Understanding predictions
5. Some variations on the basic theme....

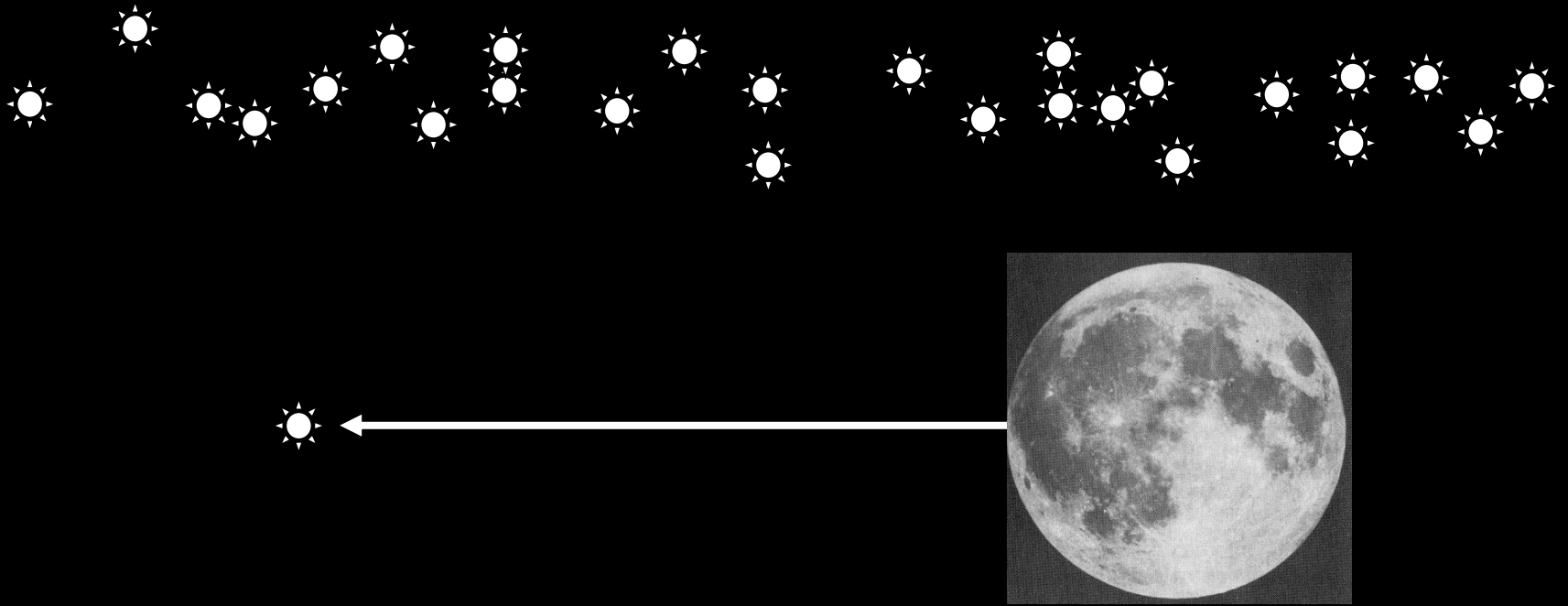
Definitions

Occultation – *complete or partial obscuration of an astronomical object by another of larger apparent diameter, especially the moon or a planet*

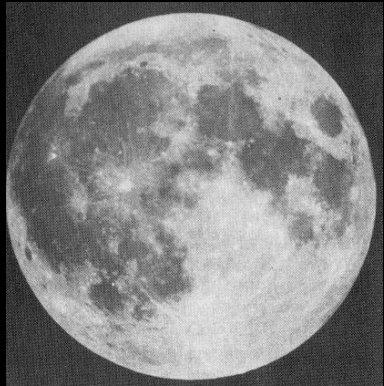
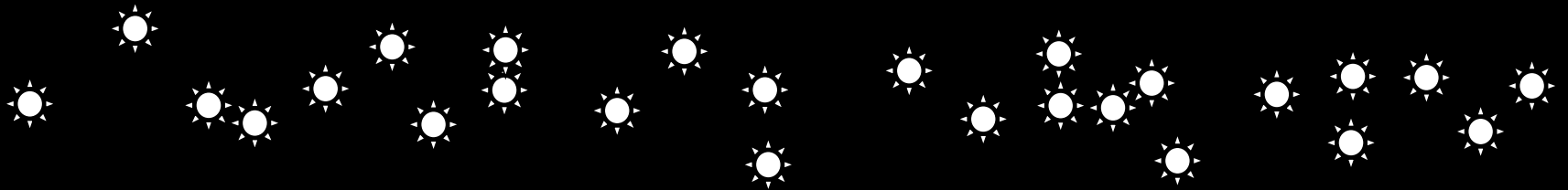
Eclipse - *total or partial obscuration of light from a celestial body as it passes through the shadow of another body*

Therefore.... An eclipse of the sun is an occultation!

A Lunar Occultation

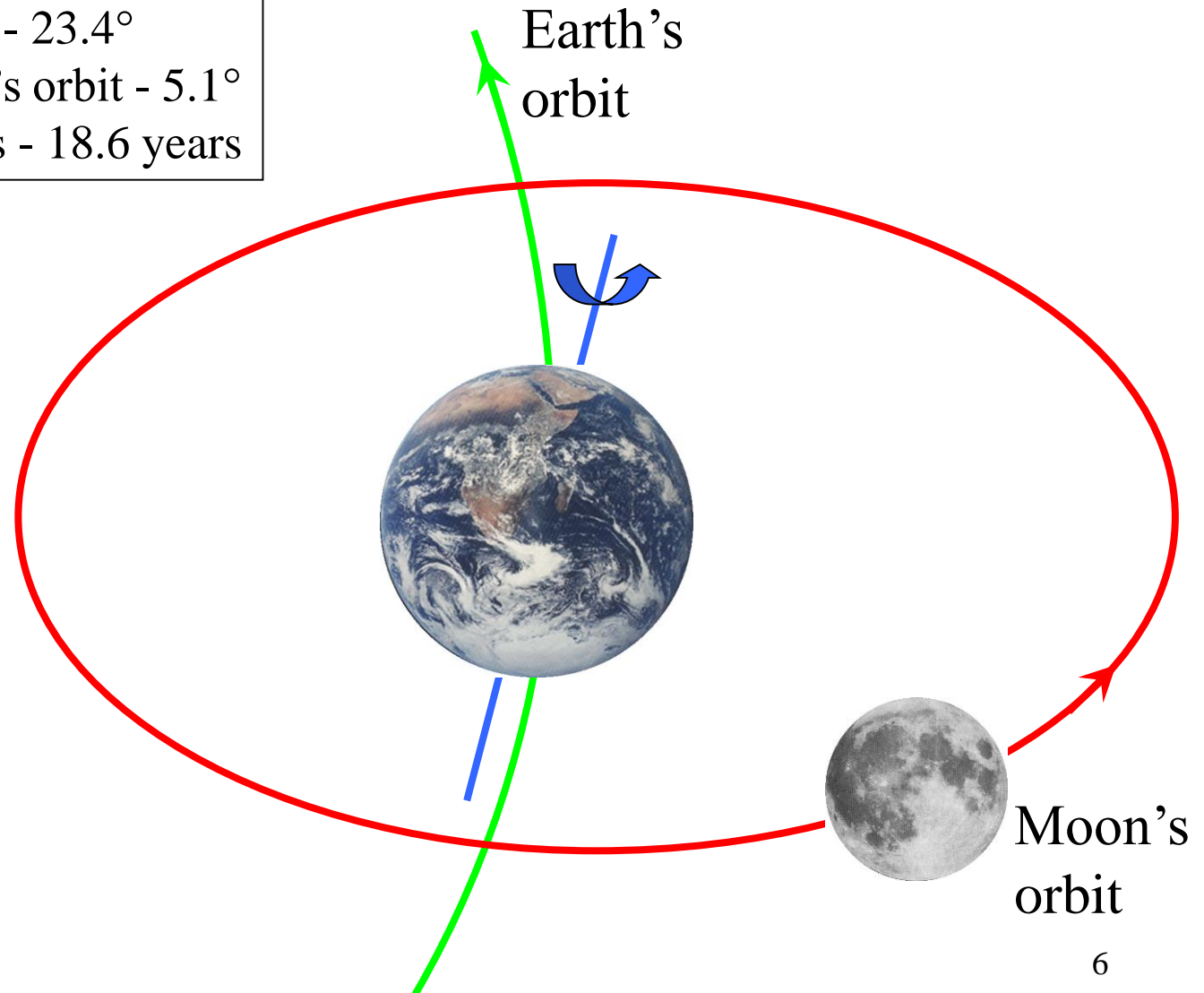


A Lunar Occultation

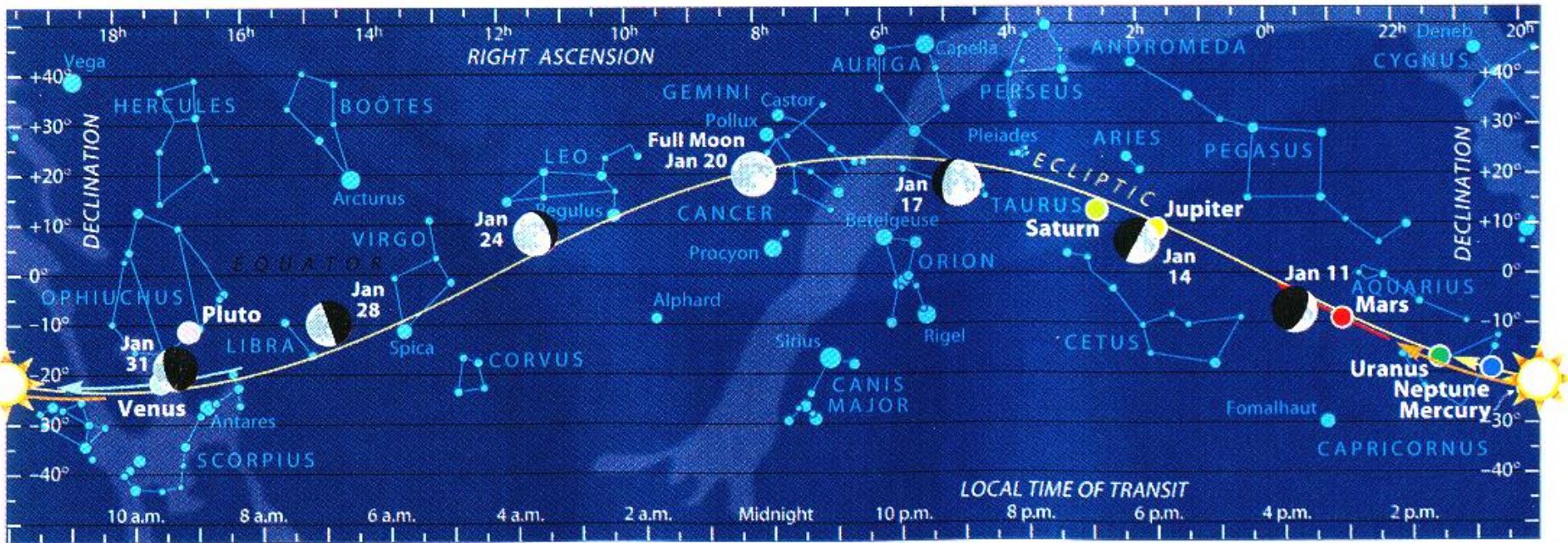


The Lunar Orbit

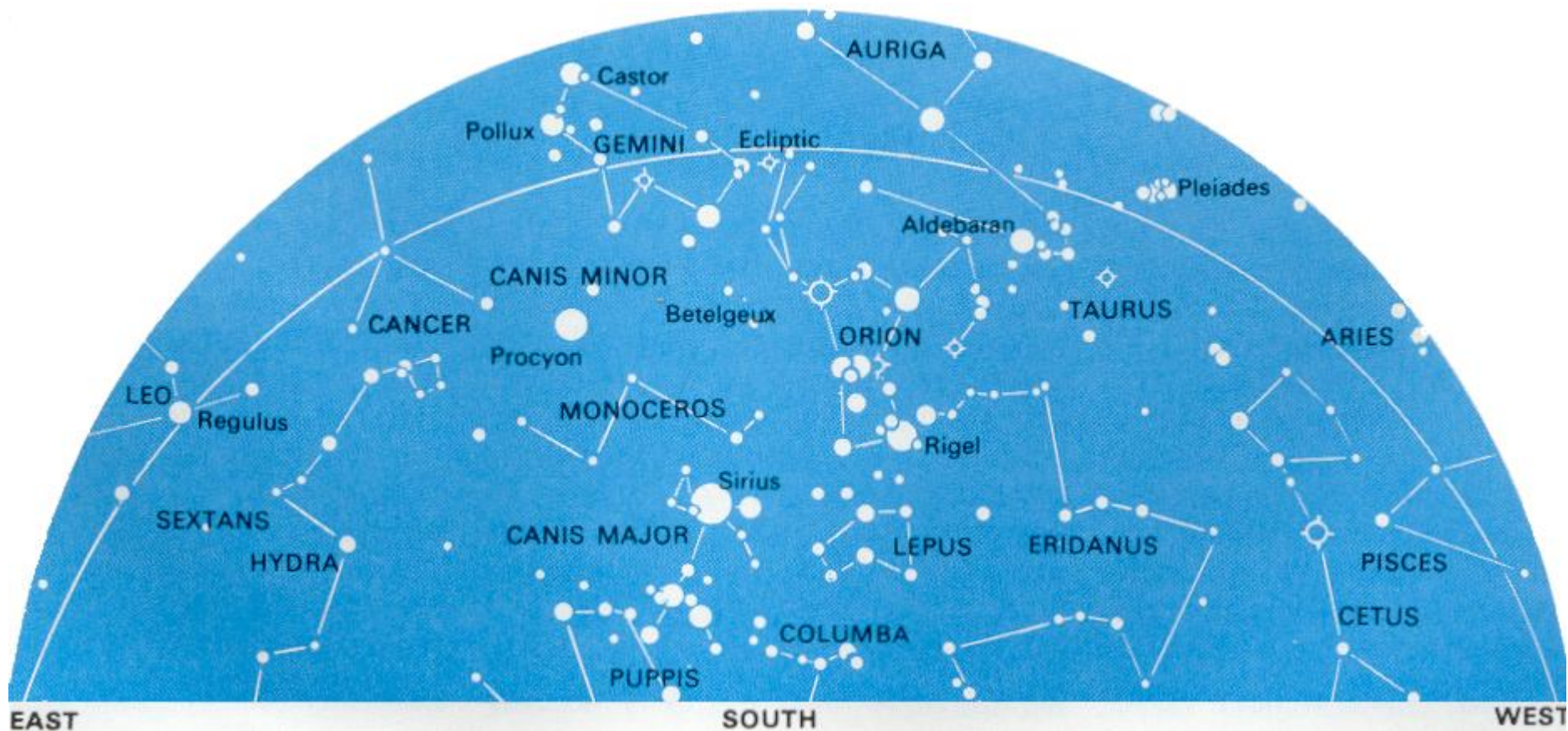
Plane of Earth's orbit - ecliptic
Obliquity of ecliptic - 23.4°
Inclination of Moon's orbit - 5.1°
Line of nodes rotates - 18.6 years



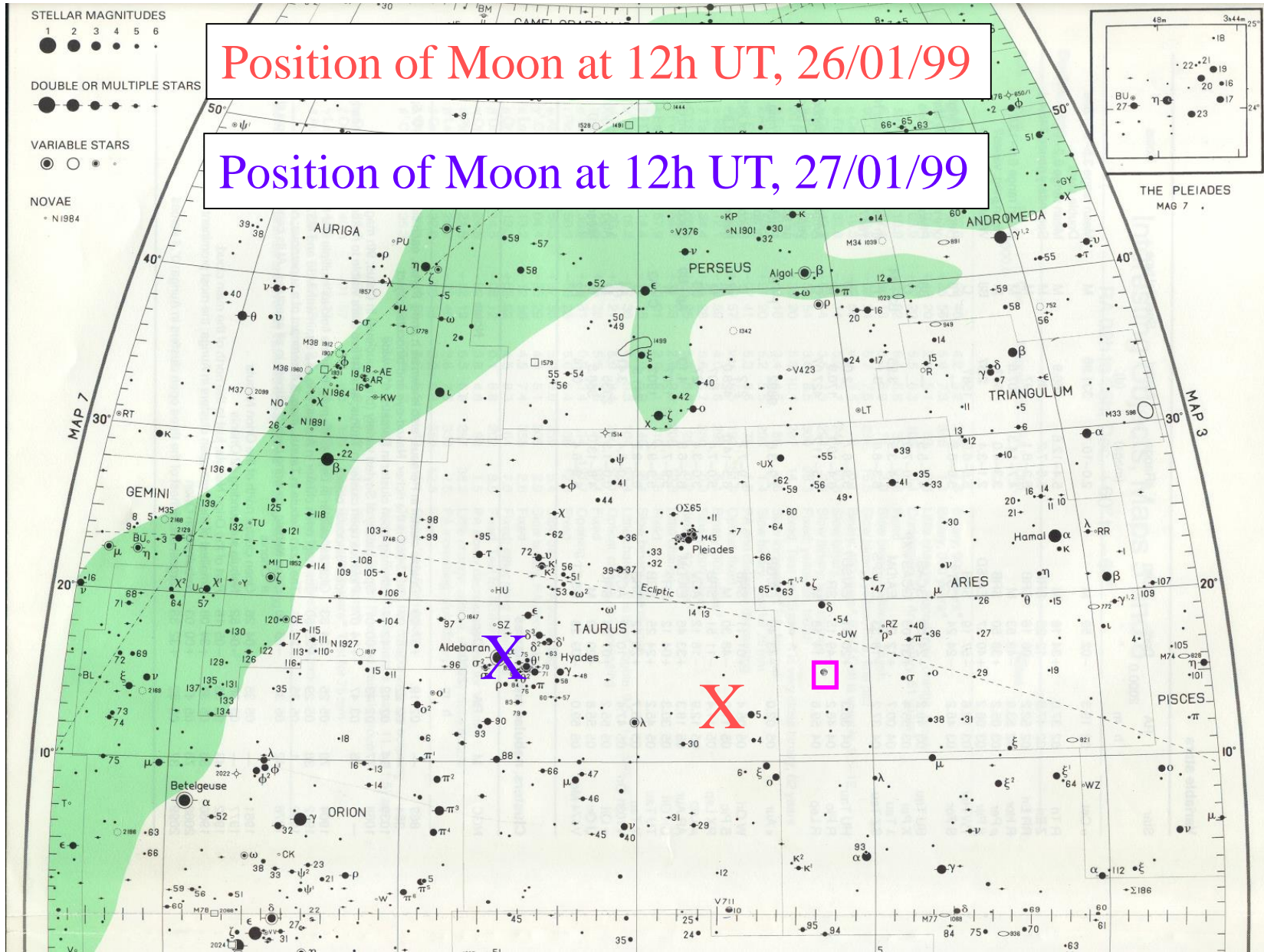
Moon's Motion In The Sky



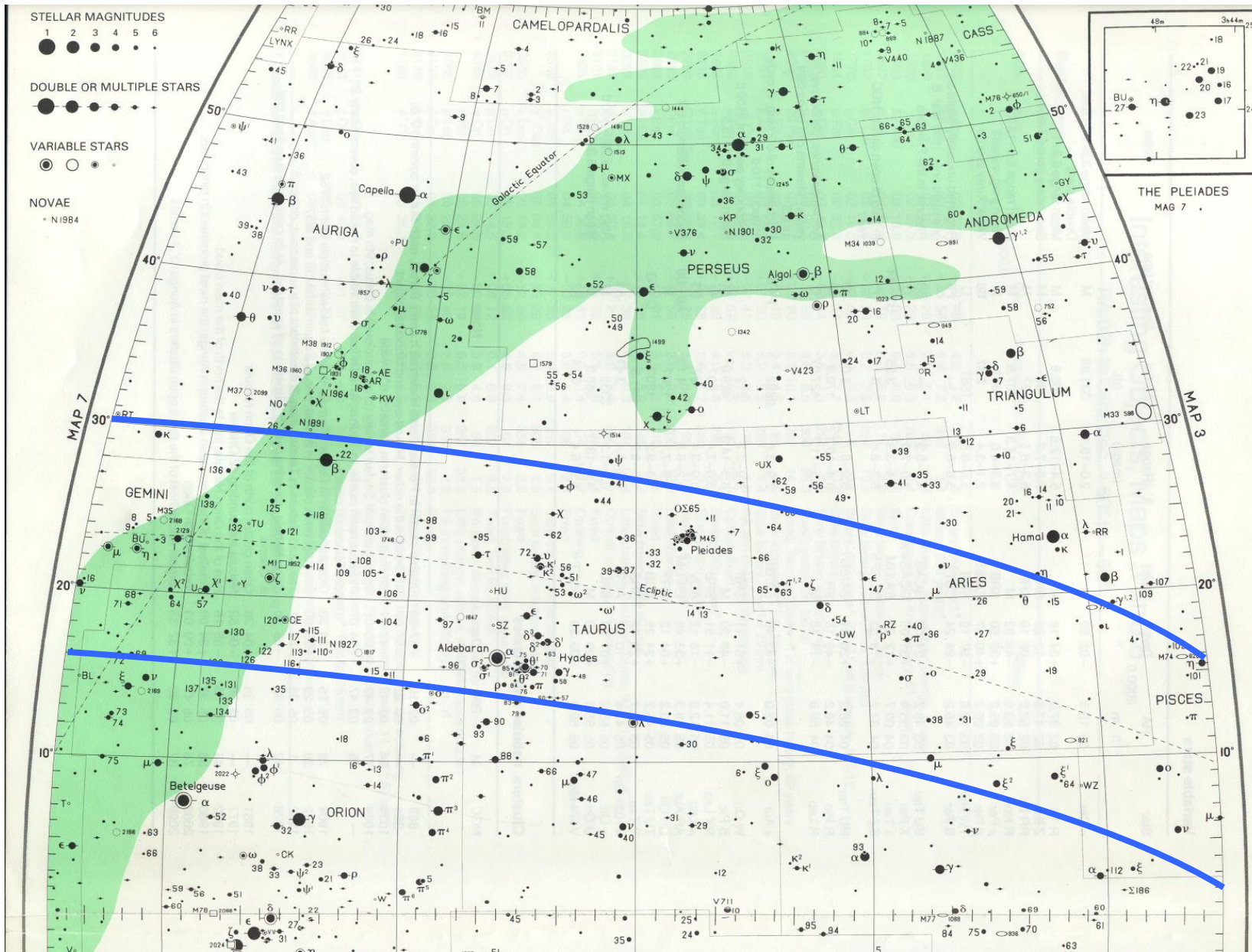
Moon's Motion In The Sky



Lunar Motion Exercise



Limits Of Lunar Position

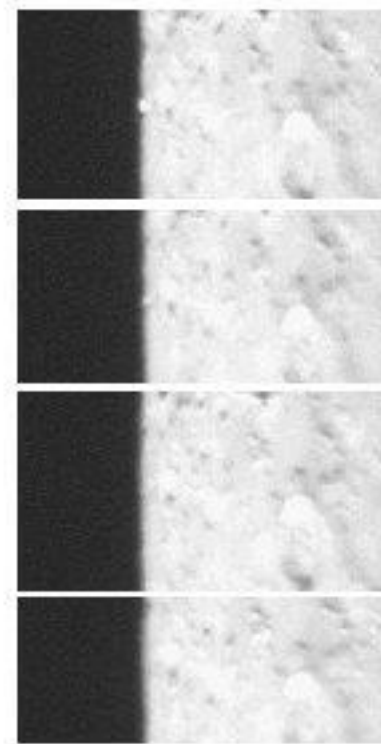
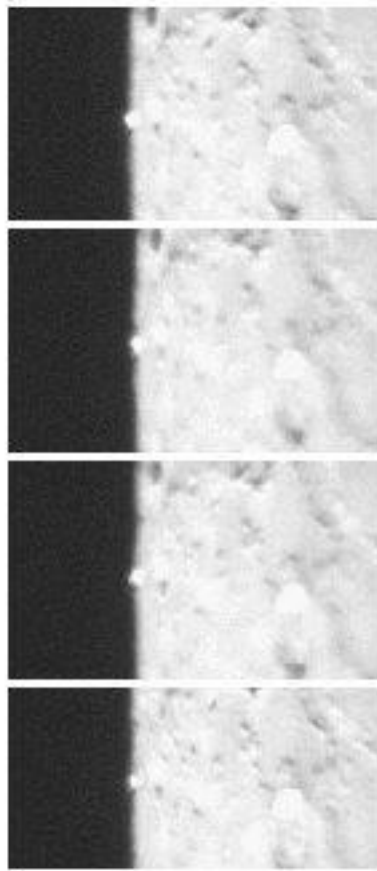


Stars Which The Moon Can Occult

Magnitude	Stars Which The Moon Can Occult
1	Aldebaran, Regulus, Spica, Antares
2	beta Tauri, gamma Geminorum, delta Scorpii, sigma Scorpii
3	20
4	77
5	201
6	623
7	1750
8	4,744
9 or fainter	~100,000

Aldebaran Disappearance

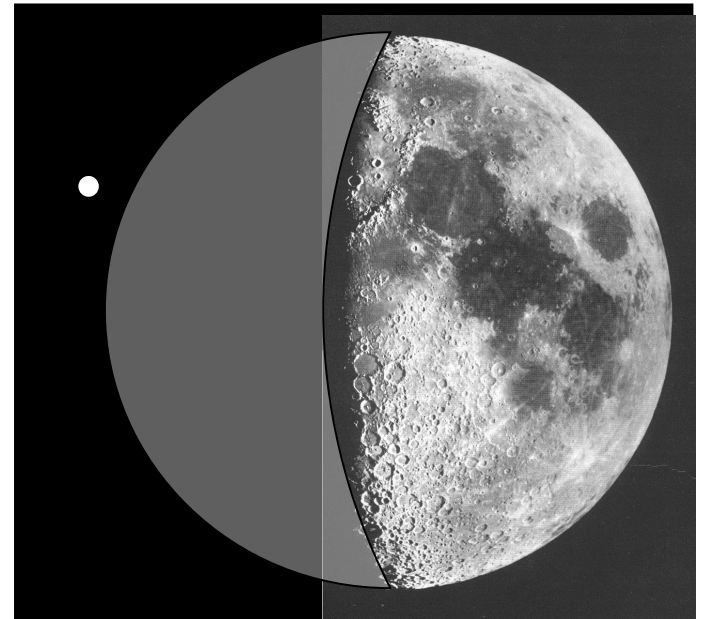
27 Jan 1999, 07:36 UT, West Coast US



Observational Aspects

Most significant factors:

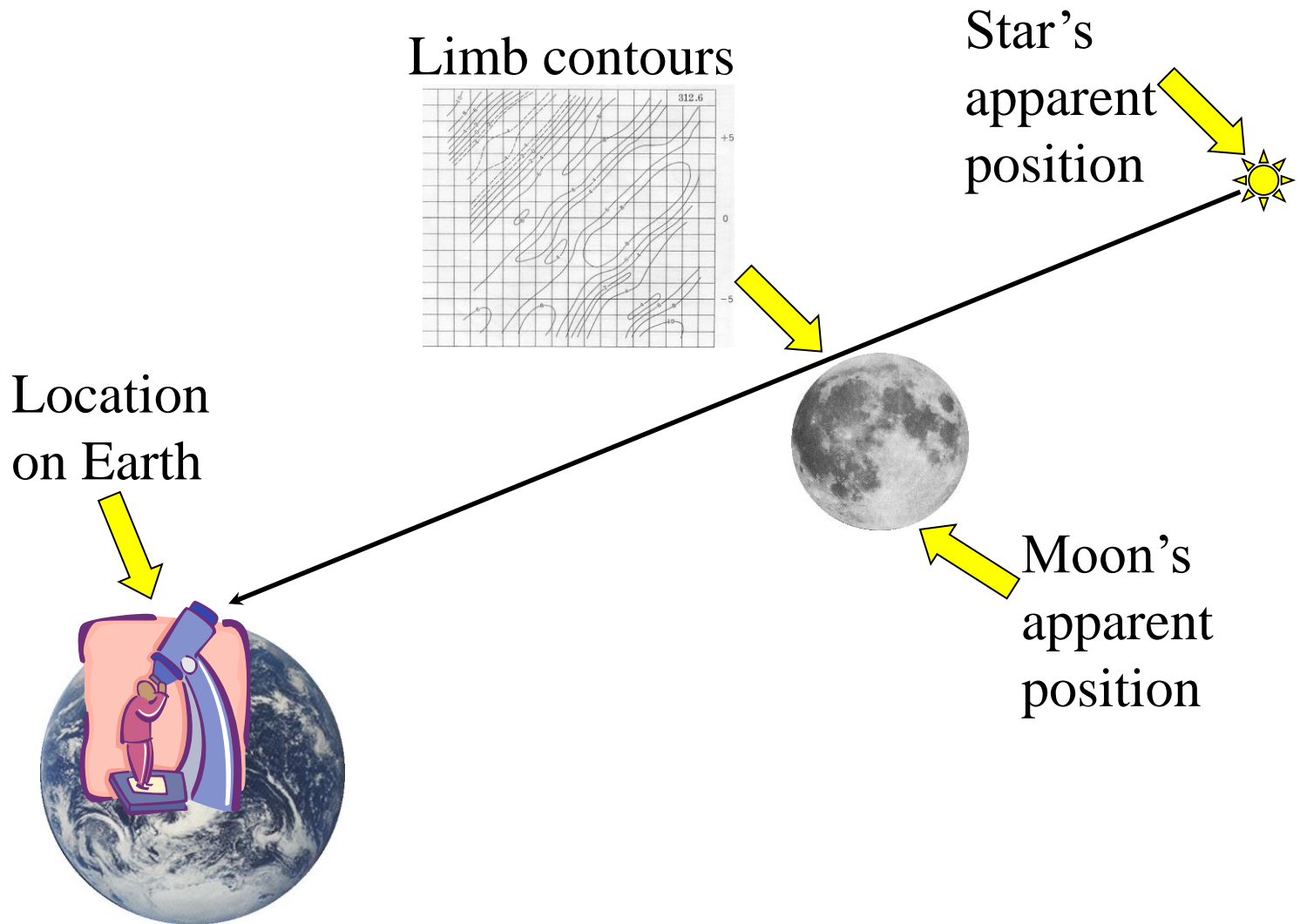
1. Lunar phase
2. Star's magnitude



Why Observe Lunar Occultations?

Who	Why
Amateur	<ul style="list-style-type: none">• Interesting to observe!• Detect close double stars• Measure red giants• Improve lunar topography (selenography) maps
Professional historical	<ul style="list-style-type: none">• Develop theories & data for:<ol style="list-style-type: none">1. Lunar motion2. Star positions3. Earth's rotation4. Lunar topography
Professional today	<ul style="list-style-type: none">• Improve upon Clementine (1994) lunar mapping data• Reconcile solar system with stellar reference frame

Factors Affecting Occultation Time



BAA Predictions

2000

Lunar Occultations

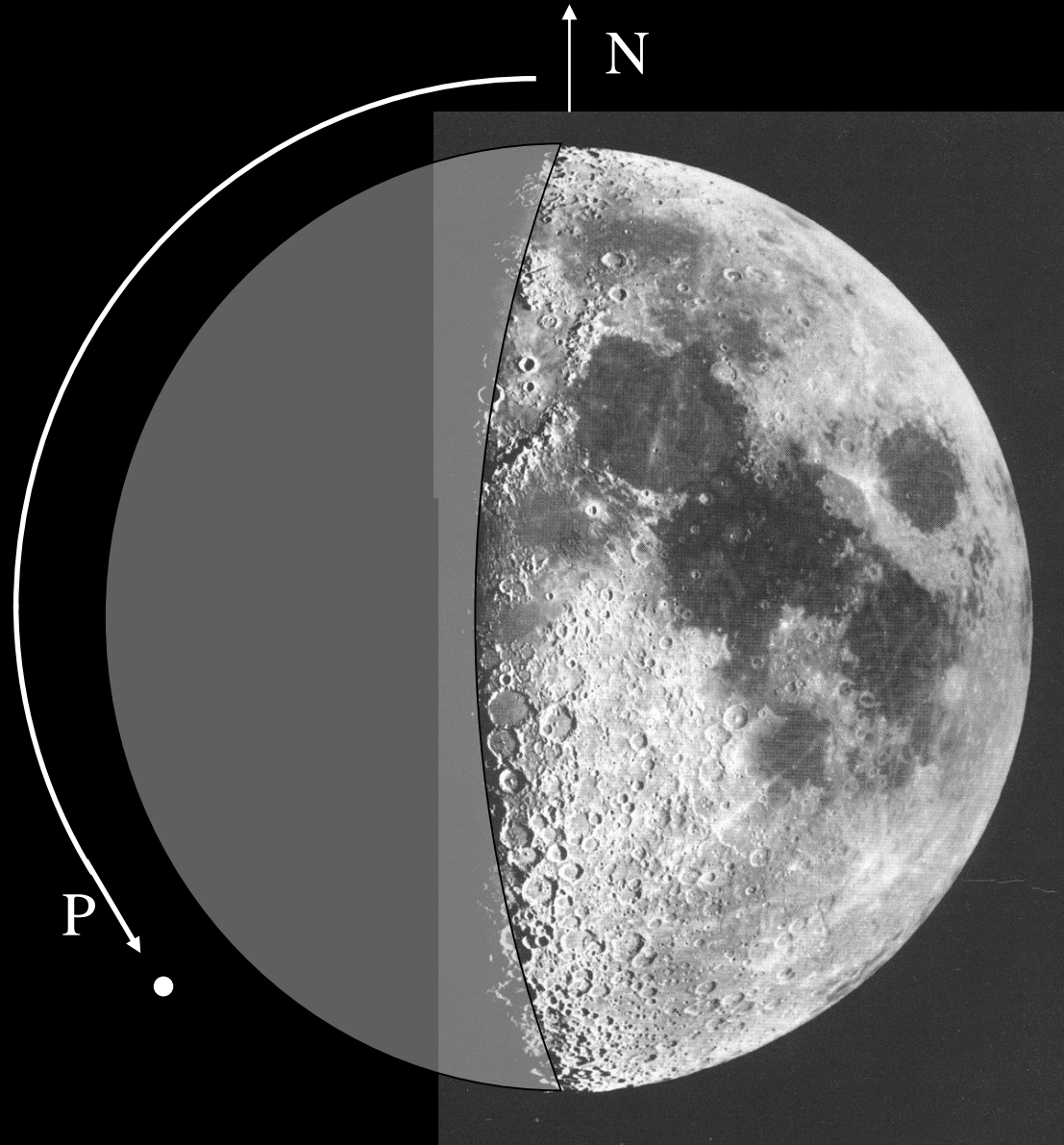
25

Date	Z.C. No.	Mag.	Ph.	El. of Moon	GREENWICH E. 0°·0, N. 51°·5					EDINBURGH W. 3°·2, N. 56°·0					
					U.T.	<i>a</i>	<i>b</i>	<i>P</i>	U.T.	<i>a</i>	<i>b</i>	<i>P</i>			
					h	m	m	m	°	h	m	m	m	°	
Jan.	11	3419	4.5	D	56	18	7.1	0.0	2.0	6	.. N ..				
	11	3425	4.6	D	56	18	49.0	-1.1	-1.1	84	18	41.7	-0.9	-0.7	69
	13	126	7.7	D	81	19	51.2	-0.5	1.5	18	20	3.2	.. G ..		347
	15	405	4.4	D	107	21	51.3	-0.8	1.1	29	21	57.6	.. G ..		4
	16	526	6.9	D	120	20	23.3	-1.4	0.3	75	20	21.6	-1.1	0.8	60
	17	705	8.0	D	134	20	58.6	-1.2	1.4	48	21	3.1	-0.9	2.2	30
	17	711	8.2	D	134	22	35.3	-1.4	-2.5	127	22	22.8	-1.3	-1.3	108
	19	888	6.0	D	150	1	34.0	-0.9	-0.6	66	1	29.2	-0.9	-0.2	54
	19	895	5.9	D	151	2	37.3	-0.4	-1.4	93	2	29.7	-0.5	-1.3	84
	19	913	5.2	D	152	.. A ..					5	43.9	0.3	-1.3	96

For greater accuracy: $\Delta t = a. \Delta \text{long} + b. \Delta \text{lat}$ (minutes)

Ipswich: $\Delta \text{long} = -1.2$, $\Delta \text{lat} = 0.5$

Position Angle (P)



JA Predictions

D or R	Date & Time (UT)	Lunar Phase	Sun Alt (°)	Star Alt (°)	Min Dist (rad)	Star Name / Catalogue No.	Mag
D R	12 Mar 22:16 23:15	0.45+ 0.46+	-36 -40	27 18	0.02S	104 Tau	4.9
D R	13 Mar 20:28 21:35	0.56+ 0.57+	-23 -32	51 42	0.27S	chi 2 Ori	4.6
D R	14 Mar 19:49 21:02	0.67+ 0.68+	-18 -28	58 54	0.11N	zeta Gem	4.0
D R	09 Apr 22:43 23:24	0.31+ 0.32+	-28 -30	15 9	0.63N	chi 1 Ori	4.4
D	10 May 00:01	0.40+	-20	9	0.27S	delta Cnc	3.9
D	11 Jul 23:53	0.82+	-16	8	0.05N	theta Lib	4.1
D R	21 Aug 02:29 03:37	0.68- 0.68-	-18 -11	41 45	0.39S	ksi 2 Cet	4.3
D R	23 Aug 23:58 24 Aug 00:10	0.36- 0.36-	-27 -27	7 8	0.97S	104 Tau,m Tau	4.9
D R	13 Nov 02:05 02:58	0.98- 0.98-	-46 -38	52 47	0.68S	delta 1 Tau	3.8
D R	01 Dec 16:40 17:40	0.27+ 0.27+	-8 -16	18 16	0.69N	eta Cap	4.8
D	08 Dec 17:20	0.91+	-14	25	0.21S	87 Cet,mu Cet	4.3

Occultations On Mon 13/03/00

Next OASI “small telescopes” evening

Day	Date	UT	G		Sun Star Min			D		CCDM	Star Name		
			R	Mag	Lunar Phase	Alt deg	Alt deg	Dist rad	PA deg			CA deg	b
.....													
Mon	13 Mar 00	18:33:37	D	8.6	0.55+	-7	58	0.43S	110	70DS	Y	PPM 95212	
Mon	13 Mar 00	18:34:11	D	7.9	1	0.55+	-7	58	0.65S	125	54DS	1	Hip 28425
Mon	13 Mar 00	19:22:28	D	8.5		0.56+	-14	57	0.85N	28	28DN	Z	PPM 95234
Mon	13 Mar 00	20:28:09	D	4.6	1	0.56+	-23	51	0.27S	104	76DS	1	62 Ori,chi 2 Ori
Mon	13 Mar 00	21:35:39	R	4.6	1	0.57+	-32	42	0.27S	254	74BS	1	62 Ori,chi 2 Ori
Mon	13 Mar 00	21:01:58	D	9.0		0.56+	-28	47	0.80N	36	36DN	Y	PPM 95340
Mon	13 Mar 00	21:12:03	D	9.0		0.56+	-29	46	0.30S	107	73DS	Y	PPM 95364
Mon	13 Mar 00	22:56:15	D	8.8		0.57+	-39	31	0.81N	38	38DN	Y	PPM 95480

Other Occultation Phenomena

- The solar system is a busy place.....
 - Lunar grazing occultation
 - Lunar occultation of a planet
 - Planetary occultation of a star
 - Planetary occultation of another planet
 - Asteroidal occultation of a star

