ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1985

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COMET HALLEY

Comet Halley will reach mag. 16.7 (20.9) by 1985 Jan 1. (First figure indicates total integrated mag. second figure in brackets the nuclear magnitude.) It will steadily brighten to 10.0 (16.7) by Oct. 17th when it will be at RA 6h00m, Dec 21°N on the Orion-Geminid border. For southern hemisphere observers it can be seen from 22h00 until morning twilight. A few days later moonlight will interfere. Closest pre-perihelion approach will occur on Nov. 27 with the comet at mag. 6.5 (14.0) and at RA 1h50m, Dec 17°N in Pisces. Unfortunately, the moon is then full and only 26° away, but a few days later, just before moonrise will be a good observing time. Comet Halley will be well placed for observation from then until a few days after new moon on Dec 12th, rising earlier each evening in its now rapid westward movement towards the Sun.

By Christmas time the comet will have brightened to mag 6.0 (14.4) but its poor position will make it rather difficult to see, being available for less than 2 hours after sunset with the full moon less than 90° away. Observers in the tropics will be able to see the tail develop as the comet is heated, but the spectacle will be lost in the glare of the Sun by mid January as the Comet Halley approaches perihelion passage (Feb 9.45).

The best views of the comet will be obtained from the southern hemisphere after perihelion. It should be recovered by Feb 24th 1986 as low down on the eastern horizon just before dawn. The tail should rapidly grow to reach a maximum in late March or early April at which time the comet will be visible all night at mag. 4.0 (12.9), situated high in the south at Dec 70°S. Closest post-perihelion approach occurs on April 11th, the 2 day old moon conveniently out of the way. Comet Halley passes through Centaurus and then rapidly moves northwards, fading as the tail shortens and by December it will be lost to small instruments for another 76 years.

According to recent investigations the figures quoted here may be too faint by as much as two magnitudes. Best views will be obtained only from a dark site using binoculars or a rich field telescope.

(Information taken from the Comet Halley Handbook, an International Halley Watch Publication.)

PREDICTED PERIHELION PASSAGES OF COMETS, 1985

Periodic comet	Perihelion date	Revolution Period years	Perihelion Distance au
Tsuchinshan 1	Jan. 2	6.7	1.51
Honda-Mrkos-Pajdusakova	May 25	5.3	0.54
Schuster	June 2	7.2	1.53
Gehrels 3	June 3	8.1	3.44
Russell 1	July 5	6.1	1.61
Kowal 2	July 10	6.5	1.50
Tsuchinshan 2	July 21	6.8	1.79
Daniel	Aug. 3	7.1	1.65
Giacobini-Zinner	Sept. 5	6.6	1.03
Giclas	Oct. 3	6.9	1.84

ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 1985

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

Boyden Observatory at Mazelspoort near Bloemfontein.

® the Astronomical Society of Southern Africa, Cape Town. 1985

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NOTE

All times are SAST unless otherwise stated.

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 Astronomical 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 produksie-fasiliteite die 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 Britain, 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 Britain and from South African Universities.

The 0.67m visual refractor at 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 Institute and Department of Astronomy of The University of The Orange Free State, under the leadership of Prof A.H. Jarrett. The site offers extremely good conditions, without being remote from a large centre. Observing facilities include a 1.52m and two 0.41m telescopes plus the 0.25m Metcalf camera. Also there is a 0.20m solar installation and a 0.33m refractor. Research is concentrated on Photographic and Photoelectric Observations of Stars and Starfields in the Southern Milky Way and variable stars, along with studies of hydrogen emission from nebulae, the Sun and interplanetary space.

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 occasion.

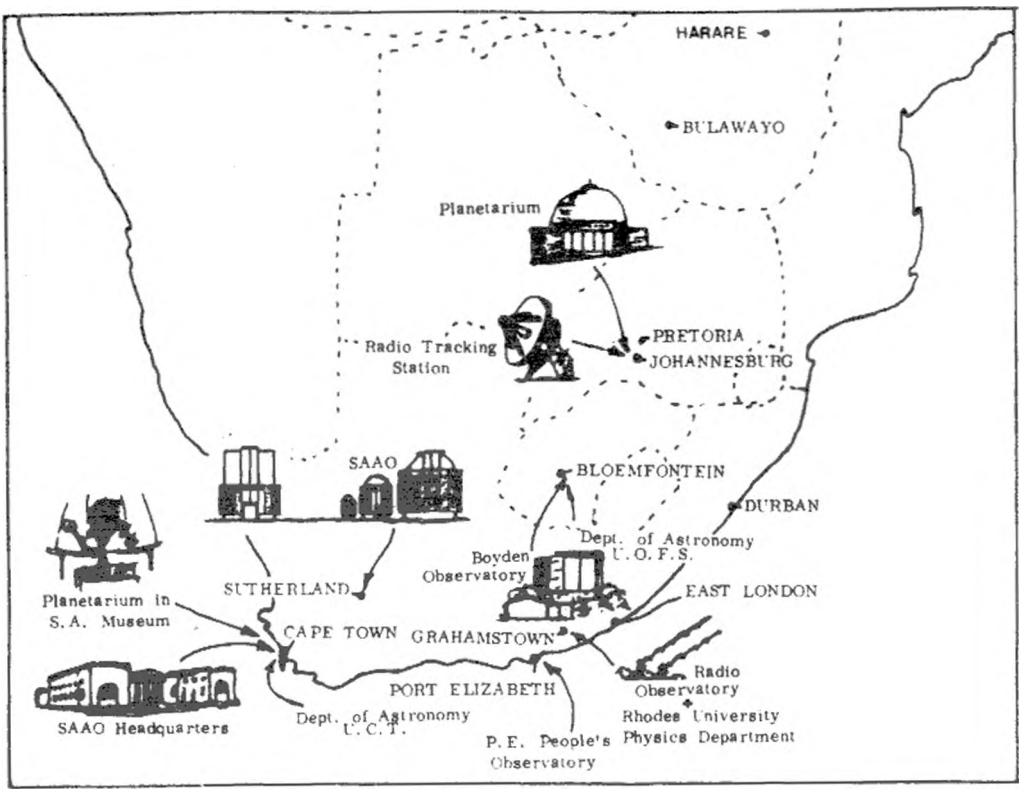
Planetaria

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 UCT is occupied by Prof Brian Warner, whose department uses the S.A.A.O. observing facilities at Sutherland. Prof G.F.R. Ellis of the Department of Applied Mathematics, UCT heads a group carrying out research in theoretical cosmology. The University of The Orange Free State has an Institute of Astronomy (created in 1981) in addition to a Department of Astronomy. Both are incorporated with the Boyden Observatory and are 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 UNISA 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 R45,00 and there is an entrance fee of R10,00. Information can be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, c/o The South African Astronomical Observatory, PO Box 9, Observatory, 7935, Cape.

LOCAL CENTRES OF THE SOCIETY

Autonomous local Centres of the Society hold regular meetings in Cape Town, Durban, Johannesburg, Bloemfontein, Pietermaritzburg, Pretoria and Harare. Visitors are very welcome at meetings 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 and Telescope".

CAPE CENTRE (Cape Town): formal meetings on 2nd Wednesday of every month at 20h00 (except January and December), when professional and prominent local amateur astronomers present lectures on the latest topics in astronomy. One or two informal meetings are held each month on Wednesdays at 20h00 when observing sessions and discussion groups are held. Two or three out-of-town weekend observing sessions are held each year in the Cedarberg mountain area under exceptional dark skies.

The Centre publishes a quarterly journal, the "Cape Observer", which gives information on meetings, current notes on the Centre's activities and information on objects to observe.

More information can be obtained by contacting Dr Peter Mack at the South African Astronomical Observatory, PO Box 9, Observatory, 7935. Telephone 47 0025 office hours. Meetings are held at the S.A.A.O., Observatory Road, Observatory.

TRANSVAAL CENTRE (Johannesburg): general meetings are held on the 2nd Wednesday of each month excluding December in the Sir Herbert Baker Building, Republic Observatory, Observatory at 20h00 when a formal lecture is delivered. On this site the Christos Papadopoulos dome houses a combined instrument, comprising of 30cm cassegrain telescope arranged for photoelectric photometry, and two refracting telescopes of 18 and 15cm aperture, which is available to members of the Centre. Public observing evenings are held every Friday and there are sections catering for the observation of variable stars and grazing occultations. Secretarial address: C.G. Jacobs, Private Bay X7, Parkview, 2122. Telephone: 011 646 5959.

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: PO Box 5330, Durban 4000. Telephone (W) 031 42 3684 or (H) 031 84 4751.

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. Information on meetings and membership is available from the Secretary, PO Box 2106, Pietermaritzburg, 3200, or by phoning 0331 33 646 or 33 710.

BLOEMFONTEIN CENTRE: meetings are held every 4th Friday of the month. For further information contact Mr F.C. Neser, telephone 051 22 1142, 108 Japie Neser Street, Uitsig, Bloemfontein.

PRETORIA CENTRE: meetings are held on the 4th Wednesday of each month (except December) at 8 pm, the venue being either the Main Academic Building of the University of South Africa or the Christian Brothers' College, Silverton Road. The Centre's observatory containing a 30cm reflecting telescope is situated on the latter site. For further information contact the Honorary Secretary, Dr C. Verburgh, PO Box 11399, Brooklyn, Pretoria, 0011.

HARARE CENTRE: the centre holds a meeting on the last Wednesday of each month (except December). These are usually held at 5.30 pm at the Queen Victoria Museum and usually consist of lectures, films or general discussions. Informal observing sessions are also held at the homes of some members. The address of the Harare Centre is PO Box UA 428, Union Avenue, Harare, Zimbabwe.

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.

Comets and Meteors see page 27
Grazing Occultations see page 38
Nova Search Section see page 32
Ordinary Occultations see page 35
Variable Stars see page 33

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h	
Jan.	2	11	Ceres stationary
	3	17	Mercury greatest elong. W. (23°)
	3	22	Earth at perihelion
	7	04	FULL MOON
	13	07	Mercury 0°.7S. of Neptune
	13	22	Spica 5°S. of Moon
	14	01	LAST QUARTER
	15	00	Jupiter in conjunction with Sun
	16	10	Saturn 2°N. of Moon
	17	07	Antares 3°S. of Moon
	17	21	Uranus 1°.8N. of Moon
	19	00	Neptune 4°N. of Moon
	19	15	Mercury 3°N. of Moon
	21	04	NEW MOON
	22	04	Venus greatest elong. E. (47°)
	25	02	Venus 5°N. of Moon
	25	06	Mars 4°N. of Moon
	29	05	FIRST QUARTER
	31	07	Mercury 1°.3S. of Jupiter
Feb.	4	15	Juno stationary
	5	17	FULL MOON
	8	04	Venus 3°N. of Mars
	9	13	Juno 1°.3S. of Moon Occn.
	10	04	Spica 5°S. of Moon
	11	12	Pluto stationary
	12	10	LAST QUARTER
	12	18	Saturn 3°N. of Moon
	13	13	Antares 3°S. of Moon
	14	04	Uranus 2°N. of Moon
	15	28	Neptune 4°N. of Moon
	15	21	Venus 4°N. of Mars
	17	12	Jupiter 4°N. of Moon
	19	10	Mercury in superior conjunction
	19	21	NEW MOON
	23	08	Venus 8°N. of Moon
	23	10	Mars 3°N. of Moon
	26	20	Venus greatest brilliancy
	28	02	FIRST QUARTER
Mar.	7	04	FULL MOON
	8	01	Saturn stationary
	8	17	Juno 0°.7N. of Moon Occn.
	9	13	Spica 5°S. of Moon
	10	17	Vesta stationary
	12	01	Saturn 3°N. of Moon
	12	10	Venus stationary
	12	19	Antares 3°S. of Moon
	13	11	Uranus 2°N. of Moon
	13	26	LAST QUARTER
	14	14	Neptune 5°N. of Moon
	17	04	Jupiter 5°N. of Moon
	17	09	Mercury greatest elong. E. (18°)
	20	18	Equinox
	21	14	NEW MOON
	22	20	Mercury 6°N. of Moon
	22	21	Venus 12°N. of Moon
	23	00	Uranus stationary
	23	04	Mercury 5°S. of Venus
	24	14	Mars 1°.4N. of Moon
	24	15	Mercury stationary
	25	21	Juno at opposition
	29	18	FIRST QUARTER

	d	h	
Apr.	3	16	Mercury in inferior conjunction
	4	00	Venus in inferior conjunction
	5	03	Neptune stationary
	5	05	Pallas in conjunction with Sun
	5	14	FULL MOON
	5	23	Spica 5°S. of Moon
	8	09	Saturn 3°N. of Moon
	9	03	Antares 3°S. of Moon
	9	18	Uranus 3°N. of Moon
	10	21	Neptune 5°N. of Moon
	12	07	LAST QUARTER
	13	19	Jupiter 5°N. of Moon
	16	02	Mercury stationary
	18	01	Venus 10°N. of Moon
	18	06	Mercury 3°N. of Moon
	18	23	Vesta at opposition
	20	09	NEW MOON
	22	13	Venus stationary
	22	15	Mars 0°.4S. of Moon Occn.
	23	16	Pluto at opposition
	28	06	FIRST QUARTER
May	1	17	Mercury greatest elong. W. (27°)
	3	10	Spica 5°S. of Moon
	4	22	FULL MOON Eclipse
	5	17	Saturn 3°N. of Moon
	6	14	Antares 3°S. of Moon
	7	03	Uranus 3°N. of Moon
	8	06	Neptune 5°N. of Moon
	9	15	Venus greatest brilliancy
	11	07	Jupiter 5°N. of Moon
	11	15	Mars 6°N. of Aldebaran
	11	20	LAST QUARTER
	15	20	Saturn at opposition
	16	01	Venus 3°N. of Moon
	17	09	Juno stationary
	18	03	Mercury 1°.5S. of Moon
	20	00	NEW MOON
	21	12	Mars 1°.9S. of Moon
	27	15	FIRST QUARTER
	30	20	Spica 5°S. of Moon
Jun.	2	00	Saturn 3°N. of Moon
	3	02	Antares 3°S. of Moon
	3	06	FULL MOON
	3	12	Uranus 2°N. of Moon
	4	15	Neptune 5°N. of Moon
	5	10	Jupiter stationary
	6	10	Vesta stationary
	6	21	Uranus at opposition
	7	16	Mercury in superior conjunction
	7	18	Jupiter 5°N. of Moon
	10	10	LAST QUARTER
	13	00	Venus greatest elong. W. (46°)
	14	13	Venus 1°.9S. of Moon
	18	14	NEW MOON
	21	13	Solstice
	23	21	Neptune at opposition
	25	21	FIRST QUARTER
	26	04	Mercury 5°S. of Pollux
	27	03	Spica 4°S. of Moon
	29	07	Saturn 3°N. of Moon
	30	10	Antares 3°S. of Moon
	30	20	Uranus 2°N. of Moon

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
July	1	01	Ceres in conjunction with Sun	
	2	00	Neptune 5°N. of Moon	
	2	14	FULL MOON	
	5	01	Jupiter 5°N. of Moon	
	5	12	Earth at aphelion	
	10	03	LAST QUARTER	
	14	03	Mercury greatest elong. E. (27°)	
	14	11	Venus 5°S. of Moon	
	15	15	Venus 3°N. of Aldebaran	
	18	02	NEW MOON	
	18	05	Mars in conjunction with Sun	
	18	20	Pluto stationary	
	19	23	Mercury 7°S. of Moon	
	24	09	Spica 4°S. of Moon	
	25	02	FIRST QUARTER	
	26	12	Saturn 3°N. of Moon	
	26	14	Saturn stationary	
	27	05	Mercury stationary	
	27	17	Antares 2°S. of Moon	
	28	02	Uranus 2°N. of Moon	
	29	07	Neptune 5°N. of Moon	
Aug.	1	00	FULL MOON	
	1	04	Jupiter 4°N. of Moon	
	4	14	Jupiter at opposition	
	8	20	LAST QUARTER	
	11	00	Mercury in inferior conjunction	
	13	10	Venus 5°S. of Moon	
	14	16	Ceres 1°.0S. of Moon	Occn.
	16	12	NEW MOON	
	20	08	Mercury stationary	
	20	14	Spica 4°S. of Moon	
	22	18	Saturn 3°N. of Moon	
	23	03	Uranus stationary	
	23	07	FIRST QUARTER	
	23	10	Venus 7°S. of Pollux	
	23	22	Antares 2°S. of Moon	
	24	07	Uranus 3°N. of Moon	
	25	12	Neptune 5°N. of Moon	
	28	06	Jupiter 4°N. of Moon	
	28	14	Mercury greatest elong. W. (18°)	
	30	11	FULL MOON	
Sept.	4	23	Mercury 0°.01S. of Mars	
	6	12	Mercury 1°.0N. of Regulus	
	7	14	LAST QUARTER	
	9	03	Mars 0°.8N. of Regulus	
	11	23	Ceres 0°.2S. of Moon	Occn.
	12	10	Venus 5°S. of Moon	
	12	11	Neptune stationary	
	13	10	Mars 4°S. of Moon	
	14	21	NEW MOON	
	16	23	Spica 4°S. of Moon	
	19	04	Saturn 3°N. of Moon	
	20	04	Antares 2°S. of Moon	
	20	13	Uranus 3°N. of Moon	
	21	13	FIRST QUARTER	
	21	17	Neptune 5°N. of Moon	
	21	19	Venus 0°.4N. of Regulus	
	22	22	Mercury in superior conjunction	
	23	04	Equinox	
	24	08	Jupiter 4°N. of Moon	
	29	02	FULL MOON	

	d	h		
Oct.	3	12	Jupiter stationary	
	5	01	Venus 0°.1N. of Mars	
	6	08	Spica 3°S. of Mercury	
	7	07	LAST QUARTER	
	10	06	Ceres 1°.1N. of Moon	Occn.
	12	03	Mars 3°S. of Moon	
	12	11	Venus 3°S. of Moon	
	14	07	NEW MOON	
	14	09	Spica 4°S. of Moon	
	15	07	Mercury 1°.3S. of Moon	Occn.
	16	17	Saturn 4°N. of Moon	
	17	12	Antares 2°S. of Moon	
	17	23	Uranus 3°N. of Moon	
	19	01	Neptune 5°N. of Moon	
	20	22	FIRST QUARTER	
	21	15	Jupiter 5°N. of Moon	
	28	06	Pluto in conjunction with Sun	
	28	20	FULL MOON	Eclipse
	30	23	Mercury 4°S. of Saturn	
Nov.	1	20	Juno in conjunction with Sun	
	3	12	Venus 4°N. of Spica	
	5	22	LAST QUARTER	
	8	11	Mercury greatest elong. E. (23°)	
	8	21	Mercury 1°.8N. of Antares	
	9	26	Mars 1°.7S. of Moon	
	10	20	Spica 4°S. of Moon	
	11	13	Venus 0°.8N. of Moon	Occn.
	12	00	Pallas stationary	
	12	11	NEW MOON	Eclipse
	13	23	Antares 2°S. of Moon	
	14	06	Mercury 0°.5N. of Moon	Occn.
	14	11	Uranus 3°N. of Moon	
	15	11	Neptune 5°N. of Moon	
	18	03	Jupiter 5°N. of Moon	
	18	21	Mercury stationary	
	19	11	FIRST QUARTER	
	23	04	Saturn in conjunction with Sun	
	27	15	FULL MOON	
	29	00	Mercury in inferior conjunction	
Dec.	2	13	Mars 3°N. of Spica	
	4	06	Mercury 1°.6N. of Venus	
	5	11	LAST QUARTER	
	5	13	Venus 1°.1S. of Saturn	
	8	06	Spica 4°S. of Moon	
	8	12	Mars 0°.01S. of Moon	Occn.
	8	13	Mercury stationary	
	10	10	Uranus in conjunction with Sun	
	10	14	Antares 5°S. of Venus	
	10	20	Mercury 5°N. of Moon	
	11	01	Saturn 4°N. of Moon	
	11	10	Antares 2°S. of Moon	
	12	03	NEW MOON	
	15	20	Jupiter 5°N. of Moon	
	16	19	Mercury 0°.5N. of Saturn	
	17	07	Mercury greatest elong. W. (21°)	
	19	04	FIRST QUARTER	
	21	12	Mercury 6°N. of Antares	
	22	00	Solstice	
	22	17	Pallas at opposition	
	25	07	Neptune in conjunction with Sun	
	27	10	FULL MOON	
	29	14	Mercury 0°.7N. of Uranus	

THE SUN 1985

Basic Data

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

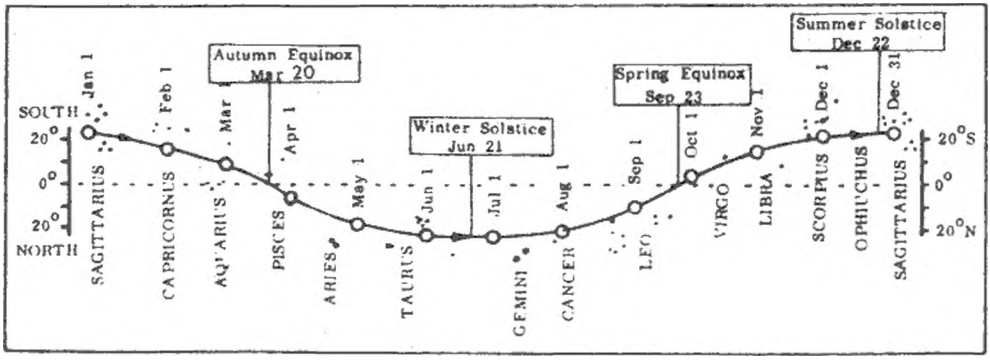
Mass: $1{,}99 \times 10^{30}$ kg (330 000 times Earth mass)

Surface Temperature: Approximately 6 000°C

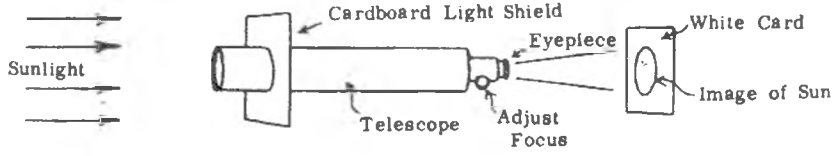
Temperature at centre: Approximately 10 million°C

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 1985 we will be closest to the Sun on January 3 (perihelion - approximate distance 147 million km) and furthest from the Sun on July 5 (aphelion - approximately 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 disc 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 disc - if monitored over a period of a week or so, the rotation of the Sun should be apparent.



SUN'S DECLINATION

Jan	1	23 02 S	Apr	1	4 24 N	Jul	10	22 17 N	Oct	8	5 45 S
	11	21 51 S		11	8 11 N		20	20 44 N		18	9 29 S
	21	19 59 S		21	11 44 N		30	18 36 N		28	13 00 S
	31	17 29 S	May	1	14 58 N	Aug	9	15 58 N	Nov	7	16 10 S
Feb	10	14 28 S		11	17 47 N		19	12 54 N		17	18 54 S
	20	11 02 S		21	20 06 N		29	9 29 N		27	21 04 S
Mar	2	7 21 S		31	21 52 N	Sep	8	5 50 N	Dec	7	22 47 S
	12	3 28 S	Jun	10	22 59 N		18	2 01 N		17	23 21 S
	22	0 29 N		20	23 26 N		28	1 53 S		22	23 27 S
				30	23 12 N					31	23 07 S

THE SUN 1985

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	05h38m	20h01m	04h58m	19h00m	05h21m	19h18m	05h11m	19h11m	05h24m	18h35m
	11	05 47	20 02	05 06	19 02	05 29	19 18	05 19	19 12	05 29	18 37
	21	05 57	19 59	05 14	19 00	05 37	19 17	05 27	19 11	05 37	18 38
Feb.	1	06 07	19 52	05 24	18 55	05 46	19 13	05 35	19 07	05 42	18 36
	11	06 17	19 43	05 33	18 47	05 54	19 06	05 43	19 01	05 47	18 32
	21	06 26	19 33	05 41	18 38	06 02	18 57	05 50	18 53	05 52	18 27
Mar.	1	06 33	19 23	05 47	18 30	06 08	18 48	05 55	18 45	05 55	18 21
	11	06 41	19 11	05 53	18 19	06 13	18 38	06 00	18 35	05 57	18 15
	21	06 49	18 57	06 00	18 07	06 18	18 27	06 05	18 24	06 00	18 06
Apr.	1	06 58	18 41	06 06	17 54	06 25	18 13	06 10	18 13	06 02	17 57
	11	07 05	18 28	06 12	17 42	06 30	18 03	06 15	18 02	06 04	17 50
	21	07 13	18 15	06 18	17 31	06 35	17 52	06 19	17 53	06 07	17 43
May	1	07 20	18 06	06 24	17 22	06 42	17 44	06 24	17 45	06 10	17 37
	11	07 28	17 57	06 31	17 14	06 49	17 36	06 29	17 38	06 13	17 32
	21	07 35	17 49	06 37	17 08	06 54	17 30	06 35	17 34	06 15	71 29
Jun.	1	07 43	17 45	06 43	17 04	07 01	17 27	06 40	17 31	06 20	17 28
	11	07 48	17 43	06 48	17 03	07 05	17 26	06 44	17 30	06 23	17 27
	21	07 51	17 44	06 51	17 04	07 06	17 27	06 47	17 32	06 26	17 29
Jul.	1	07 53	17 48	06 52	17 08	07 10	17 30	06 48	17 35	06 27	17 32
	11	07 51	17 52	06 52	17 12	07 06	17 34	06 48	17 39	06 27	17 35
	21	07 47	17 58	06 48	17 16	07 05	17 39	06 45	17 43	06 26	17 40
Aug.	1	07 39	18 06	06 42	17 23	07 00	17 45	06 40	17 48	06 23	17 42
	11	07 30	18 13	06 35	17 29	06 53	17 51	06 33	17 53	06 18	17 46
	21	07 19	18 20	06 24	17 35	06 42	17 55	06 25	17 57	06 11	17 48
Sep.	1	07 05	18 28	06 13	17 41	06 31	18 01	06 14	18 02	06 04	17 49
	11	06 52	18 34	06 00	17 46	06 19	18 06	06 03	18 06	05 55	17 51
	21	06 38	18 41	05 47	17 52	06 07	18 10	05 52	18 10	05 46	17 52
Oct.	1	06 24	18 48	05 35	17 57	05 57	18 16	05 41	18 14	05 39	17 54
	11	06 10	18 56	05 25	18 02	05 45	18 22	05 30	18 19	05 30	17 57
	21	05 58	19 03	05 12	18 10	05 33	18 27	05 21	18 25	05 23	17 59
Nov.	1	05 46	19 14	05 02	18 18	05 24	18 35	05 11	18 32	05 16	18 03
	11	05 37	19 23	04 55	18 25	05 17	18 44	05 05	18 39	05 14	18 08
	21	05 31	19 33	04 49	18 34	05 12	18 52	05 01	18 46	05 11	18 13
Dec.	1	05 28	19 43	04 47	18 43	05 11	19 00	05 00	18 54	05 12	18 19
	11	05 28	19 50	04 48	18 51	05 11	19 07	05 01	19 01	05 14	18 25
	21	05 31	19 56	04 52	18 57	05 15	19 14	05 05	19 07	05 18	18 31
	31	05 37	20 00	04 57	19 00	05 20	19 17	05 10	19 11	05 22	18 34

Solar Eclipses

The Partial Eclipse of the Sun on May 4 will be visible from Northeast Asia, Japan, Northern parts of North America, Greenland, Iceland and the Arctic regions.

Total Eclipse of the Sun on November 12 will be visible from Antarctica and South America.

THE MOON 1985

BASIC DATA

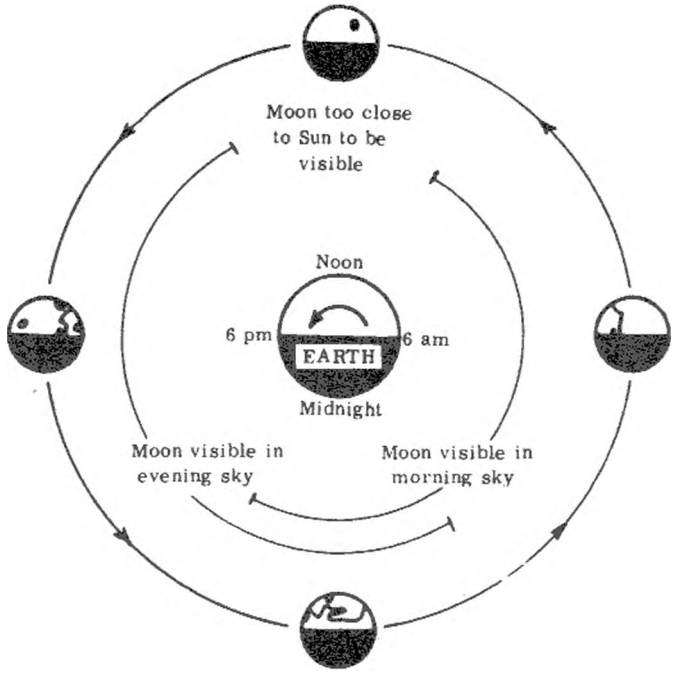
Diameter: 3 480 km (0,27 of Earth)
Mass: $7{,}35 \times 10^{22}$ kg (1/81 of Earth)
Surface Gravity: 0,16 of Earth
Average distance from Earth: 384 000 km

PHASES AND VISIBILITY

NEW MOON

	d	h	m		d	h	m		d	h	m
Jan	21	04	28	May	19	23	41	Sep	14	21	20
Feb	19	20	43	Jun	18	13	58	Oct	14	06	33
Mar	21	13	59	Jul	18	01	56	Nov	12	16	20
Apr	20	07	21	Aug	16	12	06	Dec	12	02	54

SCHEMATIC DIAGRAM OF MOON'S ORBIT



FIRST QUARTER

	d	h	m
Jan	29	05	29
Feb	28	01	41
Mar	29	18	11
Apr	28	06	25
May	27	14	56
Jun	25	18	53
Jul	25	01	39
Aug	23	06	36
Sep	21	13	03
Oct	20	22	13
Nov	19	11	04
Dec	19	03	58

LAST QUARTER

	d	h	m
Jan	14	01	27
Feb	12	09	57
Mar	13	19	34
Apr	12	06	41
May	11	19	34
Jun	10	10	14
Jul	10	02	49
Aug	8	20	29
Sep	7	14	16
Oct	7	07	04
Nov	5	22	07
Dec	5	11	01

FULL MOON

	d	h	m		d	h	m		d	h	m
Jan	7	04	16	May	4	21	53	Sep	29	02	08
Feb	5	17	19	Jun	3	05	50	Oct	28	19	38
Mar	7	04	13	Jul	2	14	08	Nov	27	14	42
Apr	5	13	32	Aug	30	11	27	Dec	27	09	30

THE MOON'S ORBIT

Dates of Apogee, when the Moon is furthest from the Earth (approximately 407 000km) and of Perigee, when the Moon is closest to the Earth (approximately 357 000km) are given below.

Moon at Perigee				Moon at Apogee			
	d	h			d	h	
Jan	12	05	Jul 25	20	Jan 27	12	Jul 11	10
Feb	8	04	Aug 20	06	Feb 24	06	Aug 8	04
Mar	8	10	Sep 16	11	Mar 23	17	Sep 4	23
Apr	15	20	Oct 15	03	Apr 19	19	Oct 2	15
May	14	07	Nov 12	15	May 17	02	Oct 30	00
Jun	1	15	Dec 11	03	Jun 13	16	Nov 26	00
Jun	29	11					Dec 23	09

As a result of its motion around the Earth, the Moon appears to make a complete circuit of 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 topography 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 a total eclipse of the Moon on May 4th. This will be visible from Southern Africa.

	SAST h m
Moon enters penumbra	19 19.8
Moon enters umbra	20 16.6
Total phase begins	21 22.1
Mid-eclipse	21 56.4
Total phase ends	22 30.7
Moon leaves umbra	23 56.2
Moon leaves penumbra	24 33.0

Magnitude of eclipse: 1.243

There will be a total eclipse of the Moon on October 28th. The starting phases will not be visible from most of Southern Africa. The total phase will be seen from the whole sub-continent.

	SAST h m
Moon enters penumbra	16 38.0
Moon enters umbra	17 54.6
Total phase begins	19 19.8
Mid eclipse	19 42.4
Total phase ends	20 05.0
Moon leaves umbra	21 30.2
Moon leaves penumbra	22 46.7

Magnitude of eclipse: 1.078

MAP OF THE MOON'S NEAR SIDE

LIBRATIONS

Jan 10, Feb 6, Mar 5
Apr 2/29, May 26, Jun 22
Jul 19, Aug 16, Sep 12
Oct 9, Nov 6, Dec 3/30

Jan 21, Feb 16, Mar 15
Apr 12, May 10, Jun 8
Jul 5, Aug 2/29, Sep 24
Oct 26, Nov 19, Dec 17

Jan 23, Feb 19, Mar 18
Apr 14, May 12, Jun 8
Jul 5, Aug 1/28, Sep 25
Oct 22, Nov 18, Dec 15

Jan 6, Feb 2, Mar 1/31
Apr 28, May 25, Jun 21
Jul 18, Aug 14, Sep 11
Oct 9, Nov 6, Dec 4

1985

TIMES OF MOON RISE AND MOON SET - JOHANNESBURG

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	13h56m	01h06m	15h28m	01h28m	14h13m	00h05m	15h31m	01h43m	15h24m	02h41m	15h52m	04h45m
2	14 50	01 38	16 28	02 16	15 10	00 57	16 14	02 49	16 01	03 45	16 39	05 55
3	15 46	02 13	17 25	03 12	16 05	01 55	16 53	03 55	16 39	04 51	17 32	07 06
4	16 45	02 52	18 19	04 14	16 55	02 58	17 31	05 01	17 19	05 59	18 31	08 15
5	17 44	03 38	19 07	05 20	17 41	04 04	18 09	06 08	18 03	07 09	19 35	09 19
6	18 43	04 31	19 51	06 27	18 23	05 12	18 48	07 15	18 54	08 20	20 39	10 14
7	19 39	05 30	20 31	07 34	19 02	06 19	19 30	08 24	19 50	09 31	21 41	11 01
8	20 30	06 33	21 08	08 39	19 40	07 25	20 17	09 34	20 50	10 36	22 40	11 41
9	21 15	07 38	21 44	09 43	20 17	08 31	21 08	10 44	21 53	11 35	23 35	12 16
10	21 56	08 44	22 21	10 47	20 56	09 38	22 05	11 50	22 54	12 25	-	12 47
11	22 34	09 47	23 00	11 51	21 39	10 45	23 04	12 50	23 54	13 07	00 28	13 16
12	23 09	10 50	23 42	12 56	22 26	11 52	-	13 43	-	13 44	01 19	13 44
13	23 44	11 52	-	14 00	23 17	12 58	00 05	14 29	00 50	14 16	02 10	14 13
14	-	12 54	00 29	15 04	-	14 00	01 04	15 08	01 43	14 46	03 01	14 43
15	00 21	13 57	01 22	16 04	00 13	14 56	02 01	15 42	02 35	15 14	03 54	15 17
16	01 00	15 02	02 18	16 58	01 12	15 45	02 55	16 14	03 25	15 42	04 48	15 54
17	01 44	16 07	03 17	17 46	02 11	16 28	03 48	16 43	04 16	16 11	05 45	16 37
18	02 33	17 10	04 17	18 28	03 09	17 06	04 39	17 11	05 07	16 43	06 42	17 25
19	03 28	18 10	05 15	19 05	04 05	17 40	05 24	17 39	06 01	17 17	07 38	18 20
20	04 26	19 03	06 11	19 38	04 59	18 10	06 20	18 09	06 56	17 56	08 32	19 18
21	05 27	19 50	07 05	20 08	05 52	18 09	07 12	18 41	07 52	18 40	09 21	20 19
22	06 27	20 31	07 57	20 37	06 43	19 07	08 06	19 17	08 49	19 30	10 06	21 21
23	07 25	21 06	08 48	21 05	07 33	19 36	09 01	19 57	09 44	20 25	10 46	22 23
24	08 21	21 38	09 39	21 35	08 25	20 07	09 57	20 43	10 36	21 24	11 23	23 24
25	09 14	22 08	10 30	22 06	09 17	20 40	10 53	21 34	11 23	22 25	11 58	-
26	10 05	22 36	11 23	22 41	10 11	21 17	11 48	22 31	12 06	23 27	12 32	00 25
27	10 55	23 05	12 18	23 20	11 07	21 59	12 38	23 31	12 45	-	13 08	01 27
28	11 46	23 35	13 15	-	12 03	22 47	13 25	-	13 22	00 24	13 46	02 31
29	12 39	-			12 59	23 41	14 08	00 33	13 57	01 31	14 29	03 37
30	13 33	00 08			13 54	-	14 47	01 39	14 33	02 33	15 18	04 46
31	14 30	00 45			14 44	00 40			15 10	03 38		

1 9 8 5

TIMES OF MOON RISE AND MOON SET - JOHANNESBURG

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

1985

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	14^h52^m	01^h31^m	16^h38^m	01^h39^m	15^h23^m	00^h15^m	16^h34^m	01^h57^m	16^h15^m	03^h06^m	16^h25^m	05^h30^m
2	15 50	01 59	17 38	02 26	16 20	01 05	17 12	03 06	16 46	04 16	17 08	06 44
3	16 50	02 30	18 35	03 21	17 13	02 04	17 46	04 18	17 19	05 27	17 58	07 59
4	17 52	03 06	19 26	04 25	18 00	03 09	18 19	05 29	17 54	06 41	18 56	09 10
5	18 54	03 49	20 10	05 34	18 42	04 20	18 51	06 42	18 34	07 56	20 00	10 13
6	19 54	04 40	20 49	06 45	19 18	05 32	19 26	07 55	19 21	09 12	21 06	11 06
7	20 48	05 39	21 24	07 57	19 52	06 44	20 03	09 09	20 15	10 25	22 12	11 50
8	21 35	06 45	21 56	09 07	20 24	07 56	20 45	10 23	21 15	11 31	23 14	12 27
9	22 16	07 54	22 27	10 17	20 57	09 08	21 34	11 36	22 19	12 28	-	12 57
10	22 52	09 03	22 59	11 25	21 32	10 20	22 29	12 44	23 23	13 16	00 14	13 24
11	23 24	10 12	23 34	12 34	22 10	11 31	23 29	13 44	-	13 55	01 11	13 49
12	23 55	11 20	-	13 43	22 53	12 42	-	14 36	00 26	14 28	02 06	14 14
13	-	12 27	00 12	14 52	23 43	13 51	00 32	15 18	01 26	14 56	03 01	14 38
14	00 26	13 34	00 56	15 57	-	14 54	01 34	15 54	02 23	15 22	03 57	15 06
15	00 58	14 42	01 47	16 58	00 38	15 49	02 34	16 25	03 19	15 46	04 54	15 34
16	01 33	15 51	02 43	17 51	01 37	16 37	03 33	16 52	04 13	16 10	05 52	16 03
17	02 13	16 59	03 44	18 37	02 39	17 17	04 29	17 17	05 08	16 35	06 52	16 47
18	03 00	18 04	04 46	19 15	03 40	17 51	05 24	17 41	06 04	17 03	07 52	17 34
19	03 53	19 04	05 48	19 49	04 40	18 21	06 19	18 06	07 02	17 33	08 49	18 28
20	04 52	19 56	06 48	20 18	05 38	18 47	07 14	18 31	08 01	18 09	09 42	19 28
21	05 54	20 40	07 45	20 44	06 34	19 12	08 11	19 00	09 01	18 50	10 28	20 33
22	06 57	21 17	08 41	21 09	07 30	19 37	09 09	19 32	09 59	19 39	11 09	21 39
23	07 59	21 48	09 36	21 33	08 25	20 02	10 07	20 08	10 54	20 34	11 44	22 45
24	08 58	22 17	10 31	21 59	09 20	20 28	11 07	20 52	11 45	21 35	12 16	23 51
25	09 55	22 42	11 27	22 26	10 17	20 57	12 04	21 42	12 29	22 40	12 46	-
26	10 50	23 07	12 24	22 57	11 15	21 31	12 58	22 40	13 08	23 46	13 16	00 57
27	11 45	23 32	13 23	23 33	12 14	22 10	13 47	23 42	13 42	-	13 47	02 04
28	12 40	23 58	14 23	-	13 13	22 56	14 30	-	14 14	00 52	14 21	03 13
29	13 37	-			14 10	23 49	15 08	00 49	14 44	01 59	15 00	04 24
30	14 36	00 27			15 03	-	15 42	01 57	15 15	03 07	15 45	05 37
31	15 36	01 00			15 51	00 50			15 48	04 17		

1985

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	16 39	06 49	18 42	08 17	20 31	08 18	21 12	07 36	22 56	07 48	23 24	08 17
2	17 41	07 55	19 46	08 53	21 27	08 43	22 09	08 03	23 51	08 33	-	09 17
3	18 47	08 53	20 47	09 24	22 23	09 08	23 08	08 34	-	09 25	00 04	10 20
4	19 54	09 42	21 45	09 51	23 20	09 34	-	09 09	00 41	10 23	00 40	11 24
5	20 59	10 22	22 42	10 17	-	10 02	00 06	09 50	01 26	11 25	01 11	12 28
6	22 01	10 56	23 37	10 41	00 18	10 34	01 03	10 38	02 05	12 29	01 41	13 33
7	23 00	11 25	-	11 06	01 17	11 12	01 57	11 33	02 40	13 35	02 10	14 39
8	23 57	11 51	00 33	11 33	02 15	11 57	02 46	12 34	03 11	14 42	02 40	15 49
9	-	12 16	01 31	12 03	03 12	12 48	03 30	13 39	03 42	15 50	03 12	17 01
10	00 52	12 40	02 29	12 38	04 06	13 48	04 08	14 47	04 12	17 01	03 49	18 17
11	01 47	13 06	03 29	13 19	04 54	14 52	04 43	15 56	04 44	18 14	04 34	19 34
12	02 44	13 34	04 28	14 07	05 36	16 00	05 15	17 05	05 20	19 30	05 27	20 46
13	03 42	14 06	05 24	15 03	06 14	17 10	05 46	18 16	06 01	20 48	06 29	21 50
14	04 41	14 43	06 16	16 06	06 47	18 20	06 17	19 29	06 50	22 02	07 38	22 43
15	05 41	15 27	07 02	17 13	07 19	19 30	06 51	20 43	07 47	23 09	08 48	23 26
16	06 40	16 19	07 42	18 22	07 50	20 40	07 29	21 59	08 52	-	09 56	-
17	07 35	17 18	08 18	19 31	08 22	21 52	08 13	23 13	10 00	00 06	11 01	00 01
18	08 24	18 22	08 50	20 39	08 56	23 05	09 05	-	11 07	00 53	12 02	00 31
19	09 08	19 29	09 21	21 47	09 35	-	10 03	00 22	12 12	01 31	13 00	00 58
20	09 45	20 36	09 51	22 56	10 21	00 17	11 07	01 23	13 13	02 02	13 56	01 23
21	10 19	21 43	10 23	-	11 13	01 27	12 13	02 13	14 11	02 30	14 52	01 47
22	10 49	22 50	10 58	00 05	12 12	02 31	13 17	02 55	15 07	02 55	15 48	02 12
23	11 19	23 56	11 38	01 16	13 16	03 27	14 20	03 30	16 03	03 19	16 45	02 39
24	11 49	-	12 24	02 26	14 20	04 14	15 19	03 59	16 59	03 44	17 44	03 10
25	12 21	01 04	13 18	03 34	15 24	04 53	16 17	04 26	17 55	04 09	18 43	03 46
26	12 57	02 13	14 19	04 36	16 26	05 26	17 13	04 50	18 53	04 38	19 40	04 27
27	13 39	03 24	15 23	05 29	17 25	05 55	18 08	05 15	19 52	05 10	20 34	05 16
28	14 29	04 35	16 29	06 14	18 23	06 21	19 05	05 39	20 50	05 47	21 22	06 11
29	15 26	05 42	17 33	06 52	19 19	06 46	20 02	06 06	21 46	06 30	22 04	07 11
30	16 30	06 42	18 35	07 24	20 15	07 10	21 00	06 35	22 38	07 21	22 41	08 14
31	17 36	07 34	19 34	07 52			21 59	07 09			23 14	09 17

1985

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	13h55m	00h44m	15h33m	00h58m	14h18m	-	15h33m	01h14m	15h21m	02h17m	15h40m	04h31m
2	14 50	01 13	16 33	01 46	15 16	00 25	16 14	02 22	15 55	03 24	16 26	05 42
3	15 49	01 46	17 30	02 41	16 09	01 24	16 51	03 30	16 30	04 33	17 17	06 55
4	16 49	02 24	18 23	03 44	16 58	02 28	17 26	04 39	17 08	05 43	18 16	08 05
5	17 50	03 08	19 10	04 51	17 42	03 36	18 02	05 48	17 51	06 55	19 20	09 08
6	18 49	04 00	19 51	06 00	18 22	04 46	18 39	06 58	18 40	08 08	20 25	10 03
7	19 44	04 59	20 29	07 09	18 58	05 55	19 19	08 10	19 35	09 20	21 28	10 49
8	20 33	06 03	21 03	08 17	19 34	07 04	20 03	09 21	20 35	10 26	22 29	11 28
9	21 17	07 10	21 37	09 23	20 09	08 13	20 54	10 32	21 38	11 24	23 26	12 01
10	21 55	08 18	22 12	10 30	20 46	09 22	21 49	11 39	22 41	12 13	-	12 30
11	22 30	09 24	22 49	11 36	21 27	10 31	22 49	12 40	23 41	12 54	00 21	12 57
12	23 03	10 29	23 30	12 42	22 12	11 40	23 50	13 32	-	13 29	01 14	13 24
13	23 37	11 33	-	13 49	23 02	12 46	-	14 17	00 39	14 00	02 66	13 51
14	-	12 37	00 15	14 53	23 58	13 49	00 51	14 55	01 34	14 28	03 00	14 19
15	00 11	13 43	01 07	15 53	-	14 45	01 49	15 28	02 28	14 55	03 54	14 50
16	00 49	14 49	02 03	16 47	00 57	15 34	02 45	15 57	03 20	15 21	04 51	15 26
17	01 31	15 55	03 03	17 34	01 57	16 16	03 40	16 24	04 13	15 48	05 49	16 07
18	02 19	17 00	04 04	18 15	02 57	16 52	04 32	16 51	05 07	16 18	06 47	16 54
19	03 13	17 59	05 03	18 51	03 54	17 24	05 25	17 17	06 02	16 50	07 44	17 48
20	04 12	18 52	06 01	19 22	04 50	17 53	06 18	17 45	06 59	17 27	08 37	18 48
21	05 13	19 38	06 57	19 50	05 44	18 20	07 12	18 15	07 57	18 10	09 25	19 50
22	06 14	20 17	07 50	20 18	06 37	18 47	08 08	18 49	08 54	18 59	10 08	20 54
23	07 14	20 51	08 43	20 44	07 30	19 14	09 05	19 28	09 50	19 54	10 46	21 58
24	08 11	21 22	09 36	21 12	08 23	19 42	10 02	20 12	10 41	20 54	11 21	23 01
25	09 05	21 50	10 29	21 41	09 17	20 14	10 59	21 03	11 27	21 57	11 53	-
26	09 59	22 16	11 24	22 14	10 13	20 49	11 53	22 00	12 08	23 01	12 26	00 04
27	10 51	22 43	12 21	22 51	11 11	21 29	12 43	23 01	12 45	-	12 59	01 09
28	11 44	23 12	13 20	23 35	12 08	22 16	13 28	-	13 19	00 05	13 35	02 15
29	12 38	23 43			13 05	23 10	14 09	00 05	13 52	01 09	14 17	03 24
30	13 35	-			13 59	-	14 46	01 11	14 26	02 14	15 04	04 34
31	14 33	00 18			14 49	01 10			15 01	03 21		

1985

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	15 59	05 44	17 58	07 16	19 39	07 26	20 13	06 49	21 51	07 08	22 21	07 37
2	17 01	06 50	19 00	07 54	20 33	07 53	21 09	07 19	22 46	07 54	23 03	08 36
3	18 06	07 49	19 58	08 28	21 27	08 20	22 05	07 51	23 36	08 46	23 40	09 37
4	19 11	08 40	20 54	08 57	22 21	08 48	23 02	08 28	-	09 43	-	10 38
5	20 14	09 22	21 48	09 25	23 17	09 18	23 58	09 10	00 23	10 43	00 15	11 40
6	21 14	09 58	22 42	09 52	-	09 53	-	09 59	01 04	11 45	00 47	12 42
7	22 10	10 29	23 36	10 19	00 14	10 32	00 52	10 53	01 41	12 49	01 18	13 46
8	23 05	10 58	-	10 48	01 11	11 17	01 42	11 53	02 16	13 53	01 51	14 52
9	23 58	11 25	00 31	11 20	02 07	12 09	02 27	12 56	02 48	14 58	02 26	16 01
10	-	11 52	01 27	11 57	03 01	13 07	03 08	14 02	03 22	16 05	03 05	17 14
11	00 51	12 19	02 25	12 39	03 50	14 10	03 45	15 08	03 56	17 16	03 52	18 29
12	01 45	12 49	03 23	13 27	04 35	15 16	04 20	16 14	04 35	18 29	04 47	19 40
13	02 41	13 23	04 19	14 23	05 15	16 23	04 54	17 22	05 18	19 44	05 49	20 45
14	03 38	14 02	05 12	15 25	05 52	17 30	05 28	18 32	06 09	20 57	06 57	21 40
15	04 37	14 47	06 00	16 30	06 26	18 37	06 05	19 43	07 08	22 04	08 06	22 25
16	05 35	15 39	06 42	17 36	06 59	19 45	06 45	20 56	08 12	23 02	09 12	23 03
17	06 30	16 37	07 21	18 43	07 34	20 54	07 32	22 09	09 18	23 51	10 14	23 36
18	07 21	17 40	07 55	19 48	08 11	22 04	08 25	23 17	10 24	-	11 13	-
19	08 06	18 45	08 29	20 54	08 53	23 14	09 24	-	11 26	00 31	12 08	00 05
20	08 46	19 50	09 02	21 59	09 40	-	10 27	00 18	12 25	01 05	13 02	00 32
21	09 22	20 55	09 36	23 06	10 33	00 22	11 31	01 10	13 21	01 35	13 56	00 58
22	09 56	21 58	10 13	-	11 32	01 26	12 34	01 54	14 15	02 03	14 50	01 26
23	10 28	23 02	10 56	00 14	12 35	02 23	13 34	02 31	15 08	02 29	15 45	01 55
24	11 00	-	11 44	01 23	13 38	03 11	14 31	03 03	16 02	02 56	16 41	02 28
25	11 35	00 07	12 39	02 29	14 40	03 53	15 26	03 32	16 56	03 23	17 39	03 05
26	12 14	01 13	13 39	03 30	15 39	04 28	16 20	03 59	17 52	03 54	18 35	03 47
27	12 58	02 22	14 42	04 25	16 36	04 59	17 13	04 25	18 49	04 28	19 29	04 36
28	13 49	03 30	15 46	05 12	17 31	05 28	18 07	04 52	19 46	05 07	20 18	05 31
29	14 46	04 37	16 48	05 52	18 25	05 55	19 02	05 21	20 41	05 51	21 02	06 30
30	15 49	05 37	17 47	06 27	19 19	06 22	19 58	05 52	21 33	06 41	21 41	07 31
31	16 54	06 30	18 44	06 57			20 55	06 27			22 16	08 32

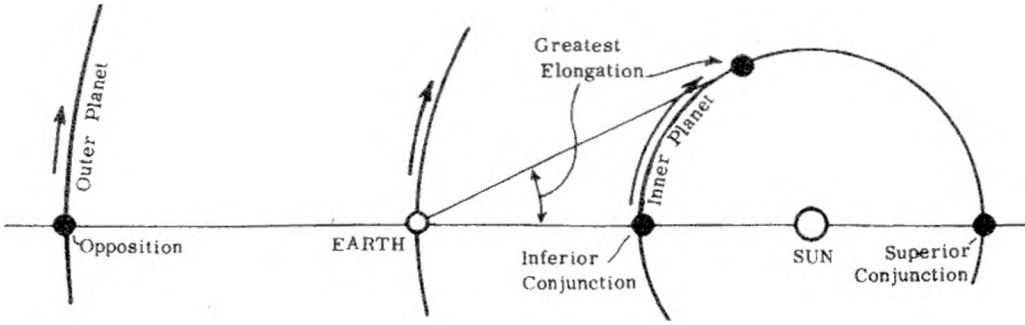
THE PLANETS 1985

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^h56^m	23°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	1 426	29,5	95,2	120,8	10 14	26 44
Uranus	2 868	84,0	14,6	47,1	10 49	27 53
Neptune	4 494	164,8	17,3	44,6	14 ?	28 48
Pluto	5 896	247,6	0,9?	?	6d?	?

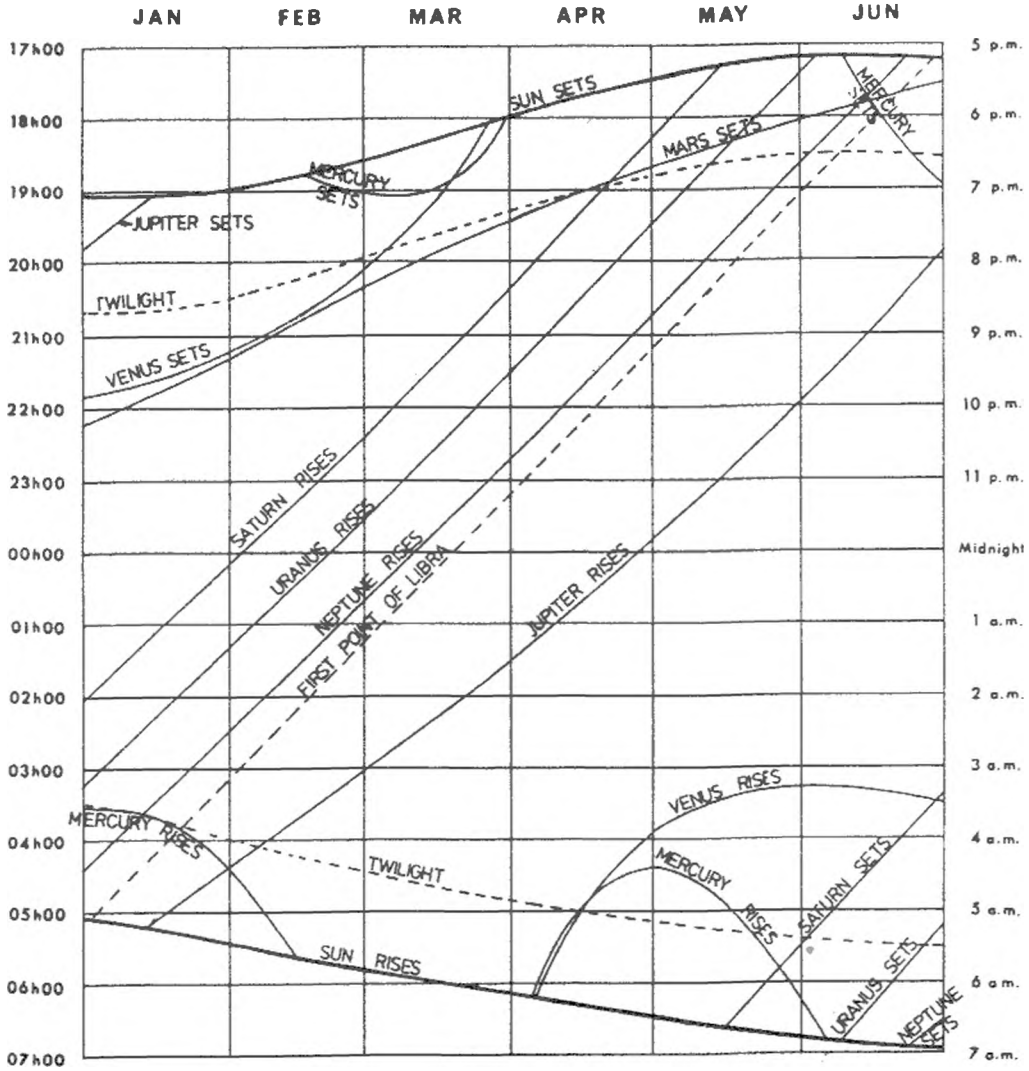
GENERAL

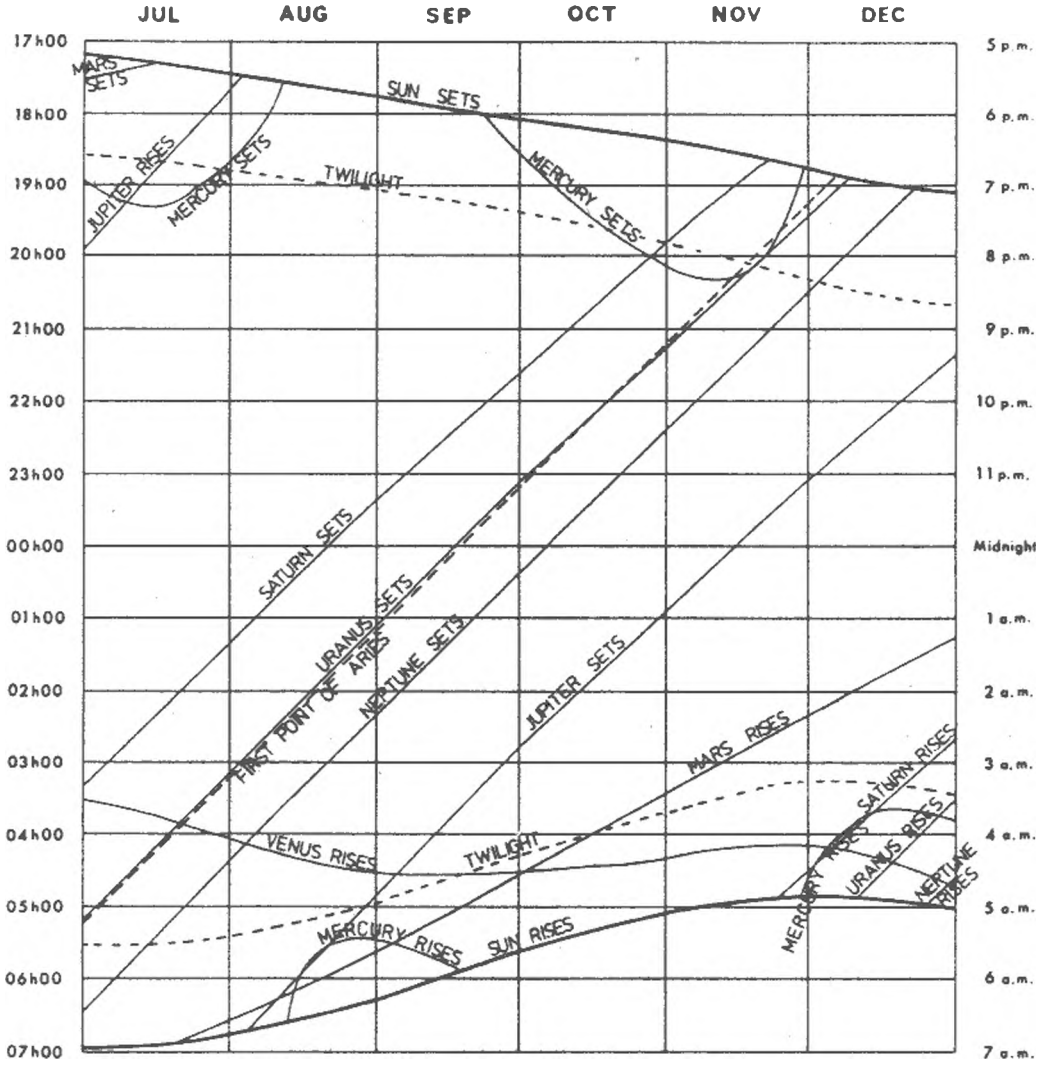
Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Unlike the distant stars, their relative positions do not remain fixed, but continually change as, like the Earth, they orbit around the Sun. Their apparent movements against the 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 1985 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
00h00
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.
MARS SETS
SUN SETS
JUPITER RISES
MERCURY SETS
TWILIGHT
MERCURY SETS
SATURN SETS
URANUS SETS
FIRST POINT OF ARIES
NEPTUNE SETS
JUPITER SETS
MARS RISES
SATURN RISES
VENUS RISES
TWILIGHT
URANUS RISES
NEPTUNE RISES
MERCURY RISES
MERCURY RISES
SUN RISES

The Planets 1985

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 rapidly among the star background but can only be seen in the early evenings or just before dawn. Its greatest angular distance from the Sun is 28° but at some elongations this may be as little at 18°.

Best evening viewings will be in mid-July and in the mornings in the first half of May.

Greatest Elongation East		Mar 17	(18°)	Jul 14	(27°)	Nov 8	(23°)
Stationary		Mar 24		Jul 27		Nov 18	
Inferior Conjunction		Apr 3		Aug 11		Nov 29	
Stationary		Apr 16		Aug 20		Dec 8	
Greatest Elongation West	Jan 3	May 1	(27°)	Aug 28	(18°)	Dec 17	(21°)
Superior Conjunction	Feb 19	Jun 7		Sep 22			

Venus

Venus in the evening sky from the beginning of the year till the end of March will brighten from -3.8 to -4.3 before disappearing into the twilight to reappear in the morning sky about mid-April. It will be at -4.2 magnitude and fade slowly to -3.4 when it vanishes into the morning twilight in December.

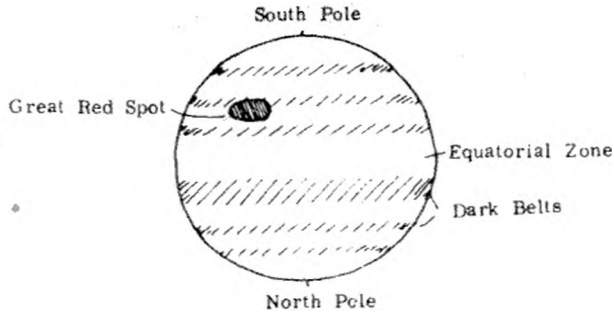
Mars

Mars at mag 1.2 at the beginning of the year will fade to mag 1.9 at the end of May, whenafter being an evening sky object, it passes into the twilight. It will reappear in the morning sky in September and slowly brighten to 1.6 at the end of the year.

Pluto

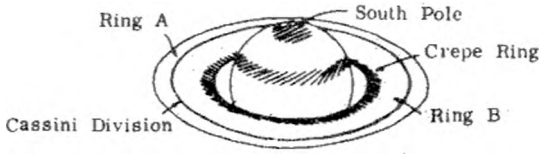
Pluto at mag 14 needs a large telescope before it can be seen. It will be at opposition on April 20th.

The Planets 1985



Jupiter

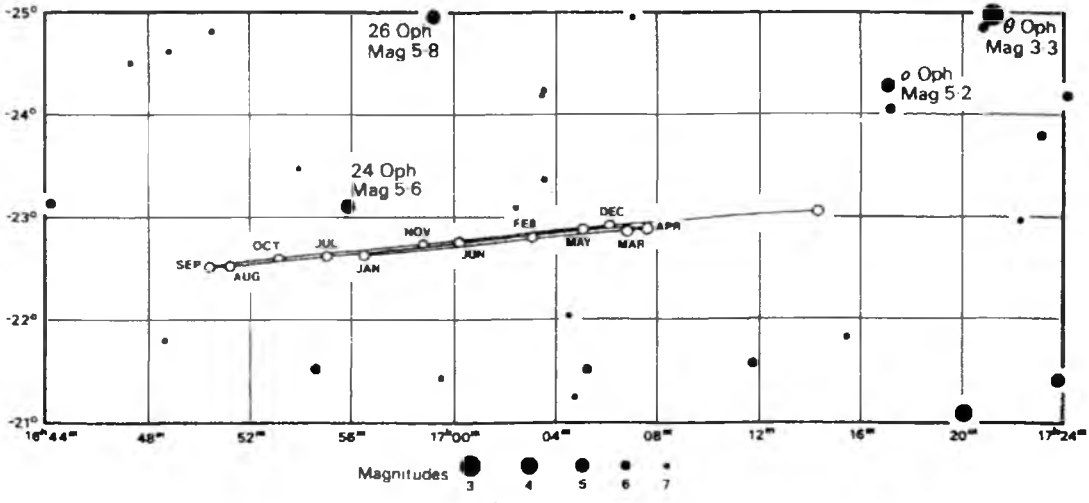
Jupiter is a morning sky object, mag -1.5, from the beginning of February and rises roughly 2 hours earlier each month, brightening to -2.4 in August. At opposition on August 4th, it will rise shortly before sunset and will then be visible all night. By the end of the year it will have faded to -1.6 and will be setting in the early evening.



Saturn

Saturn will be in the constellation of Libra all year. It will be at mag 0.8 at the beginning of the year rising about 3 hours before the Sun. It will, like Jupiter, move steadily forward among the stars and will be at opposition on May 15th when it will rise at sunset and be visible all night at mag 0.2. It will slowly fade to mag 0.8 as it moves towards the evening twilight to be lost in mid-November.

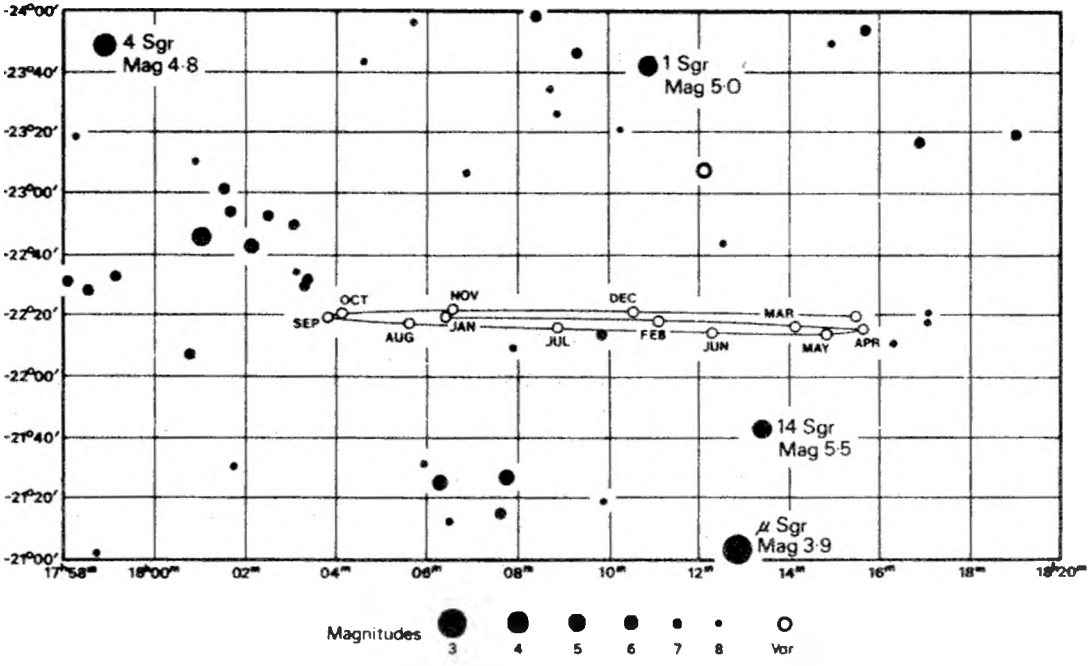
PATH OF URANUS 1985



Uranus

Uranus, being far out in the solar system will spend another year in the constellation Ophiuchus. It will be in the morning sky at the beginning of the year and move steadily forward till it is at opposition June 6th. It will then be at mag 5.8 and will be seen till mid-November when it will disappear into the evening twilight. Binoculars will help to identify this difficult object as they will only just show up its 3.8" diameter.

PATH OF NEPTUNE 1985



Neptune

Neptune is in Sagittarius all year. At mag 7.7 at opposition on June 23rd, it needs a small telescope to identify its 2.5" disc. It is in the constellation of Virgo all year.

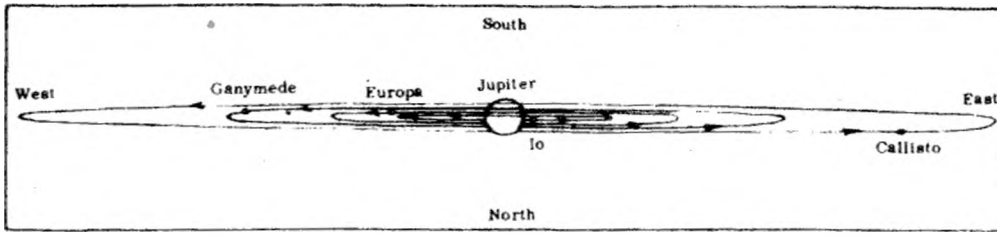
Continued from Page 24

Dec	2	20 44	II Sh E
	5	21 39	I Oc D
	6	20 08	I Sh I
	6	20 30	III Tr I
	6	21 18	I Tr E
	9	20 29	II Sh I
	9	21 10	II Tr E
	13	21 01	I Tr I
	14	21 29,0	I Ec R
	16	20 36,4	IV Ec R
	16	21 04	II Tr I
	18	21 07,7	II Ec R
	21	20 09	I Oc D
	22	20 45	I Sh E
	24	20 20	IV Tr E
	29	20 23	I Sh I
Jan	1	21 51	II Oc D

THE MOONS OF JUPITER AND SATURN 1985

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 Callisto - 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 page 26 which cover the period when Jupiter is clearly visible in the evening sky. The horizontal lines show their relative configurations at 2am each day.

When the moons pass in front and behind the planet, transits, occultations and eclipses occur. Details of such phenomena occurring 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-phenomean 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 disc of Jupiter
D. - Disappearance
R. - Reappearance
Tr. - Transit: the satellite crosses the disc of Jupiter
Sh. - Shadow Transit: the shadow of the satellite transits the disc
I - Ingress
E - Egress

	d	h	m																				
Apr	2	4	2,7	I	Ec	D	Apr	18	2	45,9	III	Ec	D	Apr	28	3	47,7	II	Ec	D	May	9	7	59,9	I	Ec	D
	3	3	29	I	Sh	E		18	3	51	IV	Tr	I		29	2	10	III	Tr	I		10	5	9	I	Sh	I
	3	4	38	I	Tr	E		18	5	54	I	Oc	R		29	5	45	III	Tr	E		11	2	28,4	I	Ec	D
	5	4	15	II	Tr	I		19	1	45	I	Sh	E		30	1	36	II	Tr	I		11	6	7	I	Oc	R
	5	4	41	II	Sh	E		19	3	01	I	Tr	E		30	1	47	II	Sh	E		12	3	13	I	Tr	E
	9	5	56,6	I	Ec	D		21	1	13,3	II	Ec	D		30	4	27	II	Tr	E		13	4	48	III	Sh	I
	10	3	07	I	Sh	I		22	1	39	III	Tr	E	May	2	6	6,2	I	Ec	D		14	4	9	II	Sh	I
	10	4	19	I	Tr	I		23	1	49	II	Tr	E		3	3	16	I	Sh	I		16	3	47	II	Oc	R
	10	5	23	I	Sh	E		23	7	44,2	I	Ec	D		3	4	34	I	Tr	I		17	3	42	III	Oc	R
	11	2	20,4	III	Ec	R		25	3	12,5	I	Ec	D		3	5	32	I	Sh	E		18	4	22	I	Ec	D
	11	3	46	III	Oc	D		25	1	22	I	Sh	I		4	4	13	I	Oc	R		19	2	49	I	Tr	I
	11	3	58	I	Oc	R		26	1	56,2	IV	Ec	D		5	3	17	IV	Tr	E		19	3	47	I	Sh	E
	12	4	28	II	Sh	I		26	2	40	I	Tr	I		6	4	21	III	Sh	E		19	3	5	I	Tr	E
	14	4	00	II	Oc	R		26	3	38	I	Sh	E		7	4	13	II	Tr	I		20	2	27	I	Oc	R
	17	5	00	I	Sh	I		26	4	56	I	Tr	E		7	4	22	II	Sh	E		21	3	53	IV	Sh	I
	18	2	18,8	I	Ec	D		27	2	19	I	Oc	R		7	7	4	II	Tr	E		24	2	17,3	III	Ec	R

	d	h	m	
May	25	1	25	II Tr E
	26	3	25	I Sh I
	26	4	40	I Tr I
	26	5	41	I Sh E
	27	4	18	I Oc R
	28	1	25	I Tr E
	30	1	42	IV Oc D
	30	3	24,7	II Ec D
	30	6	31	IV Oc R
	31	2	40,6	III Ec D
	31	6	16,7	III Ec R
Jun	1	1	3	II Tr I
	1	1	26	II Sh E
	1	3	53	II Tr E
	1	8	9,3	I Ec D
	2	5	18	I Sh I
	2	6	31	I Tr I
	2	7	35	I Sh E
	3	2	37,7	I Ec D
	3	6	8	I Oc R
	4	0	58	I Tr I
	4	1	13	III Tr E
	4	2	3	I Sh E
	4	3	15	I Tr E
	6	6	0,1	II Ec D
	7	2	40	IV Sh E
	7	6	39,5	III Ec D
	8	1	11	II Sh I
	8	3	29	II Tr I
	8	4	1	II Sh E
	10	0	30	II Oc R
	10	4	31,3	I Ec D
	11	1	16	III Tr I
	11	1	40	I Sh I
	11	2	47	I Tr I
	11	3	57	I Sh E
	11	4	53	III Tr E
	11	5	4	I Tr E
	12	2	25	I Oc R
	15	3	46	II Sh I
	15	5	53	II Tr I
	17	2	54	II Oc R
	18	0	44	III Sh I
	18	3	34	I Sh I
	18	4	19	III Sh E
	18	4	35	I Tr I
	18	4	52	III Tr I
	18	5	51	I Sh E
	19	0	53,5	I Ec D
	19	4	12	I Oc R
	20	0	20	I Sh E
	20	1	19	I Tr E
	24	0	29,3	II Ec D
	24	1	0	IV Tr I
	24	5	17	II Oc R
	24	5	49	IV Tr E
	25	4	43	III Sh I
	25	5	28	I Sh I
	26	0	15	II Tr E
	26	2	47,3	I Ec D
	26	5	59	I Oc R
	26	23	56	I Sh I
	27	0	49	I Tr I
	27	2	14	I Sh E
	27	3	6	I Tr E
	28	0	25	I Oc R
	29	1	42	III Oc R
Jul	1	3	5,4	II Ec D
	2	2	12,4	IV Ec D
	2	23	43	II Tr I
	3	1	3	II Sh E
	3	2	34	II Tr E
	3	4	41,1	I Ec D
	4	1	50	I Sh I
	4	2	35	I Tr I

	d	h	m	
Jul	4	4	8	I Sh E
	4	4	53	I Tr E
	4	20	47	II Oc R
	4	23	9,5	I Ec D
	5	2	11	I Oc R
	5	22	36,8	III Ec D
	5	23	19	I Tr E
	6	5	7	III Oc R
	8	5	41,8	II Ec D
	10	0	46	II Sh I
	10	2	0	II Tr I
	10	3	37	II Sh E
	10	4	51	II Tr E
	11	3	44	I Sh I
	11	4	20	I Tr I
	11	4	2	I Sh E
	11	23	6	II Oc R
	12	1	3,4	I Ec D
	12	3	55	I Oc R
	12	22	13	I Sh I
	12	22	46	I Tr I
	13	0	31	I Sh E
	13	1	4	I Tr E
	13	2	37	III Ec D
	13	22	21	I Oc R
	16	22	11	III Tr E
	17	3	21	II Sh I
	17	4	15	II Tr I
	18	5	39	I Sh I
	18	21	37,3	II Ec D
	19	1	22	II Oc R
	19	2	57,4	I Ec D
	19	4	57	IV Oc R
	19	5	39	I Oc R
	20	0	7	I Sh I
	20	0	31	I Tr I
	20	2	25	I Sh E
	20	2	49	I Tr E
	20	21	25,9	I Ec D
	21	0	5	I Oc R
	23	21	52	III Tr I
	24	0	19	III Sh E
	24	1	30	III Tr E
	26	0	14,4	II Ec D
	26	3	38	II Oc R
	26	4	51,5	I Ec D
	27	2	2	I Sh I
	27	2	15	I Tr I
	27	4	20	IV Sh I
	27	4	28	I Sh E
	27	4	33	I Tr E
	27	22	4	II Sh E
	27	22	27	II Tr E
	27	23	28	I Ec D
	28	1	49	I Oc R
	28	22	49	I Sh E
	28	22	59	I Tr E
	31	1	9	III Tr I
	31	4	19	III Sh E
	31	4	47	III Tr E
Aug	2	2	51,6	II Ec D
	2	5	54	II Oc R
	3	3	56	I Sh I
	3	3	59	I Tr I
	3	21	47	II Sh I
	3	21	49	II Tr I
	4	0	39	II Sh E
	4	0	40	II Tr E
	4	1	14,2	I Ec D
	4	3	32	I Oc R
	4	22	25	I Tr I
	4	22	25	I Sh I
	5	0	43	I Tr E
	5	0	44	I Sh E
	5	22	0,3	I Ec R

	d	h	m	
Aug	7	4	25	III Tr I
	7	4	42	III Sh I
	9	5	14	II Oc D
	10	22	14,5	III Ec R
	11	0	3	II Tr I
	11	0	22	II Sh I
	11	2	54	II Tr E
	11	2	59	I Oc D
	11	3	14	II Sh E
	11	5	26,1	I Ec R
	12	0	9	I Tr I
	12	0	20	I Sh I
	12	2	27	I Tr E
	12	2	38	I Sh E
	12	20	27	IV Tr I
	12	21	25	I Oc D
	12	21	42,2	II Ec R
	12	22	29	IV Sh I
	12	23	54,7	I Sh E
	13	1	17	IV Tr E
	13	3	21	IV Sh E
	13	21	7	I Sh E
	17	21	15	III Oc D
	18	2	15,3	III Ec R
	18	2	17	II Tr I
	18	2	57	II Sh I
	18	4	42	I Oc D
	19	1	53	I Tr I
	19	2	15	I Sh I
	19	4	11	I Tr E
	19	4	34	I Sh E
	19	20	38	II Oc D
	19	23	9	I Oc D
	20	0	20,1	II Ec R
	20	1	49,2	I Ec R
	20	20	19	I Tr I
	20	2044		I Sh I
	20	22	38	I Tr E
	20	23	2	I Sh E
	21	4	39	IV Oc D
	21	19	6	I Sh E
	21	20	17,8	I Ec R
	25	0	33	III Oc D
	26	3	38	I Tr I
	26	22	55	II Oc D
	27	0	53	I Oc D
	27	2	58,2	II Ec R
	27	3	43,7	I Ec R
	27	22	5	I Tr I
	27	22	39	I Sh I
	28	0	23	I Tr E
	28	0	58	I Sh E
	28	18	50	II Sh I
	28	19	19	I Oc D
	28	20	22	III Sh E
	28	20	30	II Tr E
	28	21	41	II Sh E
	28	22	12,4	I Ec R
	29	18	49	I Tr E
	29	19	26	I Sh E
	29	21	32	IV Sh E
Sep	1	3	56	III Oc D
	3	1	14	II Oc D
	3	2	39	I Oc D
	3	23	51	I Tr I
	4	0	35	I Sh I
	4	2	9	I Tr E
	4	2	53	I Sh E
	4	19	57	II Tr I
	4	20	44	III Sh I
	4	21	5	I Oc D
	4	21	21	III Tr E
	4	21	25	II Sh I
	4	22	47	II Tr E
	5	0	7,1	I Ec R

	d	h	m	
Sep	5	0	15	II Sh E
	5	0	23	III Sh E
	5	19	3	I Sh I
	5	20	35	I Tr E
	5	21	22	I Sh E
	6	18	35,8	I Ec R
	6	18	56,1	II Ec R
	6	19	21	IV Oc D
	7	0	09	IV Oc R
	7	2	42,6	IV Ec D
	11	1	38	I Tr I
	11	2	30	I Sh I
	11	21	12	III Tr I
	11	22	16	II Tr I
	11	22	52	I Oc D
	12	0	00	II Sh I
	12	0	46	III Sh I
	12	0	49	III Tr E
	12	1	06	II Tr E
	12	2	02,0	I Ec R
	12	2	51	II Sh E
	12	20	05	I Tr I
	12	20	59	I Sh I
	12	22	23	I Tr E
	12	23	17	I Sh E
	13	20	38,7	I Ec R
	13	21	34,5	II Ec R
	15	1	53	IV Tr I
	19	0	37	II Tr I
	19	0	39	I Oc D
	19	0	44	III Tr I
	19	2	35	II Sh I
	19	21	54	I Tr I
	19	22	55	I Sh I
	20	0	11	I Tr E
	20	1	12	I Sh E
	20	19	07	I Oc D
	20	19	11	II Oc D
	20	22	25,6	I Ec R
	21	0	13,0	II Ec R
	21	18	39	I Tr E
	21	19	41	I Sh E
	22	18	39,8	III Ec D
	22	18	43	II Sh E
	22	22	19,1	III Ec R
	23	20	53,1	IV Ec D
	24	1	43,2	IV Ec R
	26	23	43	I Tr I
	27	0	50	I Sh I
	27	2	01	I Tr E
	27	3	08	I Sh E
	27	20	56	I Oc D
	27	21	38	II Oc D
	28	0	20,7	I Ec R
	28	2	51,4	II Ec R
	28	19	19	I Sh I
	28	20	28	I Tr E
	28	21	37	I Sh E
	29	18	49,4	I Ec R
	29	19	03	II Tr E
	29	21	19	II Sh E
	29	21	39	III Oc R
	29	22	40,6	III Ec D
Oct	1	22	39	IV Tr E
	4	1	34	I Tr I
	4	22	46	I Oc D
	5	0	06	II Oc D
	5	20	02	I Tr I
	5	21	15	I Sh I
	5	22	20	I Tr E
	5	23	32	I Sh E
	6	18	40	II Tr I
	6	20	44,6	I Ec R
	6	21	04	II Sh I
	6	21	30	II Tr E

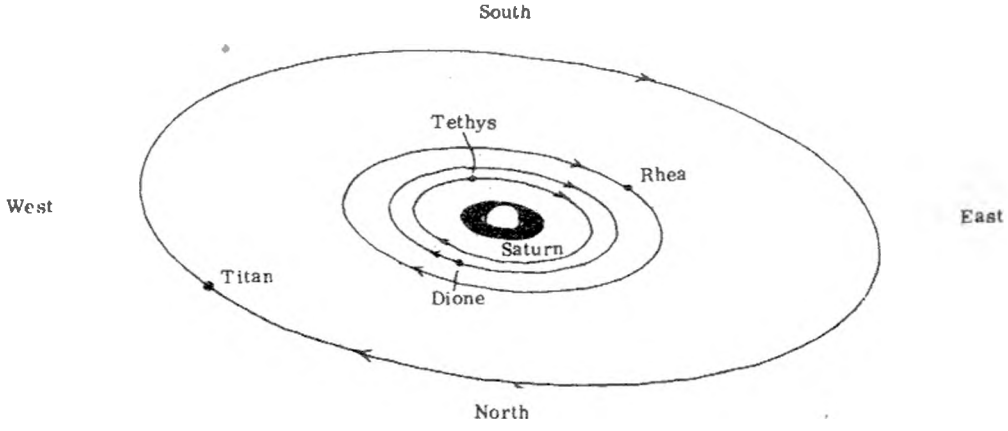
	d	h	m	
Oct	6	21	44	III Oc D
	6	23	54	II Sh E
	7	1	23	III Oc R
	10	19	53,7	IV Ec R
	10	20	29	III Sh E
	12	0	38	I Oc D
	12	21	55	I Tr I
	12	23	11	I Sh I
	13	0	12	I Tr E
	13	19	06	I Oc D
	13	21	09	II Tr I
	13	22	39,8	I Ec R
	13	23	39	II Sh I
	13	23	59	II Tr E
	14	19	57	I Sh E
	15	21	27,2	II Ec R
	17	19	15	III Tr E
	17	20	53	III Sh I
	18	0	30	III Sh E
	18	23	20	IV Sh I
	19	23	48	I Tr I
	20	20	59	I Oc D
	20	23	41	II Tr I
	21	0	35,0	I Ec R
	21	19	36	I Sh I
	21	20	34	I Tr E
	21	21	53	I Sh E
	23	0	5,6	II Ec R
	24	19	34	III Tr I
	24	23	18	III Tr E
	26	20	48	IV Oc D
	27	22	53	I Oc D
	28	20	12	I Tr I
	29	21	31	I Sh I
	28	22	29	I Tr E
	28	23	48	I Sh E
	29	20	59,1	I Ec R
	29	21	06	II Oc D
	31	21	00	II Sh E
	31	23	34	III Tr I
Nov	4	22	08	I Tr I
	4	22	21	IV Sh E
	4	22	27,0	III Ec R
	4	23	27	I Sh I
	5	19	17	I Oc D
	5	22	54,5	I Ec R
	5	23	45	II Oc D
	6	20	13	I Sh E
	7	20	45	II Sh I
	7	20	59	II Tr E
	7	23	36	II Sh E
	11	21	09	III Oc R
	11	22	48,5	III Ec D
	12	20	02	IV Oc R
	12	21	14	I Oc D
	13	19	52	I Sh I
	13	20	51	I Tr E
	13	22	09	I Sh E
	14	19	18,7	I Ec R
	14	20	48	II Tr I
	16	21	19,3	II Ec R
	18	21	39	III Oc D
	20	20	32	I Tr I
	20	21	48	I Sh I
	20	22	50	I Tr E
	21	21	14,0	I Ec R
	22	20	39	III Sh E
	27	22	31	I Tr I
	28	19	39	I Oc D
	28	23	09,4	I Ec R
	29	19	50	III Tr E
	29	20	29	I Sh E
	29	21	03	III Sh I
	29	21	39,3	IV Ec D
	30	21	16	II Oc D

Continued on Page 22

THE MOONS OF JUPITER AND SATURN 1985

SATURN'S MOONS

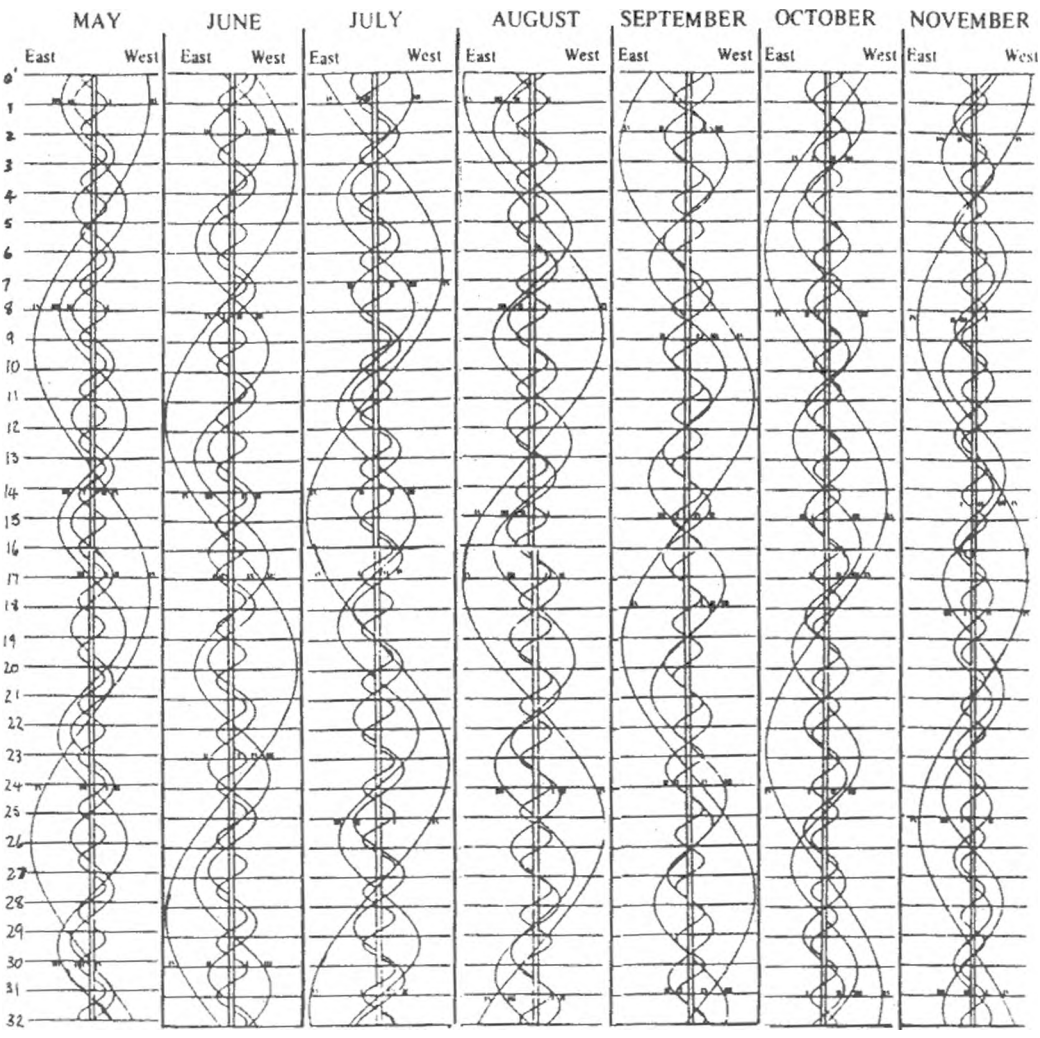
Saturn's moons are considerably fainter than the four Galilean moons of Jupiter. The diagram shows the orbi of four of Saturn's ten moons. The easiest to find is Titan (magnitude 8,5), according to the diagram and the information in the table below.



TITAN 1985

Eastern Elongation			Inferior Conjunction			Western Elongation			Superior Conjunction		
	d	h		d	h		d	h		d	h
Jan	2	15.3	Jan	6	11.8	Jan	10	15.1	Jan	14	18.8
	18	15.5		22	11.9		26	15.3		30	18.7
Feb	3	15.2	Feb	7	11.6	Feb	11	14.9	Feb	15	18.2
	19	14.6		23	10.9		27	14.1	Mar	3	17.3
Mar	7	13.5	Mar	11	09.7	Mar	15	12.8		19	15.8
	23	11.9		27	08.0		31	11.0	Apr	4	13.9
Apr	8	10.0	Apr	12	05.9	Apr	16	08.7		20	11.6
	24	07.6		28	03.4	May	2	06.1	May	6	09.0
May	10	05.1	May	14	00.8		18	03.4		22	06.4
	26	02.6		29	22.2	Jun	3	00.7	Jun	7	03.9
Jun	11	00.1	Jun	14	19.8		18	22.2		23	01.5
	26	21.9		30	17.6	Jul	4	20.1	Jul	8	23.5
Jul	12	20.0	Jul	16	15.8		20	18.4		24	21.9
	28	18.6	Aug	1	14.5	Aug	5	17.2	Aug	9	20.8
Aug	13	17.6		17	13.6		21	16.5		25	20.2
	29	17.0	Sep	2	13.2	Sep	6	16.2	Sep	10	20.0
Sep	14	16.8		18	13.1		22	16.3		26	20.1
	30	17.0	Oct	4	13.4	Oct	8	16.8	Oct	12	20.6
Oct	16	17.4		20	14.0		24	17.6		28	21.3
Nov	1	18.0	Nov	5	14.8	Nov	9	18.5	Nov	13	22.1
	17	18.8		21	15.6		25	19.5		29	23.0
Dec	3	19.5	Dec	7	16.5	Dec	11	20.5	Dec	15	23.8
	19	20.2		23	17.3		27	21.4		32	00.6
	35	20.8									

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 2 am (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 7,5cm, 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: (021)70 4895.

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.

PREDICTED METEOR SHOWERS 1985

	Shower	Radiant R.A.	Radiant Dec.	Date	Maximum Hourly Rate	Transit of Radiant (approx)	Recommended Time of Watch	Conditions at Maximum
Mar 14 - Mar 18	Corona Australids	16^h20^m	-48°	Mar 16	5	04^h45^m	02h - dawn	Favourable
Apr 19 - Apr 24	April Lyrids	18 08	+32	Apr 22	15	04 15	03h30-dawn	Favourable
May 1 - May 12	Eta Aquarids	22 24	00	May 5	18	07 30	-	Unfavourable
Apr 20 - Jul 30	Sco-Sgr System	18 00	-30	Jun 14	?	00 30	23h - 03h	Favourable
Jun 10 - Jun 21	June Lyrids	18 32	+35	Jun 16	8	01 00	00h - 04h	Favourable
Jun 17 - Jun 26	Ophiuchids	17 20	-20	Jun 20	8	23 30	22h - 03h	Favourable
* Jun 26 - Jun 29	Cetids (new)	02 00	-15	Jun 28	?	07 40	-	Unfavourable
Jul 10 - Aug 5	Capricornids	21 00	-15	Jul 25	8	00 50	22h - 04h	Favourable
Jul 15 - Aug 15	Delta Aquarids	22 36	(-17 (00	Jul 29	35	02 10	-	Unfavourable
Jul 15 - Aug 20	Pisces Australids	22 40	-30	Jul 31	11	02 10	-	Unfavourable
Jul 15 - Aug 25	Alpha Capricornids	20 36	-10	Aug 2	10	00 00	-	Unfavourable
Jul 15 - Aug 24	Iota Aquarids	(22 04 (22 32	- 6 -15	Aug 6	12	(01 10 (01 40	- -	Unfavourable
Oct 16 - Oct 27	Orionids	06 24	+15	Oct 21	35	04 30	01h - dawn	Favourable
Oct 10 - Dec 5	Taurids	(03 44 (03 44	+14 +21	Nov 4	16	(00 50 (00 50	21h - 24h	Favourable
Nov 14 - Nov 20	Leonids	10 08	+22	Nov 17	10	06 30	00h - dawn	Favourable
Dec 3 - Dec 5	Phoenicids	01 00	-55	Dec 4	?	20 10	18h - 23h	Favourable
Dec 7 - Dec 15	Geminids	07 28	+32	Dec 14	55	02 00	00h - dawn	Favourable
Dec 5 - Jan 7	Velaids	09 56	-51	Dec 29	?	03 00	-	Unfavourable

*Uncertain

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.

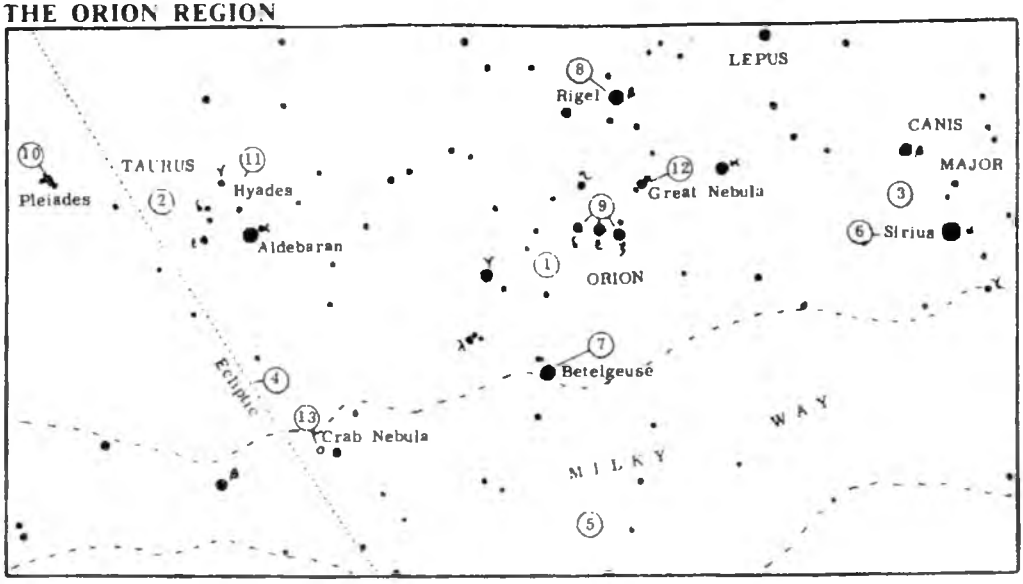
NEBULAE

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.

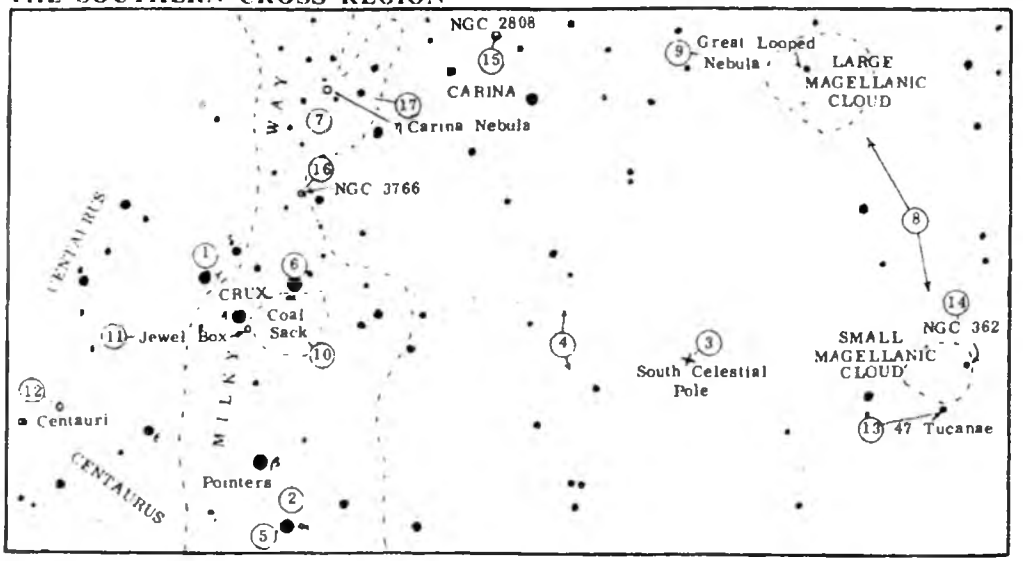
(10) The Pleiades or Seven Sisters form the best known nearby star cluster. Six or seven stars are visible to the naked eye, binoculars or a small telescope show more.

(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 million million km or 4,3 light years. A small telescope readily shows that it is a double star - the two components take 80 years to revolve 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).

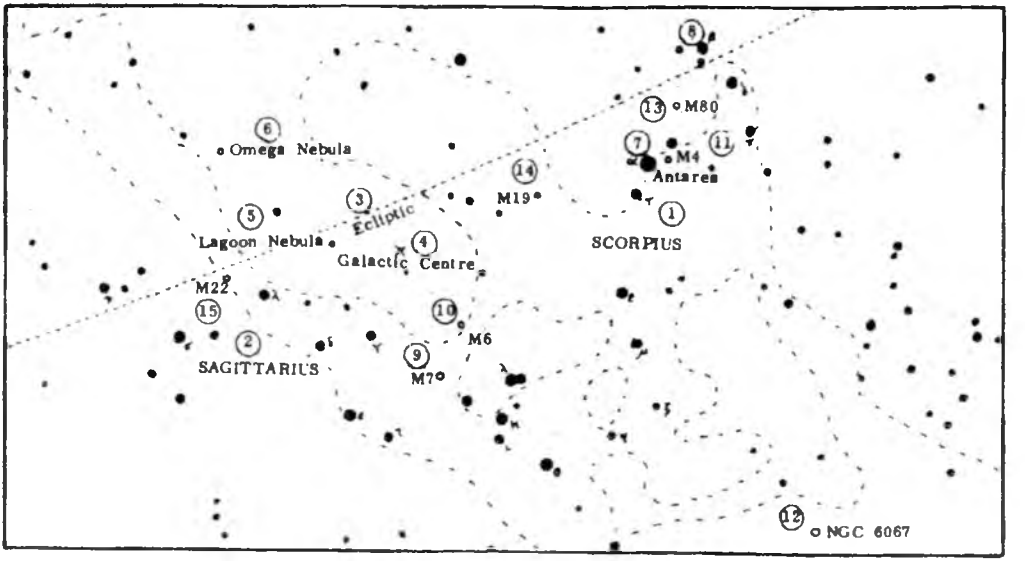
(11) Herschel's "Jewel Box" - a galactic cluster containing stars of different colours. (Small telescope or binoculars).

(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 - 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 α in the centre of the body and β and π the claws. The distinctive tail ε — ζ — θ curls round to the sting 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) δ 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 worldwide 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 50mm 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, then an assistant can read off time intervals of, say, ten seconds from a quartz watch synchronised with the SABC "sic 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, PO Box 212, Edenvale, 1610. Further updated information may also be obtained from him at 011 535 447.

OCCULTATIONS BY MINOR PLANETS

The following predictions for occultations by Minor Planets indicate possible occurrences during 1985. 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 UT. Star numbers are from AGK3 or SAO catalogues.

Date 1985		Occulting Body Name	m_v	No.	Star m_v	Spectrum	Magnitude changes at occultation	Maximum duration (seconds)
Jan	20.01 566	Stereoskopia	14.2	- 0° 1800	8.9	K5	5.3	22
	22.92 747	Winchester	10.9	+10° 0702	9.7	A0	1.5	20
	22.83 74	Galatea	13.8	+ 1° 1368	9.3	K0	4.5	8
Apr	15.09 275	Sapienta	11.8	- 2° 0828	7.0	K2	4.8	11
Aug	17.90 28	Bellona	12.0	162924	9.1	K0	3.0	11
Sep	9.84 386	Siegena	10.7	146494	8.7	K5	2.2	15
	30.87 196	Philomela	11.7	189888	9.0	K2	2.8	55
Nov	5.14 70	Panopaea	12.0	+26° 0449	7.7	G0	4.3	14
Dec	30.08 18	Melpomene	9.2	+ 8° 0871	9.8	F0	0.5	13

CAPE TOWN	Cliff Turk, 20 Nerina Avenue, Pinelands, 7405.
PIETERMARITZBURG	C.S. Lake, 23 Munroe Avenue, Northern Park, Pietermaritzburg, 3201.
BULAWAYO	Arthur G.F. Morrisby, Dept. of Surveyor General, PO Box 1580, Bulawaya, Zimbabwe.
BLOEMFONTEIN	J. van Ellekenhuisen, 30 Melville Drive, Brandwag, Bloemfontein, 9301.
WITWATERSRAND	M.D. Overbeek, PO Box 212, Edenvale, 1610.
HARARE	R.W. Fleet, PO 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	V. Hirsh, PO Box 13115, Port Elizabeth, 6013.

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
Harare	-31°.100	-17°.700

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

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DATE		ZC No.	MAG	PH	ELG	CAPE TOWN E18.5 , S33.9				JOHANNESBURG E28.1 , S26.2				HARARE E31.0 , S17.8			
						UT	A	B	P	UT	A	B	P	UT	A	B	P
M	D				°	H M	°	°	°	H M	°	°	°	H M	°	°	°
Jan	0	257	4.5	DD	107	19 34.1	-0.7	3.1	8	20 7.0	-0,7	3.8	5				
	3	601	6.0	DD	139									17 6.2	-1.1	1.5	38
	3	599	4.5	DD	139									17 12.7			354
	3	621	6.2	DD	142									22 42.3	-1.3	-0.5	117
	9	1363	5.2	RD	205					0 45.9	-4.0	2.0	240	1 2.7	-2.6	0.1	276
	9	1365	6.1	RD	206					1 31.5	-2,7	0.9	261	1 39.9	-1.9	-0.4	292
	12	1725	7.5	DD	245					2 24.4			216				
	24	3419	4.5	DD	42									17 17.5	-0.1	2.4	26
	24	3425	4.6	DD	43									18 16.9	-0.8	-0.7	118
	27	215	6.7	DD	75	18 57.2	-1.4	1.7	69	19 22.5	-0.9	1.8	61	19 41.3	-0.7	2.1	42
	30	534	6.0	DD	107									17 27.7	-2.1	2.4	35
Feb	1	844	5.7	DD	132	19 59.5	-2.1	1.8	35								
	1	849	6.5	DD	132	20 58.7	-2.1	-0.4	122	21 18.4	-2.0	0.4	99	21 30.9	-2.2	1.1	74
	3	1149	4.2	DD	155	18 43.2	-1.1	0.1	53	19 2.4	-1.8	1.6	40				
	4	1169	5.4	DD	158									0 34.8			174
	10	1921	5.9	RD	240	0 19.7	-0.1	-3.0	354								
	10	1924	5.8	RD	240	1 11.3	-0.2	-3.0	354								
	11	2159	5.3	RD	265	22 40.3	0.1	-1.6	303	22 25.0	0.3	-2.0	328	22 2.7			0
	28	780	6.8	DD	99	19 10.7			5								
Mar	2	1093	6.4	DD	124	21 9.2	-1.5	-0.1	120	21 27.5	-1.8	0.9	87	21 46.7	-2.9	2.8	51
	2	1088	5.6	DD	124									21 20.9			167
	3	1232	6.7	DD	135	19 7.9	-2.3	-0.1	79	19 35.6	-3.6	1.8	53				
	3	1233	5.8	DD	136	19 38.6	-1.7	-2.2	155	19 45.1	-2.1	-1.0	126	19 46.1	-2.7	-0.4	103
	4	1363	5.2	DD	148									19 24.5	-1.3	-3.8	169
	4	1365	6.1	DD	149									19 53.0	-1.7	-2.5	153
	8	1869	6.1	DD	207									23 53.8			198
	9	1869	6.1	RD	207									0 26.3			247
	11	2241	5.0	RD	246					20 28.5	0.1	-1.1	285	20 17.7	0.3	-1.3	308
	18	3164	4.7	RD	322					2 5.1	-0.1	-0.5	259	1 57.0	0.2	-1.5	293
	27	733	7.2	DD	68					18 26.5	-0.8	-0.2	122	18 30.8	-1.1	0.5	94
	29	1035	6.8	DD	91	18 20.0	-1.5	-1.3	145	18 31.0	-1.8	-0.1	113	18 38.9	-2.2	0.6	87
	30	1181	6.8	DD	105	21 38.6	-0.2	-0.4	140								
Apr	1	1424	6.8	DD	128					17 4.6	-2.0	-1.6	123	17 0.6	-2.4	-0.9	102
	1	1432	7.0	DD	129	19 44.4			59								
	4	1702	4.2	DD	160	2 28.8	-0.7	1.8	77								
	7	2192	6.2	RD	214	21 21.9	-0.7	-1.6	295	21 12.7	-0.3	-2.3	328	20 47.8			4
	8	2217	5.5	RD	218	4 21.0	-1.4	0.2	289								
	8	2359	4.8	RD	229					23 38.3	-3.0	0.6	249	23 43.4	-2.2	-1.0	285
	9	2514	6.3	RD	242	22 49.5			225	23 2.8	-1.3	-0.9	274	22 55.2	-0.8	-1.7	304
	10	2524	6.0	RD	243	1 23.6	-2.9	1.5	235	1 50.2	-2.5	-0.6	279	1 45.6	-2.2	-2.3	312
	10	2669	6.2	RD	254	22 27.9	0.0	-1.4	289	22 11.1	0.6	-2.6	328				
	10	2673	6.3	RD	255	22 38.7	-0.3	-1.0	266	22 31.0	-0.1	-1.7	301	22 11.2	1.0	-3.2	338
	10	2676	6.5	RD	255	22 52.7	0.2	-2.1	312								
	26	1119	5.7	DD	72	17 18.1			44								
	27	1252	7.4	DD	84					16 43.8	-2.2	-0.8	122	16 47.4	-2.9	-0.0	97
	30	1621	7.5	DD	123	19 3.9	-2.6	-0.2	92								
May	2	1869	6.1	DD	153					22 7.7	-0.6	-2.6	167	21 54.9	-1.6	-1.4	134
	4	2117	5.3	DD	180									19 43.8	-0.3	-2.8	163
	4	2118	2.9	DD	180									19 52.6	-0.2	-2.9	165
	4	2117	5.3	RD	181									20 44.1	-2.8	-0.3	271
	4	2118	2.9	RD	181									20 52.0	-2.9	-0.2	269
	6	2442	5.9	RD	210	23 8.7	-2.2	-0.1	258	23 22.9	-2.0	-1.5	298	23 8.5	-1.3	-3.5	334
	6	2443	5.8	RD	210	23 15.1	-1.8	-1.1	283	23 17.5	-1.5	-2.7	323				
	27	1586	7.5	DD	94	20 41.1	0.5	-2.6	179	20 32.5	-0.5	-0.6	132	20 33.2	-1.0	0.3	99
	28	1702	4.2	DD	107	20 6.1	-1.2	-0.6	130	22 22.1	-2.0	1.1	86				
	30	1937	6.1	DD	134	19 49.0	-2.9	0.4	83								
	30	1947	7.1	DD	135					22 42.0	-0.9	-1.6	152	22 36.4	-1.2	-0.5	119
	31	1951	7.1	DD	136	0 29.9	-0.6	-0.1	124	0 36.7	-0.3	0.7	95				
Jun	2	2217	5.5	DD	164	0 50.0	-1.3	0.5	103	1 8.2	-0.8	1.4	76	1 32.1			31
	5	2721	3.3	RD	207	2 19.4	-2.0	0.6	272	2 40.9	-2.0	0.0	286	2 39.9	-3.4	-2.7	318
	6	3018	6.3	RD	230					21 33.0	-1.6	1.4	220	21 41.9	-1.4	-0.1	256
	7	3158	5.8	RD	242					21 19.5			195	21 34.6	-0.9	0.5	239
	7	3164	4.7	RD	242	22 58.0	-0.8	-1.5	278	22 40.1			331				
	8	3175	4.8	RD	244	2 33.6	-3.8	-3.5	302								
	9	3304	6.4	RD	255	0 55.4	-1.6	-1.0	267	1 1.8	-2.9	-3.1	295				
	10	3425	4.6	RD	267	1 43.5	-2.0	-2.3	285								
	20	1181	6.8	DD	26					16 7.7	-0.6	0.3	108	16 16.3	-1.2	1.3	75
	24	1659	6.8	DD	76					16 39.2	-1.1	-1.7	149	16 32.8	-2.0	-0.9	119
	27	2013	7.5	DD	116	18 28.1	-0.9	-2.5	159	18 29.4	-2.1	-1.0	117	18 35.5	-3.6	0.9	81
	27	2025	6.8	DD	118	22 2.5	-0.8	-3 2	172	21 58.6	-1.0	-0.8	133	21 58.9	-1.0	0.1	102

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DATE		ZC No.	MAG	PH	ELG	CAPE TOWN E18.5 , S33.9				JOHANNESBURG E28.1 , S26.2				HARARE E31.0 , S17.8			
						UT	A	B	P	UT	A	B	P	UT	A	B	P
M	D				°	H M	°	°	°	H M	°	°	°	H M	°	°	°
Jun	28	2132	7.1	DD	129									17 12.0	-0.4	-3.3	167
	28	2147	7.0	DD	132					21 50.8			176	21 34.6	-1.6	-1.3	134
Jul	22	1741	7.2	DD	60	17 0.2	-0.6	-1.7	159	17 2.2	-1.3	-0.3	118	17 9.6	-2.1	1.2	81
	23	1866	5.9	DD	75					20 0.6	-0.4	-1.3	150	19 55.4	-0.4	-0.3	118
	23	1869	6.1	DD	75	20 1.9	-1.0	2.7	67								
	24	1973	6.2	DD	87					17 58.8			186	17 37.1	-1.5	-1.9	144
	25	2117	5.3	DD	103	22 40.2	-0.1	2.4	62								
	25	2118	2.9	DD	103	22 43.7	-0.1	2.0	70								
	25	2118	2.9	RB	103	23 29.8	-0.4	-0.7	324								
	27	2398	6.1	DD	127	19 18.7	-2.0	-1.2	118	19 39.3	-2.5	0.8	83	20 5.7	-2.4	4.9	41
	27	2417	7.0	DD	129	23 41.4	-0.6	1.2	86	23 54.8	-0.1	1.4	73				
	28	2537	7.4	DD	139									17 11.4			178
	28	2558	6.2	DD	142					22 20.5	-2.8	-2.6	143	22 17.5	-2.0	-0.3	110
	29	2721	3.3	DD	152	18 3.3	-1.4	-1.1	94	18 21.8	-2.7	1.4	53				
Aug	4	13	6.3	DD	228	21 23.9			339								
	4	12	6.3	RD	228	21 25.8			300								
	4	13	6.3	RD	228	21 35.9			319								
	18	1709	6.7	DD	30	16 59.7	-0.1	-1.7	164	16 55.6	-0.4	-0.3	125	16 57.8	-0.5	0.6	92
	19	1821	2.9	DD	44	17 16.7	-0.8	-0.5	132	17 25.0	-0.8	0.7	97	17 42.8			48
	19	1821	2.9	RB	45	18 19.0	-0.5	0.4	291	18 20.2	-0.2	-0.9	323	18 1.4			11
	19	1825	6.1	DD	44	18 14.9	-0.6	0.8	100								
	20	1947	7.1	DD	57	17 2.3			52								
	20	1946	7.2	DD	58									17 42.7	-0.8	-2.1	156
	20	1948	7.4	DD	58									18 24.4	-0.6	-2.5	164
	22	2207	7.0	DD	85	19 40.8	-1.5	-3.1	165	19 41.1	-1.2	-0.8	132	19 42.0	-1.0	0.1	103
	22	2214	6.2	DD	86	21 45.3	-0.5	-0.0	126								
	24	2501	7.5	DD	110					16 43.1	-3.1	1.3	66				
	24	2524	6.0	DD	112	21 48.8	-0.6	2.2	59	22 9.3	0.2	2.5	45				
Sep	5	433	5.6	RD	244	3 57.3	-1.9	1.7	227								
	18	2118	2.9	DD	49	8 6.4	0.1	-1.4	116	7 58.1	-0.4	-0.9	91	7 57.7			59
	18	2118	2.9	RB	49	9 1.3	-0.2	-1.6	302	8 48.0	0.0	-2.2	331	8 24.7			3
	19	2290	2.5	DD	66	14 17.8	-0.6	-3.8	165	14 13.3	-2.1	-1.4	121	14 15.3	-3.1	0.2	88
	19	2290	2.5	RB	66	15 10.5	-3.0	1.8	246	15 38.9	-2.3	-0.3	287	15 35.6	-2.2	-2.2	320
	21	2621	7.4	DD	93					17 17.6			175	16 51.4	-3.0	-1.4	119
	21	2634	7.4	DD	94	19 25.2	-2.2	-0.6	121	19 42.4	-1.7	0.2	107	19 50.9	-1.1	0.8	84
	21	2650	4.7	DD	96	21 27.3	0.1	2.6	42	21 43.3	0.7	2.6	33				
	22	2796	6.8	DD	106									16 36.0			359
	22	2805	7.0	DD	106	18 9.7	-2.1	2.0	54	18 47.9	-1.2	3.5	33				
	23	2939	7.2	DD	118									16 28.5	-2.6	2.6	40
	24	3106	5.4	DD	133	22 54.3	-0.3	2.6	31	23 14.5	0.1	2.4	31	23 35.0	0.7	2.9	12
	25	3116	6.7	DD	134	0 25.1	0.0	2.1	42	0 38.8	0.3	1.9	39				
	25	3228	6.5	DD	143	19 18.2	-1.6	2.1	34	19 52.4	-1.2	3.0	24	20 25.3	0.1	4.4	2
Oct	3	492	5.9	RD	224					1 30.0	-3.4	0.1	276	1 37.3	-4.6	-1.6	296
	8	1189	5.0	RD	280	1 48.2	-1.0	-0.9	264	1 54.3	-1.7	-0.9	271	1 51.3	-2.2	-1.3	290
	17	2411	6.6	DD	50									17 57.3	-1.2	-1.0	132
	18	2564	6.8	DD	63					17 32.7	-0.1	3.8	32				
	18	2575	6.8	DD	64	18 32.5	-1.3	0.3	110	18 46.4	-0.8	0.5	100	18 54.3	-0.4	0.9	79
	19	2743	7.4	DD	76									16 40.4	-2.7	-0.2	102
	24	3434	7.4	DD	135									16 40.3	-1.6	1.8	40
	24	3446	7.2	DD	136									18 55.0			110
	25	13	6.3	DD	148					19 7.4	-2.4	1.0	63	19 22.4	-2.1	1.9	47
Nov	2	1008	5.1	RD	237									22 33.1	0.2	2.7	204
	3	1022	5.8	RD	238	1 10.6	-1.2	2.2	205	1 47.1	-2.9	2.0	224	2 9.4	-3.4	1.1	249
	19	3284	7.1	DD	95					18 28.5	-2.1	1.3	75	18 46.4	-1.6	1.6	61
	21	3537	6.9	DD	120	23 32.5	-0.7	1.3	92								
	23	204	7.3	DD	140	19 6.7	-2.8	-0.2	84	19 38.1	-3.7	0.2	90				
	25	416	5.4	DD	161	18 1.9			347								
	30	1103	5.9	RD	218	22 48.0	-1.7	-0.9	267	23 2.3	-2.5	-0.7	275	23 2.2	-3.1	-1.4	294
Dec	7	1821	2.9	DB	295	7 58.8	-1.5	-0.7	124	8 19.5	-2.5	1.7	78				
	7	1821	2.9	RD	296	9 12.3	-1.1	-0.6	312	9 6.7	-0.2	-3.1	356				
	8	MARS	1.8	DB	310	11 36.2	-0.7	-0.9	142	11 39.8	-0.5	0.1	113	11 45.7	-0.3	1.1	80
	8	MARS	1.8	RD	311	12 34.0	-0.3	1.2	271								
	15	3089	5.3	DD	50					17 24.0	-0.2	2.1	39	17 43.0	0.3	2.5	22
	15	3106	5.4	DD	52	20 24.9	-0.1	0.8	104								
	16	3228	6.5	DD	62									17 3.6	-1.8	1.0	81
	20	167	5.7	DD	109									18 59.3			116
	21	272	5.9	DD	119					17 34.0	-2.7	0.8	70	17 51.3	-2.5	1.5	57
	23	487	5.3	DD	141					18 31.6	-0.6	2.5	14	19 2.1			353
	23	492	5.9	DD	141	19 7.1	-1.8	0.7	55	19 29.1	-2.4	1.2	57	19 49.7	-2.3	2.1	43
	28	1189	5.0	RD	198	20 57.6	-1.7	-1.6	292	21 3.9	-2.4	-1.8	302	20 52.0	-3.0	-3.3	325

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.

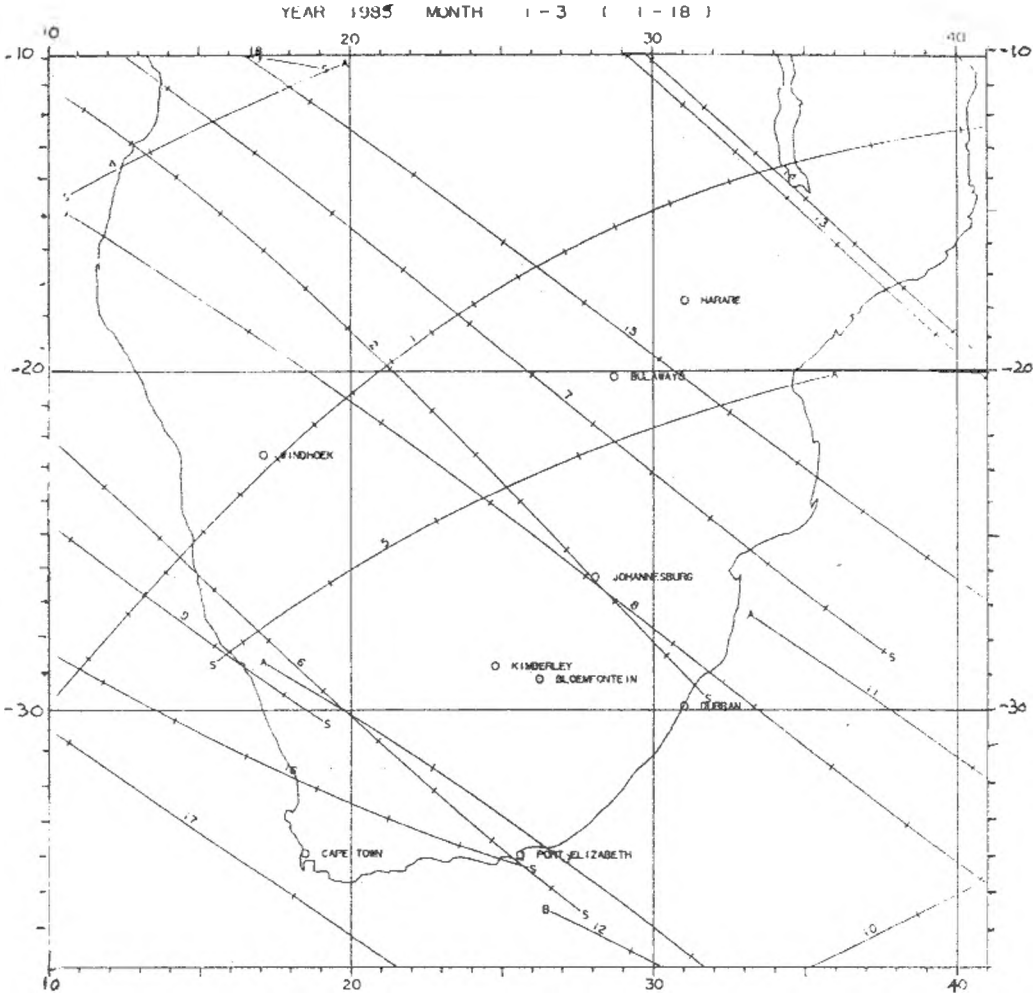
It will be seen from the maps that many grazing occultations occur in regions which are rather far removed from the main cities, and which cannot easily be reached by teams of observers from one of the ASSA centres. It is worth remembering, however, that a team of many observers, while ideal, is by no 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) 535 447.

EXPLANATION OF COLUMN HEADINGS IN TABLES:

SEQ	:	Sequential number in the year. The same number is attached to the corresponding track on the map.
NZC NO	:	Zodiacal Catalogue number of the star.
MAG	:	Magnitude of the star.
MON, DAY, H, M, S	:	Month, day, hour, minute and second in UT for the west end of the track.
SUNLIT (%)	:	Percent of the Moon sunlit (a minus sign indicates a waning Moon).
Limit	:	Whether the track is the north (N) or the south (S) limits of the occultation.
		(A) denotes that the Moon is at a low altitude.
		(B) denotes that the star is occultated at bright limb.
		(C) denotes that the daylight interferes.

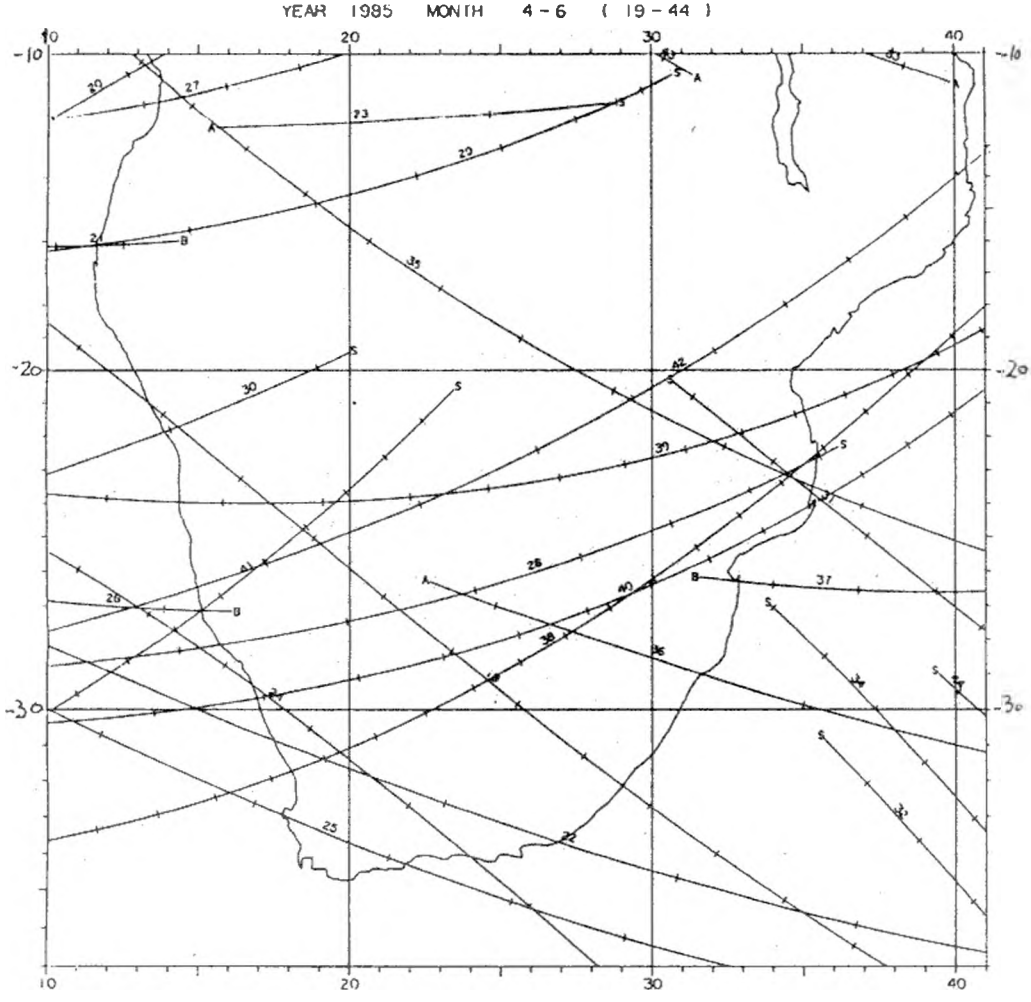
The map gives the graze tracks or the limits of occultations. Along each track on the map, tick marks are given for the points corresponding to the multiples of five minutes of every hour, while the prediction for the west end of each track is shown on the computer list, e.g. if the time for the west end of a track is 5h 43m 21s, the tick marks proceeding eastward correspond to 5h 45m 00s, 5h 50m 00s, 5h 55m 00s etc.



GRAZING OCCULTATIONS 1985
KEY TO MAP 1

SEQ	NZC NO	MAG	MON	DAY	UT H	UT M	UT S	SUNLIT (%)		LIMIT	
1	258	6.62	1	0	19	0	7.41	64.62	S		
2	1725	7.50	1	12	1	26	13.31	-70.88	S		(S)
3	2500	3.37	1	18	1	33	39.02	- 9.90	S	(A)	
4	3175	4.82	1	22	18	3	2.91	2.77	S	(S)	(A)
5	3425	4.56	1	24	18	8	21.59	12.75	S	(S)	(A)
6	2182	6.31	2	12	2	25	8.95	-52.11	S		(S)
7	2319	6.92	2	13	1	47	38.79	-41.02	S		(S)
8	2459	7.22	2	14	1	24	48.62	-30.62	S		
9	2469	6.32	2	14	3	38	38.06	-29.91	S		(S)
10	2500	3.37	2	14	9	56	10.93	-28.49	N		
11	2605	7.14	2	15	0	0	39.49	-21.78	S	(A)	
12	780	6.84	2	28	19	32	17.46	57.74	N	(B)	
13	2117	5.33	3	10	23	14	51.05	-78.97	S		
14	2118	2.90	3	10	23	24	26.20	-78.93	S		
15	2417	7.02	3	12	23	57	12.49	-57.29	S		
16	2579	7.33	3	14	3	16	17.49	-45.13	S		(S)
17	2735	7.22	3	15	0	34	49.28	-35.55	S		
18	3178	6.17	3	18	4	23	54.42	- 9.78	S		(S)

Grazing Occultations 1985

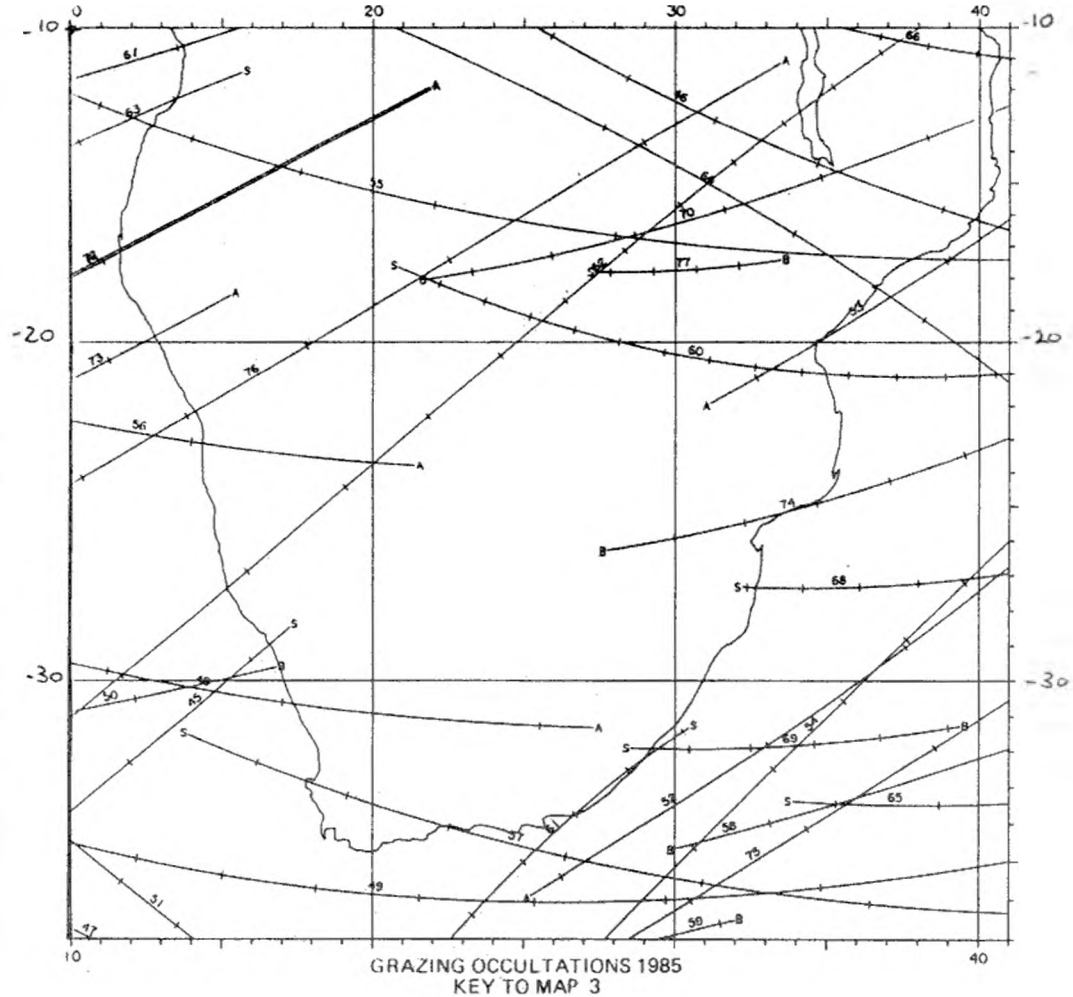


GRAZING OCCULTATIONS 1985
KEY TO MAP 2

SEQ	NZC NO	MAG	MON	DAY	UT H	UT M	UT S	SUNLIT (%)		LIMIT	
19	2359	4.76	4	8	22	43	13.46	-82.60	S		
20	2721	3.30	4	11	7	49	43.01	-59.85	N		
21	3012	6.71	4	13	4	29	21.30	-39.39	S		(B)
22	3130	5.47	4	14	0	55	14.61	-30.74	S		
23	3506	6.27	4	17	3	40	0.51	- 7.90	S	(A)	(S)
24	1119	5.71	4	26	17	22	37.21	34.66	N		
25	2939	7.24	5	9	23	23	26.04	-67.16	S		
26	3227	6.38	5	12	2	0	42.72	-45.73	S		(B)
27	3478	6.51	5	14	3	15	1.82	-26.56	N		
28	36	7.16	5	15	3	2	1.10	-18.58	N		(S)
29	37	7.47	5	15	3	10	38.66	-18.55	N		(S)
30	257	4.50	5	17	4	41	51.31	- 6.10	N		(S)
31	1213	6.96	5	24	15	48	46.84	20.60	N	(S)	
32	1570	5.64	5	27	15	10	50.24	50.97	N	(S)	
33	1586	7.47	5	27	20	59	15.90	52.91	N		(A)
34	1689	5.47	5	28	15	9	47.09	62.34	N	(S)	
35	1702	4.20	5	28	20	9	2.29	64.10	N		
36	3158	5.79	6	7	21	4	21.13	-73.11	S	(A)	
37	3164	4.72	6	7	22	36	5.58	-72.65	N	(B)	
38	3175	4.82	6	8	1	51	7.63	-71.62	N		
39	3304	6.37	6	9	0	7	42.86	-62.37	N		
40	3425	4.56	6	10	1	5	47.32	-52.16	N		
41	3434	7.38	6	10	3	47	9.35	-51.42	N		(S)
42	215	6.68	6	13	2	25	4.76	-24.11	N		(S)
43	1181	6.82	6	20	16	39	51.44	4.82	N		(A)
44	1424	6.80	6	22	14	58	50.41	17.29	N	(S)	

Grazing Occultations 1985

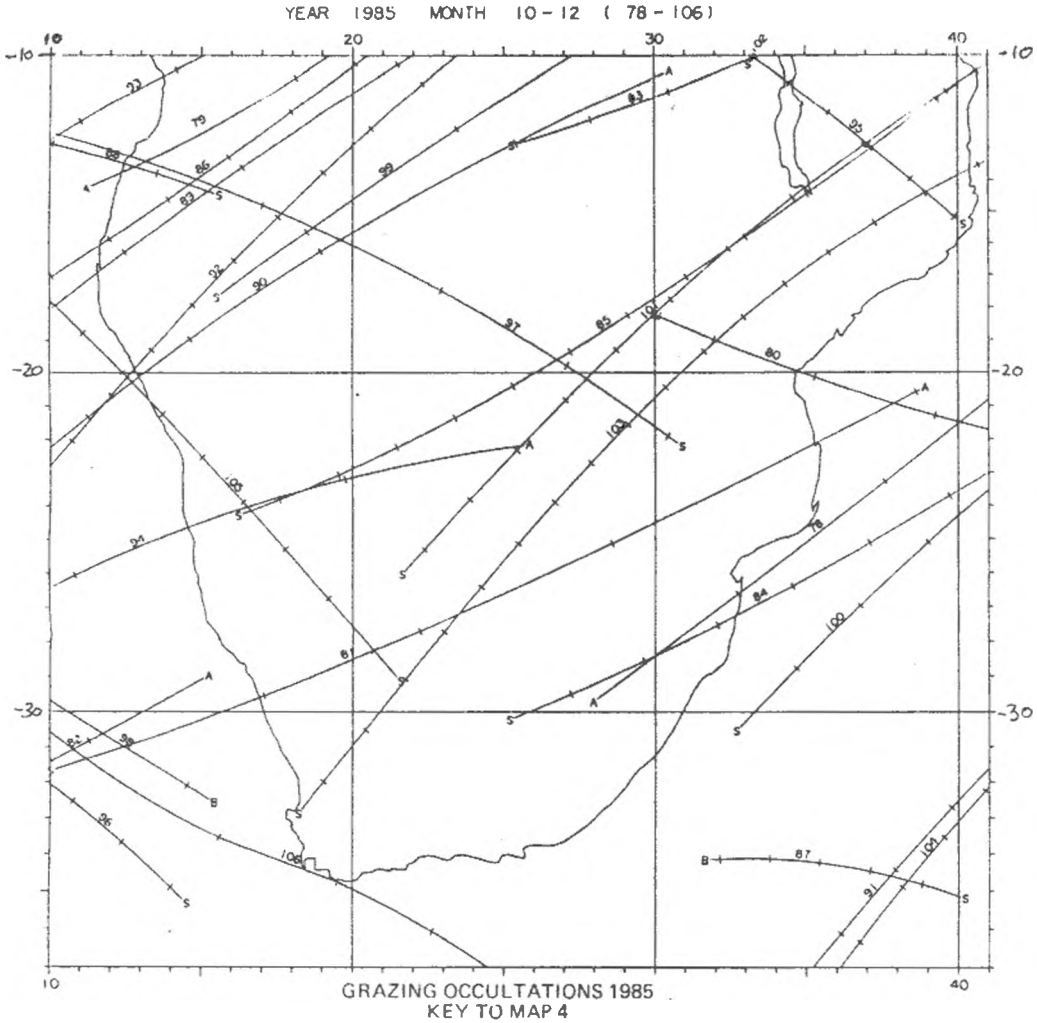
YEAR 1985 MONTH 7 - 9 (45 - 77)



GRAZING OCCULTATIONS 1985
KEY TO MAP 3

SEQ	NZC NO	MAG	MON	DAY	H	UT M	S	SUNLIT (%)		LIMIT	
45	652	6.35	7	14	5	8	3.23	-13.80	N		(S)
46	1741	7.24	7	22	17	18	55.30	24.69	N		
47	1864	6.76	7	23	18	49	1.57	35.82	N		
48	1969	6.17	7	23	20	13	45.04	36.30	N		(A)
49	2105	6.60	7	25	20	10	52.41	59.29	N		
50	2117	5.33	7	25	22	58	34.17	60.29	N		(B)
51	2230	6.78	7	26	17	15	27.60	69.60	N		
52	457	6.48	8	9	0	9	26.35	-46.99	N	(A)	
53	582	5.76	8	10	0	4	10.80	-37.57	N	(A)	
54	594	6.93	8	10	2	55	12.48	-36.80	N		
55	1821	2.91	8	19	17	28	14.58	13.58	N		
56	1825	6.08	8	19	18	36	49.61	13.87	N		(A)
57	1947	7.88	8	20	17	5	48.91	22.44	N	(S)	
58	2207	7.04	8	22	20	8	1.20	45.21	S	(B)	
59	2357	6.56	8	23	19	46	56.35	56.58	N		(B)
60	2501	7.50	8	24	16	50	25.85	66.95	N	(S)	
61	432	5.94	9	5	3	22	56.71	-71.74	N		(S)
62	683	7.31	9	7	1	28	22.93	-53.65	N		
63	1119	5.21	9	10	4	24	34.65	-24.20	N		(S)
64	2118	2.90	9	18	8	1	27.42	17.50	N		
65	2147	7.04	9	18	16	2	46.62	19.51	N	(S)	
66	2290	2.54	9	19	15	0	54.11	29.44	N		
67	2314	5.70	9	19	19	31	21.97	31.00	S		
68	2452	6.69	9	20	16	9	34.13	40.92	N	(S)	
69	2455	6.76	9	20	16	25	7.10	41.04	N	(S)	(B)
70	2458	6.20	9	20	17	47	6.02	41.50	S	(B)	
71	2470	5.29	9	20	21	44	18.78	42.96	S		(A)
72	2480	5.33	9	20	21	44	24.95	42.96	S		(A)
73	2482	6.66	9	20	22	4	19.95	43.11	S		(A)
74	2621	7.40	9	21	17	20	14.63	52.69	S	(B)	
75	2634	7.40	9	21	20	2	11.01	53.58	S		
76	2643	6.70	9	21	21	14	28.12	54.06	S		(A)
77	2796	6.79	9	22	16	28	14.57	63.49	N	(S)	(B)

Grazing Occultations 1985



GRAZING OCCULTATIONS 1985
KEY TO MAP 4

SEQ	HZC NO	MAG	MON	DAY	UT H	UT M	UT S	SUBLIT (S)		(M)	
78	750	6.86	10	4	22	16	46.46	-70.84	N	(A)	
79	1189	4.99	10	8	0	53	37.59	-40.95	N	(A)	
80	1821	2.91	10	13	12	22	0.31	- 0.84	N	(B)	
81	2411	6.57	10	17	17	57	4.43	17.24	S	(S)	(A)
82	2424	6.91	10	17	20	14	24.32	17.98	S		(A)
83	2554	4.40	10	18	16	25	0.07	26.41	S	(S)	
84	2743	7.43	10	19	16	56	3.00	37.33	S	(S)	
85	2910	4.81	10	20	17	11	56.74	48.57	S	(S)	
86	2914	4.95	10	20	18	59	47.89	49.08	S		
87	1022	5.84	11	3	1	24	2.26	-76.41	S	(B)	(S)
88	1741	7.24	11	9	3	49	52.26	-16.10	S		(S)
89	3018	6.33	11	17	20	16	14.19	33.38	S		
90	3164	4.72	11	18	21	17	55.05	44.28	S		(A)
91	3284	7.06	11	19	18	52	26.03	53.89	S		
92	3409	7.00	11	20	20	2	17.02	64.33	S		
93	3419	4.46	11	20	22	38	9.32	64.94	S		
94	3535	5.15	11	21	23	43	40.94	74.44	S		(A)
95	1363	5.22	12	3	2	4	51.25	-73.19	S		(S)
96	1586	7.47	12	5	2	57	45.92	-52.54	S		(S)
97	2053	4.60	12	9	2	37	13.42	-11.79	S		(S)
98	2721	3.30	12	13	7	35	19.05	2.76	N		(B)
99	2939	7.24	12	14	17	51	25.76	9.82	S	(S)	
100	3228	5.49	12	16	17	15	16.77	26.39	S	(S)	
101	3356	5.89	12	17	17	47	56.90	36.40	S	(S)	
102	155	6.75	12	20	16	29	25.71	65.46	S	(S)	
103	167	5.67	12	20	18	22	28.16	66.13	S	(S)	
104	272	5.94	12	21	18	17	50.41	74.67	S		
105	1669	6.72	12	33	2	30	43.95	-68.24	S		(S)
106	1758	7.03	12	33	23	42	30.70	-58.69	S	(A)	

TIME SYSTEMS AND TELESCOPE SETTINGS

This section is intended to serve established amateurs and profession 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 signal 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 (formerly 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	$12^h03^m36^s$	May	11	$11^h56^m19^s$	Sep	18	$11^h54^m09^s$
	11	12 07 57		21	11 56 32		28	11 50 40
	21	12 11 21		31	11 57 36	Oct	8	11 47 34
	31	12 13 30	Jun	10	11 59 21		18	11 45 11
Feb	10	12 14 16		20	12 01 28		28	11 43 49
	20	12 13 47		30	12 03 35	Nov	7	11 43 41
Mar	2	12 12 12	Jul	10	12 05 17		17	11 44 58
	12	12 09 48		20	12 06 18		27	11 47 37
	22	12 06 56		30	12 06 23	Dec	7	11 51 26
Apr	1	12 03 55	Aug	9	12 05 28		17	11 56 06
	11	12 01 04		19	12 03 36		27	12 01 03
	21	11 58 43		29	12 00 56		31	12 02 59
May	1	11 57 05	Sep	8	11 57 40			

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^h42^m	3^h45^m	May 11	15^h15^m	12^h18^m	Sep 18	23^h47^m	20^h52^m
11	7 21	4 25	21	15 54	12 57	28	0 27	21 30
21	8 01	5 04	31	16 33	13 37	Oct 8	1 06	22 09
31	8 40	5 44	Jun 10	17 13	14 16	18	1 45	22 49
Feb 10	9 20	6 23	20	17 52	14 56	28	2 25	23 28
20	9 59	7 03	30	18 32	15 35	Nov 7	3 04	0 08
Mar 2	10 39	7 42	Jul 10	19 11	16 16	17	3 44	0 47
12	11 18	8 21	20	19 51	16 54	27	4 23	1 27
22	11 57	9 01	30	20 30	17 33	Dec 7	5 03	2 06
Apr 1	12 37	9 40	Aug 9	21 09	18 13	17	5 42	2 45
11	13 16	10 20	19	21 49	18 52	27	6 21	3 25
21	13 56	10 59	29	22 28	19 32	31	6 37	3 40
May 1	14 35	11 39	Sep 8	23 08	20 11			

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 one can calculate the sidereal time and then set the circle, but it 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	$1^h37,2^m$	-57°19'	0,6	B5	Procyon	$7^h38,5^m$	+ 5°16'	0,5	F5
Aldebaran	4 35,0	+16 29	1,1	K5	Regulus	10 07,6	+12 02	1,3	B8
Rigel	5 13,8	- 8 13	0,3	B8	Spica	13 24,4	-11,05	1,2	B2
Betelgeuse	5 54,4	+ 7 24	0,4	M0	Arcturus	14 15,0	+19,15	0,2	K0
Canopus	6 23,6	-52,41	-0,9	F0	Antares	16 28,5	-26,24	1,2	M1
Sirius	6 44,5	-16,42	-1,6	A0	Altair	19 50,1	+ 8,50	0,9	A5

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	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
	2446	2446	2446	2446	2446	2446	2446	2446	2446	2446	2446	2446
1	067	098	126	157	187	218	248	279	310	340	371	401
2	068	099	127	158	188	219	49	280	311	341	372	402
3	069	100	8	159	189	220	50	281	312	342	373	403
4	070	101	129	160	190	221	51	282	313	343	374	404
5	071	102	130	161	191	222	52	283	314	344	375	405
6	072	103	131	162	192	223	53	284	315	345	376	406
7	073	104	132	163	193	224	54	285	316	346	377	407
8	074	105	133	164	194	225	55	286	317	347	378	408
9	075	106	134	165	195	226	56	287	318	348	379	409
10	076	107	135	166	196	227	57	288	319	349	380	410
11	077	108	136	167	197	228	58	289	320	350	381	411
12	078	109	137	168	198	229	59	290	321	351	382	412
13	079	110	138	169	199	230	260	291	22	352	383	413
14	180	111	139	170	200	231	261	292	23	353	384	414
15	081	112	140	171	201	232	262	293	324	354	385	415
16	082	113	141	172	202	233	263	294	325	355	386	416
17	083	114	142	173	203	234	264	295	326	356	387	417
18	084	115	143	174	204	235	265	296	327	357	388	418
19	085	116	144	175	205	236	266	297	328	358	389	419
20	086	117	145	176	206	237	267	298	329	359	390	420
21	087	118	146	177	207	238	268	299	330	360	391	421
22	088	119	147	178	208	239	269	300	331	361	392	422
23	089	120	148	179	209	240	270	301	332	362	393	423
24	080	121	149	180	210	241	271	302	333	363	394	424
25	091	122	150	181	211	242	272	303	334	364	395	425
26	092	123	151	182	212	243	273	304	335	355	396	426
27	093	124	152	183	213	244	274	305	336	366	397	427
28	094	125	153	184	214	245	275	306	337	367	398	428
29	095		154	185	215	246	276	307	338	368	399	429
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