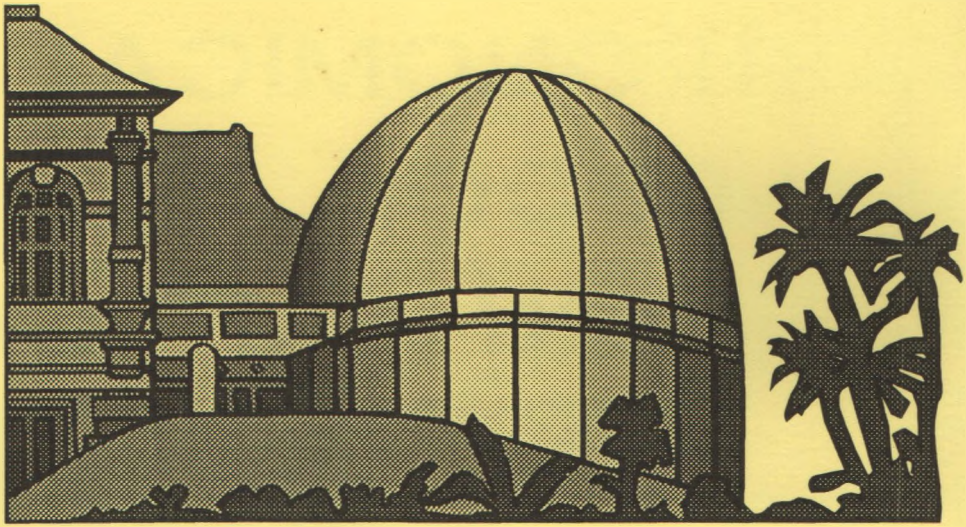
R10,00

ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1995



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ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 1995

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.

This edition is dedicated to
JOSEPH CHURMS
16 May 1926 - 25 September 1994
He was associated with the Handbook from 1953 to 1957 when, as a result of his guidence and instruction, the Transvaal Centre Computing Section calculated tables for the booklet among which were those for Moon Rise and Set and Occultation Predictions to supplement those listed in the then Nautical Almanac.
He was a proof reader and advisor from 1990 to 1994.
Front cover: Joe and his 209mm (8") Newtonian Telescope in April 1986 viewing Comet Halley.
Photograph: Mrs. M. Bowen

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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 1995, the Handbook of the British Astronomical Association for 1995 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.

Further copies of this booklet are available at R10,00 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.

The ASSA regrets that due to the restriction of funds it is not possible to print this handbook in any of the other official languages of South Africa.

P.J.Booth
Editor

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 telescope, which is gradually being upgraded as funds become available, as well as a 0.41-m telescope, 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. M. Hofman).

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.

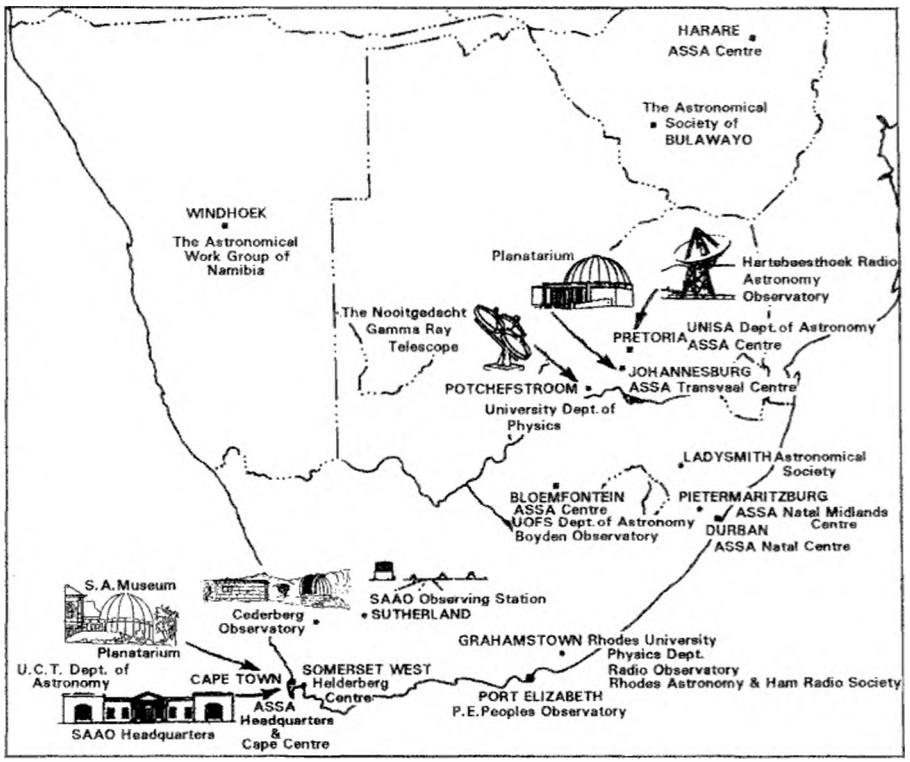
THE CEDERBERG OBSERVATORY. This observatory, situated 250 km by road north of Cape Town, is operated by 6 amateur astronomers. It has excellent dark skys and public open nights are held twice monthly at Last Quarter and New Moon. Enquiries to Mr. Chris Forder Tel 021-9134200.

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.

The Dept. of Computational and Applied Mathematics, WITS, offers an Introductory first year course in Astronomy and a postgraduate course in Cosmology/Astrophysics. Unique research facilities are available, such as Photomicrographic Tubes, the Schmidt Surveys (in blue and red) and SUN work stations. Contact Prof D.L. Block.

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. The society publishes a monthly journal ΣOctantis. 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. Meetings 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, Harare and Somerset West. 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.

BLOEMFONTEIN CENTRE: Meetings are usually held on the last Thursday of the month in the Physics Dept. UOFS or at Boyden Observatory, Mazelspoort.
Secretarial address: Miss. D. Bekker, P O Box 1599, Bloemfontein, 9300 or telephone 051-4012321(o/h), 051-4058730(o/h) or 051-471921(a/h).

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.

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.

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. 024-8521405 o/h or 024-8524630 a/h.

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 031-255979 / 7011104 / 288213.

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.

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.

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. There are two small observatories on the site, one houses the 30cm F8 Newtonian Jacobs telescope, and the Papadopoulos Dome houses a combined instrument comprising a 18cm F16 refractor, a 15cm refractor and a 30cm F16 Cassegrain reflector. 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.

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 and 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 was formed 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	1	13	NEW MOON
	2	4	Mercury 3° S. of Neptune
	2	21	Pallas stationary
	4	3	Mercury 1·7° S. of Uranus
	4	3	Mars stationary
	4	13	Earth at perihelion
	5	19	Saturn 7° S. of Moon
	8	18	FIRST QUARTER
	12	0	Moon at apogee
	13	14	Venus greatest elong. W. (47°)
	13	19	Neptune in conjunction with Sun
	14	11	Venus 3° N. of Jupiter
	16	0	Venus 8° N. of Antares
	16	22	FULL MOON
	17	2	Uranus in conjunction with Sun
	19	10	Mercury greatest elong. E. (19°)
	19	21	Mars 9 N. of Moon
	23	3	Jupiter 5° N. of Antares
	23	13	Spica 0·6° S. of Moon
	24	7	LAST QUARTER
	25	14	Mercury stationary
	26	19	Jupiter 1·7° S. of Moon
	27	14	Venus 0·2° S. of Moon
	28	1	Moon at perigee
	28	20	Mars 4° N. of Regulus
	29	22	Neptune 4° S. of Moon
	31	1	NEW MOON
Feb	2	10	Saturn 6° S. of Moon
	3	3	Ceres at opposition
	4	1	Mercury in inferior conjunction
	7	15	FIRST QUARTER
	8	20	Moon at apogee
	11	16	Mars closest approach
	11	22	Vesta stationary
	12	5	Mars at opposition
	15	12	Mars 10° N. of Moon
	15	14	FULL MOON
	15	21	Mercury stationary
	19	19	Spica 0·9° S. of Moon
	22	15	LAST QUARTER
	23	4	Moon at perigee
	23	7	Jupiter 2° S. of Moon
	26	7	Neptune 4° S. of Moon
	26	7	Venus 4° S. of Moon
	26	12	Venus 0·7° N. of Neptune
	26	15	Uranus 6° S. of Moon
	27	13	Mercury 5° S. of Moon
Mar	1	13	Mercury greatest elong. W. (27°)
	1	14	NEW MOON
	2	7	Venus 1·5° N. of Uranus
	6	4	Saturn in conjunction with Sun
	6	12	Pluto stationary
	8	17	Moon at apogee
	9	12	FIRST QUARTER
	14	6	Mars 9° N. of Moon
	17	3	FULL MOON
	19	2	Spica 1·0° S. of Moon
	20	15	Moon at perigee
	21	4	Equinox
	22	16	Jupiter 2° S. of Moon
	23	15	Ceres stationary
	23	22	LAST QUARTER
	25	14	Neptune 5° S. of Moon
	25	19	Mars stationary
	25	23	Uranus 6° S. of Moon
	26	6	Mercury 0·6° S of Saturn
	28	11	Venus 6° S. of Moon
	29	15	Saturn 6° S. of Moon
	30	3	Mercury 6° S. of Moon
	31	4	NEW MOON
Apr	1	15	Jupiter stationary
	5	12	Moon at apogee
	8	8	FIRST QUARTER
	10	16	Maes 8° N. of Moon
	13	19	Venus 0·6° N. of Saturn
	14	15	Mercury in superior conjunction
	15	11	Spica 1·0° S. of Moon
	15	14	FULL MOON
	17	10	Moon at perigee
	18	23	Jupiter 3° S. of Moon
	21	20	Neptune 5° S. of Moon
	22	5	LAST QUARTER
	22	6	Uranus 6° S. of Moon
	24	11	Juno stationary
	26	3	Saturn 6° S. of Moon
	27	7	Venus 4° S. of Moon
	27	23	Neptune stationary
	29	20	NEW MOON
May	1	7	Mercury 4° N.of Moon
	3	3	Moon at apogee
	5	13	Uranus stationary
	8	0	FIRST QUARTER
	8	16	Mars 7° N. of Moon
	10	18	Mercury 8° N. of Aldebaran
	12	4	Mercury greatest elong. E. (22°)
	12	22	Spica 1·0° S. of Moon
	14	23	FULL MOON
	15	17	Moon at perigee
	16	4	Jupiter 2° S. of Moon
	19	3	Neptune 5° S. of Moon
	19	12	Uranus 6° S. of Moon
	20	19	Pluto at opposition
	21	14	LAST QUARTER
	22	10	Passage of the Earth through the ring-plane of Saturn from N to S
	23	13	Saturn 6° S. of Moon
	24	9	Mars 1·1° N. of Regulus
	24	18	Mercury stationary
	27	9	Venus 0·8° S. of Moon
	29	11	NEW MOON
	30	10	Moon at apogee
Jun	1	13	Jupiter at opposition
	5	8	Mercury in inferior conjunction
	5	22	Mars 6° N. of Moon
	6	12	FIRST QUARTER
	9	8	Spica 1·1° S. of Moon
	12	10	Jupiter 2° S. of Moon
	13	3	Moon at perigee
	13	6	FULL MOON
	14	16	Jupiter 5° N. of Antares
	15	12	Neptune 5° S. of Moon
	15	21	Uranus 6° S. of Moon
	15	23	Mercury 1·2° N. of Aldebaran
	17	8	Mercury stationary
	18	16	Mercury 1·1° N. of Aldebaran
	18	17	Juno at opposition
	19	7	Venus 5° N. of Aldebaran
	19	9	Mercury 4° S. of Venus
	19	21	Saturn 6° S. of Moon
	20	0	LAST QUARTER
	21	23	Solstice
	26	4	Mercury 0·6° S. of Moon
	26	13	Moon at apogee
	26	17	Venus 3° N. of Moon
	28	3	NEW MOON

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h	
Jun	29	18	Mercury greatest elong. W. (22°)
Jul	4	4	Earth at aphelion
	4	7	Mars 4° N. of Moon
	5	22	FIRST QUARTER
	7	13	Saturn stationary
	9	15	Jupiter 2° S. of Moon
	11	12	Moon at perigee
	12	13	FULL MOON
	12	21	Neptune 4° S. of Moon
	13	5	Uranus 6° S. of Moon
	17	6	Saturn 6° S. of Moon
	17	7	Neptune at opposition
	19	13	LAST QUARTER
	21	20	Uranus at opposition
	23	22	Moon at apogee
	27	17	NEW MOON
	28	4	Mercury in superior conjunction
Aug	1	17	Mars 2° N. of Moon
	3	0	Jupiter stationary
	4	5	FIRST QUARTER
	5	22	Jupiter 2° S. of Moon
	8	16	Moon at perigee
	9	6	Neptune 5° S. of Moon
	9	14	Uranus 6° S. of Moon
	9	18	Mercury 1·1° N. of Regulus
	10	20	FULL MOON
	10	23	Passage of the Earth through the ring-plane of Saturn from S to N
	12	6	Pluto stationary
	13	13	Saturn 5° S. of Moon
	15	8	Juno stationary
	18	5	LAST QUARTER
	20	14	Moon at apogee
	21	2	Venus in superior conjunction
	23	17	Pallas in conjunction with Sun
	26	3	Vesta in conjunction with Sun
	26	7	NEW MOON
	27	15	Mars 2° N. of Spica
	28	9	Mercury 1·8° N. of Moon
	30	6	Mars 0·2° N.of Moon
Sep	2	6	Jupiter 3° S. of Moon
	2	11	FIRST QUARTER
	5	3	Moon at perigee
	5	13	Neptune 5° S. of Moon
	5	21	Uranus 6° S. of Moon
	9	6	FULL MOON
	9	6	Mercury greatest elong. E. (27°)
	9	19	Saturn 6° S.of Moon
	14	17	Saturn at opposition
	16	23	LAST QUARTER
	17	8	Moon at apogee
	20	9	Jupiter 5° N. of Antares
	22	8	Mercury stationary
	23	14	Equinox
	24	19	NEW MOON
	26	1	Mercury 3° S. of Moon
	27	20	Mars 2° S. of Moon
	28	23	Mercury 5° S. of Venus
	29	17	Jupiter 3° S. of Moon
	30	6	Moon at perigee
Oct	1	17	FIRST QUARTER
	2	19	Neptune 5° S. of Moon
	3	2	Uranus 6° S. of Moon
	4	11	Venus 3° N. of Spica
	5	2	Neptune stationary
	5	3	Mercury in inferior conjunction
	6	17	Uranus stationary
	7	0	Saturn 6° S. of Moon
	8	18	FULL MOON Penumbral Eclipse
	10	1	Ceres in conjunction with Sun
	13	11	Mercury stationary
	15	4	Moon at apogee
	16	18	LAST QUARTER
	20	16	Mercury greatest elong. W. (18°)
	22	0	Pallas 0·9° S. Moon
	23	0	Mercury 4° N. of Moon
	24	7	NEW MOON
	25	13	Venus 1·9° S. of Moon
	26	13	Mars 4° S. of Moon
	26	23	Moon at perigee
	27	8	Jupiter 4° S. of Moon
	30	1	Neptune 5° S. of Moon
	30	8	Uranus 6° S. of Moon
	30	15	Mercury 4° N. of Spica
	30	23	FIRST QUARTER
Nov	2	14	Mars 4° N. of Antares
	3	4	Saturn 6° S. of Moon
	7	9	FULL MOON
	10	20	Venus 4° N. of Antares
	11	23	Moon at apogee
	15	14	LAST QUARTER
	16	10	Mars 1·2° S. of Jupiter
	19	14	Venus 1·3° S. of Jupiter
	22	16	Saturn stationary
	22	18	NEW MOON
	23	0	Venus 0.2° S. of Mars
	23	7	Mercury in superior conjunction
	23	9	Pluto in conjunction with Sun
	24	1	Moon at perigee
	24	3	Jupiter 4° S. of Moon
	24	10	Mars 5° S. of Moon
	24	11	Venus 6° S. of Moon
	26	9	Neptune 5° S. of Moon
	26	16	Uranus 6° S. of Moon
	29	8	FIRST QUARTER
	30	9	Saturn 6° S. of Moon
Dec	7	3	FULL MOON
	9	12	Moon at apogee
	15	8	LAST QUARTER
	16	19	Venus 2° S. of Neptune
	19	0	Jupiter in conjunction with Sun
	20	15	Venus 1·3° S. of Uranus
	22	4	NEW MOON
	22	10	Solstice
	22	12	Moon at perigee
	23	9	Mercury 7° S. of Moon
	23	9	Mars 6° S. of Moon
	23	11	Mercury 1·1° S. of Mars
	23	20	Neptune 5° S. of Moon
	24	4	Uranus 6° S. of Moon
	24	12	Venus 7° S. of Moon
	27	17	Saturn 5° S. of Moon
	28	4	Mercury 2° S. of Neptune
	28	21	FIRST QUARTER

THE SUN

BASIC DATA:

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

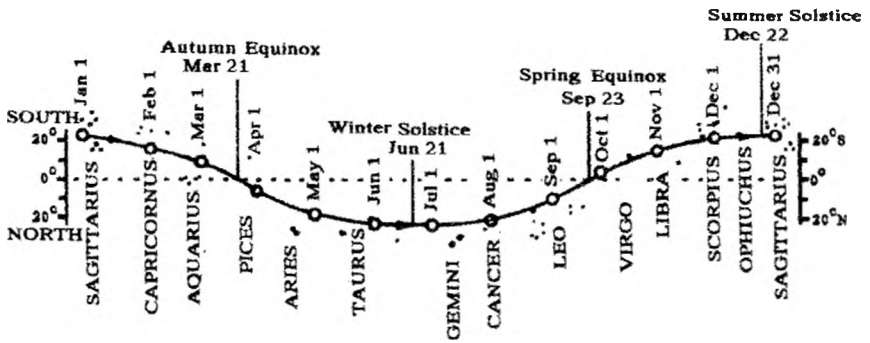
Mass: 1,99 x 10^{30}kg (330 000 times Earth mass)

Surface Temperature: Approximately 6 000°C

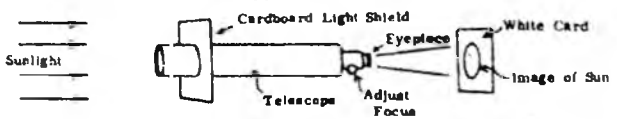
Temperature at centre: Approximately 10 million°C

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 1995 we will be closest to the Sun on January 4 (perihelion - approximate distance 147 million km) and furthest from the Sun on July 4 (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° 3'	Apr	11	8° 4'	Jul	20	20°47'	Oct	28	-12°53'
	11	-21 54		21	11 37		30	18 40	Nov	7	-16 4
	21	-20 3	May	1	14 52	Aug	9	16 3		17	-18 49
	31	-17 34		11	17 42		19	13 0		27	-21 0
Feb	10	-14 34		21	20 2		29	9 36	Dec	7	-22 31
	20	-11 10		31	21 49	Sep	8	5 57		17	-23 20
Mar	2	-7 28	Jun	10	22 57		18	2 8		27	-23 21
	12	-3 35		20	23 26		28	-1 45			
	22	0 21		30	23 13	Oct	8	-5 37			
Apr	1	4 17	Jul	10	22 19		18	-9 22			

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, one an annular eclipse on April 29 and the other a total eclipse on October 24, take place during the year. Neither will be visible from Southern Africa.

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

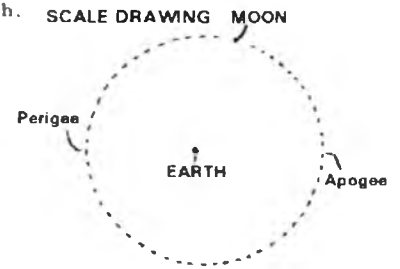
THE SURFACE OF THE MOON

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.

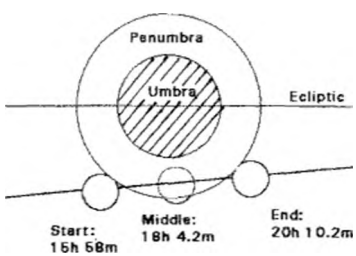


The Moon is best positioned for evening viewing from 3 to 4 days before First Quarter to shortly after Full Moon.

ECLIPSES OF THE MOON

The partial eclipse on April 15 will not be visible over Southern Africa. The penumbral eclipse on the evening of October 8 will already be in progress as the moon rises over Southern Africa.

Eclipse Data for 8 October:



Penumbral Magnitude 0.851

TERMINATOR AND LIBRATION

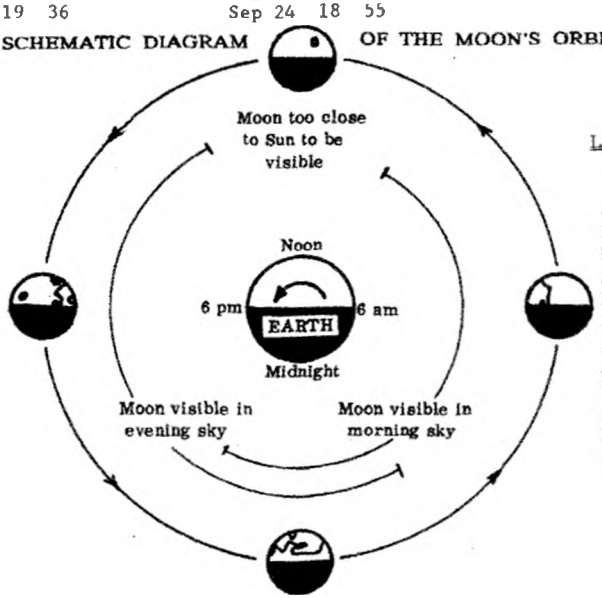
During the changing phases, the terminator (the boundary between illuminated and dark portions) progresses from left to right in the diagram on the next page. Since the moon does not follow a perfectly circular orbit and its axis is not parallel to the Earth's axis, it is sometimes possible to see a 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	1	12	56
	31	0	48
Mar	1	13	48
	31	4	09
Apr	29	19	36
May	29	11	27
Jun	28	2	50
Jul	27	17	13
Aug	26	6	31
Sep	24	18	55
Oct	24	6	36
Nov	22	17	43
Dec	22	4	22

SCHEMATIC DIAGRAM OF THE MOON'S ORBIT



FIRST QUARTER

	d	h	m
Jan	8	17	46
Feb	7	14	54
Mar	9	12	14
Apr	8	7	35
May	7	23	44
Jun	6	12	26
Jul	5	22	02
Aug	4	5	16
Sep	2	11	03
Oct	1	16	36
Oct	30	23	17
Nov	29	8	28
Dec	28	21	06

LAST QUARTER

	d	h	m
Jan	24	6	58
Feb	22	15	04
Mar	23	22	10
Apr	22	5	18
May	21	13	36
Jun	20	0	01
Jul	19	13	10
Aug	18	5	09
Sep	16	23	09
Oct	16	18	26
Nov	15	13	40
Dec	15	7	31

FULL MOON

	d	h	m
Jan	16	22	26
Feb	15	14	15
Mar	17	3	26
Apr	15	14	08
May	14	22	48
Jun	13	6	03
Jul	12	12	49
Aug	10	20	15
Sep	9	5	37
Oct	8	17	52
Nov	7	9	20
Dec	7	3	27

MOON at PERIGEE

d	h	d	h	d	h
Jan 28	1	Jun 13	3	Oct 26	23
Feb 23	4	Jul 11	12	Nov 24	1
Mar 20	15	Aug 8	16	Dec 22	12
Apr 17	10	Sep 5	3		
May 15	17	30	6		

MOON at APOGEE

d	h	d	h	d	h
Jan 12	0	May 30	10	Oct 15	4
Feb 8	20	Jun 26	13	Nov 11	23
Mar 8	17	Jul 23	22	Dec 9	12
Apr 5	12	Aug 20	14		
May 3	3	Sep 17	8		

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 5	9.3	207	Jan 11	2.0	305	Jul 15	8.8	210	Jul 22	4.4	307
18	8.2	55	25	2.9	139	29	7.6	54	Aug 5	5.1	137
Feb 1	8.2	201	Feb 8	2.1	301	Aug 12	7.7	206	18	4.8	305
14	8.2	53	21	1.9	133	24	7.3	46	31	4.1	129
28	7.8	196	Mar 7	2.1	296	Sep 7	7.1	191	Sep 14	4.8	295
Mar 13	8.7	56	20	1.4	137	21	7.5	47	27	3.4	137
27	8.2	198	Apr 3	2.1	292	Oct 4	7.4	191	Oct 11	4.5	283
Apr 10	9.4	62	17	1.8	152	18	7.9	56	25	3.6	146
23	9.0	205	30	2.4	296	31	8.1	200	Nov 7	4.5	286
May 8	9.7	67	May 14	2.9	155	Nov 16	8.2	68	22	4.7	153
21	9.6	208	28	3.0	299	28	8.6	208	Dec 5	5.1	297
Jun 5	9.3	70	Jun 12	4.1	154	Dec 14	8.0	85	21	5.9	159
18	9.5	210	25	3.8	305	26	8.6	215			
Jul 2	8.4	67	Jul 9	5.0	151						

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.

1995 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	05 37	19 55	07 39	20 38	06 25	19 09	08 07	19 26	08 44	19 22	09 52	20 32
2	06 44	20 44	08 41	21 13	07 25	19 44	09 03	20 03	09 35	20 07	10 33	21 25
3	07 51	21 28	09 41	21 47	08 24	20 18	09 58	20 43	10 24	20 54	11 11	22 20
4	08 56	22 07	10 39	22 21	09 22	20 53	10 51	21 26	11 10	21 45	11 47	23 16
5	09 58	22 42	11 36	22 55	10 19	21 29	11 41	22 11	11 53	22 37	12 21	
6	10 58	23 16	12 31	23 31	11 14	22 06	12 29	23 00	12 33	23 31	12 55	00 13
7	11 56	23 49	13 25		12 07	22 47	13 14	23 52	13 11		13 30	01 12
8	12 52		14 18	00 10	12 59	23 31	13 56		13 46	00 27	14 07	02 13
9	13 47	00 22	15 09	00 52	13 49		14 36	00 46	14 22	01 25	14 48	03 17
10	14 41	00 56	15 58	01 37	14 36	00 18	15 14	01 42	14 57	02 25	15 33	04 23
11	15 34	01 33	16 44	02 26	15 21	01 08	15 50	02 40	15 34	03 26	16 24	05 32
12	16 27	02 13	17 28	03 19	16 02	02 02	16 26	03 40	16 14	04 31	17 21	06 40
13	17 17	02 56	18 09	04 14	16 42	02 58	17 03	04 42	16 58	05 38	18 25	07 45
14	18 05	03 43	18 47	05 12	17 19	03 56	17 42	05 47	17 47	06 47	19 32	08 45
15	18 50	04 34	19 24	06 11	17 56	04 56	18 24	06 53	18 42	07 56	20 40	09 39
16	19 33	05 28	20 00	07 12	18 33	05 58	19 10	08 02	19 42	09 03	21 47	10 26
17	20 12	06 25	20 36	08 14	19 10	07 02	20 01	09 10	20 46	10 05	22 51	11 08
18	20 49	07 23	21 13	09 16	19 50	08 07	20 58	10 17	21 52	11 00	23 53	11 46
19	21 25	08 22	21 52	10 20	20 32	09 13	21 58	11 20	22 58	11 49		12 21
20	22 00	09 22	22 35	11 25	21 19	10 20	23 01	12 17		12 32	00 52	12 56
21	22 35	10 22	23 22	12 30	22 10	11 26		13 07	00 01	13 11	01 49	13 29
22	23 11	11 24		13 34	23 06	12 29	00 04	13 52	01 02	13 46	02 45	14 04
23	23 51	12 27	00 14	14 35		13 28	01 07	14 32	02 01	14 20	03 40	14 41
24		13 32	01 10	15 32	00 06	14 21	02 08	15 09	02 59	14 53	04 34	15 20
25	00 35	14 37	02 11	16 25	01 08	15 09	03 08	15 44	03 55	15 27	05 27	16 02
26	01 23	15 41	03 14	17 12	02 11	15 52	04 06	16 17	04 50	16 03	06 17	16 47
27	02 18	16 43	04 19	17 54	03 13	16 31	05 03	16 51	05 45	16 40	07 05	17 36
28	03 18	17 40	05 22	18 33	04 14	17 08	06 00	17 26	06 39	17 20	07 51	18 27
29	04 23	18 32			05 14	17 42	06 56	18 02	07 31	18 04	08 33	19 20
30	05 29	19 18			06 13	18 16	07 50	18 40	08 21	18 50	09 12	20 15
31	06 35	20 00			07 11	18 51			09 08	19 40		

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

1995 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	05 12	19 01	07 04	19 54	05 48	18 28	07 20	18 56	07 50	18 57	08 58	20 05
2	06 17	19 53	08 03	20 33	06 46	19 06	08 13	19 35	08 40	19 42	09 40	20 57
3	07 21	20 40	09 00	21 10	07 41	19 43	09 05	20 17	09 29	20 30	10 21	21 49
4	08 23	21 22	09 54	21 47	08 36	20 21	09 56	21 01	10 15	21 19	10 59	22 43
5	09 22	22 01	10 48	22 25	09 30	20 59	10 46	21 47	11 00	22 10	11 37	23 37
6	10 19	22 38	11 40	23 03	10 22	21 40	11 34	22 36	11 42	23 03	12 14	
7	11 13	23 14	12 32	23 44	11 14	22 22	12 20	23 26	12 22	23 56	12 53	00 32
8	12 06	23 50	13 23		12 05	23 07	13 04		13 00		13 33	01 30
9	12 58		14 13	00 27	12 54	23 54	13 46	00 18	13 39	00 50	14 17	02 30
10	13 50	00 27	15 02	01 13	13 41		14 26	01 12	14 18	01 47	15 05	03 33
11	14 41	01 06	15 49	02 02	14 27	00 44	15 06	02 07	14 58	02 45	15 58	04 38
12	15 32	01 48	16 35	02 53	15 10	01 36	15 45	03 04	15 41	03 46	16 57	05 45
13	16 21	02 32	17 18	03 47	15 52	02 30	16 26	04 03	16 28	04 49	18 00	06 50
14	17 10	03 20	17 59	04 42	16 33	03 25	17 08	05 03	17 20	05 55	19 06	07 51
15	17 56	04 10	18 39	05 39	17 13	04 22	17 53	06 06	18 16	07 02	20 11	08 47
16	18 40	05 03	19 19	06 36	17 53	05 20	18 42	07 11	19 18	08 07	21 15	09 37
17	19 22	05 57	19 58	07 34	18 34	06 20	19 36	08 17	20 21	09 10	22 16	10 22
18	20 02	06 52	20 39	08 33	19 17	07 22	20 33	09 22	21 25	10 07	23 14	11 03
19	20 41	07 48	21 21	09 34	20 03	08 24	21 33	10 24	22 28	10 58		11 42
20	21 19	08 44	22 06	10 35	20 52	09 28	22 35	11 22	23 28	11 44	00 10	12 19
21	21 58	09 42	22 56	11 37	21 45	10 32	23 36	12 15		12 26	01 04	12 56
22	22 38	10 40	23 49	12 39	22 42	11 34		13 02	00 26	13 05	01 58	13 34
23	23 21	11 40		13 39	23 41	12 32	00 36	13 45	01 22	13 42	02 50	14 13
24		12 41	00 46	14 37		13 27	01 34	14 26	02 16	14 18	03 42	14 54
25	00 07	13 43	01 46	15 31	00 41	14 17	02 31	15 03	03 09	14 55	04 32	15 37
26	00 58	14 46	02 47	16 20	01 42	15 03	03 26	15 40	04 02	15 33	05 22	16 23
27	01 54	15 47	03 49	17 06	02 41	15 45	04 20	16 17	04 54	16 13	06 10	17 12
28	02 54	16 45	04 49	17 48	03 39	16 25	05 13	16 54	05 45	16 55	06 56	18 02
29	03 57	17 39			04 36	17 03	06 06	17 33	06 36	17 39	07 40	18 53
30	05 01	18 28			05 31	17 40	06 58	18 14	07 25	18 26	08 21	19 45
31	06 04	19 13			06 26	18 18			08 13	19 15		

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

1995 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	04 52	18 54	06 49	19 43	05 34	18 16	07 10	18 39	07 43	18 38	08 52	19 46
2	05 58	19 45	07 49	20 21	06 33	18 53	08 05	19 18	08 34	19 23	09 33	20 39
3	07 03	20 31	08 47	20 57	07 30	19 28	08 58	19 58	09 23	20 10	10 13	21 32
4	08 07	21 12	09 44	21 32	08 26	20 05	09 50	20 41	10 09	21 00	10 50	22 27
5	09 07	21 49	10 39	22 08	09 21	20 42	10 40	21 27	10 53	21 52	11 27	23 22
6	10 05	22 25	11 32	22 46	10 15	21 21	11 28	22 16	11 34	22 45	12 03	
7	11 01	22 59	12 25	23 25	11 07	22 03	12 14	23 07	12 13	23 39	12 39	00 19
8	11 56	23 34	13 17		11 59	22 47	12 57	24 00	12 51		13 18	01 19
9	12 49		14 08	00 08	12 48	23 34	13 38		13 28	00 35	14 00	02 20
10	13 42	00 10	14 57	00 53	13 35		14 17	00 55	14 05	01 33	14 47	03 25
11	14 34	00 48	15 43	01 42	14 20	00 24	14 55	01 51	14 44	02 33	15 39	04 31
12	15 26	01 29	16 28	02 34	15 03	01 17	15 33	02 49	15 25	03 35	16 37	05 38
13	16 16	02 12	17 10	03 28	15 44	02 12	16 12	03 49	16 11	04 40	17 40	06 44
14	17 04	03 00	17 50	04 25	16 24	03 08	16 53	04 52	17 01	05 47	18 46	07 44
15	17 50	03 50	18 29	05 22	17 02	04 07	17 37	05 56	17 57	06 55	19 53	08 39
16	18 33	04 43	19 07	06 21	17 41	05 07	18 24	07 03	18 58	08 01	20 58	09 28
17	19 14	05 39	19 45	07 21	18 20	06 08	19 16	08 10	20 01	09 03	22 01	10 12
18	19 53	06 35	20 24	08 22	19 01	07 11	20 13	09 16	21 06	10 00	23 01	10 52
19	20 30	07 32	21 05	09 24	19 46	08 15	21 13	10 18	22 10	10 50	23 58	11 29
20	21 07	08 30	21 49	10 27	20 34	09 20	22 16	11 16	23 12	11 35		12 05
21	21 44	09 29	22 37	11 30	21 26	10 25	23 18	12 08		12 15	00 54	12 41
22	22 23	10 29	23 29	12 33	22 22	11 28		12 54	00 11	12 53	01 48	13 17
23	23 04	11 30		13 34	23 21	12 27	00 19	13 36	01 09	13 29	02 42	13 55
24	23 49	12 33	00 26	14 31		13 21	01 19	14 15	02 04	14 04	03 35	14 35
25		13 37	01 26	15 24	00 22	14 10	02 17	14 51	02 59	14 39	04 26	15 18
26	00 39	14 40	02 29	16 13	01 24	14 55	03 13	15 27	03 53	15 16	05 16	16 04
27	01 34	15 42	03 31	16 57	02 25	15 36	04 09	16 02	04 46	15 55	06 05	16 52
28	02 34	16 39	04 33	17 38	03 24	16 14	05 03	16 38	05 39	16 36	06 50	17 42
29	03 37	17 32			04 22	16 50	05 57	17 16	06 30	17 20	07 33	18 35
30	04 42	18 20			05 19	17 26	06 51	17 55	07 20	18 06	08 14	19 28
31	05 46	19 04			06 15	18 02			08 07	18 55		

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

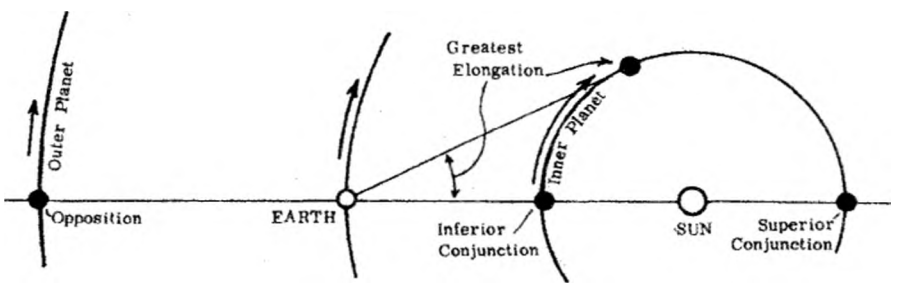
THE PLANETS

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.

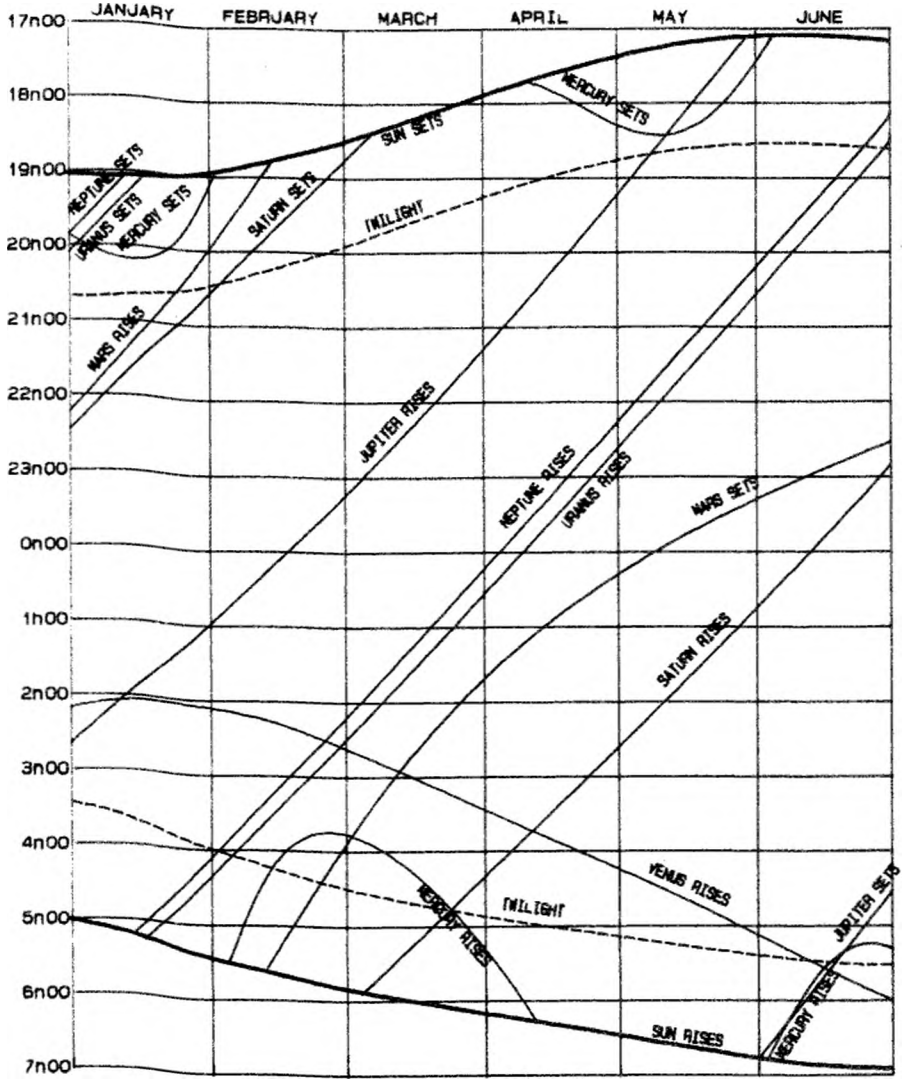


OBSERVING THE PLANETS

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.

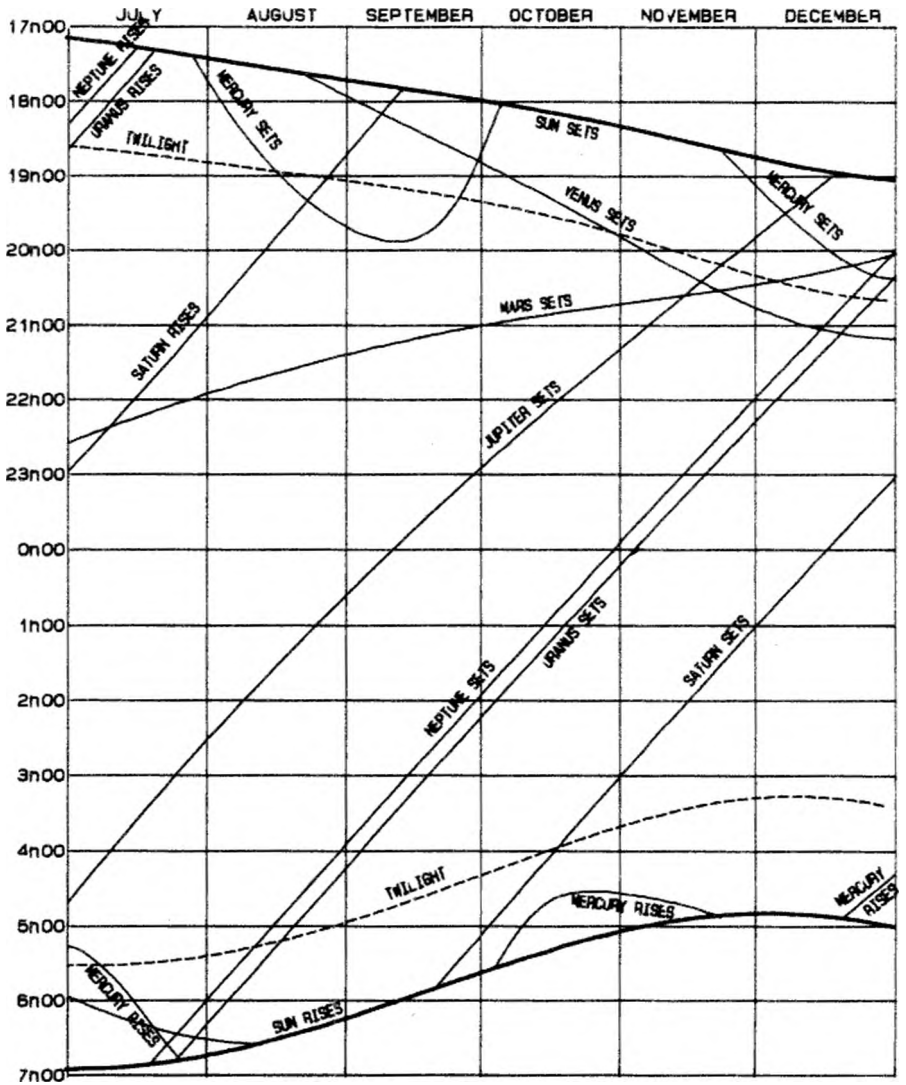
TIMES OF RISING AND SETTING

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 10 (at mag.+2.2) to April 6 (at mag.-1.1),
June 15 (at mag.+2.8) to July 20 (at mag.-1.5) and
October 12 (at mag.+1.5) to November 8 (at mag.-1.0)

The best conditions for viewing will occur from the third week of February until the third week of March when Mercury is in Capricornus and later in Aquarius.

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

January 1 (at mag.-0.9) to January 29 (at mag.+1.7),
April 22 (at mag.-1.6) to May 26 (at mag.+2.8),
August 6 (at mag.-1.1) to September 29 (at mag.+2.4) and
December 10 to 31 (at mag.-0.7).

The best conditions for viewing will be from the third week of August when the planet will be in Leo until the third week of September when the planet will be in Virgo.

	d h	d h	d h	d h
Superior Conjunction		Apr 14 15	Jul 28 4	Nov 23 7
Greatest Elongation East	Jan 19 10 (19°)	May 12 4 (22°)	Sep 9 6 (27°)	
Stationary	Jan 25 14	May 24 18	Sep 22 8	
Inferior Conjunction	Feb 4 1	Jun 5 8	Oct 5 3	
Stationary	Feb 15 21	Jun 17 8	Oct 13 11	
Greatest Elongation West	Mar 1 13 (27°)	Jun 29 18 (22°)	Oct 20 16 (18°)	

VENUS

Venus will be in the morning sky (at mag.-4.5) until mid July (at mag.-3.9). It returns to the evening sky from late September (at mag. -3.9) and remains an evening sky object for the rest of the year (at mag.-4.0).

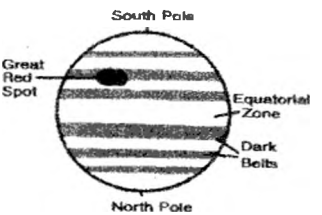
	d h
Greatest Elongation West	Jan 13 14 (47°)
Venus superior conjunction	Aug 21 2

MARS

Mars (at mag.-0.4), visible most of the night, begins the year in the constellation of Leo, passing to Cancer in early January and back into Leo in the third week of April (at mag. +0.3), to Virgo in early July (at mag.+1.2), to Libra in mid September (at mag.+1.4), to Scorpius after mid October, then to Ophiuchus in late October, and to Sagittarius towards the end of November (at mag.+1.3). Late December will find the planet too close to the Sun to be seen.

JUPITER

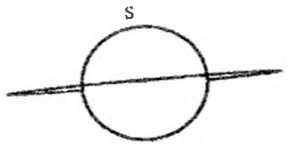
Jupiter begins the year in Scorpius (at mag.-1.8) as a morning sky object,passes to Ophiuchus in mid January and by early March (at mag.-2.1) will be visible for more than half the night sothat by June (at mag.-2.6) it will be visibleall night. In early July it passes back into Scorpius and in late August returns to Ophiuchus where after mid September (at mag.-2.0) will only be seen in the evening sky. It becomes too close to the Sun to be seen by early December.



SATURN

Saturn, seen in Aquarius all year, will be in the evening sky from 1 January until mid February. It will reappear in the morning sky after mid March (at mag. +1.1). It will be an all night object by mid September (at mag. +0.7) but becomes an evening sky object from mid December at magnitude +1.1. The rings, in the edge

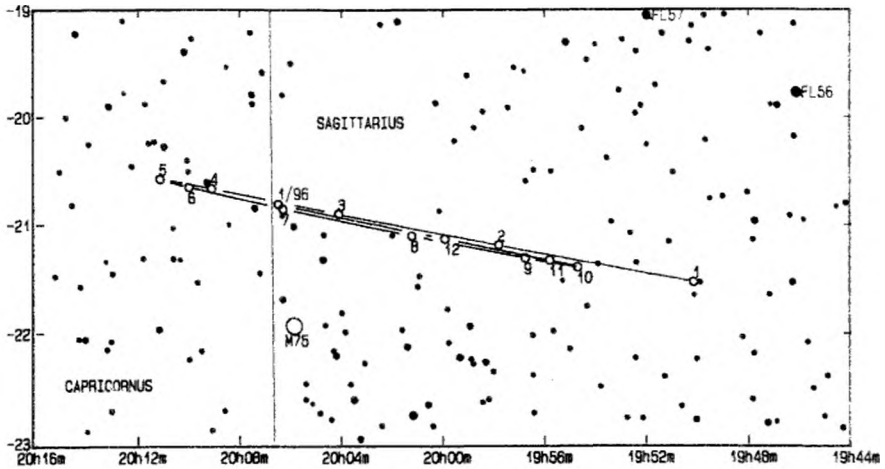
on position, will probably be not be visible during most of the year, the Earth passing through the ring plane in May and August.



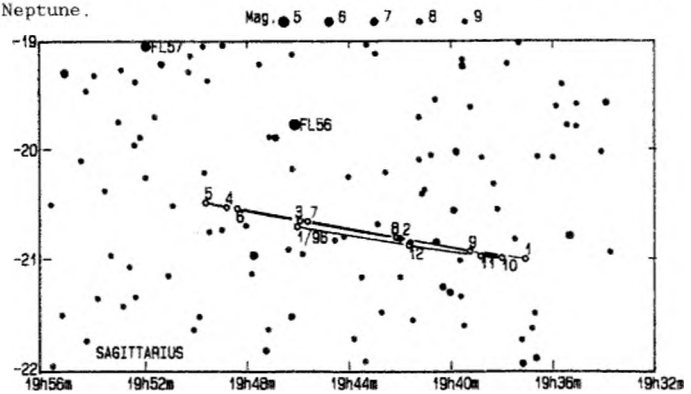
URANUS AND NEPTUNE

Uranus,in Sagittarius except from mid March to very late June when it is in Capricornus, is at magnitude 5.6 at opposition on July 20 and Neptune, in Sagittarius all year, is at magnitude +7.9. at opposition on July 17.

The Path of Uranus.



The Path of Neptune.



PLUTO

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

EVENTS OF INTEREST

Evening Sky:

1 Jan	to 29 Jan	Mercury and Saturn visible
12 Feb	to 17 Feb	Mars and Saturn visible
22 Apr	to 26 May	Mercury and Mars visible
1 Jun	to 5 Aug	Mars and Jupiter visible
6 Aug	to 13 Sep	Mercury, Mars and Jupiter visible
14 Sep	to 26 Sep	Mercury, Mars, Jupiter and Saturn visible
27 Sep	to 29 Sep	Mercury, Venus, Mars, Jupiter and Saturn visible
28 Sep		Mercury and Venus in conjunction

30 Sep to 6 Dec Venus, Mars, Jupiter and Saturn visible
16 Nov Mars and Jupiter in conjunction
19 Nov Venus and Jupiter in conjunction
23 Nov Venus and Mars in conjunction
7 Dec to 9 Dec Venus, Mars and Saturn visible
10 Dec to 29 Dec Mercury, Venus, Mars and Saturn visible
23 Dec Mercury and Mars in conjunction
30 Dec to 31 Dec Mercury, Venus and Saturn visible

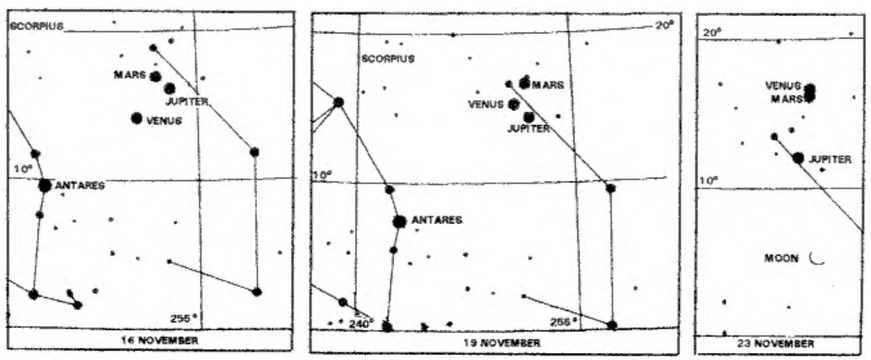
Morning Sky:
1 Jan to 9 Feb Venus, Mars and Jupiter visible
10 Feb to 12 Feb Mercury, Venus, Mars and Jupiter visible
13 Feb to 23 Mar Mercury, Venus and Jupiter visible
14 Jan Venus and Jupiter in conjunction
24 Mar to 6 Apr Mercury, Venus, Jupiter and Saturn visible
7 Apr to 1 Jun Venus, Jupiter and Saturn visible
2 Jun to 14 Jun Venus and Saturn visible
15 Jun to 15 Jul Mercury, Venus and Saturn visible
16 Jul to 20 Jul Mercury and Saturn visible
26 Mar Mercury and Saturn in conjunction
13 Apr Venus and Saturn in conjunction
19 Jun Mercury and Venus in conjunction

APPARENT PLACES:

	Mercury		Venus		Mars		Jupiter	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	19 29.8	-24 1	15 29.6	-15 14	10 23.6	13 46	16 11.7	-20 20
Jan 11	20 36.9	-20 19	16 8.6	-17 18	10 22.6	14 16	16 19.9	-20 40
Jan 21	21 25.8	-15 3	16 51.3	-19 8	10 16.4	15 12	16 27.6	-20 58
Jan 31	21 22.0	-12 24	17 37.0	-20 26	10 5.3	16 30	16 34.7	-21 13
Feb 10	20 38.4	-14 55	18 24.9	-21 0	9 50.6	17 53	16 41.0	-21 25
Feb 20	20 33.5	-17 10	19 14.0	-20 41	9 34.9	19 7	16 46.4	-21 34
Mar 2	21 6.0	-16 58	20 3.4	-19 25	9 21.1	19 57	16 50.8	-21 41
Mar 12	21 55.2	-14 24	20 52.2	-17 15	9 11.4	20 18	16 54.1	-21 46
Mar 22	22 52.2	-9 40	21 40.1	-14 15	9 7.0	20 13	16 56.2	-21 49
Apr 1	23 54.7	-2 56	22 26.8	-10 36	9 7.6	19 46	16 56.9	-21 49
Apr 11	1 3.9	5 28	23 12.4	-6 26	9 12.7	19 1	16 56.3	-21 48
Apr 21	2 21.1	14 29	23 57.2	-1 56	9 21.5	18 0	16 54.4	-21 45
May 1	3 37.9	21 30	0 41.8	2 42	9 33.1	16 46	16 51.3	-21 40
May 11	4 37.2	24 37	1 26.8	7 17	9 47.0	15 19	16 47.2	-21 33
May 21	5 6.9	24 18	2 12.6	11 39	10 2.7	13 41	16 42.3	-21 24
May 31	5 3.2	21 39	2 59.9	15 35	10 19.7	11 52	16 36.9	-21 15
Jun 10	4 42.5	18 33	3 48.8	18 54	10 37.8	9 53	16 31.6	-21 5
Jun 20	4 36.5	17 42	4 39.6	21 24	10 56.7	7 46	16 26.5	-20 56
Jun 30	5 0.5	19 31	5 32.0	22 56	11 16.4	5 32	16 22.1	-20 47
Jul 10	5 55.0	22 15	6 25.2	23 23	11 36.7	3 11	16 18.6	-20 41
Jul 20	7 16.3	23 3	7 18.4	22 41	11 57.7	0 44	16 16.2	-20 37
Jul 30	8 45.8	19 48	8 10.9	20 53	12 19.3	-1 46	16 15.0	-20 37
Aug 9	10 3.5	13 32	9 1.8	18 4	12 41.6	-4 18	16 15.2	-20 39
Aug 19	11 6.5	6 18	9 51.0	14 25	13 4.6	-6 51	16 16.6	-20 45
Aug 29	11 58.2	-0 45	10 38.5	10 6	13 28.4	-9 22	16 19.2	-20 54
Sep 8	12 39.5	-6 48	11 24.7	5 20	13 53.1	-11 50	16 23.0	-21 4
Sep 18	13 5.4	-10 50	12 10.2	0 18	14 18.8	-14 13	16 27.9	-21 17
Sep 28	13 2.0	-10 35	12 55.7	-4 47	14 45.5	-16 27	16 33.7	-21 31
Oct 8	12 28.0	-4 21	13 41.8	-9 43	15 13.2	-18 30	16 40.4	-21 46
Oct 18	12 25.8	-1 8	14 29.1	-14 17	15 42.2	-20 19	16 47.9	-22 1
Oct 28	13 10.5	-5 16	15 18.3	-18 16	16 12.2	-21 51	16 56.0	-22 16
Nov 7	14 10.0	-11 43	16 9.5	-21 27	16 43.3	-23 4	17 4.7	-22 29
Nov 17	15 12.6	-17 40	17 2.6	-23 38	17 15.3	-23 55	17 13.8	-22 42
Nov 27	16 17.4	-22 14	17 57.0	-24 40	17 48.1	-24 20	17 23.3	-22 52
Dec 7	17 24.8	-24 57	18 51.6	-24 27	18 21.4	-24 20	17 33.0	-23 1
Dec 17	18 33.6	-25 26	19 45.3	-23 0	18 54.9	-23 52	17 42.9	-23 7
Dec 27	19 39.1	-23 29	20 37.3	-20 25	19 28.4	-22 57	17 52.8	-23 10

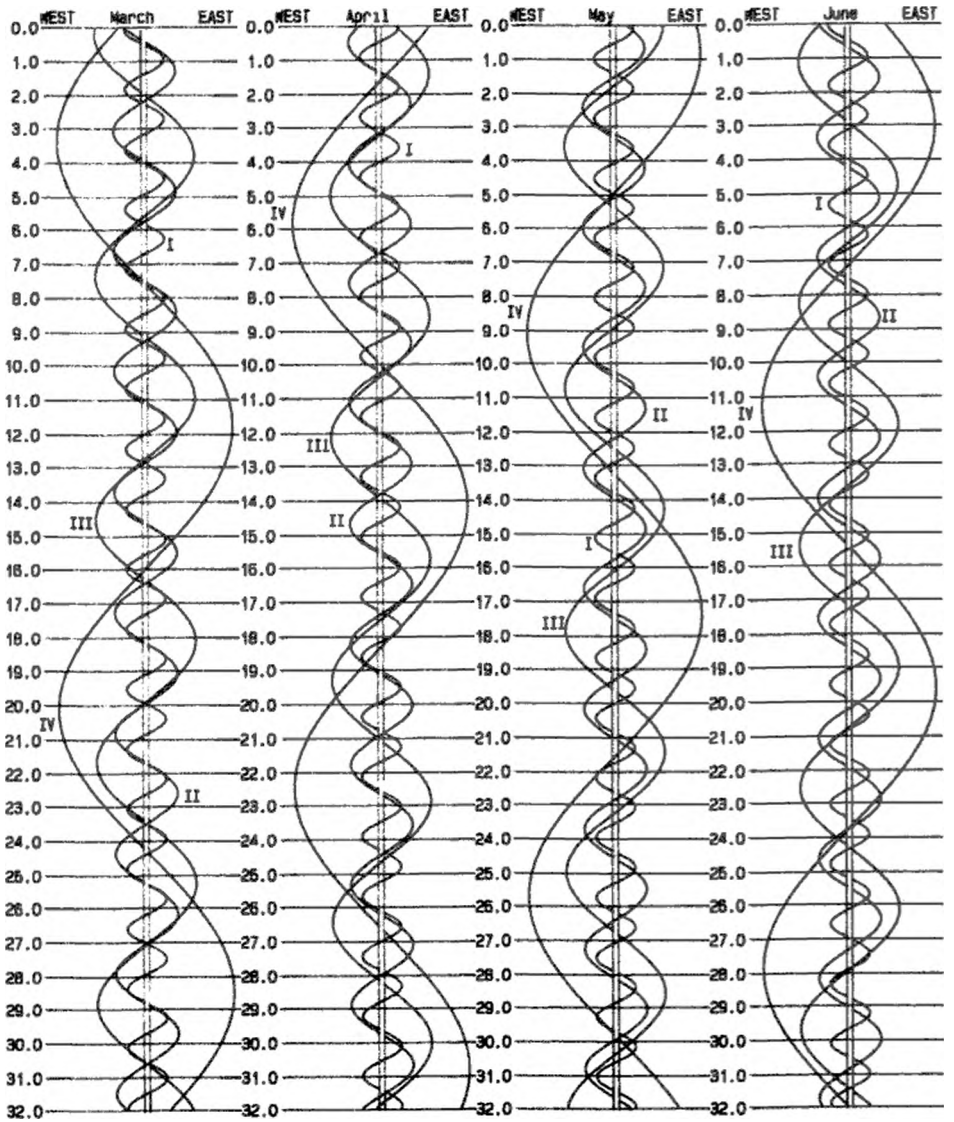
	Saturn		Uranus		Neptune		Pluto	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	22 41.3	-10 14	19 50.1	-21 32	19 37.1	-21 0	16 0.7	-7 1
Jan 11	22 44.7	-9 53	19 52.6	-21 25	19 38.7	-20 57	16 1.9	-7 2
Jan 21	22 48.4	-9 30	19 55.1	-21 19	19 40.3	-20 53	16 3.0	-7 2
Jan 31	22 52.4	-9 5	19 57.6	-21 12	19 41.9	-20 49	16 3.8	-7 1
Feb 10	22 56.7	-8 39	20 0.0	-21 5	19 43.4	-20 46	16 4.5	-6 59
Feb 20	23 1.1	-8 11	20 2.2	-20 59	19 44.8	-20 42	16 4.9	-6 57
Mar 2	23 5.7	-7 43	20 4.3	-20 53	19 46.1	-20 39	16 5.1	-6 53
Mar 12	23 10.3	-7 15	20 6.2	-20 48	19 47.2	-20 36	16 5.1	-6 49
Mar 22	23 14.8	-6 47	20 7.8	-20 43	19 48.1	-20 34	16 4.9	-6 45
Apr 1	23 19.2	-6 20	20 9.1	-20 40	19 48.8	-20 32	16 4.5	-6 40
Apr 11	23 23.5	-5 55	20 10.1	-20 37	19 49.3	-20 30	16 3.8	-6 36
Apr 21	23 27.5	-5 31	20 10.8	-20 35	19 49.6	-20 29	16 3.0	-6 31
May 1	23 31.2	-5 9	20 11.2	-20 34	19 49.6	-20 29	16 2.1	-6 27
May 11	23 34.5	-4 49	20 11.1	-20 35	19 49.5	-20 30	16 1.1	-6 23
May 21	23 37.4	-4 33	20 10.8	-20 36	19 49.1	-20 31	16 0.1	-6 21
May 31	23 39.9	-4 20	20 10.1	-20 39	19 48.5	-20 32	15 59.0	-6 18
Jun 10	23 41.8	-4 10	20 9.1	-20 42	19 47.7	-20 34	15 58.0	-6 17
Jun 20	23 43.2	-4 4	20 7.9	-20 46	19 46.8	-20 36	15 57.0	-6 17
Jun 30	23 44.0	-4 2	20 6.5	-20 50	19 45.7	-20 39	15 56.1	-6 18
Jul 10	23 44.1	-4 4	20 4.9	-20 55	19 44.6	-20 42	15 55.4	-6 19
Jul 20	23 43.6	-4 9	20 3.2	-21 0	19 43.5	-20 45	15 54.9	-6 22
Jul 30	23 42.6	-4 19	20 1.6	-21 5	19 42.4	-20 48	15 54.5	-6 26
Aug 9	23 41.0	-4 32	19 59.9	-21 10	19 41.3	-20 51	15 54.3	-6 31
Aug 19	23 38.9	-4 47	19 58.4	-21 14	19 40.3	-20 53	15 54.4	-6 36
Aug 29	23 36.5	-5 4	19 57.1	-21 18	19 39.5	-20 55	15 54.6	-6 43
Sep 8	23 33.8	-5 23	19 56.0	-21 20	19 38.8	-20 57	15 55.1	-6 49
Sep 18	23 30.9	-5 42	19 55.2	-21 22	19 38.3	-20 59	15 55.8	-6 56
Sep 28	23 28.1	-6 0	19 54.8	-21 23	19 38.0	-21 0	15 56.6	-7 4
Oct 8	23 25.5	-6 16	19 54.6	-21 24	19 38.0	-21 0	15 57.7	-7 11
Oct 18	23 23.3	-6 29	19 54.9	-21 23	19 38.2	-21 0	15 58.9	-7 18
Oct 28	23 21.4	-6 40	19 55.5	-21 21	19 38.6	-20 59	16 0.2	-7 25
Nov 7	23 20.1	-6 46	19 56.4	-21 18	19 39.3	-20 58	16 1.6	-7 32
Nov 17	23 19.5	-6 49	19 57.7	-21 14	19 40.1	-20 56	16 3.1	-7 38
Nov 27	23 19.4	-6 47	19 59.2	-21 10	19 41.2	-20 54	16 4.6	-7 43
Dec 7	23 20.0	-6 41	20 1.0	-21 5	19 42.4	-20 51	16 6.1	-7 48
Dec 17	23 21.3	-6 31	20 3.1	-20 59	19 43.8	-20 48	16 7.6	-7 52
Dec 27	23 23.2	-6 17	20 5.3	-20 52	19 45.3	-20 44	16 9.0	-7 55

THE CONJUNCTIONS 16 NOVEMBER - 23 NOVEMBER AT 20:00 CAPE TOWN

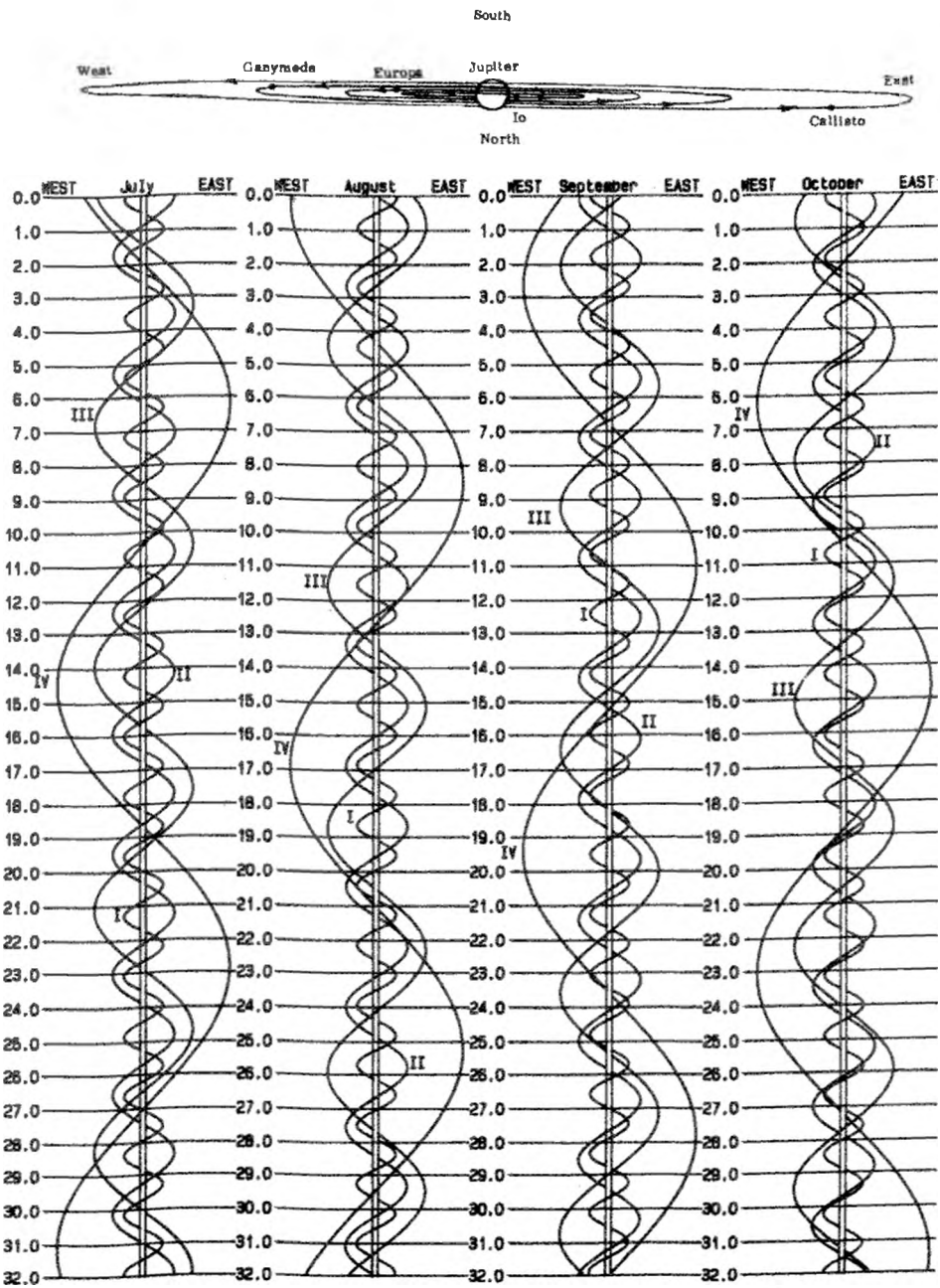


THE MOONS OF JUPITER

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	13	04	04	II.Ec.D.	Mar	11	05	50	II.Oc.R.	Apr	10	05	45	I.Ec.D.	May	03	05	53	I.Ec.D.
	16	04	18	I.Sh.I		12	00	58	I.Sh.I.			05	49	II.Sh.I.		04	03	09	I.Sh.I.
		05	12	I.Tr.I.			02	12	I.Tr.I.		11	03	00	I.Sh.I.			03	49	I.Tr.I.
	22	03	42	II.Tr.I.			03	17	I.Sh.E.			04	02	I.Tr.I.			05	20	I.Sh.E.
		04	12	II.Sh.E.			04	22	I.Tr.E.			05	10	I.Sh.E.			05	59	I.Tr.E.
	24	03	31	I.Ec.D.		13	01	38	I.Oc.R.		12	00	13	I.Ec.D.		05	00	21	I.Ec.D.
	25	03	51	I.Tr.E.		16	04	34	III.Ec.D.			00	27	II.Ec.D.			02	43	II.Sh.I.
		05	01	III.Oc.D.		18	03	21	II.Ec.D.			03	24	I.Oc.R.			03	09	I.Oc.R.
	29	04	20	II.Sh.I.			05	38	I.Ec.D.			05	03	II.Oc.R.			03	59	II.Tr.I.
	31	03	13	II.Oc.R.			05	51	II.Ec.R.			23	39	I.Sh.E.			05	13	II.Sh.E.
Feb	01	03	38	I.Tr.I.			05	52	II.Oc.D.		13	00	39	I.Tr.E.			21	38	I.Sh.I.
		04	43	I.Sh.E.		19	02	51	I.Sh.I.			23	30	II.Tr.E.			22	15	I.Tr.I.
		04	51	III.Ec.D.			04	04	I.Tr.I.		14	00	30	III.Oc.D.			23	49	I.Sh.E.
	02	03	08	I.Oc.R.			05	01	I.Sh.E.			02	30	III.Oc.R.		06	00	25	I.Tr.E.
	08	04	27	I.Sh.I.		20	00	34	II.Tr.I.		18	04	53	I.Sh.I.			21	32	II.Ec.D.
		05	35	I.Tr.I.			00	38	II.Sh.E.			05	50	I.Tr.I.			21	35	I.Oc.R.
	09	05	05	I.Oc.R.			01	31	III.Tr.E.		19	02	06	I.Ec.D.		07	01	16	II.Oc.R.
	12	03	29	III.Tr.I.			03	02	II.Tr.E.			03	03	II.Ec.D.		08	22	13	III.Sh.I.
		05	33	III.Tr.E.			03	30	I.Oc.R.			05	11	I.Oc.R.		09	00	26	III.Sh.E.
	14	03	42	II.Ec.D.		21	00	42	I.Tr.E.			23	22	I.Sh.I.			00	34	III.Tr.I.
	16	03	32	II.Tr.E.		26	04	44	I.Sh.I.		20	00	16	I.Tr.I.			02	32	III.Tr.E.
		03	38	I.Ec.D.			05	56	I.Tr.I.			01	33	I.Sh.E.		11	05	03	I.Sh.I.
	17	02	58	I.Sh.E.		27	00	35	III.Sh.E.			02	27	I.Tr.E.			05	34	I.Tr.I.
		04	11	I.Tr.E.			00	43	II.Sh.I.			23	23	II.Tr.I.		12	02	15	I.Ec.D.
	19	02	39	III.Sh.I.			01	59	I.Ec.D.			23	38	I.Oc.R.			04	54	I.Oc.R.
		04	44	III.Sh.E.			03	02	II.Tr.I.		21	00	06	II.Sh.E.			05	17	II.Sh.I.
	23	03	41	II.Tr.I.			03	11	II.Sh.E.			00	21	III.Ec.D.			06	14	II.Tr.I.
		03	42	II.Sh.E.			03	20	III.Tr.I.			01	51	II.Tr.E.			23	32	I.Sh.I.
		05	31	I.Ec.D.			05	19	III.Tr.E.			02	33	III.Ec.R.		13	00	00	I.Tr.I.
	24	02	42	I.Sh.I.			05	20	I.Oc.R.			04	02	III.Oc.D.			01	43	I.Sh.E.
		03	56	I.Tr.I.			05	30	II.Tr.E.			06	03	III.Oc.R.			02	10	I.Tr.E.
		04	52	I.Sh.E.		28	00	23	I.Tr.I.		26	04	00	I.Ec.D.			20	43	I.Ec.D.
	25	03	24	I.Oc.R.			01	23	I.Sh.E.			05	39	II.Ec.D.			23	20	I.Oc.R.
Mar	02	01	46	III.Oc.D.			02	33	I.Tr.E.		27	01	16	I.Sh.I.		14	00	08	II.Ec.D.
		03	49	II.Sh.I.			23	47	I.Oc.R.			02	03	I.Tr.I.			03	33	II.Oc.R.
		03	51	III.Oc.R.		29	00	10	II.Oc.R.			03	26	I.Sh.E.			20	36	I.Tr.E.
	03	04	36	I.Sh.I.	Apr	03	02	25	III.Sh.I.			04	13	I.Tr.E.		15	21	04	II.Sh.E.
		05	50	I.Tr.I.			03	16	II.Sh.I.			22	28	I.Ec.D.			21	50	II.Tr.E.
	04	01	52	I.Ec.D.			03	52	I.Ec.D.		28	00	10	II.Sh.I.		16	02	12	III.Sh.I.
		03	15	II.Oc.R.			04	33	III.Sh.E.			01	24	I.Oc.R.			03	54	III.Tr.I.
		05	17	I.Oc.R.			05	28	II.Tr.I.			01	42	II.Tr.I.			04	25	III.Sh.E.
	05	01	14	I.Sh.E.			05	44	II.Sh.E.			02	40	II.Sh.E.			05	53	III.Tr.E.
		02	29	I.Tr.E.		04	01	06	I.Sh.I.			04	09	II.Tr.E.		19	04	08	I.Ec.D.
	09	02	46	III.Ec.R.			02	13	I.Tr.I.			04	18	III.Ec.D.		20	01	26	I.Sh.I.
		05	44	III.Oc.D.			03	17	I.Sh.E.			21	55	I.Sh.E.			01	44	I.Tr.I.
	11	03	16	II.Ec.R.			04	23	I.Tr.E.			22	40	I.Tr.E.			03	37	I.Sh.E.
		03	19	II.Oc.D.		05	01	36	I.Oc.R.		29	22	57	II.Oc.R.			03	55	I.Tr.E.
		03	45	I.Ec.D.			02	38	II.Oc.R.	May	01	23	10	III.Tr.E.			22	37	I.Ec.D.

	d	h	m	
May	21	01	03	I.Oc.R.
		02	45	II.Ec.D.
		05	50	II.Oc.R.
		20	10	I.Tr.I.
		22	06	I.Sh.E.
		22	21	I.Tr.E.
	22	21	07	II.Sh.I.
		21	36	II.Tr.I.
		23	38	II.Sh.E.
	23	00	04	II.Tr.E.
		06	10	III.Sh.I.
	26	06	02	I.Ec.D.
		20	09	III.Ec.D.
		22	51	III.Oc.R.
	27	03	20	I.Sh.I.
		03	28	I.Tr.I.
		05	31	I.Sh.E.
		05	39	I.Tr.E.
	28	00	30	I.Ec.D.
		02	47	I.Oc.R.
		05	21	II.Ec.D.
		21	49	I.Sh.I.
		21	54	I.Tr.I.
	29	00	00	I.Sh.E.
		00	05	I.Tr.E.
		21	13	I.Oc.R.
		23	41	II.Sh.I.
		23	49	II.Tr.I.
	30	02	12	II.Sh.E.
		02	18	II.Tr.E.
	31	21	13	II.Oc.R.
Jun	03	00	05	III.Oc.D.
		02	24	III.Ec.R.
		05	12	I.Tr.I.
		05	14	I.Sh.I.
	04	02	21	I.Oc.D.
		04	35	I.Ec.R.
		23	38	I.Tr.I.
		23	43	I.Sh.I.
	05	01	49	I.Tr.E.
		01	55	I.Sh.E.
		20	47	I.Oc.D.
		23	04	I.Ec.R.
	06	02	03	II.Tr.I.
		02	15	II.Sh.I.
		04	31	II.Tr.E.
		04	46	II.Sh.E.
		20	15	I.Tr.E.
		20	23	I.Sh.E.
	07	20	58	II.Oc.D.
		23	49	II.Ec.R.
	10	03	21	III.Oc.D.
	11	04	05	I.Oc.D.
	12	01	23	I.Tr.I.
		01	38	I.Sh.I.
		03	33	I.Tr.E.
		03	49	I.Sh.E.
		22	31	I.Oc.D.
	13	00	58	I.Ec.R.
		04	17	II.Tr.I.
		04	49	II.Sh.I.
		19	03	III.Tr.E.
		19	49	I.Tr.I.

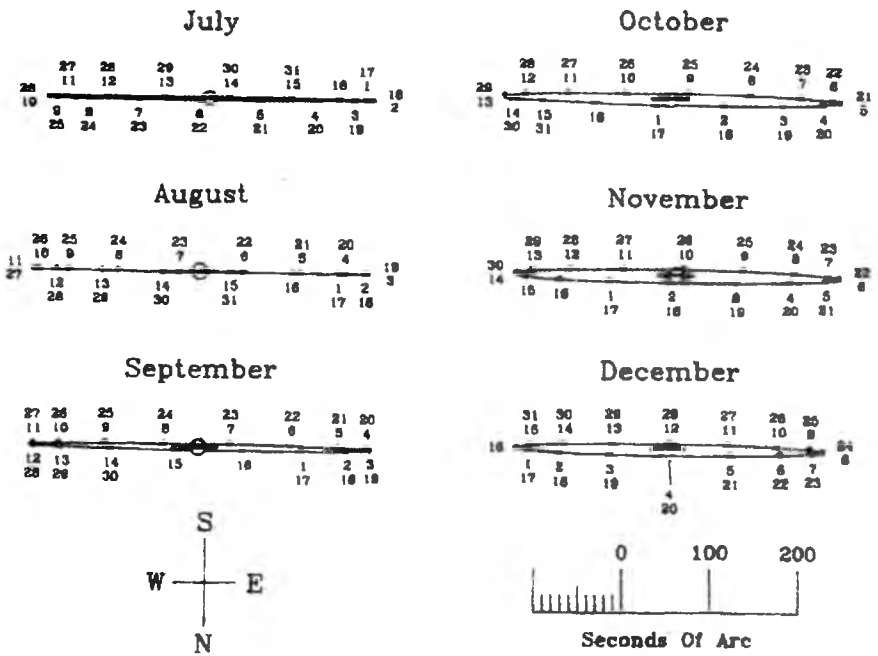
	d	h	m	
Jun	13	20	06	I.Sh.I.
		20	21	III.Sh.E.
		21	59	I.Tr.E.
		22	18	I.Sh.E.
	14	19	26	I.Ec.R.
		23	14	II.Oc.D.
	15	02	25	II.Ec.R.
	16	19	53	II.Tr.E.
		20	38	II.Sh.E.
	19	03	07	I.Tr.I.
		03	32	I.Sh.I.
	20	00	15	I.Oc.D.
		02	52	I.Ec.R.
		20	18	III.Tr.I.
		21	33	I.Tr.I.
		22	01	I.Sh.I.
		22	04	III.Sh.I.
		22	24	III.Tr.E.
		23	44	I.Tr.E.
	21	00	12	I.Sh.E.
		00	21	III.Sh.E.
		18	41	I.Oc.D.
		21	21	I.Ec.R.
	22	01	31	II.Oc.D.
		18	41	I.Sh.E.
	23	19	40	II.Tr.I.
		20	41	II.Sh.I.
		22	09	II.Tr.E.
		23	13	II.Sh.E.
	27	02	00	I.Oc.D.
		23	19	I.Tr.I.
		23	38	III.Tr.I.
		23	55	I.Sh.I.
	28	01	30	I.Tr.E.
		01	46	III.Tr.E.
		02	03	III.Sh.I.
		02	07	I.Sh.E.
		20	26	I.Oc.D.
		23	15	I.Ec.R.
	29	19	56	I.Tr.E.
		20	35	I.Sh.E.
	30	21	57	II.Tr.I.
		23	16	II.Sh.I.
Jul	01	00	26	II.Tr.E.
		01	48	II.Sh.E.
	02	20	57	II.Ec.R.
	05	01	05	I.Tr.I.
		01	50	I.Sh.I.
		03	02	III.Tr.I.
		03	16	I.Tr.E.
		22	12	I.Oc.D.
	06	01	10	I.Ec.R.
		19	32	I.Tr.I.
		20	19	I.Sh.I.
		21	43	I.Tr.E.
		22	30	I.Sh.E.
	07	19	38	I.Ec.R.
	08	00	16	II.Tr.I.
		01	51	II.Sh.I.
		02	46	II.Tr.E.
		18	56	III.Oc.R.
		19	59	III.Ec.D.
		22	20	III.Ec.R.

	d	h	m	
Jul	09	19	18	II.Oc.D.
		23	33	II.Ec.R.
	12	23	59	I.Oc.D.
	13	21	20	I.Tr.I.
		22	14	I.Sh.I.
		23	30	I.Tr.E.
	14	00	25	I.Sh.E.
		21	33	I.Ec.R.
	15	18	53	I.Sh.E.
		20	13	III.Oc.D.
		22	28	III.Oc.R.
		23	59	III.Ec.D.
	16	02	20	III.Ec.R.
		21	40	II.Oc.D.
	17	02	10	II.Ec.R.
	18	20	18	II.Sh.E.
	20	01	48	I.Oc.D.
		23	08	I.Tr.I.
	21	00	09	I.Sh.I.
		01	19	I.Tr.E.
		20	15	I.Oc.D.
		23	28	I.Ec.R.
	22	19	46	I.Tr.E.
		20	48	I.Sh.E.
		23	46	III.Oc.D.
	24	00	04	II.Oc.D.
	25	20	20	II.Sh.I.
		20	43	II.Tr.E.
		22	54	II.Sh.E.
	26	20	19	III.Sh.E.
	28	00	58	I.Tr.I.
		22	04	I.Oc.D.
	29	01	23	I.Ec.R.
		19	26	I.Tr.I.
		20	32	I.Sh.I.
		21	36	I.Tr.E.
		22	43	I.Sh.E.
	30	19	52	I.Ec.R.
Aug	01	20	39	II.Tr.I.
		22	56	II.Sh.I.
		23	10	II.Tr.E.
	02	19	33	III.Tr.E.
		21	58	III.Sh.I.
	03	00	19	III.Sh.E.
		20	40	II.Ec.R.
	04	23	55	I.Oc.D.
	05	21	17	I.Tr.I.
		22	27	I.Sh.I.
		23	27	I.Tr.E
	06	00	38	I.Sh.E.
		21	47	I.Ec.R.
	07	19	07	I.Sh.E.
	08	23	08	II.Tr.I.
	09	21	01	III.Tr.I.
		23	20	III.Tr.E.
	10	23	17	II.Ec.R.
	12	23	09	I.Tr.I.
	13	00	22	I.Sh.I.
		20	15	I.Oc.D.
		23	42	I.Ec.R.
	14	18	51	I.Sh.I.
		19	47	I.Tr.E.
		21	02	I.Sh.E.

	d	h	m	
Aug	17	20	46	II.Oc.D.
		19	20	02	II.Sh.E.
		20	19	54	III.Ec.D.
			22	08	I.Oc.D.
			22	20	III.Ec.R.
		21	19	30	I.Tr.I.
			20	46	I.Sh.I.
			21	41	I.Tr.E.
			22	57	I.Sh.E.
	22	20	06	I.Ec.R.
	24	23	19	II.Oc.D.
	26	20	02	II.Tr.E.
			20	04	II.Sh.I.
			22	39	II.Sh.E.
	27	21	06	III.Oc.R.
	28	21	25	I.Tr.I.
			22	41	I.Sh.I.
			23	35	I.Tr.E.
	29	22	01	I.Ec.R.
	30	19	20	I.Sh.E.
Sep	02	20	06	II.Tr.I.
			22	40	II.Tr.E.
			22	41	II.Sh.I.
	03	22	40	III.Oc.D.
	04	20	22	II.Ec.R.
	05	20	27	I.Oc.D.
	06	19	05	I.Sh.I.
			20	00	I.Tr.E.
			21	15	I.Sh.E.
	07	20	20	III.Sh.E.
	09	22	45	II.Tr.I.
	12	22	24	I.Oc.D.
	13	19	45	I.Tr.I.
			21	00	I.Sh.I.
			21	56	I.Tr.E.
	14	19	16	III.Tr.E.
			20	21	I.Ec.R.
			21	54	III.Sh.I.
	18	20	31	II.Oc.D.
	20	19	51	II.Sh.E.
			21	43	I.Tr.I.
	21	18	50	I.Oc.D.
			20	57	III.Tr.I.
			22	16	I.Ec.R.
	22	19	34	I.Sh.E.
	27	19	51	II.Sh.I.
			20	06	II.Tr.E.
	28	20	49	I.Oc.D.
	29	19	18	I.Sh.I.
			20	21	I.Tr.E.
			21	29	I.Sh.E.
Oct	02	19	51	III.Ec.D.
	04	20	15	II.Tr.I.
	06	20	02	II.Ec.R.
			20	08	I.Tr.I.
			21	13	I.Sh.I.
	07	20	36	I.Ec.R.
	09	19	32	III.Oc.D.
	14	19	18	I.Oc.D.
	15	19	47	I.Sh.E.
	20	20	22	III.Sh.E.
			20	44	II.Oc.D.
	23	18	55	I.Ec.R.

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 diagrams which show its orbit when Saturn is most prominent and the information in the table below.



TITAN

Eastern Elongation			Inferior Conjunction			Western Elongation			Superior Conjunction		
	d	h		d	h		d	h		d	h
									Jan	2	21.4
Jan	6	18.5	Jan	10	22.6	Jan	15	01.4		18	21.4
	22	18.7		26	22.9		31	01.7	Feb	3	21.7
Feb	7	19.1	Feb	11	23.4	Feb	16	02.2		19	22.1
	23	19.6		28	00.0	Mar	4	02.7	Mar	7	22.5
Mar	11	20.2	Mar	16	00.7		20	03.2		23	22.9
	27	20.7	Apr	1	01.3	Apr	5	03.6	Apr	8	23.3
Apr	12	21.2	Apr	17	01.8		21	03.9		24	23.5
	28	21.4	May	3	02.0	May	7	04.0	May	10	23.5
May	14	21.5		19	02.0		23	03.9		26	23.2
	30	21.2	Jun	4	01.7	Jun	8	03.4	Jun	11	22.7
Jun	15	20.6		20	01.0		24	02.6		27	21.8
Jul	1	19.6	Jul	6	00.0	Jul	10	01.4	Jul	13	20.5
	17	18.3		21	22.5		25	23.8		29	18.8
Aug	2	16.5	Aug	6	20.6	Aug	10	21.8	Aug	14	16.8
	18	14.4		22	18.3		26	19.6		30	14.6
Sep	3	12.0	Sep	7	15.9	Sep	11	17.2	Sep	15	12.2
	19	09.5		23	13.4		27	14.8	Oct	1	09.8
Oct	5	07.1	Oct	9	11.0	Oct	13	12.5		17	07.6
	21	04.8		25	08.8		29	10.4	Nov	2	05.7
Nov	6	02.9	Nov	10	06.9	Nov	14	08.8		18	04.1
	22	01.4		26	05.5		30	07.5	Dec	4	02.9
Dec	8	00.4	Dec	12	04.6	Dec	16	06.6		20	02.1
	23	23.7		28	4.1						

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 1995, and which are predicted to become brighter than about magnitude 12. The table does not of course include any new comets which might possibly be discovered during the year.

COMET	PERIHELION DATE	PREDICTED MAXIMUM MAGNITUDE
Borrelly	1994 November 1	7.0
d'Arrest	1995 July 27	10.8
Tuttle Giacobini Kresak	1995 July 28	12.1
Schwassmann Wachmann 3	1995 September 22	12.2
Jackson Neujmin	1995 October 6	11.3
Honda Mrkos Pajdusakova	1995 December 26	6.9

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, sketches and 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 below. *Beginning observers should note that comets are notoriously unpredictable, and that the predicted brightness in the above table is given as a guide only.* The magnitude given is the total magnitude of the coma and the brightness is spread out across the whole diameter of the comet. For this reason the comet will appear much fainter than a star of the same magnitude. As a guide, a comet of magnitude 10-11 would appear about as bright as a star of magnitude 12-13.

Details on how to observe either comets or 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.

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 1995
α Crucids	Jan19	Jan06-Jan28	12h48	-63	<5	50	00h00	03h30	Unfavourable
θ Centaurids	Feb 8	Jan28-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	56	00h00	04h30	Poor
δ Pavonids	Apr 6	Mar11-Apr16	20h20	-63	5	59	02h00	04h30	Favourable
April Lyrids	Apr 22	Apr16-Apr24	18h05	+34	15	49	03h00	05h00	Good
π Puppids	Apr 23	Apr16-Apr25	07h20	-45	<5	18	19h00	22h00	Favourable
α Scorpiids	May 3	Apr11-May12	16h00	-22	5	35	21h00	04h00	Favourable
η Aquarids	May 4	Apr21-May12	22h24	-02	30	65	04h00	05h30	Favourable
χ Scorpiids	Jun 5	May27-Jun20	16h28	-13	5	21	21h00	04h30	Favourable
Sagittarids	Jun 11	Jun08-Jun16	20h16	-35	<5	52	03h30	05h30	Unfavourable
θ Ophiuchids	Jun 13	Jun08-Jun16	17h48	-28	5	27	20h00	05h30	Full Moon
June Lyrids	Jun 16	Jun11-Jun21	18h32	+35	9	31	23h30	02h00	Poor
Ophiuchids	Jun 20	Jun17-Jun26	17h20	-20	10	?	20h00	05h00	Poor
Cetids	Jun 28	Jun26-Jun29	02h00	-15	<5	?	03h00	05h30	New Moon
Capricornids	Jul 26	Jul10-Aug05	21h00	-15	8	?	20h30	05h30	Favourable
Piscis Australids	Jul 28	Jul19-Aug17	22h40	-30	8	35	21h30	05h00	Favourable
South δ Aquarids	Jul 29	Jul21-Aug29	22h12	-16	30	42	22h00	05h00	Favourable
α Capricornids	Jul 30	Jul15-Aug25	20h36	-10	10	25	20h00	04h00	Favourable
South ι Aquarids	Aug 5	Jul15-Aug25	22h20	-15	<5	34	22h00	04h30	Good
North δ Aquarids	Aug 12	Jul14-Aug25	22h36	-05	10	42	23h00	05h00	Unfavourable
North ι Aquarids	Aug 20	Jul15-Sep20	21h48	-06	10	36	20h00	05h00	Good
Orionids	Oct 21	Oct02-Nov07	06h24	+16	30	68	02h00	04h00	Favourable
Southern Taurids	Nov 3	Sep15-Dec01	03h22	+14	10	29	21h30	03h30	Unfavourable
Northern Taurids	Nov 13	Sep19-Dec01	03h53	+22	5	31	21h30	03h30	Good
Leonids	Nov 17	Nov14-Nov20	10h08	+22	5	70	03h00	04h00	Poor
Dec. Phoenicids	Dec 5	Dec03-Dec05	01h00	-55	5	22	20h30	01h00	Unfavourable
Geminids	Dec 14	Dec04-Dec16	07h28	+32	50	36	23h30	03h00	Poor
Velids	Dec 29	Dec05-Jan07	09h56	-51	5	40	22h30	03h30	Good

Notes to Table: 1.)The radiant of most showers drifts slightly eastward each night. The position given is for night of maximum. 2.)The ZHR is the expected maximum rate under observing conditions when stars of magnitude 6.5 can be discerned and with the radiant at the zenith. Rates under poorer conditions and when the radiant is low will consequently be lower. 3.)Showers listed as favourable are the best prospects for observation. Those listed as good may be observed under slight hindrance from the moon

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 ß (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

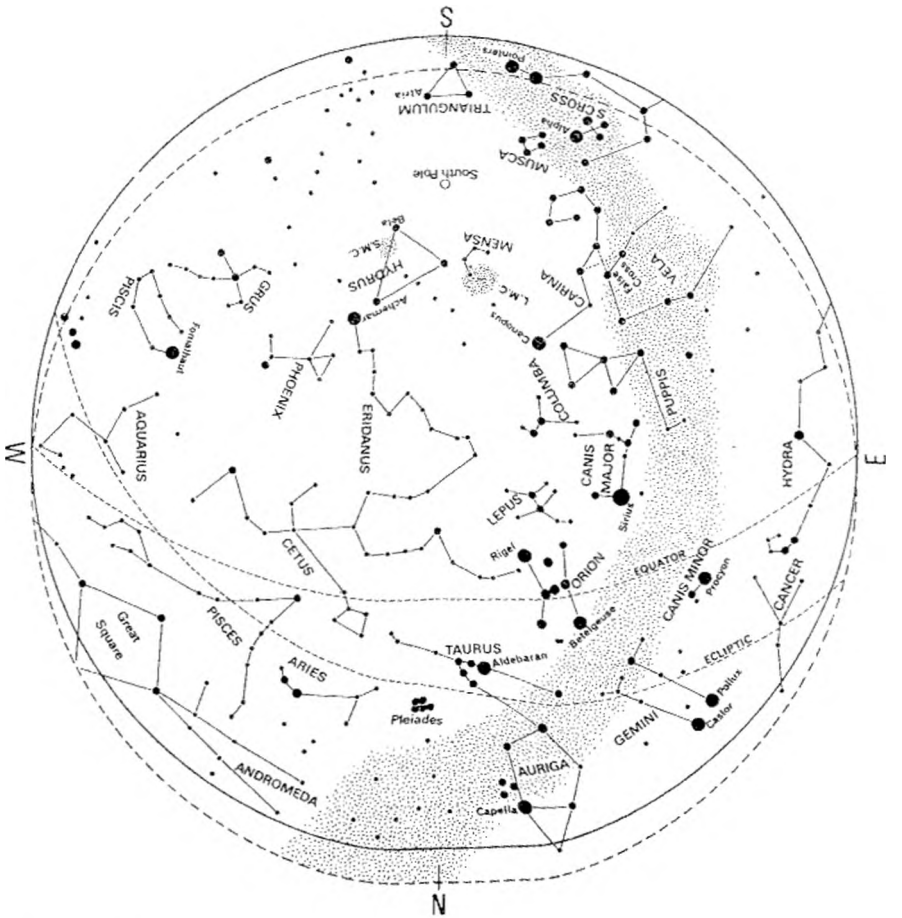
The star charts in this section show the night sky for each of the four seasons of the year. These seasonal charts depict stars down to magnitude 3.5 which is approximately what will be visible to the naked eye in city areas. Charts of 3 of the most interesting regions in the sky (showing stars down 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

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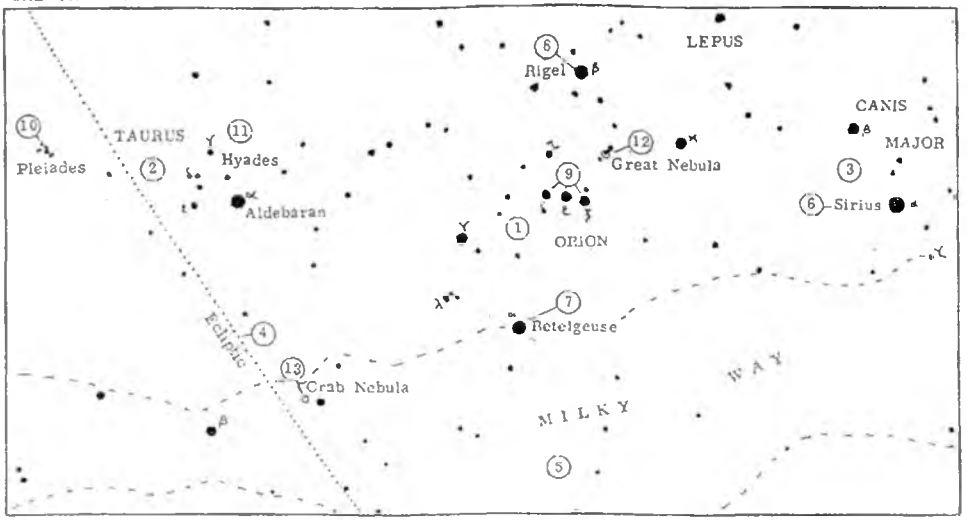
THE ORION REGION



(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 - η 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.

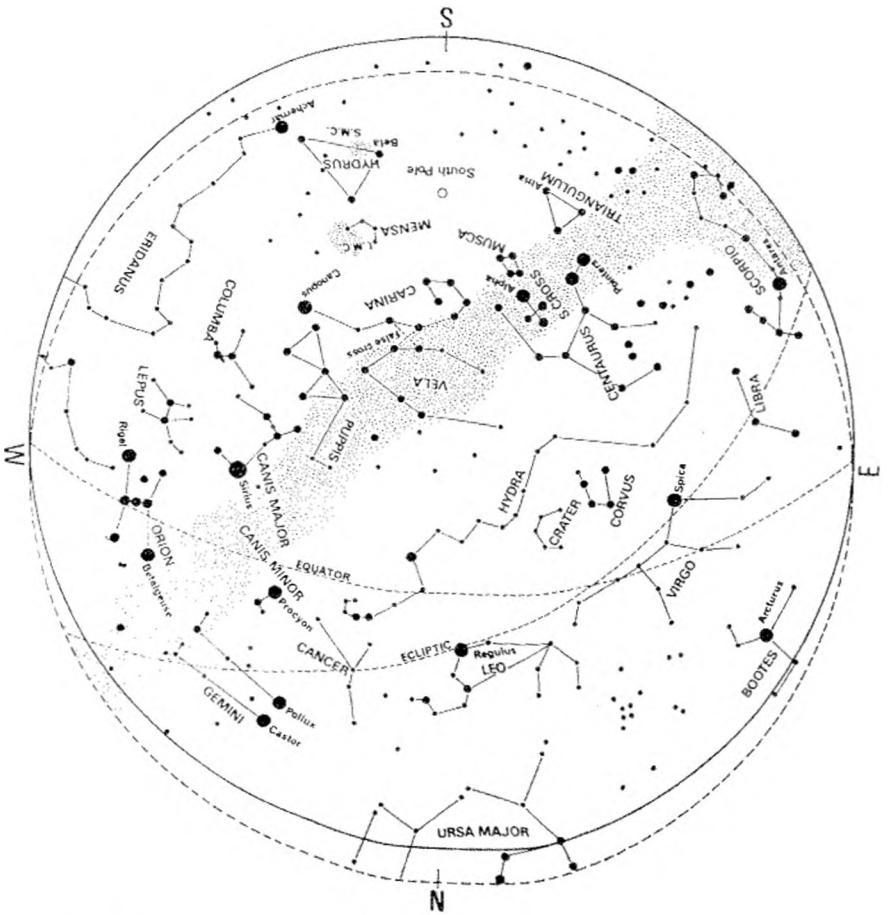
(13) The Crab Nebula, the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraodinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly rotating neutron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

THE AUTUMN SKY

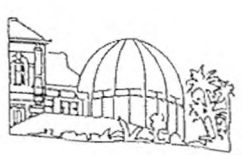
The chart below represents the sky in Cape Town on March 1 at midnight, April 1 at 10 pm and May 1 at 8 pm. Corrections for places other than Cape Town are

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

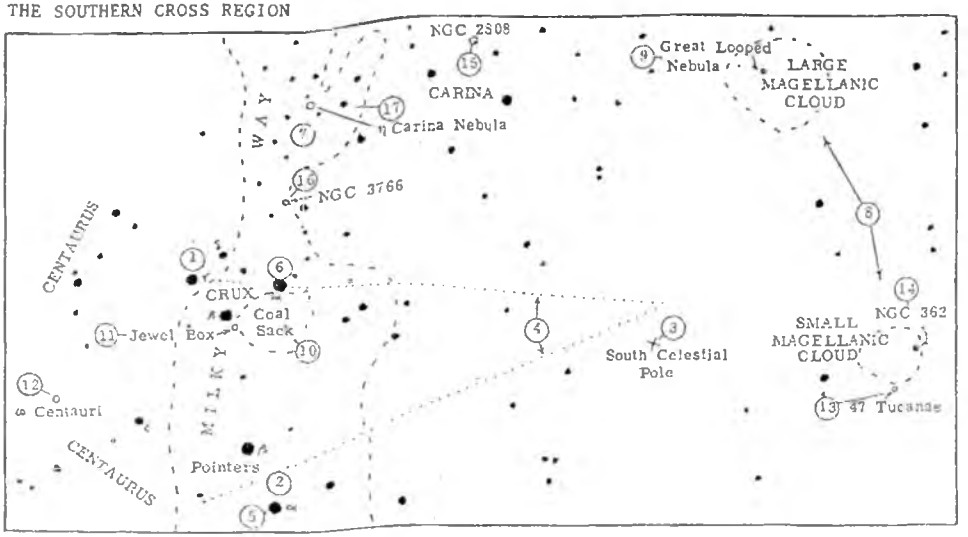
Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



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 3766 – a fine galactic cluster. (Binoculars or small telescope).

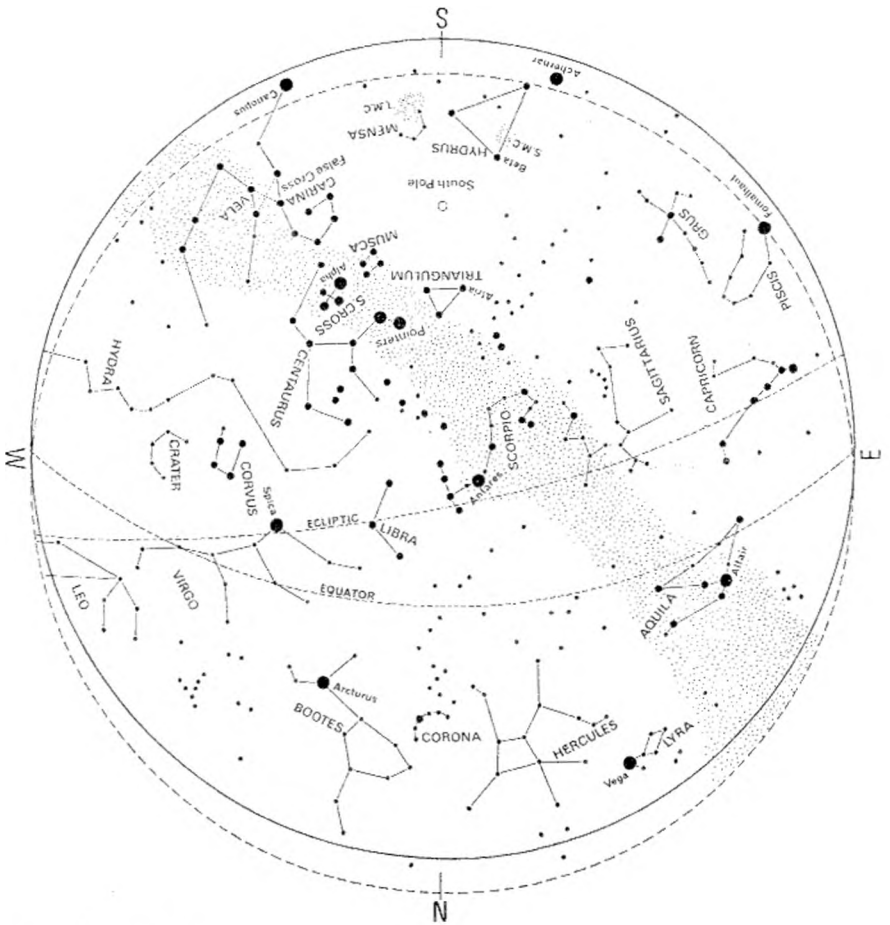
(17) The η Carinae nebula – site of a slow supernova that brightened to magnitude –0,8 in 1843 and is now of magnitude 6,4.

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

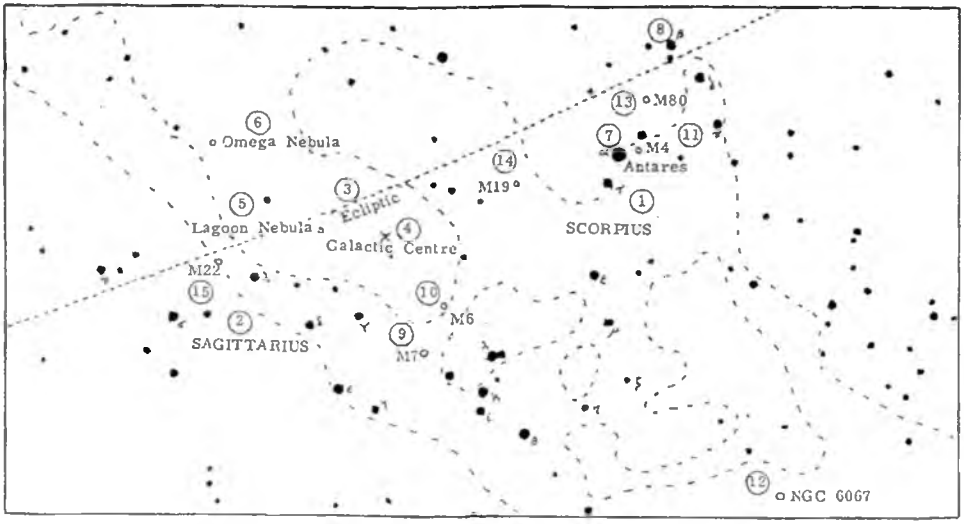
Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



Courtesy of the

PLANETARIUM  SA MUSEUM

THE SCORPIUS REGION



(1) The constellation of Scorpius. The creature is depicted with α in the centre of the body and β and π the claws. The distinctive tail ε — ζ — θ curls round to the sting λ.

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

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

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

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

(8) ξ 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).

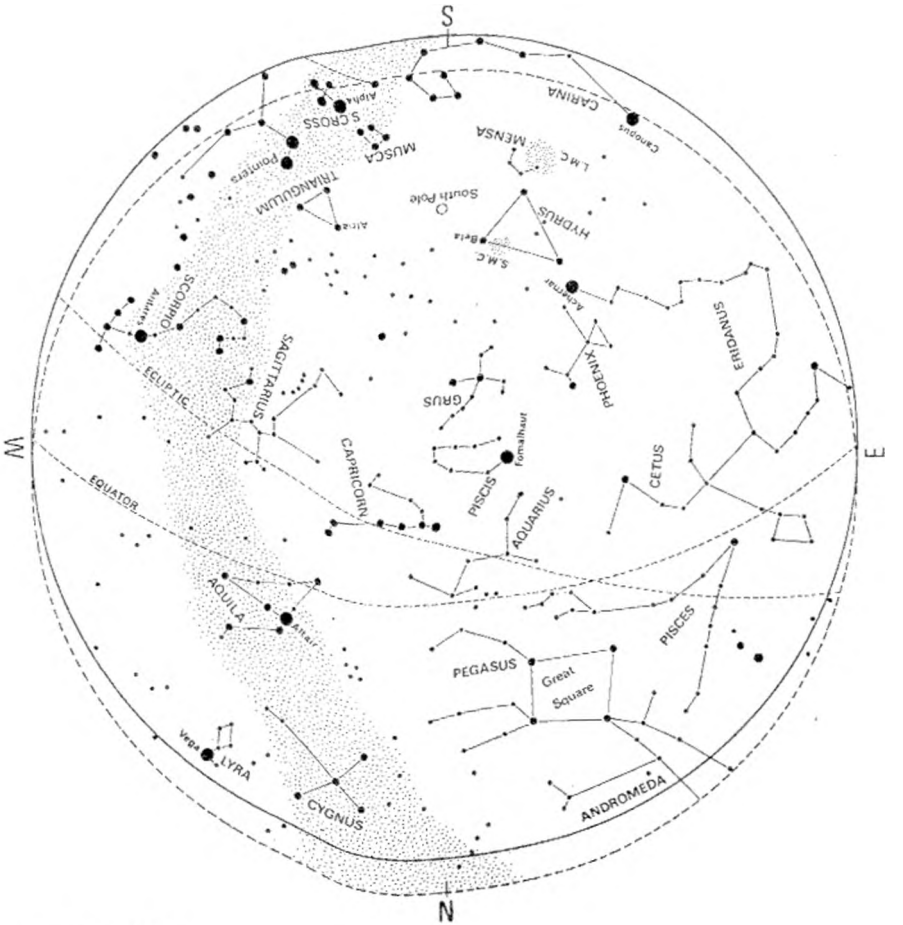
Further from the plane of the Milky Way are some globular clusters: (13) M80 (14) M19 and (15) M22.

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.



Courtesy of the

PLANETARIUM SA MUSEUM

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		Z.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	°
Jan	8	166	6.9	DD	92					19 25.8	-1.8	-1.1	126	19 29.2	-1.6	+0.4	98
Jan	8	173	6.7	DD	92	21 4.3	-0.8	+0.6	110								
Jan	14	915	4.7	DD	156					17 25.1	-2.0	-2.1	121	17 18.3	-1.9	-0.9	97
Jan	19	1519	6.5	RD	216					21 9.0	-1.7	-0.1	250	21 9.5	-1.7	-0.9	277
Jan	21	1744	6.5	RD	241	22 0.6	-0.3	-2.0	313	21 45.2	-0.2	-3.0	340				
Jan	27	2436	6.3	RD	308					1 51.2	-0.8	-0.2	250	1 48.5	-0.5	-0.9	280
Feb	5	240	5.6	DD	71					18 19.9	-1.4	+2.6	41	18 56.4			360
Feb	5	241	6.9	DD	71					18 32.7	-1.3	+1.7	66	18 53.5	-1.2	+2.5	40
Feb	8	614	5.7	DD	105	21 14.6	-1.5	+1.7	70	21 49.1			28				
Feb	10	888	6.0	DD	127					22 51.0	+0.4	-2.3	157	22 42.5	-0.5	-0.4	119
Feb	10	892	6.6	DD	127	22 43.3	-1.5	+1.6	75								
Feb	10	894	4.6	DD	127	23 23.1	-1.3	+2.0	68								
Feb	11	1025	7.4	DD	136	19 13.7	-2.7	+1.2	52								
Feb	12	1038	6 8	DD	139	0 7.1			173					0 1.0	-0.7	+0.6	91
Feb	26	2876	5.5	RD	316					2 4.0	-0.5	+0.1	242	2 2.6	-0.4	-0.7	274
Feb	26	2880	5.1	RD	317	2 54.9	-0.6	+0.1	235	2 58.2	-0.7	-0.8	269	2 48.7	-0.5	-2.1	304
Mar	8	691	6.6	DD	83					17 44.2	-2.6	+1.6	67	18 15.8			30
Mar	13	1341	4.3	DD	141									23 6.3	-0.6	-1.4	141
Mar	19	2053	4.6	RD	218	21 58.0	-1.6	-0.3	251	22 6.2	-1.5	-1.3	288	21 55.4	-1.1	-2.2	318
Mar	21	2209	5.9	RD	234	3 23.8	-1.7	+4.2	340								
Mar	22	2361	4.9	RD	247	2 19.2	-1.7	-2.6	316								
Mar	23	2658	5.4	RD	271									22 50.6	-0.7	+0.7	234
Mar	24	2680	5.8	RD	274					3 38.0	-2.5	+1.9	230				
Mar	24	2686	5.2	RD	274	4 16.0	-2.2	-0.2	266								
Apr	5	769	6.6	DD	63	17 40.2	-1.1	-0.7	135	17 51.5	-1.3	+0.5	102	18 3.2	-1.6	+1.4	72
Apr	6	913	5.2	DD	75	20 2.6	-0.9	+1.3	87								
Apr	8	1176	7.4	DD	97	21 16.2	-1.0	+1.0	93								
Apr	12	1611	5.7	DD	144	19 26.6	-1.7	-1.6	127	19 40.5	-2.9	-0.1	91				
Apr	18	2448	6.4	RD	228	22 35.2	-1.0	-1.2	279	22 31.2	-0.9	-2.6	316				
May	5	1116	7.4	DD	65	17 5.6	-1.4	-0.8	134	17 20.0	-1.8	+0.5	98	17 36.5	-2.7	+2.4	62
May	8	1454	7.1	DD	100	18 50.4	-2.0	-0.4	114	19 17.5	-2.9	+2.1	70				
May	8	1457	6.7	DD	101	20 26.6	-0.8	-1.2	145	20 32.9	-1.1	+0.2	107	20 44.2	-1.6	+1.8	70
May	9	1564m	6.6	DD	112									18 35.5	-1.4	-2.5	151
May	10	1685	4.5	DD	125	19 53.3	-1.9	-0.9	121	20 15.0	-2.7	+1.2	80				
May	11	1792	7.1	DD	139									21 1.8			188
May	12	1807	5.9	DD	141	0 8.3			38								
May	13	1945	5.4	DD	154	0 12.3			26								
May	13	2053	4.6	DD	164					16 37.0	-0.2	-2.1	141	16 23.8	-0.5	-1.2	114
May	18	2876	5.5	RD	236									20 39.8	-0.8	+1.1	225
May	18	2880	5.1	RD	237					21 31.0	-1.1	+1.3	218	21 38.6	-1.0	+0.0	255
Jun	2	1197	6.0	DD	47	16 29.0			174	16 22.7	-1.1	-0.6	127	16 25.8	-1.6	+0.4	95
Jun	3	1320	6.8	DD	59					18 28.5	+0.0	-1.7	154	18 21.6	-0.5	-0.4	119
Jun	5	1519	6.5	DD	81					16 9.6	-2.3	-1.1	119	16 14.2	-3.4	+0.4	88
Jun	7	1744	6.5	DD	106	17 35.3	-2.2	-0.8	107	18 8.1			58				
Jun	7	1754	6.9	DD	108	21 21.3	-1.2	+0.7	99	21 43.4	-0.9	+2.6	61				
Jun	9	2000	7.1	DD	133	19 43.2	-2.0	-0.9	112	20 7.2	-2.8	+1.4	73				
Jun	11	2159	5.3	DD	150					1 1.6			160	0 53.6	-0.7	-0.5	121
Jun	16	3104	6.5	RD	232	20 57.2	-0.4	+0.2	232	21 0.3	-0.6	-0.6	263	20 52.3	-0.6	-2.0	298
Jun	17	3133	5.8	RD	235	3 14.3	-1.0	+3.0	204	3 46.6	-1.1	+2.7	212				
Jun	18	3272	5.8	RD	248	2 10.1	-2.5	-0.8	275	2 31.4	-3.6	-1.3	288				

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		Z.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	°
Jun	21	103	6.1	RD	284	2 52.0	-0.1	+3.0	189	3 17.5	-0.9	+2.5	202	3 39.5	-1.9	+1.8	225
Jun	21	105	4.6	RD	284	3 43.5	-1.7	+0.3	242	4 6.7	-2.4	+0.6	249				
Jul	5	1817	6.9	DD	88	16 52.6			184	16 40.8	-1.9	-1.7	133	16 39.0	-2.8	-0.4	101
Jul	6	1945	5.4	DD	101	16 35.3	-1.2	-2.7	150	16 38.7	-2.4	-1.0	111	16 46.1	-3.6	+1.0	76
Jul	8	2209	5.9	DD	127	16 24.8	-0.8	-2.4	137	16 23.8	-1.8	-1.0	101	16 29.0	-3.0	+1.0	66
Jul	8	2213	5.9	DD	128	17 35.3	-2.2	+0.0	77								
Jul	8	2218	5.6	DD	129	18 55.8	-2.2	-0.4	96	19 26.5	-2.8	+2.4	57				
Jul	17	3494	4.6	RD	243	3 17.6	-2.0	+1.2	241	3 48.1	-2.1	+1.5	246				
Jul	20	325	7.4	DD	278	4 51.7			337								
Jul	31	1685	4.5	DD	48									17 18.4	-0.6	-1.6	145
Aug	1	1787	6.0	DD	60	17 2.0	-1.9	+1.1	87								
Aug	1	1798	6.3	DD	61	19 22.0	-0.6	+0.8	100								
Aug	3	2053	4.6	DD	87									20 50.4	-0.7	-1.2	138
Aug	4	2170	6.8	DD	98					18 38.7	-2.0	-3.5	155	18 29.5	-2.2	-0.8	117
Aug	5	2313	7.0	DD	110									16 19.8	-2.1	-2.3	131
Aug	5	2316	6.4	DD	111									17 33.8	-2.5	-2.3	133
Aug	6	2463	6.9	DD	124									16 57.1			168
Aug	7	2640	6.1	DD	138	17 30.5	-1.5	-1.3	103	17 45.0	-2.3	+0.5	70	18 8.3	-2.8	+4.3	30
Aug	7	2647	6.4	DD	139	18 39.3	-2.1	+0.8	62	19 19.0	-2.1	+4.8	25				
Aug	7	2649	6.6	DD	139	19 2.3	-2.1	-3.7	140	19 9.3	-2.6	-0.9	106	19 16.7	-2.7	+0.7	76
Aug	7	2653	6.4	DD	139	19 18.5	-2.2	-0.7	99	19 41.8	-2.4	+0.9	73	20 3.4	-2.1	+2.8	42
Aug	7	2658	5.4	DD	140									21 33.1	-2.7	-1.4	123
Aug	19	639	6.0	RD	280	1 37.8	-0.7	+0.1	234	1 48.4	-1.4	+0.1	244	1 52.8	-2.1	-0.4	265
Aug	21	913	5.2	RD	303	3 5.3	-1.5	-2.1	298	3 4.3	-2.4	-3.0	313				
Sep	2	2441	6.5	DD	96	20 42 7			8								
Sep	2	2448	6.4	DD	97									21 48.0			145
Sep	3	2578	6.4	DD	108	17 29.7	-2.3	-1.6	119	17 47.7	-2.5	+0.1	92	18 2.3	-2.4	+1.6	63
Sep	4	2789	7.3	DD	125									23 43.4	-0.6	-0.4	119
Sep	5	2913	5.1	DD	135					18 30.7	-3.3	-3.4	129	18 27.0	-2.9	-0.3	94
Sep	15	593	5.8	RD	250	0 34.7	-1.7	-0.7	263	0 49.4	-2.6	-0.7	272	0 48.4	-3.6	-2.0	295
Sep	16	736	6.2	RD	262	3 5.8	-2.6	-0.7	279								
Sep	27	2092	7.2	DD	39					17 3.7	-0.8	-0.1	117	17 8.0	-0.5	+0.6	89
Sep	29	2390	6.7	DD	65					16 58.2	-1.6	+0.9	85	17 14.8	-1.2	+2.1	56
Sep	29	2396	6.6	DD	66	18 11.5	-1.1	+1.6	72	18 33.8	-0.4	+2.2	54	19 2.1			10
Oct	1	2722	7.1	DD	93	20 2.7	-1.3	+1.0	88	20 21.3	-0.7	+1.2	77	20 34.8	-0.3	+1.6	55
Oct	1	2737	6.8	DD	94	22 44.6	+0.0	+1.3	74								
Oct	2	2883	5.5	DD	106	19 30.8	-1.5	+1.8	58	19 58.9	-1.0	+2.2	47	20 23.4	-0.1	+3.4	21
Oct	4	3154	7.4	DD	130					16 37.6			142	16 22.3	-2.4	-0.9	97
Oct	11	422	5.5	RD	208					0 39.9			168	1 31.3	-2.3	+3.2	215
Oct	15	947	5.2	RD	252	0 54.6	-1.7	-0.6	259	1 10.5	-2.6	-0.7	272	1 9.9	-3.1	-1.6	295
Oct	15	1072	6.2	RD	262									23 15.6	-0.6	+1.1	231
Oct	17	1197	6.0	RD	275					2 55.2	-3.1	+1.7	232				
Oct	20	1518	6.3	RD	308					2 5.1	-0.7	-2.7	328				
Oct	27	2508	6.3	DD	48	18 6.3	-0.7	+1.0	91	18 19.4	-0.3	+1.1	79	18 30.6	+0.2	+1.6	55
Oct	28	2674	6.0	DD	62	18 56.3	-0.7	+1.4	76	19 11.5	-0.2	+1.5	65	19 25.4	+0.3	+2.0	42
Oct	31	3133	5.8	DD	103									21 37.8	-0.8	-0.2	111
Nov	1	3259	7.4	DD	114									17 47.5	-4.3	-1.6	112
Nov	1	3272	5.8	DD	115	20 40.0	-1.1	+2.4	39	21 7.9	-0.6	+2.7	31	21 36.8			2
Nov	4	98	6.2	DD	151	18 56.3	-2.7	-1.6	106	19 15.9	-3.2	-0.6	96	19 25.1	-2.9	+0.6	75
Nov	4	103	6.1	DD	151	20 17.8	-0.5	+3.4	9	20 54.5			359				

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	°
Nov 15	1468	4.9	RD	276					23 47.9	-0.7	+0.1	243	23 47.3	-0.9	-0.7	270
Nov 27	3075	7.1	DD	70									16 46.9	-3.2	-1.2	117
Nov 28	3229	5.6	DD	85	20 17.2	-0.5	+2.3	41	20 38.3	-0.1	+2.5	29				
Dec 12	1428	3.8	RD	244					21 12.4	-0.5	-1.7	297	20 57.1	-0.7	-2.5	323
Dec 14	1637	6.0	RD	267									23 4.4	-1.0	+0.6	243
Dec 15	1652m	5.5	RD	269	2 35.5	-2.2	-0.8	269					2 33.7	-1.6	-3.0	330
Dec 20	2271	4.3	RD	331					2 4.1	+0.1	-0.9	275				
Dec 26	3320	5.3	DD	65	19 3.7	-1.1	+0.8	100	19 18.3	-0.5	+1.0	87	19 28.7	-0.3	+1.2	66
Dec 30	290	6.1	DD	113	18 37.3	-1.5	+2.5	26	19 17.2	-1.4	+4.3	13				
Dec 31	422	5.5	DD	125	20 8.9	-2.8	-0.7	119	20 32.1	-2.3	+0.3	102	20 44.3	-2.2	+1.1	78

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 mmn 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.

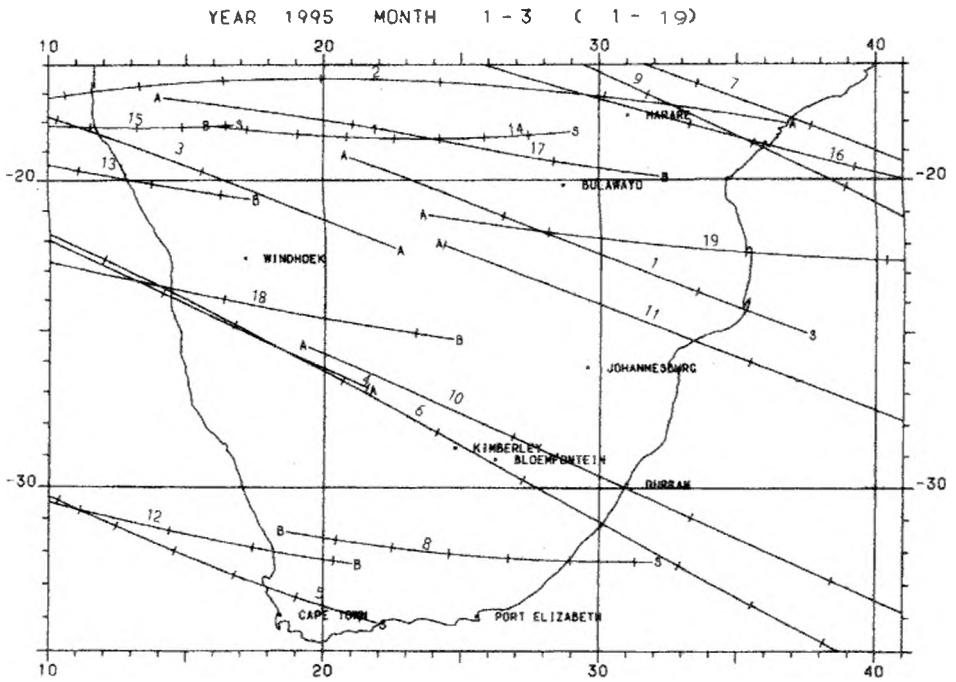
Interested observers - especially those living in the more distant regions - who wish to be informed of favourable grazes occurring in their neighbourhood, are therefore invited to contact the co-ordinator for grazing occultations:

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

EXPLANATION OF THE COLUMN HEADINGS IN THE TABLES:

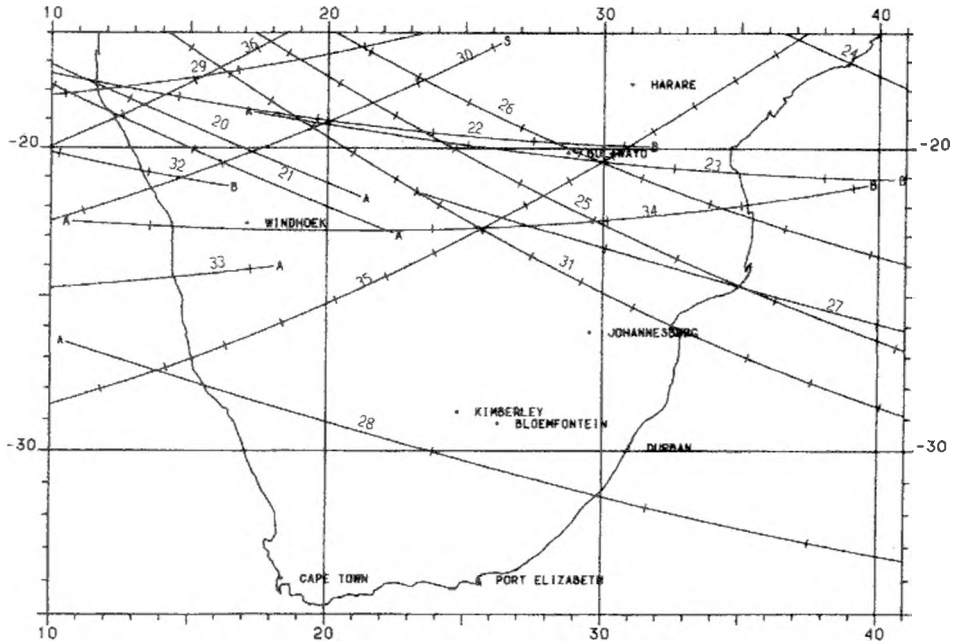
SEQ	: Sequential number in the year. The same number is attached to the corresponding track on the map.
NZC NO	: Zodiacal Catalogue number of the star.
MAG	: Magnitude of the star.
MON, DAY, H, M, S	: Month, day, hour, minute and second in SAST for the west end of the track.
SUNLIT (%)	: Percentage of 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.



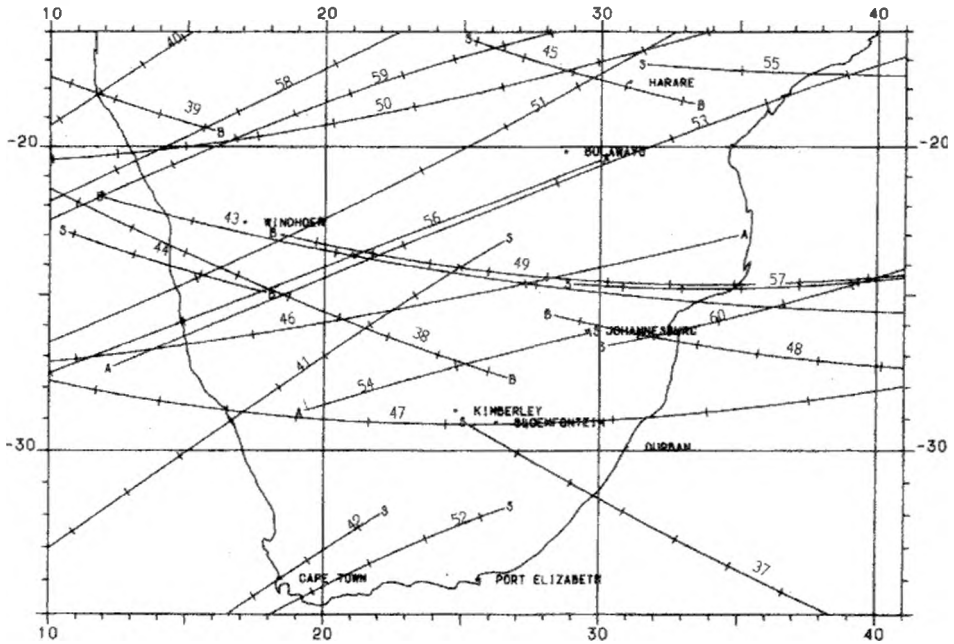
SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
1	2596	7.28	1	28	4	27	5.43	-10.35	N	(A)	(S)
2	240	5.63	2	5	20	38	47.19	33.15	N	( )	(A)
3	614	5.67	2	8	23	54	38.48	62.22	N	( )	(A)
4	894	4.62	2	11	1	52	7.68	79.83	N	( )	(A)
5	2105	6.60	2	21	5	19	10.62	-65.68	S	( )	(S)
6	2232	7.23	2	22	1	53	15.54	-55.54	S	( )	( )
7	691	6.56	3	8	20	37	15.32	43.31	N	( )	( )
8	2209	5.92	3	21	5	0	33.71	-79.51	N	(B)	(S)
9	2345	6.89	3	22	0	2	19.19	-70.74	S	( )	( )
10	2497	6.55	3	23	0	11	12.80	-59.66	S	(A)	( )
11	2658	5.40	3	24	0	31	0.14	-48.06	S	(A)	( )
12	2680	5.76	3	24	4	33	20.07	-46.40	S	( )	(B)
13	2685	6.98	3	24	5	2	58.84	-46.19	S	( )	(B)
14	2686	5.17	3	24	5	21	40.35	-46.17	N	(B)	(S)
15	2690	6.98	3	24	6	15	35.54	-45.84	N	( )	(S)
16	2830	6.92	3	25	2	10	45.92	-36.14	S	( )	( )
17	2972	6.70	3	26	3	39	5.40	-25.27	S	(A)	(B)
18	2975	7.00	3	26	4	6	55.12	-25.11	S	( )	(B)
19	3111	6.85	3	27	3	52	59.07	-16.34	N	(A)	( )

YEAR 1995 MONTH 4 - 6 (20- 36)

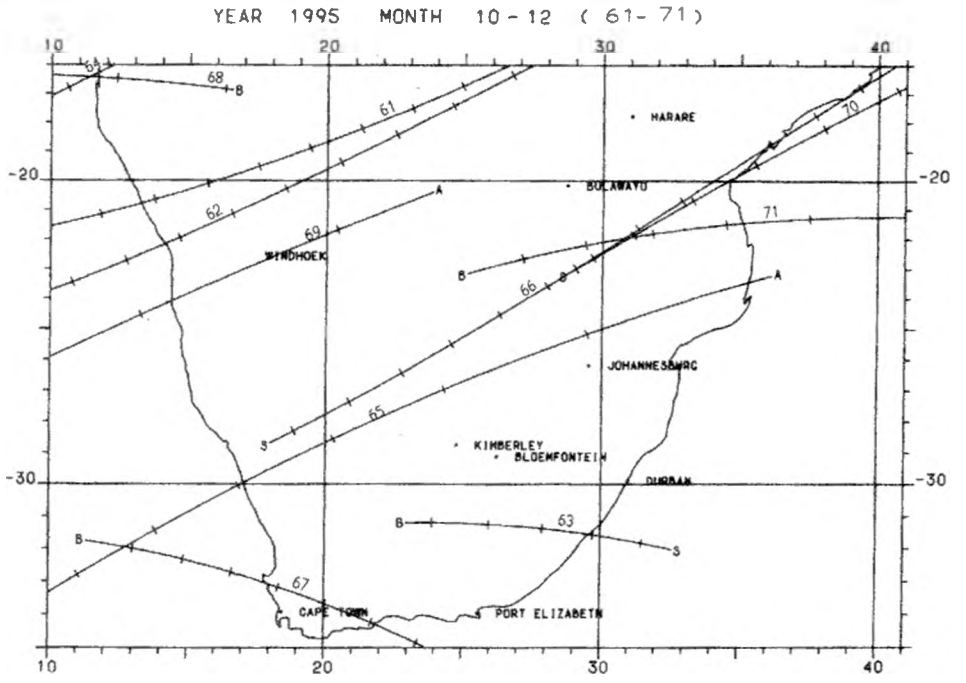


SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
20	913	5.17	4	6	22	37	56.32	36.27	N	( )	(A)
21	1176	7.40	4	8	23	44	54.14	55.79	N	( )	(A)
22	2936	6.79	4	22	2	46	20.83	-50.36	S	( )	(B)
23	3075	7.07	4	23	2	16	55.63	-39.55	S	(A)	(B)
24	1116	7.40	5	5	20	7	49.33	28.83	N	( )	( )
25	1454	7.09	5	8	21	16	40.40	58.65	N	( )	( )
26	1685	4.47	5	10	22	21	17.75	78.78	N	( )	( )
27	2876	5.45	5	18	22	18	25.60	-77.29	S	(A)	( )
28	2880	5.10	5	18	23	5	46.46	-76.98	S	(A)	( )
29	3444	6.53	5	23	3	44	40.96	-32.73	N	( )	( )
30	143	6.83	5	25	5	49	1.36	-15.09	N	( )	(S)
31	1744	6.47	6	7	19	42	12.23	63.78	N	( )	( )
32	1754	6.92	6	7	23	44	28.93	64.88	N	( )	(B)
33	1886	5.70	6	9	2	17	18.09	76.03	S	( )	(A)
34	3259	7.37	6	18	0	19	12.69	-69.86	S	(A)	(B)
35	3272	5.80	6	18	3	21	21.15	-68.83	N	( )	( )
36	105	4.55	6	21	4	55	34.08	-37.17	N	( )	( )

YEAR 1995 MONTH 7 - 9 (37 - 60)



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
37	2070	6.69	7	7	18	0	24.02	70.17	N	(S)	( )
38	2213	5.86	7	8	19	37	32.85	80.95	N	( )	(B)
39	2218	5.59	7	8	21	2	45.45	81.31	N	( )	(B)
40	3494	4.61	7	17	4	33	56.87	-73.04	N	( )	( )
41	201	7.47	7	19	5	42	57.33	-52.65	N	( )	(S)
42	325	7.36	7	20	6	47	39.17	-42.50	N	( )	(S)
43	1685	4.47	7	31	19	31	16.71	15.87	S	(B)	( )
44	1787	6.03	8	1	19	19	30.79	24.34	N	(S)	(B)
45	1911	7.06	8	2	18	29	40.16	33.90	N	(S)	(B)
46	2053	4.60	8	3	22	59	6.02	46.31	S	( )	(A)
47	2170	6.80	8	4	20	26	10.71	56.93	S	( )	( )
48	2313	6.97	8	5	18	57	43.15	67.62	S	(B)	( )
49	2316	6.40	8	5	19	41	39.35	67.95	S	(B)	( )
50	2331	6.37	8	5	22	19	49.23	68.75	S	( )	( )
51	391	7.42	8	17	2	0	42.27	-60.05	N	( )	( )
52	517	6.39	8	18	6	1	24.15	-49.34	N	( )	(S)
53	913	5.17	8	21	4	25	6.93	-22.62	N	(A)	( )
54	1176	7.40	8	23	5	51	16.19	-8.73	S	(A)	(S)
55	1754	6.92	8	28	18	7	56.24	6.34	S	(S)	( )
56	2448	6.37	9	2	23	44	54.95	55.35	S	( )	(A)
57	2573	7.30	9	3	18	15	53.95	64.93	S	(S)	( )
58	593	5.76	9	15	1	42	48.42	-66.93	N	( )	( )
59	736	6.24	9	16	4	1	23.05	-56.98	N	( )	( )
60	2531	7.34	9	30	18	21	25.94	39.14	S	(S)	( )



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
61	2876	5.45	1 0	2	19	45	27.57	62.94	S	( )	( )
62	2880	5.10	1 0	2	20	57	54.49	63.26	S	( )	( )
63	1197	5.96	1 0	17	4	17	48.78	-45.75	S	(B)	(S)
64	2975	7.00	1 0	30	19	58	16.74	48.28	S	( )	( )
65	3133	5.76	1 0	31	23	22	57.24	60.76	S	( )	(A)
66	3259	7.37	1 1	1	19	32	52.75	70.18	S	(S)	( )
67	1271	5.90	1 1	14	4	0	37.01	-63.12	S	(B)	( )
68	1478	7.24	1 1	16	3	37	29.14	-43.69	N	( )	(B)
69	2789	7.31	1 1	25	20	46	55.38	13.60	S	( )	(A)
70	3075	7.07	1 1	27	18	59	16.43	32.51	S	(S)	( )
71	290	6.14	1 2	30	21	40	16.05	69.82	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 3	22 08	15 Eunomia	GSC	1890 01311
Jan 17	1 29	654 Zelinda	PPM	122559
Feb 2	0 09	764 Gedania	PPM	193294
Feb 6	0 54	257 Silesia	DM	+18°2290
Feb 8	1 07	15 Eunomia	GSC	1867 00387
Feb 11	19 45	925 Alphonsina	PPM	68822
Feb 14	1 20	654 Zelinda	PPM	122197
Feb 19	2 17	593 Titania	PPM	161072
Feb 24	23 23	849 Ara	PPM	119864
Mar 5	22 52	791 Ani	PPM	100205
Mar 10	4 14	241 Germania	DM	-26°2824
Mar 19	1 52	23 Thalia	DM	-24°3743
Apr 2	3 46	324 Bamberga	DM	-36°2563
Apr 4	19 49	35 Leukothea	PPM	157429
May 1	3 58	115 Thyra	PPM	293470
May 3	5 09	18 Melpomene	GSC	5223 00024
May 26	20 56	74 Galatea	DM	-06°3827
May 27	4 12	271 Penthesilea	PPM	265607
Jun 21	20 37	1330 Spiridonia	FK5E	5823
Jun 28	3 15	535 Montague	DM	-26°2791
Jul 8	18 18	618 Elfriede	PPM	160114
Jul 13	2 48	241 Germania	DM	-23°2551
Jul 23	1 29	94 Aurora	PPM	297783
Jul 23	18 50	5145 Pholus	GSC	1440 01954
Jul 29	2 52	492 Gismonda	PPM	238493
Aug 6	2 40	704 Interamnia	GSC	5739 01514
Aug 16	4 27	121 Hermione	GSC	6384 00037
Aug 16	18 39	357 Ninina	DM	-06°4393
Aug 21	5 05	248 Lameia	DM	+20°0505
Aug 23	22 19	10 Hygiea	Lick5	1406
Aug 26	0 06	166 Rhodope	DM	-17°6704
Aug 31	19 17	983 Gunila	PPM	203264
Sep 2	0 13	99 Dike	PPM	208223
Sep 2	20 42	173 Ino	PPM	237570
Sep 19	20 19	83 Beatrix	PPM	207407
Nov 6	20 13	210 Isabella	Lick5	3795
Dec 20	3 55	375 Ursula	PPM	226526

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	25	May 11	11	56	23	Sep 18	11	54	16
11	12	7	49	21	11	56	32	28	11	50	47
21	12	11	14	31	11	57	35	Oct 8	11	47	39
31	12	13	25	Jun 10	11	59	20	18	11	45	14
Feb 10	12	14	16	20	12	1	26	28	11	43	50
20	12	13	48	30	12	3	33	Nov 7	11	43	40
Mar 2	12	12	15	Jul 10	12	5	17	17	11	44	53
12	12	9	54	20	12	6	18	27	11	47	29
22	12	7	2	30	12	6	25	Dec 7	11	51	17
Apr 1	12	4	1	Aug 9	12	5	32	17	11	55	54
11	12	1	11	19	12	3	41	27	12	0	53
21	11	58	48	29	12	1	2	31	12	2	50
May 1	11	57	9	Sep 8	11	57	48				

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

SIDEREAL TIME ON THE 30° MERIDIAN

	At 0 hrs	At 21 hrs		At 0 hrs	At 21 hrs		At 0 hrs	At 21 hrs
	h m	h m		h m	h m		h m	h m
Jan 1	6 40	3 44	May 11	15 13	12 16	Sep 18	23 45	20 49
11	7 20	4 23	21	15 52	12 56	28	0 25	21 28
21	7 59	5 3	31	16 32	13 35	Oct 8	1 4	22 8
31	8 39	5 42	Jun 10	17 11	14 15	18	1 44	22 47
Feb 10	9 18	6 22	20	17 51	14 54	28	2 23	23 27
20	9 58	7 1	30	18 30	15 34	Nov 7	3 3	0 6
Mar 2	10 37	7 40	Jul 10	19 9	16 13	17	3 42	0 45
12	11 16	8 20	20	19 49	16 52	27	4 21	1 25
22	11 56	8 59	30	20 28	17 32	Dec 7	5 1	2 4
Apr 1	12 35	9 39	Aug 9	21 8	18 11	17	5 40	2 44
11	13 15	10 18	19	21 47	18 51	27	6 20	3 23
21	13 54	10 58	29	22 27	19 30	31	6 39	3 39
May 1	14 33	11 37	Sep 8	23 6	20 9			

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 (1995.5)

Star	R.A. h m	Dec. ° ′	Mag.	Sp.	Star	R.A. h m	Dec. ° ′	Mag.	Sp.
ACHERNAR	1 37.5	-57 15	0.6	B5	PROCYON	7 39.1	5 14	0.5	F5
ALDEBARAN	4 35.7	16 30	1.1	K5	REGULUS	10 8.1	11 59	1.3	B8
RIGEL	5 14.3	-8 12	0.3	B8	SPICA	13 25.0	-11 8	1.2	B2
BETELGEUSE	5 54.9	7 24	0.4	M0	ARCTURUS	14 15.5	19 12	0.2	K0
CANOPUS	6 23.8	-52 42	-0.9	F0	ANTARES	16 29.2	-26 25	1.2	M1
SIRIUS	6 44.9	-16 43	-1.6	A0	ANTARES	16 29.2	-26 25	1.2	M1

JULIAN DATE AT 1400 HOURS - SAST 1995

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.
	2449	2449	2449	2449	2449	2449	2449	2449	2449	24	2450	2450
1	719	750	778	809	839	870	900	931	962	49992	023	053
2	720	751	779	810	840	871	901	932	963	49993	024	054
3	721	752	780	811	841	872	902	933	964	49994	025	055
4	722	753	781	812	842	873	903	934	965	49995	026	056
5	723	754	782	813	843	874	904	935	966	49996	027	057
6	724	755	783	814	844	875	905	936	967	49997	028	058
7	725	756	784	815	845	876	906	937	968	49998	029	059
8	726	757	785	816	846	877	907	938	969	49999	030	060
9	727	758	786	817	847	878	908	939	970	50000	031	061
10	728	759	787	818	848	879	909	940	971	50001	032	062
11	729	760	788	819	849	880	910	941	972	50002	033	063
12	730	761	789	820	850	881	911	942	973	50003	034	064
13	731	762	790	821	851	882	912	943	974	50004	035	065
14	732	763	791	822	852	883	913	944	975	50005	036	066
15	733	764	792	823	853	884	914	945	976	50006	037	067
16	734	765	793	824	854	885	915	946	977	50007	038	068
17	735	766	794	825	855	886	916	947	978	50008	039	069
18	736	767	795	826	856	887	917	948	979	50009	040	070
19	737	768	796	827	857	888	918	949	980	50010	041	071
20	738	769	797	828	858	889	919	950	981	50011	042	072
21	739	770	798	829	859	890	920	951	982	50012	043	073
22	740	771	799	830	860	891	921	952	983	50013	044	074
23	741	772	800	831	861	892	922	953	984	50014	045	075
24	742	773	801	832	862	893	923	954	985	50015	046	076
25	743	774	802	833	863	894	924	955	986	50016	047	077
26	744	775	803	834	864	895	925	956	987	50017	048	078
27	745	776	804	835	865	896	926	957	988	50018	049	079
28	746	777	805	836	866	897	927	958	989	50019	050	080
29	747		806	837	867	898	928	959	990	50020	051	081
30	748		807	838	868	899	929	960	991	50021	052	082
31	749		808		869		930	961		50022		083

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
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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
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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
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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
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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
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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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1958 J Jackson
1960 W H van den Bos
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1965 R H Stoy
1967 W S Finsen
1970 J C Bennett
1976 A D Thackeray
1981 C Papadopoulos
1983 M W Feast
1984 M D Overbeek
1988 D S Evans
1992 B Warner

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1983 B Warner

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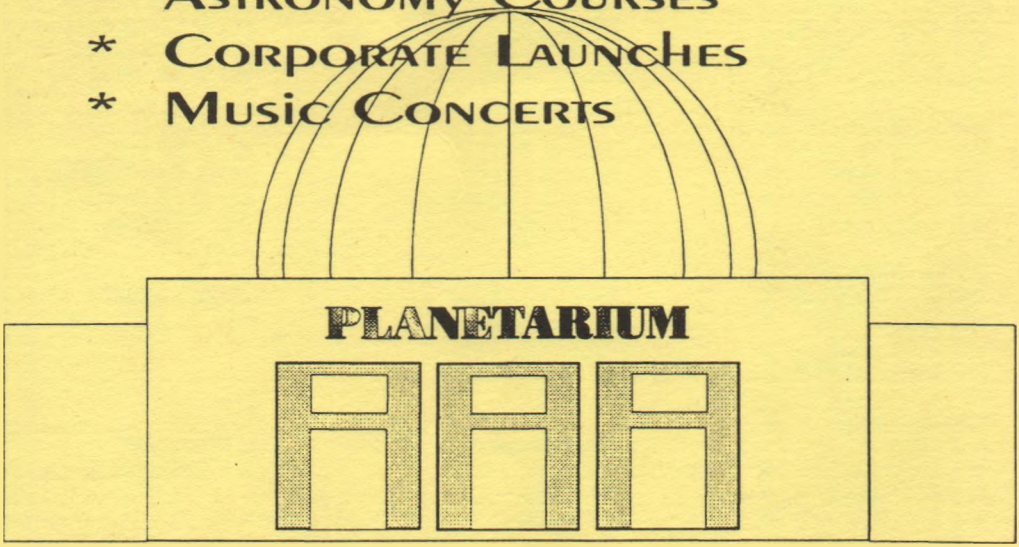

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