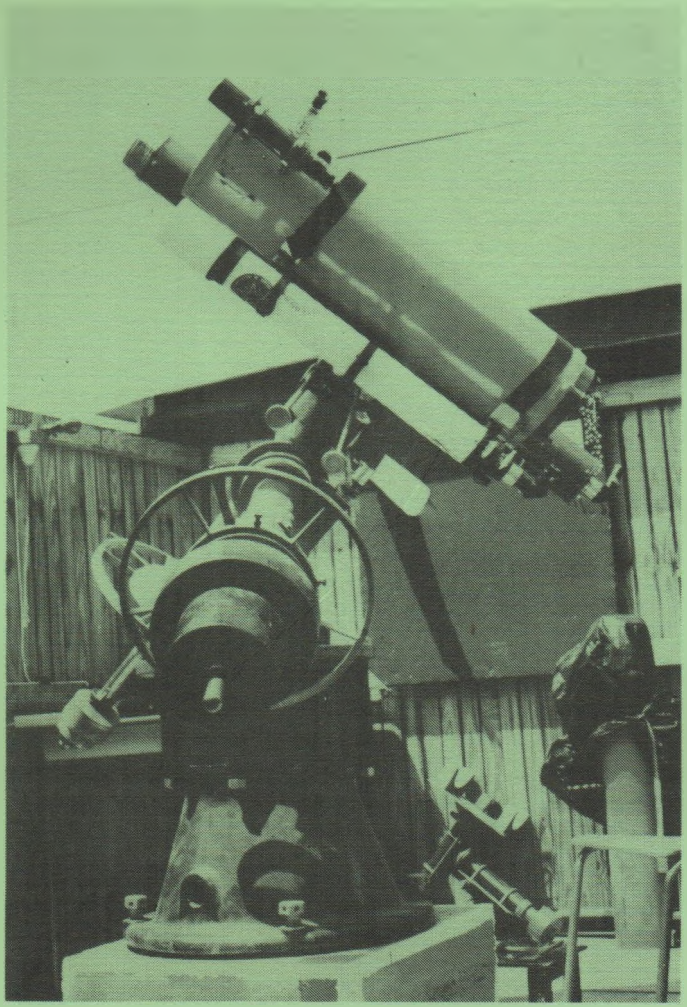
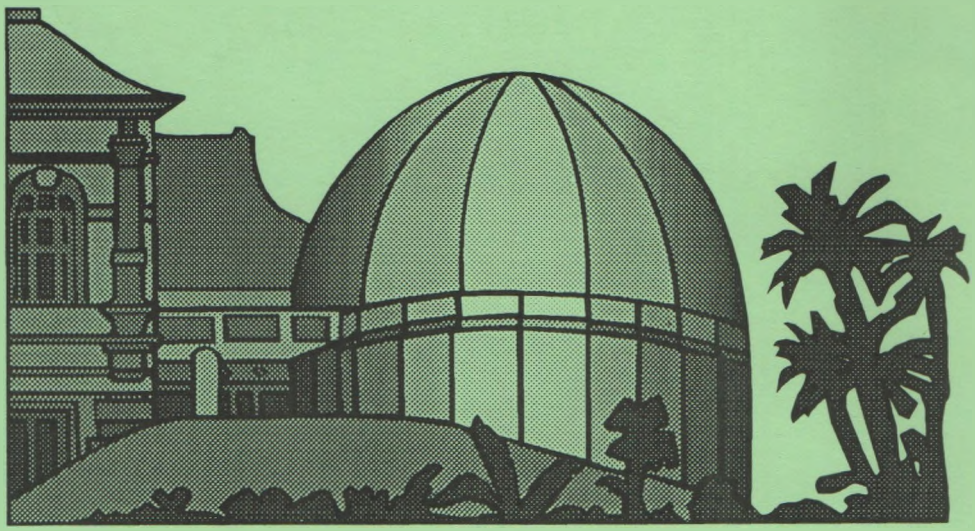
ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1994





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ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 1994

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

Front cover
The telescope of Mr Jim Knight, the Director of the ASSA Solar Section.
Photograph courtesy of Mr J Knight.

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NOTE

All times are SAST unless otherwise stated. Right Ascension and Declination are given for equinox of date 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 Astronomical Almanac for 1994, the Handbook of the British Astronomical Association for 1994 and the International Lunar Occultation Centre,Tokyo. The star charts on pages 32, 34, 36 and 38 are from "A Beginner's Guide to the Southern Stars" by J.S. Bondietti, published by the South African Museum. The Minor Planet Occultations were provided by Edwin Goffin, who wishes to thank Dr. Josef de Kerfo, General Manager of Agfa-Gevaert IVV (Mortsel, Belguim) for making the computing facilities available.

Assistance in the compilation of this booklet was received from the Directors of the sections of the ASSA and Mr C. Jacobs.

Further copies of this booklet are available at R5,00 per copy from The Business Manager, Astronomical Society of Southern Africa, P O Box 9, Observatory, 7935. All other correspondence concerning this booklet should be addressed to the Handbook Editor, Astronomical Society of Southern Africa, 10 Bristol Rd., Observatory, 7925.

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

P.J.Booth

ASTRONOMY IN SOUTHERN AFRICA

Southern Africa, enjoying the rich southern skies and a suitable climate, has a number of professional observatories engaged in research while many individuals have become enthusiastic amateur astronomers. Thus South Africa, Namibia and Zimbabwe have numerous private observatories, built and operated by 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 (SAAO), directed by Dr. R. Stobie is part of the Foundation for Research and Developement. It has headquarters in Cape Town and an observing station at Sutherland in the Karoo, where there are 1.9-m, 1.0-m, 0.75-m and 0.5-m telescopes. The headquarters in Cape Town also carries out a limited amount of observing. Research is undertaken in many areas, with considerable effort being put into the study of variable stars, the Galactic Centre, the Magellanic Clouds and sources detected by satellites. These studies involve the use of spectroscopic, photometric and infrared techniques. Besides providing research facilities for its own staff, SAAO observing time is allocated to astronomers from South African universities and elsewhere in the world.

BOYDEN OBSERVATORY, situated at Mazelspoort, 25 km from Bloemfontein, is owned by the Dept of Physics and Astronomy of the University of the Orange Free State. Observing facilities include a 1.52-m and two 0.41-m telescopes, as well as the 0.25-m Metcalf camera, a 0.33-m refractor and a 0.20-m solar installation.

The HARTEBEESTHOEK RADIO ASTRONOMY OBSERVATORY, 30 km NW of Krugersdorp, is a national facility managed by the Foundation for Research Development. The Director is Dr G D Nicolson. The 26 m telescope operates at 18, 13, 6, 3.6 and 2.5 cm wavelengths and is used for observations of interstellar and circumstellar molecules, pulsars, x-ray sources as well as quasars and active galaxies. The observatory provides research facilities for astronomers in South African universities as well as its own staff and frequently collaborates in global networks of telescopes using the technique of very long baseline interferometry.

The NOOITGEDACHT GAMMA RAY TELESCOPE, established in 1985 in the Vredefort area south of Potchefstroom, is operated as a facility of the FRD/PU Cosmic Ray Research unit of the Potchefstroom University, under the leadership of Prof B C Raubenheimer. It consists of twelve parabolic mirrors with a total reflecting area of 21 square metres. The weak blue Cerenkov light emitted by high energy gamma rays in the atmosphere is detected by fast coincidence techniques. Radio pulsars, X-ray binaries, Supernova Remnants and Cataclysmic Variables are some of the objects studied.

OBSERVATORIES OPEN TO THE PUBLIC

SAAO headquarters in Observatory, Cape Town is open to visitors on the second Saturday of each month at 20h00. It is not necessary to make a booking, unless there are more than ten persons in a party. Day visits are possible to the SAAO observing site near Sutherland, and enquiries should be made to Sutherland prior to the intended visit.

BOYDEN OBSERVATORY, BLOEMFONTEIN. Enquiries as to visits should be made to the Dept of Physics and Astronomy of the University of the Orange Free State. Tel 051-4012321 (Mr. Hofman) or 051-4012843 (Mr. J. Calitz).

THE NOOITGEDACHT TELESCOPE, POTCHEFSTROOM. Interested individuals or groups are welcome to contact Prof. B C Raubenheimer to arrange visits.

The PORT ELISABETH PEOPLES OBSERVATORY SOCIETY. The Observatory, situated on the corner of Westview Drive and MacFarlane Road, is open to the public on the 1st and 3rd Wednesdays of every month and on every Wednesday during December and January. Admission is free. Donations are accepted to help with running costs. Viewing evenings are arranged for groups at other times during the month.

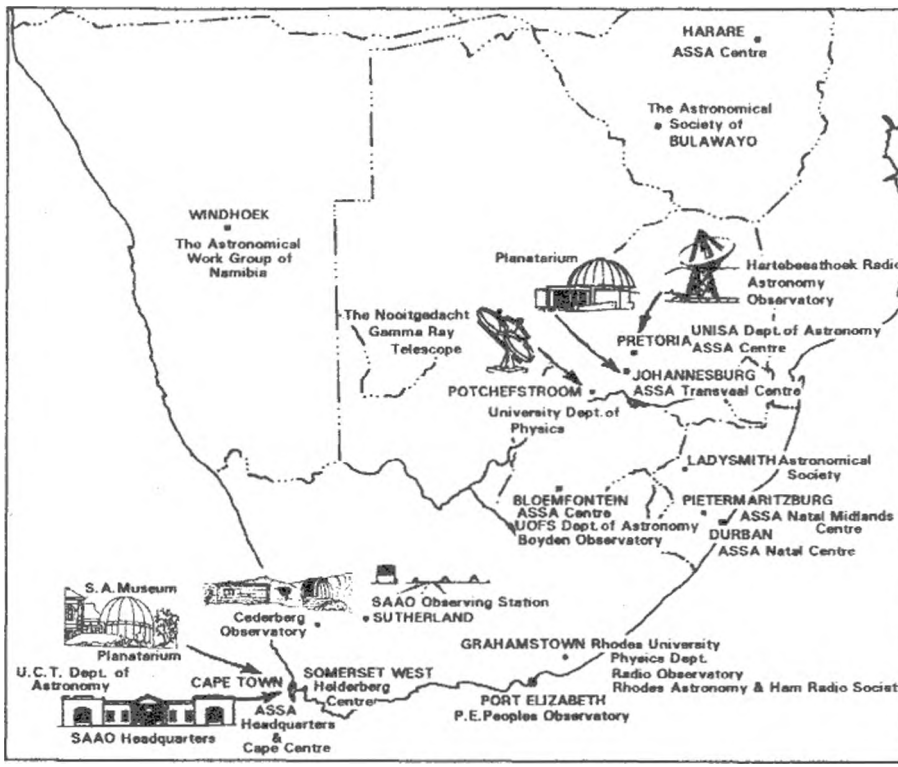
THE CEDERBERG OBSERVATORY. This observatory, situated 250 km by road north of Cape Town, is operated by 6 amateur astronomers. It has excellent dark skys and public open nights are held twice monthly at Last Quarter and New Moon. Enquiries to Mr. Chris Forder Tel 021-9134200.

PLANETARIA

A planetarium is located within the South African Museum in Cape Town, containing a Minolta Series 4 projector and seating 120.

A planetarium is situated in the grounds of the University of the Witwatersrand in Johannesburg (entrance in Yale Road, alongside the M1). It is equipped with a Zeiss projector and seats over 400 persons.

Regular shows are given at both of these planetaria, from which details may be obtained.



UNIVERSITIES

Several universities undertake research in astronomy and offer teaching courses. The chair of astronomy at UCT is occupied by Brian Warner, whose department uses the SAAO observing facilities at Sutherland. The Dept of Applied Mathematics, UCT has a group carrying out research in theoretical cosmology lead by Profs G F R Ellis and D R Matravers. The University of OFS has a Dept of Physics and Astronomy, headed by Prof. P E Viljoen, incorporated with the Boyden Observatory. The Dept of Physics and Electronics at Rhodes University, under Prof. E E Baart, specialises in radio astronomy, and has its own observatory outside Grahamstown. The Dept of Mathematics, Applied Mathematics and Astronomy at UNISA offers a number of courses in astronomy and astrophysics. Prof. W F Wargau is the head of Astronomy at UNISA. Courses in Gamma Ray Astronomy and General Astrophysics form part of the regular honors and masters courses of the Department of Physics at Potchefstroom.

ASTRONOMICAL SOCIETIES

THE ASTRONOMICAL SOCIETY OF BULAWAYO, ZIMBABWE. The society holds meetings on the second Monday of every month at the City Club, 95 Josiah Tongara St. Visitors are welcome. The Society also publishes monthly newsletters. Secretarial address: c/o Mr. Derek Shaw, 2 Sinclair Ave., Bulawayo - Tel. 75439.

THE ASTRONOMICAL WORK GROUP, NAMIBIA. The Society, situated in Windhoek, is active in the fields of astrophotography, solar and occultation observing. It has an observing site, housing a .36m telescope, at the Brakwater Agricultural Centre outside Windhoek. Exibitions and public viewing sessions are organised. For further information contact Mrs. S. Enke, P O Box 5198, Windhoek.

THE LADYSMITH ASTRONOMICAL SOCIETY, NATAL. The society holds meetings on the third Wednessday of every month which are alturnatly a talk or an observing evening. Visitors are welcome. For further information contact 0361-22992 a/h.

THE PORT ELISABETH PEOPLES OBSERVATORY SOCIETY. Society meetings are held bi-monthly on the 3rd Monday. Secretarial address: P. O. Box 7988, Newton Park, Port Elizabeth, 6055.

THE RHODES ASTRONOMY AND HAM RADIO SOCIETY, RHODES UNIVERSITY, GRAHAMSTOWN. The society meets twice monthly in Physics Department during the university terms. Meeetings consist of talks, discussions, slide shows and videos. Frequent observing sessions including public evenings are held. The society is active in fields of astrophotography, variable star and comet observing. It also has an astronomy education program for schools. Although this is largely a student society membership is open to all interested persons as well as bodies such as school clubs. Secretarial address: c/o The Physics Department, Rhodes University, Grahamstown. 6140. For information about meetings contact 0461-22023 ext 450 o/h or 0461-26063 a/h.

THE ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA. This Society 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 the popular monthly magazine "Sky and Telescope" published in the USA, which provides information on professional and amateur activities, together with news of space research and other related subjects. The Society's annual subscription is R85.00 and there is an entrance fee of R10.00. A prospectus and application form may be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, c/o S A Astronomical Observatory, P O Box 9, Observatory 7935, or telephone 021-7612112 (Mrs. A. Joubert).

AUTONOMOUS LOCAL CENTRES OF THE ASSA 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 receive neither Society publications, nor "Sky and Telescope". Centres publish newsletters and journals carrying information on meetings, centre activities and topics of interest.

CAPE CENTRE (Cape Town): Formal meetings, involving lectures on the latest Astronomical topics are held on the second Wednesday of the month (except in January and December). Informal meetings are held on other Wednesdays except during January and December. Meetings are held at the SAAO, Observatory Road, Observatory at 20h00. The Centre publishes a journal, the "Cape Observer" and a monthly newsletter. Secretarial address: P.O.Box 13018, Mowbray, 7705, or tel. 021-6852664.

TRANSVAAL CENTRE (Johannesburg): General meetings, consisting of lectures, films or observing evenings are held on the second Wednesday of each month, excluding December, in the Sir Herbert Baker building in the grounds of the former Republic Observatory, 18A Gill Street, Observatory, Johannesburg at 20h00. Informal observing evenings are held every Friday night. The Centre publishes a newsletter "Canopus". Secretarial address: P O Box 93145, Yeoville 2143, tel. 011-8865602.

NATAL CENTRE (Durban): Regular monthly meetings are held at 19h45 on the second Wednesday of each month at Marist Brothers School, South Ridge Road, Durban. The Centre publishes a monthly magazine "Ndaba". Secretarial address: P O Box 5330, Durban, 4000, or telephone 031-3072093 / 7011104 / 7013178 / 0323-51647.

NATAL MIDLANDS CENTRE (Pietermaritzburg): Regular monthly meetings on the second Wednesday of each month starting at 19h45 are held at St Charles College, Harwin Rd. Secretarial address: P O Box 2106, Pietermaritzburg, 3200 or by phoning 0331-33646.

BLOEMFONTEIN CENTRE: Meetings are held every fourth Friday of the month. Secretarial address: Mrs. T Hattingh, P O Box 1238, Bloemfontein, 9300 or tel.051-224977.

PRETORIA CENTRE: Meetings are held on the fourth Wednesday of each month (except December) at 19h00 at the Christian Brothers' College, Silverton Road, where the Centre's observatory containing a 30cm reflecting telescope is situated. Secretarial address: Mr N Young at 201 Kritzinger St., Meyers Park, Pretoria, 0184 tel. 012-833765.

HARARE CENTRE: The Centre holds a meeting on the last Wednesday of each month (except December). These are usually held at 17h30 at the Harry Robinson Study Centre Prince Edward School, consist of lectures, films or general discussions. Informal observing sessions are also held at the homes of members. Secretarial address: P O Box UA 428, Union Avenue, Harare, Zimbabwe.

THE HELDERBERG CENTRE, SOMERSET WEST. The society holds meetings on the last Thursday of every month at the Hottentots Holland High School at 7:30pm. Secretarial address: P. O. Box 358, Somerset West, 7129. Tel. 024-21405 o/h or 024-24630 a/h.

SECTIONS OF THE ASSA

These sections exist to co-ordinate the activities of special interest groups within the Society. Several of these sections co-ordinate constructive observing programmes ard more information on an observing section is given in the appropriate part of this handbook.

THE COMPUTING SECTION. This section invites all those interested in Astronomical Computing in any form to share their expertise and any Software they may have with other members in the Society.

The objectives of the Computing Section were outlined in MNASSA. Vol 46 Nos. 5 & 6 June 1987 Page 66. Please refer to this write up for detailed information. Persons interested in the activities of the Computing Section are urged to contact the Director of the Societies Computing Section:

Mr Tony Hilton, P O Box 68846, Bryanston, 2021. Phone (w) (011) 53 8714
(h) (011) 465 2257.

Mr Hilton has compiled a comprehensive DATA BASE of all interested person's, equipment, available software etc. If you wish to become a subscriber to this DATA BASE list please contact Mr Hilton for the relevant questionnaire.

Furthermore, if you are embarking on any Computer Projects, Mr Hilton would like to hear from you, and would make himself or any other competent individuals available to supply expert advice or additional information where necessary.

THE HISTORICAL SECTION. This section has been formed (during 1992) for the purpose of establishing a stronger historical record than hitherto available relating to astronomy in Southern Africa and in particular, to the ASSA and its members. Amongst the activities are

- maintaining an archive of photographic and other material of historical interest;
- undertaking research into specific topics and publishing articles, obituaries etc;
- following up specific enquiries.

All members (and families of deceased members) are invited to donate material to the archive and to participate in the other activities of the Section.

For further information, contact the Director :
Jonathan H. Spencer Jones, P O Box 398, Cape Town, 8000. Tel: 021-4623412

DIARY OF PHENOMENA

	d	h	
Jan	2	8	Earth at perihelion
	3	22	Mercury in superior conjunction
	5	2	LAST QUARTER
	5	19	Spica 1°·2 N. of Moon
	6	3	Moon at perigee
	7	0	Jupiter 3° N. of Moon
	11	10	Neptune in conjunction with Sun
	12	1	NEW MOON
	12	19	Uranus in conjunction with Sun
	15	2	Saturn 7° S. of Moon
	17	4	Venus in superior conjunction
	19	7	Moon at apogee
	19	22	FIRST QUARTER
	27	15	FULL MOON
	31	6	Moon at perigee
Feb	2	0	Spica 1°·0 N. of Moon
	2	6	Mercury 1°·3 N. of Saturn
	3	10	Jupiter 3° N. of Moon
	3	10	LAST QUARTER
	4	23	Mercury greatest elong. E. (18°)
	8	10	Neptune 3° S. of Moon
	8	14	Uranus 5° S. of Moon
	10	16	NEW MOON
	10	20	Mercury stationary
	16	4	Moon at apogee
	18	20	FIRST QUARTER
	20	10	Mercury in inferior conjunction
	21	19	Saturn in conjunction with Sun
	23	16	Juno stationary
	26	3	FULL MOON
	27	3	Mercury 4° N. of Mars
	28	0	Moon at perigee
	28	23	Jupiter stationary
Mar	1	7	Spica 0°·7 N. of Moon
	2	18	Jupiter 2° N. of Moon
	4	3	Pluto stationary
	4	14	Mercury stationary
	4	19	LAST QUARTER
	7	18	Neptune 4° S. of Moon
	7	23	Uranus 5° S. of Moon
	10	6	Mercury 5° S. of Moon
	11	1	Mars 7° S. of Moon
	11	6	Saturn 7° S. of Moon
	12	9	NEW MOON
	13	19	Venus 5° S. of Moon
	14	12	Mars 0°·4 N. of Saturn
	15	19	Moon at apogee
	19	4	Mercury greatest elong. W. (28°)
	20	5	Pallas in conjunction with Sun
	20	14	FIRST QUARTER
	20	22	Equinox
	24	10	Mercury 0°·3 S. of Saturn
	27	13	FULL MOON
	28	8	Moon at perigee
	28	17	Spica 0°·6 N. of Moon
	30	1	Jupiter 2° N. of Moon
Apr	3	5	LAST QUARTER
	4	0	Neptune 4° S. of Moon
	4	4	Mercury 1°·5 S. of Mars
	4	6	Uranus 5° S. of Moon
	7	18	Saturn 7° S. of Moon
	9	4	Mars 6° S. of Moon
	9	13	Mercury 7° S. of Moon
	11	2	NEW MOON
	12	2	Moon at apogee
	13	1	Venus 1°·0 S. of Moon
	15	3	Juno at opposition
Apr	19	5	FIRST QUARTER
	25	4	Spica 0°·6 N. of Moon
	25	11	Neptune stationary
	25	19	Moon at perigee
	25	22	FULL MOON
	26	7	Jupiter 3° N. of Moon
	28	7	Vesta in conjunction with Sun
	30	11	Jupiter at opposition
	30	12	Mercury in superior conjunction
May	1	3	Uranus stationary
	1	8	Neptune 4° S. of Moon
	1	14	Uranus 5° S. of Moon
	2	17	LAST QUARTER
	5	2	Venus 6° N. of Aldebaran
	5	5	Saturn 7° S. of Moon
	8	6	Mars 4° S. of Moon
	9	4	Moon at apogee
	10	19	NEW MOON
	13	8	Venus 4° N. of Moon
	15	13	Mercury 8° N. of Aldebaran
	17	22	Pluto at opposition
	18	15	FIRST QUARTER
	22	14	Spica 0°·6 N. of Moon
	23	13	Jupiter 3° N. of Moon
	24	5	Moon at perigee
	25	6	FULL MOON — Eclipse
	28	16	Neptune 4° S. of Moon
	28	22	Uranus 5° S. of Moon
	30	9	Mercury greatest elong. E. (23°)
Jun	1	6	LAST QUARTER
	1	14	Saturn 7° S. of Moon
	5	15	Moon at apogee
	6	7	Mars 2° S. of Moon
	8	5	Ceres in conjunction with Sun
	9	10	NEW MOON
	10	7	Venus 5° S. of Pollux
	11	2	Mercury 3° N. of Moon
	11	17	Juno stationary
	12	14	Mercury stationary
	12	15	Venus 7° N. of Moon
	16	22	FIRST QUARTER
	18	22	Spica 0°·6 N. of Moon
	19	18	Jupiter 3° N. of Moon
	21	9	Moon at perigee
	21	17	Solstice
	23	14	FULL MOON
	24	6	Saturn stationary
	25	1	Neptune 4° S. of Moon
	25	7	Uranus 5° S. of Moon
	25	12	Mercury in inferior conjunction
	28	23	Saturn 7° S. of Moon
	30	22	LAST QUARTER
Jul	2	18	Jupiter stationary
	3	7	Moon at apogee
	5	7	Mars 0°·3 N. of Moon — Occn.
	5	21	Earth at aphelion
	6	22	Mercury stationary
	7	15	Mercury 1°·3 S. of Moon
	9	0	NEW MOON
	10	19	Venus 1°·1 N. of Regulus
	12	14	Venus 7° N. of Moon
	14	18	Neptune at opposition
	16	3	FIRST QUARTER
	16	4	Spica 0°·4 N. of Moon
	17	1	Jupiter 3° N. of Moon
	17	6	Uranus at opposition
	17	16	Mercury greatest elong. W. (21°)

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		
Jul	18	20	Moon at perigee	
	18	23	Mars 5° N. of Aldebaran	
	22	9	Neptune 4° S. of Moon	
	22	14	Uranus 5° S. of Moon	
	22	22	FULL MOON	
	26	6	Saturn 7° S. of Moon	
	30	15	LAST QUARTER	
	31	1	Moon at apogee	
	31	9	Mercury 6° S. of Pollux	
Aug	3	6	Mars 3° N. of Moon	
	7	11	NEW MOON	
	9	16	Pluto stationary	
	11	1	Venus 3°N. ofMoon	
	12	9	Spica 0°·1 N. of Moon	
	13	1	Moon at perigee	
	13	3	Mercury in superior conjunction	
	13	9	Jupiter 2° N. of Moon	
	14	8	FIRST QUARTER	
	18	16	Neptune 4° S. of Moon	
	18	20	Uranus 5° S. of Moon	
	21	9	FULL MOON	
	22	12	Saturn 7° S. of Moon	
	25	1	Venus greatest elong. E. (46°)	
	27	20	Moon at apogee	
	29	9	LAST QUARTER	
	31	6	Vesta 0°·7 S. of Moon	
	31	23	Venus 0°·7 S. of Spica	
Sep	1	5	Mars 4°N. of Moon	
	1	19	Saturn at opposition	
	5	21	NEW MOON	
	7	11	Mercury 3° N. of Moon	
	8	16	Moon at perigee	
	8	16	Spica 0°·08 S. of Moon	Occn.
	9	3	Venus 2° S. of Moon	
	9	22	Jupiter 1°·4 N. of Moon	
	12	14	FIRST QUARTER	
	14	21	Neptune 4° S. of Moon	
	15	1	Uranus 5° S. of Moon	
	18	15	Saturn 7° S. of Moon	
	19	22	FULL MOON	
	21	15	Mercury 0°·1 S. of Spica	
	23	8	Equinox	
	24	14	Moon at apogee	
	24	17	Mars 6° S of Pollux	
	26	18	Mercury greatest elong. E. (26°)	
	28	2	LAST QUARTER	
	28	5	Vesta 0°·06 N. of Moon	
	29	0	Venus greatest brilliancy	
	30	0	Mars 6° N. of Moon	
Oct	2	5	Uranus stationary	
	2	16	Neptune stationary	
	5	6	NEW MOON	
	6	16	Moon at perigee	
	6	20	Mercury 3° S. of Moon	
	7	7	Pallas stationary	
	7	12	Venus 7° S. of Moon	
	7	14	Jupiter 0°·7 N. of Moon	
	9	11	Mercury stationary	
Oct	11	21	FIRST QUARTER	
	12	3	Neptune 4° S. of Moon	
	12	6	Uranus 5° S. of Moon	
	13	1	Venus stationary	
	15	18	Saturn 7° S. of Moon	
	19	14	FULL MOON	
	21	7	Mercury in inferior conjunction	
	22	4	Moon at apogee	
	25	21	Vesta 0°·6 N of Moon	
	27	19	LAST QUARTER	
	28	15	Mars 7° N of Moon	
	29	19	Mercury stationary	
Nov	2	12	Mercury 4° N. of Moon	
	2	12	Spica 0°·2 S. of Moon	Occn.
	3	1	Venus in inferior conjunction	
	3	3	Mercury 4° N. of Spica	
	3	16	NEW MOON	Eclipse
	4	2	Moon at perigee	
	6	3	Mercury greatest elong. W. (19°)	
	6	17	Vesta stationary	
	8	10	Neptune 4° S. of Moon	
	3	14	Uranus 6° S. of Moon	
	8	22	Pallas at opposition	
	9	23	Saturn stationary	
	10	8	FIRST QUARTER	
	11	23	Saturn 7° S. of Moon	
	12	20	Mercury 5° N. of Venus	
	17	22	Jupiter in conjunction with Sun	
	18	7	Moon at apogee	
	18	9	FULL MOON	
	18	19	Juno in conjunction with Sun	
	20	15	Pluto in conjunction with Sun	
	21	18	Venus stationary	
	22	2	Vesta 1°·0 N. of Moon	
	25	22	Mars 8° N. of Moon	
	26	9	LAST QUARTER	
	29	23	Spica 0°·2 S. of Moon	
	30	16	Venus 2° N. of Moon	
Dec	2	14	Moon at perigee	
	3	2	NEW MOON	
	5	21	Neptune 4° S. of Moon	
	6	2	Uranus 6° S. of Moon	
	6	10	Mars 2° N. of Regulus	
	9	7	Saturn 7° S. of Moon	
	9	13	Venus greatest brilliancy	
	9	23	FIRST QUARTER	
	14	5	Mercury in superior conjunction	
	15	10	Moon at apogee	
	18	4	FULL MOON	
	22	4	Solstice	
	23	17	Mars 9° N. of Moon	
	24	19	Ceres stationary	
	25	4	Vesta at opposition	
	25	21	LAST QUARTER	
	27	8	Spica 0°·3 S. of Moon	
	29	7	Venus 3° N. of Moon	
	30	2	Jupiter 1°·1 S. of Moon	
	31	1	Moon at perigee	

THE SUN

BASIC DATA:

Diameter: 1 392 000 km (109 times Earth diameter)

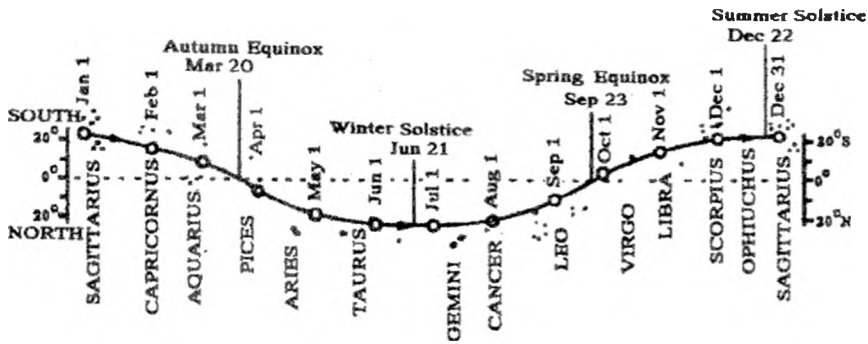
Mass: 1,99 x 10^{30}kg (330 000 times Earth mass)

Surface Temperature: Approximately 6 000°C

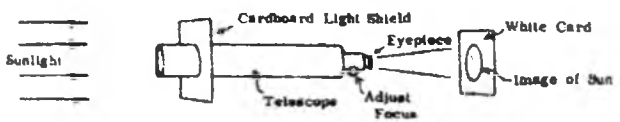
Temperature at centre: Approximately 10 million°C

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 short-lived flares.

The Earth's orbit round the Sun is not quite circular. In 1994 we will be closest to the Sun on January 2 (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.



THE SUN'S DECLINATION AT 02 HOURS:

Jan	1	-23° 2′	Apr	11	8° 9′	Jul	20	20°45′	Oct	28	-12°58′
	11	-21 52		21	11 42		30	18 37	Nov	7	-16 9
	21	-20 0	May	1	14 56	Aug	9	15 59		17	-18 52
	31	-17 30		11	17 46		19	12 55		27	-21 2
Feb	10	-14 29		21	20 5		29	9 31	Dec	7	-22 33
	20	-11 5		31	21 51	Sep	8	5 52		17	-23 20
Mar	2	-7 23	Jun	10	22 58		18	2 3		27	-23 21
	12	-3 30		20	23 26		28	-1 51			
	22	0 27		30	23 12	Oct	8	-5 43			
Apr	1	4 22	Jul	10	22 17		18	-9 27			

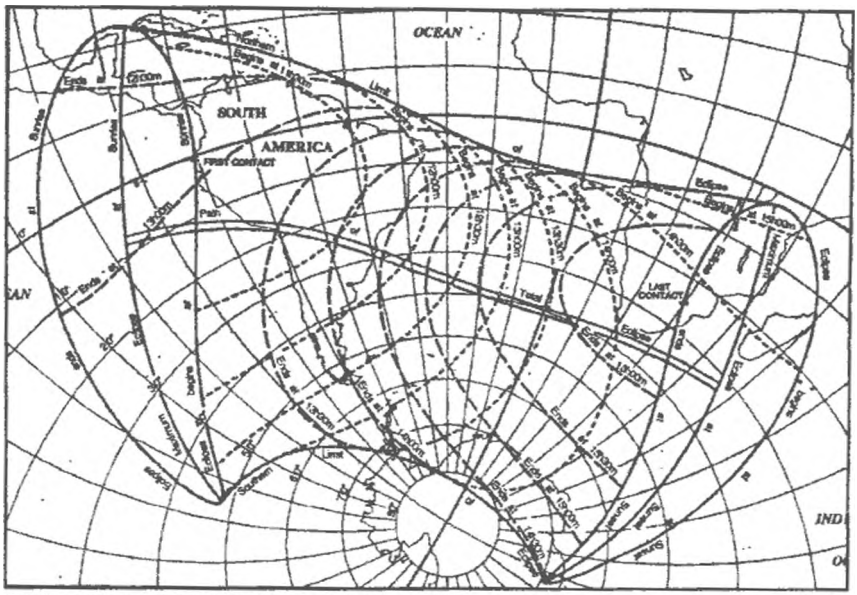
TIMES OF SUNRISE AND SUNSET FOR THE MAIN CITIES OF SOUTHERN AFRICA

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

ECLIPSES OF THE SUN

Two eclipses of the Sun take place during the year. The first, an annular eclipse on May 10 will not be visible from Southern Africa. The second, a total eclipse on November 3, will be visible from Southern Africa as a partial eclipse during the afternoon. Much of the region will see more than 50% of the Sun's disk obscured by that of the Moon at mid eclipse. However the Sun will set before the eclipse ends over the north eastern parts.

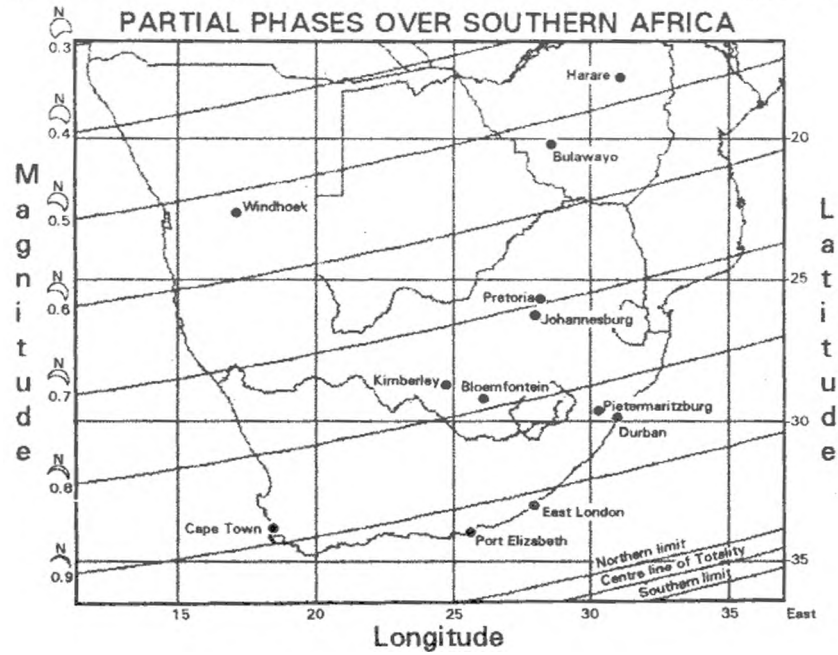
THE TOTAL ECLIPSE OF 3 NOVEMBER



This Map has been copied from the Astronomical Almanac for 1994

Times are in UT.

PARTIAL PHASES OVER SOUTHERN AFRICA



Predictions

	Start	PA	Middle	PA	Mag.	Area of Sun	End	PA	Sun Alt
	h m s	° ′	h m s	° ′		Obscured	h m s	° ′	° ′
Bloemfontein	16 13 36	264 43	17 16 04	187 14	0.787	0.741	18 12 18	109 58	+04 31
Bulawayo	16 27 45	247 57	17 22 26	186 31	0.525	0.423	18 12 00	125 10	-00 00
Cape Town	16 00 28	271 38	17 08 07	188 22	0.885	0.865	18 08 51	105 21	+12 41
Durban	16 16 17	267 26	17 16 59	186 56	0.842	0.809	18 11 58	106 38	+00 45
East London	16 10 54	272 01	17 13 42	187 23	0.914	0.901	18 10 31	102 57	+04 23
Grahamstown	16 09 25	272 14	17 12 56	187 31	0.915	0.902	18 10 19	103 00	+05 38
Harare	16 32 36	244 06	17 24 04	186 15	0.471	0.363	18 10 59	128 27	-02 39
Johannesburg	16 18 40	259 47	17 18 48	186 54	0.710	0.644	18 13 01	114 10	+01 58
Kimberley	16 13 01	263 27	17 15 50	187 19	0.764	0.711	18 12 19	111 24	+05 32
Ladysmith	16 17 25	264 20	17 17 55	186 54	0.788	0.742	18 12 36	109 38	+00 59
Pietermaritzburg	16 16 12	266 41	17 17 04	186 58	0.828	0.792	18 12 09	107 25	+01 11
Port Elisabeth	16 08 03	273 09	17 12 03	187 38	0.928	0.919	18 09 52	102 21	+06 34
Pretoria	16 19 26	258 54	17 19 10	186 51	0.696	0.626	18 13 04	114 58	+01 41
Somerset West	16 00 52	272 01	17 08 17	188 19	0.893	0.875	18 08 52	104 54	+12 20
Windhoek	16 14 01	249 22	17 14 59	187 46	0.522	0.420	18 09 30	126 21	+11 31

Note: PA is the position angle of the Moon counterclockwise from the north point of the Sun's disk.
Mag. is the fraction of the Sun's diameter covered.

SOLAR SECTION

The work undertaken by this section covers a broad range of techniques to observe activity on the sun's disk. Members of the section note their observations on appropriate forms, which are then forwarded to various organisations in the United States of America, the United Kingdom, the Federal Republic of Germany and South Africa. The results we provide are further reduced by these organisations and incorporated with the information provided by other world-wide groups of Solar Observers, such as ours. The data produced is then fed to over 450 scientific institutions all over the world, where it is used by a very wide range of scientific disciplines.

Observational techniques employed include the visual observation of the sun's disk (using suitable filters or by projecting the image onto an appropriate screen) to determine sun spots and active areas, the monitoring of solar flares by very low frequency radio waves and monitoring changes in the earth's magnetic field caused by solar activity. Other activities such as photographing and the drawing of visible solar features are also undertaken.

Towards the end of 1986, the Sun entered the new 11 year Solar cycle and this cycle is characterised by a steady climb over approximately 4½ years, followed by a slower decline to minimum lasting approximately 6½ years. The present Solar (cycle 22) has been rather special and very unusual, with the fastest rise to maximum yet recorded.

A word of caution - NEVER observe the sun directly without adequate filtration as permanent eye damage can occur,and do not use the screw-in filters provided with some commercial telescopes, as they are inclined to shatter! Large instruments are not a prerequisite! Any telescope from 50mm, reflector or refractor can be used and provides an ideal opportunity for owners of small instruments to contribute immediately to Science. If one has no filter, then the only safe method is to project the image on to a white card. Image quality will be enhanced if the card is kept in the shade, or enclosed in a screen. Details of suitable filters are best sought from experienced solar observers or from the Director of the Solar Section.

Persons interested in observing the sun,or requiring information are invited to contact The Director of the Solar Section:
Jim Knight, 17 Mars Street, Atlasville, Boksburg, 1459 or tel. 011-9731380.

The Moon

BASIC DATA

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

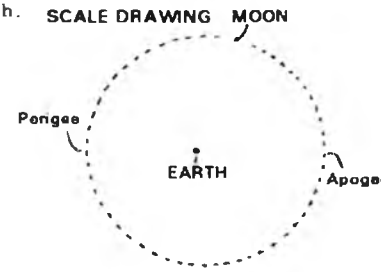
THE SURFACE OF THE MOON

In common with the bodies of our solar system, the Moon's surface suffered bombardment by numerous minor bodies during the period 4,5 to 3,0 billion years ago. This has 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 mare basins which appear smoother and darker then the rest of the surface (the latin words mare and maria come from older times when the basins 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.

THE MOON'S ORBIT

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.

The Moon's orbit around the Earth is slightly elliptical; the Earth is situated at one of the foci of the ellipse. Thus the Earth-Moon distance varies slightly during the course of a revolution. Dates of Apogee, when the moon is furthest from the Earth (approximately 407 000 km) and of Perigee, when the Moon is closest to the Earth (approximately 357 000 km) are given on the next page.



The Moon is best positioned for evening viewing from 3 to 4 days before First Quarter to shortly after Full Moon.

ECLIPSES OF THE MOON

The umbral phase of the partial eclipse on May 25 will be visible over most of Southern Africa. The penumbral eclipse on the morning of November 18 will not be visible.

The eclipse data is as follows:

	d	h	m
Moon enters penumbra	May 25	3	17.9
Moon enters umbra	25	4	37.3
Middle of eclipse	25	5	30.3
Moon leaves umbra	25	6	23.3
Moon leaves penumbra	25	7	42.7

Contacts of Umbra with Limb of Moon	Position Angles from the North Point
First	155.5 to East
Last	145.0 to West

Magnitude of the eclipse 0.249

	h	m
Moon set at Harare	6	21
Durban	6	43
Johannesburg	6	49
Bloemfontein	7	02
Port Elizabeth	7	15
Cape Town	7	45

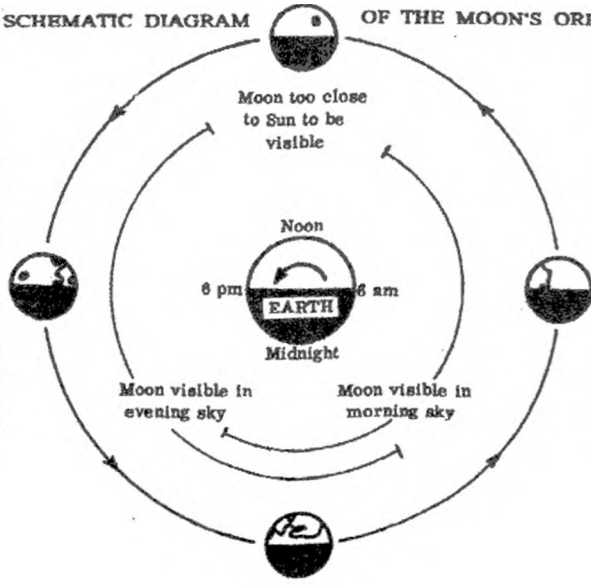
TERMINATOR AND LIBRATION

During the changing phases,the terminator (the boundary between illuminated and dark portions) progresses from left to right in the diagram on the next page. Since the moon does not follow a perfectly circular orbit and its axis is not parallel to the Earth's axis, it is sometimes possible to see a slightly greater proportion of one limb than the opposite one. This effect is known as libration.

PHASES and VISIBILITY

NEW MOON

	d	h	m
Jan	12	01	10
Feb	10	16	30
Mar	12	09	05
Apr	11	02	17
May	10	19	07
Jun	9	10	26
Jul	8	23	37
Aug	7	10	45
Sep	5	20	33
Oct	5	05	55
Nov	3	15	35
Dec	5	01	54



FIRST QUARTER

	d	h	m
Jan	19	22	27
Feb	18	19	47
Mar	20	14	14
Apr	19	04	34
May	18	14	50
Jun	16	21	56
Jul	16	03	12
Aug	14	07	57
Sep	12	13	34
Oct	11	21	17
Nov	10	08	14
Dec	9	23	06

LAST QUARTER

	d	h	m
Jan	5	02	00
Feb	3	10	06
Mar	4	18	53
Apr	3	04	55
May	2	16	32
Jun	1	06	02
Jun	30	21	31
Jul	30	14	40
Aug	29	08	41
Sep	28	02	23
Oct	27	18	44
Nov	26	09	04
Dec	25	21	06

FULL MOON

	d	h	m
Jan	27	15	23
Feb	26	03	15
Mar	27	13	09
Apr	25	21	45
May	25	05	39
Jun	23	13	33
Jul	22	22	16
Aug	21	08	47
Sep	19	22	00
Oct	19	14	18
Nov	18	08	57
Dec	18	04	17

MOON at PERIGEE

	d	h		d	h		d	h
Jan	6	3	May	24	5	Oct	6	16
	31	6	Jun	21	9	Nov	4	2
Feb	28	0	Jul	18	20	Dec	2	14
Mar	28	8	Aug	13	1		31	1
Apr	25	19	Sep	8	16			

MOON at APOGEE

	d	h		d	h		d	h
Jan	19	7	Jun	5	15	Oct	22	4
Feb	16	4	Jul	3	7	Nov	18	7
Mar	15	19		31	1	Dec	15	10
Apr	12	2	Aug	27	20			
May	9	4	Sep	24	14			

MAP OF THE MOON'S NEAR SIDE

LIBRATION

Maximum			Minimum			Maximum			Minimum		
Date	Size	P.A.	Date	Size	P.A.	Date	Size	P.A.	Date	Size	P.A.
d	°	°	d	°	°	d	°	°	d	°	°
			Jan 7	2.3	313	Jul 11	8.3	54	Jul 18	0.2	94
Jan 14	8.0	197	Jan 20	3.3	115	Jul 24	8.6	201	Jul 31	0.8	139
Jan 27	7.8	53	Feb 3	3.3	314	Aug 7	8.2	53	Aug 13	0.8	307
Feb 10	7.8	197	Feb 16	3.2	117	Aug 20	8.3	199	Aug 27	0.7	94
Feb 23	8.8	60	Mar 2	3.7	332	Sep 3	8.7	56	Sep 9	1.5	320
Mar 9	8.3	205	Mar 16	2.8	118	Sep 16	8.7	203	Sep 23	0.3	37
Mar 23	9.8	64	Mar 29	3.0	340	Sep 30	9.6	61	Oct 7	1.0	336
Apr 5	9.3	212	Apr 12	2.2	115	Oct 13	9.6	209	Oct 21	0.6	258
Apr 20	10.3	65	Apr 26	1.9	344	Oct 28	10.1	65	Nov 4	0.3	206
May 2	9.9	212	May 10	1.5	122	Nov 10	10.3	211	Nov 17	1.0	310
May 17	10.0	64	May 24	0.8	4	Nov 25	9.9	66	Dec 2	1.6	156
May 30	9.8	209	Jun 6	1.0	107	Dec 8	10.2	210	Dec 15	1.6	295
Jun 14	9.1	60	Jun 21	0.3	181	Dec 22	9.0	63	Dec 29	2.7	149
Jun 27	9.2	204	Jul 4	0.7	136						

NOTE: Size of libration is given as an angle measured at the centre of the Moon. Position Angle (P.A.) is measured through East on the face of the Moon from the North point of the disk.

1994 TIMES OF MOON RISE AND 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
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	22 21	09 10	22 49	11 22	21 30	10 17	22 51	12 24	23 43	12 45	00 28	13 05
2	22 56	10 14	23 31	12 29	22 16	11 25	23 52	13 18		13 25	01 24	13 36
3	23 32	11 19		13 36	23 06	12 32		14 06	00 43	14 00	02 19	14 06
4		12 24	00 17	14 40		13 34	00 52	14 48	01 41	14 33	03 13	14 38
5	00 09	13 30	01 08	15 40	00 00	14 32	01 51	15 25	02 36	15 03	04 07	15 12
6	00 48	14 37	02 04	16 36	00 58	15 23	02 49	15 59	03 31	15 34	05 01	15 48
7	01 31	15 43	03 02	17 25	01 57	16 08	03 46	16 30	04 25	16 04	05 55	16 28
8	02 19	16 47	04 03	18 09	02 57	16 48	04 41	17 01	05 19	16 37	06 48	17 13
9	03 13	17 48	05 04	18 48	03 56	17 24	05 36	17 31	06 13	17 11	07 40	18 02
10	04 11	18 42	06 04	19 23	04 54	17 57	06 30	18 02	07 07	17 49	08 29	18 55
11	05 12	19 31	07 02	19 56	05 51	18 28	07 24	18 35	08 01	18 30	09 15	19 51
12	06 15	20 13	07 59	20 27	06 46	18 58	08 18	19 11	08 53	19 16	09 57	20 50
13	07 16	20 51	08 54	20 57	07 41	19 29	09 12	19 49	09 44	20 06	10 36	21 49
14	08 16	21 25	09 49	21 27	08 36	20 00	10 05	20 32	10 31	21 00	11 13	22 50
15	09 14	21 56	10 44	21 59	09 30	20 34	10 57	21 19	11 15	21 56	11 49	23 52
16	10 10	22 26	11 38	22 34	10 24	21 10	11 47	22 10	11 57	22 55	12 24	
17	11 05	22 56	12 32	23 11	11 18	21 50	12 33	23 05	12 35	23 56	13 00	00 56
18	11 59	23 27	13 26	23 53	12 11	22 34	13 17		13 11		13 38	02 01
19	12 54	24 00	14 20		13 02	23 23	13 58	00 03	13 47	00 58	14 20	03 08
20	13 48		15 12	00 40	13 52		14 36	01 03	14 24	02 01	15 08	04 16
21	14 43	00 35	16 01	01 32	14 38	00 16	15 14	02 06	15 02	03 07	16 01	05 24
22	15 38	01 15	16 48	02 29	15 22	01 14	15 51	03 11	15 43	04 15	17 00	06 30
23	16 32	02 00	17 31	03 30	16 03	02 15	16 29	04 18	16 29	05 25	18 03	07 31
24	17 24	02 50	18 12	04 35	16 42	03 19	17 10	05 28	17 20	06 36	19 08	08 25
25	18 13	03 46	18 51	05 41	17 21	04 25	17 54	06 39	18 18	07 45	20 13	09 12
26	18 58	04 46	19 29	06 49	17 59	05 33	18 43	07 51	19 20	08 49	21 16	09 54
27	19 40	05 50	20 07	07 58	18 39	06 43	19 38	09 01	20 24	09 47	22 16	10 31
28	20 19	06 55	20 47	09 07	19 21	07 54	20 37	10 08	21 28	10 37	23 14	11 04
29	20 57	08 02			20 07	09 06	21 39	11 07	22 31	11 21		11 36
30	21 33	09 09			20 58	10 16	22 42	12 00	23 31	11 59	00 10	12 07
31	22 10	10 15			21 53	11 23				12 33		

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

1994 TIMES OF MOON RISE AND SET JOHANNESBURG

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

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

1994 TIMES OF MOON RISE AND 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
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	21 26	08 21	22 02	10 25	20 43	09 18	22 08	11 22	22 57	11 46	00 28	12 12
2	22 04	09 23	22 46	11 30	21 31	10 25	23 07	12 17	23 55	12 27	00 31	12 45
3	22 41	10 26	23 33	12 35	22 22	11 30		13 06	00 11	13 05	01 24	13 17
4	23 20	11 29	00 17	13 38	23 17	12 32	00 06	13 49	00 51	13 39	02 17	13 50
5	00 09	12 32	00 25	14 38	00 00	13 30	01 04	14 28	01 45	14 11	03 09	14 26
6	00 01	13 37	01 20	15 34	00 14	14 22	02 01	15 04	02 37	14 43	04 02	15 03
7	00 46	14 42	02 19	16 24	01 13	15 08	02 55	15 37	03 30	15 16	04 55	15 45
8	01 35	15 45	03 18	17 10	02 11	15 50	03 49	16 09	04 22	15 50	05 47	16 30
9	02 29	16 45	04 17	17 50	03 09	16 27	04 42	16 41	05 15	16 26	06 38	17 19
10	03 28	17 41	05 16	18 28	04 05	17 02	05 34	17 14	06 07	17 04	07 28	18 11
11	04 28	18 30	06 12	19 02	05 00	17 35	06 27	17 49	07 00	17 47	08 14	19 06
12	05 29	19 14	07 07	19 35	05 53	18 07	07 19	18 25	07 52	18 33	08 58	20 03
13	06 29	19 54	08 01	20 07	06 46	18 40	08 12	19 05	08 42	19 23	09 39	21 02
14	07 27	20 30	08 54	20 39	07 39	19 13	09 04	19 48	09 30	20 16	10 17	22 01
15	08 23	21 03	09 47	21 13	08 32	19 48	09 55	20 36	10 15	21 11	10 55	23 01
16	09 18	21 35	10 39	21 48	09 25	20 25	10 45	21 26	10 58	22 08	11 32	
17	10 11	22 07	11 32	22 27	10 17	21 06	11 32	22 20	11 38	23 07	12 10	00 02
18	11 03	22 39	12 25	23 10	11 09	21 51	12 17	23 17	12 16		12 50	01 05
19	11 56	23 14	13 18	23 57	12 01	22 40	12 59	00 03	12 54	00 07	13 34	02 09
20	12 49	23 51	14 10	00 17	12 50	23 33	13 40	00 16	13 32	01 09	14 23	03 16
21	13 43	00 09	15 00	00 49	13 37	00 16	14 19	01 17	14 12	02 12	15 17	04 23
22	14 36	00 31	15 47	01 45	14 22	00 29	14 58	02 20	14 55	03 18	16 16	05 28
23	15 30	01 17	16 32	02 45	15 05	01 29	15 39	03 24	15 43	04 26	17 19	06 29
24	16 22	02 07	17 15	03 47	15 47	02 31	16 21	04 31	16 36	05 35	18 23	07 24
25	17 12	03 02	17 56	04 52	16 27	03 35	17 08	05 40	17 34	06 43	19 26	08 13
26	17 59	04 02	18 37	05 57	17 08	04 41	17 59	06 51	18 36	07 47	20 27	08 56
27	18 42	05 04	19 17	07 04	17 50	05 48	18 54	08 00	19 39	08 45	21 25	09 35
28	19 24	06 07	19 59	08 11	18 34	06 57	19 53	09 05	20 42	09 37	22 21	10 11
29	20 03	07 11			19 22	08 06	20 55	10 06	21 43	10 22	23 16	10 45
30	20 42	08 16			20 14	09 15	21 57	10 59	22 41	11 02	00 10	11 17
31	21 21	09 21			21 09	10 21			23 37	11 39		

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

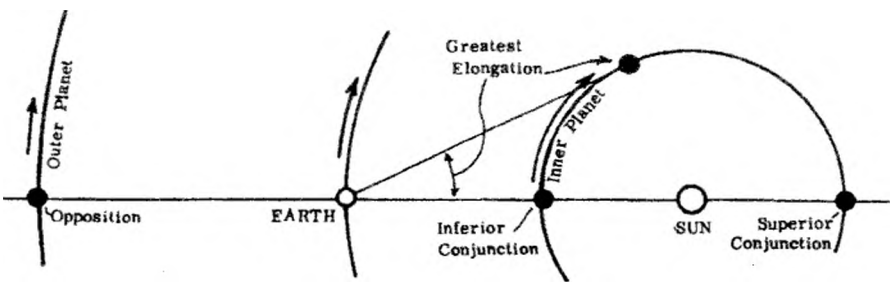
THE PLANETS

BASIC DATA

	Dist from Sun 10^6 km	Period of Revolution years	Mass (Earth = 1)	Equatorial Diameter 10^3 km	Rotation Period	Inclination of Equator to orbit	No. of known satellites
Mercury	58	0.24	0.055	4.98	58.65d	0°	0
Venus	108	0.62	0.815	12.10	243d R	178°	0
Earth	150	1.00	1.000	12.76	23h56m	23°27′	1
Mars	228	1.88	0.107	6.79	24h37m	23°59′	2
Jupiter	778	11.9	318.867	142.80	09h51m	03°04′	16
Saturn	1 426	29.5	95.142	120.00	10h14m	26°44′	18
Uranus	2 868	84.0	14.559	52.00	17.2h	97°52′	15
Neptune	4 494	164.8	17.207	48.40	17.8h	29°34′	8
Pluto	5 896	247.6	0.002	3.00	6.39d	118°?	1

GENERAL

Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Their apparent brightness is measured in magnitudes. A planet of magnitude 1.0, that of the brightest stars, will be 100 times brighter than one of magnitude 6.0, the limit of visibility to the naked eye in the total absence of artificial lighting. Unlike the distant stars, the relative positions of the planets 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 during the year are listed chronologically in the DIARY OF PHENOMENA and are also mentioned in the text below.

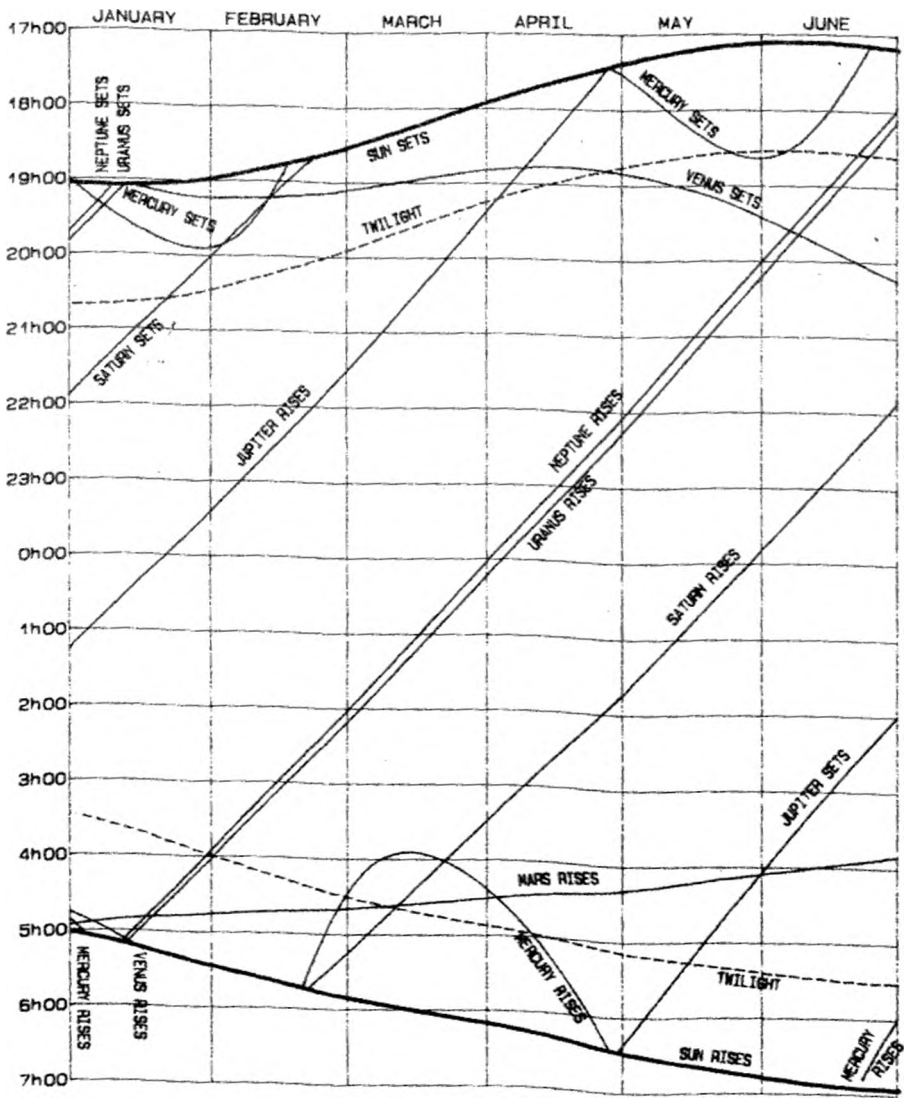


OBSERVING THE PLANETS

To the naked eye, planets appear as virtually point 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.

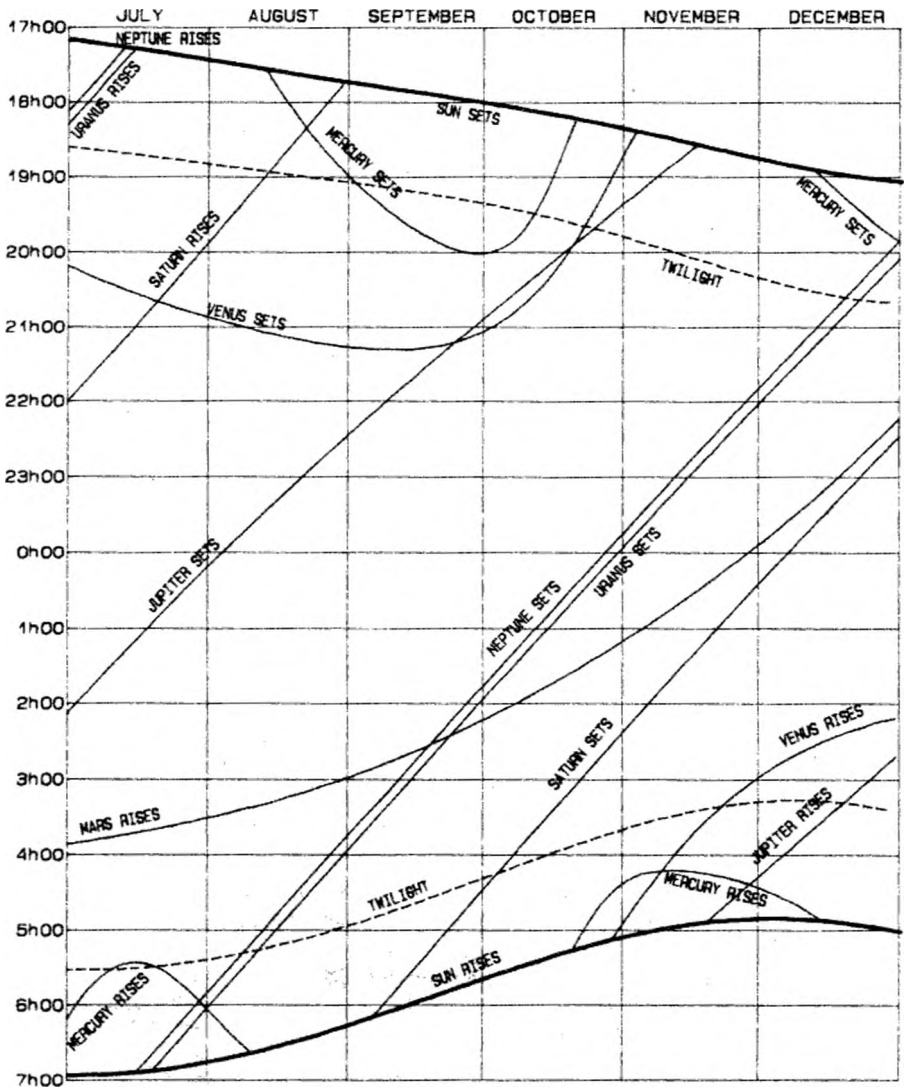
TIMES OF RISING AND SETTING

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.



CORRECTION FOR PLACES NOT ON THE 30° E MERIDIAN
Approximate longitude corrections from the 30° East meridian are:

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



MERCURY

The planet may be seen low in the east before sunrise between the following approximate dates:

February 27 (at mag.+2.3) to April 22 (at mag.-1.2),
July 4 (at mag.+2.9) to August 5 (at mag.-1.5) and
October 28 (at mag.+1.4) to November 27 (at mag.-0.8)

The best conditions for viewing will occur from the middle of March until early April when Mercury is in Aquarius.

Mercury may also be seen low in the west after sunset between the following approximate dates:

January 18 (at mag.-1.0) to February 14 (at mag.+1.8),
May 8 (at mag.-1.5) to June 16 (at mag.+3.0),
August 23 (at mag.-0.9) to October 15 (at mag.+2.1) and
December 30 and 31 (at mag.-0.9)

The best conditions for viewing will be from beginning of September until almost mid October when the planet is in Virgo.

	d h	d h	d h	d h
Superior Conjunction	Jan 3 22	Apr 30 12	Aug 13 3	Dec 14 5
Greatest Elongation East	Feb 4 23 (18°)	May 30 9 (23°)	Sep 26 18 (26°)	
Stationary	Feb 10 20	Jun 12 14	Oct 9 11	
Inferior Conjunction	Feb 20 10	Jun 25 12	Oct 21 7	
Stationary	Mar 4 14	Jul 6 22	Oct 29 19	
Greatest Elongation West	Mar 19 4 (28°)	Jul 17 16 (21°)	Nov 6 3 (19°)	

VENUS

Venus will be in the evening sky from the end of February (at mag.-3.9) until the late October (at mag.-4.2) reaching greatest brilliancy on Sep 29 at magnitude -4.6.

It returns to the morning sky from mid November (at mag. -4.3) until the end of the year (at mag.-4.5) and reaches greatest brilliancy on December 9 at magnitude -4.7.

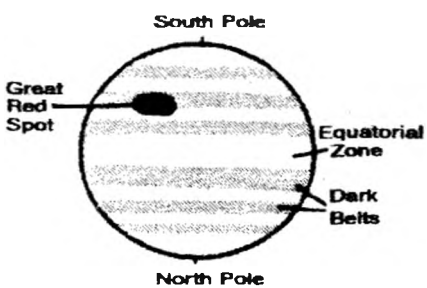
	d h
Venus superior conjunction	Jan 17 4
Greatest Elongation East	Aug 25 1 (46°)
Stationary	Oct 13 1
Inferior Conjunction	Nov 3 1
Stationary	Nov 21 18

MARS

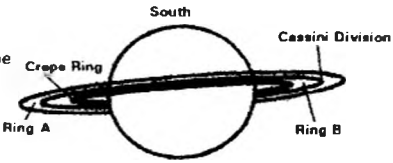
Mars returns to the morning sky in late February (at mag.+1.2) in the constellation of Capricornus, then passes to Aquarius at the beginning of March, to Pisces just after the beginning of April, to Aries in late May, to Taurus in late June, to Gemini in mid August, to Cancer in late September (at mag.+1.0) and Leo in early November (at mag.+0.7) by which time it will be visible throughout the night.

JUPITER

Jupiter begins the year in Libra (at mag.-1.8) as a morning sky object. It will be visible all night by late April (at mag.-2.5). It passes to Virgo in late May and returns to Libra in mid August, where it will be seen in the evening sky (at mag.-2.0). It becomes too close to the Sun by the beginning of November to be seen. Jupiter re-appears in the morning sky at the beginning of December (at mag.-1.7) and passes to Scorpius in mid December.



SATURN

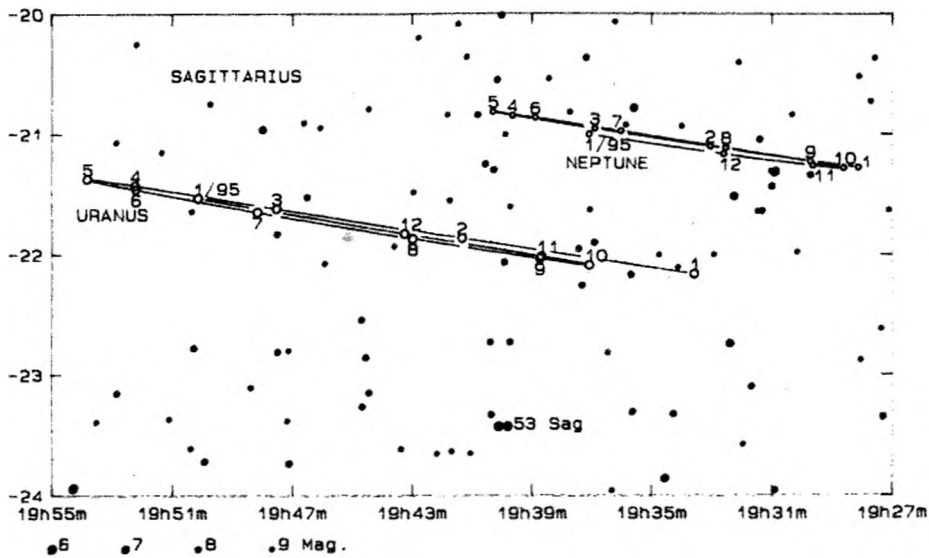


Saturn, seen in Aquarius all year, will be in the evening sky until early February(at mag.+0.9). It reappears in the morning sky in early March (at mag.+0.9). It will be an all night object by the beginning of September (at mag.+0.5) but becomes an evening sky object from early December at magnitude +0.9.

URANUS AND NEPTUNE

Uranus and Neptune are both in Sagittarius all year. Uranus is at magnitude 5.6 at opposition on July 17 and Neptune is at magnitude +7.9. at opposition on July 14.

THE PATHS OF URANUS AND NEPTUNE



PLUTO

Pluto at magnitude +14 in Serpens is visible only in a telescope of at least 25cm aperture.

EVENTS OF INTEREST

Evening Sky:

18 Jan to 4 Feb	Mercury and Saturn visible
2 Feb	Mercury and Saturn in conjunction
30 Apr to 7 May	Jupiter and Venus visible
8 May to 16 Jun	Mercury, Venus and Jupiter visible
17 Jun to 22 Aug	Venus and Jupiter visible
23 Aug to 31 Aug	Mercury, Venus and Jupiter visible
1 Sep to 15 Oct	Mercury,Jupiter,Venus and Saturn visible
16 Oct to 29 Oct	Venus, Jupiter and Saturn visible
30 Oct to 5 Nov	Jupiter and Saturn visible
30 Dec to 31 Dec	Mercury and Saturn visible

Morning Sky:

27 Feb	Mercury and Jupiter visible
	Mercury and Mars in conjunction, the planets rising during the morning twilight
28 Feb to 10 Mar	Mercury, Mars and Jupiter visible
11 Mar to 22 Apr	Mercury, Mars, Jupiter and Saturn visible
14 Mar	Mars and Saturn in conjunction
24 Mar	Mercury and Saturn in conjunction

4 Apr	Mercury and Mars in conjunction
23 Apr to 30 Apr	Mars, Jupiter and Saturn visible
1 May to 3 Jul	Mars and Saturn visible
4 Jul to 5 Aug	Mercury, Mars and Saturn visible
6 Aug to 1 Sep	Mars and Saturn visible
29 Oct to 8 Nov	Mercury and Mars visible
9 Nov to 27 Nov	Mercury, Venus and Mars visible
12 Nov	Mercury and Venus in conjunction
28 Nov to 30 Nov	Venus and Mars visible
1 Dec to 31 Dec	Venus, Mars and Jupiter visible

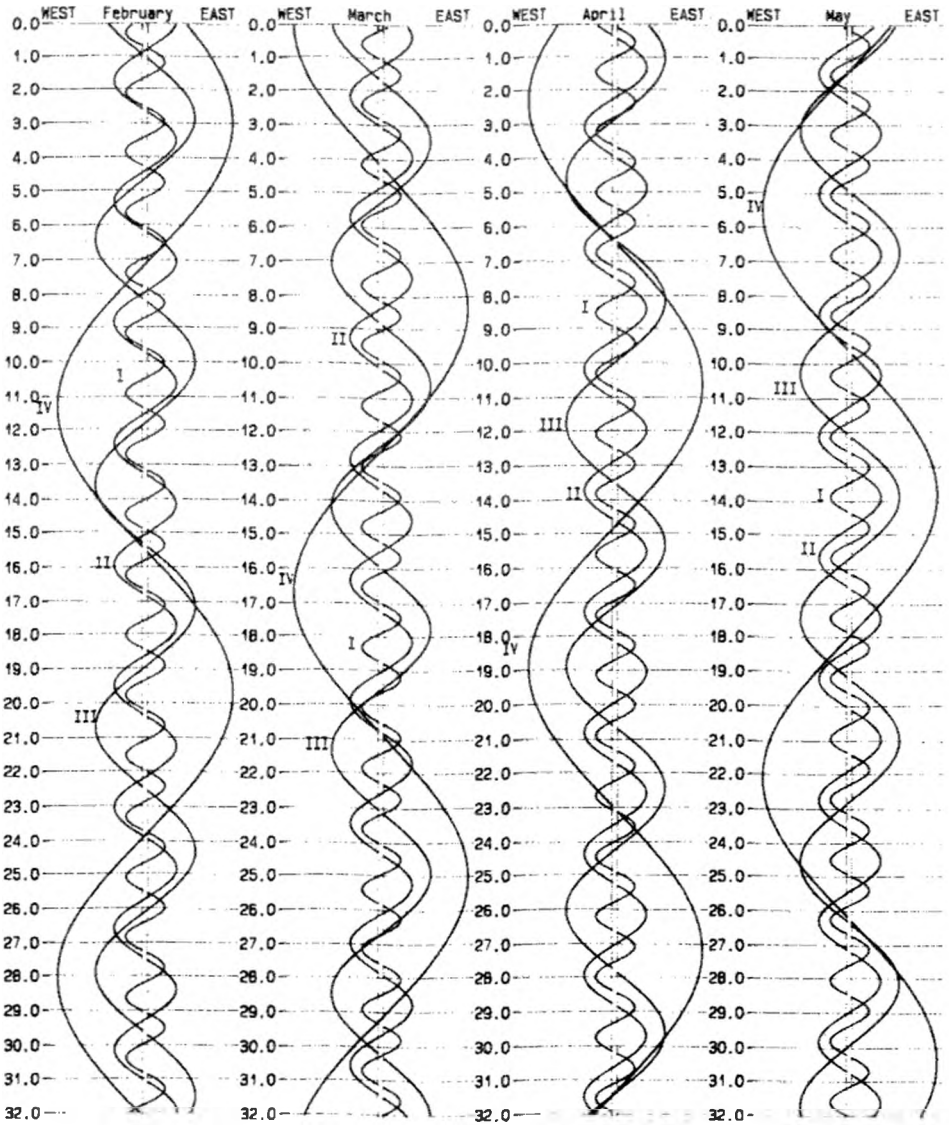
APPARENT PLACES:

	Mercury		Venus		Mars		Jupiter	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	18 38.2	-24 47	18 28.4	-23 39	18 39.7	-23 57	14 30.9	-13 40
Jan 11	19 49.2	-23 12	19 23.1	-22 48	19 13.0	-23 17	14 36.6	-14 5
Jan 21	20 59.4	-19 2	20 16.6	-20 49	19 46.1	-22 10	14 41.4	-14 26
Jan 31	22 1.5	-12 44	21 8.3	-17 47	20 18.8	-20 39	14 45.3	-14 42
Feb 10	22 33.6	-7 3	21 57.9	-13 56	20 51.0	-18 45	14 48.2	-14 53
Feb 20	22 10.0	-7 21	22 45.7	-9 26	21 22.5	-16 31	14 49.9	-14 59
Mar 2	21 38.9	-11 27	23 32.0	-4 32	21 53.4	-13 59	14 50.4	-14 59
Mar 12	21 48.0	-13 2	0 17.4	0 34	22 23.6	-11 14	14 49.6	-14 54
Mar 22	22 24.4	-11 30	1 2.8	5 41	22 53.2	-8 18	14 47.6	-14 43
Apr 1	23 14.1	-7 27	1 48.7	10 35	23 22.3	-5 15	14 44.6	-14 28
Apr 11	0 11.9	-1 20	2 35.8	15 4	23 51.0	-2 9	14 40.6	-14 9
Apr 21	1 17.9	6 27	3 24.5	18 56	0 19.4	0 59	14 36.0	-13 47
May 1	2 34.8	15 0	4 14.9	21 59	0 47.7	4 4	14 31.0	-13 24
May 11	3 59.5	22 6	5 6.9	24 1	1 16.0	7 3	14 26.1	-13 1
May 21	5 16.1	25 23	5 59.7	24 57	1 44.4	9 54	14 21.5	-12 39
May 31	6 10.5	25 9	6 52.4	24 41	2 13.0	12 34	14 17.6	-12 22
Jun 10	6 35.3	22 59	7 43.9	23 16	2 41.8	15 1	14 14.5	-12 8
Jun 20	6 28.1	20 20	8 33.5	20 48	3 10.8	17 12	14 12.5	-12 1
Jun 30	6 4.8	18 46	9 20.6	17 27	3 40.1	19 6	14 11.6	-11 59
Jul 10	5 59.3	19 22	10 5.0	13 25	4 9.5	20 41	14 11.9	-12 3
Jul 20	6 29.5	21 15	10 47.0	8 52	4 39.0	21 56	14 13.3	-12 13
Jul 30	7 34.5	21 54	11 26.8	4 2	5 8.4	22 51	14 15.8	-12 29
Aug 9	8 58.8	18 47	12 4.8	-0 56	5 37.5	23 25	14 19.3	-12 49
Aug 19	10 17.9	12 21	12 41.0	-5 51	6 6.3	23 39	14 23.8	-13 14
Aug 29	11 24.2	4 47	13 15.4	-10 33	6 34.4	23 35	14 29.1	-13 42
Sep 8	12 20.6	-2 39	13 47.4	-14 51	7 1.8	23 13	14 35.1	-14 13
Sep 18	13 9.6	-9 15	14 16.0	-18 36	7 28.2	22 36	14 41.9	-14 47
Sep 28	13 49.6	-14 25	14 38.6	-21 34	7 53.5	21 47	14 49.2	-15 21
Oct 8	14 11.4	-16 57	14 51.9	-23 28	8 17.5	20 47	14 57.0	-15 57
Oct 18	13 54.1	-14 3	14 51.7	-23 49	8 40.2	19 40	15 5.2	-16 33
Oct 28	13 20.1	-7 24	14 37.1	-22 4	9 1.4	18 30	15 13.8	-17 8
Nov 7	13 38.4	-7 50	14 16.0	-18 24	9 20.9	17 19	15 22.6	-17 43
Nov 17	14 30.1	-13 1	14 1.9	-14 31	9 38.5	16 11	15 31.6	-18 16
Nov 27	15 31.1	-18 26	14 2.4	-12 8	9 53.9	15 11	15 40.7	-18 48
Dec 7	16 36.1	-22 35	14 16.4	-11 37	10 6.6	14 22	15 49.8	-19 17
Dec 17	17 44.2	-24 53	14 40.5	-12 30	10 16.3	13 51	15 58.7	-19 44
Dec 27	18 54.5	-24 56	15 11.8	-14 13	10 22.2	13 41	16 7.4	-20 9

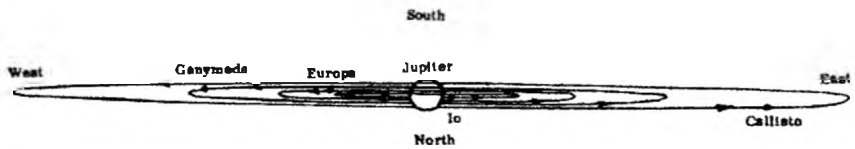
	Saturn		Uranus		Neptune		Pluto	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	21 58.9	-13 51	19 33.6	-22 9	19 28.1	-21 16	15 51.7	-6 5
Jan 11	22 2.7	-13 30	19 36.1	-22 4	19 29.7	-21 13	15 52.9	-6 6
Jan 21	22 6.9	-13 7	19 38.6	-21 58	19 31.3	-21 10	15 53.9	-6 6
Jan 31	22 11.3	-12 43	19 41.1	-21 52	19 32.9	-21 6	15 54.7	-6 5
Feb 10	22 15.9	-12 18	19 43.5	-21 47	19 34.4	-21 3	15 55.3	-6 3
Feb 20	22 20.5	-11 52	19 45.7	-21 41	19 35.8	-21 0	15 55.7	-6 0
Mar 2	22 25.1	-11 26	19 47.7	-21 37	19 37.0	-20 57	15 55.8	-5 56
Mar 12	22 29.7	-11 1	19 49.5	-21 32	19 38.1	-20 54	15 55.8	-5 52
Mar 22	22 34.1	-10 36	19 51.0	-21 28	19 39.0	-20 52	15 55.5	-5 47
Apr 1	22 38.4	-10 12	19 52.2	-21 26	19 39.7	-20 51	15 55.0	-5 42
Apr 11	22 42.3	-9 50	19 53.1	-21 24	19 40.1	-20 49	15 54.3	-5 37
Apr 21	22 46.0	-9 30	19 53.7	-21 22	19 40.3	-20 49	15 53.5	-5 32
May 1	22 49.2	-9 12	19 53.8	-21 22	19 40.3	-20 49	15 52.6	-5 28
May 11	22 52.0	-8 58	19 53.7	-21 23	19 40.1	-20 49	15 51.6	-5 24
May 21	22 54.3	-8 46	19 53.1	-21 25	19 39.6	-20 50	15 50.5	-5 21
May 31	22 56.0	-8 38	19 52.3	-21 27	19 39.0	-20 52	15 49.5	-5 19
Jun 10	22 57.2	-8 33	19 51.2	-21 30	19 38.2	-20 54	15 48.4	-5 18
Jun 20	22 57.8	-8 32	19 49.9	-21 34	19 37.2	-20 56	15 47.5	-5 18
Jun 30	22 57.7	-8 35	19 48.3	-21 38	19 36.1	-20 58	15 46.7	-5 19
Jul 10	22 57.1	-8 41	19 46.7	-21 43	19 35.0	-21 1	15 46.0	-5 21
Jul 20	22 55.8	-8 51	19 45.0	-21 47	19 33.9	-21 4	15 45.5	-5 24
Jul 30	22 54.1	-9 4	19 43.3	-21 51	19 32.8	-21 6	15 45.1	-5 28
Aug 9	22 51.8	-9 20	19 41.7	-21 55	19 31.7	-21 9	15 45.0	-5 33
Aug 19	22 49.3	-9 37	19 40.3	-21 58	19 30.7	-21 11	15 45.1	-5 39
Aug 29	22 46.5	-9 55	19 39.1	-22 1	19 29.9	-21 13	15 45.4	-5 45
Sep 8	22 43.6	-10 12	19 38.1	-22 3	19 29.3	-21 15	15 46.0	-5 53
Sep 18	22 40.9	-10 29	19 37.4	-22 5	19 28.9	-21 16	15 46.7	-6 0
Sep 28	22 38.3	-10 44	19 37.1	-22 5	19 28.6	-21 17	15 47.6	-6 8
Oct 8	22 36.2	-10 56	19 37.1	-22 5	19 28.7	-21 17	15 48.7	-6 15
Oct 18	22 34.5	-11 5	19 37.5	-22 4	19 28.9	-21 17	15 49.9	-6 23
Oct 28	22 33.3	-11 11	19 38.3	-22 2	19 29.4	-21 16	15 51.2	-6 30
Nov 7	22 32.8	-11 12	19 39.4	-21 59	19 30.1	-21 15	15 52.7	-6 37
Nov 17	22 32.9	-11 10	19 40.8	-21 56	19 31.0	-21 13	15 54.2	-6 43
Nov 27	22 33.7	-11 4	19 42.5	-21 51	19 32.1	-21 11	15 55.7	-6 49
Dec 7	22 35.2	-10 54	19 44.5	-21 46	19 33.4	-21 8	15 57.2	-6 53
Dec 17	22 37.2	-10 40	19 46.6	-21 41	19 34.8	-21 5	15 58.7	-6 57
Dec 27	22 39.8	-10 24	19 48.9	-21 35	19 36.3	-21 2	16 0.1	-7 0

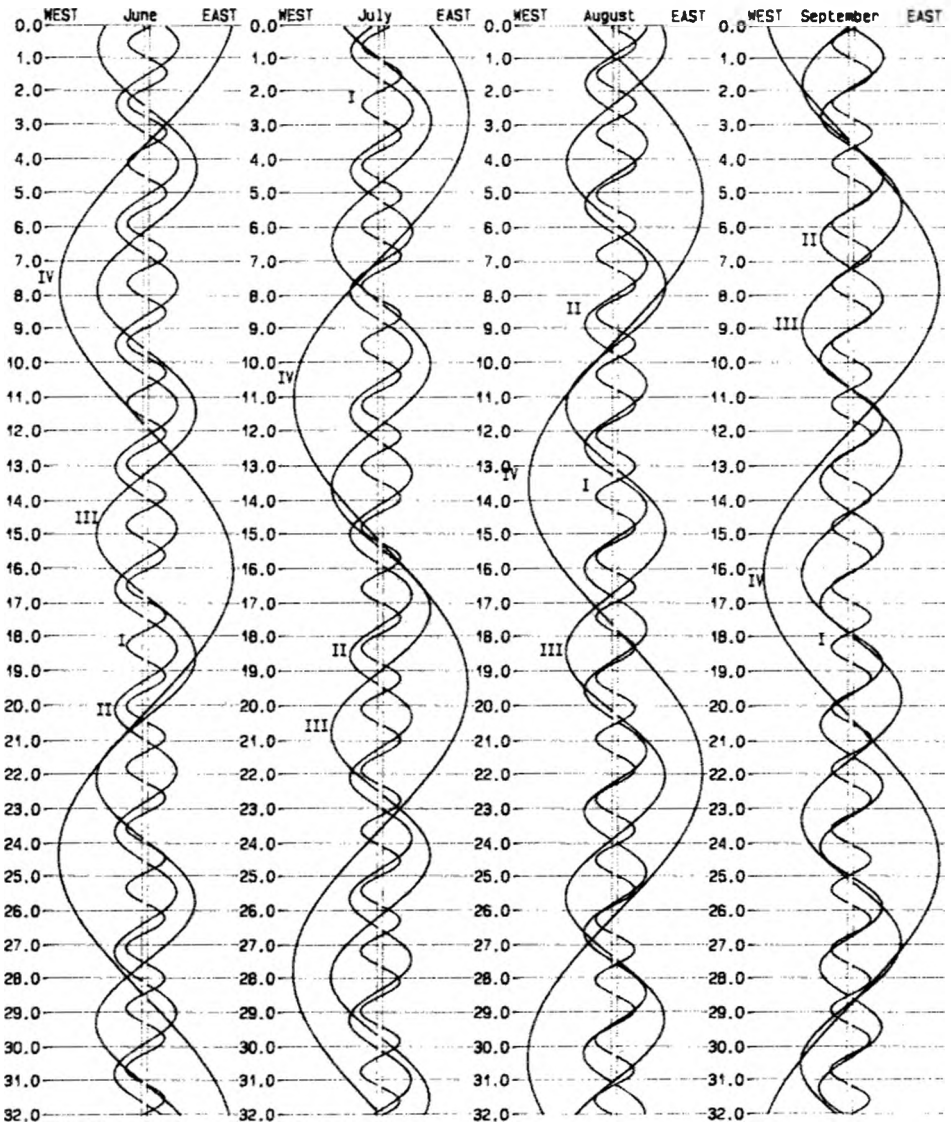
THE MOONS OF JUPITER

One of the most popular sights for an observer with a small telescope is Jupiter and its moons. Four of the sixteen - 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 on the next page 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 following diagrams which show how their positions along such a straight line change during the 8 months when Jupiter is prominent. For each month, time increases downward; the disk of Jupiter is stretched to make the central column, and horizontal lines representing midnight



(0am SAST), are shown for every day of the month. The wavy lines show how the moons appear to ossilate from each side of the planet to the other.





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 in the evening and its commencement in the morning when the planet is above the horizon in Southern Africa, are given in the table below.

EXPLANATION OF THE TABLE.

- Date and predicted times are given; these are for mid-phenomean and are not instantaneous.
- The moon concerned are I - Io, II - Europa, III - Ganymede and IV - Callisto.
- Phenomena - the abbreviations used are D - Disappearance; Ec - Eclipse ie.the satellite passes through the shadow of Jupiter; R - Reappearance; Oc - Occultation ie.the satellite is obscured by the disc of Jupiter; I - Ingress; Sh - Shadow Transit ie.the shadow of the satellite transits the disc; E - Egress; Tr - Transit ie.the satellite crosses the disc of Jupiter.

d	h	m		d	h	m		d	h	m		d	h	m	
Jan	03	02	20	III.Ec.D.	Feb	15	04	18	III.Ec.R.	Mar	16	03	03	I.Tr.E.	Apr	08	02	48	I.Tr.E.
		04	37	III.Ec.R.			20	02	33	I.Ec.D.		17	00	12	I.Oc.R.			21	16	I.Ec.D.
	05	02	19	I.Ec.D.				23	50	I.Sh.I.			02	25	II.Ec.D.			23	55	I.Oc.R.
	06	02	48	I.Tr.E.		21	01	01	I.Tr.I.				21	30	I.Tr.E.		09	04	24	II.Sh.I.
	12	03	05	II.Ec.D.				02	00	I.Sh.E.		18	22	33	II.Tr.I			20	46	I.Sh.E.
		04	12	I.Ec.D.				03	09	I.Tr.E.			23	04	II.Sh.E.			21	14	I.Tr.E.
	13	01	26	I.Sh.I.				23	49	II.Sh.I.		19	00	47	II.Tr.E.			21	51	III.Sh.E.
		02	36	I.Tr.I.		22	00	20	I.Oc.R.			22	04	33	I.Ec.D.			21	57	III.Tr.I.
		03	36	I.Sh.E.				02	08	II.Sh.E.			21	52	III.Ec.D			23	30	III.Tr.E.
	14	02	00	I.Oc.R.				02	09	II.Tr.I.		23	00	02	III.Ec.R		10	23	30	II.Ec.D.
		02	25	II.Tr.E.				04	24	II.Tr.E.			01	30	III.Oc.D.		11	02	43	II.Oc.R.
		03	01	III.Tr.E.		23	23	20	II.Oc.R.				01	52	I.Sh.I.		12	20	02	II.Sh.E.
	20	03	20	I.Sh.I.		26	00	50	III.Tr.I.				02	42	I.Tr.I.			20	48	II.Tr.E.
		04	32	I.Tr.I.			02	29	III.Tr.E.				03	05	III.Oc.R.		14	04	41	I.Ec.D.
	21	02	21	III.Sh.E.		27	04	25	I.Ec.D.				04	02	I.Sh.E.		15	02	01	I.Sh.I.
		02	42	II.Sh.E.		28	01	43	I.Sh.I.				04	50	I.Tr.E.			02	24	I.Tr.I.
		02	44	II.Tr.I.			02	51	I.Tr.I.				23	01	I.Ec.D.			04	12	I.Sh.E.
		03	54	I.Oc.R.			03	53	I.Sh.E.			24	01	58	I.Oc.R.			04	32	I.Tr.E.
	22	01	09	I.Tr.E.			04	59	I.Tr.E.				05	01	II.Ec.D.			23	09	I.Ec.D.
	28	02	26	I.Ec.D.			22	54	I.Ec.D.				21	09	I.Tr.I.		16	01	39	I.Oc.R.
		02	54	II.Sh.I.	Mar	01	02	09	I.Oc.R.				22	30	I.Sh.E.			20	30	I.Sh.I.
		04	06	III.Sh.I.			02	21	II.Sh.I.				23	17	I.Tr.E.			20	50	I.Tr.I.
	29	00	55	I.Tr.I.			04	35	II.Tr.I.			25	23	17	II.Sh.I.			22	40	I.Sh.E.
		01	51	I.Sh.E.			04	41	II.Sh.E.			26	00	52	II.Tr.I.			22	58	I.Tr.E.
		03	04	I.Tr.E.			23	27	I.Tr.E.				01	37	II.Sh.E.			23	42	III.Sh.I.
	30	02	26	II.Oc.R.		03	01	48	II.Oc.R.				03	06	II.Tr.E.		17	01	16	III.Tr.I.
Feb	01	01	12	III.Oc.R.		04	23	55	III.Sh.I.			27	22	08	II.Oc.R.			01	49	III.Sh.E.
	04	04	19	I.Ec.D.		05	02	04	III.Sh.E.			30	01	50	III.Ec.D.			02	49	III.Tr.E.
	05	01	35	I.Sh.I.			04	33	III.Tr.I.				03	46	I.Sh.I.			20	05	I.Oc.R.
		02	49	I.Tr.I.		07	03	37	I.Sh.I.				03	59	III.Ec.R.		18	02	05	II.Ec.D.
		03	44	I.Sh.E.			04	40	I.Tr.I.				04	28	I.Tr.I.			04	59	II.Oc.R.
		04	57	I.Tr.E.		08	00	47	I.Ec.D.				04	57	III.Oc.D.		19	20	15	II.Sh.I.
	06	00	10	II.Ec.D.			03	58	I.Oc.R.			31	00	54	I.Ec.D.			20	48	II.Tr.I.
		02	10	I.Oc.R.			04	54	II.Sh.I.				03	44	I.Oc.R.			22	36	II.Sh.E.
		02	33	II.Ec.R.			22	05	I.Sh.I.				22	14	I.Sh.I.			23	03	II.Tr.E.
		02	43	II.Oc.D.			23	08	I.Tr.I.				22	55	I.Tr.I.		22	03	55	I.Sh.I.
	08	00	21	III.Ec.R.		09	00	15	I.Sh.E.		Apr	01	00	24	I.Sh.E.			04	08	I.Tr.I.
		03	17	III.Oc.D.			01	16	I.Tr.E.				01	03	I.Tr.E.		23	01	03	I.Ec.D.
	12	03	28	I.Sh.I.			22	25	I.Oc.R.				22	10	I.Oc.R.			03	23	I.Oc.R.
	13	00	40	I.Ec.D.			23	50	II.Ec.D.			02	01	50	II.Sh.I.			22	24	I.Sh.I.
		02	46	II.Ec.D.		10	04	13	II.Oc.R.				03	10	II.Tr.I.			22	34	I.Tr.I.
		04	01	I.Oc.R.		11	22	26	II.Tr.E.				04	11	II.Sh.E.		24	00	34	I.Sh.E.
	14	00	06	I.Sh.E.		12	03	52	III.Sh.I.			03	20	54	II.Ec.D.			00	42	I.Tr.E.
		01	18	I.Tr.E.		15	02	40	I.Ec.D.			04	00	26	II.Oc.R.			03	41	III.Sh.I.
		23	36	II.Sh.E.			22	00	III.Oc.D.			07	02	48	I.Ec.D.			04	32	III.Tr.I.
		23	40	II.Tr.I.			23	36	III.Oc.R.			08	00	08	I.Sh.I.			19	32	I.Ec.D.
	15	01	56	II.Tr.E.			23	59	I.Sh.I.				00	40	I.Tr.I.			21	49	I.Oc.R.
		02	05	III.Ec.D.		16	00	55	I.Tr.I.				02	18	I.Sh.E.		25	04	40	II.Ec.D.

	d	h	m	
Apr	25	19	02	I.Sh.E.
		19	08	I.Tr.E.
	26	22	50	II.Sh.I.
		23	03	II.Tr.I.
	27	01	11	II.Sh.E.
		01	18	II.Tr.E.
		19	50	III.Oc.R.
	28	20	21	II.Oc.R.
	30	02	57	I.Ec.D.
		05	07	I.Ec.R.
May	01	00	18	I.Tr.I.
		00	18	I.Sh.I.
		02	26	I.Tr.E.
		02	28	I.Sh.E.
		21	24	I.Oc.D.
		23	36	I.Ec.R.
	02	18	44	I.Tr.I.
		18	48	I.Sh.I.
		20	52	I.Tr.E.
		20	56	I.Sh.E.
	04	01	17	II.Tr.I.
		01	24	II.Sh.I.
		03	32	II.Tr.E.
		03	46	II.Sh.E.
		21	26	III.Oc.D.
		23	47	III.Ec.R.
	05	20	20	II.Oc.D.
		22	55	II.Ec.R.
	07	04	42	I.Oc.D.
	08	02	02	I.Tr.I.
		02	12	I.Sh.I.
		04	10	I.Tr.E.
		04	22	I.Sh.E.
		23	08	I.Oc.D.
	09	01	30	I.Ec.R.
		20	28	I.Tr.I.
		20	41	I.Sh.I.
		22	36	I.Tr.E.
		22	51	I.Sh.E.
	10	19	58	I.Ec.R.
	11	03	31	II.Tr.I.
		03	59	II.Sh.I.
	12	00	41	III.Oc.D.
		03	45	III.Ec.R.
		22	35	II.Oc.D.
	13	01	31	II.Ec.R.
	14	18	55	II.Tr.E.
		19	39	II.Sh.E.
	15	03	46	I.Tr.I.
		04	06	I.Sh.I.
	16	00	52	I.Oc.D.
		03	24	I.Ec.R.
		22	12	I.Tr.I.
		22	35	I.Sh.I.
	17	00	21	I.Tr.E.
		00	45	I.Sh.E.
		19	18	I.Oc.D.
		21	53	I.Ec.R.
	18	18	47	I.Tr.E.
		19	13	I.Sh.E.
	19	03	58	III.Oc.D.
	20	00	51	II.Oc.D.
		04	06	II.Ec.R.

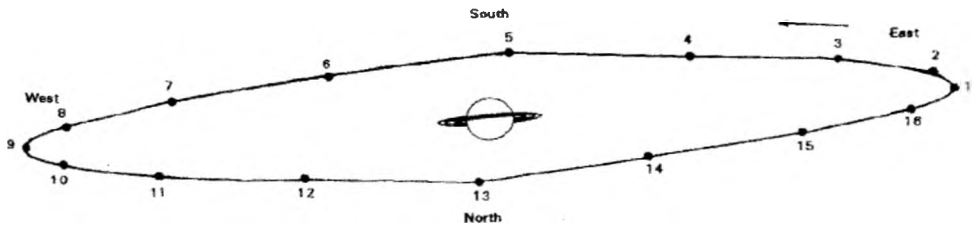
	d	h	m	
May	21	18	55	II.Tr.I.
		19	53	II.Sh.I.
		21	12	II.Tr.E.
		22	14	II.Sh.E.
	22	19	25	III.Tr.E.
		19	34	III.Sh.I.
		21	38	III.Sh.E.
	23	02	37	I.Oc.D.
		23	57	I.Tr.I.
	24	00	29	I.Sh.I.
		02	06	I.Tr.E.
		02	39	I.Sh.E.
		21	03	I.Oc.D.
		23	47	I.Ec.R.
	25	18	23	I.Tr.I.
		18	58	I.Sh.I.
		20	32	I.Tr.E.
		21	07	I.Sh.E.
	26	18	16	I.Ec.R.
	27	03	08	II.Oc.D.
	28	21	12	II.Tr.I.
		22	29	II.Sh.I.
		23	30	II.Tr.E.
	29	00	50	II.Sh.E.
		20	56	III.Tr.I.
		22	50	III.Tr.E.
		23	34	III.Sh.I.
	30	01	37	III.Sh.E.
		19	59	II.Ec.R.
	31	01	43	I.Tr.I.
		02	24	I.Sh.I.
		03	52	I.Tr.E.
		22	49	I.Oc.D.
Jun	01	01	42	I.Ec.R.
		20	09	I.Tr.I.
		20	52	I.Sh.I.
		22	18	I.Tr.E.
		23	02	I.Sh.E.
	02	20	10	I.Ec.R.
	04	23	31	II.Tr.I.
	05	01	05	II.Sh.I.
		01	50	II.Tr.E.
		03	26	II.Sh.E.
	06	00	20	III.Tr.I.
		02	18	III.Tr.E.
		03	32	III.Sh.I.
		18	36	II.Oc.D.
		22	34	II.Ec.R.
	07	03	30	I.Tr.I.
	08	00	36	I.Oc.D.
		21	56	I.Tr.I.
		22	47	I.Sh.I.
	09	00	05	I.Tr.E.
		00	56	I.Sh.E
		19	03	I.Oc.D.
		19	38	III.Ec.R.
		22	05	I.Ec.R.
	10	18	32	I.Tr.E.
		19	25	I.Sh.E.
	12	01	52	II.Tr.I.
	13	20	57	II.Oc.D.
	14	01	09	II.Ec.R.
	15	02	24	I.Oc.D.

	d	h	m	
Jun	15	19	20	II.Sh.E.
		23	44	I.Tr.I.
	16	00	41	I.Sh.I.
		01	53	I.Tr.E.
		02	50	I.Sh.E.
		19	40	III.Oc.R.
		20	51	I.Oc.D.
		21	32	III.Ec.D.
		23	37	III.Ec.R.
	17	00	00	I.Ec.R.
		19	10	I.Sh.I.
		20	20	I.Tr.E.
		21	19	I.Sh.E.
	18	18	29	I.Ec.R.
	20	23	19	II.Oc.D.
	22	19	35	II.Sh.I.
		19	48	II.Tr.E.
		21	57	II.Sh.E.
	23	01	33	I.Tr.I.
		21	10	III.Oc.D.
		22	40	I.Oc.D.
		23	18	III.Oc.R.
	24	01	32	III.Ec.D.
		01	55	I.Ec.R.
		20	01	I.Tr.I.
		21	05	I.Sh.I.
		22	10	I.Tr.E.
		23	14	I.Sh.E.
	25	20	24	I.Ec.R.
	28	01	44	II.Oc.D.
	29	19	55	II.Tr.I.
		22	12	II.Sh.I.
		22	16	II.Tr.E.
	30	00	34	II.Sh.E.
Jul	01	00	30	I.Oc.D.
		00	49	III.Oc.D.
		19	37	II.Ec.R.
		21	51	I.Tr.I.
		22	59	I.Sh.I.
	02	00	00	I.Tr.E.
		01	08	I.Sh.E.
		18	58	I.Oc.D.
		22	19	I.Ec.R.
	03	18	28	I.Tr.E.
		19	37	I.Sh.E.
	04	19	28	III.Sh.I.
		21	29	III.Sh.E.
	06	22	24	II.Tr.I.
	07	00	46	II.Tr.E.
		00	49	II.Sh.I.
	08	19	50	II.Ec.D.
		22	12	II.Ec.R.
		23	43	I.Tr.I.
	09	00	54	I.Sh.I.
		20	50	I.Oc.D.
	10	00	14	I.Ec.R.
		20	20	I.Tr.E.
		21	31	I.Sh.E.
	11	20	36	III.Tr.E.
		23	27	III.Sh.I.
	14	00	55	II.Tr.I.
	15	19	56	II.Oc.D.
		22	19	II.Oc.R.

	d	h	m	
Jul	15	22	25	II.Ec.D.
		16	00	47	II.Ec.R.
			22	43	I.Oc.D.
	17	20	03	I.Tr.I.
			21	18	I.Sh.I.
			22	12	I.Tr.E.
			23	26	I.Sh.E.
	18	20	38	I.Ec.R.
			22	14	III.Tr.I.
	19	00	29	III.Tr.E.
	22	22	28	II.Oc.D.
	24	21	44	II.Sh.E.
			21	57	I.Tr.I.
			23	12	I.Sh.I.
	25	00	06	I.Tr.E.
			22	33	I.Ec.R.
	29	21	28	III.Ec.D.
			23	31	III.Ec.R.
	31	21	48	II.Tr.E.
			22	00	II.Sh.I.
			23	52	I.Tr.I.
Aug	01	21	01	I.Oc.D.
	02	20	30	I.Tr.E.
			21	44	I.Sh.E.
	05	20	11	III.Oc.D.
			22	31	III.Oc.R.
	07	22	03	II.Tr.I.
	08	22	57	I.Oc.D.
	09	20	16	I.Tr.I.
			21	30	I.Sh.I.
			21	49	II.Ec.R.
			22	25	I.Tr.E.
	10	20	53	I.Ec.R.
	16	21	22	III.Sh.E.
			22	00	II.Oc.R.
			22	01	II.Ec.D.
			22	13	I.Tr.I.
	17	22	48	I.Ec.R.
	18	20	02	I.Sh.E.
	23	20	45	III.Tr.E.
			22	15	II.Oc.D
	24	21	21	I.Oc.D.
	25	20	49	I.Tr.E.
			21	34	II.Sh.E.
			21	57	I.Sh.E.
Sep	01	20	37	I.Tr.I.
			21	43	I.Sh.I.
			21	49	II.Sh.I.
			21	58	II.Tr.E.
	02	21	07	I.Ec.R.
	10	20	14	I.Sh.E.
			21	24	III.Ec.D.
			21	25	II.Ec.R.
	17	20	00	I.Sh.I.
			21	14	I.Tr.E.
Oct	02	20	21	I.Oc.D.
	03	20	07	II.Tr.I.
			20	27	I.Sh.E.
	05	20	16	III.Tr.I.
Dec	24	04	08	I.Sh.I.
	25	04	16	I.Oc.R.
	31	03	51	III.Tr.E.

THE MOONS OF SATURN

Saturn's moons are considerably fainter than the 4 Galilean moons of Jupiter. The easiest to find is Titan (magnitude +8.5), according to the diagram which shows its orbit at opposition on September 1, and information in the table below.



TITAN

Eastern Elongation			Inferior Conjunction			Western Elongation			Superior Conjunction		
	d	h		d	h		d	h		d	h
Jan	4	13.8	Jan	8	17.3	Jan	12	20.9	Jan	16	17.4
	20	14.1		24	17.8		28	21.3	Feb	1	17.8
Feb	5	14.6	Feb	9	18.4	Feb	13	21.8		17	18.2
	21	15.2		25	19.1	Mar	1	22.4	Mar	5	18.7
Mar	9	15.7	Mar	13	19.7		17	22.9		21	19.1
	25	16.2		29	20.3	Apr	2	23.3	Apr	6	19.3
Apr	10	16.5	Apr	14	20.6		18	23.5		22	19.4
	26	16.6		30	20.7	May	4	23.4	May	8	19.2
May	12	16.5	May	16	20.5		20	23.0		24	18.8
	28	16.0	Jun	1	19.9	Jun	5	22.3	Jun	9	17.9
Jun	13	15.1		17	19.0		21	21.2		25	16.8
	29	13.8	Jul	3	17.6	Jul	7	19.7	Jul	11	15.2
Jul	15	12.1		19	15.8		23	17.9		27	13.3
	31	10.1	Aug	4	13.7	Aug	8	15.8	Aug	12	11.2
Aug	16	07.8		20	11.3		24	13.4		28	08.8
Sep	1	05.4	Sep	5	08.8	Sep	9	11.0	Sep	13	06.4
	17	02.9		21	06.4		25	08.6		29	04.2
Oct	3	00.7	Oct	7	04.1	Oct	11	06.5	Oct	15	02.1
	18	22.7		23	02.1		27	04.7		31	00.4
Nov	3	21.0	Nov	8	00.6	Nov	12	03.3	Nov	15	23.1
	19	19.8		23	23.4		28	02.2	Dec	1	22.1
Dec	5	19.0	Dec	9	22.8	Dec	14	01.6		17	21.6
	21	18.6		25	22.5		30	01.4			

COMETS AND METEORS

COMETS

Located at the outer extremes of the solar system is a cloud of material, probably left over from the formation of the solar system itself. This cloud, known as the Oort Cloud, is believed to be the reservoir from which the comets emanate. At such vast distances from the sun this material, consisting of gases and dust, is preserved in the same state as when the sun and planets were formed, and thus a study of comets is important to understanding the birth of the solar system.

Every now and then, part of the material may break away from the cloud, and under the influence of gravity, accelerates towards the sun as a comet. These comets, travelling in parabolic orbits, are known as long period comets and by definition have orbital periods greater than 200 years, though the actual periods are generally a few thousand years or more. Occasionally the orbits of comets travelling in the same plane as the planets may be perturbed by the gravitational effects of the major planets, mainly Jupiter, into elliptical orbits. These comets have shorter periods, by definition less than 200 years, and since their orbits are known fairly precisely, their returns can be predicted with some degree of accuracy. The table below lists those periodic comets predicted to appear during 1994, and which are predicted to become brighter than magnitude 12. The table does not of course include any new comets which might possibly be discovered during the year.

COMET	PERIHELION DATE	PREDICTED MAGNITUDE AT PERIHELION
West Kohoutek Ikemura	1993 December 25	11.9
Mueller 1993a	1994 January 12	9.6
Schwassmann Wachmann 2	1994 January 23	10.9
Encke	1994 February 9	6.7
Tempel 2	1994 March 16	11.1
Tuttle	1994 June 25	9.4
Tempel 1	1994 July 3	8.9
Borrelly	1994 November 1	7.0

In the cold depths of space, comets are no more than chunks of frozen gases, ices and dust. However, in the vicinity of the sun the constituents of the nucleus vaporise, and the gases and dust form a coma around the nucleus. Under the influence of the solar wind the gas and dust in the coma is swept away to form the tail, such that the tail always points away from the sun.

The Director of the Comet and Meteor Section welcomes all observations of comets, but to be of scientific value the observer should concentrate on the following:

- Estimates of the total visual magnitude of the comet, preferably made over the entire apparition to allow construction of a light curve
- Estimates of the diameter of the coma
- Estimates of the degree of condensation of the comet
- Estimates of the length and position angle of the tail
- Detailed visual descriptions and sketches of the comet
- Photographs of the comet

In making the above observations it is essential that the observer uses the standard procedures developed and used by observers world-wide. Detailed notes on observing techniques and visibility of comets may be obtained from the Director at the address overpage

METEORS

The name given to particles travelling through space is *meteoroids*. Several thousand tonnes of these particles, mostly smaller than grains of sand, enter the earths atmosphere every day. When a particle enters the atmosphere, it heats up due to the effects of friction and may become visible before burning up. The resultant streak of light is known as a *meteor*. Those which become equal or brighter than Venus are termed *fireballs*. In general, meteors appear in the upper atmosphere, at an altitude of between 80-120 km and disappear at between 60-80 km. Heavier and slower fireballs may descend below this, and bodies which reach the earths surface are called *meteorites*.

Most meteors entering the atmosphere are *sporadic*, particles travelling through space in isolation. However, several meteor *showers*, streams of particles which are left behind by comets in their passage around the sun, may be observed throughout the year. The table below lists the showers requiring observation.

SHOWER	MAX DATE	SHOWER DURATION	RADIANT RA 1950.0	RADIANT DEC °	ZHR	VEL km/s	REC.WATCH BEGIN SAST	REC.WATCH END SAST	OBSERVING CONDITIONS 1994
α Crucids	Jan19	Jan06-Jan28	12h48	-63	<5	50	00h00	03h30	Good
θ Centaurids	Feb 8	Jan26-Feb23	14h00	-40	5	60	22h00	03h30	Favourable
Pyxids	Mar 6	Mar03-Mar09	09h00	-35	<5		20h00	03h30	Good
γ Normids	Mar 14	Feb25-Mar22	16h20	-49	5		00h00	04h30	Favourable
δ Pavonids	Apr 6	Mar11-Apr16	20h20	-63	5		02h00	04h30	Good
April Lyrids	Apr 22	Apr16-Apr24	18h05	+34	15	49	03h00	05h00	Unfavourable
σ Puppids	Apr 23	Apr16-Apr25	07h20	-45	<5		19h00	22h00	Unfavourable
α Scorpiids	May 3	Apr11-May12	16h00	-22	5	35	21h00	01h00	Good
η Aquarids	May 4	Apr21-May12	22h24	-02	30	65	04h00	05h30	Poor
χ Scorpiids	Jun 5	May27-Jun20	16h28	-13	5	21	19h00	04h30	Favourable
Sagittarids	Jun 11	Jun08-Jun16	20h16	-35	<5	52	22h00	05h30	Favourable
θ Ophiuchids	Jun 13	Jun08-Jun16	17h48	-28	5	27	20h00	05h30	Favourable
June Lyrids	Jun 16	Jun11-Jun21	18h32	+35	9	31	23h30	02h00	Good
Ophiuchids	Jun 20	Jun17-Jun26	17h20	-20	10		19h00	04h00	Unfavourable
Cetids	Jun 28	Jun26-Jun29	02h00	-15	<5		03h00	05h30	Unfavourable
Capricornids	Jul 26	Jul10-Aug05	21h00	-15	8		20h30	05h30	Unfavourable
Piscis Australids	Jul 28	Jul19-Aug17	22h40	-30	8	35	21h30	05h00	Poor
South δ Aquarids	Jul 29	Jul21-Aug29	22h12	-16	30	42	22h00	05h00	Poor
α Capricornids	Jul 30	Jul15-Aug25	20h36	-10	10	25	20h00	04h00	Poor
South ι Aquarids	Aug 5	Jul15-Aug25	22h20	-15	<5	34	22h00	04h30	Favourable
North δ Aquarids	Aug 12	Jul14-Aug25	22h36	-05	10	42	23h00	04h30	Favourable
Perseids	Aug 12	Jul23-Aug23	03h04	+57	60	60	02h00	05h00	Favourable
North ι Aquarids	Aug 20	Jul15-Sep20	21h48	-06	10	36	20h00	04h00	Full moon
Orionids	Oct 21	Oct02-Nov07	06h24	+16	30	68	02h00	04h00	Full moon
Southern Taurids	Nov 3	Sep15-Dec01	03h22	+14	10	29	21h30	03h30	New moon
Northern Taurids	Nov 13	Sep19-Dec01	03h53	+22	5	31	23h00	02h00	Poor
Leonids	Nov 17	Nov14-Nov20	10h08	+22	5	70	03h00	03h30	Full moon
Dec. Phoenicids	Dec 5	Dec03-Dec05	01h00	-55	5	22	20h30	01h00	Favourable
Geminids	Dec 14	Dec04-Dec16	07h28	+32	50	36	23h30	03h00	Poor
Velids	Dec 29	Dec05-Jan07	09h56	-51	5	40	22h30	03h30	Favourable

Details on how to observe meteors are available from the Director of the Comet and Meteor Section, T P Cooper, 56 Tenth Avenue, Northmead 1501, BENONI. Tel. 011-849-8375.

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 patterns, 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 α (Alpha), the next β (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 AND STELLAR DISTANCES

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.

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 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).

THE STAR CHARTS

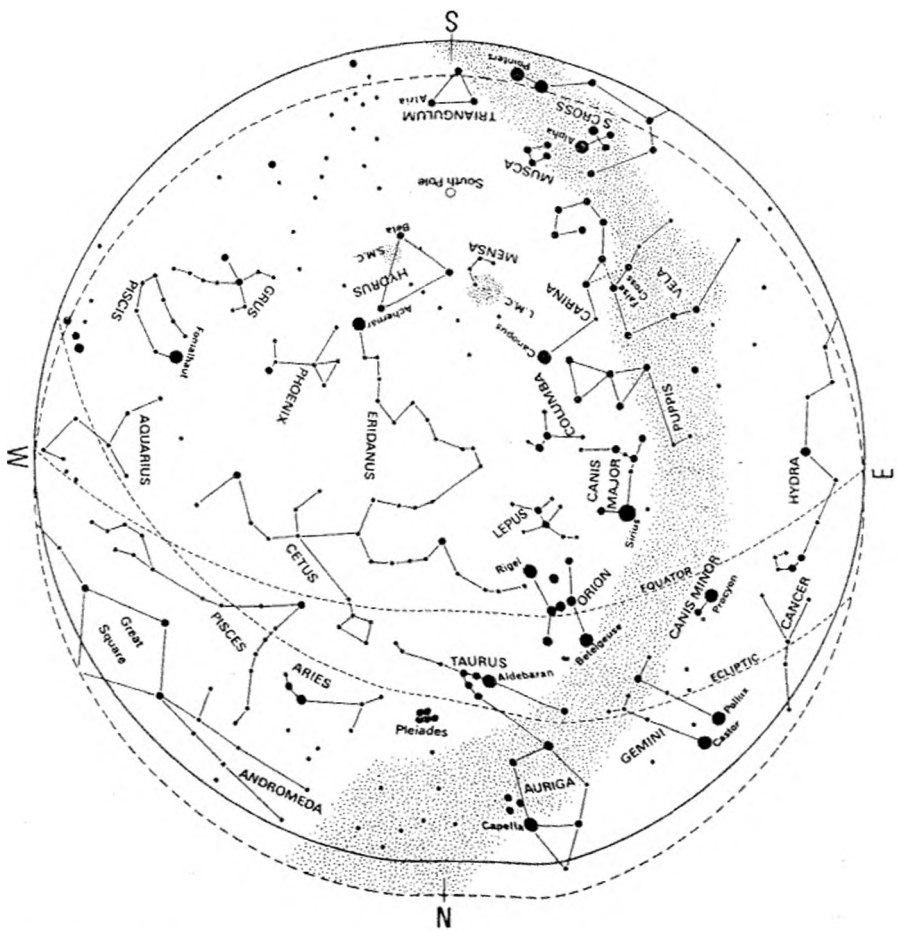
The star charts in this section show the night sky for each of the four seasons of the year. These seasonal charts depict stars down to magnitude 3.5 which is approximately what will be visible to the naked eye in city areas. Charts of 3 of the most interesting regions in the sky (showing stars down to magnitude 4.5) - the Orion region, visible in Summer; the Scorpius region, visible in Winter and the Southern Cross Region, visible all year round - are featured. They are rich in interesting objects visible to the naked eye, or with the aid of binoculars or a small telescope. To use them locate the constellations in the sky from the seasonal chart and rotate the regional chart to match the orientation of the constellations in the sky.

THE SUMMER SKY

The chart below represents the sky in Cape Town on December 1 at midnight, January 1 at 10 pm and February 1 at 8 pm. Corrections for places other than Cape Town are

Bloemfontein and Port Elisabeth	-30 minutes
Johannesburg	-40 minutes
Durban	-50 minutes
Harare	-52 minutes

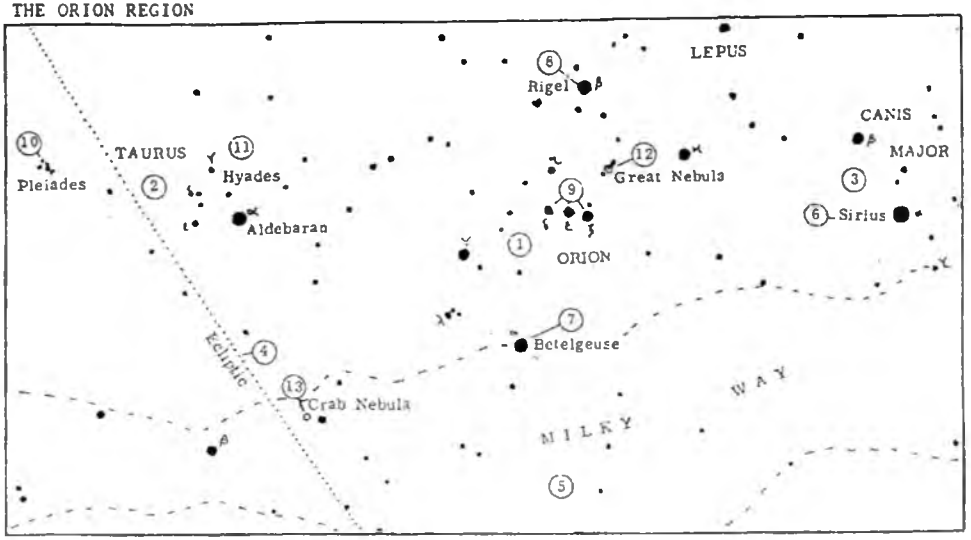
Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



Courtesy of the

PLANETARIUM  SA MUSEUM

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.

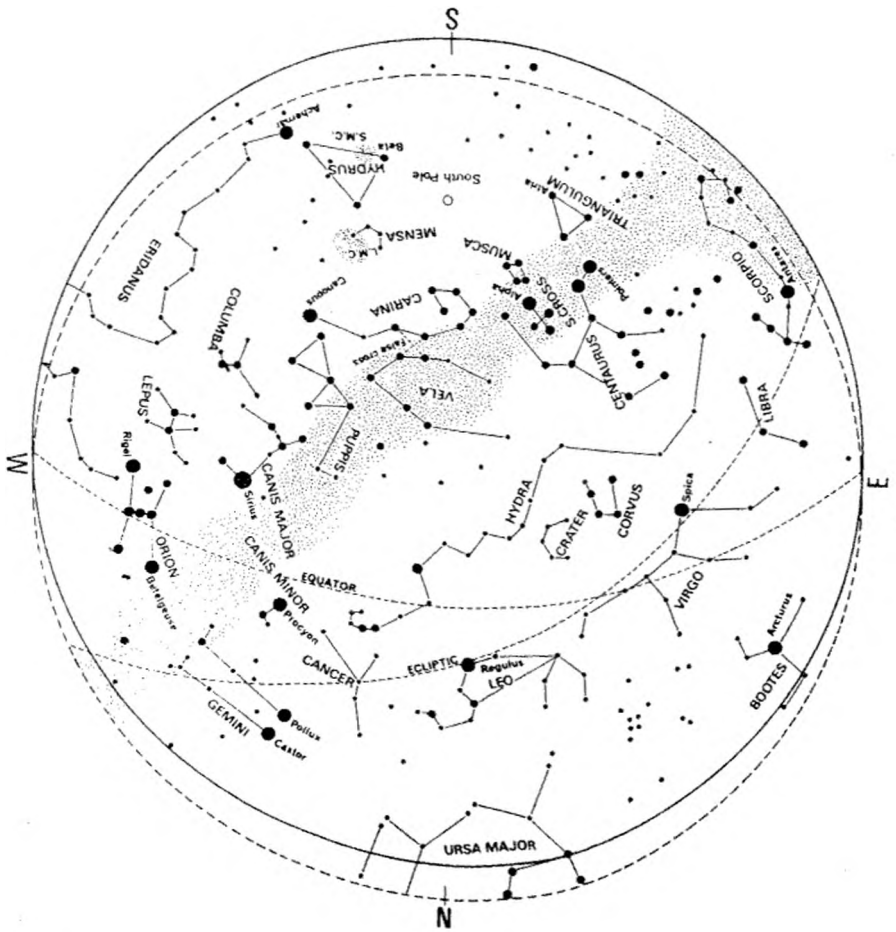
(13) The Crab Nebula, the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraodinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly rotating neutron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

THE AUTUMN SKY

The chart below represents the sky in Cape Town on March 1 at midnight, April 1 at 10 pm and May 1 at 8 pm. Corrections for places other than Cape Town are

Bloemfontein and Port Elisabeth	-30 minutes
Johannesburg	-40 minutes
Durban	-50 minutes
Harare	-52 minutes

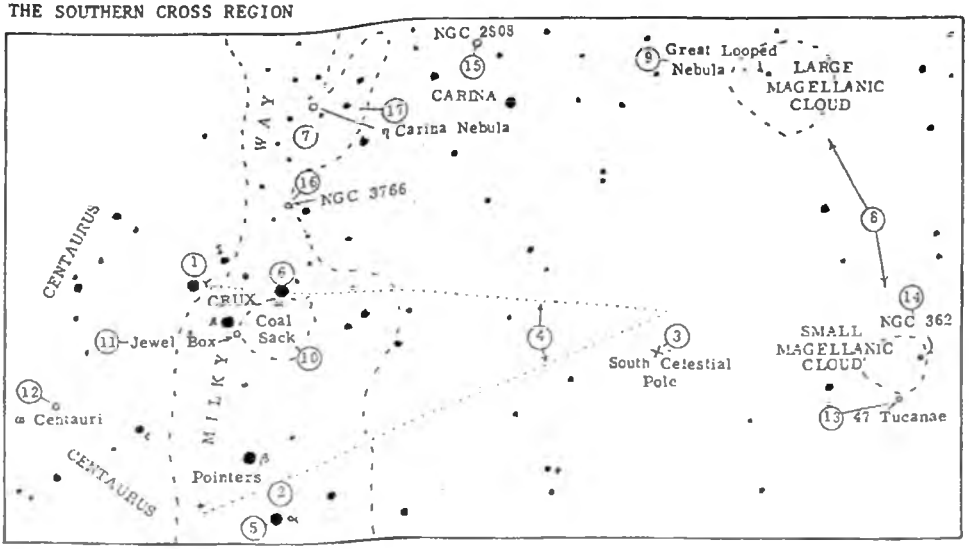
Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



Courtesy of the

PLANETARIUM SA MUSEUM

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).

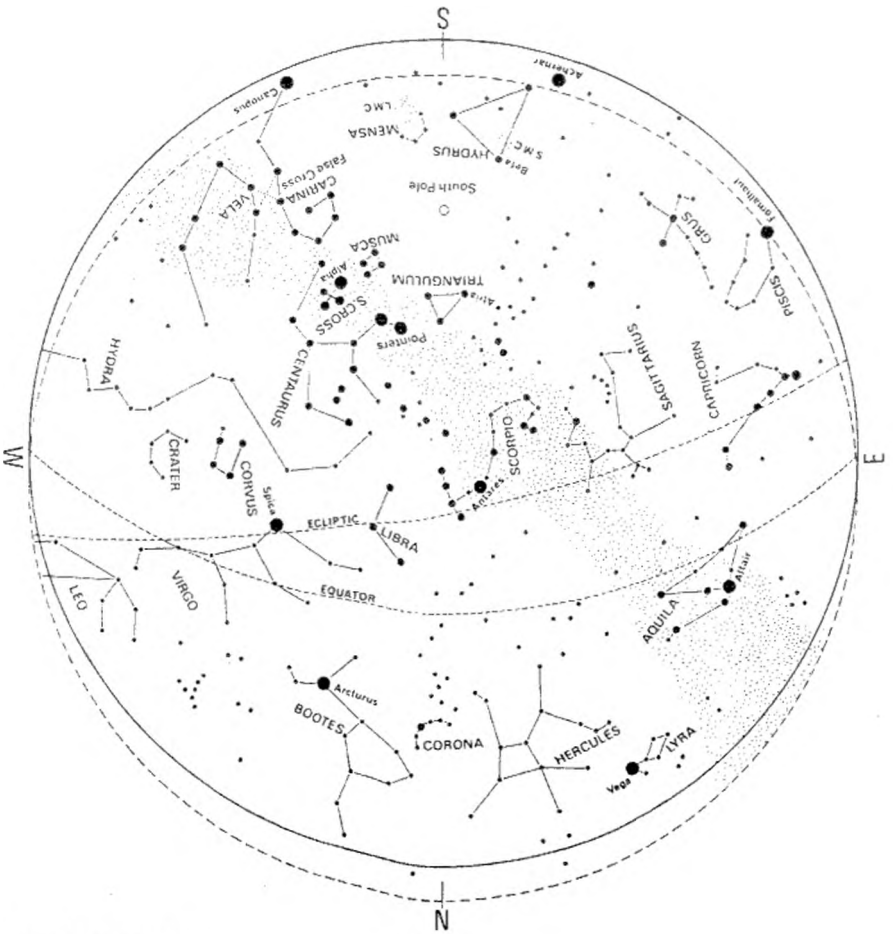
(17) The η Carinae nebula - site of a slow supernova that brightened to magnitude -0,8 in 1843 and is now of magnitude 6,4.

THE WINTER SKY

The chart below represents the sky in Cape Town on June 1 at midnight, July 1 at 10 pm and August 1 at 8 pm. Corrections for places other than Cape Town are

Bloemfontein and Port Elisabeth	-30 minutes
Johannesburg	-40 minutes
Durban	-50 minutes
Harare	-52 minutes

Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



Courtesy of the

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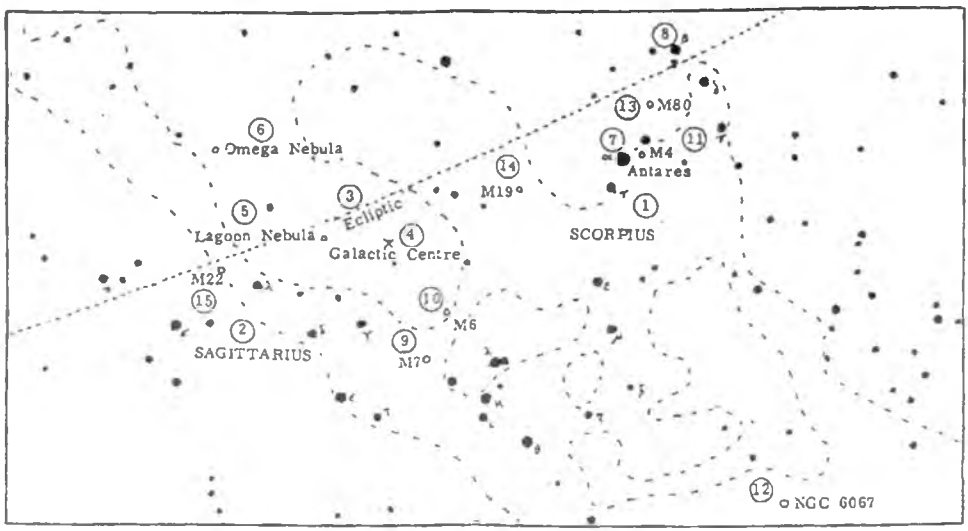
THE SCORPIUS REGION



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

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

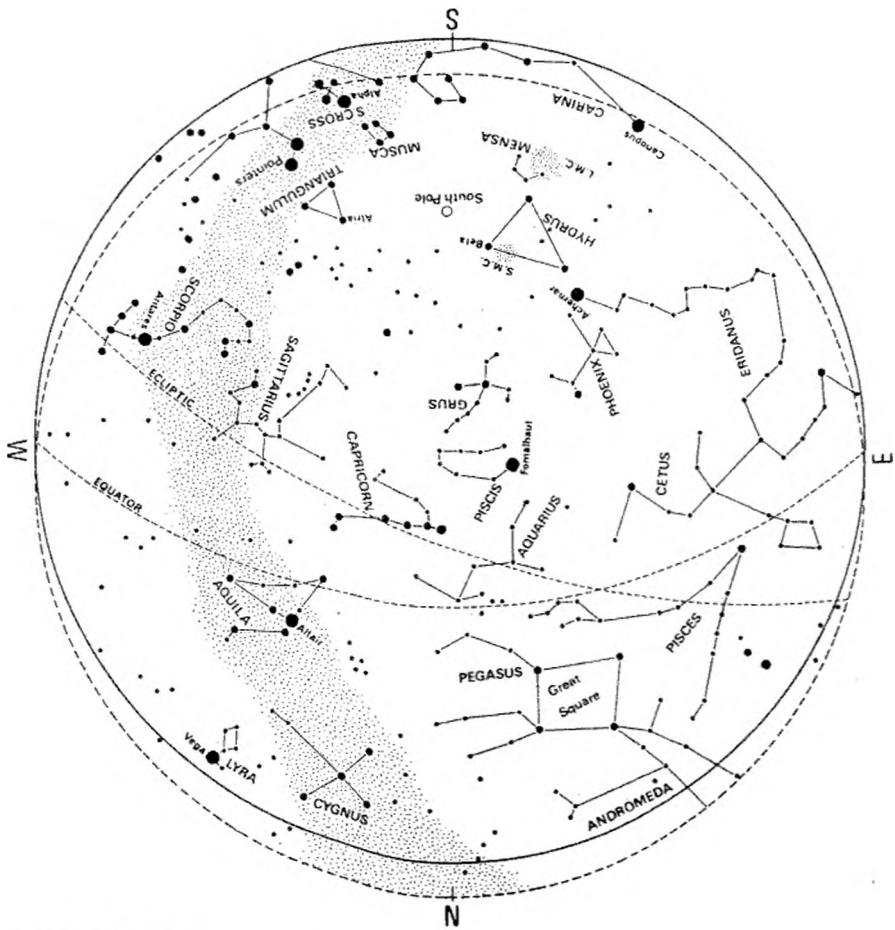
Further from the plane of the Milky Way are some globular clusters: (13) M80 (14) M19 and (15) M22.

THE SPRING SKY

The chart below represents the sky in Cape Town on September 1 at midnight, October 1 at 10 pm and November 1 at 8 pm. Corrections for places other than Cape Town are

Bloemfontein and Port Elisabeth	-30 minutes
Johannesburg	-40 minutes
Durban	-50 minutes
Harare	-52 minutes

Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



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VARIABLE STAR OBSERVING

The latest (1985) edition of the "General Catalogue of Variable Stars" lists more than 28 000 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 these 28 000 stars at least 2 000 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 less than 400 variables are at present being observed from Southern Africa.

The Variable Star Section of the A.S.S.A. exists for the purpose of encouraging observers and of acting as a medium 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.

In recent years amateur observers have played an invaluable part by alerting the operators of orbiting satellite observatories whenever outburst occurred of certain eruptive variables.

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) 31736.

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 071044 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 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:

			Approximate 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.

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.

DEEP SKY SECTION

The Deep-Sky Observing Section is dedicated to observing objects outside our solar system: clusters, nebulae and galaxies. New members receive a brief observing guide explaining some of the basics of deep-sky observing.

In order to promote visual observing, the Section offer a Bennett Certificate to those who observe the comet-like objects listed by the late Jack Bennett, past director of the Comet and Meteor Section. These and other observations will contribute to the long-term goal of the Section, namely the production of a handbook of southern deep-sky objects.

ASSA members who would like more information or who would like to join the Section are encouraged to write to the Director :

Mr Auke Slotegraaf, PO Box 608, Stellenbosch, 7599. (Tel. 021-887-887-8)

TOTAL LUNAR OCCULTATIONS

These phenomena concern a specialised branch of observational astronony 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. M.D. Overbeek, P.O. Box 212, Edenvale, 1610 Tel: (011) 453 6918

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 E	33°.933 S
Johannesburg	28°.075 E	26°.182 S
Harare	31°.000 E	17°.800 S

This does not restrict its use to observers in those centres. The approximate time of an occultation at a place $\Delta\lambda$ degrees west and $\Delta\varphi$ degrees north of one of the standard stations given above may be found from:

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

where a and b, in minutes of time, are given in the tables. Alternatively, rough times for intermediate stations can usually be estimated directly 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 ordinary occultations are given in U.T.

EXPLANATIONS OF ABBREVIATIONS USED IN THE 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 UT
a,b	-	parameters in minutes for predicting times other than at standard stations (as explained above in the text)
P.A.	-	The Position Angle on the Moon's limb measured eastward from the north point

TIME IN UT					CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
DATE M D	I.C.	Mag.	Ph	ELG °	TIME h m	a. m	b. m	P.A. °	TIME h m	a. m	b. m	P.A. °	TIME h m	a. m	b. m	P.A. °
Jan 0	1381	6.3	RD	218	23 57.3	-0.7	-3.6	354								
Jan 5	1853	4.9	RD	272	2 46.5			230								
Jan 8	2241	5.0	RD	310					0 39.2	-0.2	-0.2	248	0 35.5	+0.0	-0.7	277
Jan 20	371	6.4	DD	100	19 34.2	-1.9	+2.9	30								
Jan 21	489	7.2	DD	112	21 26.1	-1.1	+0.1	121	21 40.1	-1.0	+0.9	91	21 53.3	-1.1	+1.6	63
Jan 22	631	5.6	DD	124	22 39.6	-1.1	+1.0	93	23 1.1	-1.1	+2.0	59				
Feb 1	1815	4.8	RD	240	2 9.0	-3.0	+0.7	253	2 31.4	-2.2	-1.0	297	2 22.6	-1.6	-2.6	329
Feb 15	197	7.0	DD	57									17 7.2			353
Feb 20	843	7.2	DD	112					17 31.1	-3.0	+2.9	38				
Feb 20	851	6.3	DD	113	19 0.1	-2.4	-0.2	106	19 26.0	-2.6	+0.9	80	19 50.0	-3.6	+3.4	46
Feb 23	1158	5.2	DD	140	0 32.7	-0.5	+0.4	111								
Feb 28	1888	6.2	RD	220					21 56.2	-2.2	-0.0	253	21 56.7	-1.7	-1.1	285
Mar 3	2302	2.9	RD	260					21 19.2	+0.0	-0.7	265				
Mar 6	2629	6.3	RD	287	0 49.0	+0.6	-3.6	330								
Mar 6	2639	6.0	RD	288					3 12.0	-2.3	+1.0	238				
Mar 7	2787	6.4	RD	299									0 49.7	-0.7	+0.6	237
Mar 16	402	6.5	DD	48					17 44.2	-1.3	+2.7	42				
Mar 18	651	5.9	DD	70					16 54.1	-1.8	-1.1	131	16 55.8	-2.2	-0.0	102
Mar 20	935	6.9	DD	93	17 46.8	-2.0	-1.0	130	18 4.3	-2.3	+0.2	101	18 17.8	-2.9	+1.4	71
Mar 22	1198	6.2	DD	116					17 3.8	-2.1	-2.3	142	16 55.8	-2.6	-1.3	116
Mar 22	1210	5.9	DD	117	18 41.0	-2.0	-1.1	125	18 58.8	-2.7	+0.1	94	19 18.1			56
Mar 31	2275	5.9	RD	231	2 14.4	-2.0	-1.8	309								
Mar 31	2302	2.9	DB	233	6 46.9	-0.9	+0.2	116	6 56.3	-0.4	+0.5	101	7 3.0	-0.0	+0.9	77
Mar 31	2302	2.9	RD	234	7 40.9	+0.0	+1.8	243	7 50.8	+0.2	+1.1	256				
Apr 1	2425	5.9	RD	243	0 14.8	-1.3	-1.4	284	0 10.2	-1.1	-3.4	324				
Apr 2	2591	6.5	RD	258	3 47.2	-2.3	+1.4	240								
Apr 2	2733	6.4	RD	268					22 56.4			207	23 6.9	-0.8	+0.1	249
Apr 15	752	4.7	DD	52	18 19.0			29								
Apr 18	1158	5.2	DD	85	16 38.1	-2.6	+0.1	87	17 25.8			36				
Apr 18	1158	5.2	RD	86					17 44.7			11				
Apr 20	1410	5.3	DD	112	21 11.6	-2.2	+2.2	69								
Apr 22	1623	5.4	DD	137									17 59.4			190
Apr 27	2343	6.4	RD	209									20 10.1	-1.7	+0.4	246
Apr 27	2353	4.6	RD	210	22 39.6	-1.7	-0.8	272	22 45.8	-1.8	-2.2	308				
Apr 30	2687	6.5	RD	238	0 13.6	-1.3	-3.5	316								
May 2	3104	6.5	RD	275					23 53.4	-0.9	+2.2	204	24 6.2	-1.0	+0.5	241
May 4	3229	5.6	RD	286									0 26.9	-0.7	+1.4	220
May 13	847	3.0	DD	32	15 31.8	-1.2	-0.3	126	15 46.5	-1.4	+0.8	93	16 2.4	-1.9	+2.2	59
May 13	847	3.0	RB	33	16 42.9	-1.3	+1.6	256	16 58.1	-0.4	+0.2	292	16 53.5	+0.3	-1.6	327
May 15	1124	6.9	DD	56	17 24.3	-1.8	+1.3	83								
May 16	1257	7.5	DD	69	19 52.0	-0.8	+1.1	92								
May 17	1364	6.5	DD	80	17 19.9	-2.7	+0.8	82								
May 20	1717	7.3	DD	121	21 44.4	-1.2	-0.5	127	21 57.0	-1.1	+0.8	92	22 16.3			47
May 21	1822	7.2	DD	131	16 34.4	-1.6	-0.8	85								
May 25	2303	5.1	DD	181	3 51.6			152								
May 25	2302	2.9	DD	181	3 52.2			153	3 52.4	-0.5	-0.5	131	3 52.1	-0.1	+0.1	105
May 25	2302	2.9	RD	181	4 16.5			205								
May 25	2303	5.1	RD	181	4 17.3			206								
May 27	2629	6.3	RD	208	3 57.3	-0.7	+2.1	234								
May 27	2764	6.3	RD	217	20 35.0			203	20 52.8	-1.2	-0.0	249	20 52.0	-1.2	-1.0	281

TIME IN UT					CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
DATE M D	I.C.	Mag.	Ph	ELG °	TIME h m	a. m	b. m	P.A. °	TIME h m	a. m	b. m	P.A. °	TIME h m	a. m	b. m	P.A. °
May 28	2913	5.1	RD	231	21 25.3	-0.5	-1.0	267	21 18.4	-0.6	-2.5	303				
Jun 13	1341	4.3	DD	52	19 5.9			190	18 48.8	-0.0	-0.6	134				
Jun 18	1908	7.2	DD	114					15 51.1	-2.9	+0.3	73				
Jun 18	1914	6.8	DD	115					18 11.3	-1.6	-2.4	146	18 3.4	-2.5	-1.0	113
Jun 20	2192	6.2	DD	143	18 20.9	-1.7	-1.1	103	18 42.4	-3.1	+1.5	61				
Jun 21	2353	4.6	DD	157	18 29.8	-1.3	-1.4	107	18 42.4	-2.4	+0.5	69				
Jun 25	2876	5.5	RD	202	1 59.5	-2.5	-0.4	291	2 19.5	-2.8	-1.2	303				
Jun 25	2880	5.1	RD	202	3 4.5	-2.0	+0.1	290	3 21.8	-1.9	-0.5	300				
Jun 26	3002	6.2	RD	214									0 14.5	-1.7	+3.1	209
Jun 26	3133	5.8	RD	225	22 12.6			189	22 41.5	-1.6	+1.5	222	22 55.6	-2.2	+0.5	250
Jun 27	3272	5.8	RD	238									23 46.5	-1.2	+3.1	201
Jul 3	326	6.0	RD	295					1 39.9	-0.9	-0.4	256	1 37.0	-1.7	-1.3	282
Jul 5	MARS	1.2	DB	317					2 45.1	-1.0	-1.3	98	2 42.0	-0.8	-0.1	74
Jul 5	MARS	1.2	RD	317	3 46.3	-0.1	+0.9	215	3 57.1	-0.8	+0.8	226	4 5.7	-1.7	+0.3	248
Jul 11	1410	5.3	DD	34					15 46.5	-2.0	+2.1	69				
Jul 14	1759m	6.5	DD	74					20 3.1	-0.5	-3.0	169	19 51.8	-0.4	-0.7	129
Jul 15	1888	6.2	DD	88	20 41.2			169	20 37.0	-0.7	-0.7	132	20 37.1	-0.5	+0.2	102
Jul 16	2002	6.8	DD	98									16 36.7	-1.0	-4.8	170
Jul 16	2021	6.7	DD	101	20 42.1	-1.2	+0.5	103	20 59.3	-0.7	+1.4	77	21 20.0			36
Jul 17	2136	6.8	DD	112					16 54.6	-1.7	-2.8	144	16 45.1	-2.5	-1.1	110
Jul 17	2147	7.0	DD	114	20 8.7			181	20 0.9	-1.9	-1.3	131	20 2.1	-1.9	+0.1	100
Jul 18	2296	7.1	DD	127					19 38.1	-2.4	-2.3	137	19 35.5	-2.6	-0.3	103
Jul 18	2303	5.1	DD	127	20 44.3	-2.2	-3.1	149	20 52.9	-2.0	-0.6	117	20 58.9	-1.8	+0.6	88
Jul 18	2302	2.9	DD	127	20 44.9	-2.2	-3.2	150	20 53.0	-2.1	-0.6	118	20 58.7	-1.8	+0.5	89
Jul 18	2302	2.9	RB	128	21 28.8	-1.2	+4.1	217	22 0.2	-1.0	+1.9	244	22 13.1	-1.1	+0.6	270
Jul 18	2322	4.3	DD	129	23 53.5	-0.3	+2.0	61	24 9.4	+0.4	+2.3	44				
Jul 19	2446	7.2	DD	139	16 55.9	-1.0	-1.9	119	17 1.0	-2.0	-0.3	83	17 15.9	-3.3	+3.0	43
Jul 19	2456	6.2	DD	140	18 50.5	-2.0	-1.3	109	19 9.5	-2.6	+0.6	78	19 32.4	-2.7	+3.5	41
Jul 20	2629	6.3	DD	154	21 35.3	-2.2	+0.5	85	22 3.4	-1.9	+1.5	66	22 25.9	-1.2	+2.8	40
Jul 27	3482	5.7	RD	232									1 43.6	-0.7	+4.1	189
Jul 31	416	5.4	RD	277	4 48.7	-2.4	+0.6	251								
Aug 10	1717	7.3	DD	43									16 19.2			174
Aug 12	1971	5.8	DD	70					17 3.4			40				
Aug 14	2264	7.4	DD	98	21 23.3	-0.9	+0.6	105	21 35.0	-0.4	+0.8	90	21 44.7	+0.0	+1.4	65
Aug 15	2401	5.6	DD	109					16 0.1	-3.3	+3.5	40				
Aug 15	2425	5.9	DD	112									22 46.7			153
Aug 17	2715	6.5	DD	135					16 33.0			149	16 15.2	-1.8	-1.3	106
Aug 17	2718	6.7	DD	135									17 5.5	-2.3	-2.1	119
Aug 17	2731	6.5	DD	136	19 43.4	-2.1	+1.5	58	20 19.3	-1.6	+3.0	38				
Aug 17	2745	6.9	DD	138	22 31.5	-2.8	-1.7	132	22 46.7	-1.9	-0.4	118	22 52.3	-1.3	+0.5	93
Aug 18	2876	5.5	DD	148	16 48.5			9								
Aug 25	240	5.6	RD	234					22 35.4			175	23 3.1	-0.9	+2.3	208
Sep 2	1158	5.2	RD	313					2 48.0			349				
Sep 8	1925	1.2	DD	38					14 48.2	-1.4	-2.5	154	14 40.4	-1.9	-0.8	118
Sep 8	1925	1.2	RB	39					15 41.9	-1.5	+2.2	245	15 54.7	-1.3	+0.2	280
Sep 9	2074	7.1	DD	54	17 56.0	-1.1	-0.2	123	18 6.0	-0.7	+0.5	100	18 14.7	-0.3	+1.3	72
Sep 13	2685	7.0	DD	106	18 19.2	-2.1	+1.5	62	18 53.2	-1.5	+2.6	44	19 27.5			9
Sep 13	2687	6.5	DD	107	18 40.9	-2.7	-1.1	116	19 2.4	-2.4	+0.2	99	19 14.5	-1.9	+1.1	74
Sep 14	2856	6.6	DD	121	21 59.4	-0.9	+1.9	61	22 20.4	-0.4	+1.9	53	22 38.6	+0.1	+2.4	32
Sep 15	2972	6.7	DD	132					18 42.5			133	18 37.9	-3.4	-0.4	96

TIME IN UT						CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
DATE		S.C.	Mag.	Ph	ELG	TIME	a.	b.	P.A.	TIME	a.	b.	P.A.	TIME	a.	b.	P.A.
M	D				°	h m	m	m	°	h m	m	m	°	h m	m	m	°
Sep	15	2975	7.0	DD	132	18 57.1			139	19 9.7	-3.6	-1.5	112	19 16.1	-3.0	+0.4	85
Sep	16	3104	6.5	DD	143	17 8.6	-1.6	-2.7	116	17 14.1	-2.1	-0.7	88	17 21.9	-2.2	+1.0	60
Sep	16	3128	6.2	DD	146	23 28.5	-1.1	+1.9	59	23 51.3	-0.6	+1.9	53	24 10.1	-0.2	+2.3	33
Sep	17	3229	5.6	DD	154					16 27.0	-1.0	+0.1	65	16 38.1	-1.1	+1.9	34
Sep	23	326	6.0	RD	216	2 24.7			324								
Sep	23	423	6.4	RD	224									19 57.1	+0.8	+3.5	189
Sep	25	700	5.7	RD	248	23 37.1			326								
Sep	27	837	6.1	RD	260									3 3.9	-3.5	+2.6	228
Oct	7	2118	2.9	DD	30	8 17.5	+0.4	-3.4	166	7 59.9	-0.5	-1.8	126	7 50.9	-1.0	-0.8	98
Oct	7	2118	2.9	RB	31	8 52.0	-1.8	+0.6	233	9 4.8	-1.5	-0.9	276	8 57.6	-1.2	-1.7	306
Oct	10	2649	6.6	DD	77	19 41.3	-0.4	+2.4	46	20 1.1	+0.2	+2.6	34				
Oct	10	2658	5.4	DD	78	21 11.4	-0.4	+0.8	101	21 18.9	+0.0	+0.8	91				
Oct	11	2808	7.4	DD	90	18 47.9	-2.1	+0.2	103	19 9.8	-1.6	+0.7	93	19 21 9	-1.1	+1.2	73
Oct	12	2936	6.8	DD	102									18 14.1			133
Oct	16	3453	4.9	DD	149					17 13.8	-1.4	+0.9	52	17 31.6	-1.2	+2.5	27
Oct	16	3455	6.4	DD	149					17 18.5	-2.1	-0.7	88	17 24.8	-2.0	+0.8	63
Oct	23	765	5.3	RD	227									20 14.4	-0.9	-1.2	284
Oct	24	915	4.7	RD	239	23 11.5	-0.9	+0.1	234	23 24.7	-1.8	+0.1	247	23 29.4	-2.4	-0.5	269
Oct	29	1410	5.3	RD	286	1 37.7	-0.9	-0.4	246	1 44.0	-1.5	-0.8	268	1 39.2	-1.6	-1.4	292
Oct	30	1519	6.5	RD	299					1 13.7	-0.6	-2.7	332				
Nov	2	1925	1.2	DB	344					11 15.5			185	10 53.2	-1.7	-1.6	135
Nov	2	1925	1.2	RD	345					11 35.0			215	12 1.3	-1.4	+0.8	264
Nov	6	2571	6.9	DD	45					17 43.1	-0.8	+0.3	108	17 49.0	-0.4	+0.7	86
Nov	6	2573	7.3	DD	45	17 54.8	-0.0	+2.7	36	18 14.8			19				
Nov	15	240	5.6	DD	153									19 30.0	-4.6	-1.8	111
Nov	21	894	4.6	RD	211	2 42.2	-2.9	+2.8	229								
Dec	7	3125	6.9	DD	65	18 33.4	-1.1	+1.4	78	18 52.4	-0.6	+1.4	70	19 6.5	-0.2	+1.7	51
Dec	7	3128	6.2	DD	65	19 6.7	-1.1	+0.8	100	19 21.2	-0.5	+0.9	90	19 30.8	-0.2	+1.1	70
Dec	12	203	6.9	DD	122					18 48.9	-2.7	+1.0	72	19 9.1	-2.5	+1.9	55

GRAZING OCCULTATIONS

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, as well as on the shape of the Moon. Some of this data cannot readily be obtained in any other way.

The maps on the following pages have been prepared by the 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 Moon is at a low altitude, the bright limb or sunlight interferes.

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 instruments with a larger aperture have often shown their superiority under difficult conditions. Timing is best carried out with a portable tape recorder and a small FM radio tuned to a pre-arranged transmission.

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.

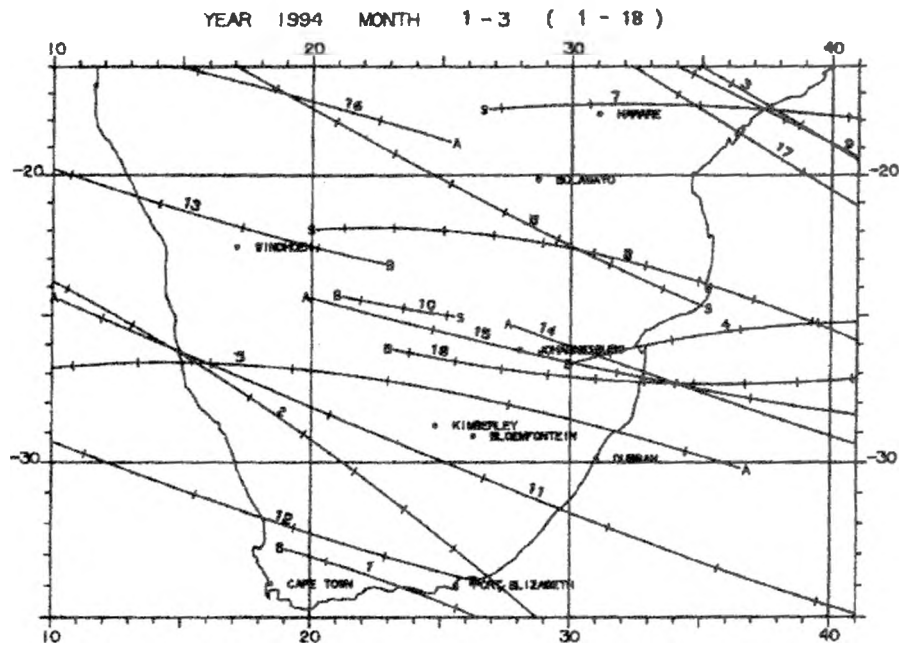
Interested observers - especially those living in the more distant regions - who wish to be informed of favourable grazes occurring in their neighbourhood, are therefore invited to contact the co-ordinator for grazing occultations:

Mr.M.D. Overbeek, P.O. Box 212, Edenvale, 1610. Tel: (011) 453 6918

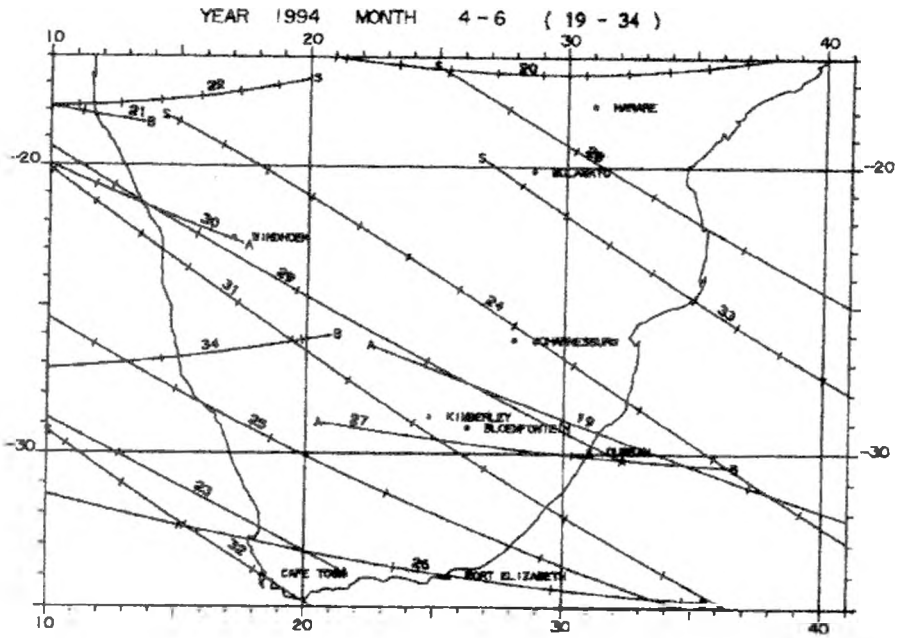
EXPLANATION OF THE COLUMN HEADINGS IN THE TABLES:

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 SAST for the west end of the track.
SUNLIT (%)	: Percentage of the Moon sunlit (a minus sign indicates a waning Moon).
LIMIT	: Whether the track is the north (N) or the south (S) limit of the occultation. (A) denotes that the Moon is at a low altitude. (B) denotes that the star is occultated at bright limb. (S) denotes that the daylight interferes.

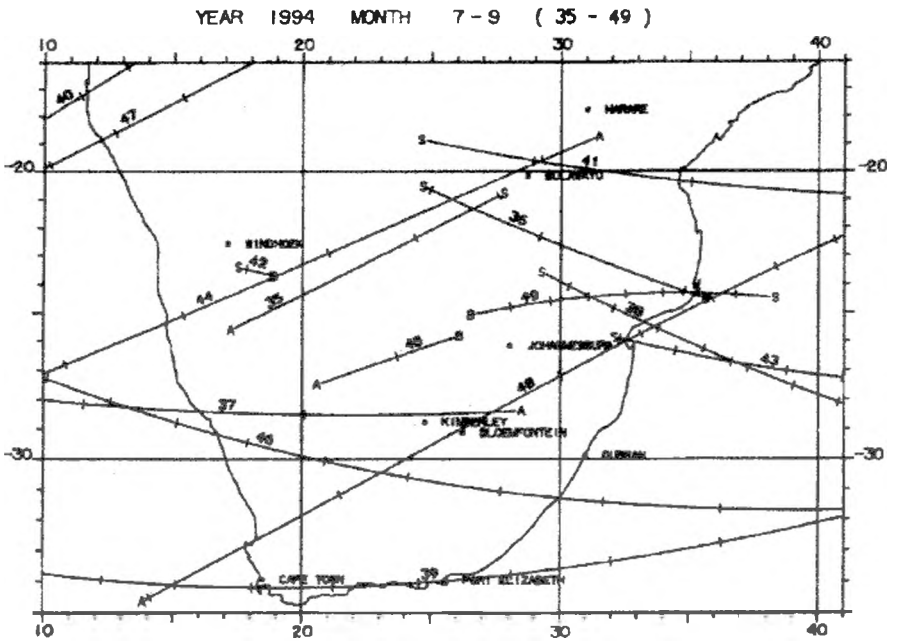
The map gives the graze tracks or the limits of occultations. Along each track on the map tick marks are given for the points corresponding to the multiples of five minutes of every hour, while the prediction for the west end of each track is shown in the table. e.g.if the time for the west end of a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



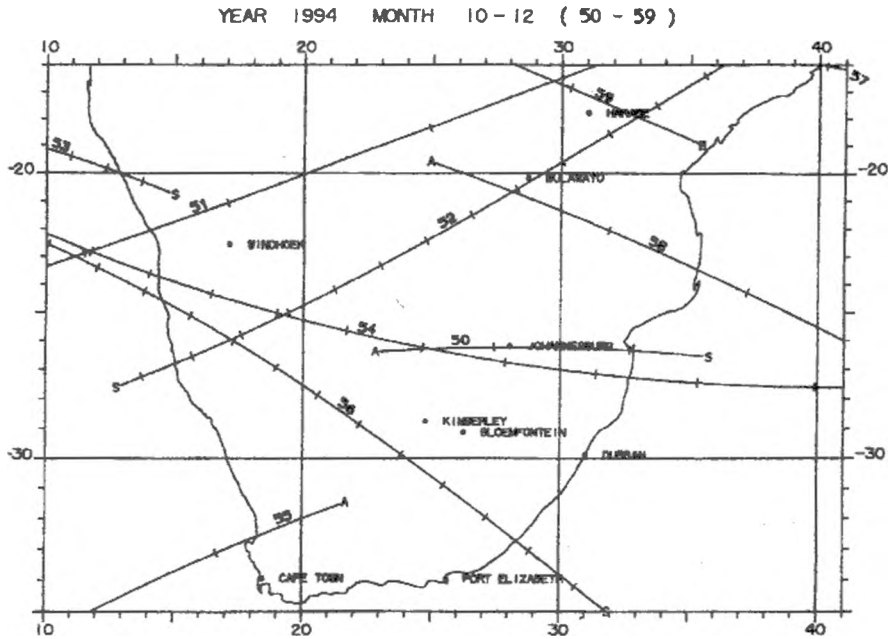
SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
1	1717	7.32	1	4	0	38	42.41	-61.48	S	(B)	( )
2	1727	7.06	1	4	2	43	57.19	-60.50	S	( )	( )
3	2104	7.49	1	7	3	43	0.38	-26.63	S	( )	( )
4	244	6.93	1	19	19	57	0.74	48.81	N	(B)	( )
5	371	6.41	1	20	21	58	17.06	58.99	N	( )	(A)
6	2217	5.46	2	4	4	26	51.23	-40.84	S	( )	(S)
7	197	7.04	2	15	19	9	14.89	22.60	N	(S)	( )
8	843	7.24	2	20	19	37	14.47	69.21	N	(S)	( )
9	851	6.32	2	20	22	19	2.03	69.58	N	( )	( )
10	2343	6.38	3	4	5	37	53.97	-56.07	N	(B)	(S)
11	2632	7.17	3	6	2	44	22.42	-34.93	S	(A)	( )
12	2639	6.02	3	6	4	18	38.40	-34.35	S	( )	(B)
13	2642	7.07	3	6	4	54	3.69	-34.10	S	( )	(B)
14	2787	6.37	3	7	2	27	23.51	-25.29	S	(A)	( )
15	2927	7.16	3	8	3	57	49.74	-16.34	N	(A)	( )
16	402	6.47	3	16	20	9	21.87	16.53	N	( )	(A)
17	1210	5.91	3	22	21	40	54.14	72.61	N	( )	( )
18	2275	5.90	3	31	3	43	16.38	-81.79	N	(B)	( )



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
19	2733	6.42	4	3	0	41	49.78	-51.08	S	(A)	( )
20	2755	6.63	4	3	4	4	0.06	-49.82	N	( )	( )
21	2758	7.03	4	3	4	27	53.75	-49.59	S	( )	(B)
22	2764	6.34	4	3	5	51	50.15	-49.21	N	( )	(S)
23	752	4.70	4	15	20	27	58.73	18.56	N	( )	(A)
24	1158	5.24	4	18	18	59	4.06	45.75	N	(S)	( )
25	1410	5.34	4	20	23	21	47.77	68.21	N	( )	( )
26	2972	6.70	5	2	1	27	55.73	-55.73	S	( )	(B)
27	3104	6.49	5	3	1	31	18.91	-45.30	S	(A)	(B)
28	1114	6.82	5	15	18	19	20.09	21.33	N	(S)	( )
29	1124	6.94	5	15	19	45	32.88	21.78	N	( )	(A)
30	1257	7.49	5	16	22	18	37.27	31.62	N	( )	(A)
31	1364	6.46	5	17	19	24	39.39	41.05	N	( )	( )
32	1440	6.74	6	14	18	53	46.83	27.04	N	(S)	( )
33	1908	7.22	6	18	18	5	51.24	70.76	N	(S)	( )
34	3272	5.80	6	28	0	46	47.08	-76.28	S	( )	(B)



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
35	725	6.91	7	6	6	15	32.06	-6.89	N	(A)	(S)
36	1410	5.34	7	11	18	4	51.07	8.16	N	(S)	(B)
37	1759m	6.54	7	14	22	8	50.23	35.65	S	( )	(A)
38	2132	7.09	7	17	17	57	30.02	68.43	N	(S)	( )
39	2147	7.04	7	17	22	0	50.46	69.73	S	( )	( )
40	416	5.36	7	31	5	51	14.29	-43.53	N	( )	( )
41	1717	7.32	8	10	18	30	41.08	13.04	S	(S)	( )
42	1971	5.82	8	12	18	54	42.73	32.25	N	(S)	(B)
43	2394	6.46	8	15	17	54	58.31	66.08	S	(S)	( )
44	2425	5.91	8	16	0	38	59.67	68.23	S	( )	(A)
45	1158	5.24	9	2	4	34	18.41	-15.19	N	(A)	(B)
46	1925	1.21	9	8	16	44	42.84	10.65	S	( )	( )
47	2699	7.19	9	13	23	9	29.74	64.88	S	( )	( )
48	700	5.73	9	26	1	19	56.73	-68.47	N	(A)	( )
49	837	6.09	9	27	4	10	52.48	-58.64	S	(B)	(S)



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
50	1457	6.72	10	2	4	42	4.96	-11.98	S	(A)	(S)
51	2322	4.29	10	8	20	33	28.06	17.38	S	( )	( )
52	2936	6.79	10	12	19	37	56.78	60.15	S	(S)	( )
53	1190	7.08	10	27	5	41	35.53	-55.32	S	( )	(S)
54	1925	1.21	11	2	12	50	55.77	-1.96	S	( )	( )
55	3054	6.40	11	9	23	45	40.17	45.71	S	( )	(A)
56	1564m	6.63	12	24	3	4	47.70	-68.04	S	( )	(S)
57	1925	1.21	12	27	8	39	37.02	-34.16	S	( )	( )
58	2034	7.18	12	28	2	30	51.04	-25.26	S	(A)	( )
59	2345	6.89	12	30	4	19	5.91	-7.61	N	( )	(B)

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 Southern Africa network comprises approximately 25 observers and more observers are badly needed. Very little experience is needed, apart from the ability to locate some of the fainter naked eye stars and familiarity with the user's telescope, which does not have to be a large equatorial. The only other equipment needed is a small FM radio and portable tape recorder.

Observations, especially when made by more than one observer, can be used to refine our knowledge of the size, shape and orbit of a minor planet, to greater accuracy than that obtainable with large Earth-based instruments.

Further information and detailed instructions on finding the occulted stars can be obtained from:

M.D. Overbeek, P O Box 212, Edenvale, 1610. Tel (011) 453-6918.

OCCULTATIONS BY MINOR PLANETS

Date	SAST	MINOR PLANET	CAT	STAR
d	h m			
Jan 6	0 44	107 Camilla	PPM	155583
Jan 15	1 48	776 Berbericia	DM	+35°1487
Jan 25	5 07	10 Hygiea	GSC	5540 01108
Feb 6	4 02	41 Daphne	GSC	4917 00502
Mar 3	2 37	501 Urhixidur	PPM	226817
Mar 10	1 16	2060 Chiron	GSC	0248 01674
Mar 14	2 59	41 Daphne	GSC	0246 00164
Mar 27	4 58	704 Interamnia	GSC	7324 00087
Mar 31	23 51	52 Europa	GSC	1390 01732
Apr 9	20 10	230 Athamantis	PPM	122217
Apr 14	3 03	613 Ginevra	PPM	264120
Apr 22	0 29	1048 Feodosia	PPM	129394
Apr 22	2 54	740 Cantabia	PPM	232942
Apr 23	0 03	859 Bouzareah	Lick2	1050
Apr 23	5 58	2393 Suzuki	PPM	233862
Apr 29	20 43	333 Badenia	DM	+17°2057
May 2	0 47	454 Mathesis	PPM	264651
May 18	19 47	5145 Pholus	GSC	1973 01072
Jun 1	5 01	1467 Mashona	PPM	272898
Jun 2	20 36	222 Lucia	PPM	265795
Jun 4	19 54	116 Sirona	PPM	265594
Jun 5	22 46	91 Aegina	AGRS	178247
Jun 13	21 40	222 Lucia	PPM	265635
Jun 23	3 09	194 Prokne	PPM	163975
Jul 11	21 55	29 Amphitrite	PPM	273049
Jul 14	18 03	357 Ninina	PPM	129031
Jul 21	4 02	2 Pallas	PPM	175231
Jul 21	18 46	508 Princetonia	PPM	299641
Jul 21	22 12	55 Pandora	PPM	227261
Jul 27	4 22	318 Magdalena	FK5	1536
Jul 28	5 17	96 Aegle	PPM	67962
Aug 9	1 02	318 Magdalena	PPM	237350
Aug 15	21 29	405 Thia	PPM	228379
Aug 20	20 54	324 Bamberga	PPM	227018
Aug 23	19 51	10 Hygiea	DM	-13°3763
Sep 9	0 07	1086 Nata	Lick5	3526
Sep 11	5 37	410 Chloris	PPM	96852
Oct 17	3 06	19 Fortuna	Lick4	3280
Oct 26	20 02	624 Hektor	PPM	271854
Nov 3	20 44	38 Leda	PPM	236848
Dec 2	0 35	142 Polana	PPM	94769
Dec 15	3 31	336 Lacadiera	PPM	121569

TIME SYSTEMS

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

TIME SIGNALS

CSIR has recently developed a new time service available through the telephone line with an accuracy to within one millisecond. This service replaces the ZUO service which has been discontinued.

Prospective users need have access to a telephone, an IBM-compatible PC with a modem and a "pulse buffer unit" which will be needed to synchronise other timing equipment external to the PC.

Registered users will be supplied with an authorised access code and user manual on a floppy disc. On running the software supplied, the user's computer automatically dials the CSIR time service number and establishes a link with the time service computer. The user's PC is then set to within one electronic "clock tick" of CSIR's national time standard. At the same time a pulse is generated at a pin on the printer port of the user's computer which is accurate to within one millisecond of the national time standard. This pulse can be used to synchronise other timing equipment external to the PC.

Users must pay a registration fee, a monthly fee and a fee for each call made to the system to the CSIR. In addition the user incurs the normal Post Office telephone charges.

Enquiries to: CSIR Time Service, Rm 230, Division of Production Technology, CSIR, P O Box 395, Pretoria, 0001. Tel: (012) 841-2036/841-4623. Telefax: (012) 841-2131.

SOUTH AFRICAN STANDARD TIME

South African Standard Time (as in everyday use) is mean solar time on 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 transists the 30° meridian - and a sundial on that meridian reads noon.

	h	m	s		h	m	s		h	m	s
Jan 1	12	3	32	May 11	11	56	20	Sep 18	11	54	12
11	12	7	55	21	11	56	32	28	11	50	42
21	12	11	19	31	11	57	35	Oct 8	11	47	36
31	12	13	27	Jun 10	11	59	21	18	11	45	13
Feb 10	12	14	15	20	12	1	28	28	11	43	49
20	12	13	46	30	12	3	34	Nov 7	11	43	42
Mar 2	12	12	11	Jul 10	12	5	18	17	11	44	57
12	12	9	48	20	12	6	19	27	11	47	35
22	12	6	57	30	12	6	24	Dec 7	11	51	25
Apr 1	12	3	55	Aug 9	12	5	30	17	11	56	3
11	12	1	5	19	12	3	38	27	12	1	0
21	11	58	44	29	12	0	57	31	12	2	57
May 1	11	57	5	Sep 8	11	57	43				

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

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

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

SIDEREAL TIME ON THE 30° MERIDIAN

	At 0 hrs h m	At 21 hrs h m		At 0 hrs h m	At 21 hrs h m		At 0 hrs h m	At 21 hrs h m
Jan 1	6 41	3 45	May 11	15 14	12 17	Sep 18	23 46	20 50
11	7 21	4 24	21	15 53	12 57	28	0 26	21 29
21	8 0	5 4	31	16 33	13 36	Oct 8	1 5	22 9
31	8 40	5 43	Jun 10	17 12	14 16	18	1 45	22 48
Feb 10	9 19	6 22	20	17 52	14 55	28	2 24	23 28
20	9 58	7 2	30	18 31	15 34	Nov 7	3 4	0 7
Mar 2	10 38	7 41	Jul 10	19 10	16 14	17	3 43	0 46
12	11 17	8 21	20	19 50	16 53	27	4 22	1 26
22	11 57	9 0	30	20 29	17 33	Dec 7	5 2	2 5
Apr 1	12 36	9 40	Aug 9	21 9	18 12	17	5 41	2 45
11	13 16	10 19	19	21 48	18 52	27	6 21	3 24
21	13 55	10 58	29	22 28	19 31	31	6 36	3 40
May 1	14 34	11 38	Sep 8	23 7	20 10			

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

Approximate longitude corrections from the 30° East Meridian are provided below. To find the sidereal times at SAST 0 hrs and SAST 21 hrs apply the following corrections to the data in the table.

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

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 (1994.5)

Star	R.A. h m	Dec. ° '	Mag.	Sp.	Star	R.A. h m	Dec. ° '	Mag.	Sp.
ACHERNAR	1 37.5	-57 16	0.6	B5	PROCYON	7 39.0	5 14	0.5	F5
ALDEBARAN	4 35.6	16 30	1.1	K5	REGULUS	10 8.1	12 0	1.3	B8
RIGEL	5 14.3	-8 13	0.3	B8	SPICA	13 24.9	-11 8	1.2	B2
BETELGEUSE	5 54.9	7 24	0.4	M0	ARCTURUS	14 15.4	19 13	0.2	K0
CANOPUS	6 23.8	-52 42	-0.9	F0	ANTARES	16 29.1	-26 25	1.2	M1
SIRIUS	6 44.9	-16 43	-1.6	A0	ALTAIR	19 50.6	8 51	0.9	A5

JULIAN DATE AT 1400 HOURS - SAST 1994

	JAN. 2449	FEB. 2449	MAR. 2449	APR. 2449	MAY 2449	JUN. 2449	JUL. 2449	AUG. 2449	SEP. 2449	OCT. 2449	NOV. 2449	DEC. 2449
1	354	385	413	444	474	505	535	566	597	627	658	688
2	355	386	414	445	475	506	536	567	598	628	659	689
3	356	387	415	446	476	507	537	568	599	629	660	690
4	357	388	416	447	477	508	538	569	600	630	661	691
5	358	389	417	448	478	509	539	570	601	631	662	692
6	359	390	418	449	479	510	540	571	602	632	663	693
7	360	391	419	450	480	511	541	572	603	633	664	694
8	361	392	420	451	481	512	542	573	604	634	665	695
9	362	393	421	452	482	513	543	574	605	635	666	696
10	363	394	422	453	483	514	544	575	606	636	667	697
11	364	395	423	454	484	515	545	576	607	637	668	698
12	365	396	424	455	485	516	546	577	608	638	669	699
13	366	397	425	456	486	517	547	578	609	639	670	700
14	367	398	426	457	487	518	548	579	610	640	671	701
15	368	399	427	458	488	519	549	580	611	641	672	702
16	369	400	428	459	489	520	550	581	612	642	673	703
17	370	401	429	460	490	521	551	582	613	643	674	704
18	371	402	430	461	491	522	552	583	614	644	675	705
19	372	403	431	462	492	523	553	584	615	645	676	706
20	373	404	432	463	493	524	554	585	616	646	677	707
21	374	405	433	464	494	525	555	586	617	647	678	708
22	375	406	434	465	495	526	556	587	618	648	679	709
23	376	407	435	466	496	527	557	588	619	649	680	710
24	377	408	436	467	497	528	558	589	620	650	681	711
25	378	409	437	468	498	529	559	590	621	651	682	712
26	379	410	438	469	499	530	560	591	622	652	683	713
27	380	411	439	470	500	531	561	592	623	653	684	714
28	381	412	440	471	501	532	562	593	624	654	685	715
29	382		441	472	502	533	563	594	625	655	686	716
30	383		442	473	503	534	564	595	626	656	687	717
31	384		443		504		565	596		657		718

JANUARY

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

FEBRUARY

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

MARCH

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

APRIL

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

MAY

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

JUNE

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

JULY

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

AUGUST

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

SEPTEMBER

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

OCTOBER

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

NOVEMBER

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

DECEMBER

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

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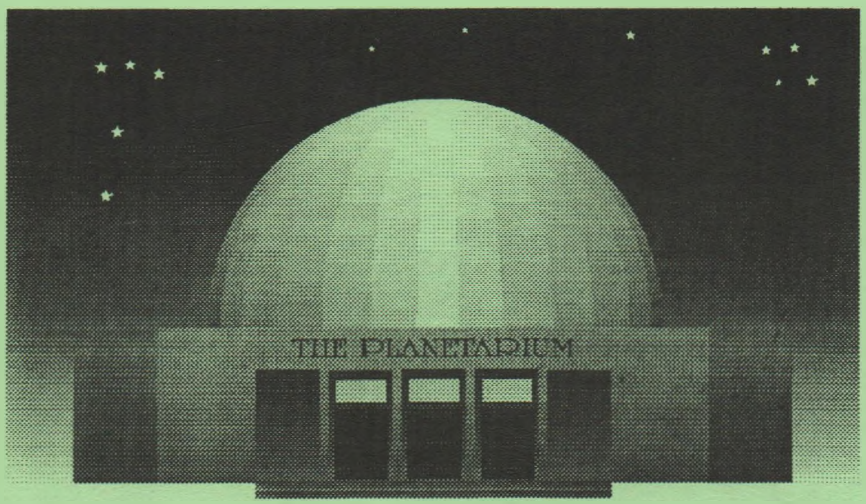

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