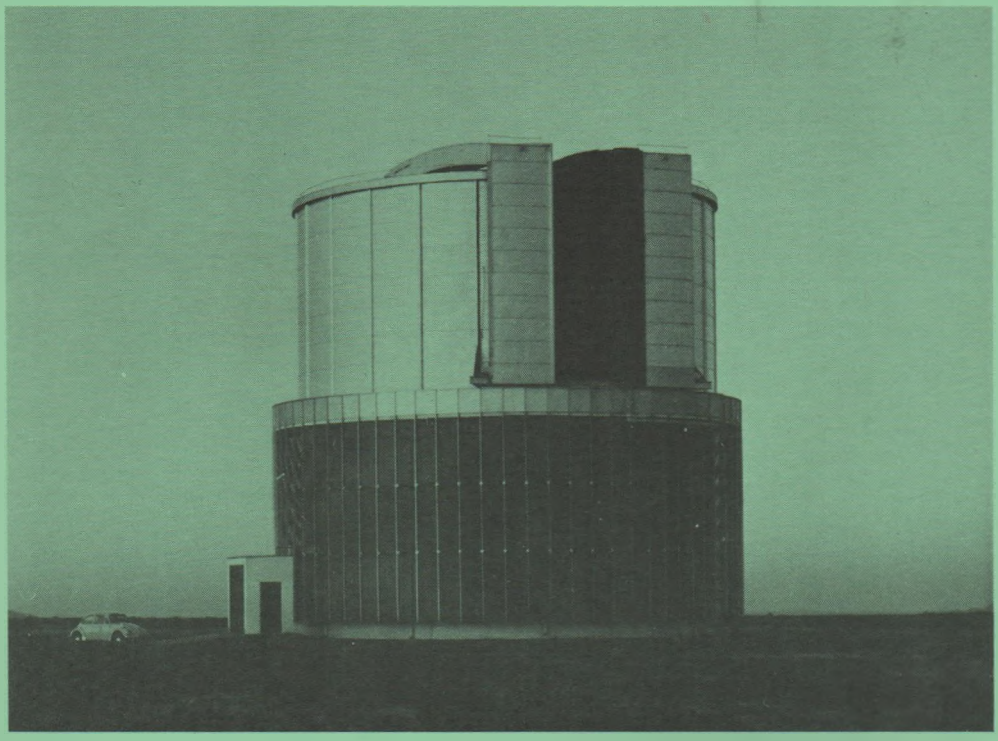
ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1984



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PREDICTED PERIHELION PASSAGES OF COMETS 1984

Periodic comet	Perihelion Date	Revolution Period years	Perihelion Distance au	Magnitude
Tritton	Mar 3	6.36	1.44	18.9
Encke	Mar 27	3.30	0.34	8.7
Wolf	May 31	8.21	2.42	19.1
Schuster	June 2	7.25	1.53	19.7
Gehrels 3	June 3	8.14	3.44	18.4
Tsuchinshan 2	July 21	6.85	1.79	20.0
Wild 2	Aug 20	6.18	1.49	11.9
Wolf-Harrington	Sep 23	6.53	1.62	16.6
Neujmin 1	Oct 8	18.21	1.55	12.5
Arend-Rigaux	Dec 1	6.84	1.45	16.0
Haneda-Campos	Dec 26	6.27	1.22	15.2

The expected magnitude at the time when the comet will be at its brightest after perihelion passage is as quoted above.

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This booklet is intended both as an introduction to observational astronomy for the interested layman – even if his interest is only a passing one – and as a handbook for the established amateur or professional astronomer.

FRONT COVER

The 1.8m reflecting telescope at Sutherland. This is the largest telescope in South Africa and was formerly at Radcliffe Observatory, Pretoria.

CONTENTS

NOTE

This handbook is produced for the Astronomical Society of Southern Africa. The data it contains has been adapted for Southern Africa from data obtained from the Royal Greenwich Observatory, Herstmonceux, from the British Astonomical Association, the International Lunar Occultation Centre, Tokyo and the Hydrographer of the South African Navy.

All correspondence concerning this booklet should be addressed to the Handbook Editor, Astronomical Society of Southern Africa, 8 Glebe Road, Rondebosch, 7700 from whom further copies are available at R2.00 per copy.

Although every care has been taken in the compilation of the Handbook, it is sold and distributed on the explicit understanding that neither the Society or any of its members accepts any responsibility for errors therein.

Dit spyt ons dat as gevolg van beperkte fondse en produksiefasiliteite dit nie moontlik is om die handboek in Afrikaans te laat druk nie.

R F HURLY
EDITOR

ASTRONOMY IN SOUTHERN AFRICA

As one of the few parts of the Earth having both access to the rich southern skies and a suitable climate, Southern Africa holds a favoured position in astronomy. Consequently, it has seen the establishment of a number of professional observatories engaged in research while many individuals have become enthusiastic amateur astronomers. Planetaria and visiting nights at observatories convey to the general public much of what goes on in this field.

Observatories

The South African Astronomical Observatory (S.A.A.O.), was established in 1972, as a joint venture between the Council for Scientific and Industrial Research of South Africa and the Science Research Council of Great Britian, combining the facilities of the former Royal, Republic and Radcliffe Observatories, and is directed by Dr M W Feast. Its excellent observing site near Sutherland, in the Karroo, has four instruments, namely the 1.8m, 1.0m, 0.75m and 0.5m telescopes. The headquarters are in Cape Town, where also a limited amount of observing continues. Research is undertaken in many areas, with considerable effort being put into the study of variable stars, the Magellanic Clouds, the Galactic centre and globular clusters as well as optical studies of celestial X-ray sources. These studies involve the use of spectroscopic, photometric and infrared techniques. Besides providing research facilities for its own staff S.A.A.O. observing time is allocated to astronomers from Great Britian and from South African Universities.

The 0.67m visual refractor of the former Republic Observatory, Johannesburg, is maintained by the National Institute for Telecommunications Research (N.I.T.R.).

The National Radio Astronomy Observatory at Hartebeeshoek, near Krugersdorp, is, under the direction of Dr G Nicolson, operated by the NITR. The telescope, a 26m dish, is used for observations of extragalactic radio objects such as quasars and X-ray sources. The Rhodes University Radio Astronomy Group led by Prof E.E. Baart use this telescope, currently in a survey of the entire southern sky at 13cm wavelength.

Boyden Observatory, situated at Mazelspoort, 25km from Bloemfontein, is operated by the Department of Astronomy of the University of the Orange Free State, under the leadership of Prof A. H. Jarrett. The site offers good conditions, without being remote from a large centre, and observing facilities include the 1.52m Rockefeller Reflector, and the 0.41m Nishimura Reflector. Research covers essentially the two areas of flare stars, and interferometry of the sun.

In addition to the professional observatories mentioned above, South Africa and Zimbabwe have numerous private observatories, built and operated by amateur astronomers.

Observatories Open to the Public

S.A.A.O. Headquarters, Observatory, Cape are open to visitors on the second Saturday of each month at 8.00 pm. It is unnecessary to give prior notification of intention to visit, unless there are more than ten persons in a party. Day visits are possible to the S.A.A.O. observing site near Sutherland, and enquiries should be made to Sutherland prior to the intended visit.

Visiting nights at Boyden Observatory are generally held around the time of first quarter. Enquiries should be made to the Observatory. Numbers are restricted to twenty persons on each ocassion.

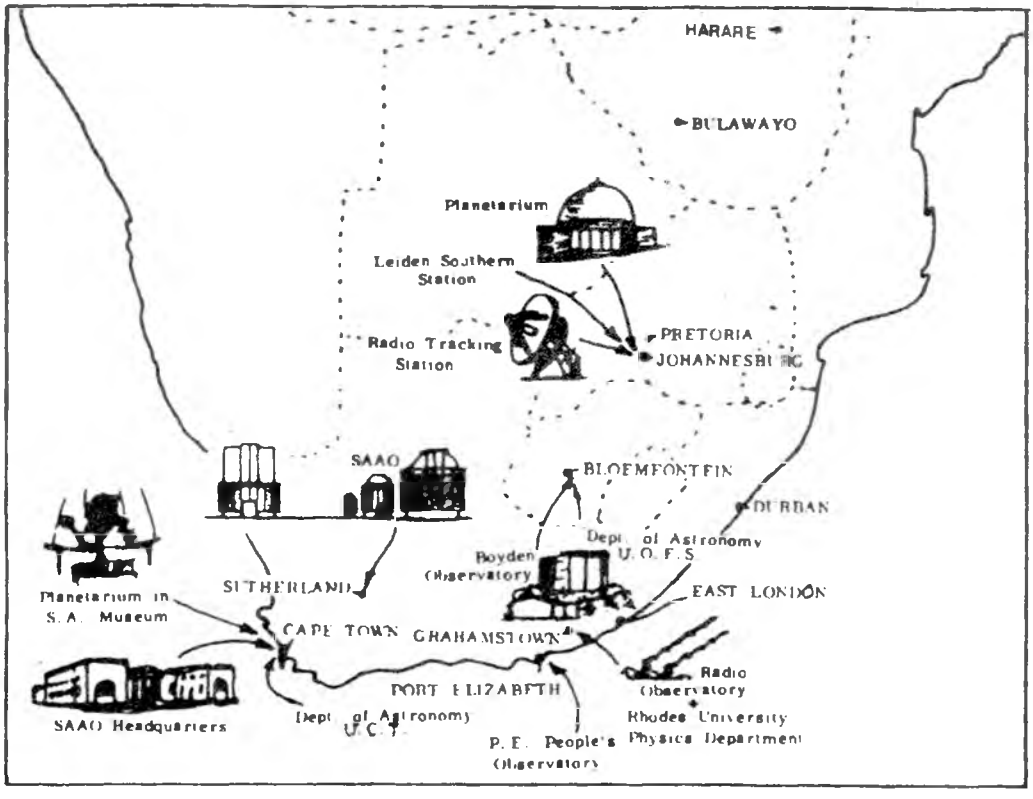
Planetaria

The major planetarium in South Africa is that situated on the grounds of the University of Witwatersrand (entrance in Yale Road, alongside M1). It is equipped with a highly complex Zeiss projector and seats over 400 persons.

A small planetarium, with a Spitz projector and seating approximately 70, is located within the South African Museum, Cape Town. Shows are given each weekend, at 3.00 pm on Saturday, and 3.30 pm on Sunday, and at 11.00 am and 3.30 pm on public holidays. Further information can be obtained by phoning the museum at 41 2668.

Teaching Departments

Both the University of Cape Town and University of the Orange Free State have departments of astronomy. The chair of astronomy at U C T is occupies by Prof Brian Warner, whose department uses the S.A.A.O. observing facilities at Sutherland. Professor G F R Ellis of the Department of Applied Mathematics, U C T heads a group carrying out research in theoretical cosmology. The U O F S department, incorporated with the Boyden Observatory is headed by Prof A H Jarrett. The Physics Department of Rhodes University specialises in radio astronomy, and has its own observatory outside Grahamstown. The Department of Mathematics, Applied Mathematics and Astronomy at U N I S A offers a number of courses in astronomy and astrophysics.



THE ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

The Astronomical Society of Southern Africa is a body consisting of both amateur and professional astronomers. Membership is open to all interested persons, regardless of knowledge or experience. In addition to this handbook, the Society issues "The Monthly Notes of the Astronomical Society of Southern Africa" (MNASSA). Members also receive copies of "Sky and Telescope", an excellent and very popular monthly magazine published in the United States. It provides up to date information on both professional and amateur activities, together with news of space research and other related subjects. The Society's annual subscription is R25-00 and there is an entrance fee of R5-00. Information can be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, c/o The South African Astronomical Observatory, P O Box 9, Observatory, 7935, Cape.

LOCAL CENTRE OF THE SOCIETY

Autonomus local Centres of the Society hold regular meetings in Cape Town, Durban, Johannesburg, Bloemfontein, Pietermaritzburg, Pretoria and Harare. Visitors are very welcome at meeting and may, if they wish, join a Centre, without becoming a full member of the Society. Centre members do not receive society publications nor Sky & Telescope.

CAPE CENTRE (Cape Town) - meetings on 2nd Wednesday of the month (except January and December) at the South African Astronomical Observatory at 8.00 pm.
The Centre possesses a small observatory housing the 30cm Ron Atkins Telescope. Secretarial address: c/o S.A.A.O., P. O. Box 9, Observatory, 7935. Information on meetings also available from telephone (day time) 69 8531 Ext 256, 2102532 evenings 614534.

TRANSVAAL CENTRE (Johannesburg) - general meetings are held on 2nd Wednesday of each month excluding December in the Sir Herbert Baker Bulding, Republic Observatory, Observatory at 20h00 when a formal lecture is delivered. On this site the Christos Papadopoulos dome houses a combined instrument, comprising of 30 cm cassegrain telescope arranged for photo-electric photometry, and two refracting telescopes of 18 and 15 cm aperture, which is available to members of the Centre. Public observing evenings are held occasionally and there are sections catering for the observation of variable stars and grazing occultations. Secretarial Address: W G C Jacobs, Private Bag X7, Parkview, 2122 Telephone: 011/6465959

NATAL CENTRE (Durban) - regular monthly meetings are held on the 3rd Wednesday of each month in St. Paul's Church Hall, Church Street, Durban (opposite the GPO) at 7.45 pm. The Natal Centre publishes a monthly booklet "NDABA", which contains news and views and current information on astronomical and related topics.
Secretarial Address: c/o P O Box 840, Durban. 4000
Telephone: 842321 (W) and 844751 (H)

NATAL MIDLANDS CENTRE (Pietermaritzburg) - meetings are held on the 2nd Wednesday of the month (except January) at the College for Further Education and Training, Havelock Road at 7.45 pm and occasionally at private homes. Information on meetings and membership is available from the Secretary, P. O. Box 330, Hilton 3245. Telephone No: 0331/24 074 or 54 038

BLOEMFONTEIN CENTRE - meetings are held every 3rd Wednesday of the month. For further information contact Mr F C Neser, Telephone 051/221142, 108 Japie Neser Street, Uitsig,Bloemfontein.

PRETORIA CENTRE - meetings are held on the 4th Wednesday of the months - January, March, May, July, September and November at 8.00pm, the venue alternating between the Main Academic Building of the University of South Africa and the Christian Brother's College, Silverton Road. The Centre's observatory containing a 32cm reflector is situated on the latter site. For further information contact the Secretary, Mr J C Bennett, 90 Milan Street, Riviera, Pretoria,0084.Telephone 012/704895

HARARE CENTRE- the centre holds fairly frequently meetings, usually at 8.00 pm at which talks on various subjects are given and/or films shown. In addition, social "star-gazing" sessions are arranged at intervals, at which telescopes are set up by those members who possess them and made available for observing by all members present. The address of the Harare Centre is P. O. Box UA 428, Union Avenue, Harare and the Hon. Secretary (to whom communication should be addressed) is Mr W L Stedman 3 Essex Road, Avondale, Harare.

OBSERVING SECTIONS OF THE SOCIETY

These sections exist to co-ordinate and encourage constructive observing programmes. Mention of the type of observations and equipment involved are made in the appropriate parts of this handbook together with the names and addresses of the directors.

CONFIGURATIONS OF SUN, MOON AND PLANETS

JANUARY

d	h	
3	07	NEW MOON
4	00	Earth at perihelion
8	05	Venus 7° N of Antares
10	15	Venus 1°.8 N of Uranus
11	03	Mercury stationary
11	12	FIRST QUARTER
19	15	FULL MOON
19	20	Jupiter 0°.9 S of Neptune
22	03	Mercury greatest elong. W (24°)
24	02	Spica 7° S of Moon
25	07	LAST QUARTER
25	10	Mars 1°.6 S of Moon
26	01	Venus 0°.03 N of Neptune
26	03	Saturn 0°.2 S of Moon Occ^{n}
27	04	Venus 0°.8 N of Jupiter
29	05	Uranus 0°.2 S of Moon Occ^{n}
29	15	Neptune 3° N of Moon
29	18	Jupiter 1°.8 N of Moon
30	00	Venus 3° N of Moon
30	23	Mercury 3° N of Moon
31	20	Vesta stationary

FEBRUARY

d	h	
2	02	NEW MOON
6	11	Pallas in conjunction with Sun
9	21	Pluto stationary
10	06	FIRST QUARTER
15	15	Mars 0°.8 S of Saturn
17	03	FULL MOON
20	16	Spica 6° S of Moon
22	11	Saturn 0°.3 N of Moon Occ^{n}
22	16	Mars 0°.3 S of Moon Occ^{n}
23	19	LAST QUARTER
24	12	Uranus 0°.2 N of Moon Occ^{n}
25	08	Saturn stationary
25	22	Neptune 3° N of Moon
26	10	Jupiter 2° N of Moon
29	05	Venus 4° N of Moon

MARCH

d	h	
2	21	NEW MOON
8	19	Mercury in superior conjunction
10	16	Vesta 1°.1 S of Moon Occ^{n}
10	20	FIRST QUARTER
17	12	FULL MOON
18	08	Uranus stationary
19	03	Spica 6° S of Moon
20	12	Equinox
20	20	Saturn 0°.6 N of Moon Occ^{n}
21	15	Mars 0°.4 N of Moon Occ^{n}
22	20	Uranus 0°.5 N of Moon Occ^{n}
22	22	Ceres in conjunction with Sun
24	05	Neptune 3°N. of Moon
24	10	LAST QUARTER
24	23	Jupiter 3°N. of Moon
30	14	Venus 4°N. of Moon

APRIL

d	h	
1	14	NEW MOON
2	16	Neptune stationary
3	02	Mercury 6° N of Moon
3	05	Mercury greatest elong. E (19°)
5	04	Mars stationary
7	13	Vesta 1°.2 S of Moon Occ^{n}
9	07	FIRST QUARTER
12	02	Mercury stationary
15	14	Spica 6° S of Moon
15	21	FULL MOON
17	01	Saturn 0°.6 N of Moon Occ^{n}
18	00	Mars 0°.04 S of Moon Occ^{n} (visible north of line Grootfontein - Durban)
19	05	Uranus 0°.6 N of Moon Occ^{n}
20	14	Neptune 3° N of Moon
20	18	Pluto at opposition
21	11	Jupiter 3° N of Moon
22	07	Mercury in inferior conjunction
23	02	LAST QUARTER
29	22	Jupiter stationary
30	02	Mercury 0°.7 N of Venus

MAY

d	h	
1	06	NEW MOON
3	10	Saturn at opposition
4	15	Mercury stationary
8	14	FIRST QUARTER
11	11	Mars at opposition
12	23	Spica 6° S of Moon
14	10	Saturn 0°.5 N of Moon Occ^{n}
14	21	Mars 2° S of Moon
15	06	FULL MOON Penumbral Eclipse
16	13	Uranus 0°.6 N of Moon Occ^{n}
17	22	Neptune 3° N of Moon
18	19	Jupiter 3° N of Moon
19	13	Mars closest approach
19	22	Mercury greatest elong. W (26°)
22	20	LAST QUARTER
28	20	Mercury 1°.0 S of Moon Occ^{n}
30	19	NEW MOON Eclipse

JUNE

d	h	
2	00	Uranus at opposition
6	19	FIRST QUARTER
9	06	Spica 6° S of Moon
10	15	Saturn 0°.2 N of Moon Occ^{n}
10	16	Mars 4° S of Moon
12	20	Uranus 0°.5 N of Moon Occ^{n}
13	03	Mercury 5° N of Aldebaran
13	17	FULL MOON Penumbral Eclipse
14	06	Neptune 3° N of Moon
15	00	Jupiter 3° N of Moon
16	01	Venus in superior conjunction
20	12	Mars stationary
21	07	Solstice
21	08	Neptune at opposition
21	13	LAST QUARTER
23	04	Mercury in superior conjunction
29	05	NEW MOON
29	18	Jupiter at opposition

DIARY OF PHENOMENA 1984

CONFIGURATIONS OF SUN, MOON AND PLANETS

JULY

d	h	
3	08	Earth at aphelion
3	16	Mercury 5° S of Pollux
5	23	FIRST QUARTER
6	12	Spica 6° S of Moon
7	19	Saturn 0°.1 N of Moon Occ^n
8	00	Mars 4° S of Moon
10	01	Uranus 0°.4 N of Moon Occ^n (visible south of line Port Nolloth - Komatipoort)
11	15	Neptune 3° N of Moon
11	22	Pallas stationary
12	01	Jupiter 3° N of Moon
13	04	FULL MOON
14	06	Saturn stationary
16	04	Pluto stationary
21	06	LAST QUARTER
26	07	Mercury 0°.8 S of Regulus
28	14	NEW MOON
30	09	Mercury 7° S of Moon

AUGUST

d	h	
1	02	Mercury greatest elong. E (27°)
2	16	Spica 6° S of Moon
4	02	Saturn 0°.3 N of Moon Occ^n
4	05	FIRST QUARTER
5	00	Mars 3° S of Moon
6	06	Uranus 0°.5 N of Moon Occ^n
7	07	Venus 1°.1 N of Regulus
7	17	Neptune 3° N of Moon
7	17	Juno in conjunction with Sun
8	03	Jupiter 2° N of Moon
10	04	Vesta in conjunction with Sun
11	18	FULL MOON
14	03	Mercury stationary
16	20	Mercury 6° S of Venus
18	08	Uranus stationary
19	22	LAST QUARTER
26	21	NEW MOON
28	05	Venus 4° S of Moon
28	17	Mercury in inferior conjunction
29	25	Jupiter stationary
30	02	Spica 5° S of Moon
31	11	Saturn 0°.5 N of Moon Occ^n

SEPTEMBER

d	h	
2	09	Mars 1°.7 S of Moon
2	12	FIRST QUARTER
2	12	Uranus 0°.8 N of Moon Occ^n
3	05	Mars 2° N of Antares
3	22	Neptune 4° N of Moon
4	05	Mercury 3° S of Regulus
4	07	Jupiter 3° N of Moon
4	13	Mars 2° S of Uranus
6	10	Mercury Stationary
6	11	Pallas at opposition
8	14	Mercury 1°6 S. of Regulus
10	01	Neptune Stationary
10	09	FULL MOON
14	03	Mercury greatest elong. W.(18°)
18	12	LAST QUARTER
19	17	Venus 3° N. of Spica
22	03	Ceres Stationary
22	23	Equinox
25	05	NEW MOON
27	12	Venus 2° S. of Moon
28	00	Saturn 0°9 N. of Moon Occ^n.
29	21	Uranus 1°1 N. of Moon Occ^n.

OCTOBER

d	h	
1	05	Neptune 4° N of Moon
1	16	Jupiter 3° N of Moon
2	00	FIRST QUARTER
3	16	Mars 3° S of Neptune
8	19	Venus 3° S of Saturn
10	02	FULL MOON
10	20	Mercury in superior conjunction
14	01	Mars 1°.9 S of Jupiter
17	23	LAST QUARTER
21	22	Vesta 0°.4 S of Moon Occ^n
23	23	Spica 5° S of Moon
24	14	NEW MOON
25	10	Pluto in conjunction with Sun
26	17	Pallas stationary
27	02	Venus 0°.3 S of Moon Occ^n
27	08	Uranus 1°.3 N of Moon
27	18	Venus 3° N of Antares
28	15	Neptune 4° N of Moon
29	07	Jupiter 3° N of Moon
29	22	Mercury 3° S of Saturn
29	23	Mars 2° N of Moon
30	02	Venus 1°.5 S of Uranus
31	15	FIRST QUARTER

NOVEMBER

d	h	
6	00	Spica 5° S of Moon
8	20	FULL MOON Penumbral Eclipse
10	14	Ceres at opposition
11	09	Saturn in conjunction with Sun
13	00	Mercury 2° N of Antares
13	21	Venus 3° S of Neptune
15	16	Mercury 2° S of Uranus
16	09	LAST QUARTER
19	05	Vesta 1°.1 N of Moon Occ^n
20	09	Spica 5° S of Moon
23	01	NEW MOON Eclipse
24	16	Mercury 0°.1 S of Moon Occ^n
24	23	Venus 2° S of Jupiter
25	02	Neptune 4° N of Moon
25	20	Mercury greatest elong. E (22°)
26	01	Jupiter 4° N of Moon
26	03	Venus 1°.6 N of Moon
27	23	Mars 4° N of Moon
30	10	FIRST QUARTER

DECEMBER

d	h	
2	17	Mercury 3° S of Neptune
4	23	Mercury stationary
5	20	Uranus in conjunction with Sun
6	17	Mercury 1°.8 S of Neptune
8	13	FULL MOON
14	16	Mercury in inferior conjunction
15	17	LAST QUARTER
17	16	Spica 6° S of Moon
19	23	Saturn 1°8 N. of Moon
21	18	Solstice
22	14	NEW MOON
22	21	Neptune in conjunction with Sun
23	22	Jupiter 4° N. of Moon
24	00	Mercury 3° N. of Uranus
24	19	Mercury Stationary
26	04	Venus 3° N. of Moon
26	09	Mercury 3° N. of Uranus
27	02	Mars 4° N. of Moon
28	01	Pallas 1°2 N. of Moon Occ^n.
30	07	FIRST QUARTER

THE SUN 1984

Basic Data

Diameter: 1 392 000 km (1 09 times Earth diameter)

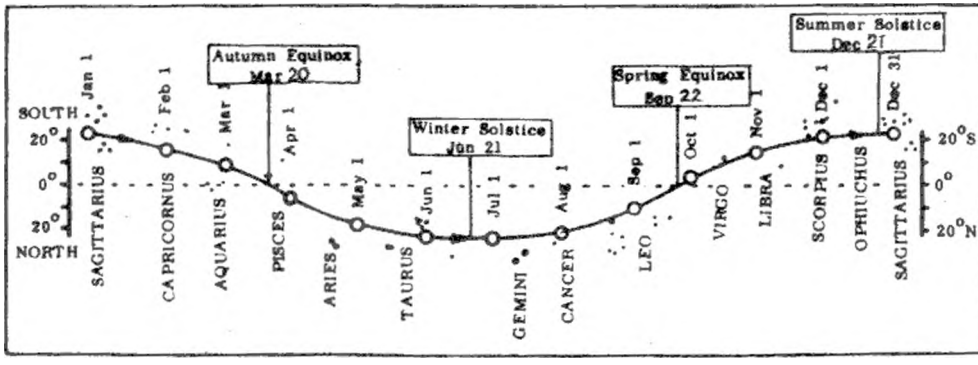
Mass: 1,99 x 10^{30}kg (330 000 times Earth mass)

Surface Temperature: Approx. 6000°C

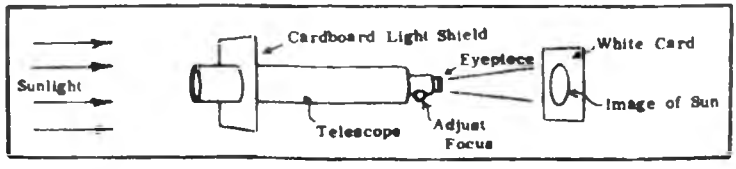
Temperature at centre: Apprx. 10 million°C

The Sun is our nearest star. It is composed chiefly of hydrogen and is in a gaseous state throughout. So hot and dense is its interior that nuclear reactions occur there - thus producing the energy that is eventually radiated from its surface. At times its surface is disturbed by sunspots (which may persist for some weeks) and flares (short lived).

The Earth's orbit round the Sun is not quite circular. In 1983 we will be closest to the Sun on January 2 (perihelion - approx. distance 147 million km) and furthest from the Sun on July 6 (aphelion - approx. 152 million km). During the year, the Sun appears to us to make a complete circuit of the sky (i.e. relative to the starry background) as indicated in the diagram.



Permanent damage to the eye can be caused by looking directly at the Sun. The diagram below shows how a small telescope (or half a binocular) may be used to project an image of the solar disk onto a piece of white card. It may also be advisable to stop down the telescope aperture so that the eyepiece is not damaged by the intense light passing through it. Tiny black sunspots are generally visible on the otherwise white solar disk - if monitored over a period of a week or so, the rotation of the Sun should be apparent.



SUN'S DECLINATION

Jan	1	23	05	S	Apr	5	6	04	N	Jul	4	22	53	N	Oct	2	3	34	S
	11	21	58	S		15	9	45	N		14	21	41	N		12	7	23	S
	21	20	08	S		25	13	11	N		24	19	53	N		22	11	02	S
	31	17	40	S	May	5	16	15	N	Aug	3	17	31	N	Nov	1	14	25	S
Feb	5	16	14	S		15	18	52	N		13	14	41	N		11	17	25	S
	15	13	02	S		25	20	57	N		23	11	28	N		21	19	54	S
	25	9	28	S	Jun	4	22	26	N	Sep	2	7	56	N	Dec	1	21	48	S
Mar	6	5	40	S		14	23	16	N		12	4	12	N		11	23	00	S
	16	1	45	S		24	23	25	N		22	0	20	N		21	23	26	S
	26	2	12	N												31	23	06	S

THE SUN 1984

TIMES OF SUNRISE AND SUNSET FOR THE MAIN CITIES OF SOUTHERN AFRICA

		CAPE TOWN		DURBAN		BLOEMFONTEIN		JOHANNESBURG		HARARE	
		sunrise	sunset	sunrise	sunset	sunrise	sunset	sunrise	sunset	sunrise	sunset
Jan	1	05h32m	20h01m	04h58m	19h01m	05h21m	19h18m	05h18m	19h04m	05h24m	18h35m
	11	05 46	20 02	05 06	19 02	05 29	19 18	05 25	19 05	05 29	18 37
	21	05 55	19 59	05 14	19 00	05 37	19 17	05 33	19 04	05 37	18 38
Feb	1	06 07	19 52	05 24	18 55	05 46	19 13	05 42	19 00	05 42	18 36
	11	06 17	19 44	05 32	18 48	05 54	19 06	05 49	18 55	05 47	18 32
	21	06 26	19 33	05 41	18 39	06 02	18 57	05 54	18 47	05 52	18 27
Mar	1	06 33	19 23	05 46	18 30	06 08	18 48	06 00	18 39	05 55	18 21
	11	06 41	19 11	05 53	18 19	06 13	18 38	06 04	18 29	05 57	18 15
	21	06 49	18 58	05 59	18 06	06 18	18 27	06 11	18 19	06 00	18 06
Apr	1	06 58	18 41	06 06	17 53	06 25	18 13	06 17	18 06	06 02	17 57
	11	07 04	18 30	06 11	17 43	06 30	18 03	06 21	17 56	06 04	17 50
	21	07 13	18 17	06 17	17 31	06 35	17 52	06 25	17 47	06 07	17 43
May	1	07 20	18 06	06 24	17 22	06 42	17 44	06 31	17 38	06 10	17 37
	11	07 28	17 57	06 31	17 14	06 49	17 36	06 37	17 31	06 13	17 32
	21	07 34	17 50	06 36	17 06	06 54	17 30	06 41	17 26	06 16	17 29
Jun	1	07 43	17 45	06 43	17 04	07 01	17 27	06 47	17 23	06 20	17 28
	11	07 48	17 44	06 48	17 03	07 05	17 26	06 52	17 22	06 23	17 27
	21	07 51	17 44	06 51	17 04	07 06	17 27	06 55	17 24	06 26	17 29
Jul	1	07 53	17 48	06 53	17 07	07 10	17 30	06 57	17 27	06 27	17 32
	11	07 51	17 52	06 51	17 11	07 06	17 34	06 55	17 30	06 27	17 35
	21	07 47	17 58	06 48	17 16	07 05	17 39	06 53	17 35	06 26	17 40
Aug	1	07 39	18 06	06 42	17 22	07 00	17 45	06 48	17 41	06 23	17 42
	11	07 30	18 13	06 34	17 29	06 53	17 51	06 41	17 46	06 18	17 46
	21	07 19	18 20	06 24	17 35	06 42	17 55	06 32	17 50	06 11	17 48
Sep	1	07 06	18 27	06 12	17 40	06 31	18 01	06 21	17 54	06 04	17 49
	11	06 52	18 34	06 00	17 46	06 19	18 06	06 11	17 59	05 55	17 51
	21	06 38	18 41	05 48	17 51	06 07	18 10	05 59	18 03	05 46	17 52
Oct	1	06 25	18 48	05 37	17 57	05 57	18 16	05 50	18 08	05 39	17 54
	11	06 12	18 55	05 25	18 03	05 45	18 22	05 39	18 12	05 30	17 57
	21	05 58	19 04	05 12	18 09	05 33	18 27	05 27	18 17	05 23	17 59
Nov	1	05 46	19 13	05 02	18 17	05 24	18 35	05 19	18 24	05 16	18 03
	11	05 38	19 23	04 55	18 26	05 17	18 44	05 13	18 32	05 14	18 08
	21	05 31	19 33	04 49	18 34	05 12	18 52	05 06	18 39	05 11	18 13
Dec	1	05 29	19 43	04 48	18 42	05 11	19 00	05 07	18 46	05 12	18 19
	11	05 28	19 50	04 48	18 50	05 11	19 07	05 08	18 53	05 14	18 25
	21	05 32	19 57	04 52	18 57	05 15	19 14	05 12	19 00	05 18	18 31

Solar Eclipses

The Annular Eclipse of the Sun on May 30 will be seen from Mexico, the south-eastern United States, Morocco and Algeria, while a partial eclipse will be seen in a belt some 30° on either side of this line. From Southern Africa nothing of the eclipse will be seen.

About midnight on the 22 - 23 November there will be a total eclipse of the Sun which will be visible from New Guinea and the South Pacific Ocean. Partial phases eill be seen from Australia and New Zealand and from Antartic and the southern tip of South America.

The Moon 1984

BASIC DATA

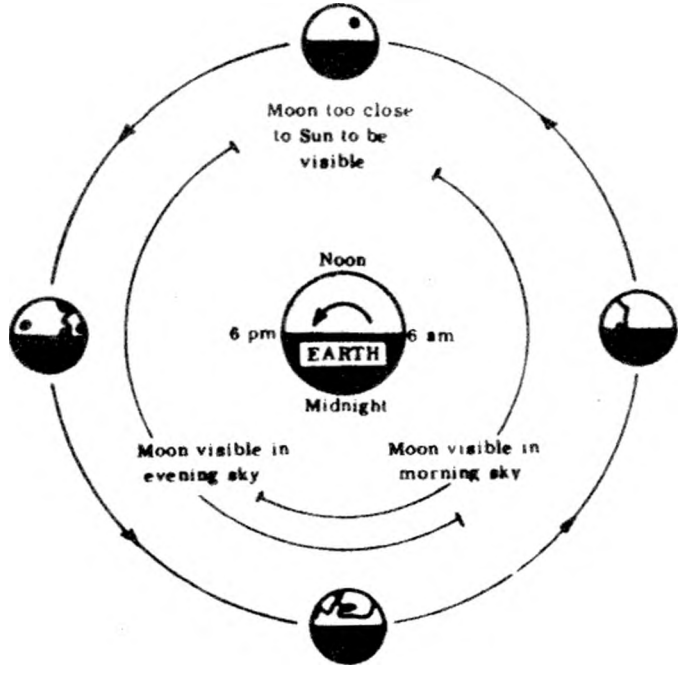
Diameter: 3 480 km (0,27 of Earth)
Mass: $7{,}35 \times 10^{22} \times$ kg (1/81 of Earth)
Surface Gravity: 0,16 of Earth
Average distance from Earth 384 000 km

PHASES AND VISIBILITY

NEW MOON

	d	h	m		d	h	m		d	h	m
Jan	3	07	16	May	1	05	45	Sep	25	05	11
Feb	2	01	46	May	30	18	48	Oct	24	14	08
Mar	2	20	31	Jun	29	05	18	Nov	23	00	57
Apr	1	14	10	Jul	28	13	51	Dec	22	13	47
				Aug	26	21	25				

SCHEMATIC DIAGRAM OF MOON'S ORBIT



FIRST QUARTER

	d	h	m
Jan	11	11	48
Feb	10	16	00
Mar	10	20	27
Apr	9	06	51
May	8	13	50
Jun	6	18	42
Jul	5	23	04
Aug	4	04	33
Sep	2	12	30
Oct	1	23	52
Oct	31	15	07
Nov	30	10	00
Dec	30	07	27

LAST QUARTER

	d	h	m
Jan	25	06	48
Feb	23	19	12
Mar	24	09	58
Apr	23	02	26
May	22	19	45
Jun	21	13	10
Jul	21	06	01
Aug	19	21	40
Sep	18	11	31
Oct	17	23	14
Nov	16	08	59
Dec	15	17	25

FULL MOON

	d	h	m		d	h	m		d	h	m
Jan	18	16	05	May	15	06	29	Sep	10	09	01
Feb	17	02	41	Jun	13	16	42	Oct	10	01	58
Mar	17	12	10	Jul	13	04	20	Nov	8	19	43
Apr	15	21	11	Aug	11	17	43	Dec	8	12	53

THE MOON'S ORBIT

Dates of Apogee, when the Moon is furthest from the Earth (approx. 407000 km) and of Perigee, when the Moon is closest to the Earth (approx. 357000 km) are given below.

	Moon at Perigee					Moon at Apogee				
	d	h		d	h		d	h		d	h
Jan	20	0	Jul	3	1	Jan	7	22	Jul	18	16
Feb	17	13	Jul	30	14	Feb	4	11	Aug	15	7
Mar	16	23	Aug	27	19	Mar	2	13	Sep	11	15
Apr	14	8	Sep	25	5	Mar	29	18	Oct	8	19
May	12	5	Oct	23	16	Apr	26	9	Nov	5	1
Jun	7	13	Nov	20	23	May	24	3	Dec	2	17
			Dec	18	12				Dec	30	14

As a result of its motion around the Earth, the Moon appears to make a complete circuit pf the heavens in just under a month. It occasionally passes in front of bright stars (details given in Occultation section - page 35) and close to visible planets (details given in Diary pages 4 and 5).

TIMES OF MOONRISE AND MOONSET

Times for Bloemfontein, Cape Town, Durban, Johannesburg and Port Elizabeth can be obtained from the tables on pages 11 to 16.

THE SURFACE OF THE MOON

In common with the inner planets of our solar system, the Moon's surface suffered bombardment by numerous minor bodies during a period 4,5 to 3,0 billion years ago. This had produced the heavily cratered topgraphy now visible. Some particularly large impacts caused large circular depressions, which were flooded by molten lava from the Moon's interior. These are the maria basins which appear smoother and darker than the rest of the surface (the latin words mare and maria come from older times when they were mistaken for seas). The maria surfaces, being younger have fewer large craters, but the entire surface is peppered with tiny craters produced by tiny bodies which have also served to plough up the ground thus forming the regolith - a layer of loose material a metre or so deep.

Lunar Eclipses

There will be no full eclipse of the Moon in 1984. Three penumbral eclipses will occur.

On May 15 the Moon enters the penumbra (half shadow) at 4.42 S A S T and leaves at 8.38. This phenomenon will be seen from all of Southern Africa till interupted by moonset.

On June 13 the penumbral eclipse will occur in mid-afternoon and so will not be seen in our longitudes.

When the Moon rises on November 8 it will already be in the partial shadow and it will leave the shadow completely by 22.12.

MAP OF THE MOON'S NEAR SIDE

LIBRATION

Due to the fact that the Moon's orbit is an elipse the speed in the orbit varies and this combined with the inclination of its orbit has the effect that we see rather more than half the entire surface of the Moon. This effect is termed Libration. Below are tabulated the days of maximum libration and the amount and direction of each libration. The direction is measured from North eastwards.

Date	Size °	P.A °	Date	Size °	P.A. °	Date	Size °	P.A. °
Jan 12	7.9	51	May 8	7.5	144	Sept 6	8.0	312
24	8.1	227	21	7.4	327	21	8.9	130
Feb 11	7.9	80	June 5	7.0	160	Oct 3	8.9	308
22	8.0	245	18	7.2	335	19	9.1	135
Mar 12	8.1	111	July 3	6.7	175	31	9.2	312
23	7.5	277	15	7.0	333	Nov 15	8.6	138
Apr 10	8.0	49	27	7.0	127	28	8.9	317
23	7.4	319	Aug 11	7.2	328	Dec 13	7.8	148
			23	8.1	118	26	8.3	324

TIMES OF MOON RISE

	JANUARY		FEBRUARY		MARCH	
	Rise	Set	Rise	Set	Rise	Set
1	03^h36^m	17^h45^m	04^h57^m	19^h00^m	04^h41^m	18^h16^m
2	04 24	18 41	05 52	19 34	05 54	18 49
3	05 15	19 33	06 46	20 15	06 26	19 19
4	06 09	20 20	07 39	20 47	07 17	19 49
5	07 04	21 03	08 30	21 17	08 09	20 19
6	07 59	21 40	09 22	21 47	09 00	20 49
7	08 52	22 14	10 13	22 16	09 53	21 22
8	09 45	22 46	11 05	22 48	10 49	21 58
9	10 34	23 16	11 59	23 22	11 46	22 39
10	11 28	23 46	12 56		12 46	23 26
11	12 20		13 56	00 00	13 47	
12	13 14	00 17	14 58	00 45	14 47	00 20
13	14 10	00 50	16 01	01 36	15 44	01 21
14	15 10	01 26	17 03	02 36	16 37	02 28
15	16 13	02 09	17 59	03 42	17 24	03 38
16	17 18	02 58	18 51	04 53	18 07	04 47
17	18 22	03 55	19 36	06 04	18 47	05 56
18	19 22	05 00	20 18	07 14	19 25	07 04
19	20 16	06 09	20 56	08 21	20 04	08 10
20	21 04	07 19	21 33	09 26	20 44	09 15
21	21 46	08 28	22 11	10 30	21 26	10 20
22	22 24	09 35	22 50	11 32	22 11	11 23
23	23 01	10 38	23 32	12 34	23 00	12 23
24	23 37	11 40		13 34	23 52	13 20
25		12 41	00 18	14 31		14 12
26	00 13	13 41	01 07	15 25	00 46	14 59
27	00 52	14 40	01 59	16 15	01 41	15 40
28	01 35	15 39	02 52	17 00	02 36	16 17
29	02 21	16 35	03 47	17 40	03 29	16 51
30	03 10	17 28			04 21	17 22
31	04 03	18 17			05 13	17 52

MOON SET - JOHANNESBURG

APRIL		MAY		JUNE	
Rise	Set	Rise	Set	Rise	Set
06^h04^m	18^h21^m	06^h38^m	17^h59^m	08^h27^m	18^h58^m
06 56	18 51	07 35	18 37	09 27	19 59
07 49	19 23	08 34	19 20	10 22	21 03
08 44	19 58	09 35	20 09	11 12	22 09
09 41	20 37	10 35	21 05	11 56	23 14
10 40	21 22	11 32	22 06	12 36	
11 40	22 13	12 25	23 10	13 14	00 18
12 39	23 11	13 13		13 49	01 20
13 36		13 56	00 16	14 25	02 22
14 28	00 13	14 36	01 21	15 03	03 25
15 16	01 19	15 13	02 25	15 43	04 29
15 59	02 27	15 50	03 29	16 28	05 33
16 39	03 34	16 27	04 33	17 17	06 36
17 17	04 41	17 01	05 38	18 11	07 38
17 55	05 47	17 50	06 44	19 07	08 34
18 34	06 53	18 37	07 49	20 06	09 25
19 16	07 59	19 29	08 52	21 02	10 10
20 01	09 04	20 24	09 52	21 57	10 49
20 50	10 08	21 21	10 46	22 50	11 23
21 42	11 09	22 17	11 33	23 42	11 55
22 37	12 05	23 13	12 15		12 24
23 33	12 55		12 51	00 33	12 54
	13 39	00 01	13 24	01 24	13 23
00 28	14 17	00 59	13 55	02 17	13 55
01 22	14 52	01 51	14 24	03 12	14 29
02 15	15 24	02 42	14 54	04 10	15 09
03 07	15 54	03 34	15 24	05 11	15 54
03 58	16 23	04 28	15 57	06 13	16 47
04 50	16 53	05 25	16 34	07 15	17 46
05 43	17 24	06 24	17 15	08 14	18 51
		07 25	18 03		

TIMES OF MOON RISE AND

	JULY		AUGUST		SEPTEMBER	
	Rise	Set	Rise	Set	Rise	Set
1	09^h07^m	19^h58^m	09^h51^m	22^h08^m	10^h20^m	
2	09 54	21 05	10 27	23 12	11 05	00 12
3	10 37	22 11	11 03		11 53	01 15
4	11 15	23 14	11 41	00 14	12 45	02 15
5	11 51		12 22	01 17	13 41	03 10
6	12 26	00 16	13 07	02 19	14 37	03 59
7	13 03	01 18	13 57	03 21	15 33	04 43
8	13 41	02 20	14 50	04 19	16 29	05 22
9	14 23	03 23	15 46	05 12	17 22	05 56
10	15 10	04 26	16 43	06 01	18 14	06 28
11	16 01	05 27	17 39	06 43	19 05	06 57
12	16 56	06 25	18 34	07 21	19 56	07 26
13	17 54	07 17	19 27	07 55	20 47	07 55
14	18 51	08 04	20 19	08 25	21 40	08 25
15	19 47	08 45	21 09	08 55	22 35	08 57
16	20 41	09 22	22 00	09 27	23 31	09 33
17	21 34	09 54	22 52	09 53		10 55
18	22 25	10 25	23 46	10 24	00 30	11 02
19	23 16	10 54		10 58	01 29	11 57
20		11 27	00 42	11 36	02 26	12 58
21	00 01	11 53	01 41	12 21	03 20	14 02
22	01 00	12 25	02 41	13 13	04 10	15 12
23	01 56	13 02	03 42	14 12	04 55	16 25
24	02 55	13 44	04 40	15 17	05 36	17 29
25	03 56	14 33	05 33	16 27	06 15	18 37
26	04 58	15 29	06 22	17 36	06 54	19 44
27	05 53	16 35	07 05	18 45	07 32	20 51
28	06 55	17 40	07 45	19 53	08 14	21 58
29	07 47	18 50	08 23	20 58	08 58	22 04
30	08 32	19 58	09 01	22 04	09 46	23 07
31	09 17	21 04	09 39	23 08		

MOON SET - JOHANNESBURG

OCTOBER		NOVEMBER		DECEMBER	
Rise	Set	Rise	Set	Rise	Set
10^h39^m		12^h17^m	01^h22^m	12^h49^m	01^h04^m
11 34	00 05	13 11	01 59	13 40	01 33
12 31	01 57	14 04	02 33	14 30	02 02
13 28	02 43	14 56	03 03	15 22	02 30
14 24	03 23	15 47	03 32	16 15	03 00
15 17	03 58	16 38	04 00	17 11	03 33
16 10	04 30	17 30	04 29	18 09	04 10
17 01	05 00	18 24	05 00	19 09	04 52
17 52	05 29	19 20	05 34	20 08	05 40
18 47	05 58	20 18	06 14	21 05	06 34
19 36	06 27	21 17	06 56	21 57	07 34
20 30	06 59	22 15	07 45	22 44	08 37
21 26	07 34	23 09	08 41	23 26	09 41
22 24	08 13	23 59	09 41		10 45
23 22	08 58		10 44	00 04	11 48
	09 43	00 44	11 48	00 40	12 50
00 19	10 46	01 25	12 52	01 15	13 52
01 13	11 48	02 03	13 56	01 51	14 56
02 02	12 53	02 40	15 00	02 29	16 01
02 47	14 00	03 16	16 05	03 11	17 08
03 28	15 06	03 54	17 12	03 58	18 15
04 07	16 13	04 35	18 20	04 51	19 18
04 45	17 20	05 20	19 28	05 49	20 16
05 23	18 27	06 11	20 35	06 49	21 07
06 03	19 36	07 07	21 36	07 50	21 51
06 47	20 44	08 06	22 30	08 49	22 29
07 34	21 51	09 06	23 17	09 45	23 03
08 27	22 54	10 05	23 57	10 39	23 33
09 23	23 50	11 02		11 31	
10 22		11 56	00 32	12 22	00 02
11 20	00 39			13 13	01 30

1984

TIMES OF MOON RISE AND MOON SET - CAPE TOWN

FOR PORT ELIZABETH SUBTRACT 28 MINUTES

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	03^h57^m	18^h41^m	05^h17^m	19^h55^m	05^h06^m	19^h06^m	06^h42^m	18^h59^m	07^h26^m	18^h26^m	09^h26^m	19^h16^m
2	04 43	19 39	06 15	20 32	06 02	19 35	07 38	19 25	08 27	19 00	10 26	20 17
3	05 34	20 31	07 12	21 04	06 58	20 03	08 35	19 53	09 29	19 40	11 20	21 23
4	06 28	21 17	08 08	21 32	07 53	20 29	09 33	20 24	10 32	20 28	12 07	22 32
5	07 25	21 57	09 03	21 59	08 48	20 55	10 34	21 00	11 34	21 23	12 47	23 41
6	08 23	22 32	09 58	22 25	09 43	21 21	11 36	21 42	12 31	22 24	13 23	
7	09 19	23 02	10 53	22 51	10 40	21 50	12 38	22 31	13 22	23 31	13 56	00 49
8	10 15	23 30	11 49	23 19	11 39	22 23	13 38	23 28	14 07		14 27	01 57
9	11 10	23 57	12 47	23 50	12 40	23 01	14 34		14 46	00 40	14 59	03 04
10	12 05		13 47		13 43	23 45	15 24	00 32	15 21	01 50	15 32	04 11
11	13 01	00 23	14 50	00 24	14 45		16 08	01 41	15 54	02 59	16 08	05 19
12	13 59	00 50	15 55	01 06	15 46	00 38	16 47	02 53	16 26	04 07	16 49	06 27
13	14 59	01 20	17 00	01 55	16 41	01 40	17 22	04 05	16 59	05 16	17 36	07 33
14	16 03	01 53	18 00	02 54	17 31	02 48	17 56	05 16	17 34	06 26	18 28	08 36
15	17 09	02 31	18 55	04 01	18 14	04 01	18 29	06 27	18 13	07 35	19 25	09 33
16	18 16	03 18	19 43	05 15	18 53	05 16	19 04	07 38	18 57	08 44	20 25	10 22
17	19 21	04 13	20 24	06 30	19 28	06 29	19 41	08 48	19 47	09 50	21 24	11 05
18	20 19	05 18	21 01	07 44	20 02	07 42	20 23	09 58	20 41	10 51	22 23	11 41
19	21 10	06 29	21 35	08 57	20 36	08 53	21 09	11 05	21 39	11 44	23 20	12 12
20	21 54	07 44	22 08	10 07	21 11	10 02	22 00	12 07	22 38	12 30		12 40
21	22 31	08 57	22 41	11 15	21 50	11 11	22 55	13 03	23 37	13 09	00 15	13 06
22	23 06	10 08	23 16	12 21	22 32	12 18	23 52	13 52		13 42	01 10	13 31
23	23 38	11 16	23 55	13 27	23 19	13 21		14 34	00 34	14 12	02 05	13 57
24		12 22		14 30		14 19	00 50	15 10	01 30	14 39	03 02	14 25
25	00 09	13 27	00 38	15 29	00 11	15 10	01 48	15 42	02 25	15 04	04 01	14 56
26	00 42	14 31	01 25	16 24	01 05	15 56	02 44	16 10	03 21	15 30	05 02	15 32
27	01 17	15 34	02 17	17 13	02 02	16 35	03 40	16 36	04 17	15 57	06 06	16 14
28	01 56	16 35	03 12	17 56	02 59	17 09	04 35	17 02	05 15	16 26	07 11	17 05
29	02 40	17 33	04 08	18 33	03 56	17 39	05 30	17 28	06 15	16 59	08 14	18 04
30	03 29	18 26			04 52	18 07	06 27	17 55	07 18	17 37	09 12	19 10
31	04 22	19 14			05 47	18 33			08 22	18 22		

1984

TIMES OF MOON RISE AND MOON SET - CAPE TOWN

FOR PORT ELIZABETH SUBTRACT 28 MINUTES

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	10^h03^m	20^h20^m	10^h31^m	22^h47^m	10^h45^m		10^h56^m	01^h06^m	12^h40^m	02^h17^m	13^h21^m	01^h50^m
2	10 47	21 31	11 03	23 55	11 26	01 07	11 52	02 04	13 38	02 51	14 16	02 15
3	11 25	22 41	11 35		12 12	02 12	12 50	02 56	14 35	03 20	15 11	02 40
4	11 59	23 49	12 09	01 02	13 03	03 13	13 49	03 39	15 30	03 47	16 07	03 05
5	12 30		12 46	02 09	13 59	04 09	14 48	04 16	16 25	04 12	17 04	03 31
6	13 01	00 56	13 28	03 15	14 57	04 57	15 46	04 49	17 20	04 37	18 03	04 00
7	13 33	02 03	14 15	04 18	15 56	05 38	16 42	05 17	18 16	05 02	19 05	04 33
8	14 08	03 09	15 08	05 18	16 54	06 14	17 37	05 43	19 14	05 29	20 07	05 12
9	14 46	04 16	16 04	06 11	17 51	06 45	18 31	06 08	20 14	06 00	21 07	05 58
10	15 30	05 21	17 03	06 57	18 47	07 13	19 27	06 33	21 15	06 34	22 04	06 51
11	16 19	06 25	18 03	07 37	19 42	07 39	20 23	06 59	22 16	07 15	22 54	07 52
12	17 14	07 23	19 01	08 12	20 37	08 04	21 21	07 27	23 14	08 02	23 38	08 57
13	18 13	08 15	19 58	08 42	21 32	08 29	22 21	07 58		08 57		10 05
14	19 12	09 00	20 53	09 10	22 28	08 55	23 21	08 34	00 08	09 59	00 16	11 13
15	20 12	09 38	21 48	09 35	23 27	09 24		09 16	00 56	11 05	00 50	12 20
16	21 10	10 12	22 42	10 00		09 57	00 21	10 06	01 38	12 13	01 22	13 27
17	22 06	10 41	23 38	10 26	00 27	10 35	01 18	11 03	02 15	13 21	01 52	14 34
18	23 01	11 07		10 53	01 28	11 20	02 11	12 07	02 48	14 30	02 23	15 43
19	23 55	11 33	00 36	11 23	02 28	12 14	02 58	13 16	03 20	15 39	02 57	16 52
20		11 58	01 35	11 59	03 25	13 16	03 39	14 26	03 52	16 49	03 35	18 03
21	00 51	12 25	02 37	12 40	04 18	14 24	04 16	15 37	04 25	18 00	04 18	19 13
22	01 48	12 53	03 40	13 30	05 04	15 36	04 50	16 49	05 01	19 13	05 09	20 18
23	02 47	13 26	04 41	14 29	05 45	16 50	05 23	18 01	05 43	20 25	06 06	21 15
24	03 49	14 05	05 38	15 36	06 21	18 03	05 56	19 13	06 30	21 34	07 07	22 04
25	04 53	14 51	06 29	16 49	06 56	19 16	06 32	20 27	07 24	22 35	08 10	22 45
26	05 57	15 47	07 14	18 03	07 29	20 28	07 11	21 39	08 23	23 28	09 13	23 20
27	06 58	16 51	07 53	19 17	08 03	21 40	07 55	22 49	09 25		10 13	23 50
28	07 52	18 01	08 28	20 29	08 40	22 51	08 45	23 53	10 27	00 13	11 10	
29	08 40	19 14	09 01	21 40	09 20		09 40		11 27	00 50	12 06	00 16
30	09 22	20 27	09 34	22 50	10 06	00 01	10 39	00 49	12 25	01 22	13 01	00 41
31	09 58	21 38	10 08	23 59			11 40	01 37			13 56	01 06

1984

TIMES OF MOON RISE AND MOON SET - DURBAN

FOR BLOEMFONTEIN ADD 19 MINUTES

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	03^h15^m	17^h38^m	04^h36^m	18^h54^m	04^h21^m	18^h08^m	05^h50^m	18^h08^m	06^h28^m	17^h41^m	08^h21^m	18^h35^m
2	04 02	18 35	05 31	19 32	05 16	18 39	06 44	18 36	07 27	18 17	09 21	19 36
3	04 53	19 28	06 27	20 06	06 09	19 09	07 38	19 07	08 27	18 59	10 16	20 41
4	05 47	20 14	07 21	20 37	07 02	19 37	08 35	19 40	09 29	19 47	11 05	21 48
5	06 43	20 56	08 14	21 06	07 55	20 05	09 33	20 17	10 29	20 42	11 48	22 55
6	07 39	21 33	09 07	21 34	08 48	20 34	10 33	21 01	11 27	21 43	12 27	
7	08 34	22 05	10 00	22 02	09 43	21 05	11 34	21 51	12 19	22 48	13 02	00 01
8	09 28	22 36	10 53	22 32	10 40	21 39	12 34	22 48	13 06	23 55	13 36	01 05
9	10 21	23 04	11 49	23 04	11 39	22 18	13 30	23 51	13 48		14 10	02 09
10	11 13	23 33	12 47	23 41	12 40	23 04	14 22		14 26	01 02	14 45	03 14
11	12 07		13 48		13 41	23 58	15 08	00 58	15 01	02 09	15 24	04 19
12	13 02	00 02	14 52	00 24	14 42		15 50	02 07	15 36	03 15	16 07	05 25
13	14 01	00 33	15 55	01 14	15 38	00 59	16 28	03 16	16 11	04 21	16 55	06 30
14	15 02	01 08	16 57	02 13	16 30	02 06	17 04	04 25	16 49	05 28	17 48	07 32
15	16 06	01 49	17 53	03 20	17 15	03 17	17 40	05 33	17 30	06 35	18 45	08 29
16	17 12	02 36	18 43	04 31	17 57	04 28	18 17	06 41	18 16	07 42	19 43	09 19
17	18 17	03 33	19 27	05 44	18 35	05 39	18 57	07 49	19 06	08 46	20 41	10 03
18	19 16	04 37	20 06	06 56	19 11	06 49	19 40	08 56	20 01	09 46	21 38	10 41
19	20 09	05 47	20 43	08 05	19 48	07 57	20 28	10 02	20 58	10 40	22 33	11 15
20	20 55	06 59	21 19	09 13	20 26	09 05	21 20	11 03	21 56	11 27	23 26	11 45
21	21 36	08 10	21 54	10 18	21 06	10 11	22 14	11 59	22 53	12 08		12 13
22	22 12	09 18	22 32	11 23	21 50	11 16	23 11	12 49	23 48	12 44	00 19	12 40
23	22 47	10 24	23 12	12 26	22 38	12 17		13 32		13 15	01 12	13 08
24	23 21	11 28	23 56	13 27	23 30	13 15	00 07	14 10	00 42	13 44	02 06	13 38
25	23 56	12 30		14 26		14 07	01 03	14 44	01 35	14 12	03 02	14 11
26		13 32	00 45	15 20	00 24	14 53	01 57	15 14	02 28	14 40	04 02	14 49
27	00 33	14 33	01 36	16 10	01 20	15 34	02 51	15 43	03 22	15 09	05 04	15 33
28	01 14	15 33	02 30	16 54	02 15	16 10	03 44	16 11	04 18	15 40	06 07	16 24
29	01 59	16 30	03 26	17 33	03 10	16 42	04 37	16 39	05 16	16 15	07 10	17 23
30	02 48	17 23			04 04	17 12	05 32	17 08	06 16	16 55	08 08	18 29
31	03 41	18 11			04 57	17 40			07 19	17 41		

1984

TIMES OF MOON RISE AND MOON SET - DURBAN

FOR BLOEMFONTEIN ADD 19 MINUTES

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	09^h01^m	19^h37^m	09^h38^m	21^h54^m	10^h01^m		10^h16^m	00^h01^m	11^h56^m	01^h16^m	12^h32^m	00^h54^m
2	09 47	20 46	10 13	22 59	10 44	00 05	11 12	01 00	12 53	01 52	13 25	01 22
3	10 27	21 53	10 47		11 31	01 09	12 09	01 52	13 47	02 24	14 18	01 49
4	11 04	22 59	11 23	00 04	12 23	02 09	13 07	02 37	14 40	02 53	15 11	02 16
5	11 38		12 03	01 08	13 18	03 05	14 04	03 16	15 33	03 20	16 06	02 44
6	12 12	00 03	12 46	02 12	14 15	03 54	14 59	03 50	16 25	03 47	17 03	03 15
7	12 46	01 06	13 34	03 15	15 13	04 37	15 53	04 21	17 19	04 14	18 02	03 50
8	13 23	02 10	14 27	04 13	16 09	05 14	16 46	04 49	18 15	04 43	19 03	04 30
9	14 03	03 15	15 23	05 07	17 04	05 48	17 38	05 16	19 13	05 15	20 03	05 17
10	14 49	04 19	16 21	05 55	17 58	06 18	18 31	05 43	20 12	05 52	21 00	06 11
11	15 39	05 21	17 19	06 37	18 51	06 46	19 25	06 11	21 12	06 34	21 51	07 11
12	16 34	06 19	18 15	07 13	19 43	07 13	20 21	06 41	22 10	07 22	22 37	08 15
13	17 31	07 12	19 10	07 46	20 36	07 40	21 19	07 14	23 04	08 17	23 18	09 21
14	18 30	07 58	20 03	08 15	21 30	08 08	22 18	07 52	23 53	09 18	23 54	10 26
15	19 27	08 38	20 56	08 43	22 26	08 39	23 17	08 36		10 22		11 31
16	20 23	09 13	21 48	09 10	23 25	09 14		09 26	00 37	11 28	00 28	12 35
17	21 17	09 45	22 42	09 38		09 54	00 14	10 23	01 17	12 34	01 01	13 39
18	22 10	10 14	23 37	10 07	00 24	10 40	01 07	11 26	01 53	13 40	01 35	14 45
19	23 03	10 41		10 39	01 24	11 34	01 56	12 32	02 28	14 46	02 11	15 52
20	23 56	11 09	00 34	11 16	02 21	12 35	02 40	13 40	03 02	15 53	02 51	17 01
21		11 37	01 34	11 59	03 15	13 41	03 19	14 49	03 38	17 02	03 37	18 09
22	00 50	12 08	02 36	12 50	04 03	14 51	03 56	15 57	04 16	18 12	04 28	19 13
23	01 47	12 43	03 37	13 49	04 47	16 02	04 32	17 06	05 00	19 22	05 25	20 11
24	02 47	13 23	04 34	14 55	05 26	17 13	05 08	18 16	05 49	20 29	06 26	21 01
25	03 50	14 11	05 27	16 05	06 03	18 22	05 46	19 27	06 44	21 31	07 28	21 44
26	04 53	15 06	06 14	17 17	06 39	19 32	06 27	20 37	07 43	22 25	08 29	22 21
27	05 53	16 10	06 56	18 28	07 16	20 41	07 13	21 45	08 44	23 11	09 27	22 53
28	06 50	17 18	07 34	19 37	07 55	21 50	08 04	22 48	09 44	23 50	10 22	23 22
29	07 40	18 29	08 10	20 45	08 38	22 57	09 00	23 45	10 43		11 16	23 49
30	08 23	19 39	08 45	21 52	09 25		09 59		11 38	00 24	12 08	
31	09 03	20 48	09 22	22 59			10 58	00 34			13 01	00 16

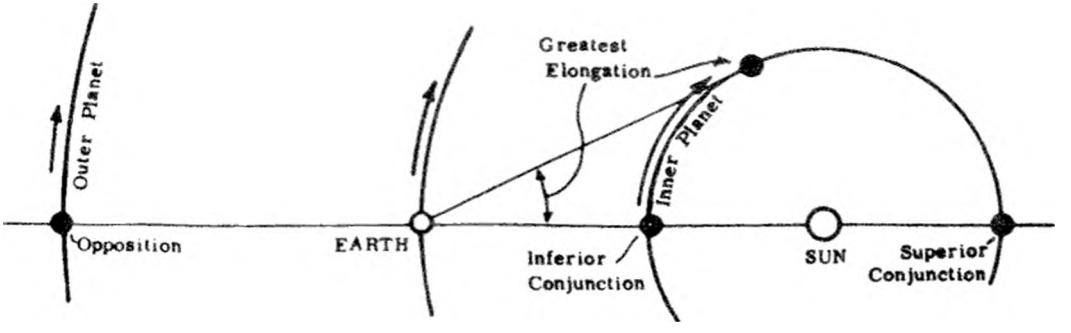
THE PLANETS 1984

BASIC DATA

	Dist from Sun 10^6 km	Period of Revolution years	Mass (Earth = 1)	Diameter 10^3 km	Rotation Period	Inclination of Equator to Orbit
Mercury	58	0,24	0,056	4,98	59d	?
Venus	108	0,62	0,817	12,4	244	?
Earth	150	1,00	1,000	12,8	$23^h 56^m$	$23^\circ 27'$
Mars	228	1.88	0,108	6,76	24 37	23 59
Jupiter	778	11,9	318,0	142,7	09 51	03 04
Saturn	1426	29,5	95,2	120,8	10 14	26 44
Uranus	2868	84,0	14,6	47,1	10 49	97 53
Neptune	4494	164,8	17,3	44,6	14 ?	28 48
Pluto	5896	247,6	0,9?	?	6d?	?

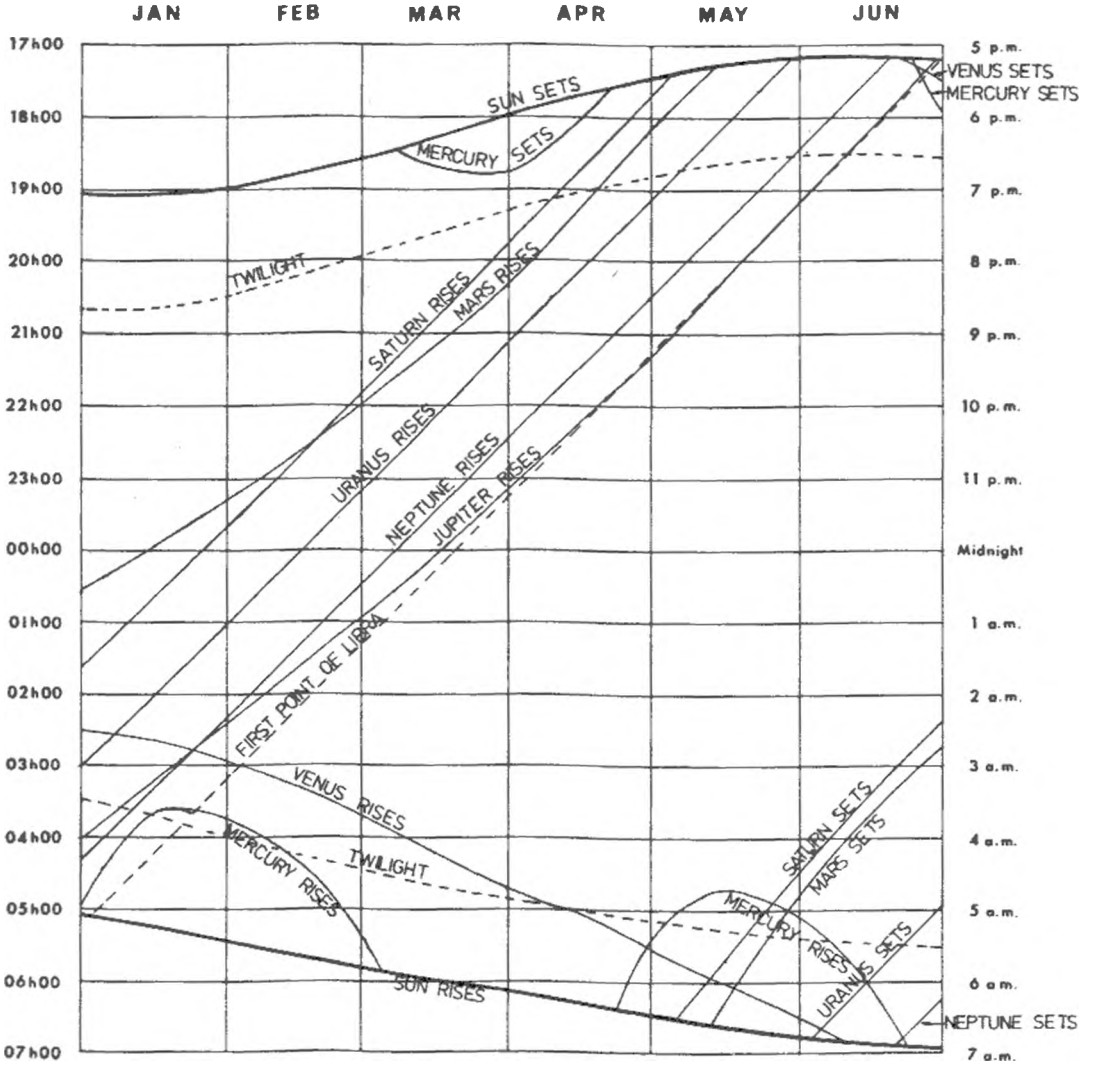
GENERAL

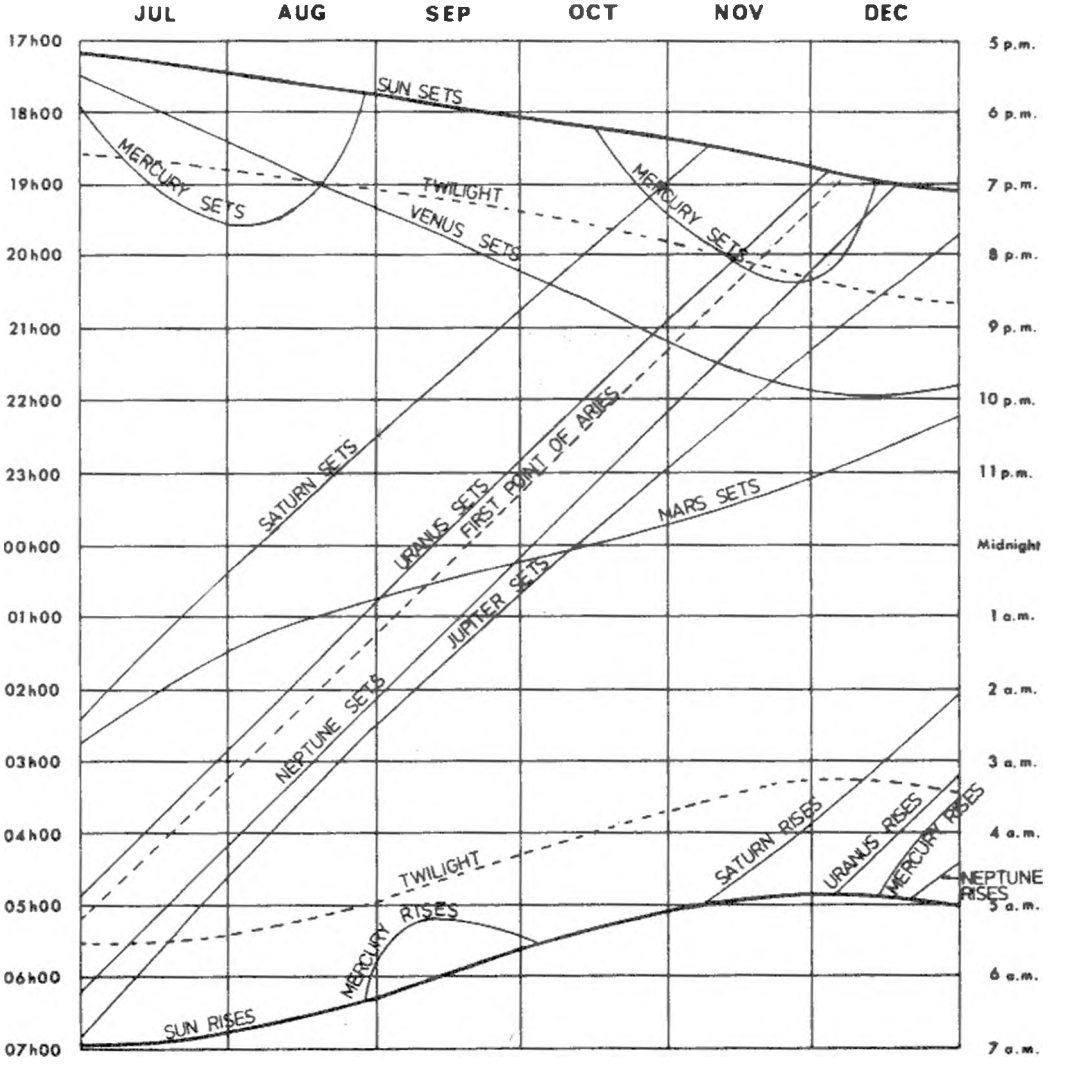
Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Unlike the distant stars, their relative positions do not remain fixed, but continually change as, like the Earth, they orbit around the Sun. Their apparent movements against the starry background are complicated as they result from a combination of their own motion and the Earth's motion. Their brightnesses also vary considerably, as both their distances from the Earth and the visible portions of their sunlit hemispheres change. Since the period of a planet increases with increasing distance from the Sun, so we find that the inner planets - Mercury and Venus - appear to "overtake" the Earth in their orbits, while the Earth in turn "overtakes" the outer planets - Mars, Jupiter and Saturn. The terms given in astronomy to the various Sun-Earth-Planet configurations are illustrated in the accompanying diagram. Dates of such configurations occuring in 1984 are listed chronologically in the Diary (pages 4 and 5) and are also mentioned in the text below.



TIMES OF RISING AND SETTING

The times of rising and setting given by the diagram are accurate for position 30° East, 30° South, and approximately correct for other places in Southern Africa. Strictly speaking, corrections for latitude and longitude should be applied, but the latitude correction is, in general sufficiently small to be ignored and in no case will exceed 15 minutes.
Longitude corrections are given on page 44.




JUL
AUG
SEP
OCT
NOV
DEC
17h00
18h00
19h00
20h00
21h00
22h00
23h00
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01h00
02h00
03h00
04h00
05h00
06h00
07h00
5 p.m.
6 p.m.
7 p.m.
8 p.m.
9 p.m.
10 p.m.
11 p.m.
Midnight
1 a.m.
2 a.m.
3 a.m.
4 a.m.
5 a.m.
6 a.m.
7 a.m.
SUN SETS
MERCURY SETS
TWILIGHT
VENUS SETS
MERCURY SETS
SATURN SETS
URANUS SETS
FIRST POINT OF ARIES
MARS SETS
JUPITER SETS
NEPTUNE SETS
TWILIGHT
SATURN RISES
URANUS RISES
MERCURY RISES
NEPTUNE RISES
MERCURY RISES
SUN RISES

OBSERVING THE PLANETS

To the naked eye, planets appear as virtually pinpoint sources of light. However, their disks can be readily resolved with the aid of a small telescope. Even so, their angular diameters are of the order of 10 seconds of arc - roughly 1/200 of the Moon's angular diameter - so it is not always possible to distinguish details on their disks. The disks of Mercury and Venus are only seen fully illuminated when they are furthest from us - as they draw closer, their disks grow larger but the phase changes to a crescent as we see more of their dark hemispheres. In contrast, the disks of the outer planets are always seen fully or near fully illuminated.

Mercury

The innermost planet, Mercury, moves rapidy among the stars and can be seen only in the early evening sky or just before dawn. Its greatest angular distance from the Sun is 28° but at some elongations this may be as little as 18°. The best times for viewing the planet are within a few days of Jan 22, May 19 and Sep 14 in the morning sky.

In the evenings the best dates will be near April 13, Aug 1 and Nov 25.

Greatest Elongation East	Apr 3(19°)	Aug 1(27°)	Nov 25(22°)
Stationary	Apr 12	Aug 14	Dec 4
Inferior Conjunction	Apr 22	Aug 28	Dec 14
Stationary	May 4	Sep 6	Dec 24
Greatest Elongation West	Jan 22(24°)	May 19(26°)	Sep 14(18°)
Superior Conjunction	Mar 4	Jun 23	Oct 10

Venus

Venus willbe a morning object from January to the beginning of June when it will pass into the twilight. It is in conjunction with the Sun on June 15 and from the beginning of July it will be an evening sky object for the rest of the year.

Venus at magnitude -3.6 at the beginning of the year varies little during the year fading to -3.3 at mid-year and brightening again to -3.8 in December.

Mars

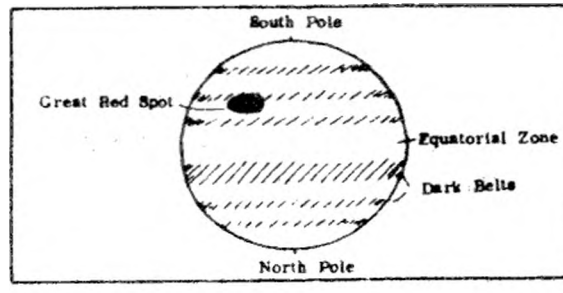
Mars rises after mid-night at the beginning of the year and moves slowly forward till on May 9 it rises at sunset. It will then be visible in the evening sky for the rest of the year. Its magnitude varies from +1.4 in January to -1.7 in May and then fades to +1.1 at the end of the year.

In Virgo in January the planet will pass into Libra at the end of that month, into Scorpius in August and into Ophiuchus at the beginning of September and into Sagitarius a month later and into Capricornus in mid-November and ends the year in Aquarius.

Jupiter

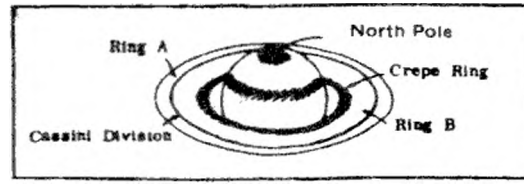
Jupiter emerges from the morning twilight in mid-January (mag -1.4). It rises earlier each night and reaches opposition on June 29 when it will rise at midnight. By then it will have brightened to mag -2.2. It will then be in the evening sky till the end of the year when having faded to mag -1.4 it will pass into the evening twilight.

It will be in Sagittarius for the whole of the year, falling back among the stars till it is stationary on April 29. Thereafter it will advance among the stars till Aug 30 when it is again stationary. It will then fall back again till the end of the year.



SATURN

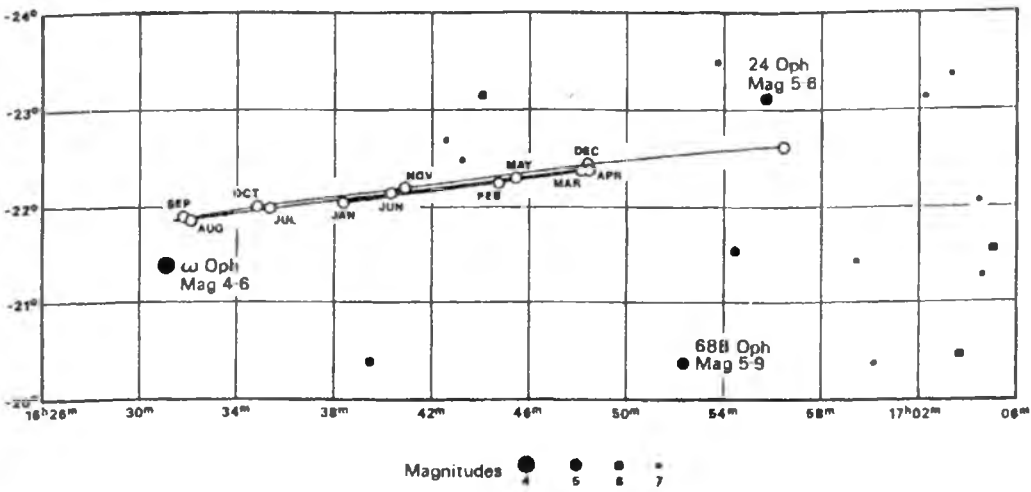
Saturn (mag 1.0) rises at 3 am at the beginning of the four year and moves steadily towards the evening sky till it rises at sunset at the beginning of May and is visible in the evening sky until October when it disappears in the evening twilight. From mid-December it will be in the morning sky. It will at all times be in the constellation of Libra.



Uranus

Uranus is in Ophiuchus and will be at opposition on June 2 at mag 5.8. Its diameter then will be 3".8. Binoculars will assist to identify it.

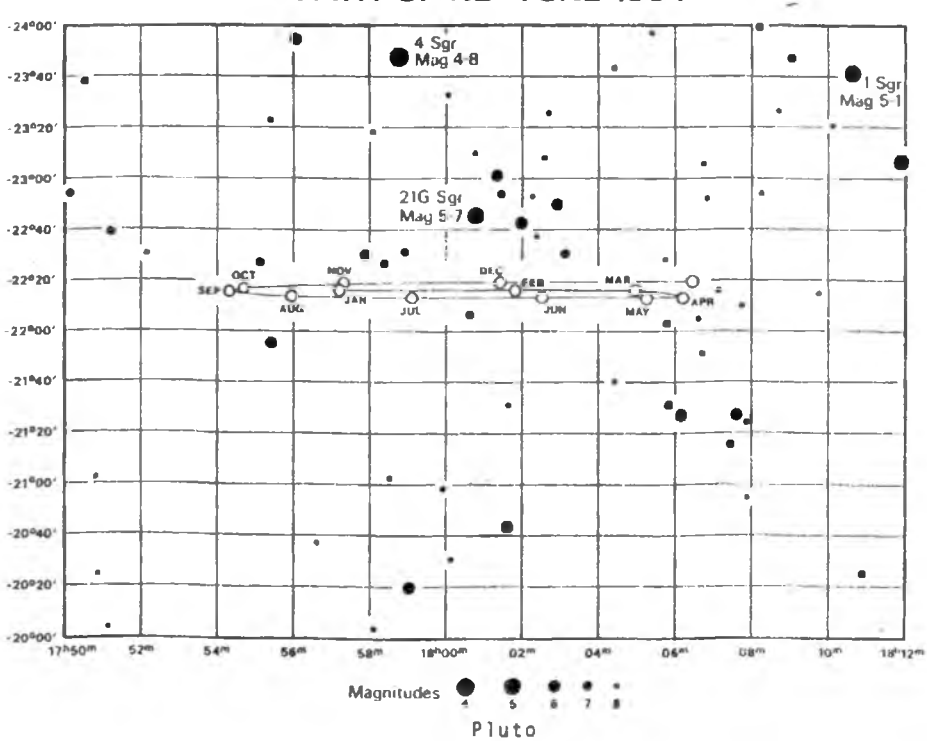
PATH OF URANUS 1984



Neptune

Neptune is in Sagittarius all year. It is at opposition on June 21 and its magnitude then will be 7.7. Its diameter varies from 2."35 to 2."5 and on dark nights binoculars will serve to identify this planet.

PATH OF NEPTUNE 1984



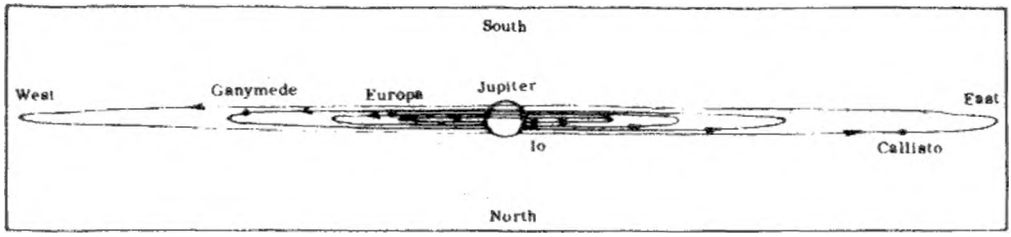
Pluto

Pluto at mag 14 needs a large telescope before it can be seen. It will be at opposition on April 20.

THE MOONS OF JUPITER AND SATURN 1984

MOONS OF JUPITER

One of the most popular sights for an observer with a small telescope is Jupiter and its Moons. Four of the fifteen - Io, Europa, Ganymede and Calliste - are generally clearly visible - they would just be visible to the naked eye were it not for the glare from the mother planet. As the diagram below indicates, the system



is seen almost edge-on so the moons always lie close to a straight line extending from the planet's equator. As they orbit, so they appear to oscillate from one side to the other, alternately passing in front and behind the planet. This motion is represented in the diagrams on pages 26 which cover the period when Jupiter is clearly visible in the evening sky. The horizontal lines show their relative configurations at 2 am each day.

When the moons pass in front and behind the planet, transits, occultations and eclipses occur. Details of such phenomena occuring between the end of astronomical twilight and just after midnight (and when the planet is above the horizon in Southern Africa) are given in the table below.

Explanation of Table.

Date and predicted times are given - these are for mid-phenomena and are not instantaneous.

The moons concerned are I - Io, II - Europa, III - Ganymede, IV - Callisto

Phenomena - the abbreviations used are:

- Ec. - Eclipse: the satellite passes through the shadow of Jupiter
- Oc. - Occultation: the satellite is obscured by the disk of Jupiter
- D. - Disappearance
- R. - Reappearance
- Tr. - Transit: the satellite crosses the disk of Jupiter
- Sh. - Shadow Transit: the shadow of the satellite transits the disk
- I - Ingress
- E - Egress

	d	h	m			
Mar	3	02	57	11	Tr	I
	3	03	11	11	Sh	E
	7	01	17	1	Tr	E
	7	04	10	1	Oc	R
	12	02	23	11	Oc	R
	13	03	22	111	Oc	R
	14	02	38	1	Ec	D
	15	03	13	1	Tr	E
	19	05	03	11	Oc	R
	20	02	19	111	Ec	R
	20	04	29	111	Oc	D
	21	04	32	1	Ec	D
	23	02	30	1	Oc	R
	23	23	37	1	Tr	E
	26	02	31	11	Ec	D
	26	05	04	11	Ec	R

	d	h	m			
	26	05	05	11	Oc	D
	27	03	23	111	Ec	D
	28	00	12	11	Sh	E
	28	00	13	11	Tr	I
	31	01	32	1	Tr	E
	31	01	35	111	Tr	E
Apr	4	02	46	11	Sh	E
	4	02	47	11	Tr	I
	4	05	21	11	Tr	E
	5	05	27	1	Sh	I
	6	02	46	1	Ec	D
	7	02	33	111	Tr	I
	7	03	25	1	Tr	E
	7	05	34	111	Tr	E
	11	05	19	11	Tr	I
	11	05	21	11	Sh	E

	d	h	m			
	13	02	09	11	Oc	R
	13	04	40	1	Ec	D
	14	02	38	1	Oc	R
	14	03	04	1	Tr	I
	14	04	02	1	Sh	E
	14	05	18	1	Tr	E
	19	23	23	11	Ec	D
	20	04	41	11	Oc	R
	22	01	01	1	EcDD	
	22	04	29	1	Oc	R
	23	00	24	1	Sh	E
	23	01	37	1	Tr	E
	23	00	58	1V	Oc	D
	23	02	45	1V	Oc	R
	25	00	05	111	Oc	D
	25	03	09	111	Oc	R

	d	h	m			
	27	02	09	11	Ec	D
	28	23	31	11	Tr	I
	28	23	46	11	Sh	E
	29	02	05	11	Tr	E
	29	02	54	1	Ec	D
	30	00	04	1	Sh	I
	30	01	13	1	Tr	I
	30	02	18	1	Sh	E
	30	03	27	1	Tr	E
	31	00	46	1	Oc	R
May	1	23	12	111	Ec	D
	2	02	12	111	Ec	R

	d	h	m			
May	2	05	47	111	Oc	B
	4	08	44	11	Sc	B
	5	23	47	11	Sh	I
	6	08	55	11	Tr	I
	6	04	30	11	Tr	E
	6	04	48	1	Ec	D
	7	22	51	11	Oc	R
	7	23	16	1	Ec	D
	8	02	34	1	Oc	R
	8	22	40	1	Sh	E
	8	23	44	1	Tr	E
	13	00	19	111	Tr	E
	13	04	18	11	Tr	I
	13	04	53	11	Sh	E
	15	01	09	1	Ec	D
	15	04	21	1	Oc	R
	15	22	20	1	Sh	I
	15	23	17	1	Tr	I
	16	01	32	1	Tr	E
	16	22	48	1	Oc	R
	17	23	33	1V	Tr	I
	18	01	23	1V	tr	E
	20	00	48	111	Tr	1
	20	03	51	111	Tr	E
	21	23	15	11	Ec	D
	22	03	38	11	Oc	R
	23	00	14	1	Sh	I
	23	01	04	1	Tr	I
	23	03	19	1	Tr	E
	26	01	43	1V	Ec	D
	26	03	03	1V	Ec	R
	27	04	11	111	Sh	E
	27	04	15	111	Tr	I
	29	01	51	11	Ec	D
	30	02	08	1	Sh	I
	30	02	50	1	Tr	I
	30	04	22	1	Sh	E
	30	13	18	11	Sh	E
	30	23	24	1	Ec	D
	31	02	20	1	Oc	R
	31	22	51	1	Sh	E
Jun	1	20	46	1	Oc	R
	5	04	27	11	Ec	D
	6	04	02	1	Sh	E
	6	04	35	1	Tr	I
	6	23	17	11	Sh	I
	7	00	19	111	Oc	R
	7	00	21	11	Tr	1
	7	01	18	1	Ec	D
	7	22	30	1	Sh	I
	7	23	01	1	Tr	I
	8	00	45	1	Sh	E
	8	01	16	1	Tr	E
	8	22	30	1	Oc	R
	11	23	29	1V	Oc	D
	13	23	01	111	Ec	D
	14	01	39	111	Oc	R
	14	01	50	11	Sh	I
	14	02	35	11	Tr	I
	14	03	12	1	Ec	D

	d	h	m			
	14	04	26	11	Sh	E
	14	05	11	11	Tr	E
	14	05	48	1	Oc	R
	15	00	24	1	Sh	I
	15	00	46	1	Tr	I
	15	21	40	1	Ec	D
	16	00	14	1	Oc	R
	21	02	59	111	Ec	D
	21	04	24	11	Sh	I
	21	04	49	11	Tr	I
	21	05	05	1	Ec	D
	22	22	59	11	Ec	D
	22	23	34	1	Ec	D
	23	01	57	11	Oc	R
	23	01	58	1	Oc	R
	23	23	02	1	Sh	E
	23	23	11	1	Tr	E
	24	20	24	1	Oc	R
	30	01	27	1	Oc	D
	30	01	35	11	Oc	D
	30	03	42	1	Ec	R
	30	22	40	1	Tr	I
	30	22	42	1	Sh	I
Jul	1	00	55	1	Sh	E
	1	00	57	1	Tr	E
	1	20	52	111	Tr	I
	1	21	04	111	Sh	I
	1	22	11	1	Ec	R
	6	20	45	1V	Sh	I
	6	21	03	1V	Tr	E
	6	22	50	1V	Sh	E
	7	03	11	1	Oc	D
	8	00	24	1	Tr	I
	8	21	37	1	Oc	D
	8	22	23	11	Tr	I
	8	22	49	11	Sh	I
	9	00	05	1	Oc	R
	9	00	09	111	Tr	I
	9	00	58	11	Tr	E
	9	01	04	111	Sh	I
	9	01	26	11	Sh	E
	9	03	14	111	Tr	E
	9	04	11	111	Sh	E
	9	21	05	1	Sh	E
	9	21	21	1	Tr	E
	10	20	11	11	Ec	R
	15	04	00	1V	Oc	D
	15	23	21	1	Oc	D
	16	00	37	11	Tr	1
	16	01	23	11	Sh	1
	16	01	59	1	Oc	R
	17	20	28	1	Ec	R
	17	20	35	1	Tr	I
	17	21	00	1	Sh	I
	17	22	49	11	Ec	R
	17	22	50	1	Tr	E
	17	23	15	1	Sh	E
	19	22	03	111	Ec	R
	23	01	06	1	Oc	D
	23	02	52	11	Tr	I
	23	22	21	1	Tr	I

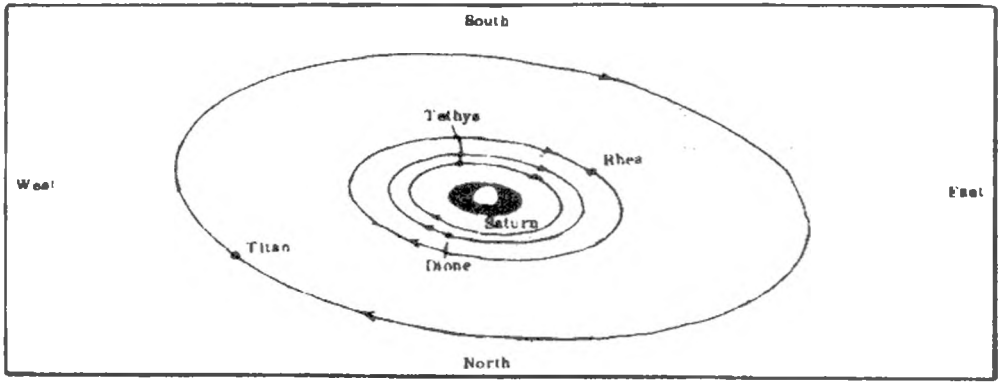
	d	h	m			
Jul	23	22	55	1	Sh	I
	24	00	35	1	Tr	E
	24	01	10	1	Sh	E
	24	21	34	11	Oc	D
	24	22	22	1	Ec	R
	25	01	26	11	Ec	R
	26	20	21	111	Oc	D
	27	02	04	111	Ec	R
	30	02	51	1	Oc	D
	30	20	40	1V	Oc	R
	31	21	18	1	Oc	D
	31	23	53	11	Oc	D
Aug	1	00	17	1	Ec	R
	1	20	48	1	Tr	E
	1	21	34	1	Sh	E
	2	19	50	11	Sh	I
	2	20	54	11	Tr	E
	2	22	27	11	Sh	E
	2	23	45	111	Oc	D
	3	02	52	111	Oc	R
	3	02	54	111	Ec	D
	7	23	04	1	Oc	D
	8	02	11	1	Ec	R
	8	02	15	11	Ec	D
	8	20	21	1	Tr	I
	8	21	14	1	Sh	I
	8	22	36	1	Tr	E
	8	23	29	1	Sh	E
	9	00	28	1V	Tr	I
	9	02	27	1V	Tr	E
	9	20	40	1	Ec	R
	11	20	00	11	Ec	R
	13	20	13	111	Tr	E
	13	21	02	111	Sh	I
	14	00	12	111	Sh	E
	15	00	52	1	Oc	D
	15	22	10	1	Tr	I
	15	23	10	1	Sh	I
	16	22	35	1	Ec	R
	16	23	00	11	Tr	I
	17	00	59	11	Sh	I
	17	01	35	11	Tr	E
	17	19	53	1	Sh	E
	17	22	06	1V	Ec	R
	18	22	28	11	Ec	R
	20	20	24	111	Tr	I
	20	23	49	111	Tr	E
	21	01	02	111	Sh	I
	22	02	41	1	Oc	D
	22	23	59	1	Tr	I
	23	01	05	1	Sh	I
	23	21	08	1	Oc	D
	24	00	30	1	Ec	R
	24	01	24	11	Tr	I
	24	19	34	1	Sh	I
	24	20	41	1	Tr	E
	24	21	48	1	Sh	E
	25	20	17	11	Oc	D
	26	01	16	11	Ec	R
	28	00	23	111	Tr	I
	30	01	50	1	Tr	I

	d	h	m			
	30	22	59	1	Oc	D
	31	20	18	1	Tr	I
	31	21	29	1	Sh	I
	31	22	06	111	Ec	R
	31	23	34	1	Sh	E
Sep	1	20	54	1	Ec	R
	1	22	46	11	Oc	D
	3	19	28	11	Sh	I
	3	22	06	11	ShE	
	7	00	50	1	Oc	D
	7	20	59	111	Oc	R
	7	22	10	1	Tr	I
	7	22	52	111	Ec	D
	7	23	54	1	Sh	I
	8	01	39	1	Sh	E
	9	01	17	11	Oc	D
	9	20	08	1	Sh	E
	10	22	03	11	Sh	I
	10	22	10	11	TrE	
Sep	11	20	45	1V	Sh	I
	12	21	50	11	Ec	R
	14	21	42	111	Oc	D
	15	00	52	111	Oc	R
	15	21	11	1	Oc	D
	16	00	44	1	Ec	R
	17	22	06	11	Tr	I
	18	20	15	111	Sh	E
	19	22	27	11	Ec	R
	19	19	25	1V	Oc	D
	19	21	53	1V	Oc	R
	22	23	05	1	Oc	D
	23	20	27	1	Tr	I
	23	21	44	1	Sh	I
	23	22	41	1	Tr	E
	23	23	59	1	Sh	E
	24	21	08	1	Ec	R
	25	21	02	111	Sh	1
	26	19	44	11	Oc	D
Oct	1	23	03	1	Ec	R
	2	20	23	1	Sh	E
	3	20	22	11	Oc	D
	5	21	49	11	Sh	E
	8	21	26	1	Oc	D
	9	21	02	1	Tr	E
	9	22	18	1	Sh	E
	12	21	45	11	Sh	I
	12	21	53	11	Tr	E
	13	22	11	111	Ec	R
	14	21	10	1V	tr	I
	16	20	45	1	Tr	I
	16	21	59	1	Sh	I
	17	21	23	1	Ec	R
	20	21	12	111	Oc	R
	20	22	53	111	Ec	D
	23	22	53	1V	Ec	R
	23	22	12	111	Oc	D
	31	21	50	1	Oc	D
Nov	9	21	38	1	Ec	R
	16	20	19	1	Oc	D

THE MOONS OF JUPITER AND SATURN 1984

SATURN'S MOONS

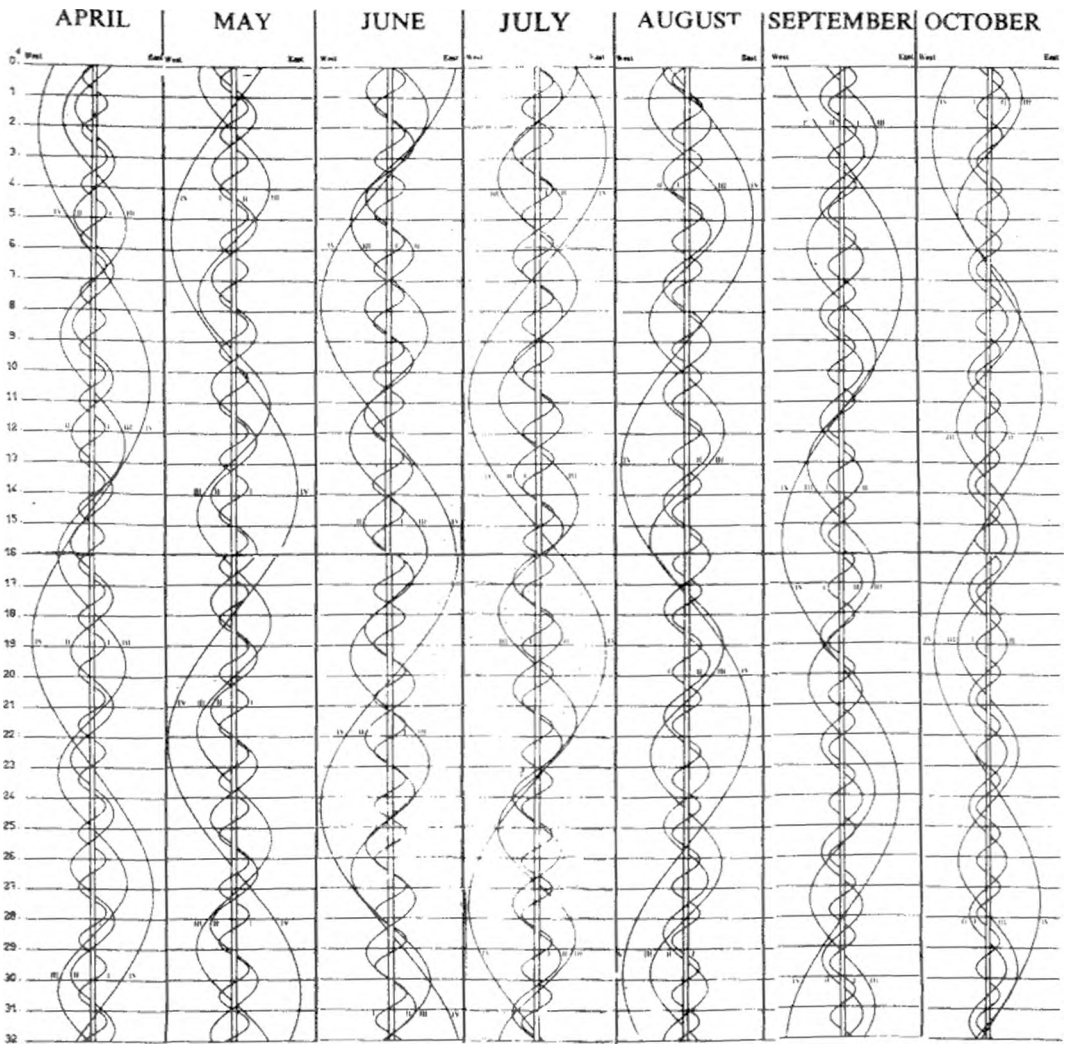
Saturn's moons are considerably fainter than the four Galilean moons of Jupiter. The diagram shows the orbits of four of Saturn's ten moons. The easiest to find is Titan (magnitude 8,5), according to the diagram and the information in the table below.



TITAN

Eastern Elongation		Inferior Conjunction		Western Elongation		Superior Conjuction	
	d h		d h		d h		d h
Jan	1 10.0	Jan	5 05.8	Jan	9 08.4	Jan	13 12.7
	17 10.0		21 05.7		25 08.2		29 12.3
Feb	2 09.5	Feb	6 05.1	Feb	10 07.6	Feb	14 11.6
	18 08.5		22 04.1		26 06.5	Mar	1 10.3
Mar	5 07.2	Mar	9 02.6	Mar	1 10.3		17 08.8
	21 05.5		25 00.7		29 02.8	Apr	2 06.4
Apr	6 03.2	Apr	9 22.4	Apr	14 00.4		18 04.0
	22 00.8		25 19.9		29 21.7	May	4 01.4
May	7 22.0	May	11 17.3	May	15 19.1		19 22.8
	23 19.8		27 14.9		31 16.6	Jun	4 20.4
Jun	8 17.5	Jun	12 12.6	Jun	16 14.3		20 18.3
	24 15.5		28 10.7	Jul	2 12.5	Jul	6 16.6
Jul	10 14.0	Jul	14 09.2		18 11.1		22 15.3
	26 12.8		30 08.2	Aug	3 10.2	Aug	7 14.5
Aug	11 12.0	Aug	15 07.5		19 09.7		23 14.1
	27 11.7		31 07.3	Sep	4 09.6	Sep	8 14.1
Sep	12 11.7	Sep	16 07.4		20 09.9		24 14.4
	28 11.9	Oct	2 07.8	Oct	6 10.5	Oct	10 14.9
Oct	14 12.4		.. .. .		.. .. .		.. .. .
	.. .. .		.. .. .	Dec	9 13.8	Dec	13 18.0
Dec	17 15.0	Dec	21 11.3		25 14.7		29 18.6

CHANGING CONFIGURATIONS OF JUPITER'S MOONS



The four bright moons of Jupiter always appear close to a straight line passing through the planet since, as shown in the drawing at the top, their orbits are seen nearby edge on. The main part of the diagram then shows how their positions along such a straight line change during the five months when Jupiter is prominent in the evening sky. For each month, time increases downward; the disk of Jupiter is stretched to make the central column and horizontal lines, representing 2a.m. (0 hrs Universal time), are shown for every day of the month. The wavy lines show how the Moons appear to oscillate from each side of the planet to the other.

COMETS AND METEORS

COMETS

Comets are celestial bodies moving around the sun, mostly in very elongated orbits. The typical comet consists of a nucleus surrounded by a hazy aura of gas and dust called the coma, and in many cases there is a tail stretching away from the sun. Faint comets, several of which are discovered each year, usually appear only as fuzzy patches without nucleus or tail, though there may be a central condensation.

While they are believed to be true members of the solar system, comets differ radically from the planets in that their orbits, besides being highly eccentric, are inclined at all angles to the plane of the ecliptic, and their motion may be direct (like that of the planets) or retrograde. Compared with that of a planet, a comet's mass is almost negligible; nearly all this mass is concentrated in the nucleus which is believed to be not one solid piece but composed of many separate particles of various sizes.

Comets are the most mysterious and capricious of solar system objects and the nature of the physical changes which they exhibit is still not fully understood.

Observers with quite modest equipment, say a refracting telescope of not less than 7.5 cm, or in the case of bright comets, a good pair of binoculars, can do useful work by following known comets and reporting on their appearance. The ability to make accurate brightness estimates is especially useful and well worth cultivating. Sweeping the sky for new comets, though requiring considerable patience and perseverance, is also within the scope of the equipment mentioned.

Many of the fainter comets are undoubtedly escaping detection, particularly in the Southern skies which are not being as intensively searched as the Northern. There is a need for more amateurs to undertake this work.

Interested persons are asked to contact the Director of the Comet and Meteor Section at 90 Malan Street, Riviera, Pretoria, 0084. TEL: 704-895

METEORS

Meteors or "shooting stars" result from small bodies entering the Earth's upper atmosphere, and are generally seen in greater abundance after midnight (due to the direction of the Earth's motion) than in the early evening.

There are two categories of meteors - the sporadic ones and the showers. A meteor shower comes from a certain direction in space (the Radiant) and is thought to be associated with the remains of a comet. When the Earth passes close to the comet's original orbit, such a shower can be expected. A list of these predicted showers is given in the table opposite.

The term "shower" is perhaps misleading (as the table indicates); the most prolific of these showers normally yields an average of less than one meteor per minute. On rare occasions however, as in the case of Leonids, there is a phenomenal rise in the number of meteors observed.

There is always the possibility of new showers occuring, and any large-scale meteor activity observed on dates other than those mentioned should be reported without delay.

Reports by a reliable observer of the number of meteors seen coming from a particular radiant in a given period are always useful, but the best work is done by organised teams making a full sky coverage. In the latter case, care must be taken to avoid the overlapping of individual reports, i.e. where more than one observer reports the same meteor(s), giving a false total for the group.

"Fireballs" are meteors of a luminosity equalling or exceeding that of the brightest planets. Accurate reports of their path among the stars, or their altitude and azimuth, at specific times, are of great value, particularly if made by observers at different places along the trajectory. Details of brightness (compared with Venus, Moon etc) size and form, colours and any train or wake, are also important.

	Shower	Radiant	
		R.A.	Dec.
Mar 14 - Mar 18	Corona Australids	16^h20^m	-48°
Apr 19 - Apr 24	April Lyrids	18 08	+32
May 1 - May 12	Eta Aquarids	22 24	00
Apr 20 - Jul 30	Sco-Sgr System	18 00	-30
Jun 10 - Jun 21	June Lyrids	18 32	+35
Jun 17 - Jun 26	Ophiuchids	17 20	-20
* Jun 26 - Jun 29	Cetids (new)	02 00	-15
Jul 10 - Aug 5	Capricornids	21 00	-15
Jul 15 - Aug 15	Delta Aquarids		(-17
		22 36	(00
Jul 15 - Aug 20	Pisces Australids	22 40	-30
Jul 15 - Aug 25	Alpha Capricornids	20 36	-10
Jul 15 - Aug 24	Iota Aquarids	(22 04	-6
		(22 32	-15
Oct 16 - Oct 27	Orionids	06 24	+15
Oct 10 - Dec 5	Taurids	(03 44	+14
		(03 44	+21
Nov 14 - Nov 20	Leonids	10 08	+22
Dec 3 - Dec 5	Phoenicids	01 00	-55
Dec 7 - Dec 15	Geminids	07 28	+32
Dec 5 - Jan 7	Velaids	09 56	-51

* Uncertain

SHOWERS 1984

Date	Maximum Hourly Rate	Transit of Radiant (approx)	Recommended Time of watch	Conditions at Maximum
Mar 16	5	04^h45^m	-	Unfavourable
Apr 22	15	04 15	20h - 24h	Favourable
May 5	18	07 30	22h - dawn	Favourable
Jun 14	?	00 30	-	Unfavourable
Jun 16	8	01 00	-	Unfavourable
Jun 20	8	23 30	19h - 23h	Favourable
Jun 28	?	07 40	22h - dawn	Favourable
Jul 25	8	00 50	20h - 02h	Favourable
Jul 29	35	02 10	22h - dawn	Favourable
Jul 31	11	02 10	22h - dawn	Favourable
Aug 2	10	00 00	00h - dawn	Favourable
Aug 6	12	(01 10 (01 40	-	Unfavourable
Oct 21	35	04 30	20h - 02h	Favourable
Nov 4	16	(00 50 (00 50	-	Unfavourable
Nov 17	10	06 30	20h - 24h	Favourable
Dec 4	?	20 10	2h30- dawn	Favourable
Dec 14	55	02 00	00h - dawn	Favourable
Dec 29	?	03 00	02h - dawn	Favourable

THE STARS

CONSTELLATIONS

Apart from our Sun all the stars that we see are so incredibly distant that, despite their high speed velocities, their apparent positions change by only minute amounts each year. Consequently the patterns that they form appear unchanged. The Greeks and other ancient civilisations identified these patters, or constellations, with various mythological characters and creatures, and most of the names they gave are still used today.

In all there are 88 constellations, roughly one half of which would be above the horizon at any one time. Some contain distinctive patterns of bright stars and are relatively easy to find; others are difficult to locate, even with suitable maps. The Southern Cross and Centaurus, Orion and Taurus, Scorpius and Sagittarius, are featured later in this section. Detailed information on other constellations is beyond the scope of this handbook and interested observers are advised to obtain a suitable star atlas.

STAR NAMES

Within each constellation, the brightest star is generally labelled a(Alpha),the next B(Beta) and so on through the Greek alphabet. Most of the brightest stars also have their own names - usually of arabic origin. For example, α Canis Majoris, otherwise known as Sirius, is the brightest star in the constellation Canis Major.

STELLAR MAGNITUDES

The apparent brightness of a star - which depends both on its true luminosity and its distance - is indicated by its magnitude. Equal intervals of magnitude represent equal ratios in light intensity. A star of magnitude 1,0 (typical of the brightest stars in the night sky) would be exactly one hundred times more luminous than a star of magnitude 6,0 (about the limit of visibility to the naked eye). The maps in this section show stars down to magnitude 4,5.

STELLAR DISTANCES

Distances are often expressed in units of light years - the distance light would travel in a year (equal to $9{,}5 \times 10^{12}$km).

DOUBLE STARS

It now appears that single stars such as our Sun are the exception, the majority of stars being double or multiple - two or more suns in orbit around one another.

STAR CLUSTERS

These are of two completely different sorts. Galactic clusters, having of the order of 100 stars, are found close to the plane of the Milky Way. The ones we can see are relatively nearby. Globular clusters are much larger and far more distant. They contain of the order of 100 000 stars each and are seen above and below the Milky Way on that side of the sky towards the centre of our galaxy. So great is their distance that small telescopes fail to resolve individual stars - instead they appear as fuzzy balls.

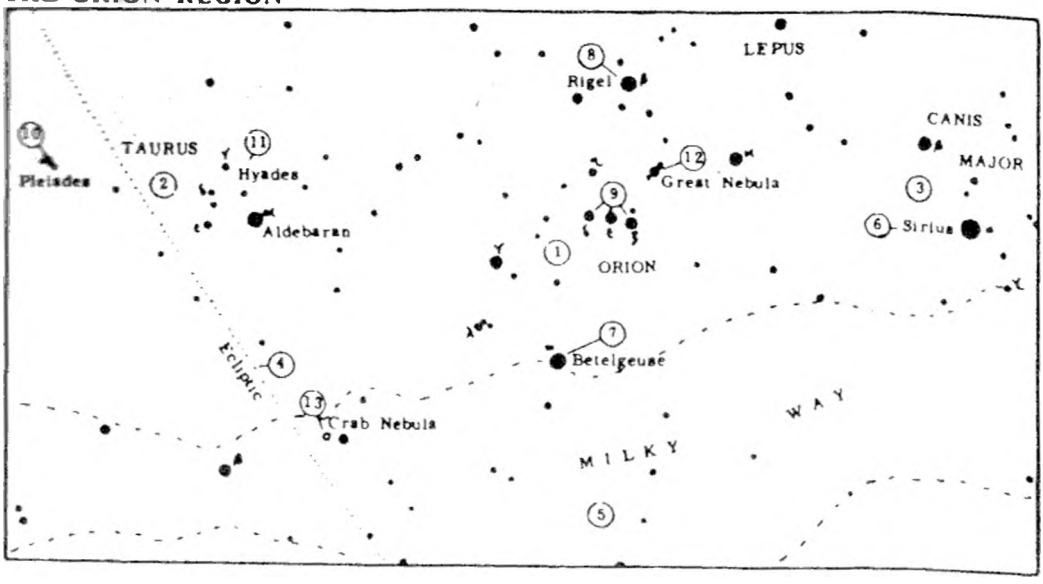
NEBULAE

Possibly one third of the matter in our region of the Galaxy is in the form of gas and dust (the remainder being contained in stars, plus a tiny amount in planets). Condensations of this material are called nebulae, some of which are illuminated by nearby stars while others are dark. They are usually referred to by their numbers in Messier's catalogue (M) or the New General Catalogue (NGC).

THREE POPULAR REGIONS

The dominating constellation of the summer skies is Orion, that of the winter skies is Scorpius, while the Southern Cross is conspicuous for most of the year. The regions around these constellations are also rich in interesting objects - visible either to the naked eye, or with the aid of binoculars or a small telescope - and are featured in the maps and text below. It may be necessary to rotate the maps to match the orientation of the constellations in the sky.

THE ORION REGION



1) The constellation of Orion. The figure of the legendary hunter of Greek mythology is unfortunately upside down when seen from Southern Africa. The faint stars by λ represent the head, α and γ the shoulders, δ ε ζ the belt, and β and κ the legs. Orion forms part of the "great hunting scene" in which he faces the onslaught of 2) Taurus, the bull. Only the forepart of the bull is depicted and, like Orion, it is upside down. α and ε are the eyes. γ the nose. Orion is accompanied by 3) Canis major, the large dog, and the small dog (off map) while Lepus, the hare, crouches at his feet.

4) A section of the Ecliptic - a line encircling the entire sky and representing the plane of the Earth's orbit. As the Earth revolves around the Sun, the Sun appears to move along the ecliptic through the constellations of the Zodiac, of which Taurus is one.

5) A portion of the Milky Way (looking out towards the edge of our Galaxy).

6) Sirius - the brightest star in the night sky. It is somewhat brighter than our Sun and relatively close by - at a distance of 9 light years. It is a double star but the companion is a white dwarf (only slightly larger than the Earth, and with a mass comparable to our Sun) and is only visible through a large telescope.

7) Betelgeuse - most famous of the red giant stars. Its diameter is of the order of the size of the Earth's orbit and its luminosity is nearly 10 000 times that of our Sun. Its red colour should be obvious to the eye. It is 520 light years distant.

8) Rigel, despite being physically smaller than Betelgeuse, is more luminous (higher surface temperature - bluish colour) and more distant.

9) The stars in Orion's belt are distant hot blue stars.

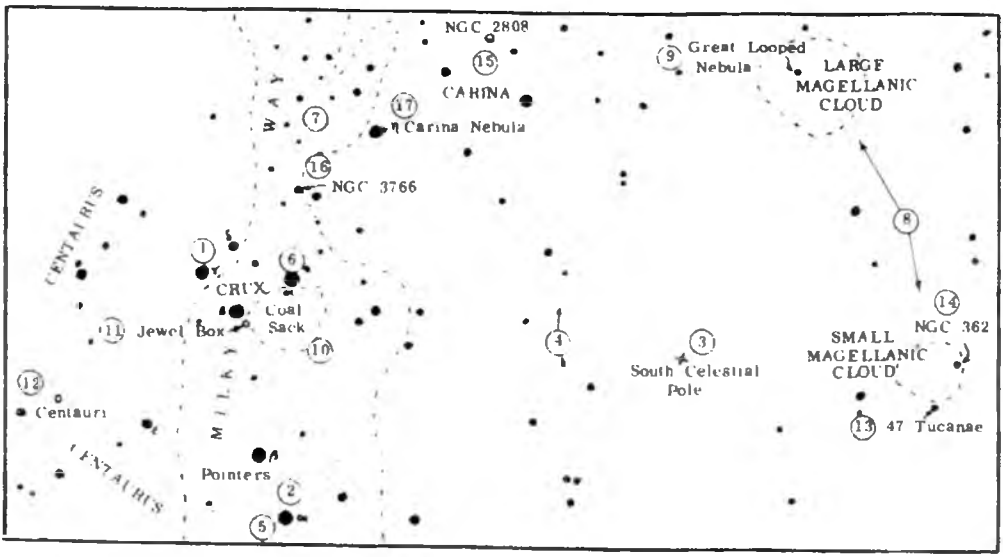
10) The Pleiades or Seven Sisters form the best known nearby star cluster. Six or seven stars are visible to the naked eye, binoculars or a small telescope show more.

11) The Hyades is another nearby galactic cluster, but Aldebaran is not a member (it lies closer to us).

12) The Great Nebula in Orion, just visible to the naked eye, shows up as a fan shaped mass of luminous gas through binoculars or a telescope. A telescope will also show a tiny "Trapezium" of four stars in the centre.

13) The Crab Nebula, the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraodinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly rotating neutron star - a star with the mass of our sun but with a diameter of only 10 km.

THE SOUTHERN CROSS REGION



1) Crux, the Southern Cross, is one of the most compact patterns of bright stars to be found in the sky. It lies on the border of that region of the sky which never sets as seen from Southern Africa.

2) The two "Pointer" stars lie close to the Cross. (A similar pattern to the Southern Cross - called the False Cross - lies just outside and above the map, but has no accompanying pointer stars).

3) The South Celestial Pole: This is one of two opposite points in space towards which the Earth's axis of rotation is directed. As the Earth rotates so the sky appears to pivot about this point. It always lies above the south point on the horizon, elevated by an angle equal to the observer's southern latitude. (The north celestial pole lies below the northern horizon and can never be seen from the Earth's southern hemisphere).

4) The intersection of a line extended through the major axis of the Cross and the perpendicular bisector to the Pointers indicates the approximate position of the South Celestial Pole.

5) α Centauri has the distinction of being the closest star to our solar system - at a distance of approximately 40×10^{12} km or 4,3 light years. A small telescope readily shows that it is a double star - the two components take 80 years to resolve about one another. A much fainter third star also belongs to the system.

6) α Crucis can also be resolved as a double star by a small telescope (separation 5 sec of arc).

7) The region indicated is one of the brightest sections of the entire Milky Way.

8) The Large and Small Magellanic Clouds are the nearest of the external galaxies (see also next section). They can be seen with the naked eye provided the sky is reasonably dark.

9) The Great Looped Nebula - possibly the remnant of a supernova explosion - in the Large Magellanic Cloud. (Naked eye or binoculars).

10) The "Coal Sack" - a dark mass of gas and dust obscuring a part of the Milky Way. (Naked eye or binoculars).

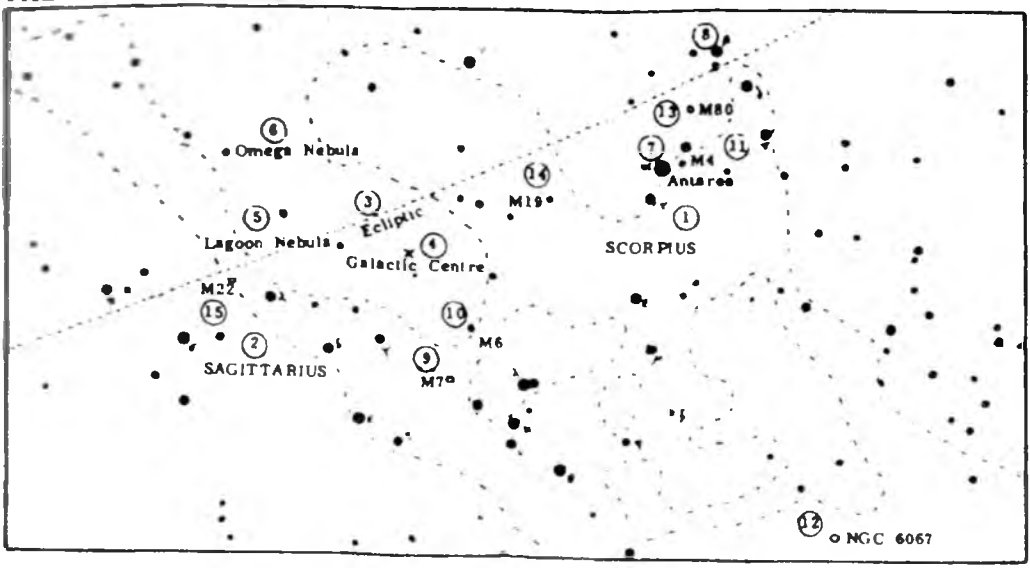
11) Herschel's "Jewel Box" - a galactic cluster containing stars of different colours. (Small telescope or binoculars).

12) ω Centauri and 13) 47 Tucanae are perhaps the best known globular clusters. Binoculars will show their fuzzy appearance. 14) NGC 362 and 15) NGC 2808 are fainter globular clusters.

16) NGC 3760 - a fine galactic cluster. (Binoculars or small telescope).

17) The η Carinae nebula - a site of a slow supernova that brightened to magnitude -0,8 in 1843 and is now of magnitude 6,4.

THE SCORPIUS REGION



1) The constellation of Scorpius. The creature is depicted with σ in the centre of the body and β and π the claws. The distinctive tail $\varepsilon - \zeta - \theta$ curls round to the stin, λ

2) Sagittarius - the figure of the centaur archer is very difficult to make out.

3) A section of the Ecliptic. Like Taurus, Scorpius and Sagittarius are constellations of the Zodiac.

4) The direction of the centre of our Galaxy - the Milky Way is that part of our Galaxy visible to us. Unfortunately the central nucleus is obscured by foreground gaseous and dusty matter - both dark and luminous - hence the irregular shape of the Milky Way in this region. Luminous nebulae include 5) the Lagoon nebula and 6) the Omega nebula. These are best seen with the aid of binoculars.

7). Antares - a distant red giant, several hundred times the diameter of our Sun - is so named because its red colour rivals that of the planet Mars.

8) β - Scorpii can be resolved as a double star (separation 16 sec of arc) with a small telescope. In fact the brighter component is in itself a triple star, and the fainter component a double star.

This region includes a number of galactic clusters including 9) M7, 10) M8, 11) M4 and 12) NGC 6067, (use binoculars or a small telescope).

Further from the plane of the Milky way are some globular clusters: 13) M80, 14) M19 and 15) M22.

NOVA SEARCHING

On rare occasions a star may undergo a nova outburst, its light increasing tremendously. The result is that a "new" star appears where previously no star was visible to the naked eye, or even with a small telescope. The light of the nova may fluctuate for a time, then gradually fades over a period of days, weeks or months.

Even observers having no telescopes can perform a useful task in keeping a watch for such novae in an allocated area of the sky. A good knowledge of the constellations is a recommendation, since part of the procedure is to scan the whole sky for bright novae before the more detailed search in the allocated area is begun. However, anyone can be given training in star recognition.

Interested persons should contact the Director of the Nova Search Section, Mr J C Bennett, 90 Malan Street, Riviera, Pretoria, 0084.

VARIABLE STAR OBSERVING

The "General Catalogue of Variable Stars" by Kukarkin and Parenago lists some 20 000 stars. Professional observatories cannot possibly monitor all of these, and this makes the observation of variable stars a field in which amateurs can make a real contribution to astronomical knowledge.

Of the 20 000 stars, at least 2000 are suitable for visual monitoring in the southern hemisphere. However, the number of active observers in this part of the world remains woefully small, and scarcely 200 variables are at present being observed from South Africa.

The Variable Star Section of the A.S.S.A. exists for the purpose of encouraging observers and of acting as a medium of communication. The Section disseminates incoming information amongst observers, and will forward (on request) the observations of individuals to various variable star bodies. These include the American Association of the Variable Star Observers (AAVSO) and the Variable Star Section of the Royal Astronomical Society of New Zealand. These bodies combine the South African light estimates with those from other parts of the world. The resulting "light curves" and tables are made available to a large number of professional observatories where astronomers are interested in investigating certain of the stars more fully.

Visual estimates of magnitude are made by comparing the variable with two or more comparison stars, respectively brighter and fainter than the unknown variable. Suitable comparison stars are shown on special charts, which have been prepared for each variable, mainly by the two variable star organisations mentioned above. The use of these charts is essential for accurate, standardized observations, and intending new observers are therefore advised to obtain the necessary data by contacting the Director of the Variable Star Section, Mr J Hers, P O Box 48, Sedgefield 6573, Telephone (04455) 736. They will then be sent charts of a few easy objects, and data on stars which may be observed with the equipment at their disposal.

Prospective observers should, when writing, give brief details of their equipment. Larger, more powerful telescopes will naturally greatly increase the number of stars which may be measured, but many variables are bright enough to be observed through most of their cycles with quite modest equipment,e.g. binoculars. Some stars, such as 07104 L2 Puppis, are so bright that they may be observed without optical aid whatever.

Variable stars are designated in two ways. The first of these, the Harvard designation, consists of six figures which give the position for 1900; the first four figures give hours and minutes of R.A., the last two give the declination in degrees, underlined for southern declinations. The second name consists of one or two letters (or letter V plus a number) and the name of the constellation.

Variables can be divided into three main classes: pulsating, eruptive, and eclipsing binary stars.

Most suitable for beginners are the long period variables (or Mira variables, named after the typical representative Mira = o Ceti) which belongs to the class of pulsating stars. They are giant stars which vary through a range of brightness of 2,5 to 5 magnitudes or more, and which have well-defined periodicities, ranging from 80 to 1000 days. In most cases one observation per observer every 10 days will suffice.

Typical examples include:

		Approx. magnitude range
021403	o Ceti Mira	2.0-10.1
092962	R Carinae	3.9-10.0
100661	S Carinae	4.5-9.9

Among the eruptive variables, two groups are of special importance:

U Geminorum type. These are dwarf novae which have long periods of apparent quiescence at minimum, with sudden rises to maximum. A typical representative in the southern hemisphere is 040971 VW Hydri.

R Coronae Borealis type. These are high luminosity variables with slow, non-periodic drops in brightness. A typical representative is 191033 RY Sagittarii.

Eclipsing Binary Stars have orbital planes which lie close to the line of sight of the observer. The two components periodically eclipse each other, thus causing variations in the apparent brightness of the system. Periods are generally short, of the order of hours, so that observational programmes need very careful planning. Monitoring these interesting stars is therefore for experienced observers only.

MINOR PLANET OCCULTATIONS:

A number of A.S.S.A. members and professional observatories form part of a world wide network which observes the above events. The observations are very useful to astronomers who study the Solar System.

Often an amateur is located on or near an occultation path, and the observation which he or she can make may be of considerable value. The equipment requirements are modest. A 50 mm telescope and means to record the times of multiple events will suffice in most instances. The timing equipment can comprise a portable tape recorder and a radio tuned to a continuous time signal such as ZUO or WWV. If a continuous time signal cannot be received reliably, than an assistant can read off time intervals of say ten seconds from a quartz watch synchronised with the S.A.B.C. "six pips" time signal. The commentary of the observer and timekeeper is thus recorded for later analysis.

Stars occulted by minor planets are not always easy to identify, but occultations notices contain hints on how to find the stars with a minimum of fuss.

If you are in touch with one of the A.S.S.A. Centres and would like to participate then you are invited to contact one of the conveners listed below. If you do not live near a Centre then please contact M.D. Overbeek, P. O. Box 212, EDENVALE. 1610

OCCULTATIONS BY MINOR PLANETS

The following predictions for occultations by Minor planets indicate possible occurrences during 1984. These include the occultations which may be observable from the African continent and details near the time for local possibilities can be obtained from Mr Overbeek. Times are in S A S T. Star numbers are from AGK3 or SAO catalogues.

DATE		Occulting Body Name	Mag	Star No	Mag	Mag change at Occultation	Max Duration (seconds)
Jan	8.02	4 Vesta	7.0	+ 19°0410	9.3	0.1	60
	29.27	46 Hestia	13.1	+ 3°1471	8.6	4.5	16
Feb	6.94	349 Dembowska	10.9	+ 15°1128	9.6	1.6	13
	27.85	566 Stereoskopia	13.6	+ 24°0996	11.4	2.3	14
May	2.15	128 Nemisis	12.4	- 2°0809	7.0	5.4	10
Jul	14.13	139 Juewa	12.4	209985	8.3	4.1	15
Jul	16.96	211 Isolda	12.7	164173	9.1	3.6	15
Aug	8.82	87 Sylvia	11.9	211985	10.0	2.1	11
Sep	17.86	8 Flora	8.6	+ 0°0197	9.4	0.4	40
Dec	4.01	40 Harmonia	10.3	+ 22°0798	8.7	1.8	14
	26.08	747 Winchester	10.4	+ 4°0801	9.3	1.4	19
	30.88	111 Ate	11.0	+ 26°0711	9.5	1.7	14

CAPE TOWN Cliff Turk, 20 Nerina Avenue, PINELANDS. 7405

PIETERMARITZBURG C.S. Lake, 23 Munroe Ave., Northern Park, PMBG. 3201

BULAWAYO Arthur G.F. Morrisby, Dept. of Surveyor General. P. O. Box 1580, Bulawayo, ZIMBABWE.

BLOEMFONTEIN G.N. Walker, 39 Vilonel St., Dan Pienaar, BLOEMFONTEIN. 9301

WITWATERSRAND M.D. Overbeek, P. O. Box 212, EDENVALE. 1610

HARARE R.W. Fleet, P.O. Box 1435, Harare, ZIMBABWE.

DURBAN R.K. Field, 303 Wakesleigh Road, BELLAIR. 4094

PRETORIA J.C. Bennett, 90 Malan Street, Riveria, PRETORIA. 0084

PORT ELIZABETH Mr D Jesson, Busaf, P.O. Box 4008, KORSTEN. 6014

ORDINARY OCCULTATIONS

This Section and that following concern a specialised branch of observational astronomy in which both professional and amateur participate. The tables of predictions must necessarily occupy a number of pages as this handbook is the sole published source for Southern Africa.

An occultation occurs when the disk of the Moon moves in front of a star. Timings of occultations, to a precision of one-tenth of a second if possible are very valuable for studies of the Moon's shape and motion. Since only very modest equipment is required, amateurs can make important contributions in this field. Persons interested in making and reporting occultation observations are urged to contact the Director of the Society's Occultation Section, Mr A G F Morrisby, (c/o Dept of Surveyor General, P O Box 1580, Bulawayo, Zimbabwe).

Predictions of occultations of all stars brighter than magnitude 7,5 supplied by Hydrographic Dept, Tokyo are given below. The main set of tables give predictions for three stations, namely,

	Longitude	Latitude
Cape Town	- 18°.475	- 33°.933
Johannesburg	- 28°.075	- 26°.182

This does not restrict its use to observers to those centres. The approximate time of an occultation at a place λ degrees west and ϕ degrees north of one of the standard stations given above may be found from

$$\text{Approximate time} = \text{predicted time} + a.\Delta\lambda + b.\Delta\phi$$

where a and b, in minutes of time, are given in the tables. Alternatively, rough times for intermediate stations can usually be estimated direct from the tables.

Occulted stars have been identified by their Z.C. numbers, that is their numbers in the "Catalogue of 3539 Zodiacal Stars for the Equinox 1950.0" by James Robertson (U S Naval Observatory, 1939).

Note: That the times of these occultations are given in U.T.

Explanations of Abbreviations used in Tables

Z.C. - the number of the star in the Zodiacal Catalogue. An "m" following the number indicates the star is not single.

Mag. - the visual magnitude
Ph - the Phase: D = Disappearance, R = Reappearance
h.m. - the time of the occultation in U T
a,b - parameters in minutes for predicting times other than at standard stations (explained above in text)
P.A. - The Position Angle on the Moon's limb measured eastward from the north point

LUNAR OCCULTATIONS 1984

CAPE TOWN
E18°5 S 33°9

Date			ZC					
Jan	h	m	No	Mag	Elg	PA	a	b
9	19	41.6	0020	6.8	72	31	-0.5	2.5
10	21	32.9	0128	7.3	84	142	-1.0	-3.2
12	19	12.3	0355	7.5	106	37	-1.5	2.0
18	19	57.4	1251	5.9	174	238	-0.9	-0.1
25	08	43.4	2023	7.9	92	290	-0.8	-1.6
27	00	31.8	2259	6.7	67	295	0.1	-1.5
29	02	19.6	2542	7.7	43	265	-0.2	-1.0
Feb								
10	20	51.7	0568	8.1	98	94	-1.2	1.0
11	19	18.1	0709	4.3	110	76	-2.2	0.9
12	20	42.4	0867	6.9	123	65	-2.1	1.3
19	02	17.3	1739	6.5	151	339	-0.7	-1.8
20	01	24.4	1856	6.6	137	262	-2.9	0.3
20	23	42.0	1976	6.9	124	264	-1.8	-0.8
21	00	16.9	1978	6.6	124	268	-2.0	-0.8
22	00	20.2	2097	7.1	111	333	-0.4	-2.5
22	10	08.4	Saturn	0.4	107	103	0.1	0.6
22	22	11.1	2213	5.9	99	300	0.2	-1.5
22	23	14.8	2218	5.6	99	302	-0.1	-1.7
23	02	44.9	2232	7.2	97	294	-1.7	-1.5
24	01	35.3	2376	4.6	85	184	1.8	-5.4
24	02	00.9	2376	4.6	85	226	-3.8	2.2
26	01	54.0	2659	6.4	62	265	-0.6	-1.0
Mar								
13	21	26.2	1270	6.1	130	66	-2.6	1.5
21	21	25.4	2302	2.9	119	154	0.5	-2.3
21	22	10.3	2302	2.9	119	255	-0.9	-0.7
21	22	10.6	2303	5.1	119	256	-0.8	-0.8
22	22	56.2	2450	7.7	106	235	-1.4	0.2
24	03	27.2	2622	6.3	92	175	.....	
24	03	51.5	2622	6.3	92	206	-4.5	8.7
Apr								
5	17	25.4	0607	8.8	48	96	-1.2	1.0
7	16	55.4	0900	4.9	71	140	-1.9	-1.3
9	17	35.1	1208	5.9	97	93	-2.3	-0.1
9	18	27.2	1211	6.2	97	150	-1.2	-1.5
10	18	37.2	1349	8.1	110	70	-2.8	0.7
17	01	45.2	2114	5.8	163	248	-2.5	2.3
18	19	16.3	2376	4.6	140	273	0.1	-1.0
20	23	34.3	2703	7.4	113	245	-1.5	-0.1
22	01	13.8	2864	4.7	100	317	-0.7	-3.5
23	03	44.7	3000	8.1	88	234	-2.3	1.3
23	23	54.8	3116	6.7	79	295	0.3	-1.9
25	00	56.9	3243	7.4	67	303	0.2	-2.7
May								
6	17	05.6	1169	5.4	67	131	-1.4	-0.5
9	17	23.2	1557	7.9	106	175	-0.5	-2.9
10	20	41.8	1689	5.5	121	165	-0.5	-2.0
14	00	35.4	2064	6.5	164	156	-1.0	-1.9
15	17	17.3	2302	2.9	172	115	0.2	-1.4
15	18	12.2	2302	2.9	172	293	-0.2	-1.5
15	18	12.2	2303	5.1	172	293	-0.1	-1.5
15	23	17.4	2330	8.3	170	233	-3.7	3.1
16	00	59.6	2337	6.4	169	244	-2.4	2.3
17	02	18.4	2490	5.4	156	262	-1.9	1.1
17	02	12.6	2491	6.7	156	110	-2.1	-1.3
17	21	06.6	2622	6.3	145	237	-1.6	0.2
18	03	06.2	2652	6.4	143	284	-2.2	0.0
20	21	33.2	3062	7.5	110	228	-0.4	0.2
22	03	59.5	3214	6.6	96	236	-2.1	1.5
23	00	25.5	3323	7.8	86	260	-0.6	-0.9
Jun								
3	16	48.3	1270	6.1	50	134	-0.9	-0.4
3	18	11.0	1274	5.7	51	92	-1.0	1.0
4	17	31.9	1401	7.9	64	65	-2.8	2.1
5	19	00.3	1533	7.2	78	103	-1.4	0.5
7	22	31.6	1773	5.1	106	78	-0.8	1.8
9	22	56.3	2016	6.5	133	113	-1.2	0.1
10	00	18.3	2022	5.5	133	62	-0.6	2.9
12	00	02.7	2275	5.9	159	45	-1.7	4.9
12	16	24.1	Uranus	5.8	169	149	0.5	-2.1
13	02	11.2	2434	5.6	173	77	-0.8	1.6
13	02	11.2	2334	5.8	173	77	-0.8	1.6
15	18	40.5	2864	4.7	153	279	0.1	-1.2
15	21	21.1	2879	6.6	152	300	-0.8	-2.3
18	02	43.1	3164	4.7	127	210	-1.4	3.0
22	02	38.9	0083	6.9	83	239	-1.4	0.3
23	03	02.9	0202	7.0	71	193	-0.3	2.2
Jul								
3	17	07.1	1610	8.7	61	73	-2.7	1.9
5	18	37.9	1848	8.0	88	164	-0.6	-2.2
6	22	40.6	1985	7.1	103	98	-0.4	0.8
8	17	55.9	2211	7.2	127	97	-2.2	-0.8
10	00	16.1	Uranus	5.8	142	47	-0.3	3.3
10	19	29.4	2510	8.3	153	65	-2.8	0.8
11	17	07.2	2652	6.4	164	143	0.2	-2.6
14	19	51.5	3089	5.3	159	255	-0.9	-0.6
15	00	44.9	3106	5.4	157	264	-2.6	0.4
15	02	51.0	3116	6.7	157	257	-1.7	1.4
17	02	22.4	3358	7.2	135	240	-2.1	1.5
20	03	04.0	0157	8.1	101	238	-2.0	0.9
22	03	05.5	0380	7.4	79	324	Graze	
Aug								
3	19	04.0	2060	6.3	86	127	-1.4	-0.8
3	19	43.0	2064	6.5	86	87	-1.4	1.2
5	20	35.9	2327	6.7	112	172	-1.8	-5.7
5	20	29.4	2330	6.3	112	88	-1.8	1.1
5	21	57.2	2337	6.4	112	99	-1.1	0.8
7	00	18.2	2490	5.4	126	118	-0.6	0.3
7	00	19.6	2491	6.7	126	69	-0.0	1.7
7	20	43.9	2622	6.3	136	52	-2.2	2.7
7	22	04.5	2627	6.9	137	121	-2.3	-0.7
9	02	00.8	2809	4.9	150	74	-0.1	1.5
12	19	22.2	3304	6.4	166	260	-0.8	-0.8
13	21	33.1	3428	5.2	154	231	-1.4	0.6
16	22	48.8	0219	5.1	121	228	-0.7	0.4
17	03	52.4	0235	6.9	120	330	.....	...
17	04	03.7	0235	6.9	120	315	.....	...
29	17	20.5	1889	8.5	41	108	-0.9	0.6
31	17	43.7	2140	8.6	68	104	-1.6	0.3
Sep								
2	19	39.5	2430	7.0	94	70	-1.5	1.9
3	19	32.2	2569	7.8	107	151	-2.7	-3.9
17	00	12.1	0664	5.4	106	244	-0.9	-0.2
17	02	14.3	0676	7.1	105	302	-3.8	-2.3
18	02	36.8	0809	8.0	93	232	-1.4	0.4
29	20	36.1	2388	7.6	64	95	-0.1	0.9
Oct								
2	19	39.8	2852	7.4	100	109	-2.4	-0.1
4	20	56.5	3116	6.7	124	350	2.0	7.1
6	01	21.2	3265	6.6	137	109	-0.6	0.7
7	18	22.8	3478	6.5	156	30	-1.1	1.7
10	20	16.2	0258	6.6	170	274	-2.2	-1.4
13	23	59.0	0621	6.2	136	237	-1.6	0.4
14	00	50.6	0625	7.0	135	202	-1.0	1.8
17	01	23.7	1075	8.0	100	227	-1.0	0.3
29	20	13.7	2804	5.9	70	80	-0.4	1.3
30	21	03.6	2943	8.1	82	72	-0.3	1.5
Nov								
2	18	45.3	3323	7.8	115	114	-4.6	-2.2
13	01	32.7	1042	6.6	130	200	-1.9	3.5
16	01	47.9	1432	7.0	93	296	-1.5	-1.6
18	02	18.7	1672	8.4	66	336	-0.7	-2.5
29	19	49.6	3284	7.1	84	27	-0.3	2.7
30	22	28.5	3409	7.0	96	33	0.0	2.2
Dec								
1	21	34.4	3521	8.0	107	35	-0.6	2.4
4	20	28.2	0301	6.8	139	355	0.3	3.7
5	23	39.9	0423	5.4	152	6	-1.2	3.7
7	00	57.8	0534	6.0	163	15	-1.8	3.7
14	00	25.3	1517	7.7	111	309	-1.4	-1.9
27	20	27.7	3356	5.9	64	41	0.0	2.1
31	19	34.3	0257	4.5	107	8	-0.7	3.1

LUNAR OCCULTATIONS 1984

JOHANNESBURG

DATE		Z C	MAG	PH	ELG	TIME	A	B	P
JAN	9	0020	6.8	D D	72	20 04.2	-0.1	2.7	22
	21	1651	4.1	R D	133	20 47.3	-0.7	-2.6	337
	27	2259	6.7	R D	67	00 17.2	0.2	-2.0	322
FEB	11	0709	4.3	D D	110	19 48.8	-2.1	1.6	62
	12	0867	6.9	D D	123	21 19.6	-2.6	3.2	15
	13	1046	6.9	D D	137	23 59.1	-0.5	-0.1	120
	13	1049	6.6	D D	137	23 54.1	-0.0	-0.5	133
	17	1484	3.6	D D	175	02 14.6	1.2	-3.9	185
	20	1856	6.6	R D	137	01 42.9	-1.8	-1.2	305
	20	1976	6.9	R D	124	23 48.8	-1.6	-1.6	299
	21	1978	6.6	R D	124	00 24.6	-1.6	-1.7	305
	22	2213	5.9	R D	99	21 55.6	0.3	-2.0	325
	22	2218	5.6	R D	99	22 59.8	0.1	-2.4	332
	23	2232	7.2	R D	99	02 42.1	-1.0	-3.1	335
	24	2376	4.6	D D	85	02 23.6	-2.1	-1.1	279
	25	2507	6.7	D D	74	00 02.6	2.1	-5.0	180
	25	2507	6.7	R D	74	00 23.0	-2.7	2.5	219
	26	2659	6.4	R D	62	01 47.9	-0.4	-1.8	301
	26	2672	2.9	R D	61	06 04.5	-3.0	1.1	251
MAR	6	0283	7.0	D D	43	17 52.6	-0.6	0.0	103
	9	0634	5.3	D D	77	16 53.0	-2.6	0.3	74
	21	2302	2.9	D B	119	21 08.3	0.0	-1.6	124
	21	2302	2.9	R D	119	22 09.2	-0.7	-1.4	289
	22	2330	6.3	R D	116	04 01.2	-3.0	4.7	228
APR	16	2088	6.2	R D	166	18 13.5	-0.6	-0.9	271
	17	Saturn	-1.1	D B	151	23 16.8	-1.5	-6.3	188
	17	Saturn	-1.1	R D	151	23 16.8	-5.0	3.6	233
	19	2523	4.9	R D	127	19 27.0	1.2	-2.8	344
	20	2703	7.4	R D	113	23 41.8	-1.4	-1.4	284
	28	0049	6.3	R D	34	02 43.2	-0.3	-1.4	278
MAY	6	1169	5.4	D D	67	17 20.4	-1.7	0.4	98
	10	1689	5.5	D D	121	20 42.0	-1.4	-0.6	122
	12	1923	7.1	D D	148	20 10.3	-3.3	0.4	84
	13	2032	7.3	D D	161	16 54.1	0.2	-3.0	172
	14	2060	6.3	D D	164	00 15.5	-1.0	-2.5	161
	14	2064	6.5	D D	164	00 38.5	-1.2	-0.4	120
	15	2302	2.9	D B	172	17 08.3	-0.3	-0.8	88
	15	2302	2.9	R D	172	17 59.5	-0.1	-2.1	323
	15	2303	5.1	R D	172	17 59.3	0.1	-2.1	324
	15	2330	6.3	R D	170	23 51.9	-2.5	-0.2	281
	16	2337	6.4	R D	169	01 28.4	-1.8	0.4	278
	17	2490	5.4	R D	156	02 40.9	-1.8	0.1	285
	17	2491	6.7	R D	156	02 08.2			355
	17	2622	6.3	R D	145	21 15.5	-1.3	1.2	279
	17	2627	6.9	R D	145	22 27.9	-2.8	1.0	241
	18	2672	2.9	D B	141	06 57.2	0.3	1.3	66
	19	2804	5.9	R D	132	00 49.3	-2.8	1.8	236
	22	3202	6.1	R D	98	00 01.0	-1.7	3.0	202
	22	3214	6.6	R D	96	04 33.0	-2.4	1.6	242
JUN	2	1131	7.2	D D	37	17 26.8	-3.2	5.5	34
	3	1263	7.1	D D	50	16 08.4	-6.0	6.6	38
	3	1263	7.1	R B	50	16 27.7	3.2	-6.7	9
	4	1270	6.1	D D	50	16 59.6	-1.3	0.6	96
	4	1408	7.4	D D	64	19 24.1	0.2	-1.1	149
	9	1994	6.5	D D	130	16 53.7	-0.7	-2.6	156
	9	2016	6.5	D D	133	23 13.1	-1.0	1.5	79
	12	4007	5.8	D D	169	16 07.9	-0.0	-1.4	118
	13	2434	5.6	D D	173	02 30.0	-0.1	2.0	60
	15	2864	4.7	R D	153	18 24.8	0.6	-2.3	317
	18	3164	4.7	R D	127	03 18.3	-1.3	2.7	216
	23	0202	7.0	R D	71	03 24.9	-0.8	2.2	202
	27	0709	4.3	D B	24	03 58.8	-1.1	-1.5	104
	27	0709	4.3	R D	24	04 54.2	0.1	1.4	207
JUL	7	4006	0.4	D D	114	16 49.0	-1.2	-2.5	150
									Saturn
	7	4006	0.4	R B	114	18 06.7	-2.6	-0.5	284
									Saturn
	10	2490	5.4	D D	152	16 05.3	1.6	-4.8	177
	10	2491	6.7	D D	152	15 39.0	-0.3	-1.6	118
	11	2652	6.4	D D	164	16 54.3	-0.7	-1.3	105
	12	2809	4.9	D D	175	16 45.7	-1.6	1.7	37
JUL	14	3089	5.3	R D	159	19 51.3	-1.0	-1.9	290
	15	3106	5.4	R D	157	01 14.5	-2.8	0.4	272
	15	3116	6.7	R D	157	03 15.7	-1.3	1.3	259
	15	3214	6.6	R D	148	18 49.0	-0.6	0.6	228
	17	3358	7.2	R D	135	02 54.8	-1.9	1.8	240
	29	1435	6.6	D D	16	15 34.0	-0.3	-1.7	162
	29	1436	6.9	D D	16	16 14.1	0.5	-1.8	164
AUG	2	1933	7.0	D D	72	18 47.6	-0.3	-4.5	183
	2	1941	4.8	D D	73	20 08.9	-0.4	-1.9	160
	2	1941	4.8	R B	73	20 48.9	0.1	1.9	248
	3	2060	6.3	D D	86	19 18.1	-1.3	0.8	93
	3	2064	6.5	D D	86	20 16.0	-0.5	8.1	37
	5	2307	4.1	D D	110	15 39.1	-1.8	-1.6	117
	5	2310	4.6	D D	110	16 16.8	-1.5	-2.5	140
	5	2337	6.4	D D	112	22 12.9	-0.5	1.3	80
	7	2490	5.4	D D	126	00 24.7	-0.2	0.4	107
	7	2491	6.7	D D	126	00 30.8	0.5	1.7	57
	7	2622	6.3	D D	136	21 36.4			11
	7	2627	6.9	D D	137	22 22.8	-1.8	0.3	103
	8	2652	6.4	D D	138	02 01.0	-0.1	0.0	119
	9	2809	4.9	D D	150	02 10.9	0.3	1.3	68
	11	3175	4.8	R D	175	19 32.9	-1.9	-0.6	265
	12	3304	6.4	R D	166	19 20.7	-1.3	-2.5	294
	13	3428	5.2	R D	154	21 54.0	-2.2	0.5	248
	14	3446	7.2	R D	153	02 34.0	-3.3	-0.2	288
	16	0219	5.1	R B	121	23 01.4	-2.5	4.0	239
	17	0235	6.9	D D	120	04 21.6			334
	21	0716	6.2	R D	75	00 50.0	-0.8	-0.5	257
	31	4006	0.6	R B	63	07 41.0	-1.0	4.5	215
SEPT	1	2267	5.1	D D	81	17 17.6	-2.2	-0.3	109
	2	2430	7.0	D D	94	20 09.0	-0.4	3.3	45
	16	0660	4.4	R D	106	23 38.6	-0.9	0.3	235
	17	0664	5.4	R D	106	00 22.6	-1.5	0.1	247
	17	0676	7.1	R D	105	02 36.5	-4.5	-2.4	305
	18	0809	8.0	R D	93	02 58.6	-2.2	0.9	236
	21	1263	7.1	R D	56	03 11.0	-1.3	-0.6	262
	30	2500	3.4	D D	74	12 02.0	-1.2	-1.7	116
	30	2500	3.5	R B	74	13 23.1	-2.1	-1.1	285
OCT	1	2676	6.5	D D	88	17 12.2	-3.2	-2.7	135
	2	2852	7.4	D D	100	20 02.0	-1.8	0.5	99
	4	3116	6.7	D D	124	21 27.3	3.3	7.4	346
	6	3265	6.6	D D	137	01 29.3	0.0	0.6	101
	7	3478	6.5	D D	156	18 51.8	-0.9	3.2	15
	14	0621	6.2	R D	136	00 22.4	-2.3	0.9	238
	14	0625	7.0	R D	135	01 20.8	-1.7	2.6	205
	17	1067	7.2	R D	100	00 11.7	-1.8	-1.3	284
	29	2750	2.1	D D	66	10 01.1	-0.9	-0.5	79
	29	2750	2.1	R B	66	11 08.0	-0.9	-1.9	299
	29	2804	5.9	D D	70	20 25.2	0.0	1.2	74
	31	3089	5.3	D D	94	23 13.2	0.2	0.7	96
NOV	6	0219	5.1	D D	158	16 40.6	-1.8	-2.3	107
	10	0714	6.2	R D	156	18 46.9	-1.2	-1.9	291
	13	1042	6.6	R D	130	02 18.6	-3.1	1.9	232
	15	1424	6.8	R D	94	23 27.6	-0.7	-0.9	269
	16	1431	7.0	R D	93	01 51.3	-1.9	-2.0	314
	21	2033	4.3	R D	25	02 43.4	0.0	-1.6	310
	24	2500	3.4	D D	19	07 23.7	-0.9	-1.2	101
	24	4001	-0.1	D D	22	15 12.1	-2.2	-1.7	138
									Mercury
	29	3284	7.1	D D	84	20 10.9	0.0	2.5	26
	30	3409	7.0	D D	96	22 44.1	0.3	2.3	23
DEC	4	0301	6.8	D D	139	20 58.1	-0.2	4.1	358
	5	0413	6.8	D D	150	19 11.6	-1.8	1.3	47
	7	0664	5.4	D D	173	17 56.0	-2.2	-2.2	114
	18	1985	7.1	R D	58	00 52.0	0.0	-1.8	318
	19	2114	5.8	R D	44	02 59.3	0.5	-3.1	354
	23	2750	2.1	D D	11	05 41.9	-0.3	-1.0	98
	23	2750	2.1	R B	11	06 45.7	-0.8	-1.2	280
	26	3228	7.2	D D	52	18 16.5	-0.5	1.4	73
	27	3356	5.9	D D	64	20 41.5	0.4	2.0	32
	29	0036	7.2	D D	85	18 21.3	-1.1	2.5	33
	31	0257	4.5	D D	107	20 06.9	-0.7	3.8	6

G R A Z I N G O C C U L T A T I O N S

When a star moves tangentially to the limb of the Moon, and is occulted for a very short period only - a few minutes, or even seconds - a grazing occultation is said to occur. Because the limb, as seen from the Earth, is in fact the outline of numerous mountains and valleys, there may be several disappearances and reappearances, which are not only fascinating, to observe, but which may be accurately timed to yield valuable data on the relative positions of star and Moon, in both right ascension and declination, as well as on the shape of the Moon. Some of these data cannot readily be obtained in any other way.

The maps on the following pages have been prepared by Hydrographic Dept, Tokyo to show the tracks of stars brighter than 7,5 magnitude which will graze the limb of the Moon when it is at a favourable elongation from the Sun and at least 10° above the observer's horizon (2° in the case of bright stars). Each track starts in the West at some arbitrary time given in the key and ends beyond the area of interest, except where the letters "A", "B" or "S" are given. "A" denotes that the Moon is at a low altitude, "B" that the bright limb interferes, and "S" that sunlight interferes. The tick marks along the tracks denote 5 minute intervals (at whole minutes), give the approximate time of the graze at places along the tracks.

The tracks as shown on the maps are approximate only. Since the observer's location is very critical, successful observations call for very accurate predictions. Such predictions, which include graphical representations of the probable profile of the Moon, are computed annually for a number of centres in Southern Africa. By plotting the predicted graze track on a reliable survey map (e.g. South African 1:50 000 series) it is usually possible to select a convenient site from where the graze may be observed. Ideally a team of observers would be stationed at intervals along a line running at right angles to the graze track - say, along a main road - each with his own telescope and timing equipment. Each observer will see a different sequence of events, the combined results forming an accurate picture of the limb of the Moon.

The equipment needed is similar to that used for ordinary (or "total") occultations, but must, of course, be portable. A 75 mm refractor is ideal for average events, but better instruments with a larger aperture have often shown their superiority under difficult conditions. Timing is best carried out with a portable tape recorder and radio receiver tuned to ZUO or other time signal station.

It will be seen from the maps that many grazing occultations occur in regions which are rather far removed from the main cities, and which cannot easily be reached by teams of observers from one of the ASSA centres. It is worth remembering, however, that a team of many observers, while ideal, is by no means essential; that a single good observer is worth more than many unsuccessful ones, and that one good observation is worth infinitely more than no observation at all.

Interested observers - especially those living in the more distant regions - who wish to be informed of favourable grazes occurring in their neighbourhood, are therefore invited to contact the co-ordinator for grazing occultations.

M.D. Overbeek, P.O. Box 212, EDENVALE. 1610 TEL: (011) 535442

EXPLANATION OF COLUMN HEADINGS IN TABLES:

No. - the number of the track on the map. An asterisk denotes that the same is double - notes are given below.

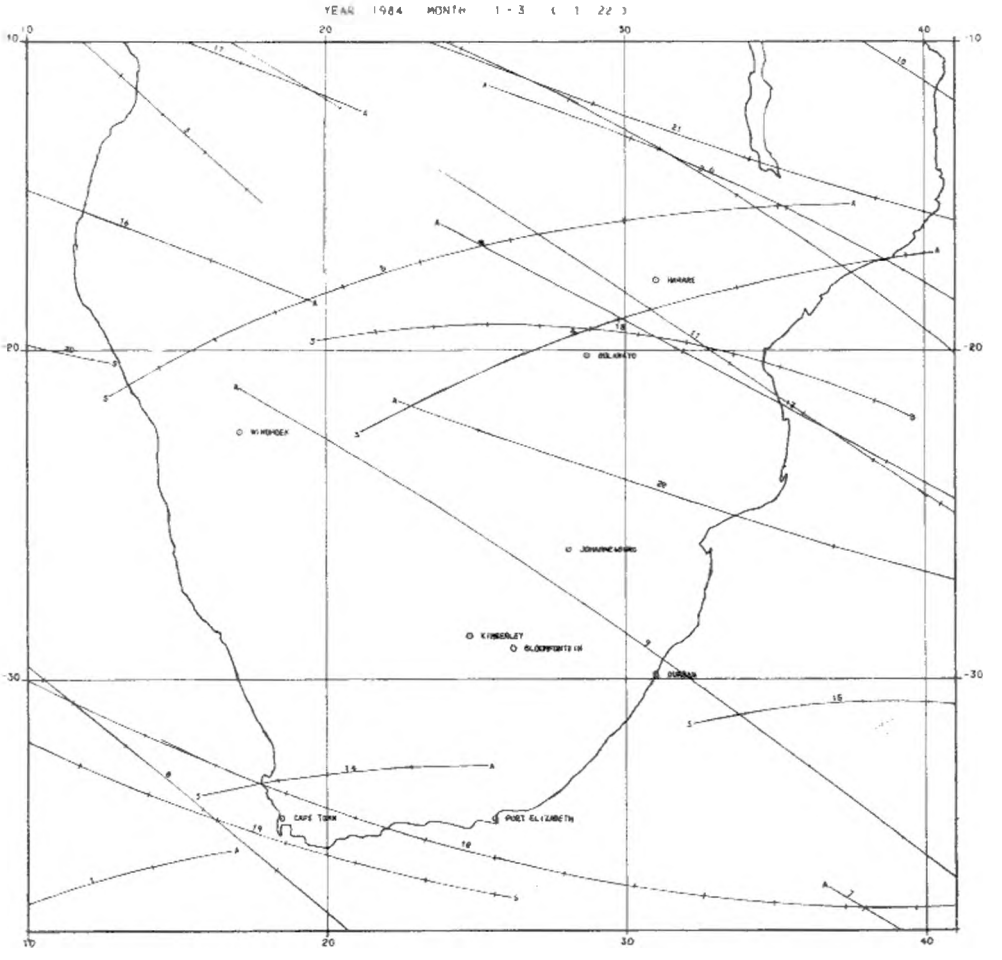
Z.C. - the number of the star in the Zodiacal Catalogue.

Date Beginning - an arbitrary time (U T) of the beginning of the track in the west.

Sunlit - the percentage of the Moon's disk lit by the Sun.

Limit - N = northern limit (a complete occultation takes place south of track)
S = southern limit (complete occultation north of the track).

Grazing Occultations 1984

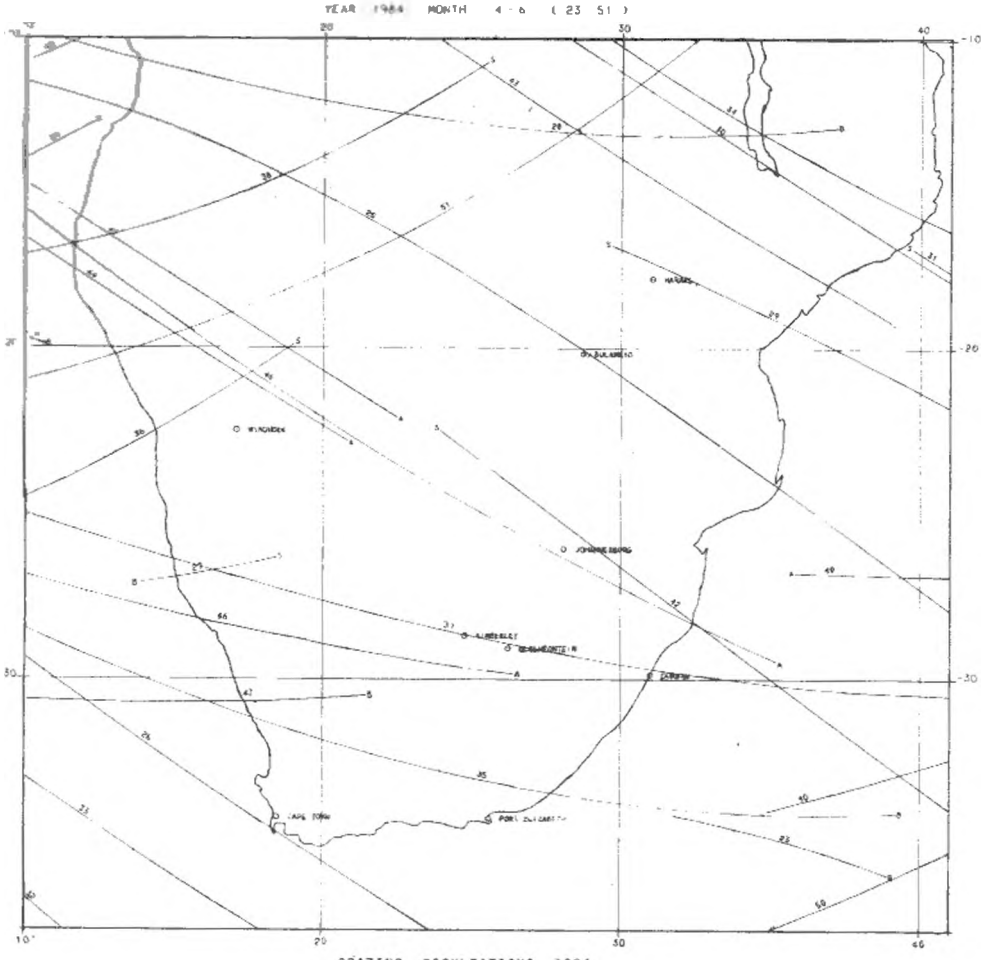


GRAZING OCCULTATIONS 1984

KEY TO MAP 1

SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT %	LIMIT
1	128	7.29	1	10	21	30	19.62	44.64	S
2	2020	6.56	1	24	23	44	17.27	-51.59	S
3	2032	7.29	1	25	3	50	25.13	-50.16	S
4	83	6.92	2	6	17	43	48.76	18.66	S
5	202	6.96	2	7	18	15	9.27	26.87	S
6	2088	6.24	2	21	21	21	55.74	-68.57	S
7	2209	5.92	2	22	20	54	15.30	-58.40	S
8	2376	4.57	2	24	1	34	3.80	-45.74	S
9	2507	6.72	2	25	0	5	56.02	-36.12	S
10	2510	6.26	2	25	0	46	18.30	-35.91	S
11	2513	4.28	2	25	1	6	21.93	-35.69	S
12	2672	2.94	2	26	4	46	52.60	-25.44	S
13	2809	4.93	2	27	1	6	52.05	-18.34	S
14	283	7.05	3	6	17	51	17.75	13.48	S
15	631	5.56	3	9	16	40	10.88	38.67	S
16	656	4.36	3	9	20	57	3.99	39.97	N
17	657	5.42	3	9	21	4	18.95	39.95	N
18	1251	5.87	3	13	17	20	9.64	80.85	S
19	2622	6.27	3	24	3	21	14.26	-51.56	S
20	2627	6.89	3	24	4	44	16.46	-51.22	S
21	3037	7.26	3	27	1	46	10.12	-23.82	S
22	3164	4.72	3	28	1	34	32.56	-16.30	S

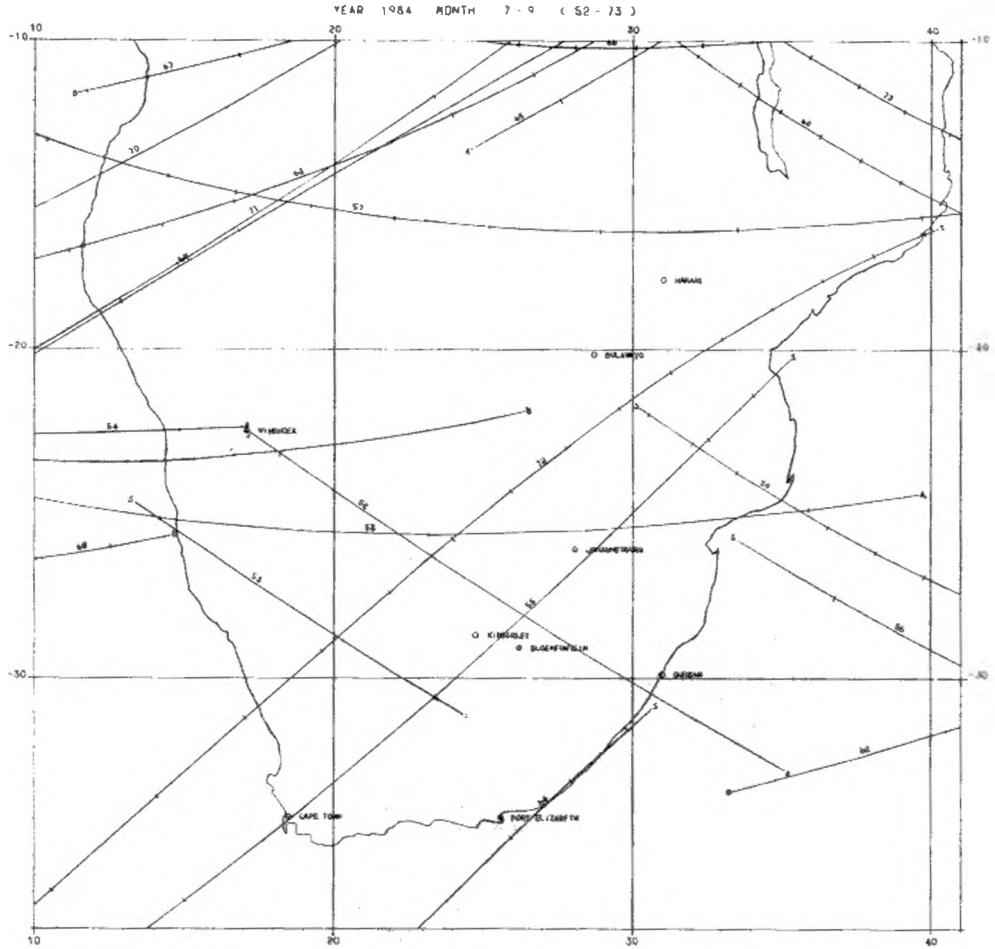
Grazing Occultations 1984



GRAZING OCCULTATIONS 1984

KEY TO MAP 2

SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT %	LIMIT
23	742	5.99	4	6	16	6	3.47	23.89	S
24	902	6.61	4	7	17	44	29.66	34.07	S
25	1206	5.88	4	9	17	47	36.50	55.97	N
26	1363	5.22	4	10	22	19	20.02	68.41	N
27	2879	6.60	4	22	4	26	17.69	- 58.09	N
28	3130	5.47	4	24	2	0	37.47	- 39.05	S
29	852	5.00	5	4	15	51	16.33	12.18	N
30	1169	5.40	5	6	17	56	3.49	30.25	N
31	1424	6.80	5	8	15	22	20.87	51.62	N
32	1432	7.00	5	8	17	14	36.98	52.46	N
33	1570	5.64	5	9	21	40	47.17	65.32	N
34	1689	5.47	5	10	21	4	43.99	75.77	N
35	2804	5.86	5	18	23	38	38.39	- 83.31	S
36	3089	5.27	5	21	4	23	42.62	- 64.73	N
37	3202	6.14	5	21	23	28	23.22	- 56.43	S
38	3214	6.61	5	22	3	4	19.72	- 55.40	N
39	128	7.29	5	26	4	56	18.35	- 18.79	N
40	237	7.14	5	27	2	3	58.28	- 12.45	N
41	1131	7.15	6	2	17	24	40.01	10.20	N
42	1263	7.10	6	3	16	11	25.09	17.66	N
43	1270	6.06	6	3	17	24	40.14	17.96	N
44	1274	5.73	6	3	18	38	8.67	18.37	N
45	1533	7.17	6	5	19	13	38.56	39.16	N
46	1773	5.10	6	7	22	48	19.98	63.51	N
47	2022	5.53	6	10	0	31	51.53	84.15	N
48	3364	4.72	6	18	2	10	4.18	- 79.96	N
49	3506	6.27	6	20	21	59	4.95	- 54.35	N
50	76	5.93	6	22	0	55	11.95	- 43.85	N
51	83	6.92	6	22	1	55	24.38	- 43.28	N

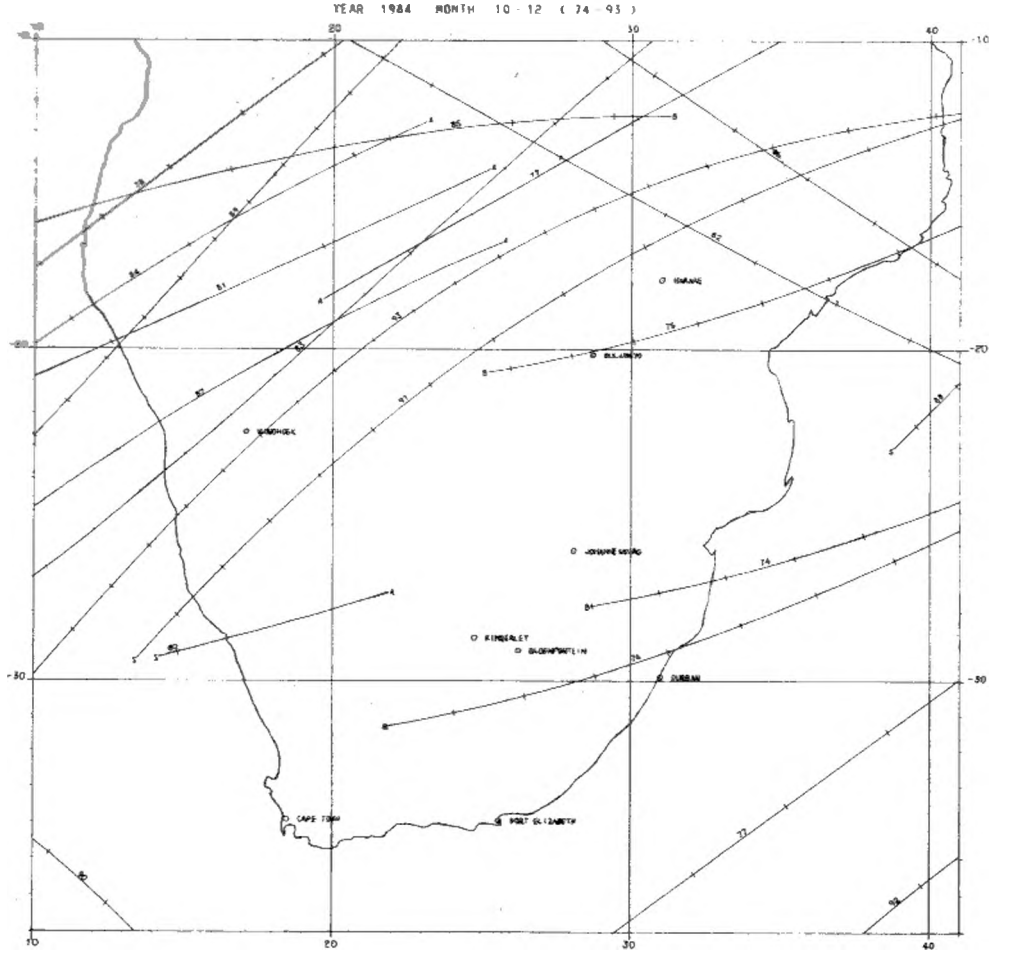


GRAZING OCCULTATIONS 1984

KEY TO MAP 3

SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT %	LIMIT
52	1363	5.22	7	1	16	28	44.85	8.20	N
53	1365	6.09	7	1	16	54	9.81	8.31	N
54	1985	7.05	7	6	23	7	10.66	61.42	N
55	380	7.40	7	22	2	58	14.85	-40.12	N
56	1689	5.47	7	31	15	30	3.22	13.55	N
57	2060	6.30	8	3	19	13	57.45	46.09	N
58	2064	6.48	8	3	20	1	18.73	46.31	N
59	2170	6.80	8	4	16	3	52.41	56.27	N
60	2307	4.13	8	5	16	2	26.55	67.09	N
61	2330	6.31	8	5	20	52	28.17	68.45	N
62	2327	6.70	8	5	21	8	35.56	68.34	S
63	219	5.12	8	16	22	14	9.27	-75.81	N
64	586	6.95	8	20	3	42	54.31	-46.36	N
65	716	6.17	8	21	0	18	18.73	-37.21	N
66	2267	5.06	9	1	17	45	50.80	41.96	N
67	2282	5.87	9	1	20	24	39.92	42.89	S
68	2430	7.04	9	2	20	4	26.55	53.77	N
69	2750	2.14	9	4	23	10	46.62	74.58	S
70	660	4.40	9	16	22	56	37.03	-63.61	N
71	664	5.41	9	16	23	31	40.48	-63.42	N
72	676	7.08	9	17	1	39	17.95	-62.84	N
73	2500	3.37	9	30	12	32	16.87	35.89	N

Grazing Occultations 1984



GRAZING OCCULTATIONS 1984

KEY TO MAP 4

SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT %	LIMIT
74	2669	6.23	10	1	16	54	53.46	47.63	S
75	2673	6.28	10	1	17	3	12.06	47.70	S
76	2676	6.46	10	1	17	25	18.57	47.86	S
77	2852	7.36	10	2	20	20	27.50	59.00	S
78	2985	6.88	10	3	21	44	36.13	69.05	S
79	1067	7.19	10	16	23	27	6.76	-58.91	N
80	2159	5.28	10	25	17	29	43.88	1.96	N
81	2459	7.22	10	27	18	32	40.87	13.70	S
82	2750	2.14	10	29	10	12	28.89	29.69	N
83	3202	6.14	11	1	18	58	43.00	61.99	S
84	3214	6.61	11	1	22	58	9.94	62.98	S
85	1432	7.00	11	16	0	40	55.88	-52.28	N
86	2500	3.27	11	24	7	37	3.69	2.73	N
87	3164	4.72	11	28	21	11	35.01	35.47	S
88	3506	6.27	12	1	16	22	16.83	62.80	S
89	76	5.93	12	2	18	51	0.07	72.57	S
90	1755	6.85	12	16	2	53	38.94	-44.30	S
91	3478	6.51	12	28	18	35	27.23	36.15	S
92	37	7.47	12	29	18	50	31.74	46.51	S
93	258	6.62	12	31	19	0	6.24	64.62	S

TIME SYSTEMS AND TELESCOPE SETTINGS

This section is intended to serve established amateurs and professional astronomers - i.e. those having some knowledge of time and coordinate systems. Space in the booklet does not permit full explanation, which in any case would appear complicated to the layman.

TIME SIGNALS FROM RADIO STATION ZUO

Radio signals of mean solar time are generated by the Precise Physical Measurements Division of the National Physical Research Laboratory in Pretoria. They are broadcast by the Post Office, the 2.5 and 5 MHz signals from Olifantsfontein, and the 100 MHz signals from Johannesburg.

Carrier Frequency	Radiated Power	Time of Transmission
2,5 MHz	4 Kw	2000 - 0600 SAST
5 MHz	4 Kw	Continuous

The signals consist of one pulse per second, each pulse consisting of 5 cycles of 1000 Hz tone. The first pulse in every minute is lengthened to 500 milliseconds. Morse code announcements are made during the minute preceding every fifth minute. They consist of the call sign ZUO (repeated 3 times) and the Universal Time (formally known as Greenwich Mean Time) at the next minute. (A special coding indicating UTI minus UTC is also indicated in the first 15 seconds of the minute by slightly lengthened second pulses).

SOUTH AFRICAN STANDARD TIME

South African Standard Time (as in everyday use) is mean solar time and the 30° East meridian (which runs east of Johannesburg and just west of Durban) and is exactly 2 hours ahead of Universal Time.

TIME OF SUN'S TRANSIT OVER 30° MERIDIAN

The table below gives the SAST when the Sun transits the 30° meridian - and a sundial on that meridian reads noon.

Jan	1	12h03m04s	May	11	11h56m21s	Sep	18	11h54m11s
	11	12 07 33		21	11 56 31		28	11 50 42
	21	12 11 02		31	11 57 35	Oct	8	11 47 36
	31	12 13 19	Jun	10	11 59 20		18	11 45 11
Feb	10	12 14 16		20	12 01 26		28	11 43 49
	20	12 13 54		30	12 03 33	Nov	7	11 43 40
Mar	2	12 12 15	Jul	10	12 05 16		17	11 44 55
	12	12 09 52		20	12 06 16		27	11 47 34
	22	12 06 59		30	12 06 23			
Apr	1	12 03 58	Aug	9	12 05 31	Dec	7	11 51 23
	11	12 01 07		19	12 03 37		17	11 56 01
	21	11 58 45		29	12 00 58		27	12 00 59
May	1	11 57 05	Sep	8	11 57 43		31	12 02 56

SIDEREAL TIME ON THE 30° MERIDIAN

		At 0 hrs SAST	At 21 hrs SAST			At 0 hrs SAST	At 21 hrs SAST			At 0 hrs SAST	At 21 hrs SAST
Jan	1	6^h39^m	3^h43^m	May	11	15^h16^m	12^h19^m	Sep	18	23^h48^m	20^h52^m
	11	7 18	4 22		21	15 55	12 58		28	0 29	21 31
	21	7 58	5 01		31	16 34	13 38	Oct	8	1 07	22 10
	31	8 37	5 41	Jun	10	17 14	14 17		18	1 46	22 50
Feb	10	9 17	6 20		20	17 53	14 57		28	2 26	23 29
	20	9 56	7 00		30	18 33	15 36	Nov	7	3 05	0 10
Mar	2	10 40	7 43	Jul	10	19 12	16 16		17	3 45	0 48
	12	11 19	8 22		20	19 51	16 55		27	4 24	1 27
	22	11 58	9 02		30	20 31	17 34	Dec	7	5 03	2 07
Apr	1	12 38	9 41	Aug	9	21 10	18 14		17	5 43	2 47
	11	13 17	10 21		19	21 50	18 53		27	6 22	3 26
	21	13 57	11 00		29	22 29	19 33		31	6 38	3 42
May	1	14 36	11 40	Sep	8	23 09	20 12				

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

Approximate longitude corrections from the 30° East Meridian are provided below. To find time of Sun's transit over local meridian, apply the longitude corrections to the data in the table above.

To find the sidereal times at SAST 0 hrs and SAST 21 hrs apply the corrections with the sign reversed to the data in the table.

Bloemfontein	$+15^m$	East London	$+ 8^m$	Port Elizabeth	$+18^m$
Bulawayo	$+ 6^m$	Grahamstown	$+14^m$	Pretoria	$+ 7^m$
Cape Town	$+46^m$	Johannesburg	$+ 8^m$	Harare	$- 4^m$
Durban	$- 4^m$	Kimberley	$+21^m$	Windhoek	$+52^m$

TELESCOPE SETTING

When a telescope equipped with setting circles is aimed on the meridian, its R.A. circle should read the sidereal time. Thus once can calculate the sidereal time and then set the circle, but is is usually simpler to aim the telescope at one of the well known stars given below and then to adjust the R.A. circle.

A LIST OF BRIGHT STARS FOR CHECKING TELESCOPE CIRCLES

Star	R.A.	Dec.	Mag.	Sp.	Star	R.A.	Dec.	Mag.	Sp.
Achernar	$1^h37^m,1$	-57°19	0,6	B5	Procyon	$7^h38^m,4$	+ 5°16'	0,5	F5
Aldebaran	4 35,0	+16 29	1,1	K5	Regulus	10 07,5	+12 03	1,3	B8
Rigel	5 13,7	- 8 13	0,3	B8	Spica	13 24,3	-11,05	1,2	B2
Betelgeuse	5 54,3	+ 7 24	0,4	M0	Arcturus	14 14,9	+19 16	0,2	K0
Canopus	6 23,6	-52,41	-0,9	F0	Antares	16 28,4	-26 24	1,2	M1
Sirius	6 44,4	-16,42	-1,6	A0	Altair	19 50,0	+ 8 49	0,9	A5

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J E van Zyl, J. Koen.

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1922 - 23	S S Hough	1942 - 43	A F I Forbes	1962 - 63	A J Wesselink
1923 - 24	R T A Innes	1943 - 44	W H van den Bos	1963 - 64	A G F Morrisby
1924 - 25	J K E Halm	1944 - 45	A W J Cousins	1964 - 65	H C Lagerwey
1925 - 26	W Reid	1945 - 46	R H Stoy	1965 - 66	A Menzies
1926 - 27	H Spencer Jones	1946 - 47	W P Hirst	1966 - 67	G R Atkins
1927 - 28	A W Roberts	1947 - 48	J Jackson	1967 - 68	J Hers
1928 - 29	A W Long	1948 - 49	A E H Bleksley	1968 - 69	J C Bennett
1929 - 30	H E Wood	1949 - 50	W S Finsen	1969 - 70	J Churms
1930 - 31	D Cameron-Swan	1950 - 51	H E Krumm	1970 - 71	W C Bentley
1931 - 32	H L Alden	1951 - 52	A D Thackeray	1971 - 72	A H Jarrett
1932 - 33	H Spencer Jones	1952 - 53	J C Bentley	1972 - 73	K J Sterling
1933 - 34	D G McIntyre	1953 - 54	David S Evans	1973 - 74	G A Harding
1934 - 35	J K E Halm	1954 - 55	P Kirchhoff	1974 - 75	C Papadopoulos
1935 - 36	J Jackson	1955 - 56	W H van den Bos	1975 - 76	P A T Wild
1936 - 37	H E Houghton	1956 - 57	S C Venter	1976 - 77	S Booysen
1937 - 38	J S Paraskevopoulos	1957 - 58	M W Feast	1977 - 78	B Warner
1938 - 39	T Mackenzie	1958 - 59	H Haffner	1978 - 79	R F Hurly
1939 - 40	R A Rossiter	1959 - 60	P Smits	1979 - 80	M W Feast
1940 - 41	E B Ford	1960 - 61	G G Cillie	1980 - 81	M A Gray
1941 - 42	H Knox Shaw	1961 - 62	M D Overbeek	1981 - 82	E Baart
				1982 - 83	J Vincent

HONORARY SECRETARIES

1922	H W Schonegevel	1923	H E Houghton	1934	H W Schonegvel
1922	T Mackenzie	1930	S Skewes	1935	A Menzies
1923	C L O'Brien Dutten	1931	H Horrocks	1965	T W Russo
				1981	Mrs M Fitzgerald
				1983	H E Krumm

HONORARY MEMBERS

Prof A E Bleksley	Mr A Menzies	Dr R H Stoy
Dr A W J Cousins	Dr J H Oort	Dr A G Velghe
Dr David S Evans	Mr G Orpen	Dr A J Wesselink
Prof Ch Fehrenbach	Mr M D Overbeek	Sir Richard Woolley
Mr H E Krumm	Dr J Schilt	

GILL MEDALLISTS

1956	H Knox Shaw	1963	A W J Cousins	1976	A D Thackeray
1957	W P Hirst	1965	R H Stoy	1981	C Papadopoulos
1958	J Jackson	1967	W S Finsen	1983	M W Feast
1960	W H van den Bos	1970	J C Bennett		

JULIAN DATE AT 1400 HOURS - 1984

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	2445	2445	2445	2445	2445	2445	2445	2445	2445	244	2446	2446
1	701	732	761	792	822	853	883	914	945	5975	006	036
2	702	733	762	793	823	854	884	915	946	5976	007	037
3	703	734	763	794	824	855	885	916	947	5977	008	038
4	704	735	764	795	825	856	886	917	948	5978	009	039
5	705	736	765	796	826	857	887	918	949	5979	010	040
6	706	737	766	797	827	858	888	919	950	5980	011	041
7	707	738	767	798	828	859	889	920	951	5981	012	042
8	708	739	768	799	829	860	890	921	952	5982	013	043
9	709	740	769	800	830	861	891	922	953	5983	014	044
10	710	741	770	801	831	862	892	923	954	5984	015	045
11	711	742	771	802	832	863	893	924	955	5985	016	046
12	712	743	772	803	833	864	894	925	956	5986	017	047
13	713	744	773	804	834	865	895	926	957	5987	018	048
14	714	745	774	805	835	866	896	927	958	5988	019	049
15	715	746	775	806	836	867	897	928	959	5989	020	050
16	716	747	776	807	837	868	898	929	960	5990	021	051
17	717	748	777	808	838	869	899	930	961	5991	022	052
18	718	749	778	809	839	870	900	931	962	5992	023	053
19	719	750	779	810	840	871	901	932	963	5993	024	054
20	720	751	780	811	841	872	902	933	964	5994	025	055
21	721	752	781	812	842	873	903	934	965	5995	026	056
22	722	753	782	813	843	874	904	935	966	5996	027	057
23	723	754	783	814	844	875	905	936	967	5997	028	058
24	724	755	784	815	845	876	906	937	968	5998	029	059
25	725	756	785	816	846	877	907	938	969	5999	030	060
26	726	757	786	817	847	878	908	939	970	6000	031	061
27	727	758	787	818	848	879	909	940	971	6001	032	062
28	728	759	788	819	849	880	910	941	972	6002	033	063
29	729	760	789	820	850	881	911	942	973	6003	034	064
30	730		790	821	851	882	912	943	974	6004	035	065
31	732		791		852		913	944		6005		066

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