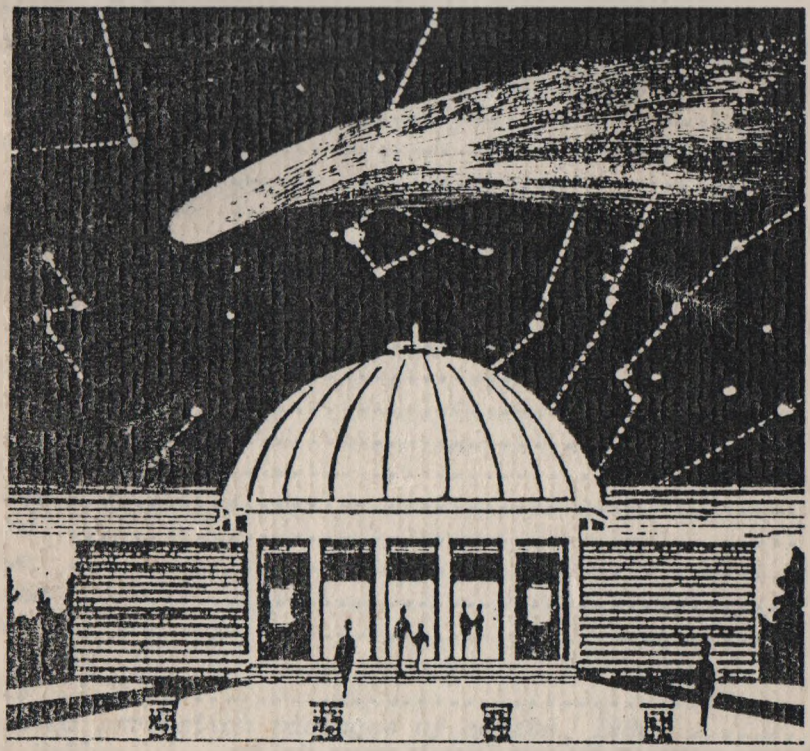
ASTRONOMICAL YEARBOOK FOR SOUTH AFRICA



1986

COMPILED BY MARY FITZGERALD AND ROBERT OLCKERS.
JOHANNESBURG PLANETARIUM

Although every precaution has been taken to ensure that the figures and information contained within this booklet are correct, the Planetarium does not accept responsibility for any errors therein.

The data in this booklet has been extracted from the Astronomical Almanac for the year 1986, published by Her Majesty's Stationery Office, and adapted for South Africa.

ASTRONOMICAL YEARBOOK FOR SOUTH AFRICA 1986

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ASTRONOMICAL EVENTS FOR 1986.

The events listed below are presented in chronological order of their occurrence to the nearest hour of South African Standard Time.

(Some of the appulses given below occur during daylight, or when the bodies are below the horizon. But the objects will still be sufficiently close in the dark for the phenomena to be of interest to observers.)

CONFIGURATION OF THE SUN, MOON AND PLANETS.

	d	h	
Jan.	2	07	Earth at perihelion
	3	22	LAST QUARTER
	6	03	Mars 1.7 degrees N. of Moon
	7	16	Saturn 4 degrees N. of Moon
	8	09	Moon at perigee
	8	12	Mercury 1.7 degrees S. of Neptune
	10	14	NEW MOON
	12	16	Jupiter 4 degrees N. of Moon
	18	00	FIRST QUARTER
	19	14	Venus in superior conjunction
	20	03	Moon at apogee
	26	03	FULL MOON
Feb.	1	03	Mercury in superior conjunction
	2	07	LAST QUARTER
	3	14	Mars 3 degrees N. of Moon
	4	03	Saturn 5 degrees N. of Moon
	4	18	Moon at perigee
	5	00	Uranus 4 degrees N. of Moon
	5	22	Neptune 5 degrees N. of Moon
	9	03	NEW MOON
	10	05	Saturn 7 degrees N. of Antares
	16	22	FIRST QUARTER
	17	00	Moon at apogee
	17	08	Mars 5 degrees N. of Antares
	18	02	Mars 1.3 degrees S. of Saturn

	18	12	Jupiter in conjunction with Sun
	24	17	FULL MOON
	28	18	Mercury greatest elong. E. (18 degrees)
Mar.	1	12	Moon at perigee
	3	10	Saturn 5 degrees N. of Moon
	3	14	LAST QUARTER
	3	22	Mars 4 degrees N. of Moon
	4	07	Uranus 4 degrees N. of Moon
	5	05	Neptune 6 degrees N. of Moon
	7	01	Mercury stationary
	8	15	Mercury 5 degrees N. of Venus
	10	17	NEW MOON
	11	17	Venus 1.3 degrees N. of Moon
	13	11	Mars 0.3 degrees N. of Uranus
	16	21	Moon at apogee
	16	22	Mercury in inferior conjunction
	18	19	FIRST QUARTER
	21	00	Equinox
	26	05	FULL MOON
	28	16	Moon at perigee
	30	15	Antares 1.2 degrees S. of Moon
	30	17	Saturn 5 degrees N. of Moon
	31	13	Uranus 4 degrees N. of Moon
Apr.	1	05	Mars 5 degrees N. of Moon
	1	11	Neptune 6 degrees N. of Moon
	1	21	LAST QUARTER
	6	04	Jupiter 3 degrees N. of Moon
	6	23	Mercury 2 degrees N. of Moon
	8	24	Mars 1.4 degrees S. of Neptune
	9	08	NEW MOON
	11	04	Venus 1.3 degrees S. of Moon
	13	14	Moon at apogee
	13	17	Mercury greatest elong. W. (28 degrees)
	17	13	FIRST QUARTER
	24	15	FULL MOON

	25	20	Moon at perigee
	26	15	Pluto at opposition
	26	23	Saturn 5 degrees N. of Moon
	26	23	Antares 1.1 degrees N. of Moon
	27	00	Saturn 7 degrees N. of Antares
	27	20	Uranus 4 degrees N. of Moon
	28	18	Neptune 6 degrees N. of Moon
	29	08	Mars 4 degrees N. of Moon
May	1	05	LAST QUARTER
	3	20	Jupiter 3 degrees N. of Moon
	5	13	Venus 6 degrees N. of Aldebaran
	7	13	Mercury 2 degrees S. of Moon
	9	00	NEW MOON
	11	01	Moon at apogee
	11	13	Venus 3 degrees S. of Moon
	17	03	FIRST QUARTER
	23	03	Mercury in superior conjunction
	23	23	FULL MOON
	24	05	Moon at perigee
	24	07	Saturn 5 degrees N. of Moon
	24	10	Antares 1.2 degrees S. of Moon
	25	05	Uranus 4 degrees N. of Moon
	26	02	Neptune 6 degrees N. of Moon
	27	05	Mars 3 degrees N. of Moon
	28	03	Saturn at opposition
	30	15	LAST QUARTER
	31	10	Jupiter 2 degrees N. of Moon
Jun.	7	04	Moon at apogee
	7	16	NEW MOON
	9	08	Mercury 3 degrees S. of Moon
	10	16	Venus 5 degrees S. of Pollux
	10	18	Venus 3 degrees S. of Moon
	11	17	Uranus at opposition
	15	14	FIRST QUARTER
	20	15	Saturn 5 degrees N. of Moon
	20	21	Antares 1.1 degrees S. of Moon

	21	01	Mercury 6 degrees S. of Pollux
	21	14	Uranus 4 degrees N. of Moon
	21	15	Moon at perigee
	21	18	Solstice
	22	06	FULL MOON
	22	12	Neptune 6 degrees N. of Moon
	23	15	Mars 0.5 degrees N. of Moon
	25	22	Mercury greatest elong. E. (25 degrees)
	26	10	Neptune at opposition
	27	22	Jupiter 1.9 degrees N. of Moon
	29	03	LAST QUARTER
Jul.	4	10	Moon at apogee
	5	12	Earth at aphelion
	7	07	NEW MOON
	8	22	Mercury 8 degrees S. of Moon
	10	07	Mars at opposition
	10	19	Venus 3 degrees S. of Moon
	11	01	Venus 1.1 degrees N. of Regulus
	14	22	FIRST QUARTER
	16	13	Mars closest approach
	17	22	Saturn 5 degrees N. of Moon
	18	06	Antares 1 degree S. of Moon
	18	22	Uranus 4 degrees N. of Moon
	19	21	Neptune 6 degrees N. of Moon
	19	22	Moon at perigee
	20	15	Mars 0.9 degrees S. of Moon
	21	13	FULL MOON
	23	13	Mercury in inferior conjunction
	25	08	Jupiter 1.5 degrees N. of Moon
	28	18	LAST QUARTER
	31	23	Moon at apogee
Aug.	4	08	Mercury 8 degrees S. of Moon
	5	21	NEW MOON
	9	13	Venus 2 degrees S. of Moon
	11	18	Mercury greatest elong. W. (19 degrees)
	13	04	FIRST QUARTER
	14	04	Saturn 5 degrees N. of Moon

	14	13	Antares 0.8 degrees S. of Moon
	15	05	Uranus 4 degrees N. of Moon
	16	05	Neptune 6 degrees N. of Moon
	16	18	Mars 0.5 degrees S. of Moon
	16	19	Moon at perigee
	19	21	FULL MOON
	21	13	Jupiter 1.4 degrees N. of Moon
	27	11	LAST QUARTER
	27	11	Venus greatest elong. E. (46 degrees)
	28	17	Moon at apogee
	31	17	Venus 0.5 degrees S. of Spica
Sep.	4	09	NEW MOON
	5	20	Mercury in superior conjunction
	7	22	Venus 3 degrees S. of Moon
	10	11	Saturn 5 degrees N. of Moon
	10	19	Antares 0.7 degrees S. of Moon
	10	23	Jupiter at opposition
	11	10	FIRST QUARTER
	11	11	Uranus 4 degrees N. of Moon
	12	02	Moon at perigee
	12	10	Neptune 6 degrees N. of Moon
	13	12	Mars 0.9 degrees N. of Moon
	17	16	Jupiter 1.6 degrees N. of Moon
	18	08	FULL MOON
	23	10	Equinox
	25	12	Moon at apogee
	26	05	LAST QUARTER
	29	10	Mercury 1.5 degrees N. of Spica
Oct.	1	12	Venus greatest brilliancy
	3	21	NEW MOON
	5	09	Mercury 0.4 degrees S. of Moon
	6	12	Venus 4 degrees S. of Moon
	7	12	Moon at perigee
	7	20	Saturn 5 degrees N. of Moon
	8	01	Antares 0.6 degrees S. of Moon
	8	17	Uranus 4 degrees N. of Moon
	9	16	Neptune 6 degrees N. of Moon

	10	15	FIRST QUARTER
	11	15	Mars 2 degrees N. of Moon
	14	18	Jupiter 1.9 degrees N. of Moon
	17	21	FULL MOON
	18	16	Mercury 4 degrees N. of Venus
	22	00	Mercury greatest elong. E. (24 degrees)
	23	08	Moon at apogee
	26	00	LAST QUARTER
	31	03	Pluto in conjunction with Sun
Nov.	2	08	NEW MOON
	3	16	Saturn 6 degrees N. of Antares
	3	16	Mercury 0.8 degrees N. of Moon
	4	04	Moon at perigee
	4	09	Saturn 6 degrees N. of Moon
	4	09	Antares 0.6 degrees S. of Moon
	5	03	Uranus 4 degrees N. of Moon
	5	12	Venus in inferior conjunction
	6	08	Neptune 6 degrees N. of Moon
	8	23	FIRST QUARTER
	9	02	Mars 3 degrees N. of Moon
	10	21	Jupiter 2 degrees N. of !Moon
	13	06	Mercury in inferior conjunction, transit over Sun
	16	14	FULL MOON
	20	00	Moon at apogee
	24	19	LAST QUARTER
	29	13	Venus 2 degrees N. of Moon
	30	05	Mercury greatest elong. W. (20 degrees)
	30	11	Mercury 5 degrees N. of Moon
Dec.	1	19	NEW MOON
	1	19	Antares 0.6 degrees S. of Moon
	2	13	Moon at perigee
	3	10	Neptune 6 degrees N. of Moon
	4	18	Saturn in conjunction with Sun
	7	18	Mars 3 degrees N. of Moon

8	06	Jupiter 1.8 degrees N. of Moon
8	10	FIRST QUARTER
11	22	Venus greatest brilliancy
14	23	Uranus in conjunction with Sun
16	03	Mercury 5 degrees N. of Antares
16	09	FULL MOON
17	07	Moon at apogee
19	09	Mars 0.5 degrees N. of Jupiter
19	17	Mercury 1.3 degrees S. of Saturn
22	06	Solstice
24	11	LAST QUARTER
25	16	Mercury 0.4 degrees S. of Uranus
27	16	Neptune in conjunction with Sun
28	03	Venus 7 degrees N. of Moon
29	07	Antares 0.6 degrees S. of Moon
29	17	Saturn 6 degrees N. of Moon
31	01	Moon at perigee
31	05	NEW MOON

THE SUN

Basic Solar Data :-

Average Earth-Sun Distance	: 149 598 000 km (= 1 Astronomical Unit)
Maximum Sun-Earth Distance	: 152 000 000 km
Radius	: 696 000 km
Rotation	: 25.38 days
Surface Temperature	: 5800 degrees K.
Spectral Type	: G2
Apparent Magnitude	: -26.8
Distance to centre of Galaxy	: 30,000 Light Years
Light-travel time from Sun to Earth	: 8.3 minutes

SOLAR ECLIPSES DURING 1986

There are two Eclipses of the Sun during 1986: A Partial eclipse on April 9th and an Annular-Total on October 3rd.
Both Sun Eclipses will not be visible from South Africa.

The Partial Eclipse on April 9th is visible from the Antarctic, South Pacific Ocean and Australia.

The Annular-Total on October 3rd is visible from North America, parts of South America and North Atlantic Ocean.

Although both eclipses of the Sun are not visible from South Africa, the following times are supplied for those interested :-

9 April	Partial Eclipse	
	Eclipse begins	06h 09 (SAST)
	Eclipse ends	10h 31
3 October	Annular-Total Eclipse	
	Eclipse begins	18h 57
	Eclipse ends	23h 13

SUNRISE AND SUNSET TIMES FOR JOHANNESBURG, DURBAN, BLOEMFONTEIN AND CAPE TOWN

	Johannesburg		Durban	
	Sunrise	Sunset	Sunrise	Sunset
Date	h m	h m	h m	h m
Jan 1	05 18	19 04	04 58	19 01
11	05 25	19 05	05 06	19 02
21	05 33	19 04	05 14	19 00
Feb 1	05 42	19 00	05 24	18 55
11	05 49	18 55	05 32	18 48
21	05 54	18 47	05 41	18 39
Mar 1	06 00	18 39	05 46	18 30
11	06 04	18 29	05 53	18 19
21	06 11	18 19	05 59	18 06
Apr 1	06 17	18 06	06 06	17 53
11	06 21	17 56	06 11	17 43
21	06 25	17 47	06 17	17 31
May 1	06 31	17 38	06 24	17 22
11	06 37	17 31	06 31	17 14
21	06 41	17 26	06 36	17 06
Jun 1	06 47	17 23	16 43	17 04
11	06 52	17 22	06 48	17 03
21	06 55	17 24	06 51	17 04
Jul 1	06 57	17 27	06 53	17 07
11	06 55	17 30	06 51	17 11
21	06 53	17 35	06 48	17 16
Aug 1	06 48	17 41	06 42	17 22
11	06 41	17 46	06 34	17 29
21	06 32	17 50	06 24	17 35
Sep 1	06 21	17 54	06 12	17 40
11	06 11	17 59	06 00	17 46
21	05 59	18 03	05 48	17 54

Oct	1	05 50	18 08	05 37	17 57
	11	05 39	18 12	05 25	18 03
	21	05 27	18 17	05 12	18 09
Nov	1	05 19	18 24	05 02	18 17
	11	05 13	18 32	04 55	18 26
	21	05 06	18 39	04 49	18 34
Dec	1	05 07	18 46	04 48	18 42
	11	05 08	18 53	04 48	18 50
	21	05 12	19 00	04 52	18 57

	Cape Town		Bloemfontein	
Date	Sunrise h m	Sunset h m	Sunrise h m	Sunset h m
Jan 1	05 38	20 01	05 21	19 18
11	05 46	20 02	05 29	19 18
21	05 55	19 59	05 37	19 17
Feb 1	06 07	19 52	05 46	19 13
11	06 17	19 44	05 54	19 06
21	06 26	19 33	06 02	18 57
Mar 1	06 33	19 23	06 08	18 48
11	06 41	19 11	06 13	18 38
21	06 49	18 58	06 18	18 27
Apr 1	06 58	18 41	06 25	18 13
11	07 04	18 30	06 30	18 03
21	07 13	18 17	06 35	17 52
May 1	07 20	18 06	06 42	17 44
11	07 28	17 57	06 49	17 36
21	07 34	17 50	06 54	17 30
Jun 1	07 43	17 45	07 01	17 27
11	07 48	17 44	07 05	17 26
21	07 51	17 44	07 06	17 27

Jul	1	07 53	17 48	07 10	17 30
	11	07 51	17 52	07 06	17 34
	21	07 47	17 58	07 05	17 39
Aug	1	07 39	18 06	07 00	17 45
	11	07 30	18 13	06 53	17 52
	21	07 19	18 20	06 42	17 55
Sep	1	07 06	18 27	06 31	18 08
	11	06 52	18 34	06 19	18 06
	21	06 38	18 41	06 07	18 10
Oct	1	06 25	18 48	05 57	18 16
	11	06 12	18 55	05 45	18 22
	21	05 58	19 04	05 33	18 27
Nov	1	05 46	19 13	05 24	18 35
	11	05 38	19 23	05 17	18 44
	21	05 31	19 33	05 12	18 52
Dec	1	05 29	19 43	05 11	19 00
	11	05 28	19 50	05 11	19 07
	21	05 32	19 57	05 15	19 14

TIME OF SUN'S TRANSIT OVER 30-DEGREE MERIDIAN

The times given below (SAST) indicate when the Sun transits the 30-degree meridian. (On this meridian all sundials should read noon at given times.)

Date	h m s
Jan 1	12 03 28
11	12 07 27
21	12 11 17
31	12 13 26
Feb 10	12 14 15
20	12 13 48

Mar	2	12 12 14
	12	12 09 52
	22	12 07 00
Apr	1	12 03 58
	11	12 01 08
	21	11 58 46
May	1	11 57 06
	11	11 56 22
	21	11 56 31
	31	11 57 34
Jun	10	11 59 22
	20	12 01 25
	30	12 03 32
Jul	10	12 05 16
	20	12 06 18
	30	12 06 24
Aug	9	12 05 31
	19	12 03 40
	29	12 01 00
Sep	8	11 57 46
	18	11 54 14
	28	11 50 45
Oct	8	11 47 39
	18	11 45 14
	28	11 43 49
Nov	7	11 43 41
	17	11 44 57
	27	11 47 31
Dec	7	11 51 20
	17	11 55 58
	27	12 00 55
	31	12 02 52

THE MOON

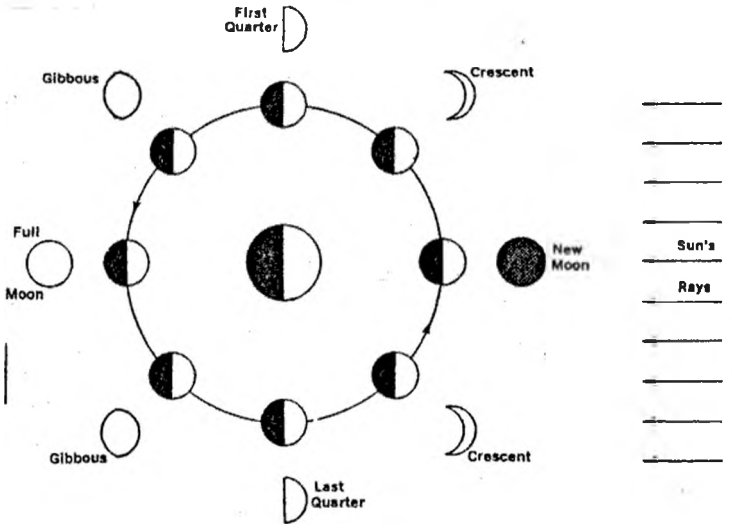
Basic Lunar Data:

Diameter	:	3 476 km (0,27 of Earth)
Mass	:	1/81 of Earth
Mean Distance from Earth	:	384 400 km (Centre to Centre)
Perigee	:	356 410 km (Closest distance to Earth)
Apogee	:	406 700 km (Farthest distance to Earth)
Sideral Period	:	27.321661 days (Fixed star period)
Synodic Period	:	29.530588 days (New Moon to New Moon)
Orbital Speed	:	3 680 km/hr. (Mean)
Escape Velocity	:	2.38 km/sec.
Mean Magnitude	:	-12.7 (At Full Phase)

The Moon's orbit about the Earth is an ellipse. The Moon is said to be at Perigee when it is nearest the Earth and at Apogee when it is farthest from Earth. The line connecting the points of perigee and apogee passes through the Earth and is called the line of apsides.

The centre-to-centre Earth-Moon distance varies from a minimum of 356 410 km at perigee to a maximum of 406 697 km at apogee. Consequently, the apparent size of the Moon as seen from Earth varies over the course of a month. At perigee, the Moon has an angular diameter of 33′ 31", whereas at apogee the Moon's diameter is only 29′ 22". The average apparent size of the Moon is 31′ 5" which corresponds to an average Earth-Moon distance of 384 400 km.

The average speed of the Moon along its orbit is 1.02 kilometers per second. As seen from the Earth, the Moon appears to move eastwards among the constellations from one day to the next. The Moon's daily eastward progress averages 13.2 degrees (which is 360 degrees divided by the 27.3 days in the sidereal month). In one hour, the Moon moves more than one-half degree, which is slightly more than its own diameter. This rate of motion means that the time of Moonrise is retarded by an average of about 50 minutes from one day to the next.



PHASES OF THE MOON

MONTH	NEW MOON	FIRST QUARTER	FULL MOON	LAST QUARTER
	d h m	d h m	d h m	d h m
January	10 14 22	18 00 13	26 02 31	03 21 47
February	09 02 55	16 21 55	24 17 02	02 06 41
March	10 16 52	18 18 39	26 05 02	03 14 17
April	09 08 08	17 12 35	24 14 46	01 21 30
May	09 00 10	17 03 00	23 22 45	01 05 22
				30 14 55
June	07 16 00	15 14 00	22 05 42	29 02 53
July	07 06 55	14 22 10	21 12 40	28 17 34
August	05 20 36	13 04 21	19 20 54	27 10 38
September	04 09 10	11 09 41	18 07 34	26 05 17
October	03 20 55	10 15 28	17 21 22	26 00 26
November	02 08 02	08 23 11	16 14 12	24 18 50
December	01 18 43	08 10 01	16 09 04	24 11 17
	31 05 10			

MAP OF

THE MOON

THE MOON'S ORBIT

MOON AT PERIGEE			MOON AT APOGEE		
Month	Day	Hour	Month	Day	Hour
Jan.	8	09	Jan.	20	03
Feb.	4	18	Feb.	17	00
March	1	12	March	16	21
March	28	16	April	13	14
April	25	20	May	11	01
May	24	05	June	7	04
June	21	15	July	4	10
July	19	22	July	31	23
Aug.	16	19	Aug.	28	17
Sept.	12	02	Sept.	25	12
Oct.	7	12	Oct.	23	08
Nov.	4	04	Nov.	20	00
Dec.	2	13	Dec.	17	07
Dec.	31	01			

LUNAR ECLIPSES DURING 1986

During 1986 there will be two total eclipses of the Moon, April 24 and October 17.

24 April Total eclipse of the Moon

The beginning of the umbral phase will be visible in the western half of North America, the Pacific Ocean, eastern USSR and Asia, southeast Asia, Australia, New Zealand, eastern Indian Ocean, and Antarctica except the Atlantic coast; the end will be visible in Western Alaska, the Pacific Ocean, the Indian Ocean except Palmer Peninsula and Princess Margaret Coast, Australia, New Zealand, and central, eastern and southeast Asia.

Although the eclipse will not be visible from South Africa, the following times are supplied :-

Moon enters penumbra	12h 04 (SAST)
Moon enters umbra	13h 02

Moon enters totality	14h 10
Middle of eclipse	14h 42
Moon leaves totality	15h 14
Moon leaves umbra	16h 22
Moon leaves penumbra	17h 20

17 October Total eclipse of the Moon

The beginning of the umbral phase visible in New Zealand, Australia, western Pacific Ocean, eastern Antarctic, Asia, Europe except extreme west, Africa except the western extremity; the end visible in extreme western Australia, eastern Antarctica, Indian Ocean, Asia except the extreme eastern parts, Europe, Africa, Greenland, extreme northeastern North America, eastern South America, and the Atlantic Ocean.

This eclipse will be visible from South Africa.

Moon enters penumbra	18h 19	(SAST)
Moon enters umbra	19h 29	
Moon enters totality	20h 40	
Middle of eclipse	21h 18	
Moon leaves totality	21h 55	
Moon leaves umbra	23h 06	
Moon leaves penumbra	00h 16	(18.10.86)

MOONRISE AND MOONSET TIMES FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
January						
1	22h58	9h50	22h49	9h34	23h43	10h21
2	23h31	10h49	23h20	10h35	-----	11h25
3	-----	11h48	23h50	11h36	0h12	12h29
4	0h03	12h49	-----	12h39	0h40	13h34
5	0h39	13h52	0h23	13h45	1h10	14h43
6	1h16	14h59	0h58	14h53	1h44	15h55
7	2h 0	16h 9	1h41	16h 5	2h23	17h 9

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
8	2h52	17h19	2h30	17h16	3h11	18h22
9	3h50	18h26	3h28	18h23	4h 7	19h30
10	4h55	19h26	4h33	19h23	5h13	20h28
11	6h 4	20h18	5h42	20h14	6h23	21h16
12	7h11	21h 2	6h51	20h57	7h34	21h56
13	8h15	21h40	7h57	21h32	8h42	22h29
14	9h14	22h12	8h58	22h 3	9h46	22h57
15	10h10	22h44	9h56	22h32	10h47	23h23
16	11h 4	23h13	10h53	22h59	11h45	23h48
17	11h57	23h41	11h47	23h26	12h42	-----
18	12h50	-----	12h41	23h55	13h39	0h13
19	13h43	0h12	13h36	-----	14h36	0h40
20	14h37	0h45	14h32	0h26	15h34	1h10
21	15h33	1h22	15h29	1h 2	16h33	1h43
22	16h29	2h 4	16h26	1h42	17h31	2h22
23	17h23	2h51	17h21	2h29	18h26	3h 8
24	18h15	3h44	18h13	3h22	19h17	4h 1
25	19h 2	4h42	18h59	4h20	20h 2	5h 0
26	19h45	5h42	19h41	5h21	20h41	6h 3
27	20h24	6h43	20h17	6h24	21h15	7h 9
28	20h59	7h44	20h50	7h27	21h46	8h13
29	21h33	8h44	21h22	8h29	22h15	9h18
30	22h 5	9h43	21h53	9h30	22h43	10h22
31	22h39	10h44	22h24	10h33	23h12	11h28
February						
1	23h16	11h45	22h59	11h37	23h44	12h35
2	23h56	12h50	23h37	12h43	-----	13h44
3	-----	13h57	-----	13h52	0h20	14h55
4	0h44	15h 4	0h22	15h 1	1h 4	16h 7
5	1h37	16h11	1h15	16h 8	1h55	17h15
6	2h38	17h12	2h15	17h10	2h55	18h15
7	3h44	18h 7	3h22	18h 4	4h 2	19h 7
8	4h51	18h53	4h30	18h48	5h12	19h49
9	5h56	19h34	5h37	19h27	6h21	20h25
10	6h58	20h 9	6h41	20h 0	7h28	20h55

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
11	7h56	20h41	7h41	20h30	8h31	21h23
12	8h52	21h11	8h39	20h58	9h32	21h48
13	9h46	21h40	9h35	21h25	10h30	22h13
14	10h39	22h10	10h31	21h53	11h27	22h39
15	11h32	22h42	11h25	22h24	12h25	23h 7
16	12h27	23h18	12h21	22h58	13h23	23h40
17	13h22	23h57	13h18	23h36	14h22	-----
18	14h18	-----	14h15	-----	15h20	0h16
19	15h13	0h42	15h10	0h20	16h16	0h59
20	16h 6	1h33	16h 3	1h10	17h 9	1h49
21	16h55	2h28	16h52	2h 6	17h56	2h45
22	17h40	3h28	17h35	3h 6	18h37	3h48
23	18h20	4h29	18h14	4h 9	19h14	4h53
24	18h57	5h31	18h49	5h13	19h46	5h59
25	19h32	6h33	19h22	6h17	20h16	7h 5
26	20h 6	7h34	19h54	7h20	20h44	8h12
27	20h40	8h35	20h26	8h24	21h14	9h18
28	21h16	9h38	21h 0	9h29	21h46	10h26
March						
1	21h55	10h43	21h36	10h35	22h20	11h35
2	22h40	11h49	22h20	11h44	23h 1	12h47
3	23h32	12h57	23h 9	12h54	23h49	13h59
4	-----	14h 3	-----	14h 1	-----	15h 7
5	0h29	15h 6	0h07	15h 4	0h46	16h 9
6	1h33	16h 1	1h10	15h57	1h50	17h 2
7	2h38	16h49	2h17	16h44	2h58	17h47
8	3h43	17h30	3h23	17h24	4h 7	18h24
9	4h45	18h 6	4h27	17h58	5h13	18h55
10	5h44	18h39	5h28	18h29	6h17	19h23
11	6h40	19h 9	6h26	18h57	7h17	19h48
12	7h35	19h39	7h23	19h25	8h16	20h14
13	8h29	20h 9	8h19	19h53	9h15	20h40
14	9h22	20h40	9h14	20h22	10h13	21h 7
15	10h17	21h14	10h10	20h55	11h11	21h37
16	11h12	21h52	11h 7	21h31	12h10	22h12

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
17	12h 7	22h34	12h 4	22h12	13h 8	22h52
18	13h 3	23h22	13h 0	23h 0	14h 5	23h38
19	13h56	-----	13h53	23h52	14h59	-----
20	14h46	0h15	14h44	-----	15h48	0h31
21	15h32	1h12	15h28	0h51	16h31	1h30
22	16h14	2h12	16h 9	1h51	17h 9	2h33
23	16h52	3h13	16h45	2h54	17h43	3h39
24	17h27	4h15	17h18	3h58	18h14	4h45
25	18h 2	5h17	17h51	5h 2	18h44	5h52
26	18h36	6h19	18h23	6h 7	19h13	7h 0
27	19h12	7h23	18h57	7h14	19h44	8h 9
28	19h52	8h29	19h34	8h21	20h18	9h20
29	20h36	9h38	20h16	9h32	20h58	10h34
30	21h26	10h47	21h 4	10h44	21h45	11h48
31	22h23	11h56	22h 1	11h54	22h40	13h 0
April						
1	23h26	13h 1	23h 3	12h59	23h43	14h 5
2	-----	13h58	-----	13h55	-----	15h 0
3	0h31	14h48	0h 9	14h44	0h50	15h47
4	1h35	15h30	1h15	15h25	1h57	16h25
5	2h37	16h 7	2h18	16h 0	3h 3	16h58
6	3h36	16h40	3h19	16h31	4h 7	17h26
7	4h32	17h10	4h17	16h59	5h 8	17h52
8	5h27	17h40	5h14	17h27	6h 7	18h17
9	6h20	18h 9	6h10	17h54	7h 5	18h42
10	7h14	18h40	7h 5	18h23	8h 2	19h 8
11	8h 8	19h13	8h 1	18h54	9h 1	19h37
12	9h 3	19h49	8h58	19h29	10h 0	20h10
13	9h58	20h29	9h55	20h 7	10h59	20h47
14	10h54	21h15	10h51	20h53	11h56	21h31
15	11h47	22h 5	11h45	21h42	12h51	22h22
16	12h39	23h 0	12h37	22h38	13h42	23h17
17	13h25	23h58	13h22	23h37	14h26	-----
18	14h 8	-----	14h 4	-----	15h 5	0h18
19	14h47	0h57	14h41	0h37	15h40	1h21

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
20	15h22	1h57	15h14	1h39	16h12	2h25
21	15h57	2h58	15h47	2h42	16h41	3h30
22	16h31	3h59	16h19	3h46	17h 9	4h37
23	17h 6	5h 2	16h52	4h51	17h40	5h46
24	17h44	6h 8	17h27	5h59	18h13	6h57
25	18h27	7h16	18h 8	7h10	18h51	8h11
26	19h17	8h28	18h56	8h24	19h36	9h27
27	20h13	9h40	19h50	9h38	20h30	10h43
28	21h15	10h49	20h52	10h47	21h32	11h53
29	22h21	11h52	21h59	11h50	22h39	12h55
30	23h28	12h45	23h 7	12h42	23h49	13h45
May						
1	-----	13h31	-----	13h25	-----	14h27
2	0h31	14h10	0h12	14h 3	0h56	15h 1
3	1h31	14h43	1h14	14h35	2h 1	15h30
4	2h28	15h14	2h12	15h 3	3h 1	15h57
5	3h22	15h43	3h 9	15h30	4h 1	16h21
6	4h15	16h12	4h 5	15h57	4h58	16h45
7	5h 8	16h42	4h59	16h25	5h55	17h11
8	6h 2	17h13	5h54	16h55	6h53	17h39
9	6h56	17h48	6h50	17h29	7h52	18h11
10	7h51	18h27	7h47	18h 6	8h51	18h46
11	8h47	19h11	8h44	18h49	9h49	19h28
12	9h41	20h 0	9h39	19h37	10h45	20h16
13	10h34	20h52	10h32	20h30	11h37	21h 9
14	11h21	21h48	11h18	21h27	12h23	22h 8
15	12h 4	22h47	12h 0	22h26	13h 3	23h 8
16	12h43	23h45	12h38	23h26	13h38	-----
17	13h20	-----	13h12	-----	14h10	0h11
18	13h53	0h43	13h44	0h26	14h39	1h14
19	14h26	1h43	14h15	1h28	15h 7	2h18
20	14h59	2h43	14h46	2h30	15h36	3h23
21	15h35	3h46	15h20	3h36	16h 6	4h31
22	16h15	4h52	15h57	4h44	16h42	5h43
23	17h 2	6h 2	16h42	5h57	17h23	6h58
24	17h56	7h15	17h34	7h12	18h14	8h16

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
25	18h57	8h28	18h34	8h26	19h14	9h32
26	20h 5	9h36	19h42	9h34	20h22	10h40
27	21h14	10h36	20h53	10h33	21h34	11h38
28	22h20	11h26	22h 1	11h22	22h44	12h24
29	23h24	12h 9	23h 6	12h 3	23h52	13h 2
30	-----	12h45	-----	12h36	-----	13h33
31	0h22	13h17	0h06	13h 7	0h55	14h 1
June						
1	1h18	13h46	1h 4	13h34	1h55	14h25
2	2h11	14h15	2h 0	14h 1	2h53	14h50
3	3h 4	14h45	2h55	14h29	3h50	15h16
4	3h57	15h16	3h49	14h58	4h47	15h42
5	4h51	15h49	4h45	15h30	5h46	16h13
6	5h46	16h27	5h41	16h 6	6h44	16h47
7	6h41	17h 9	6h38	16h47	7h42	17h26
8	7h36	17h56	7h34	17h34	8h39	18h13
9	8h29	18h48	8h27	18h25	9h33	19h 4
10	9h18	19h43	9h16	19h22	10h21	20h 1
11	10h 3	20h40	9h59	20h20	11h 3	21h 1
12	10h43	21h38	10h38	21h18	11h39	22h 3
13	11h19	22h35	11h12	22h18	12h11	23h 4
14	11h53	23h33	11h44	23h17	12h40	-----
15	12h25	-----	12h15	-----	13h 8	0h06
16	12h57	0h30	12h44	0h17	13h35	1h09
17	13h30	1h30	13h16	1h19	14h 4	2h13
18	14h 6	2h32	13h50	2h24	14h36	3h21
19	14h48	3h39	14h29	3h32	15h12	4h32
20	15h38	4h49	15h17	4h45	15h57	5h48
21	16h36	6h 2	16h14	5h59	16h53	7h 4
22	17h42	7h13	17h19	7h11	17h58	8h17
23	18h52	8h19	18h30	8h16	19h10	9h21
24	20h 2	9h15	19h41	9h11	20h24	10h14
25	21h 9	10h 2	20h51	9h56	21h36	10h57
26	22h11	10h42	21h55	10h34	22h43	11h32
27	23h10	11h16	22h55	11h 7	23h46	12h 1

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
28	-----	11h47	23h53	11h36	-----	12h28
29	0h 6	12h17	-----	12h 4	0h46	12h54
30	0h59	12h46	0h49	12h31	1h44	13h19
July						
1	1h52	13h17	1h43	13h 0	2h41	13h45
2	2h46	13h50	2h39	13h31	3h40	14h14
3	3h40	14h26	3h35	14h 6	4h38	14h47
4	4h36	15h 7	4h32	14h45	5h36	15h25
5	5h32	15h52	5h29	15h30	6h34	16h 9
6	6h25	16h43	6h22	16h20	7h28	17h 0
7	7h15	17h38	7h13	17h16	8h18	17h56
8	8h 2	18h36	7h58	18h15	9h 2	18h56
9	8h43	19h33	8h39	19h14	9h40	19h57
10	9h20	20h31	9h14	20h12	10h14	20h58
11	9h54	21h27	9h46	21h11	10h44	22h 0
12	10h27	22h24	10h17	22h10	11h11	23h 1
13	10h58	23h22	10h46	23h10	11h37	-----
14	11h30	-----	11h16	-----	12h 5	0h 3
15	12h 4	0h21	11h48	0h12	12h34	1h 8
16	12h42	1h24	12h23	1h17	13h 8	2h16
17	13h26	2h30	13h 6	2h25	13h47	3h27
18	14h18	3h40	13h56	3h37	14h36	4h42
19	15h19	4h51	14h56	4h49	15h36	5h54
20	16h27	5h58	16h 5	5h56	16h45	7h 2
21	17h39	6h59	17h17	6h56	17h59	8h 0
22	18h48	7h50	18h28	7h46	19h12	8h48
23	19h54	8h34	19h37	8h28	20h24	9h27
24	20h56	9h12	20h41	9h 3	21h30	10h 0
25	21h54	9h45	21h41	9h35	22h33	10h28
26	22h49	10h16	22h38	10h 4	23h33	10h55
27	23h44	10h46	23h35	10h32	-----	11h20
28	-----	11h17	-----	11h 0	0h32	11h46
29	0h38	11h49	0h31	11h31	1h31	12h14
30	1h33	12h25	1h28	12h 5	2h29	12h46
31	2h29	13h 3	2h25	12h42	3h29	13h22

MOONRISE AND MOONSET TIMES FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
August						
1	3h25	13h48	3h22	13h25	4h26	14h 4
2	4h19	14h37	4h16	14h14	5h22	14h53
3	5h11	15h31	5h 9	15h 8	6h14	15h47
4	5h59	16h28	5h56	16h 7	7h 0	16h47
5	6h42	17h26	6h38	17h 6	7h40	17h48
6	7h21	18h25	7h15	18h 6	8h15	18h51
7	7h56	19h23	7h48	19h 6	8h46	19h54
8	8h29	20h20	8h20	20h 5	9h14	20h55
9	9h 0	21h17	8h49	21h 5	9h41	21h58
10	9h33	22h16	9h18	22h 6	10h 8	23h 2
11	10h 5	23h17	9h49	23h 9	10h36	-----
12	10h41	-----	10h24	-----	11h 8	0h07
13	11h22	0h20	11h 2	0h14	11h44	1h16
14	12h10	1h28	11h49	1h24	12h29	2h27
15	13h 6	2h37	12h43	2h34	13h22	3h40
16	14h 9	3h43	13h46	3h41	14h26	4h48
17	15h18	4h45	14h56	4h43	15h36	5h48
18	16h27	5h39	16h 6	5h36	16h50	6h39
19	17h35	6h26	17h17	6h20	18h 1	7h20
20	18h38	7h 6	18h22	6h58	19h10	7h55
21	19h39	7h41	19h25	7h31	20h16	8h26
22	20h37	8h13	20h25	8h 2	21h18	8h53
23	21h33	8h44	21h23	8h30	22h19	9h20
24	22h28	9h15	22h20	8h59	23h18	9h46
25	23h23	9h47	23h17	9h29	-----	10h13
26	-----	10h21	-----	10h 2	0h18	10h44
27	0h20	10h59	0h15	10h38	1h18	11h19
28	1h15	11h41	1h12	11h19	2h17	11h59
29	2h10	12h29	2h 8	12h 7	3h14	12h45
30	3h 3	13h21	3h 1	12h58	4h 7	13h37
31	3h53	14h17	3h51	13h55	4h55	14h35
September						
1	4h38	15h15	4h34	14h54	5h37	15h36
2	5h19	16h14	5h14	15h55	6h14	16h39

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
3	5h55	17h13	5h48	16h55	6h47	17h42
4	6h29	18h11	6h20	17h56	7h17	18h45
5	7h 1	19h10	6h51	18h57	7h44	19h49
6	7h34	20h 9	7h21	19h58	8h11	20h53
7	8h 6	21h10	7h51	21h 2	8h39	21h59
8	8h41	22h14	8h25	22h 7	9h10	23h 8
9	9h21	23h21	9h 1	23h16	9h44	-----
10	10h 6	-----	9h46	-----	10h27	0h19
11	10h59	0h28	10h37	0h25	11h17	1h31
12	11h59	1h35	11h37	1h33	12h15	2h39
13	13h 4	2h37	12h42	2h35	13h22	3h41
14	14h14	3h32	13h53	3h29	14h33	4h34
15	15h19	4h21	15h 0	4h16	15h44	5h17
16	16h23	5h 2	16h 6	4h55	16h53	5h54
17	17h24	5h38	17h 9	5h29	17h59	6h25
18	18h23	6h11	18h10	6h 0	19h 2	6h53
19	19h20	6h42	19h 9	6h29	20h 4	7h20
20	20h16	7h13	20h 7	6h58	21h 4	7h45
21	21h12	7h44	21h 5	7h27	22h 5	8h13
22	22h 8	8h18	22h 3	7h59	23h 5	8h42
23	23h 5	8h54	23h 1	8h34	-----	9h15
24	-----	9h35	23h58	9h13	0h05	9h53
25	0h 1	10h20	-----	9h58	1h 3	10h37
26	0h55	11h11	0h52	10h48	1h58	11h27
27	1h46	12h 5	1h44	11h43	2h49	12h22
28	2h32	13h 2	2h29	12h41	3h33	13h22
29	3h12	14h 0	3h10	13h40	4h12	14h23
30	3h52	14h59	3h46	14h41	4h46	15h26
October						
1	4h27	15h58	4h19	15h41	5h16	16h30
2	4h59	16h56	4h50	16h42	5h44	17h33
3	5h32	17h56	5h20	17h45	6h12	18h38
4	6h 5	18h58	5h51	18h49	6h40	19h45
5	6h40	20h 3	6h24	19h55	7h10	20h55
6	7h19	21h10	7h 0	21h 5	7h44	22h 7
7	8h 3	22h19	7h43	22h16	8h24	23h21

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
8	8h55	23h28	8h32	23h26	9h12	-----
9	9h53	-----	9h30	-----	10h 9	0h32
10	10h57	0h32	10h34	0h31	11h14	1h36
11	12h 4	1h30	11h42	1h27	12h23	2h32
12	13h10	2h19	12h50	2h15	13h33	3h18
13	14h14	3h 2	13h56	2h56	14h42	3h55
14	15h15	3h38	14h59	3h30	15h47	4h27
15	16h13	4h11	15h59	4h 2	16h50	4h56
16	17h 9	4h42	16h57	4h30	17h51	5h21
17	18h 5	5h12	17h55	4h58	18h52	5h47
18	19h 1	5h43	18h53	5h27	19h52	6h14
19	19h57	6h16	19h51	5h58	20h52	6h42
20	20h54	6h51	20h50	6h32	21h54	7h14
21	21h51	7h30	21h48	7h 9	22h52	7h49
22	22h45	8h14	22h43	7h52	23h49	8h31
23	23h38	9h 2	23h36	8h40	-----	9h18
24	-----	9h55	-----	9h32	0h41	10h11
25	0h25	10h50	0h23	10h28	1h28	11h 8
26	1h 9	11h47	1h 5	11h27	2h 8	12h 8
27	1h48	12h44	1h43	12h25	2h43	13h10
28	2h23	13h42	2h16	13h25	3h14	14h12
29	2h56	14h40	2h48	14h25	3h43	15h14
30	3h28	15h39	3h17	15h26	4h10	16h18
31	4h 0	16h39	3h47	16h29	4h37	17h24
November						
1	4h34	17h44	4h19	17h35	5h 6	18h33
2	5h12	18h51	4h54	18h45	5h39	19h46
3	5h55	20h 2	5h35	19h58	6h17	21h 2
4	6h45	21h13	6h23	21h11	7h 4	22h16
5	7h42	22h22	7h20	22h20	7h59	23h26
6	8h47	23h24	8h24	23h22	9h 3	-----
7	9h55	-----	9h33	-----	10h13	0h27
8	11h 3	0h17	10h43	0h14	11h25	1h17
9	12h 7	1h 2	11h49	0h57	12h34	1h56
10	13h 9	1h40	12h52	1h33	13h40	2h30
11	14h 7	2h14	13h52	2h 5	14h43	2h59

MOONRISE AND MOONSET TIMES FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
12	15h 3	2h45	14h50	2h34	15h43	3h26
13	15h58	3h15	15h47	3h 1	16h43	3h51
14	16h53	3h44	16h44	3h29	17h42	4h16
15	17h48	4h16	17h42	3h59	18h42	4h44
16	18h45	4h50	18h40	4h31	19h43	5h14
17	19h41	5h27	19h38	5h 7	20h42	5h48
18	20h55	6h 9	20h36	5h47	21h41	6h27
19	21h32	6h56	21h29	6h34	22h34	7h12
20	22h20	7h47	22h18	7h24	23h23	8h 4
21	23h 5	8h41	23h 1	8h19	-----	8h59
22	23h44	9h38	23h40	9h17	0h 5	9h58
23	-----	10h34	-----	10h15	0h41	10h57
24	0h20	11h30	0h14	11h13	1h13	11h58
25	0h54	12h26	0h46	12h10	1h42	12h58
26	1h25	13h22	1h15	13h 8	2h 9	13h59
27	1h56	14h21	1h44	14h 9	2h35	15h 2
28	2h28	15h21	2h14	15h12	3h 3	16h 8
29	3h 3	16h26	2h47	16h19	3h33	17h18
30	3h43	17h36	3h24	17h31	4h 8	18h33
December						
1	4h29	18h49	4h 9	18h46	4h50	19h50
2	5h24	20h 1	5h 2	19h59	5h42	21h 5
3	6h28	21h 8	6h 5	21h 6	6h44	22h13
4	7h38	22h 8	7h16	22h 4	7h55	23h 9
5	8h49	22h58	8h27	22h53	9h10	23h54
6	9h57	23h39	9h38	23h33	10h22	-----
7	11h 2	-----	10h45	-----	11h32	0h31
8	12h 2	0h15	11h47	0h 6	12h36	1h 2
9	12h59	0h47	12h46	0h37	13h38	1h30
10	13h54	1h18	13h43	1h 5	14h37	1h56
11	14h48	1h47	14h39	1h32	15h36	2h20
12	15h43	2h18	15h36	2h 1	16h36	2h47
13	16h39	2h51	16h34	2h32	17h35	3h15
14	17h35	3h27	17h31	3h 7	18h35	3h48
15	18h31	4h 7	18h28	3h45	19h33	4h26
16	19h25	4h52	19h23	4h30	20h29	5h 9

MOONRISE AND MOONSET TIMES
FOR JOHANNESBURG, DURBAN AND CAPE TOWN

	JOHANNESBURG		DURBAN		CAPE TOWN	
	Rise	Set	Rise	Set	Rise	Set
17	20h16	5h42	20h14	5h19	21h19	5h58
18	21h 2	6h35	20h59	6h13	22h 3	6h52
19	21h44	7h31	21h40	7h10	22h41	7h51
20	22h20	8h28	22h14	8h 8	23h15	8h50
21	22h54	9h23	22h46	9h 5	23h44	9h50
22	23h25	10h18	23h16	10h 2	-----	10h49
23	23h54	11h13	23h43	10h59	0h10	11h48
24	-----	12h 8	-----	11h55	0h36	12h48
25	0h25	13h 6	0h12	12h55	1h 2	13h50
26	0h57	14h 6	0h42	13h58	1h29	14h56
27	1h33	15h11	1h16	15h 5	2h 1	16h 6
28	2h15	16h21	1h55	16h17	2h38	17h20
29	3h 5	17h33	2h43	17h31	3h24	18h36
30	4h 3	18h44	3h41	18h42	4h20	19h48
31	5h12	19h49	4h49	19h47	5h28	20h51

THE PLANETS

MERCURY

Basic data on Mercury:

Mean distance from the Sun	:	57 900 000 km
Mean orbital velocity	:	47.9 km/sec
Revolution period	:	87.969 days
Rotation period	:	58.646 days
Diameter	:	4878 km
Surface gravity	:	0.38 (Earth = 1)
Escape velocity	:	4.3 km/sec
Mean surface temperature (day)	:	+ 350 deg C
(night)	:	- 170 deg C

VISIBILITY OF MERCURY

Mercury can only be seen low in the east before sunrise, or low in the west after sunset. It is visible in the mornings between the following approximate dates:

January 1 to January 17
March 24 to May 15
July 31 to August 28
November 19 to December 27

The planet is brighter at the end of each period (the best conditions in southern latitudes occur in April.) It is visible in the evening between the following approximate dates:

February 13 to March 10
May 31 to July 16
September 17 to November 7

The planet is brighter in the beginning of each period (the best conditions in southern latitudes occur in October.)

On November 13th a rather interesting phenomenon will occur. Mercury will transit the Sun's disc. First contact will occur at 03h 43. At 06h 07, minimum geocentric angular distance will be 7' 50".6. At this time most of South Africa will be able to see the event. Final contact will occur at 08h 31. The next transit of Mercury will only occur on November 6, 1993.

WARNING : DO NOT view the Sun or this transit of Mercury without proper professionally made protective accessories (Solar Filters or Solar Projection screens), as irreparable harm can be done to the eyes.
Minors should never view the Sun without adult supervision!

V E N U S

Basic data for Venus:

Mean distance from Sun	:	108 200 000 km
Mean orbital velocity	:	35.0 km/sec
Revolution period	:	224.70 days
Rotation period	:	243.01 days
Diameter	:	12 104 km
Surface gravity	:	0.903 (Earth = 1)
Escape velocity	:	10.3 km/sec
Mean surface temperature	:	480 deg C
Brightest magnitude	:	-4.4

VISIBILITY OF VENUS

Venus is too close to the Sun for observation from the beginning of the year until early March, and can then be seen as a brilliant object in the evening sky until early November. Venus reaches greatest brilliancy on October 1 (magnitude -4.6) and December 11 (magnitude -4.7). By mid-November it appears as a morning star and can be seen in the morning sky for the rest of the year. Venus is in conjunction with Mercury on March 8th and October 18

E A R T H

Basic data on Earth:

Mean distance from Sun	:	149 600 000 km (= 1 AU)
Maximum distance from Sun	:	152 100 000 km
Minimum distance from Sun	:	147 100 000 km
Mean orbital velocity	:	29.8 km/sec
Revolution period	:	365.256 days
Rotation period	:	23.9345 hours
Inclination of equator to orbit	:	23 deg 27′
Diameter (equatorial)	:	12 756 km
Escape velocity	:	11.2 km/sec

Autumn equinox	: 21 March 00h 00
Solstice	: 21 June 18h 00
Spring equinox	: 23 September 10h 00
Solstice	: 22 December 06h 00

M A R S

Basic data on Mars:

Mean distance from Sun	:	227 900 000 km
Mean orbital velocity	:	24.1 km/sec
Revolution period	:	1.88 years (= 686.98 days)
Rotation period	:	24 hrs 37 min 23 sec
Diameter	:	6796 km
Surface gravity	:	0.380 (Earth = 1)
Escape velocity	:	5.0 km/sec
Surface temperature		
maximum	:	20 deg C
minimum	:	-140 deg C
Brightest magnitude	:	-2.8

VISIBILITY OF MARS

Mars rises well after midnight at the beginning of the year in Libra. Its westward motion gradually increases, and in February and March it moves through Scorpio, passing 5 deg. N of Antares on February 17th, and then into Sagittarius. On July 10 Mars is in opposition and can therefore be seen throughout the night. It remains in Sagittarius until early October and then moves through Capricorn, Aquarius and into Pisces in late December. From mid-November until the end of the year it can only be seen in the evening sky. Mars is in conjunction with Saturn on February 18 at 02h 00 and with Jupiter on December 19 at 09h 00.

Throughout the year Mars varies in magnitude from +1.5 on January 1 to -2.7 on July 13 and then fades to 0.6 by the end of December.

THE MOONS OF MARS

Two tiny Moons move around Mars in orbits that are close to the planet surface. They are named Phobos ("Fear") and Deimos ("Panic").
Phobos is the nearer and the larger of the Martian moons. It circles Mars in only 7 hours 39 minutes, moving over the Martian surface at an average distance of only 6000 km.
Deimos, which is farther from Mars and somewhat smaller than Phobos, orbits Mars at a distance of about 20 000 km. Large telescopes are required to view the two moons.

J U P I T E R

Basic data on Jupiter:

Mean distance from Sun	:	778 300 000 km
Mean orbital velocity	:	13.1 km/sec
Revolution period	:	11.86 years
Rotation period at equator	:	9 hrs 50 min 30 sec
Equatorial diameter	:	143 800 km
Surface gravity	:	2.64 (Earth = 1)
Escape Velocity	:	61 km/sec
Mean temperature (at cloud tops)	:	-110 deg. C
Brightest magnitude	:	-2.6

VISIBILITY OF JUPITER

Jupiter can be seen in the evening sky in Capricornus from the beginning of the year until early February, when it moves too close to the Sun for observation. It reappears in the morning sky early in March in the constellation of Aquarius where it remains for the balance of the year. Jupiter is at opposition on September 10 when it can be seen throughout the night, and from early December until the end of the year it can only be seen in the evening sky. Jupiter is in conjunction with Mars on December 19 at 09 hours. The magnitude of Jupiter changes from -2.0 on January 1st to -2.9 in September and fades to -2.3 in December.

JUPITER'S MOONS

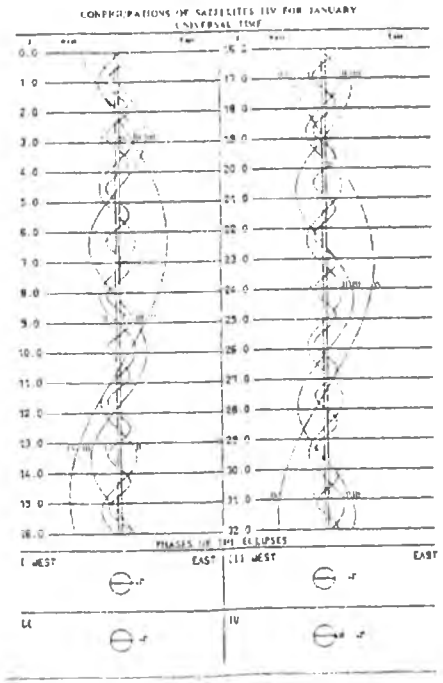
The planes of the orbits of the Galilean moons almost correspond with the plane of the ecliptic as does that of Jupiter itself, and therefore, our line of sight. Consequently, we see Jupiter and these 4 satellites arranged in a fairly straight line. The inner satellites (I,II, and III) also named Io, Europa, and Ganymede are from Earth, always seen to transit Jupiter, or be occulted by it. Also the Sun is so close to the satellite plane that these always cast a shadow-transit on Jupiter's surface, and suffer eclipses whenever passing behind Jupiter.

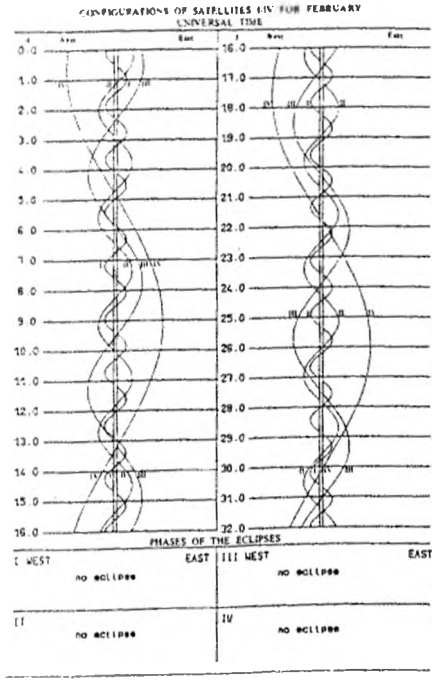
Satellite IV (Callisto) is considerably further from the planet than are the other three. It exhibits eclipses and transit phenomena when the satellite's orbital plane is sufficiently 'edge-on' to Earth and Sun.

It may be somewhat mystifying to see a satellite approaching Jupiter and while still some distance from the planet gradually fade from sight. This happens with an eclipse when the satellite enters the shadow cast by Jupiter which lies to the west of the planet before opposition. The reverse effect can be seen after opposition, when a satellite which has been occulted appears as a point of light, some distance from the planet's disc, and gradually increases in brightness. At this time the planet's shadow is to the east of the disc.
An indication of the distance at which these phenomena will occur from the disc of Jupiter may be obtained from the small diagram listed below which shows disappearance (d) and reappearance (r) of each satellite at the eclipse occuring nearest the middle of the month; these small diagrams are appended for each month in which Jupiter is well placed for viewing. The diagrams show the positions of the four Galilean satellites relative to each other and the planet.
Each strip represents the movements for one month indicating 0 Hours Universal Time (for South African Standard Time add 2 hours) of each day.

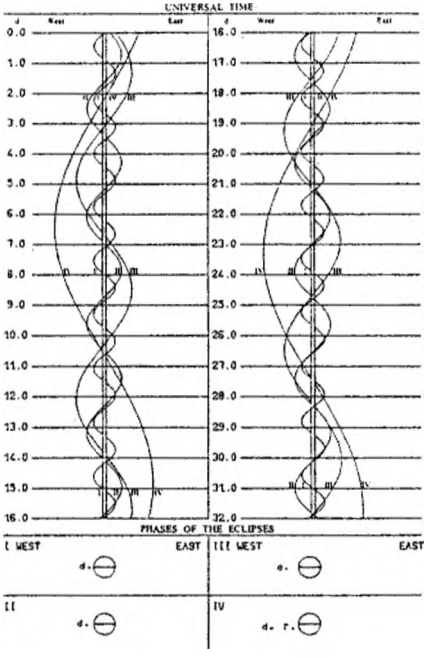
The twin vertical lines represent Jupiter and the four curves the motions of the satellites.
The satellites, labelled by Roman numerals, are I = Io, II = Europa, III = Ganymede, and IV = Callisto.

Away from Jupiter's disc the satellites can be seen with binoculars, and the commencement and ending of the eclipses can be seen on dates sufficiently before and after (respectively) the date of opposition. A telescope is needed for observing other phenomena, where the actual discs (in a diameter range in the order of 0.75 to 1.75 seconds of arc) of the satellites and their shadows, have to be 'resolved'. Minimum apertures of about 75 mm for shadows and 150 mm for satellites in transit, are necessary. The satellite visibility depends on the contrast of albedos which vary among the four and also in the markings of their Jupiter background. The magnification should be as high as possible.
(The listed phenomena occur between one hour after sunset and one hour before sunrise, provided it is also not less than one hour after Jupiter rises or less than one hour before Jupiter sets. The times of other phenomena outside these limitations may be obtained by reference to the Astronomical Almanac for 1986.)

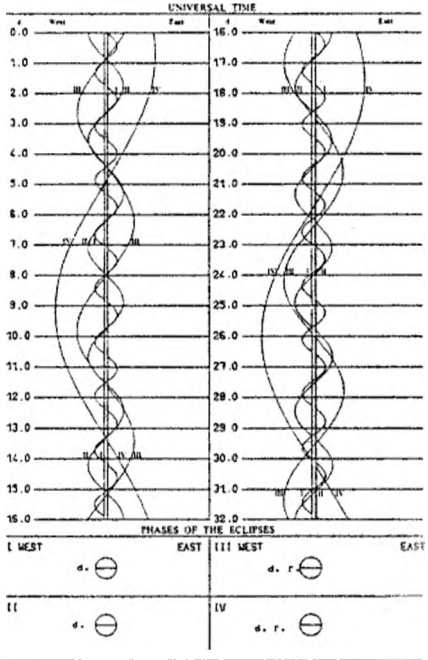




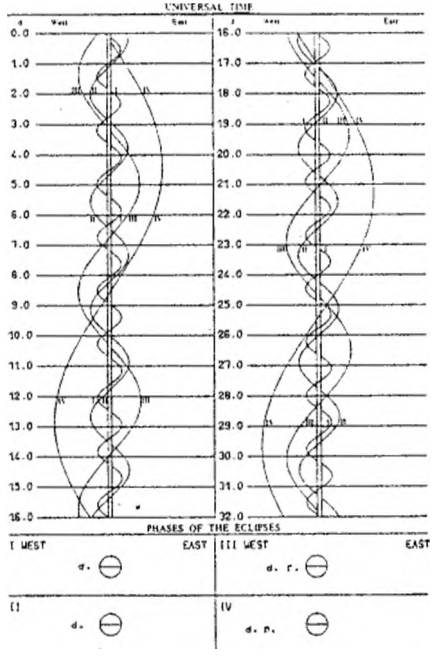
CONFIGURATIONS OF SATELLITES I-IV FOR MARCH
UNIVERSAL TIME



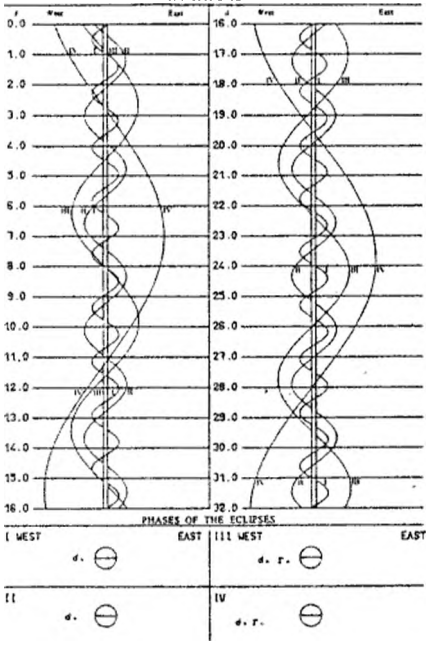
CONFIGURATIONS OF SATELLITES I-IV FOR APRIL
UNIVERSAL TIME

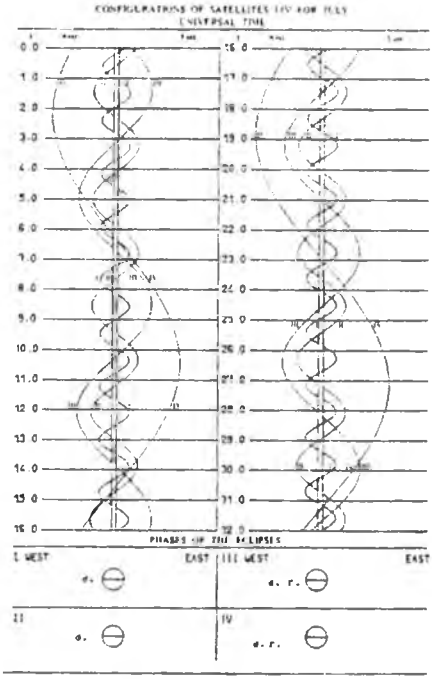


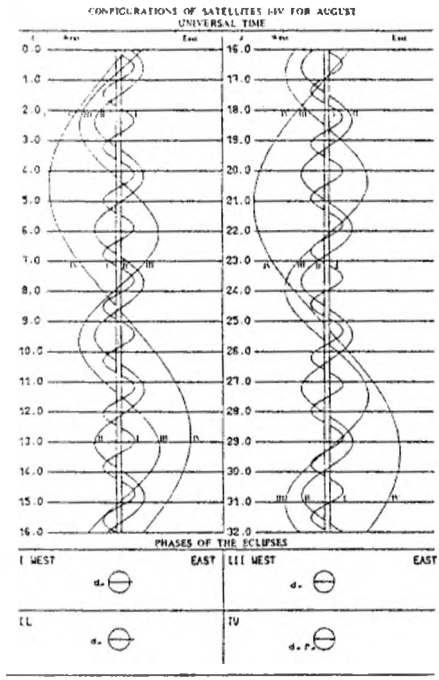
CONFIGURATIONS OF SATELLITES I-IV FOR MAY
UNIVERSAL TIME

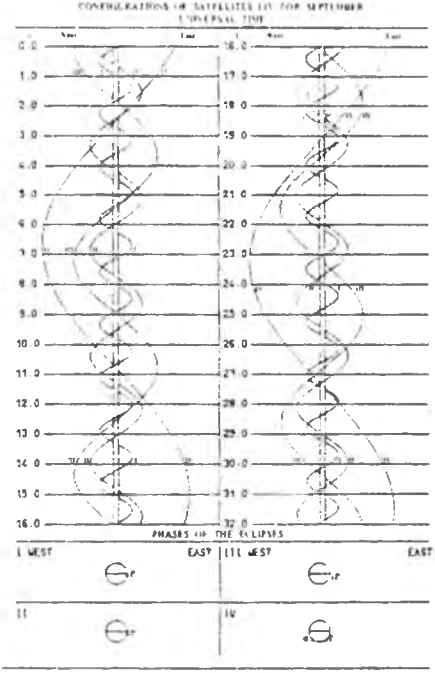


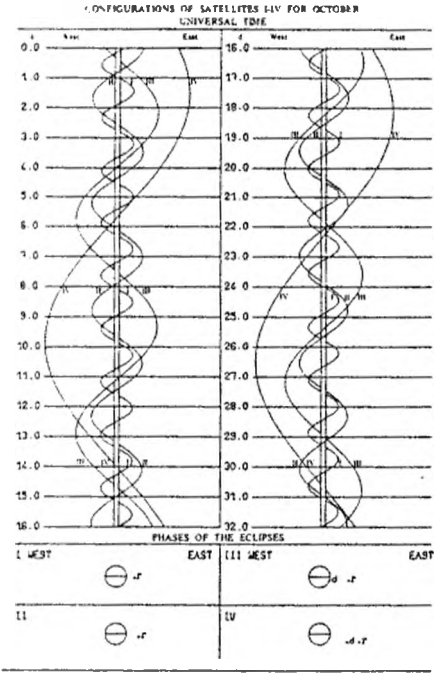
CONFIGURATIONS OF SATELLITES I-IV FOR JUNE
UNIVERSAL TIME

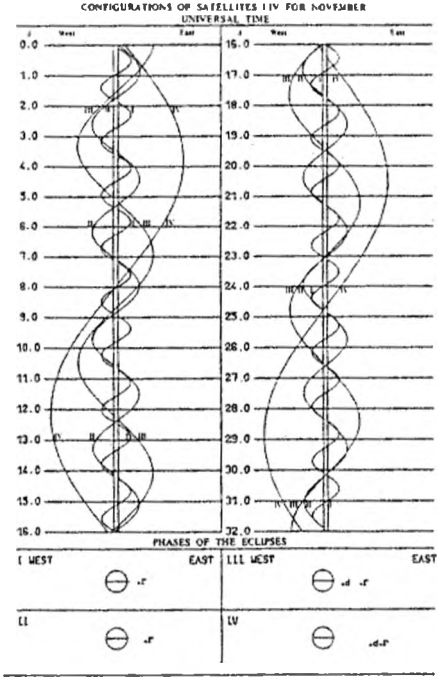


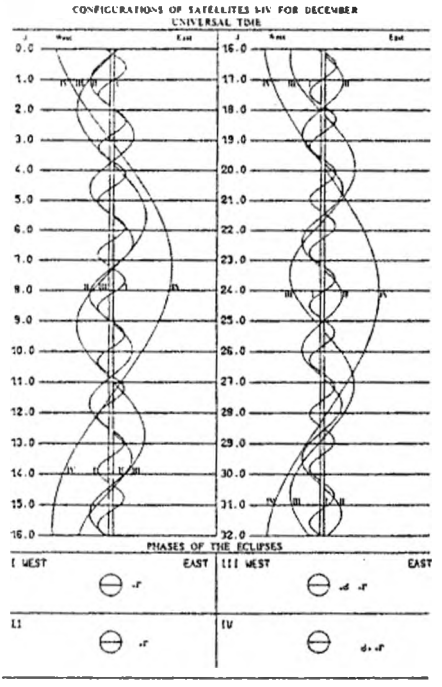

CONFIGURATIONS OF SATELLITES I-IV FOR JULY
UNIVERSAL TIME
PHASES OF THE ECLIPSES
I WEST
EAST
III WEST
EAST
II
IV


CONFIGURATIONS OF SATELLITES I-IV FOR AUGUST
UNIVERSAL TIME
PHASES OF THE ECLIPSES
I WEST
EAST
III WEST
EAST
II
IV


CONFIGURATIONS OF SATELLITES I-IV FOR SEPTEMBER
UNIVERSAL TIME
PHASES OF THE ECLIPSES
I WEST
EAST
III WEST
EAST
II
IV


CONFIGURATIONS OF SATELLITES I-IV FOR OCTOBER
UNIVERSAL TIME
PHASES OF THE ECLIPSES
I WEST
EAST
III WEST
EAST
II
IV





S A T U R N

Basic Data on Saturn:

Mean distance from the Sun	:	1 427 000 000 km
Mean orbital velocity	:	9.6 km/sec
Revolution period	:	29.46 years
Rotation period	:	10 hours 13 min. 59 sec.
Equatorial diameter	:	120 660 km
Surface gravity	:	1.16 (Earth = 1)
Escape velocity	:	35.6 km/sec
Mean surface temperature	:	-180 deg. C (at cloud tops)
Brightest magnitude	:	-0.3

VISBILITY OF SATURN

Saturn rises before sunrise at the beginning of the year in Scorpio and moves into Ophiuchus in mid-January. It will be 7 degrees North of star Antares in Scorpio on February 10 and again on April 26.

It returns to Scorpio in late May and is at opposition on May 28 when it can be seen throughout the night. By mid-October it returns to Ophiuchus where it will remain for the rest of the year.
On November 3 it is again close to Antares, 6 degrees North.
From late August until shortly after mid-November it can only be seen in the evening sky and then moves too close to the Sun for observation until late December, when it appears in the morning sky.
Saturn is in conjunction with Mars on February 18.

SATURN'S MOONS

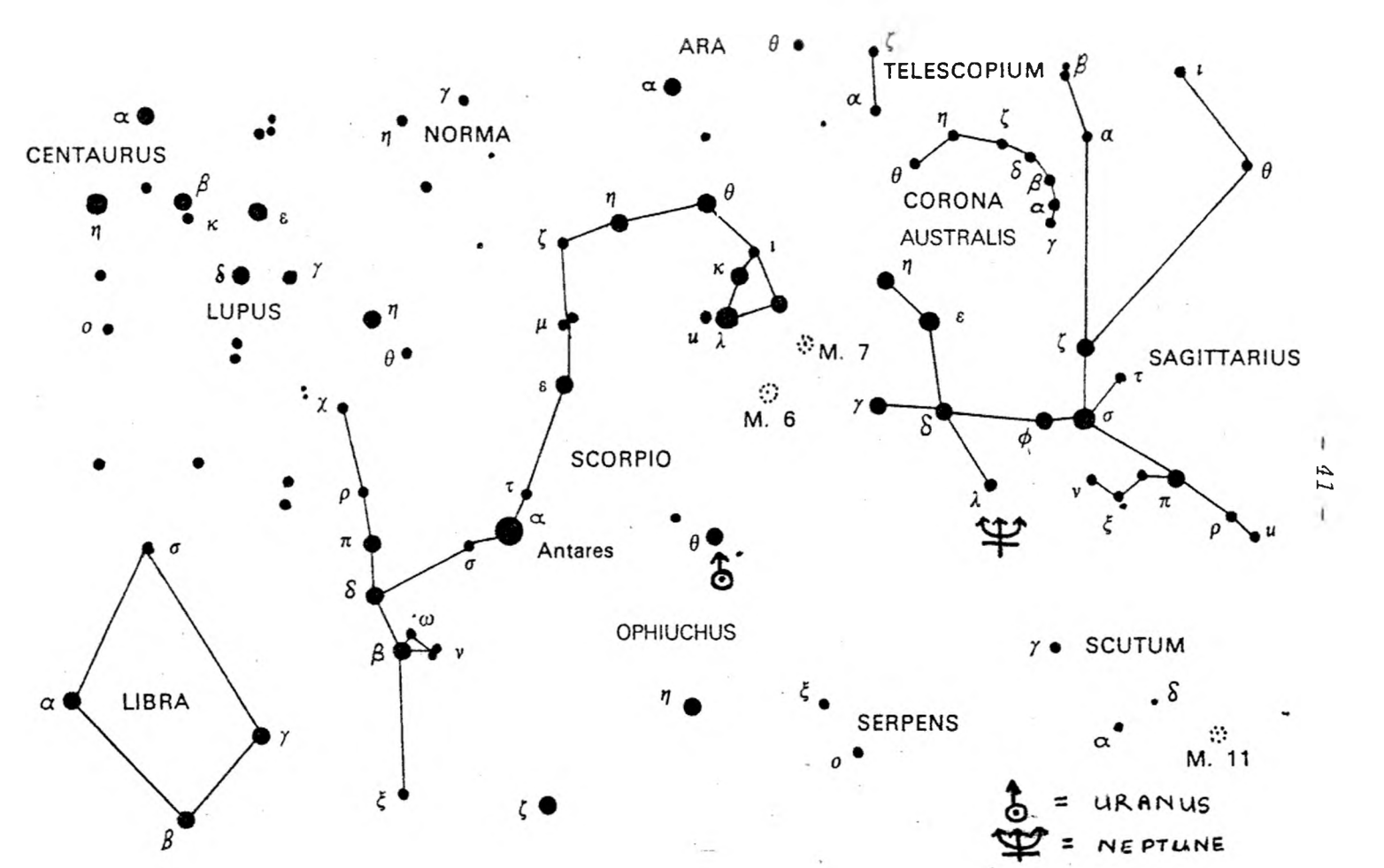
Nearly two dozen satellites are known to orbit about Saturn. The most prominent of these are :

Name	: Distance from Saturn
Mimas	: 185 540 km
Enceladus	: 238 040 km
Tethys	: 294 670 km
Dione	: 377 420 km
Rhea	: 527 100 km
Titan	: 1 221 860 km
Hyperion	: 1 481 000 km
Iapetus	: 3 560 800 km
Phoebe	: 12 954 000 km

U R A N U S

Basic data on Uranus:

Mean distance from Sun	: 2 869 600 000 km
Mean orbital velocity	: 6.8 km/sec
Revolution period	: 84.01 years
Rotation period	: 23.9 hrs
Diameter	: 52 290 km
Surface gravity	: 0.79 (Earth = 1)
Escape velocity	: 21.2 km/sec
Surface temperature	: -216 deg. C (57 K)
Brightest magnitude	: +5.6



APPROXIMATE POSITIONS OF URANUS AND NEPTUNE, JUNE 1986

VISIBILITY OF URANUS

Uranus rises shortly before sunrise at the beginning of the year in Ophiuchus and remains in this constellation throughout the year. It is at opposition on June 11, when it can be seen throughout the night. It is too close to the Sun for observation from late November until the end of the year. (see diagram below)

N E P T U N E

Basic data on Neptune:

Mean distance from Sun	: 4 496 600 000 km
Mean orbital velocity	: 5.4 km/sec
Revolution period	: 164.79 years
Rotation period	: 18 hours
Surface gravity	: 1.12 (Earth = 1)
Escape velocity	: 23.6 km/sec
Surface temperature	: -216 deg. C (57 K)
Brightest magnitude	: +7.7

VISIBILITY OF NEPTUNE

Neptune is too close to the Sun for observation from the beginning of the year until mid-January, when it can be seen in the morning sky in Sagittarius. It remains in Sagittarius throughout the year. On June 26, Neptune is at opposition when it can be seen throughout the night. From early December until the end of the year it is again too close to the Sun for observation.

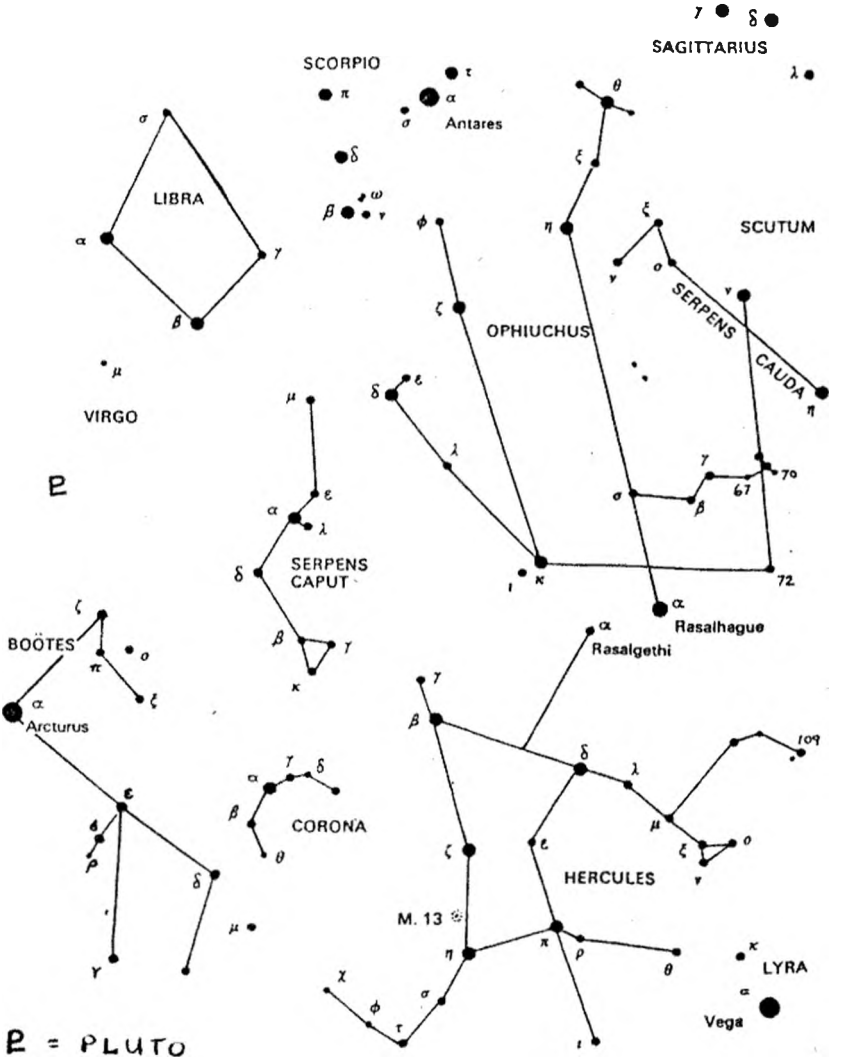
P L U T O

Basic data on Pluto:

Mean distance from Sun	: 5 900 000 000 km
Mean orbital velocity	: 4.7 km/sec
Revolution period	: 247.7 years
Rotation period	: 24.6 hours
Diameter	: 3000 km (?)
Surface gravity	: 0.4 (?) (Earth = 1)
Escape velocity	: 5 km/sec (?)

VISIBILITY OF PLUTO

Pluto can only be seen through a large telescope which has an aperture of at least 25cm. The chart below shows the approximate position of Pluto in the constellation of Virgo during 1986.



APPROXIMATE POSITION OF PLUTO, JUNE 1986

COMETS

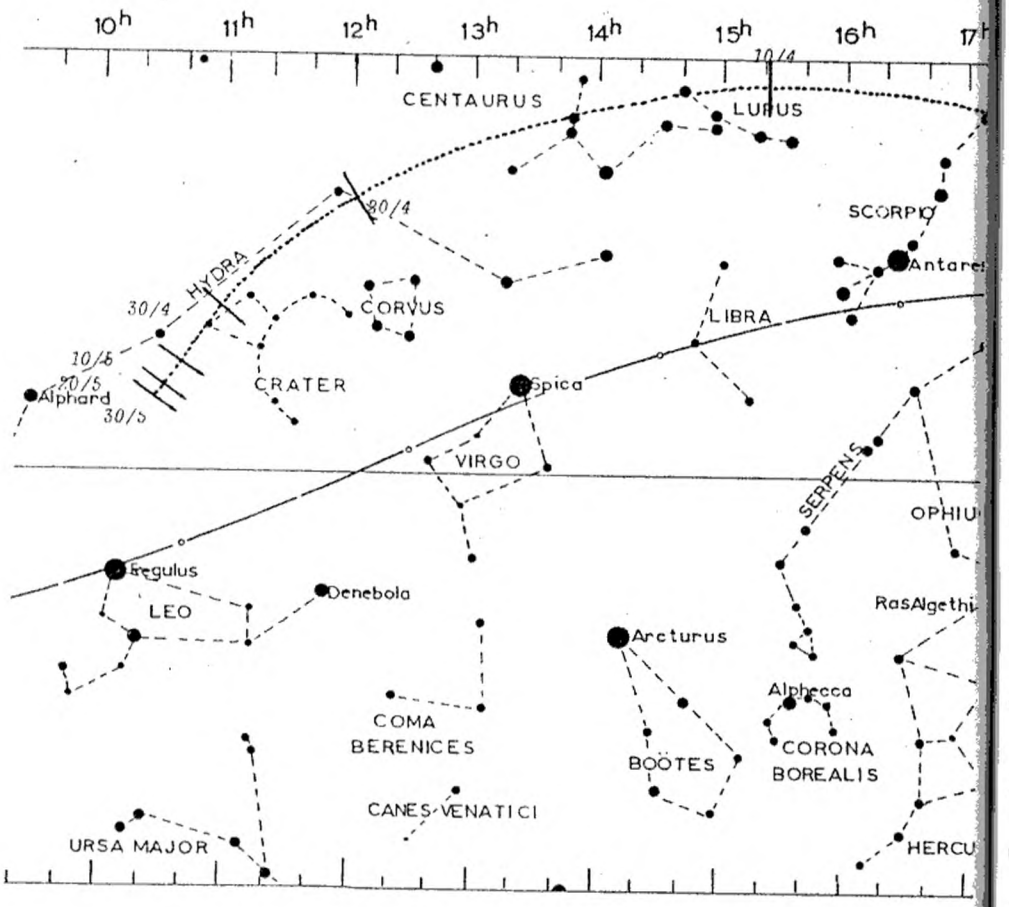
PREDICTED PERIHELION PASSAGES OF COMETS, 1986

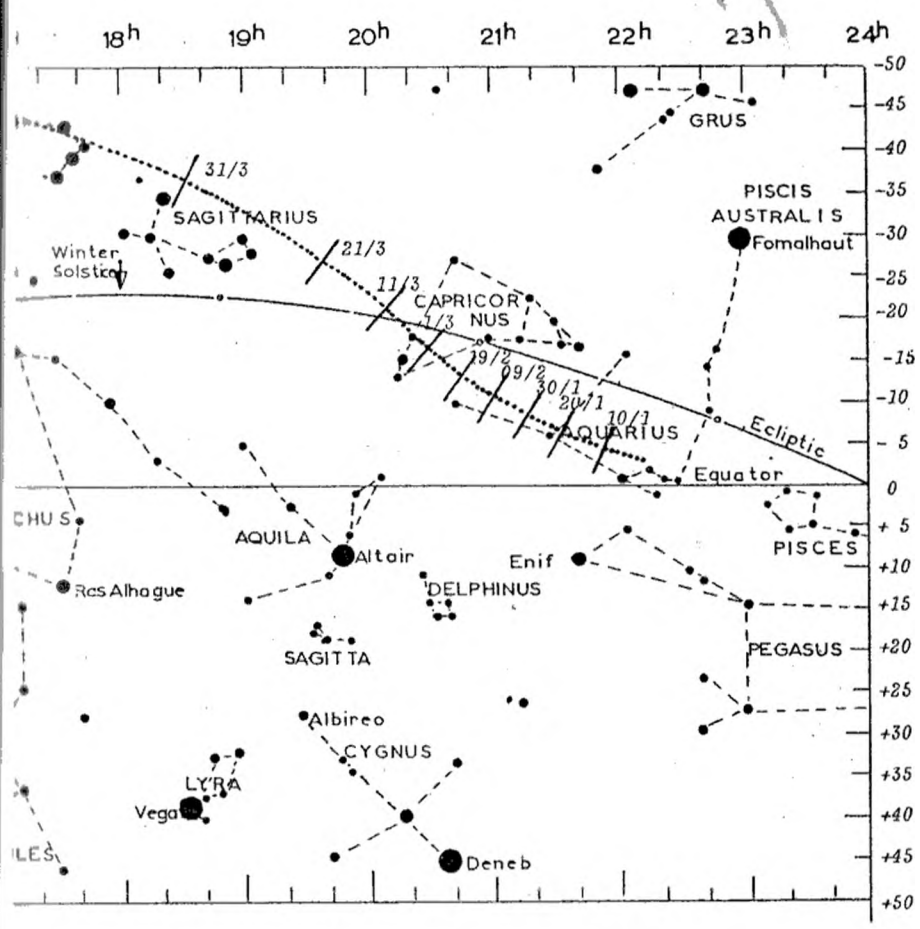
Name	Perihelion date	Period (years)	Perihelion distance (Astronomical units)
Boethin	Jan 26	11.2	1.11
Ashbrook-Jackson	Jan 24	7.5	2.31
Halley	Feb 9	76.0	0.59
Holmes	Mar 14	7.1	2.17
Wirtanen	Mar 20	5.5	1.08
Kojima	Apr 5	7.9	2.41
Spitaler	May 17	6.5	1.84
Shajn-Schaldach	May 27	7.5	2.33
Whipple	Jun 25	8.5	3.08
Wild 1	Oct 1	13.3	1.98

COMET HALLEY

Date	RA		Dec		Distance	Magnitude
	h	m	deg	m		
Jan 5	22	05.894	- 3	27.96	1.24	5.7
Jan 10	21	55.823	4	28.18	1.32	5.4
Jan 15	21	46.624	5	23.34	1.40	5.1
Jan 20	21	37.828	6	16.92	1.47	4.8
Jan 25	21	29.092	7	11.89	1.52	4.5
Jan 30	21	20.203	8	10.67	1.55	4.2
Feb 4	21	11.099	- 9	15.00	1.56	4.0
Feb 9	21	01.872	10	25.80	1.55	4.1
Feb 14	20	52.711	11	43.21	1.51	4.1
Feb 19	20	43.786	13	07.21	1.45	4.2
Feb 24	20	35.119	14	38.46	1.37	4.3
Mar 1	20	26.520	- 16	19.06	1.27	4.4
Mar 6	20	17.556	18	13.12	1.16	4.5
Mar 11	20	07.493	20	27.34	1.04	4.5

Mar 16	19 55.140	23 12.10	0.91	4.5
Mar 21	19 38.451	26 42.86	0.79	4.4
Mar 26	19 13.571	31 20.90	0.66	4.3
Mar 31	18 32.573	37 24.52	0.55	4.1
Apr 5	17 19.738	- 44 11.82	0.46	4.0
Apr 10	15 21.785	47 23.82	0.42	4.0
Apr 15	13 20.433	42 03.87	0.44	4.3
Apr 20	12 03.880	32 47.80	0.52	4.8
Apr 25	11 21.967	24 53.98	0.64	5.4
Apr 30	10 58.123	19 13.50	0.77	6.0
May 5	10 43.812	- 15 14.48	0.92	6.5
May 10	10 34.962	12 24.29	1.08	7.0
May 15	10 29.490	10 20.70	1.24	7.4
May 20	10 26.237	8 49.46	1.41	7.8
May 25	10 24.516	7 41.35	1.57	8.2
May 30	10 23.895	6 50.29	1.74	8.5
Jun 4	10 24.096	- 6 12.20	1.90	8.8
Jun 9	10 24.926	5 44.24	2.06	9.1
Jun 14	10 26.245	5 24.36	2.22	9.4
Jun 19	10 27.946	5 11.04	2.38	9.6
Jun 24	10 29.949	5 03.10	2.53	9.9
Jun 29	10 32.196	4 59.63	2.68	10.1





COMET HALLEY'S PATH JAN TO MAY 86

APPROXIMATE RISING TIMES FOR HALLEY'S COMET, 1986

Date	Rise	Date	Rise
19/02	05h32	31/03	00h12
01/03	03h40	09/04	20h28
11/03	02h48	19/04	16h37
21/03	01h49	29/04	12h41

THE STARS

The hemispherical charts given do not pretend to be anything but basic. They are not of high accuracy, and on this projection there is bound to be a certain amount of distortion: they should, however, serve your immediate needs.

Because the stars appear to rise about four minutes earlier every successive night, it follows that every week the stars will rise about thirty minutes earlier than the previous week; every month they will rise about two hours earlier than the previous month. It is for this reason that we see different stars and constellations throughout the year.

STARS OF SUMMER EVENINGS: LOOKING NORTH

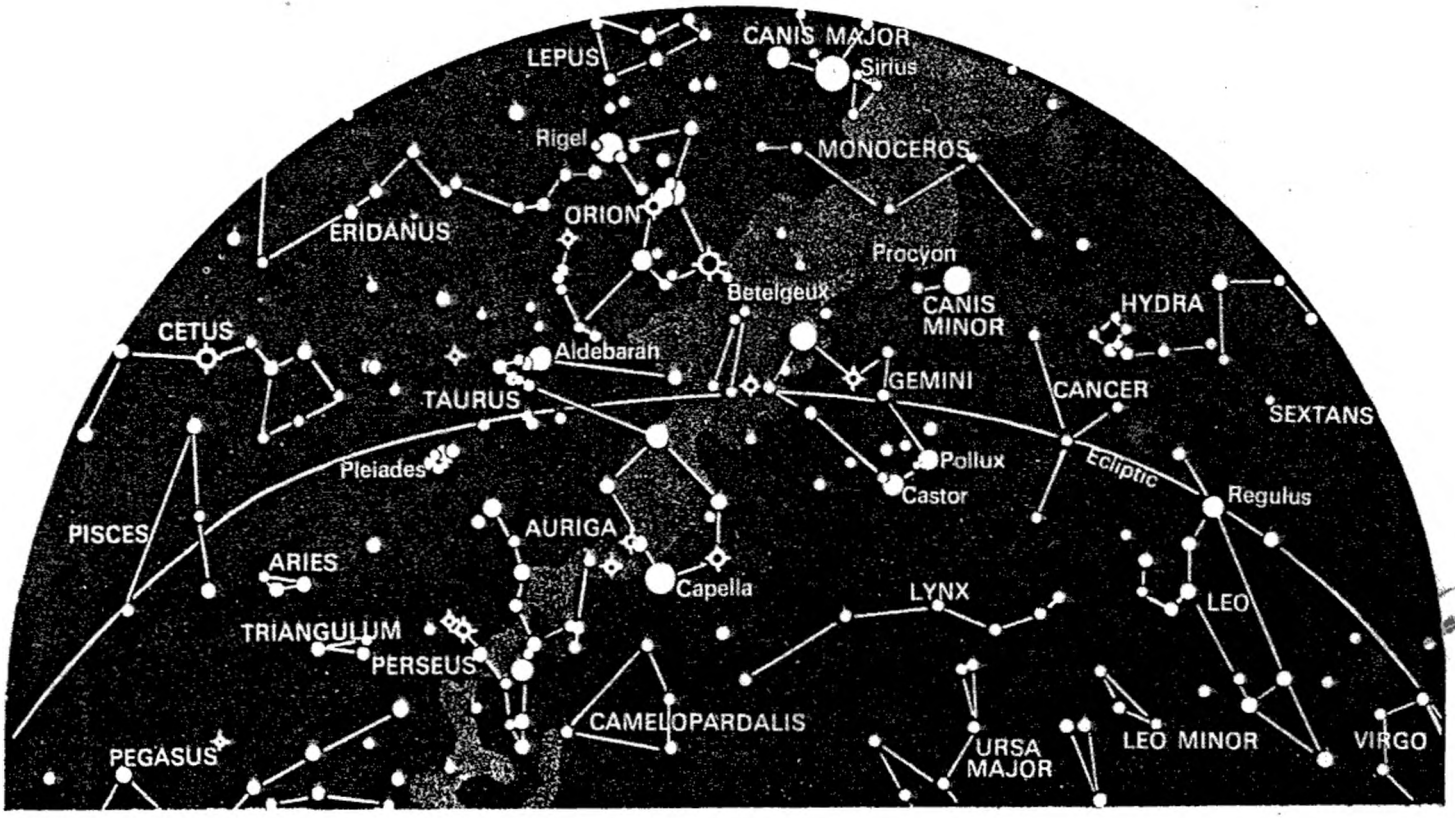
AURIGA (The Charioteer) : The outstanding feature of this beautiful and prominent constellation is the star Capella, magnitude 0.2. The name Capella means 'She-Goat'. The area within the pentagonal figure of Auriga is rich in stars and clusters and is well worth sweeping with binoculars. Auriga lies directly in the plane of the Milky Way.

CANIS MAJOR (The Great Dog) : Sirius, the brightest star in the sky (magnitude -1.6) is the most conspicuous star in the constellation of the Great Dog. It is easily located by following downward the line connecting the three stars in the Belt of Orion. Sirius is the second nearest star to the Sun, being about 8.7 light years distant.

Sirius has a white dwarf companion, a star so dense that one cubic metre weighs a few thousand metric tonnes. Observe Sirius in a telescope, particularly when rising or setting; it seems to change colour constantly and kaleidoscopically, with brilliant flashes of red, green, blue, orange, gold, white and turquoise (This effect is simply due to the Earth's atmosphere refracting the light of Sirius.)

CANIS MINOR (The Little Dog) : Canis Minor is easily located; its brightest star, Procyon, forms an equilateral triangle with Sirius in Canis Major and Betelgeuse in Orion.

Procyon is a star similar to our own Sun, golden-yellow in colour and having a magnitude of 0.5, making it the 8th brightest star in the sky. The name 'Procyon' means 'before the Dog', so called because it rises about half an hour before Sirius, the Dog Star.



SUMMER, LOOKING NORTH

GEMINI (The Twins) : Gemini is a conspicuous zodiacal constellation made up of two almost parallel lines of stars with two bright stars, Castor and Pollux, at the head of each line. Castor and Pollux have long been known as the Twins and give the constellation its name.

The star 1 Geminorium is almost exactly at the location of the summer solstice, the northernmost point of the Sun's journey around the celestial sphere. It was in Gemini that the planets Uranus and Neptune were first discovered.

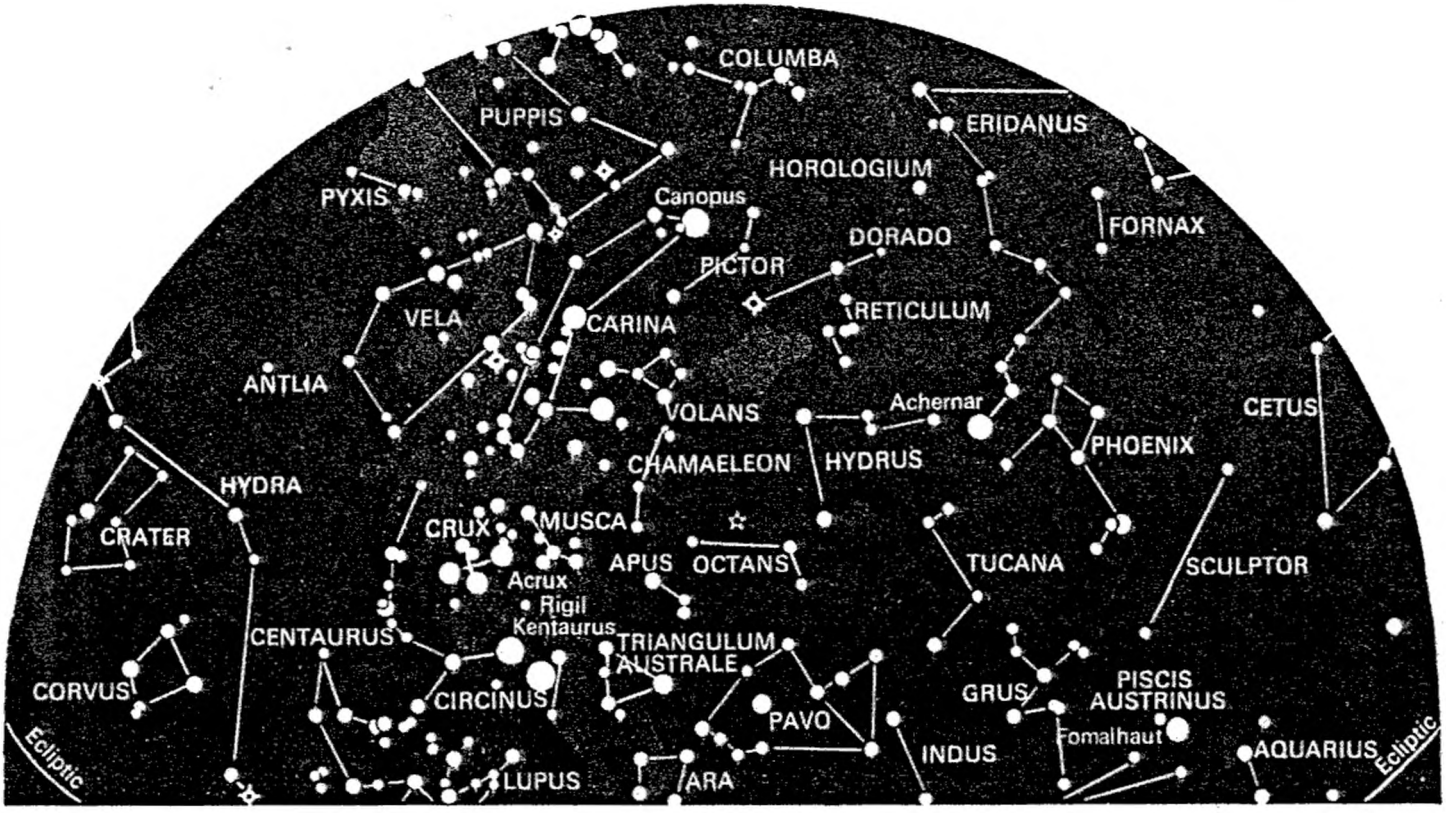
The open star cluster M35, considered to be one of the most beautiful in the sky, can be located in Gemini with the aid of binoculars.

ORION (The Hunter) : Orion is generally considered to be the most beautiful and imposing constellation of the heavens. It is most easily recognised : the four bright stars forming a large rectangle and the three second magnitude stars, equally spaced and forming a straight line (the Belt of Orion) enclosed by a triangle, are a delight to the eye. No other constellation has so many bright stars. Compare the colours of Betelgeuse, a giant red star depicting the Hunter's right shoulder, and Rigel (the left Knee star), a brilliant blue-white star. Rigel is of magnitude 0.3 and is the 7th brightest star in the sky. Betelgeuse has a magnitude of 0.9 and ranks 12th in brightness.

Orion is in a portion of the sky that contains seven of the twenty brightest stars in the heavens; these are to be found in Orion, Auriga, Gemini, Taurus, Canis Major and Canis Minor.

There are two famous nebulae in Orion. One, the Great Nebula, is visible to the naked eye. It is the prototype of the diffuse nebula, a great cloud of cosmic dust 26 light years in diameter and 1625 light years away. The star Theta Orionis marks the centre of the Great Nebula; viewed through binoculars, the star seems to be enveloped in a hazy field that marks the nebula's presence. Even in a small telescope, the Great Nebula is an awe-inspiring sight. The other famous nebula is the so-called 'Horse's Head' nebula, a dark nebula silhouetted against a glowing cloud of cosmic dust in the shape of a horse's head. This remarkable object is not visible to the naked eye, long photographic exposures are required to show its detail. The northernmost star in the belt of Orion lies almost exactly on the celestial equator. The three belt stars serve as valuable pointers: the line through them extended to the southeast points to Sirius, and extended to the northwest, to Aldebaran in Taurus.

TAURUS (The Bull) : Taurus is a zodiacal constellation and is one of the oldest of the star groups, being recognized by the ancient Babylonians, Persians, Egyptians, and Greeks. An upside-down 'V'-shaped group of stars , the



SUMMER, LOOKING SOUTH

well-known Hyades cluster, forms the bull's face. Aldebaran, a great red star, is the bull's right eye; it ranks 13th in brightness, having a magnitude of 1.0. El Nath, at the tip of the bull's left horn, would seem to properly belong to the constellation of Auriga; it is shared by both constellations.

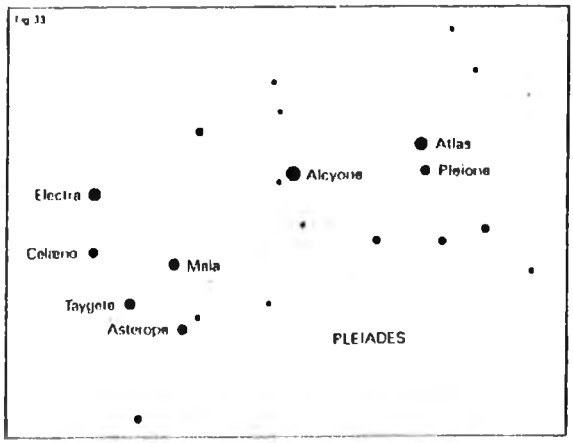
The Pleiades (M45) make up the best open cluster in the entire sky. They lie in Taurus and are very prominent to the naked eye. The brightest stars, with their magnitudes, are:

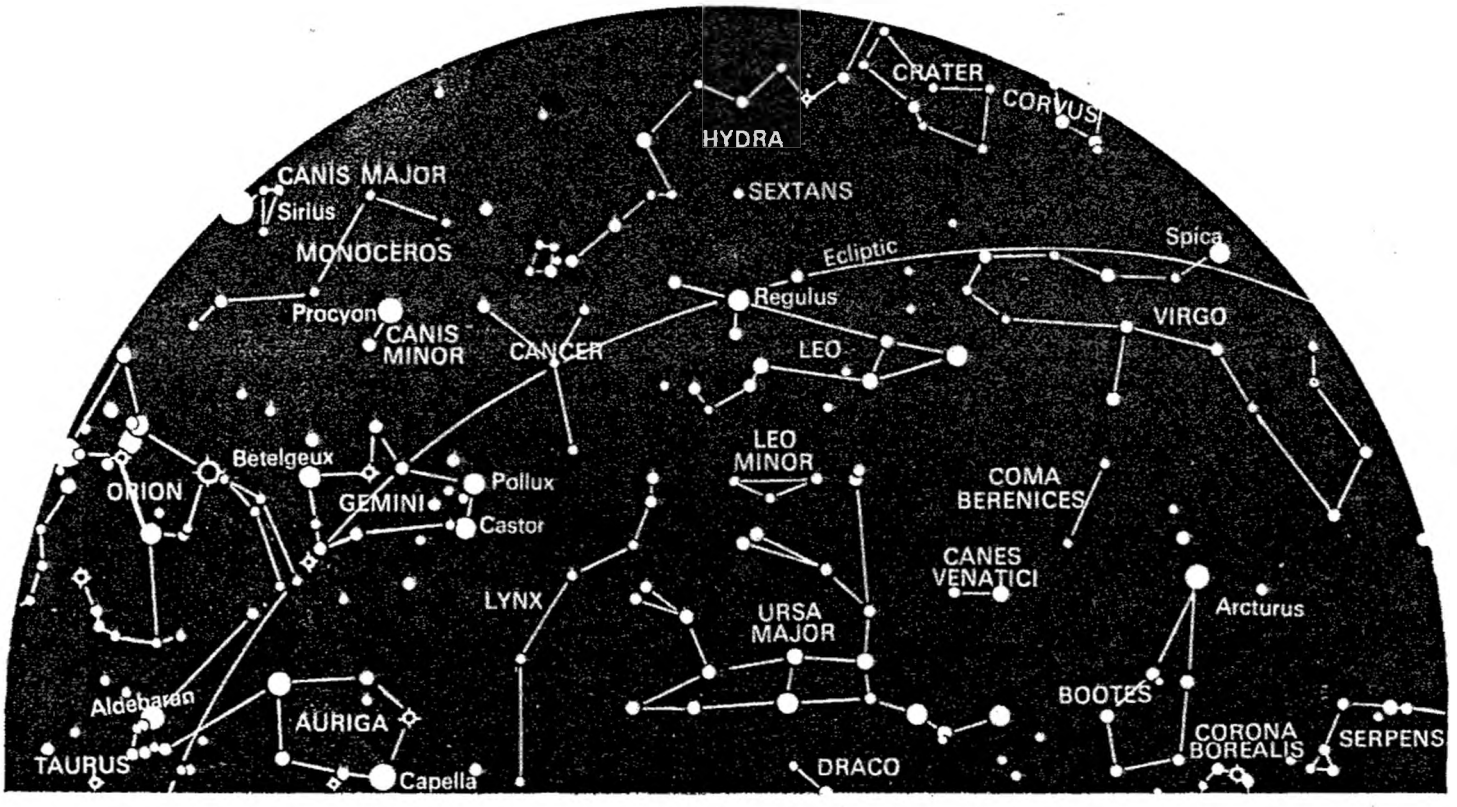
Name	Magnitude
Alcyone	2.9
Atlas	3.6
Electra	3.7
Maia	3.9
Merope	4.2
Taygete	4.3
Pleione	5.1 (rather variable)
Celaeno	5.5
Asterope	5.8

People with normal sight can see at least seven of the Pleiades under good conditions; the record exceeds 15, and binoculars will show many more. The total number of stars exceeds 400, and the distance of the cluster is 410 light years. Most of the members of the cluster are hot, white and relatively young.

The Pleiades cluster also contains nebulosity. The nebular material shines by reflection, and is well studied only when photographed through a large telescope.

Look at the Pleiades with binoculars, or with a low power, wide-field eyepiece on a telescope. They make a magnificent spectacle.





AUTUMN, LOOKING NORTH

STARS OF SUMMER EVENINGS: LOOKING SOUTH

VELA (The Sails) : Vela is part of the ancient constellation Argo Navis (The Ship) which is no longer recognised as a single constellation.

CARINA (The Keel) : Carina is also part of Argo Navis (The Ship), built by Argos for Jason and his Argonauts. Carina is easily found near Canopus, the second brightest star in the sky. It has been called the Great Star of the South. Probably because of the inaccessibility to the great telescopes of the northern hemisphere, Canopus has not been adequately observed until recently, and different estimates of its distance, size and brightness have appeared in astronomical catalogues. A distance of over 600 light years has been quoted in many observing lists, and the luminosity has been thought to be as high as 60 000 times that of the Sun. Modern studies do not support these large estimates, yet there is no doubt that Canopus is actually a very large and brilliant star when compared with our Sun.

According to measurements obtained at the S A Astronomical Observatory in Sutherland, Cape, the distance of Canopus is in the range of about 100 to 120 light years and the diameter about 30 times that of our Sun.

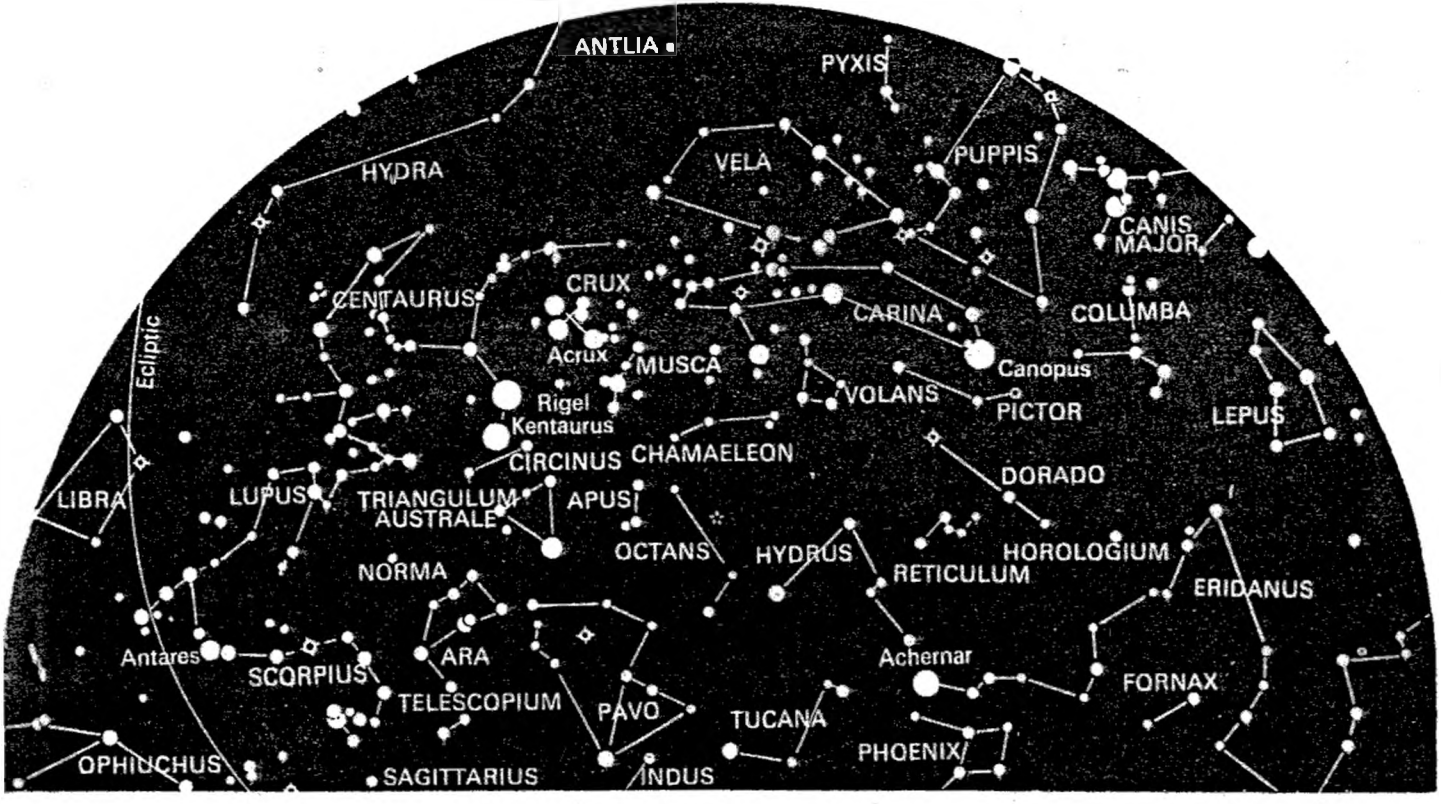
STARS OF AUTUMN EVENINGS: LOOKING NORTH

COMA BERENICES (Queen Berenice's Hair) : Coma Berenices is an open cluster of 5th and 6th magnitude stars about 15 deg. northwest of Canes Venatici. It should be observed on a clear and moonless night with binoculars when 20 to 30 stars can be seen, clearly suggesting the shape of a head of flowing hair. There are many spiral galaxies in this constellation.

LEO (The Lion) : Leo is a zodiacal constellation and quite easily recognised. The stars forming the head of the lion are arranged in the shape of a sickle, or upside-down '?'. Regulus, its brightest star, has a magnitude of 1.3 and ranks 19th among the 20 brightest stars in the sky. It lies almost exactly on the plane of the ecliptic and is therefore eclipsed by the Sun once a year (on about August 23). A meteor shower, the Leonids, radiates from the head of the lion every year about 14th or 15th of November.

STARS OF AUTUMN EVENINGS: LOOKING SOUTH

HYDRA (The Sea Serpent) : Hydra is a long constellation stretching over 100 deg. through the heavens. It is rather difficult to identify because its stars are rather faint, with the exception of Alphard, also known as Cor Hydrae, the "Dragon's Heart". Alphard is a 2nd magnitude star, red in colour, and the only bright star in the area. It forms a fat isoceles triangle with Regulus and



AUTUMN, LOOKING SOUTH

Denebola in Leo. The head of Hydra, a beautiful grouping of stars, lies directly south of the Bee-Hive cluster in Cancer.

STARS OF WINTER EVENINGS: LOOKING NORTH

CYGNUS (The Swan) : Cygnus is a beautiful and easily recognised constellation in the form of a giant cross. It is sometimes called the 'Northern Cross'. Deneb, the brilliant white star of magnitude 1.3 marks the top of the Cross or the Swan's tail. There are many bright stars in Cygnus; it lies in the galactic plane and is therefore embedded in the Milky Way. Sweep this entire area with binoculars and note the many stars.

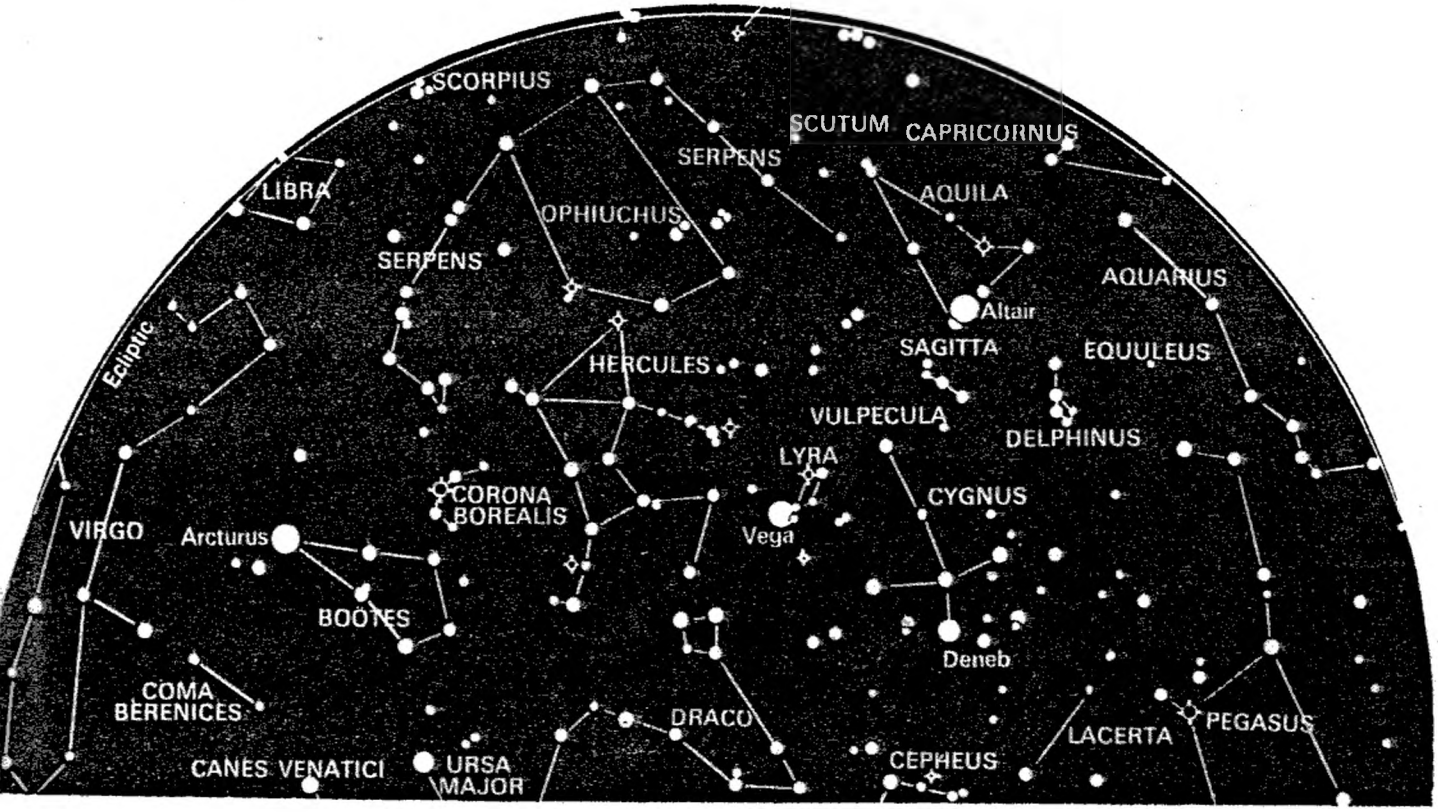
HERCULES (Hercules) : This is one of the most ancient of the constellations. The outstanding feature of Hercules is the great globular cluster, M13. On dark nights it is barely visible to the naked eye but is easily seen in binoculars. A small telescope begins to reveal its beauty, while at least a 100mm (4-inch) telescope is necessary to resolve the stars. In a large telescope, it is a never-to-be-forgotten sight. There are thought to be no less than 100 000 stars in this cluster.

LYRA (The Lyre) : Lyra is easily identified because of Vega, a brilliant white star of magnitude 0.1 and fourth brightest star in the sky. Four smaller stars lie in a faint but conspicuous parallelogram just to the southeast of Vega. Although a small constellation, Lyra is rich in stars; sweep slowly with binoculars to explore the beauty.

STARS OF WINTER EVENINGS: LOOKING SOUTH

CRUX (The Southern Cross) : This well-known constellation consists four bright stars in the shape of a cross, with a fifth, less-bright star depicting the misplaced centre of the cross. It is a useful reference for finding direction, since the upright bar of the cross points toward the south celestial pole.

SAGITTARIUS (The Archer) : Sagittarius is the southernmost of the zodiacal constellations, lying between Capricorn in the east and Scorpio in the west. The central part of Sagittarius has a group of stars resembling in shape a giant teapot with spout and handle, an aid in identifying this constellation. The stars forming the handle and dome of the teapot comprise a group of stars known as the 'Milk Dipper', another distinguishing feature. Sagittarius lies directly in the plane of the brightest part of the Milky Way. The Galactic Centre is located in this constellation. The region is very rich in star clusters and nebulae. An enormous number of stars also lie in this region of the sky and this is a grand area to scan with binoculars. Observe in binoculars the dark areas in the Milky Way; these are clouds of cosmic dust with no nearby stars to illuminate them.



WINTER, LOOKING NORTH

The famous 'Lagoon Nebula' (M8), 'Trifid Nebula' (M18) and Swan Nebula (M17) are also located in this constellation, but require large telescopes for detailed observation.

SCORPIUS (The Scorpion) : Scorpius is a very conspicuous zodiacal constellation lying just south of Ophiuchus. It is the most aptly named of all the constellations, bearing considerable resemblance to a giant scorpion with its sting poised to strike. Antares, a giant red star, is the brightest star in the constellation with a magnitude of 1.2, making it the 16th brightest star in the sky. It is a supergiant star: if it were in the Sun's position, its diameter (650 000 000 km) would engulf the orbits of the asteroids between Mars and Jupiter. Its density is very low; on Earth it would be considered a vacuum. There are many objects worth observing with binoculars in this constellation; it lies in the Milky Way and is rich in countless stars. M6 and M7 are open clusters visible to the naked eye and striking when viewed with binoculars.

STARS OF SPRING EVENINGS: LOOKING NORTH

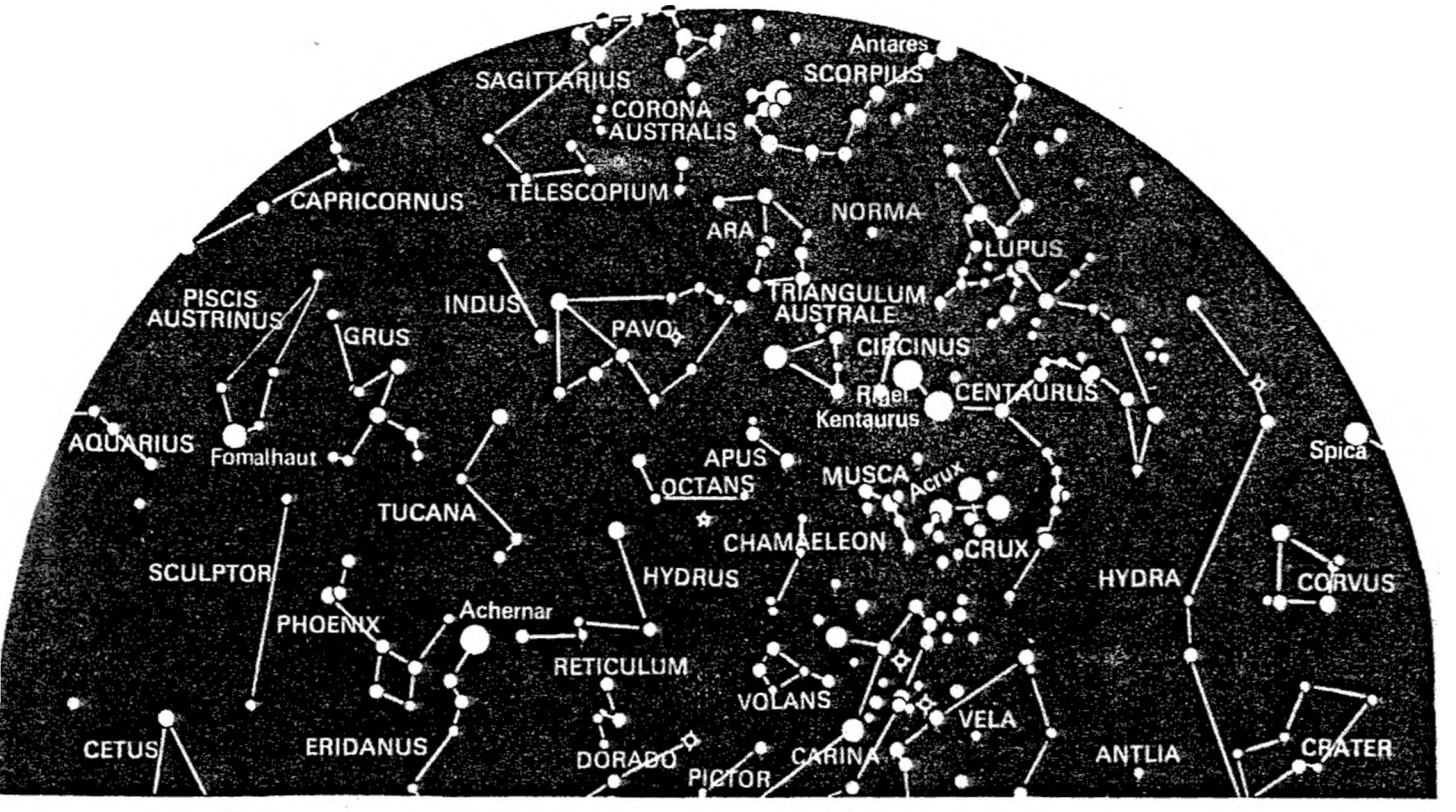
DELPHINUS (The Dolphin) : Delphinus is a compact, attractive group of five rather faint stars between Sagitta and Equuleus. It takes little imagination to picture a leaping dolphin. This is a splendid area for sweeping with binoculars as there are many striking objects.

PEGASUS (The Flying Horse) : The feature of this constellation is the so-called Great Square of Pegasus. The bottom right-hand star, Alpheratz, actually belongs to the constellation of Andromeda as well. The Square of Pegasus is conspicuous enough, though not perhaps quite as striking as it looks on star charts. One rather interesting experiment may be done: look inside the square and see how many stars can be counted with the naked eye. Then use binoculars and note how many more stars come into view. The difference is quite remarkable.

STARS OF SPRING EVENINGS: LOOKING SOUTH

ERIDANUS (The River) : Eridanus is a quite extensive, winding constellation of faint stars that cannot be seen in its entirety. It begins just to the west of the left foot of Orion and traces a long sinuous line heading generally westward, then curving south and back to the east, eventually ending in the star Archenar.

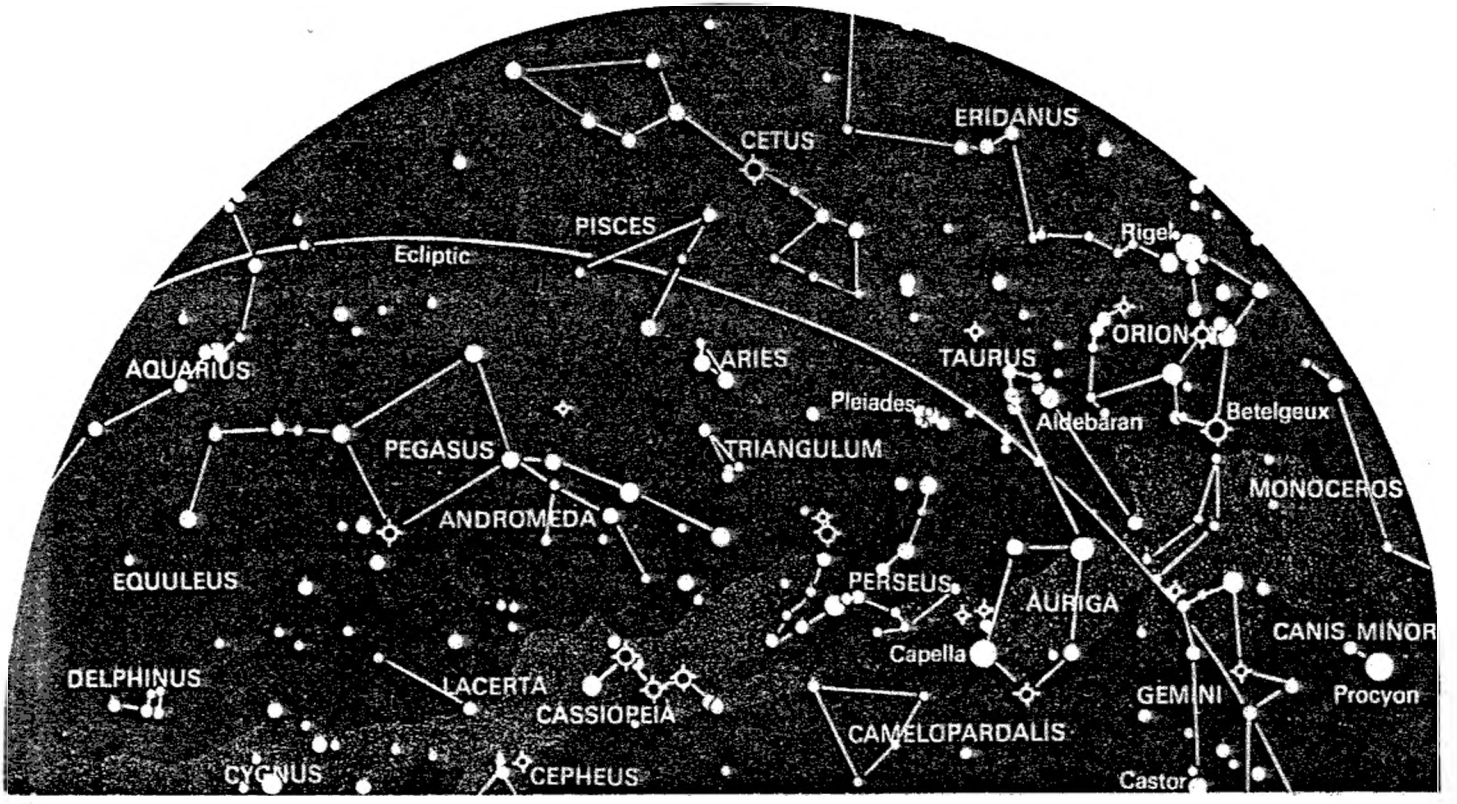
GRUS (The Crane Bird) : Grus being a kite-shaped figure of four stars can be mistaken for the Southern Cross, but it is one of the Southern Birds, of which there are four - Grus (the Crane Bird), Phoenix (the Phoenix), Tucana (the



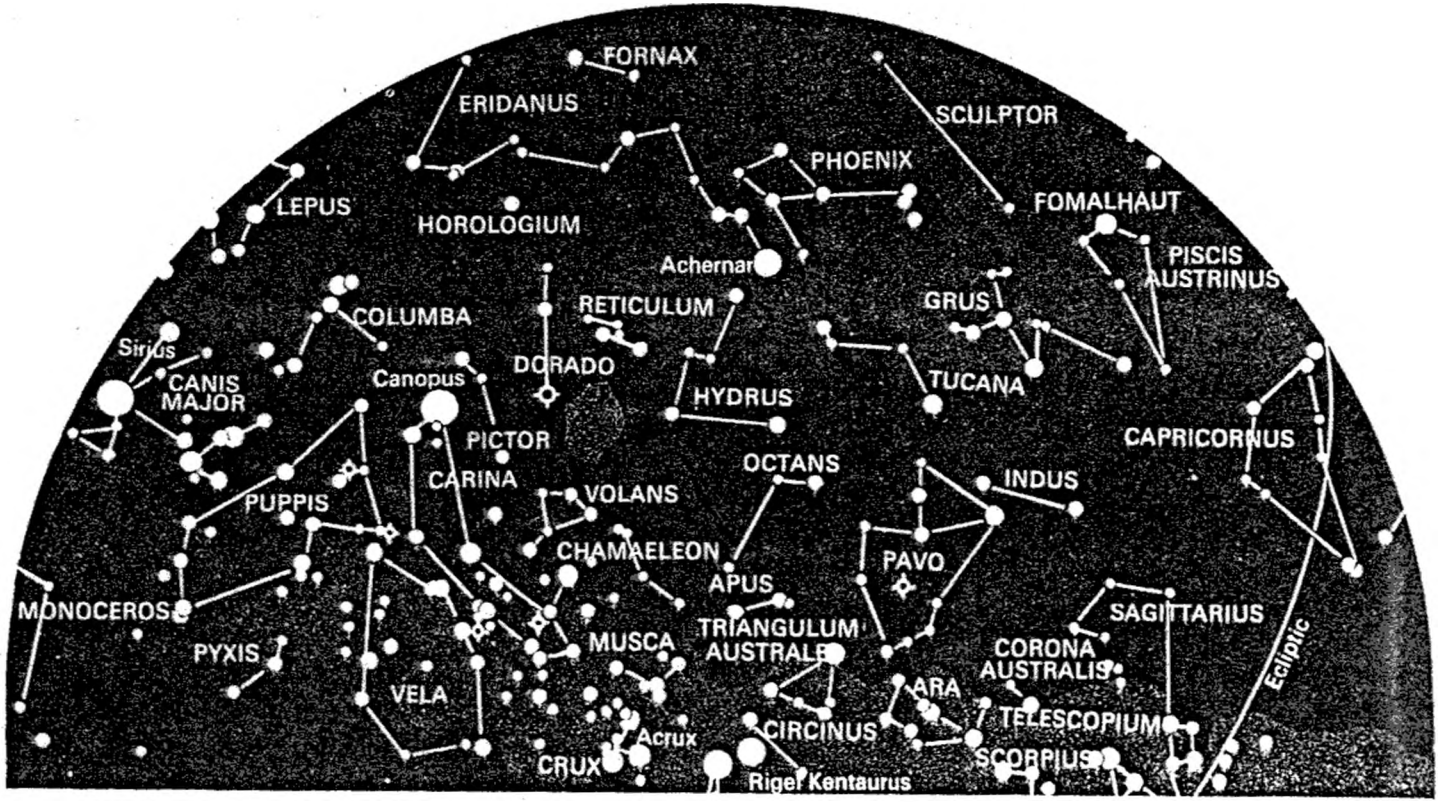
WINTER, LOOKING SOUTH

Toucan) and Pavo (the Peacock). Of all the regions in the sky, this is probably one of the most difficult to 'sort out', partly because there are no obvious signposts and partly because of all the Birds, only Grus has a definite shape.

DORADO: (The Goldfish) One of the nearest of the external galaxies is located in the constellation of Dorado. The Large Magellanic Cloud appears to the naked eye like a detached Milky Way and is even bright enough to be visible in full moonlight. The Small Magellanic Cloud is located in Tucana. These two galaxies were discovered by Portuguese seamen in the 15th century and later named in honour of Ferdinand Magellan.
The Magellanic Clouds are irregular galaxies, members of the Local Group, and close enough to be regarded as possibly satellites of the Milky Way. According to recent studies the Large Magellanic Cloud is at a distance of about 190 000 light years, and the Small Magellanic Cloud about 200 000 light years. Owing to their positions in the far southern sky, the Clouds only been observed with telescopes in Australia and South Africa.
The two Clouds are some 22 degrees apart in the sky, corresponding to an actual separation of about 80 000 light years, centre to centre.



SPRING, LOOKING NORTH



SPRING, LOOKING SOUTH

CHARACTERISTICS OF STARS

SIZE

Supergiants are the largest stars and range from 100 to 1 000 times the diameter of the Sun.

Giants are very large stars whose diameter may be from 10 to 100 times larger than that of the Sun.

Main sequence stars range in size from smaller than Earth to several times the diameter of the Sun.

COLOUR (as an indicator of temperature)

Colour	Surface Temperature	Example
Blue-white	20 000 to 33 000 deg. C.	Rigel in Orion
White	11 000 deg. C.	Vega in Lyra
Yellow-White	6 000 deg. C.	Capella in Auriga
Orange	4 200 deg. C.	Arcturus in Bootes
Red	3 100 deg. C.	Antares in Scorpius

SPECTRAL CLASS

Stars are also classified according to their spectra, i.e. the physical and chemical characteristics that are revealed by the spectroscope. Each of the 11 spectral classes of stars is designated by a letter:

W O B A F G K M R N S

To enable astronomers to remember the classification a mnemonic has been devised:

Wow Oh Be A Fine Girl Kiss Me Right Now Sweetheart

Over 99% of the approximately 250 000 stars classified according to their spectra, however, belong to the spectral classes of O, B, A, F, G, K and M. Each spectral class is further subdivided by ten numerals ranging from 0 to 9 (eg. B1 A5 G0 etc) to accomodate the small differences in spectral lines within a major class.

MAGNITUDE

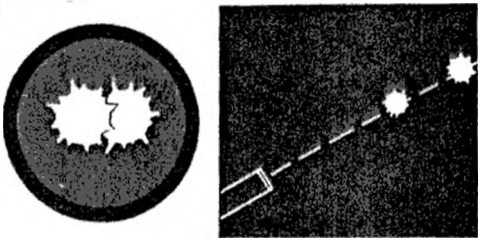
Magnitude is the classification of stars according to their brightness, calculated by two standards:

Absolute magnitude - the measure of a star's brightness at a distance of 10 parsecs (1 parsec = 3.26 light years).

Apparent magnitude - the measure of a star's brightness as seen from Earth, which is determined by two factors: its distance and its absolute magnitude.

TYPES OF STARS

Double star - one that appears as a single star to the naked eye but is revealed to be two stars when viewed through a telescope. The two stars are not necessarily contiguous or bound together by gravity, but may simply be in the same line of sight.

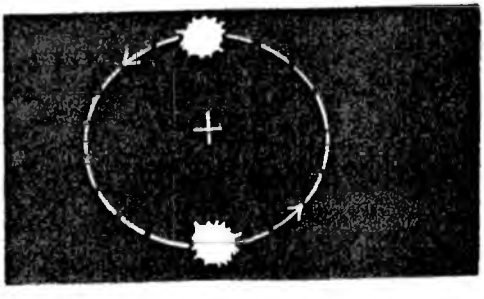


Binary star - a double star whose two member stars form their own system in that they revolve around a common centre of gravity. Types of binary stars are:

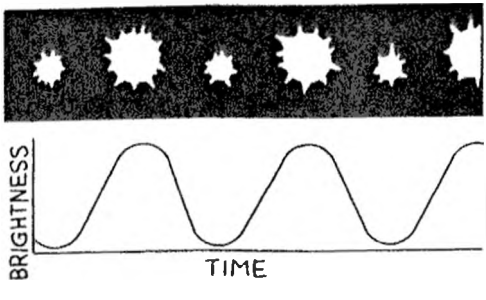
Visual - a binary that will appear as two stars when viewed through a telescope.

Spectroscopic - a binary whose two stars are so close together that they cannot be seen separately through a telescope but are revealed as two stars through spectroscopic observation.

Eclipsing - a binary whose two stars orbit in such a plane as to eclipse each other.



Variable star - a star that has a cycle of varying brightness. Brightness ranges from a minimum within each cycle, and variation can be as long as several years or as short as a few hours.



ERRATA

ASTRONOMICAL YEARBOOK FOR 1986

Please substitute the following Comet Rising Times for those given on page 47 of the Yearbook.

COMET HALLEY : APPROXIMATE RISING TIMES AND POSITIONS ABOVE HORIZON

DATE :	RISING TIME :	POSITION ABOVE HORIZON
February 20th	04.20 a.m.	At 5 a.m. 10° South of East and 10° above the horizon
March 1st	03.15 a.m.	At 5 a.m. 7° South of East and 22° above the horizon.
March 11th	02.20 a.m.	At 4 a.m. 12° South of East and 24° above the horizon.
March 21st	00.50 a.m.	At 3 a.m. 19° South of East and 26° above the horizon.
March 31st	10.50 p.m.	At Midnight 35° South of East and 22° above the horizon.
April 10th	Already above horizon by sunset.	At 8 p.m. 43° South of East and 21° above the horizon.
April 20th	Visible all night.	At 8 p.m. 18° South of East and 63° above the horizon.

PLANETARIUM

P.O. Box 31149, Braamfontein, 2017, JHB. Tel.: 716-3038
University of the Witwatersrand, Yale Road, Milner Park,
Johannesburg, 2001.

MARCH, 1986.

TO : FRIENDS OF THE PLANETARIUM

As stated in the February, 1986 issue of the Planetarium Newsletter, we are sending a copy of our "Astronomical Yearbook" for 1986 to all of you who have sent your R15 for 1986. You will receive a third envelope towards the middle of the year containing information on the Halley visit and a final Newsletter at the end of 1986 to guide your night sky viewing in 1987. After that the Planetarium Newsletter will be discontinued.

We are including another leaflet giving the new show times, which will be in force as long as public interest in Halley's Comet lasts. We have had to turn people away on many occasions because the auditorium was packed to capacity.

Two new shows have been introduced. There will be 2 extra English shows; one on Wednesday night at 8pm and one on Sunday at 6pm.

EXCEPTIONS: No shows on Wednesday 26 March at 8pm or Sunday 6 April at 6pm

Enquiries : (011) 716-3199

REVISED SHOW TIMES AND PRICES:

Evenings :	*Wednesday, Thursday & Friday*	*8.00pm*
Matinees :	*Saturday*	*3.00pm*
	Sunday	*4.00pm & 6.00pm*
Special Afrikaans Programme		
	Saturday	*8.00pm*

Prices :	*Adults*	*R3.50*
	Children	*R2.25*

----------oooOOOooo----------

D O N ' T M I S S H A L L E Y ! ! !

The first good viewing period for Comet Halley has arrived!

From the 9th to 20th March, 1986 the comet will be in the morning sky about 25 degrees about East at 4.00am. If you can get away from street lights, if the sky is clear and there are no big buildings, trees or mountains on your Eastern horizon, you will be able to find it easily with the naked eye. It is even easier to locate through binoculars.

After the 20th March the Moon starts interfering but from about 7th April to 14th April viewing conditions improve again and Comet Halley will be visible for most of the night, rising in the South East around 9.00pm it will be high (70 Deg) above the South after midnight, only setting after sunrise.

First reports on Comet Halley from space craft should be coming in soon. Spacecraft Giotto's exciting encounter when it will fly through Comet Halley's tail just about 500 kilometers behind the nucleus, will be on 13th March and excitement is mounting. The big question is: will Giotto survive the close approach?

We wish you good viewing and clear skies when you look at the Comet.

Do make sure that all the children in your family have a chance to see Halley. They'll remember it until the next time around in 2061.

M. Hurley asked that this be
circulated to the SAAO Council
Members who work at SAAO

ISG ✓

TLE ✓ Chart on pp 41, 43 are totally inadequate.
✓ Constellation note inadequate. Dr S Hon — no
mention of 9 Ca, 10 Cen, 47 Tuc, 0 Carina Cruc,
Delphinus in wrong season. P63 superfluous, Errors.

JSJ

J ✓ P 27 and Errata: For what lat, long are these
rising times calculated. Position of Uranus w.r.t
a given for Feb, Mar but omitted in Jan. (p2)

MWF ?

Dr Sloss ⇒

⇒ ISG