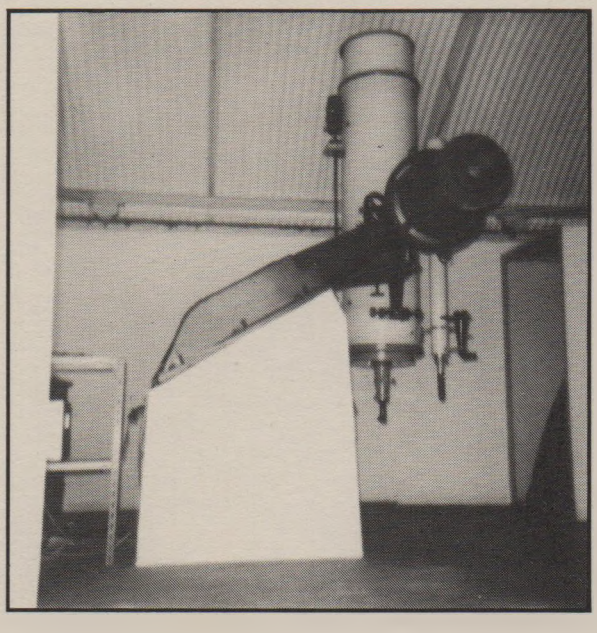
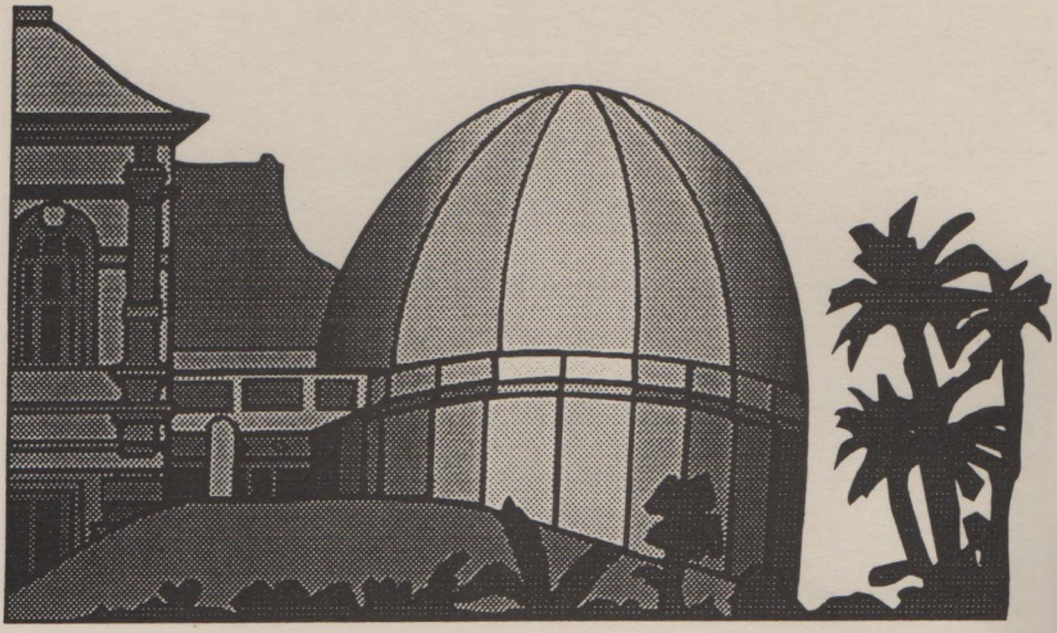
ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1997



Astronomical Society of Southern Africa

ASSA



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ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 1997

The 51st year of publication

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

Front cover
The Nishimura 0.41m (16") Cassigrain Telescope at Boyden, Bloemfontein, presently used by the Bloemfontein Centre. It was used previously in a professional capacity for stellar spectroscopy.
Photograph: Ed. Dec 1995

ISSN 0571-7191

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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 1997, the Handbook of the British Astronomical Association for 1997 and the International Lunar Occultation Centre, Tokyo. The star charts on pages 36, 38, 40 and 42 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. The Editor is indebted to the South African Astronomical Observatory for supplying the additional data of The Horizon Charts for the Visibility of the Lunar Cresent at Sunset and to Dion Steyn for generously giving up his time in the holiday season to make this photographic opportunity possible. Assistance in the compilation of this booklet was received from the Directors of the sections of the ASSA and B Wagener.

Further copies of this booklet are available at R15,00 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 FRIENDS OF BOYDEN is an organisation, recently founded, to foster a wider public appreciation of the historical, cultural and scientific value of Boyden, to promote public interest in the affairs of the Observatory and to raise funds for the restoration and preservation of the installation. The Friends intend to organise a number of activities such as popular lectures on astronomy and viewing sessions at Boyden. Membership of the Friends is open to all interested persons. Contact Mrs M. Schoch (tel 051-311 061) or Mr M. Hoffman (tel 051-401 2924 or on email at nwfsmjh@med.uofs.ac.za).

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 051-401 2324 (Mr. M. Hoffman).

THE HARTEBEESTHOEK RADIO ASTRONOMY OBSERVATORY has visiting days for the public once a month on a Sunday at 15:00. It is essential to book, phone 011-642 4692

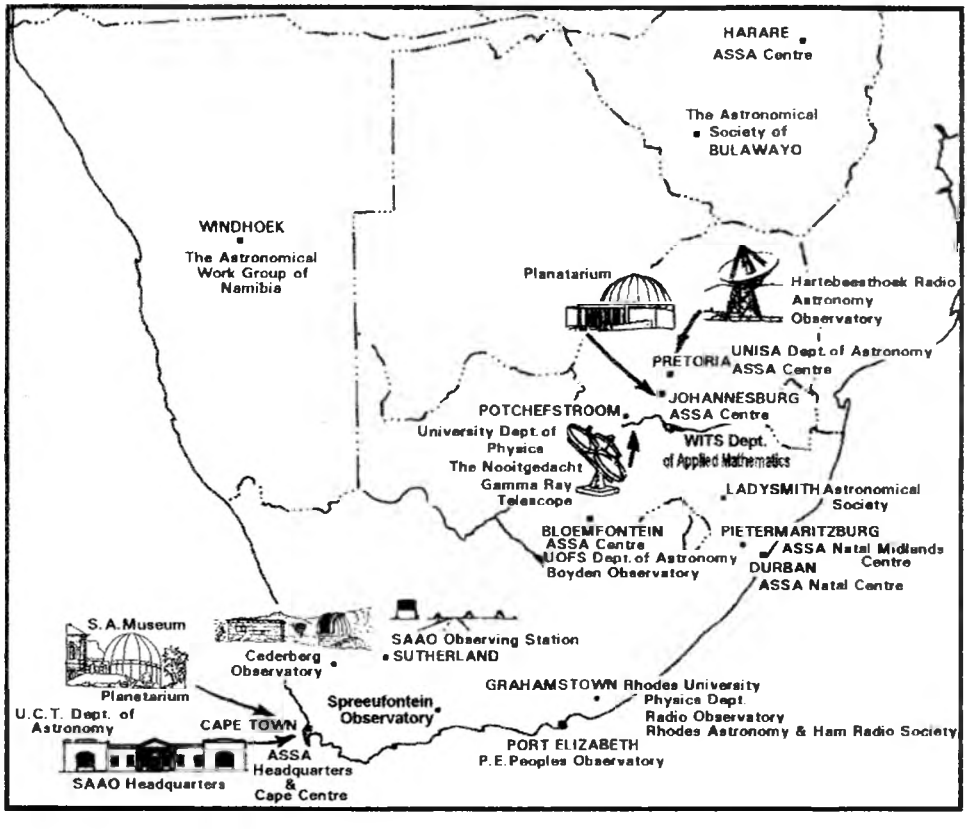
between 9:00 and 12:00 during the week for more details.

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

The PORT ELIZABETH 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.

THE SPREEUFONTEIN OBSERVATORY is an astronomical guest house on a farm in the Great Karoo 75km SSW of Beaufort West, 30km from the N1 National road. Vacilities include a 10" Meade LX200 and 16" Meade Dobsonian Starfinder. Contact Mr A. Jansen, Markstraat 3, Prins Albert, 6930 , Tel/Fax 04436-871.



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.

EDUCATIONAL INSTITUTIONS

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, University of Witwatersrand, 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 a viewing evening for the public on the third Tuesday of every month weather permitting. Members receive the monthly journal Z Octantis. For further information contact Mr W. Venter 0361-310770.

THE PORT ELIZABETH 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 may 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 has an entrance fee of R40.00 and an annual subscription of R200.00 inclusive of Sky and Telescope or R80.00 for MNASSA and Handbook only. A prospectus

and application form may be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, P O Box 9, Observatory 7935, or telephone 021-7612112 (Mrs. A. Joubert).

AUTONOMOUS LOCAL CENTRES OF THE ASSA hold regular meetings in Cape Town, Durban, Johannesburg, Bloemfontein, Pietermaritzburg, Pretoria and Harare. Visitors are very welcome at meetings and may, if they wish, join a Centre without becoming a full member of the Society. Centre members receive neither Society publications, nor "Sky and Telescope". Centres publish newsletters and journals carrying information on meetings, centre activities and topics of interest.

BLOEMFONTEIN CENTRE: Meetings are usually held every second Friday of the month at Boyden Observatory, Mazelspoort. Phoning for confirmation beforehand is essential. The Centre publishes a monthly newsletter 'Clear Skys'. Secretarial address: P O Box 1599, Bloemfontein, 9300 or telephone 051-4012924(o/h) or 051-4471921(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.

JOHANNESBURG CENTRE: 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.

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 0331-433646.

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: P O Box 11151, Queenswood, 0121, tel: 012-333 9991.

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

THE SUN

BASIC DATA:

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

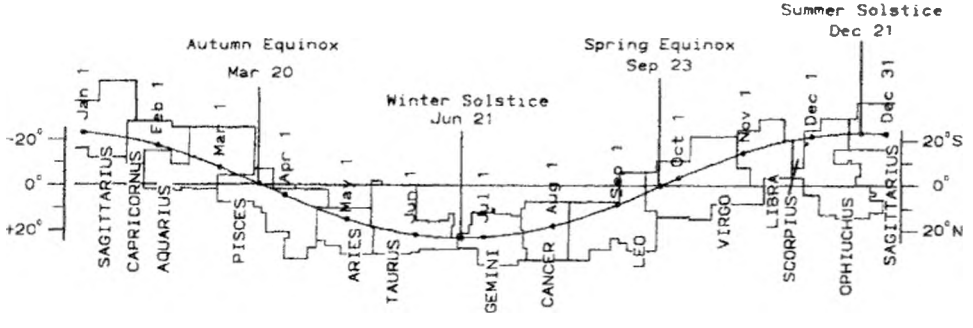
Mass: 1,99 x 10^{30}kg (330 000 times Earth mass)

Surface Temperature: Approximately 6 000°C

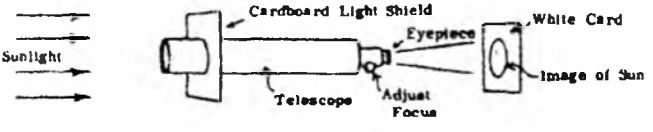
Temperature at centre: Approximately 10 million°C

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 1997 we will be closest to the Sun on January 2 (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° 1′	Apr 11	8°15′	Jul 20	20°42′	Oct 28	-13° 3′
11	-21 50	21	11 48	30	18 33	Nov 7	-16 13
21	-19 56	May 1	15 1	Aug 9	15 54	17	-18 56
31	-17 26	11	17 50	19	12 50	27	-21 5
Feb 10	-14 24	21	20 9	29	9 25	Dec 7	-22 35
20	-10 59	31	21 53	Sep 8	5 46	17	-23 21
Mar 2	-7 16	Jun 10	23 0	18	1 56	27	-23 20
12	-3 23	20	23 26	28	-1 57		
22	0 34	30	23 11	Oct 8	-5 49		
Apr 1	4 28	Jul 10	22 15	18	-9 33		

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

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

ECLIPSES OF THE SUN

A total eclipse of the Sun, on March 8-9, and a partial eclipse on September 1-2, 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.

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 x 10^{22} x kg (1/81 of Earth)
Surface Gravity: 0,16 of Earth
Average distance from Earth: 384 000 km, Perigee: ±357 000km, Apogee: ±407 000km

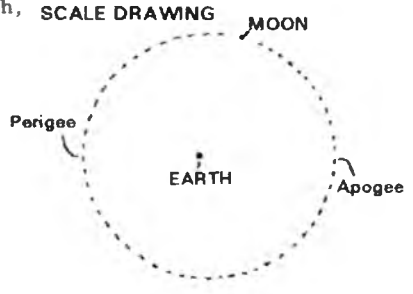
THE SURFACE OF THE MOON

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 and of Perigee, when the Moon is closest to the Earth are given on the next page.



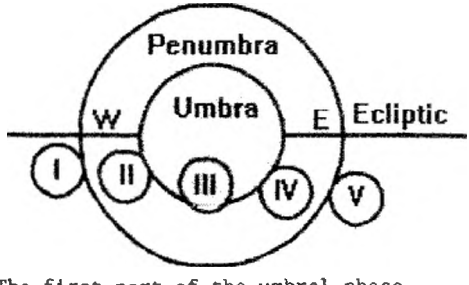
ECLIPSES OF THE MOON

The eclipse data is as follows:

Partial Eclipse	d	h	m	
Moon enters penunbra	Mar 24	3	40.6	I
Moon enters umbra		4	57.5	II
Middle of eclipse		6	39.4	III
Moon leaves umbra		8	21.3	IV
Moon leaves penumbra		9	38.1	V

Contacts of Umbra with Limb of Moon	Position Angles from the North Point
First	137.2° to East
Last	101.9° to West

Magnitude of the eclipse: 0.924

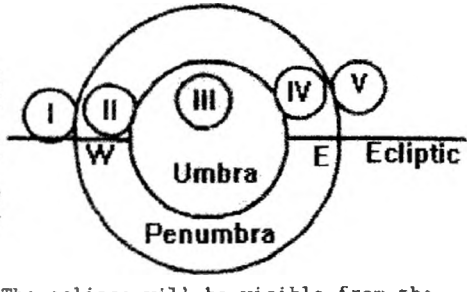


The first part of the umbral phase will be visible over Southern Africa.

Total Eclipse	d	h	m	
Moon enters penumbra	Sep 16	18	11.0	I
Moon enters umbra		19	08.0	II
Moon enters totality		20	15.4	
Middle of eclipse		20	46.6	III
Moon leaves totality		21	17.9	
Moon leaves umbra		22	25.2	IV
Moon leaves penumbra		23	22.2	V

Contacts of Umbra with Limb of Moon	Position Angles from the North Point
First	50.8° to East
Last	86.2° to West

Magnitude of the eclipse: 1.197



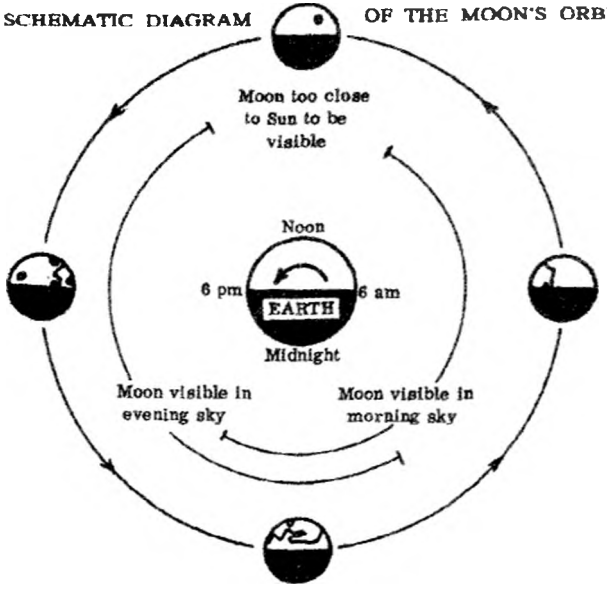
The eclipse will be visible from the penumbral phase over the eastern parts of Southern Africa but only from the umbral phase over the western parts.

PHASES and VISIBILITY

NEW MOON

	d	h	m
Jan	9	6	26
Feb	7	17	06
Mar	9	3	15
Apr	7	13	02
May	6	22	46
Jun	5	9	03
Jul	4	20	40
Aug	3	10	14
Sep	2	1	52
Oct	1	18	51
Oct	31	12	01
Nov	30	04	14
Dec	29	18	56

SCHEMATIC DIAGRAM OF THE MOON'S ORBIT



FIRST QUARTER

	d	h	m
Jan	15	22	02
Feb	14	10	57
Mar	16	02	06
Apr	14	19	00
May	14	12	55
Jun	13	6	51
Jul	12	23	44
Aug	11	14	42
Sep	10	3	31
Oct	9	14	22
Nov	7	23	43
Dec	7	8	09

LAST QUARTER

	d	h	m
Jan	2	3	45
	31	21	40
Mar	2	11	37
	31	21	38
Apr	30	4	37
May	29	9	51
Jun	27	14	42
Jul	26	18	28
Aug	25	4	23
Sep	23	15	35
Oct	23	6	48
Nov	22	1	58
Dec	21	23	43

FULL MOON

	d	h	m
Jan	23	17	11
Feb	22	12	27
Mar	24	6	45
Apr	22	22	33
May	22	11	13
Jun	20	21	09
Jul	20	5	20
Aug	18	12	55
Sep	16	20	50
Oct	16	5	46
Nov	14	16	12
Dec	14	4	37

MOON at PERIGEE

	d	h		d	h		d	h
Jan	10	11	May	29	9	Oct	15	4
Feb	7	23	Jun	24	7	Nov	12	10
Mar	8	11	Jul	22	1	Dec	9	19
Apr	5	19	Aug	19	7			
May	3	13	Sep	16	17			

MOON at APOGEE

	d	h		d	h		d	h
Jan	25	19	Jun	12	7	Oct	27	11
Feb	21	19	Jul	10	1	Nov	24	4
Mar	21	2	Aug	6	16	Dec	22	1
Apr	17	17	Sep	2	23			
May	15	12		30	1			

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.

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	9.0	141	Jan 12	4.4	200	Jul 16	9.3	143	Jul 23	2.0	205
Jan 19	8.6	306	Jan 26	3.2	66	Jul 29	9.1	310	Aug 6	0.9	50
Feb 2	9.9	138	Feb 8	3.3	198	Aug 13	10.0	139	Aug 19	1.4	210
Feb 15	9.5	303	Feb 23	2.5	67	Aug 26	10.0	306	Sep 2	0.4	126
Mar 2	10.1	138	Mar 9	1.9	200	Sep 10	10.1	137	Sep 16	0.9	220
Mar 15	9.7	307	Mar 22	1.9	73	Sep 22	10.4	307	Sep 30	0.8	273
Mar 30	9.4	140	Apr 5	0.8	217	Oct 7	9.6	137	Oct 14	1.5	27
Apr 12	9.3	313	Apr 19	1.6	67	Oct 20	10.0	311	Oct 27	1.1	240
Apr 26	8.5	146	May 3	0.7	177	Nov 4	8.6	143	Nov 11	2.0	25
May 9	8.6	319	May 16	1.6	67	Nov 17	9.1	316	Nov 24	1.3	252
May 23	8.1	149	May 30	1.1	206	Nov 30	8.1	149	Dec 7	1.6	33
Jun 6	8.2	321	Jun 12	1.5	74	Dec 14	8.2	321	Dec 21	1.4	255
Jun 19	8.5	147	Jun 26	1.9	213	Dec 27	8.4	149			
Jul 3	8.3	318	Jul 9	1.2	73						

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.

1997 TIMES OF MOON RISE AND SET CAPE TOWN

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

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

1997 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	23 38	11 26		12 56	22 54	11 45		13 20	00 25	13 41	02 30	14 27
2		12 20	00 12	13 54	23 43	12 41	00 28	14 11	01 29	14 24	03 32	15 09
3	00 14	13 15	01 00	14 53		13 38	01 31	14 59	02 33	15 06	04 34	15 54
4	00 52	14 12	01 54	15 52	00 38	14 34	02 36	15 45	03 37	15 48	05 34	16 41
5	01 34	15 11	02 53	16 50	01 38	15 28	03 42	16 29	04 41	16 31	06 33	17 31
6	02 21	16 11	03 58	17 44	02 42	16 20	04 48	17 12	05 45	17 15	07 28	18 22
7	03 14	17 12	05 05	18 35	03 48	17 09	05 54	17 56	06 48	18 02	08 20	19 15
8	04 13	18 12	06 14	19 23	04 56	17 55	07 00	18 40	07 48	18 50	09 07	20 09
9	05 16	19 08	07 22	20 08	06 04	18 40	08 04	19 26	08 46	19 41	09 50	21 02
10	06 23	20 00	08 29	20 51	07 12	19 23	09 05	20 13	09 39	20 34	10 30	21 55
11	07 30	20 48	09 34	21 33	08 17	20 07	10 04	21 03	10 28	21 27	11 06	22 47
12	08 37	21 33	10 36	22 15	09 21	20 51	10 59	21 53	11 13	22 19	11 41	23 38
13	09 42	22 15	11 37	22 58	10 22	21 37	11 49	22 45	11 54	23 12	12 15	
14	10 46	22 56	12 35	23 43	11 21	22 24	12 35	23 37	12 32		12 48	00 30
15	11 47	23 36	13 30		12 16	23 12	13 18		13 08	00 04	13 23	01 22
16	12 47		14 23	00 29	13 08		13 57	00 29	13 42	00 56	13 59	02 16
17	13 45	00 17	15 12	01 17	13 55	00 02	14 33	01 21	14 16	01 47	14 39	03 11
18	14 41	01 00	15 58	02 07	14 39	00 53	15 08	02 12	14 50	02 40	15 22	04 08
19	15 35	01 44	16 41	02 57	15 20	01 44	15 42	03 04	15 26	03 33	16 11	05 06
20	16 27	02 31	17 21	03 49	15 58	02 36	16 17	03 56	16 04	04 28	17 04	06 05
21	17 15	03 20	17 58	04 41	16 34	03 27	16 51	04 49	16 45	05 24	18 03	07 03
22	18 00	04 10	18 33	05 32	17 08	04 19	17 28	05 43	17 31	06 22	19 05	07 59
23	18 42	05 01	19 07	06 24	17 42	05 11	18 07	06 38	18 21	07 20	20 09	08 51
24	19 21	05 53	19 41	07 16	18 17	06 03	18 50	07 34	19 16	08 18	21 14	09 39
25	19 57	06 45	20 15	08 08	18 52	06 56	19 36	08 31	20 14	09 13	22 18	10 24
26	20 32	07 37	20 51	09 00	19 29	07 49	20 27	09 28	21 16	10 06	23 21	11 07
27	21 06	08 28	21 28	09 54	20 09	08 44	21 22	10 24	22 19	10 55		11 48
28	21 39	09 20	22 09	10 49	20 52	09 40	22 21	11 17	23 22	11 41	00 24	12 28
29	22 14	10 12			21 39	10 36	23 22	12 08		12 24	01 25	13 09
30	22 50	11 05			22 31	11 32		12 56	00 25	13 05	02 26	13 52
31	23 29	12 00			23 28	12 27			01 28	13 46		

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

1997 TIMES OF MOON RISE AND SET HARARE

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

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

1997 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	23 52	11 39		13 04	23 12	11 52		13 27	00 42	13 50	02 41	14 42
2		12 31	00 30	14 01		12 48	00 46	14 18	01 44	14 35	03 42	15 26
3	00 29	13 24	01 19	15 00	00 02	13 45	01 49	15 08	02 47	15 18	04 42	16 12
4	01 09	14 20	02 13	15 58	00 57	14 41	02 52	15 55	03 49	16 02	05 42	17 00
5	01 52	15 18	03 13	16 56	01 57	15 36	03 57	16 41	04 52	16 46	06 40	17 50
6	02 40	16 18	04 17	17 52	03 00	16 28	05 02	17 25	05 54	17 32	07 35	18 42
7	03 33	17 19	05 23	18 44	04 06	17 18	06 06	18 11	06 55	18 20	08 26	19 34
8	04 32	18 18	06 30	19 33	05 12	18 06	07 10	18 56	07 55	19 09	09 14	20 27
9	05 35	19 15	07 37	20 20	06 18	18 52	08 12	19 43	08 52	20 01	09 58	21 20
10	06 41	20 09	08 42	21 04	07 24	19 37	09 13	20 32	09 46	20 53	10 38	22 11
11	07 47	20 58	09 45	21 48	08 28	20 23	10 11	21 22	10 35	21 45	11 16	23 02
12	08 53	21 44	10 46	22 31	09 30	21 08	11 05	22 13	11 20	22 38	11 52	23 52
13	09 56	22 28	11 45	23 16	10 30	21 55	11 55	23 04	12 02	23 29	12 27	
14	10 58	23 10	12 42		11 28	22 43	12 42	23 55	12 41		13 02	00 43
15	11 58	23 52	13 37	00 01	12 23	23 31	13 25		13 18	00 20	13 37	01 34
16	12 56		14 29	00 48	13 14		14 05	00 47	13 53	01 10	14 15	02 26
17	13 53	00 34	15 19	01 36	14 02	00 21	14 43	01 37	14 28	02 01	14 56	03 20
18	14 48	01 17	16 05	02 26	14 46	01 12	15 19	02 28	15 04	02 52	15 41	04 16
19	15 42	02 03	16 48	03 16	15 28	02 02	15 54	03 18	15 41	03 44	16 30	05 13
20	16 33	02 50	17 29	04 07	16 07	02 53	16 30	04 09	16 20	04 37	17 24	06 12
21	17 21	03 39	18 07	04 58	16 44	03 43	17 06	05 00	17 03	05 32	18 22	07 10
22	18 07	04 29	18 43	05 48	17 19	04 34	17 44	05 53	17 49	06 29	19 24	08 05
23	18 49	05 20	19 19	06 38	17 55	05 24	18 24	06 47	18 40	07 27	20 27	08 58
24	19 29	06 11	19 54	07 29	18 30	06 15	19 08	07 42	19 35	08 24	21 30	09 48
25	20 07	07 02	20 29	08 20	19 07	07 07	19 55	08 38	20 34	09 20	22 33	10 34
26	20 43	07 52	21 06	09 11	19 45	07 59	20 47	09 34	21 34	10 13	23 35	11 18
27	21 18	08 43	21 45	10 03	20 26	08 53	21 42	10 30	22 36	11 03		12 01
28	21 52	09 33	22 27	10 57	21 10	09 48	22 40	11 24	23 38	11 50	00 36	12 43
29	22 28	10 24			21 58	10 43	23 40	12 15		12 35	01 36	13 25
30	23 06	11 15			22 50	11 39		13 04	00 39	13 17	02 35	14 09
31	23 46	12 09			23 47	12 33			01 40	14 00		

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

1997 TIMES OF MOON RISE AND SET WINDHOEK

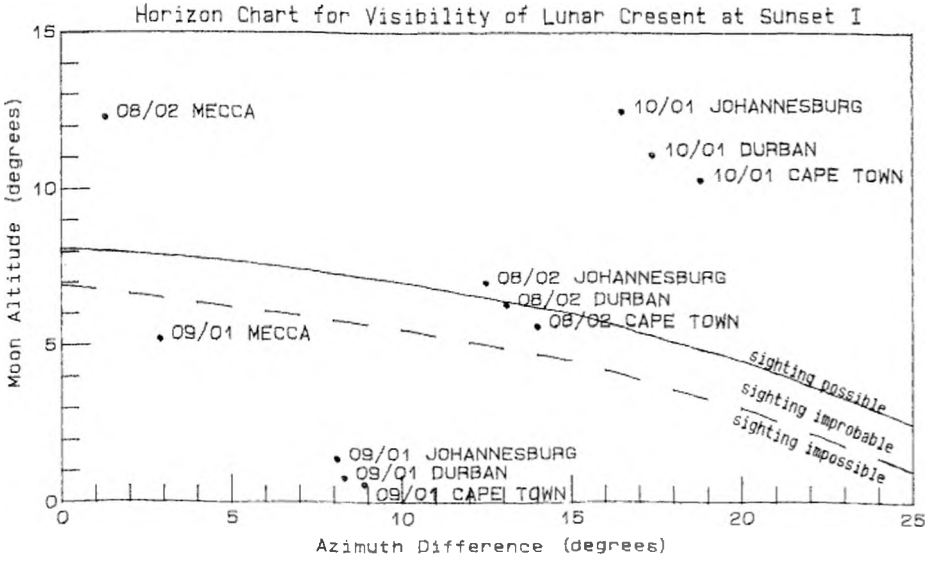
	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	00 02	12 24	00 35	13 45		12 33	00 38	14 07	01 31	14 33	03 26	15 30
2	00 38	13 15	01 20	14 42	00 03	13 28	01 37	14 59	02 32	15 19	04 25	16 15
3	01 16	14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

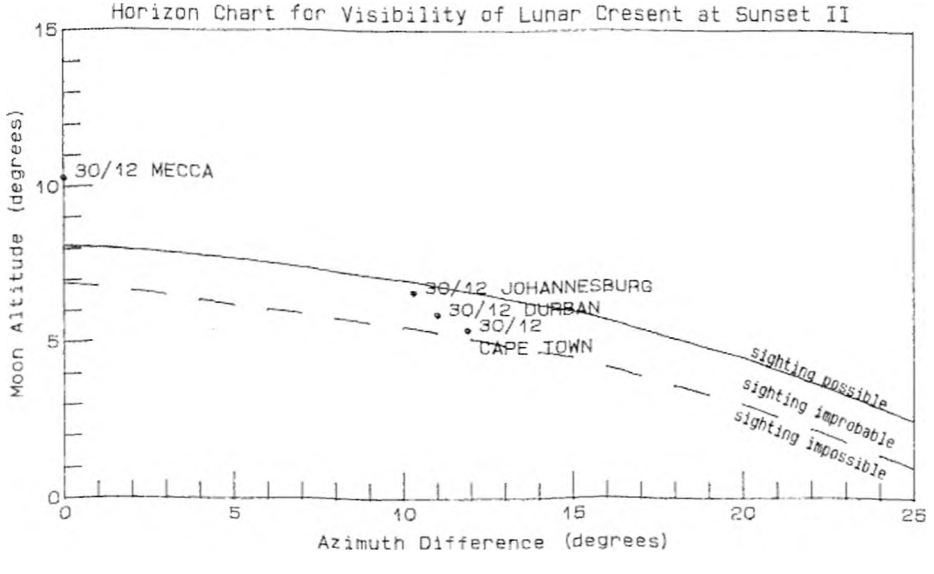
	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	04 15	15 46	05 44	17 04	06 33	18 23	06 23	18 46	06 54	20 05	07 09	20 41
2	05 11	16 35	06 30	17 56	07 10	19 12	06 59	19 36	07 37	20 58	08 02	21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

PREDICTIONS FOR YOUNG CRESCENT VISIBILITY FOR RAMADAAN AND SHAWWALL

The tabulation below is for the difference in altitude and azimuth between the Sun and the Moon at sunset for the period after New Moon on each occasion when the moon is above the horizon. Positions of the moon at altitudes less than 15° and differences of azimuth less than 25° in the table, are plotted on the accompanying charts.

OCCASION	DATE	CAPE TOWN		JOHANNESBURG		DURBAN		MECCA		HORIZON
	d m	Alt°	DAzm°	Alt°	DAzm°	Alt°	DAzm°	Alt°	DAzm°	CHART
RAMADAAN	09 01	0.6	8.9	1.4	8.1	0.8	8.3	5.2	2.9	I
	10 01	10.3	18.8	12.5	16.5	11.1	17.4	18.5	1.1	I
SHAWWALL	07 02									
	08 02	5.6	14.0	7.0	12.5	6.3	13.1	12.3	1.3	I
	09 02	14.4	25.2	17.4	22.5	15.8	23.6	26.5	0.8	
RAMADAAN	29 12									
	30 12	5.4	11.9	6.6	10.3	5.9	11.0	10.3	0.0	II
	31 12	15.2	20.5	17.7	17.4	16.4	18.7	22.4	5.1	





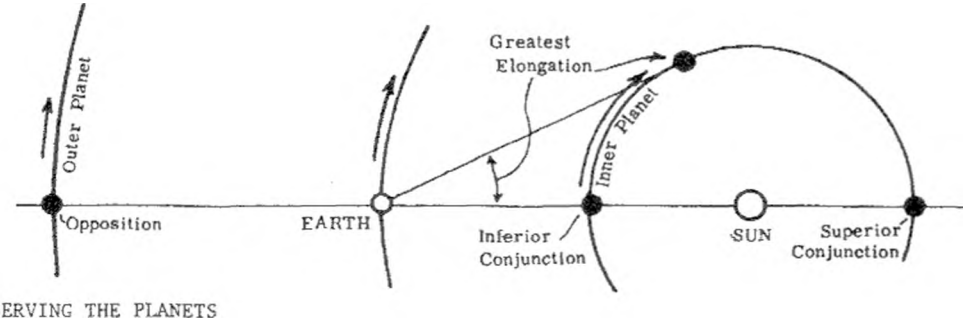
THE PLANETS

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.

MERCURY

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

January 8 (at mag.+1.7) to March 1 (at mag.-0.9),
May 4 (at mag.+3.0) to June 18 (at mag.-1.4),
September 8 (at mag.+2.0) to October 2 (at mag.-1.2) and
December 23 (at mag.+1.7) to December 31 (at mag. 0.0)

The best conditions for viewing will occur from the middle of May until early June when Mercury will be in Pisces and passes through Cetus into Aries.

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

March 21 (at mag.-1.5) to April 17 (at mag.+2.6),
July 3 (at mag.-1.3) to August 25 (at mag.+2.8), and
October 29 (at mag.-0.6) to December 11 (at mag.+1.4)

The best conditions for viewing will be from the middle of July, with Mercury in Cancer, until the middle of August when the planet will be in Leo.

	d h	d h	d h	d h
Superior Conjunction		Mar 11 18	Jun 25 21	Oct 13 23
Greatest Elongation East		Apr 6 3 (19°)	Aug 4 2 (27°)	Nov 28 18 (22°)
Stationary		Apr 15 7	Aug 17 5	Dec 7 18
Inferior Conjunction	Jan 2 3	Apr 25 13	Aug 31 16	Dec 17 10
Stationary	Jan 12 23	May 7 20	Sep 9 8	Dec 27 15
Greatest Elongation West	Jan 24 7 (25°)	May 23 1 (25°)	Sep 17 0 (18°)	

VENUS

Venus will be in the morning sky from the beginning of the year (at mag.-3.9) until the end of the third week of February.

It returns to the evening sky from the second week of May (at mag. -3.9) where it remains for the rest of the year, reaching greatest brilliancy (at mag.-4.7) on 12 December.

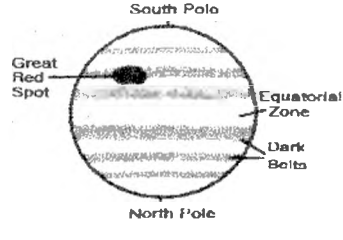
	d h
Superior conjunction	Apr 2 16
Greatest Elongation East	Nov 6 9 (47°)
Stationary	Dec 25 16

MARS

Mars, visible in the morning sky, begins the year in the constellation of Virgo, where, by the middle of March it will be visible through out the night (at mag.-1.3). Mars will make its closest approach to Earth of the last two years on March 20. It passes to Leo in late March (at mag.-1.2), back into Virgo (at mag. +0.2)in early June, where by mid June it will only be seen in the evening sky (at mag.+0.4). The planet passes to Libra in late August (at mag.+1.0), to Scorpius in late September (at mag.+1.1), to Ophiuchus in the second week of October), to Sagittarius in early November and into Capricornus after the middle of December (at mag.+1.2).

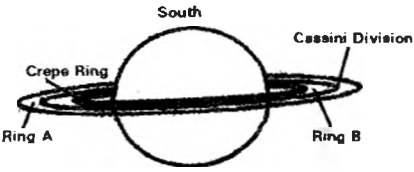
JUPITER

Jupiter (at mag.-1.9) will be seen in the evening sky, in Sagittarius, during the first week of January. The planet re-appears in the morning sky at the beginning of February (at mag.-1.9) having passed to Capricornus, in the mean time, where it remains for the rest of the year. It will be visible for more than half the night after mid May (at mag.-2.4), visible all night by October 10, (at mag.-2.6) and becomes an evening sky object by early November.



SATURN

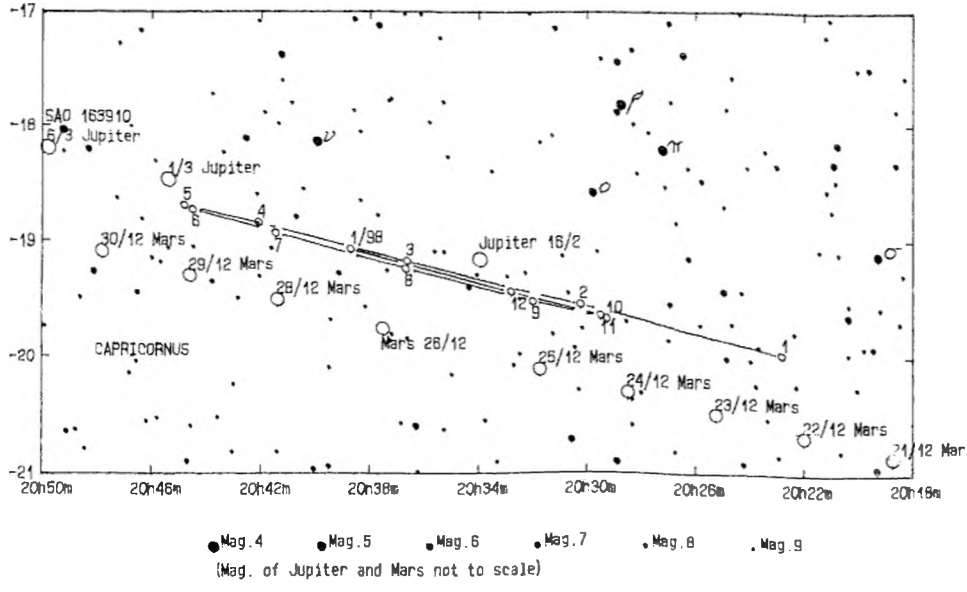
Saturn, found in Pisces, will be in the evening sky from January (at mag.+1.0) to mid March (at mag.+0.9). It will reappear in the morning sky in mid April (at mag.+0.8). It will be an all night object by early October (at mag. +0.2), and becomes an evening sky object from early November (at mag.+0.3).



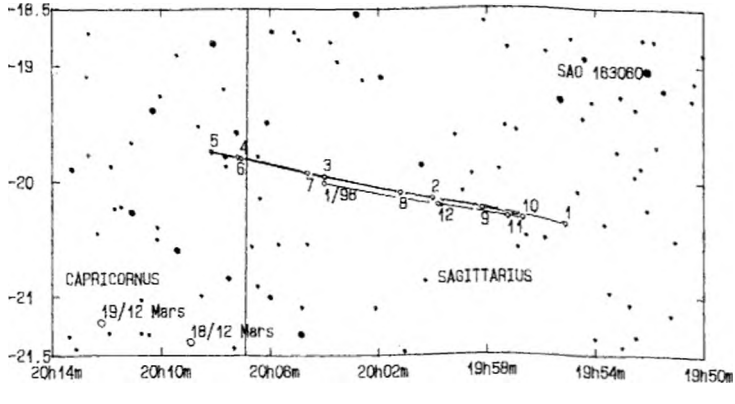
URANUS AND NEPTUNE

Uranus, visible with optical aid, will reappear in the morning sky after mid February. At opposition on July 29, it will be at magnitude 5.6. Neptune, also visible with optical aid, will be found in the morning sky, after the first week in February. At opposition on July 21, it will be at magnitude +7.9.

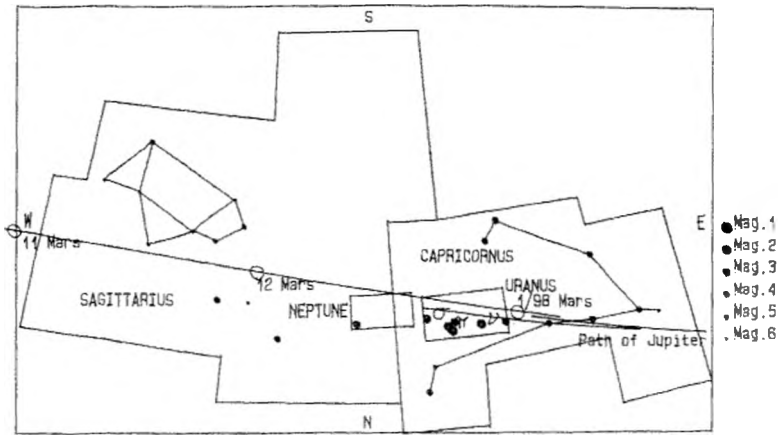
The Path of Uranus.



The Path of Neptune.



Sky Chart for the Paths of Uranus and Neptune



PLUTO

Pluto at magnitude +14 on the borders of Scorius and Ophiuchus is visible only in a telescope of at least 25cm aperture.

EVENTS OF INTEREST

Evening Sky:

1 Jan	6 Jan	Jupiter and Saturn visible
21 Mar	17 Apr	Mercury and Mars visible
12 May	2 Jul	Venus and Mars visible
3 Jul	8 Aug	Mercury, Mars and Venus visible
9 Aug	25 Aug	Mercury, Mars, Jupiter and Venus visible
26 Aug	9 Oct	Mars, Jupiter and Venus visible
10 Oct	28 Oct	Mars, Jupiter, Saturn and Venus visible
26 Oct		Mars and Venus in conjunction
29 Oct	11 Dec	Mercury, Mars, Jupiter, Saturn and Venus visible
12 Dec	31 Dec	Mars, Jupiter, Saturn and Venus visible
22 Dec		Mars and Venus in conjunction

Morning Sky:

1 Jan	7 Jan	Mars and Venus visible
8 Jan	1 Feb	Mars, Mercury and Venus visible
12 Jan		Mercury and Venus in conjunction
2 Feb	21 Feb	Jupiter, Mars, Mercury and Venus visible
12 Feb		Jupiter and Mercury in conjunction
22 Feb	1 Mar	Mars, Mercury and Jupiter visible
2 Mar	17 Mar	Jupiter and Mars visible
4 May	18 Jun	Mercury, Jupiter and Saturn visible
19 Jun	9 Aug	Jupiter and Saturn visible
8 Sep	2 Oct	Mercury and Saturn visible

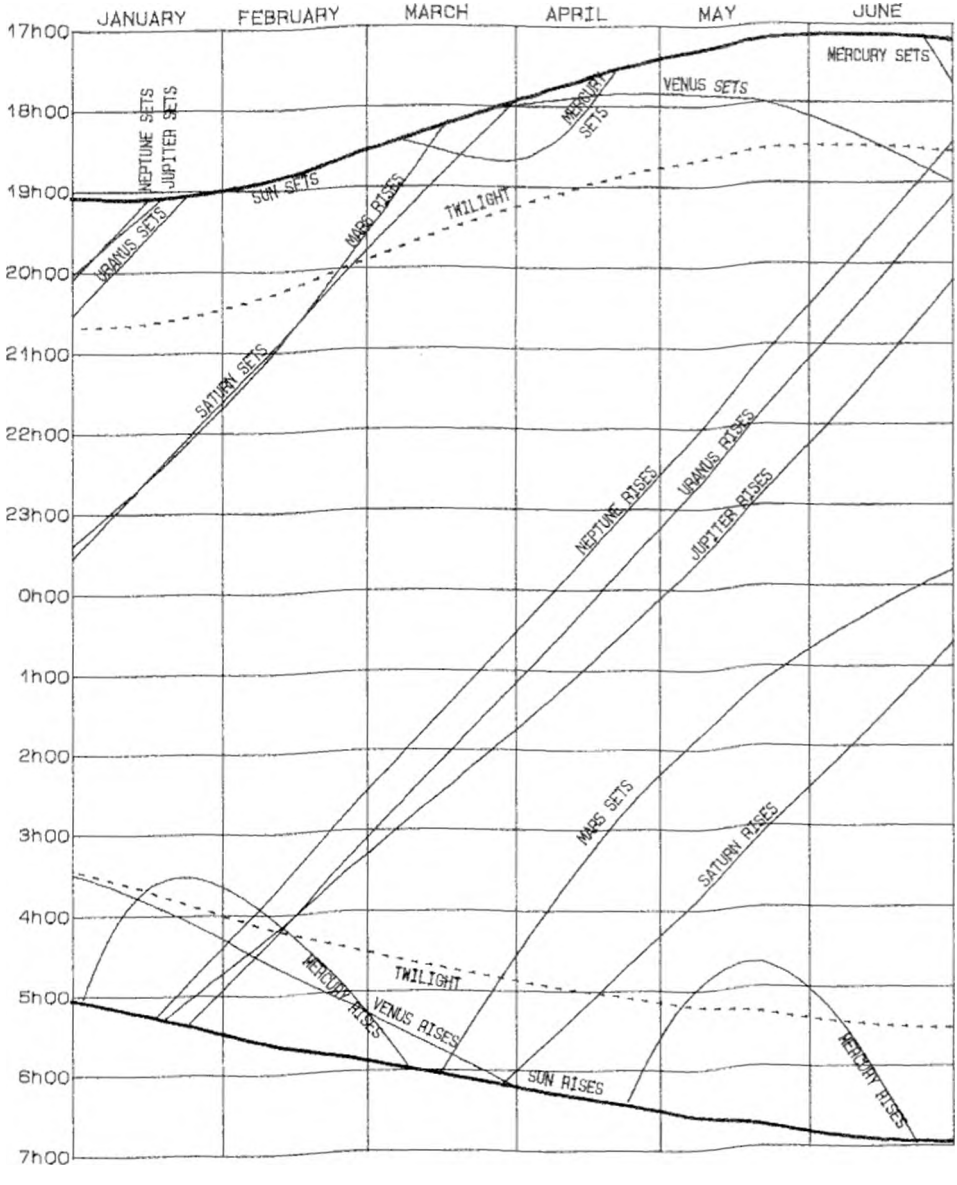
APPARENT PLACES:

	Mercury				Venus				Mars				Jupiter			
	RA		DEC		RA		DEC		RA		DEC		RA		DEC	
	h	m	°	′	h	m	°	′	h	m	°	′	h	m	°	′
Jan 1	18	56.0	-20	28	17	10.0	-22	10	12	1.4	2	44	19	48.7	-21	25
Jan 11	18	13.7	-20	14	18	4.2	-23	5	12	12.7	1	44	19	58.6	-21	0
Jan 21	18	29.1	-21	33	18	58.6	-22	50	12	21.2	1	4	20	8.4	-20	32
Jan 31	19	15.8	-22	11	19	52.4	-21	25	12	26.2	0	46	20	18.2	-20	2
Feb 10	20	14.3	-21	2	20	44.8	-18	57	12	27.0	0	56	20	27.9	-19	31
Feb 20	21	17.8	-17	46	21	35.2	-15	33	12	23.0	1	33	20	37.2	-18	58
Mar 2	22	23.8	-12	18	22	23.8	-11	27	12	14.3	2	35	20	46.3	-18	25
Mar 12	23	32.3	-4	41	23	10.8	-6	50	12	1.7	3	55	20	54.9	-17	52
Mar 22	0	42.7	4	30	23	56.7	-1	55	11	47.1	5	18	21	3.0	-17	20
Apr 1	1	45.8	12	56	0	42.1	3	7	11	33.3	6	27	21	10.5	-16	49
Apr 11	2	21.6	17	20	1	27.9	8	2	11	22.4	7	10	21	17.3	-16	20
Apr 21	2	19.4	16	19	2	14.6	12	39	11	16.1	7	21	21	23.3	-15	55
May 1	1	58.7	11	44	3	2.8	16	46	11	14.6	7	3	21	28.5	-15	32
May 11	1	54.2	8	53	3	52.7	20	10	11	17.5	6	18	21	32.6	-15	15
May 21	2	15.4	9	55	4	44.5	22	39	11	24.3	5	12	21	35.7	-15	2
May 31	2	57.9	13	48	5	37.6	24	5	11	34.3	3	47	21	37.6	-14	55
Jun 10	4	0.2	19	0	6	31.3	24	20	11	46.9	2	7	21	38.2	-14	55
Jun 20	5	23.5	23	27	7	24.5	23	24	12	1.7	0	15	21	37.7	-15	0
Jun 30	6	58.7	24	23	8	16.4	21	21	12	18.2	-1	47	21	35.9	-15	12
Jul 10	8	24.3	21	10	9	6.3	18	18	12	36.2	-3	56	21	33.0	-15	28
Jul 20	9	31.5	15	41	9	54.1	14	27	12	55.7	-6	11	21	29.0	-15	50
Jul 30	10	21.4	9	40	10	39.9	9	59	13	16.5	-8	29	21	24.4	-16	13
Aug 9	10	53.7	4	25	11	24.1	5	5	13	38.5	-10	48	21	19.3	-16	38
Aug 19	11	2.6	1	37	12	7.2	-0	1	14	1.7	-13	5	21	14.2	-17	3
Aug 29	10	41.6	3	31	12	49.9	-5	10	14	26.3	-15	18	21	9.4	-17	25
Sep 8	10	17.0	8	35	13	32.9	-10	10	14	52.1	-17	23	21	5.2	-17	43
Sep 18	10	37.4	9	36	14	16.6	-14	49	15	19.2	-19	19	21	2.1	-17	56
Sep 28	11	35.2	4	43	15	1.4	-18	57	15	47.6	-21	2	21	0.1	-18	4
Oct 8	12	40.3	-2	43	15	47.4	-22	23	16	17.3	-22	28	20	59.4	-18	6
Oct 18	13	42.9	-10	6	16	34.4	-24	56	16	48.1	-23	35	21	0.0	-18	3
Oct 28	14	43.9	-16	30	17	21.5	-26	30	17	20.0	-24	20	21	1.9	-17	53
Nov 7	15	45.2	-21	30	18	7.3	-27	1	17	52.6	-24	40	21	5.1	-17	39
Nov 17	16	46.6	-24	44	18	50.2	-26	31	18	25.8	-24	34	21	9.4	-17	19
Nov 27	17	43.1	-25	50	19	28.1	-25	9	18	59.2	-24	0	21	14.8	-16	55
Dec 7	18	14.6	-24	36	19	58.5	-23	8	19	32.6	-23	0	21	21.0	-16	26
Dec 17	17	42.2	-21	33	20	18.4	-20	47	20	5.7	-21	33	21	28.0	-15	52
Dec 27	17	5.1	-19	50	20	24.2	-18	27	20	38.2	-19	43	21	35.6	-15	15

	Saturn		Uranus		Neptune		Pluto	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	0 8.7	-1 38	20 22.8	-19 59	19 55.1	-20 22	16 18.8	-8 50
Jan 11	0 10.7	-1 22	20 25.2	-19 51	19 56.7	-20 18	16 20.1	-8 51
Jan 21	0 13.4	-1 3	20 27.6	-19 42	19 58.3	-20 14	16 21.2	-8 51
Jan 31	0 16.5	-0 41	20 30.0	-19 34	19 59.8	-20 9	16 22.1	-8 51
Feb 10	0 20.0	-0 16	20 32.4	-19 26	20 1.4	-20 5	16 22.9	-8 49
Feb 20	0 23.9	0 10	20 34.7	-19 18	20 2.8	-20 1	16 23.4	-8 47
Mar 2	0 28.1	0 38	20 36.8	-19 10	20 4.1	-19 57	16 23.7	-8 44
Mar 12	0 32.5	1 7	20 38.8	-19 3	20 5.3	-19 54	16 23.8	-8 41
Mar 22	0 37.0	1 36	20 40.6	-18 56	20 6.3	-19 51	16 23.6	-8 37
Apr 1	0 41.6	2 6	20 42.1	-18 51	20 7.1	-19 48	16 23.3	-8 33
Apr 11	0 46.2	2 35	20 43.3	-18 47	20 7.7	-19 46	16 22.7	-8 29
Apr 21	0 50.8	3 3	20 44.2	-18 44	20 8.0	-19 45	16 22.0	-8 25
May 1	0 55.2	3 30	20 44.8	-18 42	20 8.2	-19 45	16 21.1	-8 22
May 11	0 59.4	3 55	20 45.1	-18 41	20 8.1	-19 45	16 20.1	-8 18
May 21	1 3.4	4 18	20 45.0	-18 42	20 7.8	-19 46	16 19.1	-8 16
May 31	1 7.1	4 39	20 44.6	-18 44	20 7.3	-19 47	16 18.0	-8 14
Jun 10	1 10.3	4 57	20 43.8	-18 47	20 6.6	-19 50	16 16.9	-8 12
Jun 20	1 13.2	5 12	20 42.8	-18 51	20 5.7	-19 52	16 15.9	-8 12
Jun 30	1 15.5	5 23	20 41.6	-18 56	20 4.7	-19 55	16 15.0	-8 13
Jul 10	1 17.3	5 31	20 40.2	-19 1	20 3.7	-19 58	16 14.2	-8 14
Jul 20	1 18.5	5 35	20 38.6	-19 7	20 2.5	-20 2	16 13.6	-8 17
Jul 30	1 19.0	5 36	20 37.0	-19 14	20 1.4	-20 5	16 13.1	-8 20
Aug 9	1 19.0	5 32	20 35.4	-19 20	20 0.3	-20 8	16 12.9	-8 24
Aug 19	1 18.2	5 25	20 33.8	-19 25	19 59.3	-20 11	16 12.8	-8 29
Aug 29	1 16.9	5 14	20 32.4	-19 30	19 58.4	-20 14	16 13.0	-8 35
Sep 8	1 15.1	5 1	20 31.1	-19 35	19 57.7	-20 16	16 13.4	-8 41
Sep 18	1 12.7	4 45	20 30.1	-19 38	19 57.1	-20 18	16 14.0	-8 47
Sep 28	1 10.1	4 28	20 29.4	-19 40	19 56.8	-20 20	16 14.8	-8 54
Oct 8	1 7.2	4 9	20 29.0	-19 41	19 56.6	-20 20	16 15.8	-9 1
Oct 18	1 4.3	3 51	20 29.0	-19 41	19 56.7	-20 20	16 16.9	-9 7
Oct 28	1 1.5	3 35	20 29.3	-19 40	19 57.0	-20 19	16 18.2	-9 14
Nov 7	0 59.0	3 20	20 29.9	-19 37	19 57.6	-20 18	16 19.6	-9 20
Nov 17	0 56.8	3 9	20 30.9	-19 34	19 58.4	-20 16	16 21.1	-9 25
Nov 27	0 55.2	3 1	20 32.2	-19 29	19 59.4	-20 14	16 22.6	-9 31
Dec 7	0 54.2	2 57	20 33.8	-19 23	20 0.5	-20 11	16 24.1	-9 35
Dec 17	0 53.8	2 58	20 35.6	-19 16	20 1.8	-20 7	16 25.6	-9 38
Dec 27	0 54.1	3 3	20 37.6	-19 8	20 3.2	-20 3	16 27.1	-9 41

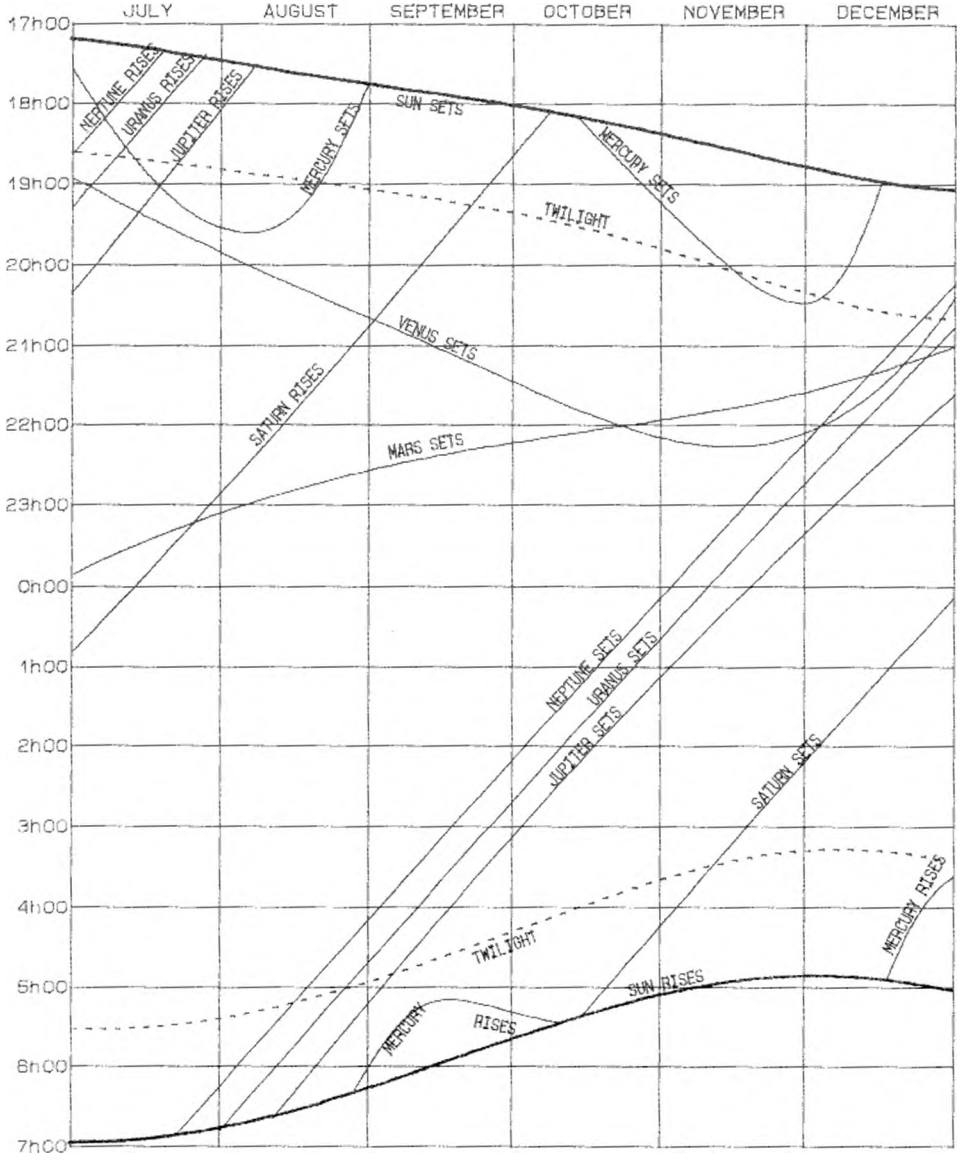
TIMES OF RISING AND SETTING

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.



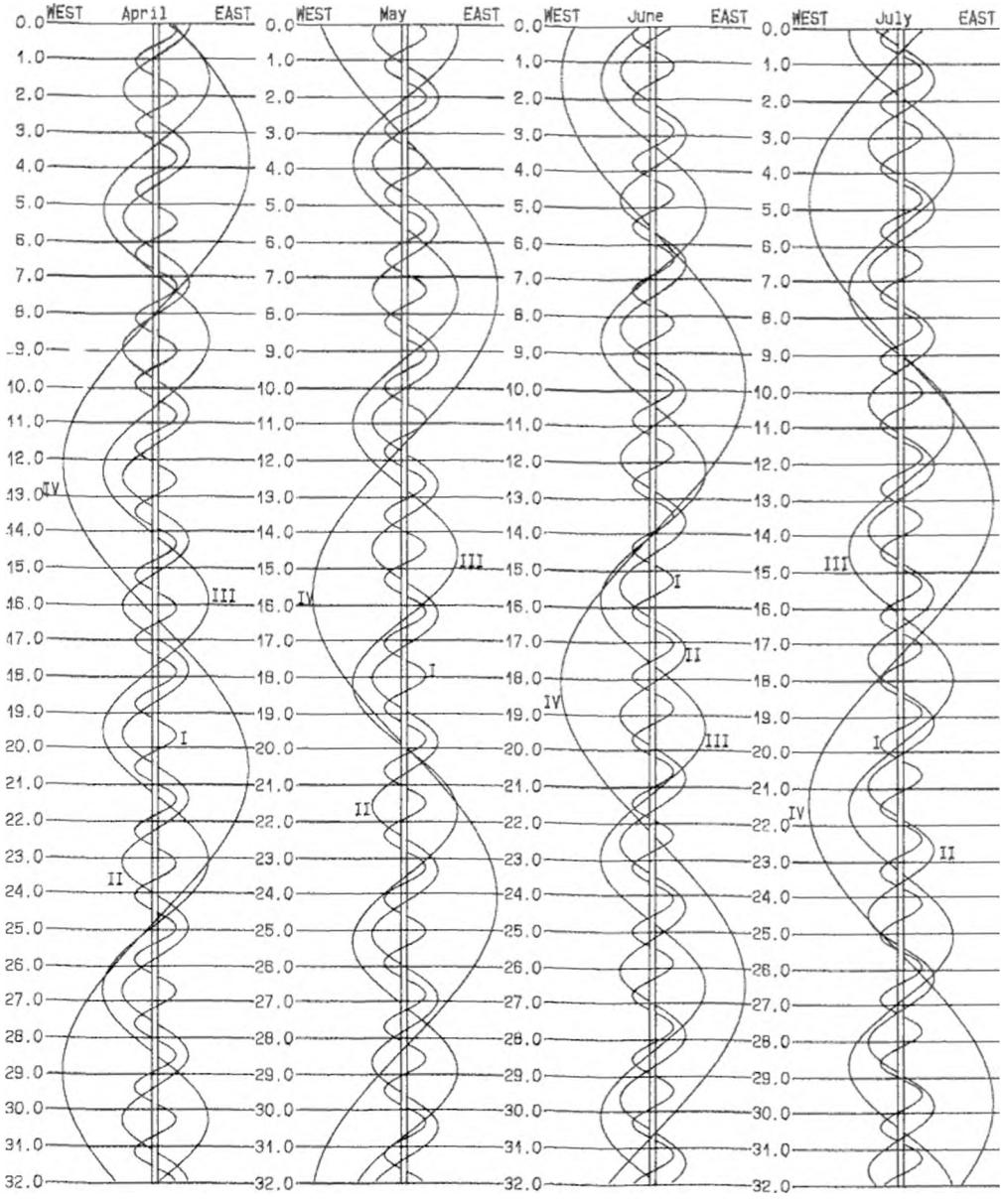
CORRECTION FOR PLACES NOT ON THE 30° E MERIDIAN
Approximate longitude corrections from the 30° East meridian are:

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

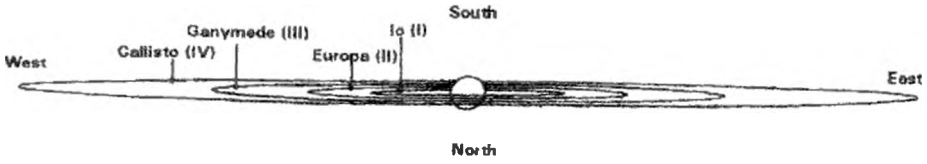


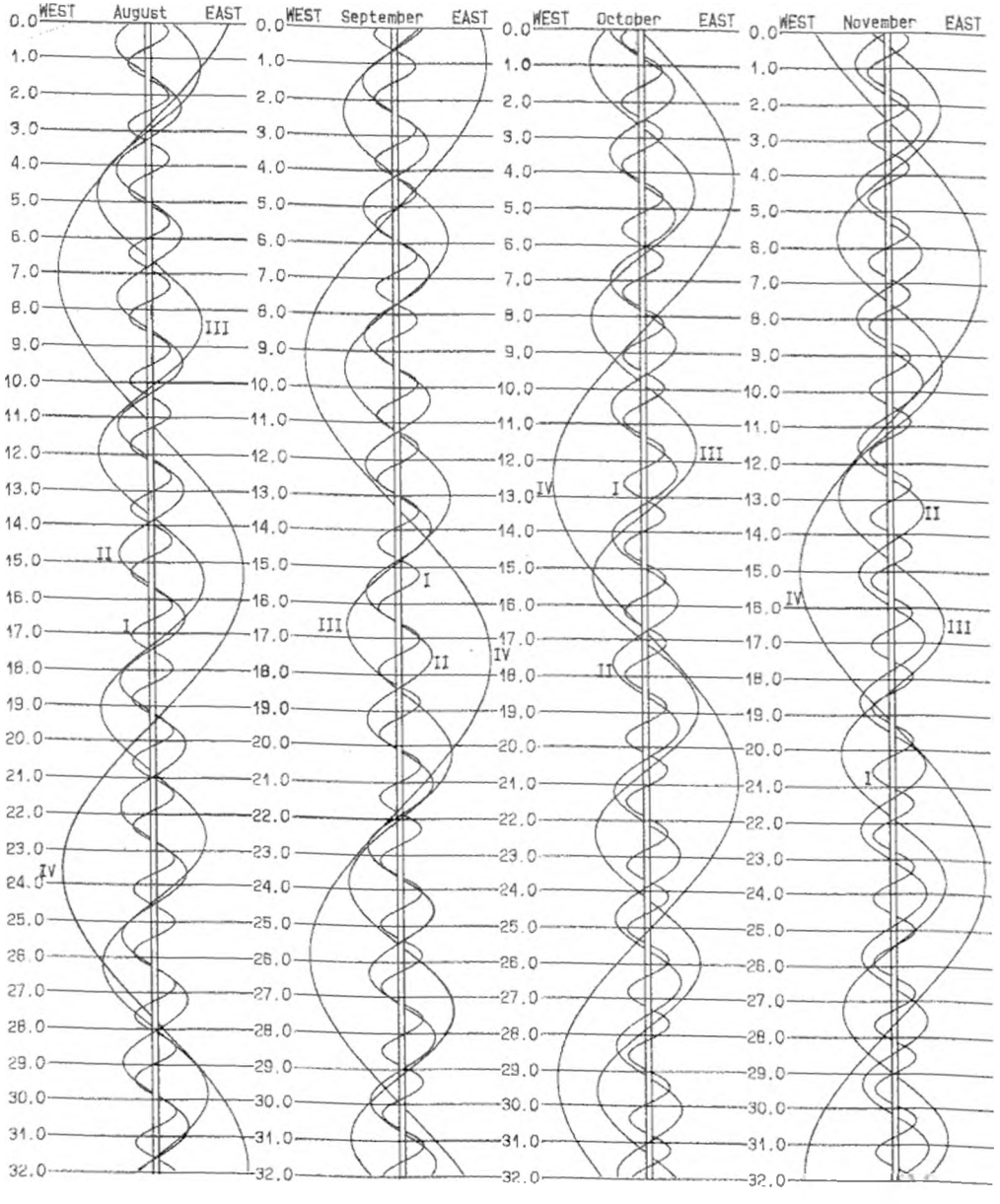
THE MOONS OF JUPITER

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	
Mar 19	04	51	I.Tr.E.	May 21	01	10	I.Oc.R.	Jun 19	03	20	I.Tr.I.	Jul 09	05	34	II.Sh.I.
26	04	33	I.Tr.I.		22	05	37	II.Ec.D.		04	33	I.Sh.E.		10	23	49	II.Ec.D.
27	04	11	I.Oc.R.		23	04	44	III.Sh.I.		05	38	I.Tr.E.		11	04	10	II.Oc.R.
	04	37	III.Tr.E.		24	00	49	II.Sh.I.		23	35	I.Ec.D.			05	16	I.Ec.D.
30	04	50	IV.Ec.R.			03	26	II.Tr.I.	20	02	57	I.Oc.R.		12	02	26	I.Sh.I.
Apr 02	05	25	I.Sh.I.			03	40	II.Sh.E.		23	01	I.Sh.E.			03	07	I.Tr.I.
03	04	22	III.Sh.E.		26	04	57	I.Ec.D.	21	00	05	I.Tr.E.			04	44	I.Sh.E.
	05	21	III.Tr.I.		27	02	06	I.Sh.I.		00	17	III.Sh.E.			05	25	I.Tr.E.
10	04	38	I.Ec.D.			03	23	I.Tr.I.		00	59	III.Tr.I.			21	42	II.Sh.E.
	04	49	III.Sh.I.			03	36	III.Oc.R.		04	37	III.Tr.E.			23	01	II.Tr.E.
11	04	04	I.Sh.E.			04	22	I.Sh.E.		23	24	IV.Ec.R.			23	44	I.Ec.D.
	05	15	I.Tr.E.			05	40	I.Tr.E.	22	04	27	IV.Oc.D.		13	02	42	I.Oc.R.
13	03	25	II.Ec.D.		28	02	42	IV.Tr.I.	23	05	18	II.Ec.D.			21	33	I.Tr.I.
14	03	19	III.Oc.R.			03	01	I.Oc.R.	25	00	25	II.Sh.I.			23	12	I.Sh.E.
15	03	54	II.Tr.E.		31	03	23	II.Sh.I.		02	24	II.Tr.I.			23	51	I.Tr.E.
16	05	50	IV.Oc.D.			05	57	II.Tr.I.		03	16	II.Sh.E.		15	22	36	III.Ec.D.
18	03	41	I.Sh.I.	Jun 02	02	59	II.Oc.R.			05	15	II.Tr.E.		16	04	40	III.Oc.R.
	04	55	I.Tr.I.		03	02	16	III.Ec.R.	26	04	09	I.Sh.I.		17	01	30	IV.Sh.E.
19	04	34	I.Oc.R.			03	45	III.Oc.D.		05	08	I.Tr.I.			02	12	IV.Tr.I.
21	03	52	III.Oc.D.			03	59	I.Sh.I.		06	27	I.Sh.E.		18	02	26	II.Ec.D.
22	03	43	II.Tr.I.			05	14	I.Tr.I.		23	30	II.Oc.R.			06	28	II.Oc.R.
	04	02	II.Sh.E.		04	01	19	I.Ec.D.	27	01	28	I.Ec.D.		19	04	20	I.Sh.I.
25	05	35	I.Sh.I.			04	52	I.Oc.R.		04	44	I.Oc.R.			04	52	I.Tr.I.
26	02	54	I.Ec.D.		05	00	29	IV.Ec.D.		22	38	I.Sh.I.			21	25	II.Sh.I.
27	03	37	I.Tr.E.			00	45	I.Sh.E.		23	35	I.Tr.I.			22	26	II.Tr.I.
28	02	43	III.Ec.D.			01	59	I.Tr.E.	28	00	40	III.Sh.I.		20	00	17	II.Sh.E.
29	03	45	II.Sh.I.			05	17	IV.Ec.R.		00	55	I.Sh.E.			01	17	II.Tr.E.
May 01	03	25	II.Oc.R.		07	05	58	II.Sh.I.		01	52	I.Tr.E.			01	38	I.Ec.D.
	03	04	47	I.Ec.D.		09	00	06	II.Ec.D.		04	17	III.Sh.E.			04	26	I.Oc.R.
	05	36	IV.Oc.R.			05	28	II.Oc.R.		04	32	III.Tr.I.			22	49	I.Sh.I.
04	03	15	I.Tr.I.		10	02	38	III.Ec.D.		23	11	I.Oc.R.			23	18	I.Tr.I.
	04	13	I.Sh.E.			05	53	I.Sh.I.	30	02	30	IV.Sh.I.		21	01	07	I.Sh.E.
	05	32	I.Tr.E.			06	15	III.Ec.R.	Jul 02	02	59	II.Sh.I.			01	36	I.Tr.E.
05	02	54	I.Oc.R.		11	00	28	II.Tr.E.		04	44	II.Tr.I.			22	52	I.Oc.R.
09	02	09	III.Tr.I.			03	13	I.Ec.D.		05	51	II.Sh.E.		23	02	35	III.Ec.D.
	05	46	III.Tr.E.		12	00	22	I.Sh.I.	03	06	03	I.Sh.I.		25	05	03	II.Ec.D.
11	03	50	I.Sh.I.			01	32	I.Tr.I.	04	01	51	II.Oc.R.		26	06	15	I.Sh.I.
	05	10	I.Tr.I.			02	39	I.Sh.E.		03	22	I.Ec.D.			21	44	III.Tr.E.
12	04	48	I.Oc.R.			03	49	I.Tr.E.		06	30	I.Oc.R.		27	00	00	II.Sh.I.
13	01	55	I.Tr.E.		13	01	09	I.Oc.R.	05	00	32	I.Sh.I.			00	41	II.Tr.I.
15	03	02	II.Ec.D.		14	00	17	IV.Tr.E.		01	21	I.Tr.I.			02	51	II.Sh.E.
16	04	18	III.Sh.E.			01	00	III.Tr.E.		02	49	I.Sh.E.			03	31	II.Tr.E.
17	03	45	II.Tr.E.		16	02	42	II.Ec.D.		03	39	I.Tr.E.			03	32	I.Ec.D.
18	05	44	I.Sh.I.		18	00	02	II.Tr.I.		04	40	III.Sh.I.			06	10	I.Oc.R.
19	03	03	I.Ec.D.			00	42	II.Sh.E.	06	00	57	I.Oc.R.		28	00	43	I.Sh.I.
20	01	31	I.Tr.I.			02	52	II.Tr.E.		22	06	I.Tr.E.			01	02	I.Tr.I.
	02	29	I.Sh.E.			05	06	I.Ec.D.	09	00	34	IV.Oc.R.			03	01	I.Sh.E.
	03	48	I.Tr.E.		19	02	15	I.Sh.I.		01	18	III.Oc.R.			03	21	I.Tr.E.

	d	h	m	
Jul	28	21	53	II.Oc.R.
		22	01	I.Ec.D.
	29	00	36	I.Oc.R.
		21	30	I.Sh.E.
		21	47	I.Tr.E.
Aug	02	20	40	III.Sh.I.
		21	18	IV.Tr.E.
		21	22	III.Tr.I.
	03	00	19	III.Sh.E.
		01	00	III.Tr.E.
		02	34	II.Sh.I.
		02	54	II.Tr.I.
		05	26	II.Sh.E.
		05	26	I.Ec.D.
		05	45	II.Tr.E.
	04	02	38	I.Sh.I.
		02	46	I.Tr.I.
		04	56	I.Sh.E.
		05	05	I.Tr.E.
		21	00	II.Ec.D.
		23	55	I.Ec.D.
	05	00	09	II.Oc.R.
		02	19	I.Oc.R.
		21	07	I.Sh.I.
		21	12	I.Tr.I.
		23	25	I.Sh.E.
		23	31	I.Tr.E.
	06	20	45	I.Oc.R.
	10	00	38	III.Tr.I.
		00	41	III.Sh.I.
		04	16	III.Tr.E.
		04	20	III.Sh.E.
		05	07	II.Tr.I.
		05	09	II.Sh.I.
	11	00	38	IV.Oc.D.
		04	30	I.Tr.I.
		04	33	I.Sh.I.
		23	30	II.Oc.D.
	12	01	46	I.Oc.D.
		02	32	II.Ec.R.
		04	07	I.Ec.R.
		22	56	I.Tr.I.
		23	01	I.Sh.I.
	13	01	15	I.Tr.E.
		01	20	I.Sh.E.
		20	11	I.Oc.D.
		21	05	II.Tr.E.
		21	18	II.Sh.E.
		22	35	I.Ec.R.
	14	19	41	I.Tr.E.
		19	49	I.Sh.E.
	17	03	54	III.Tr.I.
		04	41	III.Sh.I.
	19	01	46	II.Oc.D.
		03	29	I.Oc.D.
	20	00	40	I.Tr.I.
		00	57	I.Sh.I.
		02	59	I.Tr.E.
		03	15	I.Sh.E.
		20	28	II.Tr.I.
		21	01	II.Sh.I.
		21	55	I.Oc.D.
		22	16	III.Ec.R.

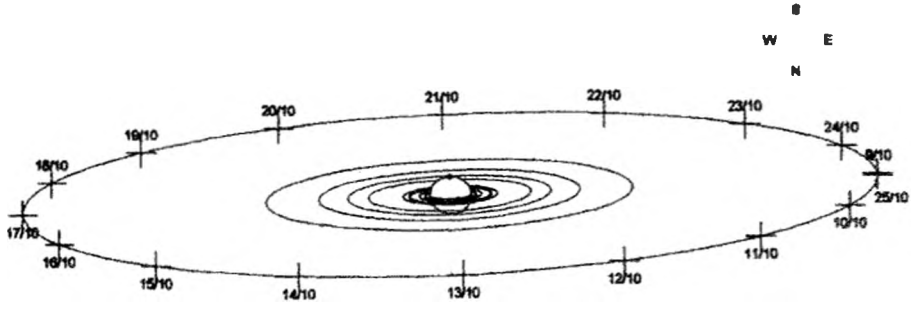
	d	h	m	
Aug	20	23	18	II.Tr.E.
		23	53	II.Sh.E.
	21	00	30	I.Ec.R.
		19	07	I.Tr.I.
		19	25	I.Sh.I.
		21	25	I.Tr.E.
		21	44	I.Sh.E.
	22	18	58	I.Ec.R.
	26	04	02	II.Oc.D.
	27	02	25	I.Tr.I.
		02	52	I.Sh.I.
		20	46	III.Oc.D.
		22	42	II.Tr.I.
		23	36	II.Sh.I.
		23	39	I.Oc.D.
		23	57	IV.Ec.R.
	28	01	33	II.Tr.E.
		02	16	III.Ec.R.
		02	24	I.Ec.R.
		02	27	II.Sh.E.
		20	51	I.Tr.I.
		21	21	I.Sh.I.
		23	10	I.Tr.E.
		23	39	I.Sh.E.
	29	18	53	I.Ec.R.
		21	07	II.Ec.R.
Sep	04	00	06	III.Oc.D.
		00	58	II.Tr.I.
		01	24	I.Oc.D.
		02	11	II.Sh.I.
		21	02	IV.Tr.I.
		22	37	I.Tr.I.
		23	16	I.Sh.I.
	05	00	55	I.Tr.E.
		01	34	I.Sh.E.
		01	50	IV.Tr.E.
		03	12	IV.Sh.I.
		19	29	II.Oc.D.
		19	51	I.Oc.D.
		22	48	I.Ec.R.
		23	45	II.Ec.R.
	06	19	22	I.Tr.E.
		20	03	I.Sh.E.
	07	20	24	III.Sh.E.
	12	00	24	I.Tr.I.
		01	11	I.Sh.I.
		02	42	I.Tr.E.
		21	37	I.Oc.D.
		21	49	II.Oc.D.
	13	00	42	I.Ec.R.
		02	23	II.Ec.R.
		18	51	I.Tr.I.
		19	40	I.Sh.I.
		21	08	I.Tr.E.
		21	58	I.Sh.E.
	14	19	11	I.Ec.R.
		19	15	II.Tr.E.
		20	47	III.Sh.I.
		20	55	II.Sh.E.
		20	59	III.Tr.E.
	15	00	25	III.Sh.E.
	19	02	11	I.Tr.I.
		23	24	I.Oc.D.

	d	h	m	
Sep	20	00	11	II.Oc.D.
		20	39	I.Tr.I.
		21	36	I.Sh.I.
		22	56	I.Tr.E.
		23	54	I.Sh.E.
	21	18	45	II.Tr.I.
		20	40	II.Sh.I.
		20	51	III.Tr.I.
		21	06	I.Ec.R.
		21	26	IV.Sh.I.
		21	35	II.Tr.E.
		23	21	II.Sh.E.
	22	00	29	III.Tr.E.
		00	48	III.Sh.I.
		02	14	IV.Sh.E.
	27	01	12	I.Oc.D.
		22	28	I.Tr.I.
		23	32	I.Sh.I.
	28	00	45	I.Tr.E.
		01	49	I.Sh.E.
		19	39	I.Oc.D.
		21	08	II.Tr.I.
		23	01	I.Ec.R.
		23	15	II.Sh.I.
		23	58	II.Tr.E.
	29	00	26	III.Tr.I.
		19	13	I.Tr.E.
		20	18	I.Sh.E.
		21	13	IV.Oc.D.
	30	20	59	II.Ec.R.
Oct	02	18	42	III.Ec.D.
		22	21	III.Ec.R.
	05	00	18	I.Tr.I.
		01	27	I.Sh.I.
		21	29	I.Oc.D.
		23	33	II.Tr.I.
	06	00	56	I.Ec.R.
		18	46	I.Tr.I.
		19	56	I.Sh.I.
		21	03	I.Tr.E.
		22	13	I.Sh.E.
	07	19	25	I.Ec.R.
		23	37	II.Ec.R.
	08	20	27	IV.Sh.E.
	09	21	29	III.Oc.R.
		22	43	III.Ec.D.
	12	23	20	I.Oc.D.
	13	20	38	I.Tr.I.
		21	52	I.Sh.I.
		22	55	I.Tr.E.
	14	00	09	I.Sh.E.
		20	47	II.Oc.D.
		21	20	I.Ec.R.
	15	18	38	I.Sh.E.
	16	20	34	II.Sh.E.
		21	36	III.Oc.D.
	20	20	32	III.Sh.E.
		22	31	I.Tr.I.
		23	48	I.Sh.I.
	21	19	40	I.Oc.D.
		23	16	I.Ec.R.
		23	20	II.Oc.D.
	22	19	16	I.Tr.E.

	d	h	m	
Oct	22	20	34	I.Sh.E.
	23	20	21	II.Sh.I.
		20	36	II.Tr.E.
		23	10	II.Sh.E.
	24	21	18	IV.Tr.I.
	27	19	12	III.Tr.E.
		20	57	III.Sh.I.
	28	21	34	I.Oc.D.
	29	18	53	I.Tr.I.
		20	13	I.Sh.I.
		21	10	I.Tr.E.
		22	29	I.Sh.E.
	30	19	40	I.Ec.R.
		20	19	II.Tr.I.
		22	57	II.Sh.I.
		23	09	II.Tr.E.
Nov	01	20	51	II.Ec.R.
	02	19	55	IV.Ec.D.
	03	19	35	III.Tr.I.
		23	12	III.Tr.E.
	04	23	29	I.Oc.D.
	05	20	49	I.Tr.I.
		22	08	I.Sh.I.
		23	06	I.Tr.E.
	06	21	35	I.Ec.R.
		22	55	II.Tr.I.
	07	18	54	I.Sh.E.
	10	20	12	IV.Tr.E.
	12	22	45	I.Tr.I.
	13	19	54	I.Oc.D.
	14	19	31	I.Tr.E.
		20	50	I.Sh.E.
		22	30	III.Ec.R.
	15	20	32	II.Oc.D.
	17	20	17	II.Sh.E.
	20	21	51	I.Oc.D.
	21	19	12	I.Tr.I.
		20	29	I.Sh.I.
		21	18	III.Oc.R.
		21	29	I.Tr.E.
	22	19	55	I.Ec.R.
	24	20	04	II.Sh.I.
		20	23	II.Tr.E.
	28	21	10	9 I.Tr.I.
		21	51	III.Oc.D.
	29	21	50	I.Ec.R.
	30	19	10	I.Sh.E.
Dec	01	20	15	II.Tr.I.
	02	20	42	III.Sh.E.
	03	20	40	II.Ec.R.
	05	21	08	IV.Oc.D.
	06	20	17	I.Oc.D.
	07	19	56	I.Tr.E.
		21	06	I.Sh.E.
	09	20	05	III.Tr.E.
		21	08	III.Sh.I.
	14	19	39	I.Tr.I.
		20	45	I.Sh.I.
	15	20	10	I.Ec.R.
	16	20	47	III.Tr.I.
	17	20	54	II.Oc.D.
	23	19	26	I.Sh.E.

THE MOONS OF SATURN

Saturn's moons are considerably fainter than the 4 Galilean moons of Jupiter. The easiest to find is Titan (magnitude +8.5),according to the diagram which shows its orbit at opposition on October 10, and information in the table below.



TITAN

Eastern Elongation			Inferior Conjunction			Western Elongation			Superior Conjunction		
	d	h		d	h		d	h		d	h
						Jan	2	11.1	Jan	6	06.3
Jan	10	04.8	Jan	14	09.5		18	10.7		22	06.0
	26	04.7		30	09.5	Feb	3	10.7	Feb	7	06.0
Feb	11	04.8	Feb	15	09.8		19.	10.9		23	06.3
	27	05.3	Mar	3	10.3	Mar	7	11.3	Mar	11	06.7
Mar	15	05.9		19	11.0		23	11.8		27	07.2
	31	06.5	Apr	4	11.7	Apr	8	12.4	Apr	12	07.7
Apr	16	07.2		20	12.3		24	12.9		28	08.2
May	2	07.8	May	6	12.9	May	10	13.3	May	14	08.6
	18	08.3		22	13.4		26	13.6		30	08.8
Jun	3	08.6	Jun	7	13.6	Jun	11	13.6	Jun	15	08.8
	19	08.6		23	13.5		27	13.3	Jul	1	08.4
Jul	5	08.2	Jul	9	13.0	Jul	13	12.7		17	07.7
	21	07.4		25	12.1		29	11.7	Aug	2	06.6
Aug	6	06.2	Aug	10	10.8	Aug	14	10.3		18	05.0
	22	04.5		26	09.0		30	08.4	Sep	3	03.1
Sep	7	02.5	Sep	11	06.9		15	06.3		19	00.9
	23	00.1		27	04.5	Oct	1	03.9	Oct	4	22.5
Oct	8	21.6	Oct	13	01.9		17	01.4		20	20.0
	24	19.0		28	23.4	Nov	1	23.0	Nov	5	17.6
Nov	9	16.6	Nov	13	21.0		17	20.8		21	15.5
	25	14.5		29	19.0	Dec	3	19.0	Dec	7	13.8
Dec	11	12.9	Dec	15	17.4		19	17.5		23	12.5
	27	11.6		31	16.3						

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 comets predicted to appear during 1997, 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
Wirtanen	1997 March 14	10
Hale-Bopp	1997 April 1	-1
Wild 2	1997 May 6	10
Encke	1997 May 23	6
Wolf Harrington	1997 September 29	12
Hartley 2	1997 December 21	8

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, P O Box 14740, Bredell, 1623.
Tel. 011-967-2250.
email: tpcooper@ilink.nis.za

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 2000.0	RADIANT DEC °	ZHR	VEL km/s	REC.WATCH BEGIN SAST	REC.WATCH END SAST	OBSERVING CONDITIONS 1997
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	Favourable
ν Normids	Mar 14	Feb25-Mar22	16h36	-51	5	56	00h00	04h30	Favourable
δ Pavonids	Apr 6	Mar11-Apr16	20h32	-63	5	59	02h00	04h30	Favourable
April Lyrids	Apr 22	Apr16-Apr24	18h05	+34	15	49	03h00	05h00	Full moon
π Puppids	Apr 23	Apr16-Apr25	07h20	-45	<5	18	19h00	22h00	Unfavourable
α Scorpiids	May 3	Apr11-May12	16h00	-27	5	35	21h00	04h00	Good
η Aquarids	May 4	Apr21-May12	22h24	-02	30	65	04h00	05h30	Favourable
χ Scorpiids	Jun 5	May27-Jun20	16h32	-14	5	21	21h00	04h30	New moon
Sagittarids	Jun 11	Jun08-Jun16	20h16	-35	<5	52	03h30	05h30	Good
θ Ophiuchids	Jun 13	Jun08-Jun16	17h48	-20	5	27	20h00	05h30	Poor
June Lyrids	Jun 16	Jun11-Jun21	18h32	+35	9	31	23h30	02h00	Unfavourable
Cetids	Jun 28	Jun26-Jun29	02h00	-15	<5	?	03h00	05h30	Poor
Capricornids	Jul 26	Jul10-Aug05	21h00	-15	8	?	20h30	05h30	Good
Piscis Australids	Jul 28	Jul19-Aug17	22h40	-30	8	35	21h30	05h00	Good
South δ Aquarids	Jul 29	Jul21-Aug29	22h36	-16	30	42	22h00	05h00	Good
α Capricornids	Jul 30	Jul15-Aug25	20h28	-10	10	25	20h00	04h00	Good
South ι Aquarids	Aug 5	Jul15-Aug25	22h12	-15	<5	34	22h00	04h30	Favourable
North δ Aquarids	Aug 12	Jul14-Aug25	22h28	-05	10	42	23h00	05h00	Good
North ι Aquarids	Aug 20	Jul15-Sep20	21h48	-06	10	36	20h00	05h00	Unfavourable
Orionids	Oct 21	Oct02-Nov07	06h20	+16	30	68	02h00	04h00	Poor
Southern Taurids	Nov 3	Sep15-Dec01	03h20	+14	10	29	21h30	03h30	Favourable
Northern Taurids	Nov 13	Sep19-Dec01	04h00	+23	5	31	21h30	03h30	Unfavourable
Leonids	Nov 17	Nov14-Nov20	10h08	+22	5	70	03h00	04h00	Unfavourable
Dec. Phoenicids	Dec 5	Dec03-Dec05	01h12	-53	5	22	20h30	01h00	Poor
Geminids	Dec 14	Dec04-Dec16	07h28	+33	50	36	23h30	03h00	Full moon
Velids	Dec 29	Dec05-Jan07	09h56	-51	5	40	22h30	03h30	New moon

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

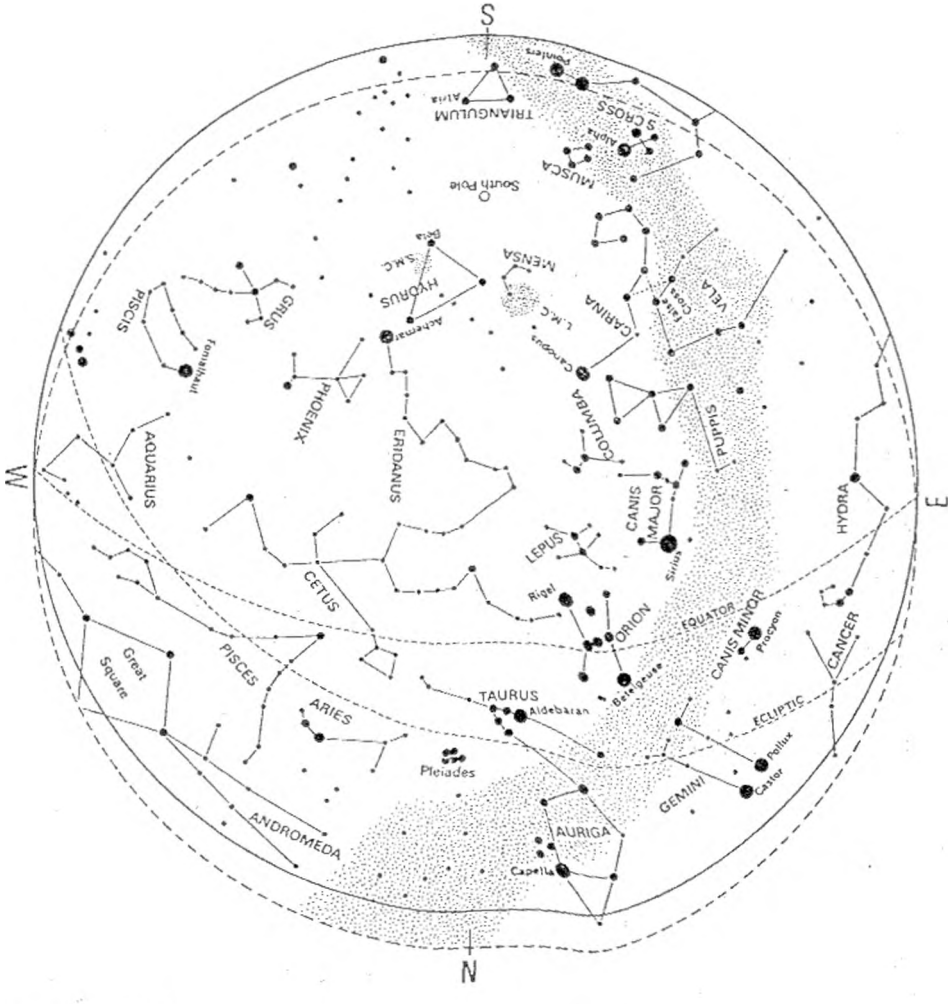
The star charts in this section show the night sky for each of the four seasons of the year. These seasonal charts depict stars down to magnitude 3.5 which is approximately what will be visible to the naked eye in city areas. Charts of 3 of the most interesting regions in the sky (showing stars down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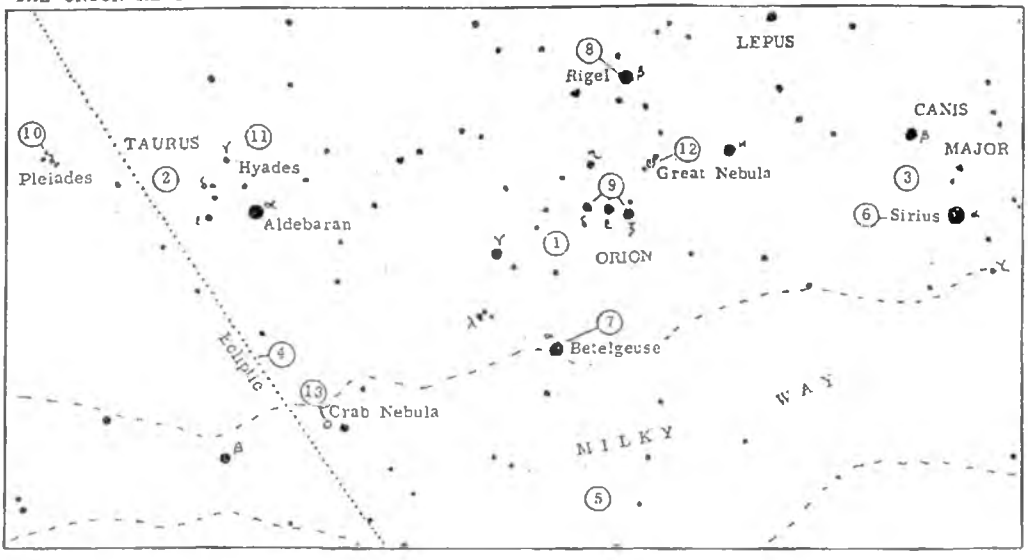
THE ORION REGION



(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.

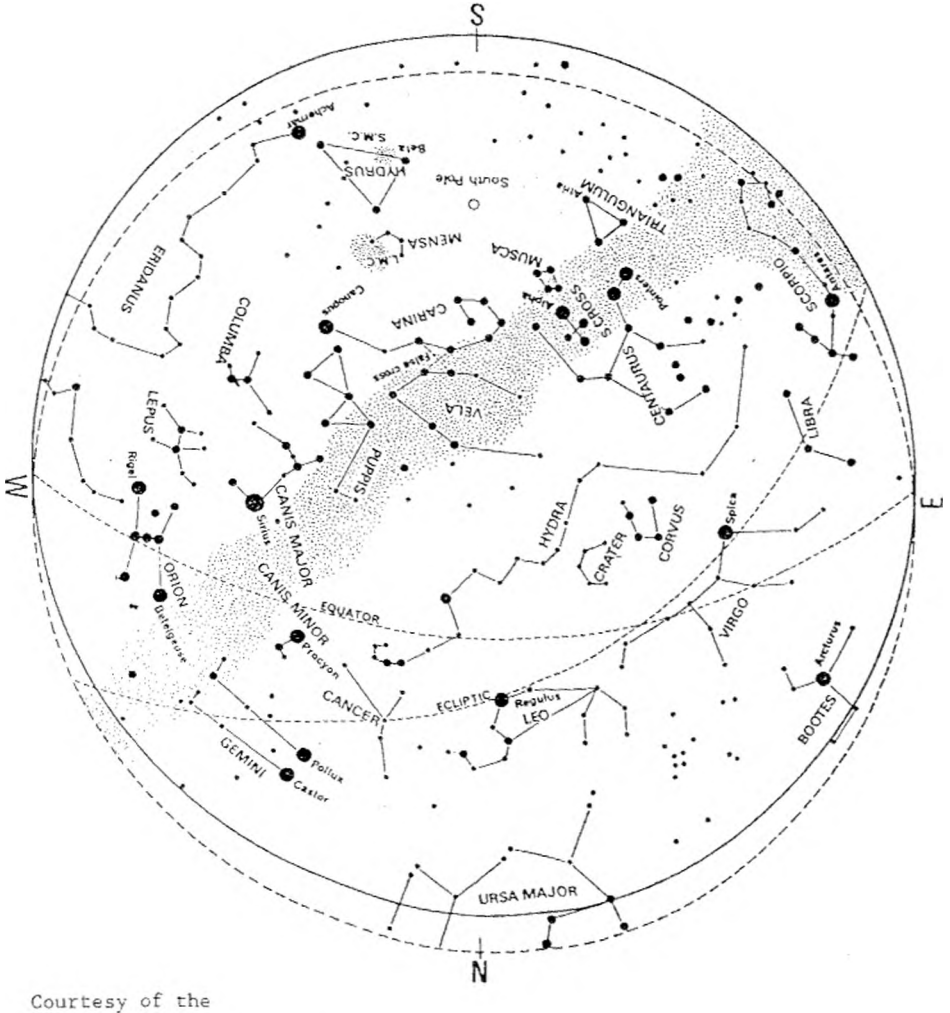
(13) The Crab Nebula, the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraodinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly rotating neutron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

THE AUTUMN SKY

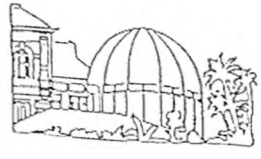
The chart below represents the sky in Cape Town on March 1 at midnight, April 1 at 10 pm and May 8 pm. Corrections for places other than Cape Town are

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

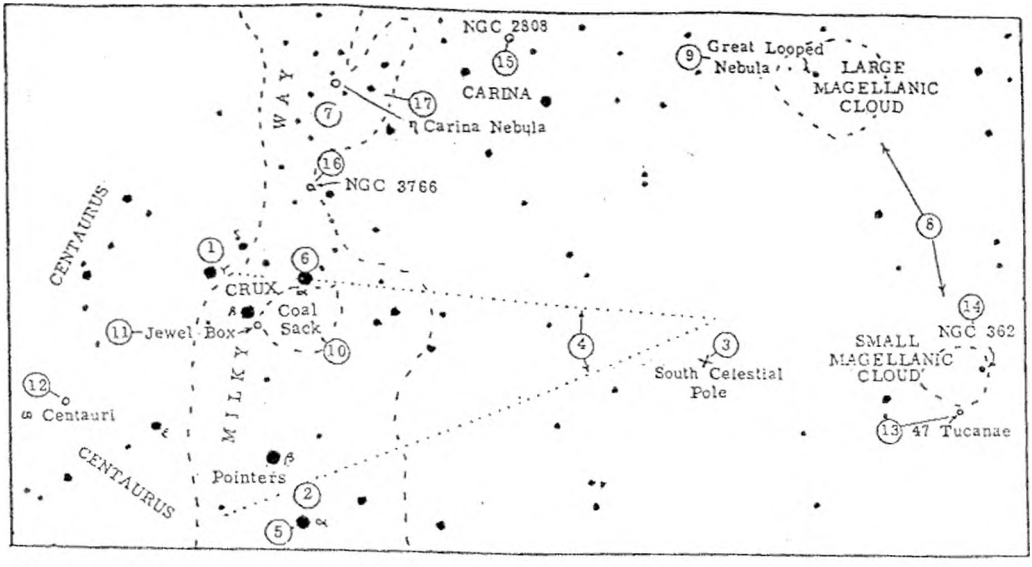
Correct times for places elsewhere may be found by subtracting 4 minutes for each degree of longitude east of Cape Town or adding 4 min for each degree of longitude west of Cape Town.



Courtesy of the

PLANETARIUM  SA MUSEUM

THE SOUTHERN CROSS REGION



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

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

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

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

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

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

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

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

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

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

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

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

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

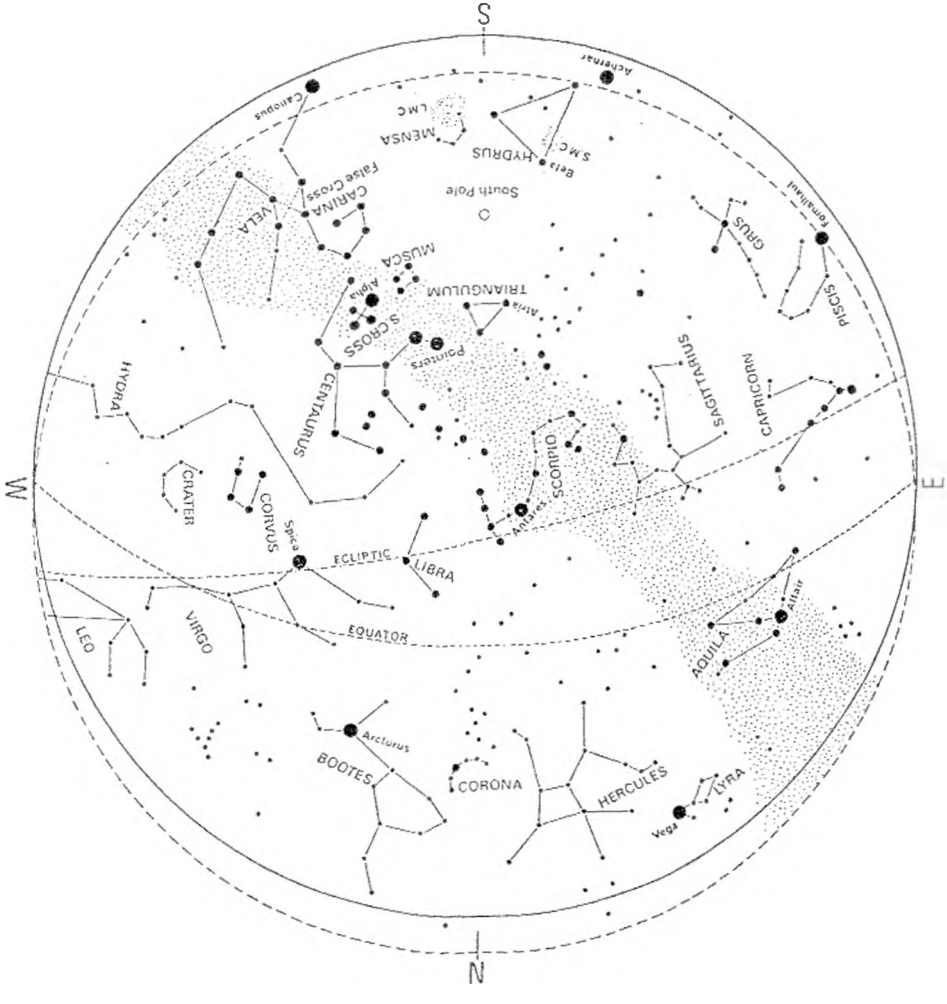
(17) The η Carinae nebula - site of a slow supernova that brightened to magnitude -0,8 in 1843 and is now of magnitude 6,4.

THE WINTER SKY

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

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

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



Courtesy of the

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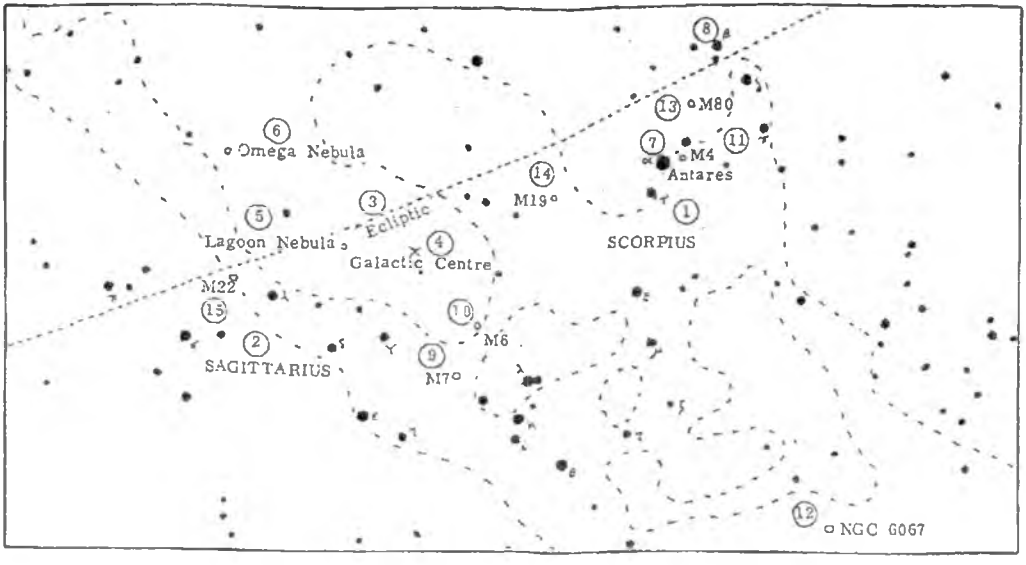
THE SCORPIUS REGION



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

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

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

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

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

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

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

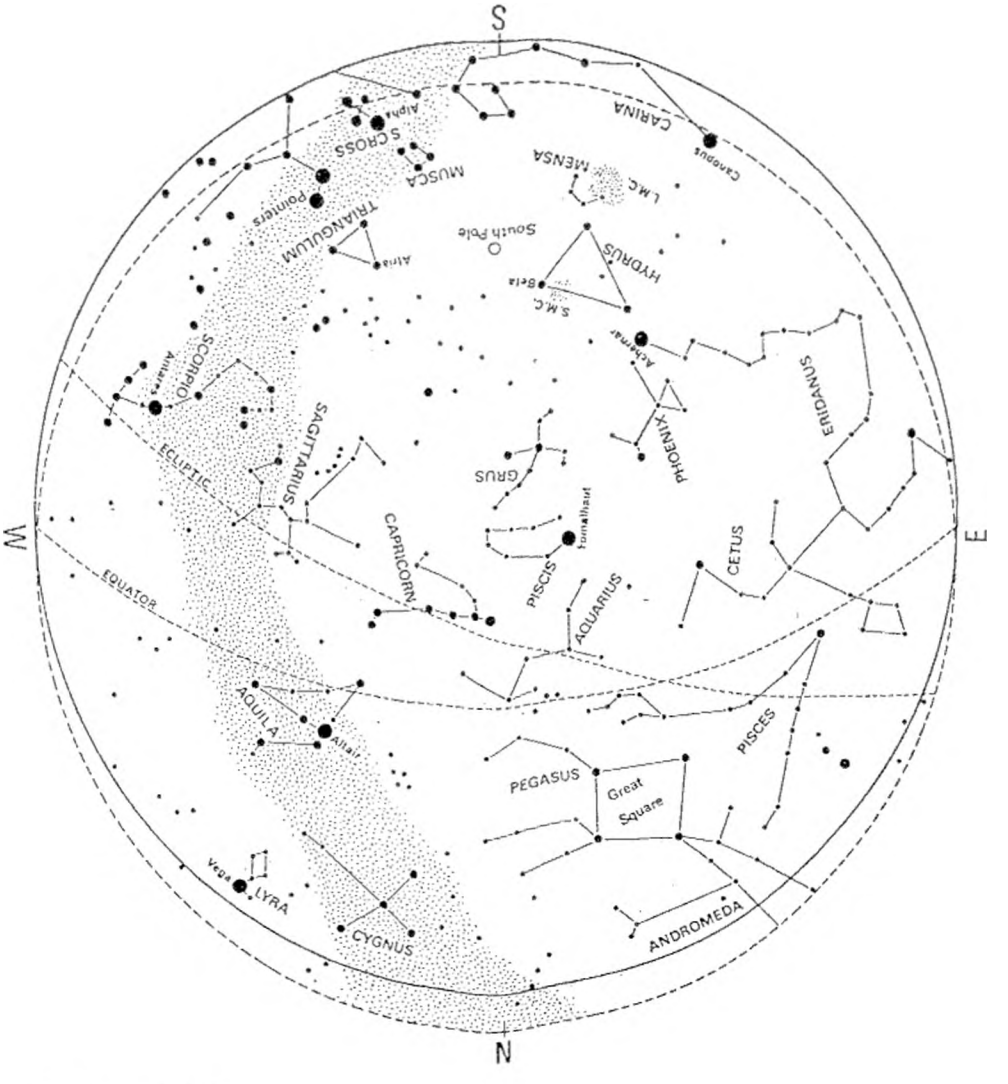
Further from the plane of the Milky Way are some globular clusters: (13) M80 (14) M19 and (15) M22.

THE SPRING SKY

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

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

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



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VARIABLE STAR OBSERVING

The latest (1985) edition of the "General Catalogue of Variable Stars" lists more than 28 000 stars. Professional observatories cannot possibly monitor all of these, and this makes the observation of variable stars a field in which amateurs can make a real contribution to astronomical knowledge.

Of these 28 000 stars at least 2 000 are suitable for visual monitoring in the southern hemisphere. However, the number of active observers in this part of the world remains woefully small, and less than 400 variables are at present being observed from Southern Africa.

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

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

Visual estimates of magnitude are made by comparing the variable with two or more comparison stars, respectively brighter and fainter than the unknown variable. Suitable comparison stars are shown on special charts, which have been prepared for each variable, mainly by the two variable star organisations mentioned above. The use of these charts is essential for accurate, standardized observations and intending new observers are therefore advised to obtain the necessary data by contacting the Director of the Variable Star Section,

Mr. J. Hers, P.O. Box 48, Sedgefield, 6573, Telephone (04455) 31736.

They will then be sent charts of a few easy objects and data on stars which may be observed with the equipment at their disposal.

Prospective observers should, when writing, give brief details of their equipment. Larger, more powerful telescopes will naturally greatly increase the number of stars which may be measured, but many variables are bright enough to be observed through most of their cycles with quite modest equipment, e.g. binoculars. Some stars, such as 071044 L2 Puppis, are so bright that they may be observed without optical aid whatever.

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

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

Most suitable for beginners are the long period variables (or Mira variables, named after the typical representative Mira = o Ceti) which belongs to the class of pulsating stars. They are giant stars which vary through a range of brightness of 2.5 to 5 magnitudes or more, and which have well defined periodicities, ranging from 80 to 1000 days. In most cases one observation per observer every 10 days will suffice.

					CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
DATE M D	E.C.	Mag.	Ph	ELG °	UT h m	a. m	b. m	P.A. °	UT h m	a. m	b. m	P.A. °	UT h m	a. m	b. m	P.A. °
JAN 1	1730	6.5	RD	259	1 41.8	-1.7	-1.7	294	1 41.2	-1.5	-2.8	325	1 11.0			4
JAN 15	226	6.6	DD	89					17 50.3	-2.2	+1.0	80	18 7.4	-2.0	+1.6	61
JAN 18	620	6.3	DD	125					18 22.4	-2.5	+1.2	59	18 46.5	-2.6	+3.0	35
JAN 19	764	5.0	DD	137	19 24.0	-2.5	-0.2	90	19 51.7	-2.8	+0.8	75	20 13.0	-3.1	+2.4	49
JAN 26	1589	6.1	RD	216	22 14.3			356								
JAN 31	2022	5.5	RD	261	1 58.7	-1.8	-1.4	285	2 0.0	-1.5	-2.6	320	1 30.9			0
JAN 31	2128	5.8	RD	272	23 36.2			12								
FEB 16	862	7.5	DD	117					17 20.3	-2.5	+1.9	45				
FEB 16	863	6.7	DD	117					17 37.2	-2.7	+1.7	49				
FEB 16	871	6.9	DD	118	19 7.7	+2.5	-2.7	147	19 19.3	-2.5	-0.7	118	19 25.2	-2.8	+0.3	92
FEB 18	1141	5.6	DD	142									22 40.6	-0.8	-1.6	140
FEB 25	1770	5.9	RD	209	1 37.9	-1.3	-2.5	335								
FEB 25	1866	5.9	RD	218	21 11.6	-0.3	-3.2	341								
MAR 1	2223	4.0	RD	255					3 27.6	-3.6	+2.7	238				
MAR 2	2495	6.0	RD	277									23 42.7	-0.9	+0.2	247
MAR 11	257	4.5	DD	37					17 41.1			360				
MAR 13	523	6.5	DD	63					17 46.3	-1.3	+0.4	103	17 56.2	-1.3	+1.1	77
MAR 15	823	6.6	DD	88					19 41.3	-0.7	-0.8	133	19 41.9	-1.1	+0.2	102
MAR 15	832	4.7	DD	88	20 53.0	-0.8	+0.9	97								
MAR 18	1210	5.9	DD	120	17 26.5	-2.3	-1.9	125	17 40.3	-2.9	-0.8	103	17 48.2	-3.6	+0.6	77
MAR 19	1328	7.0	DD	133	20 54.3			177	20 48.1	-1.8	-1.1	130	20 49.3	-2.6	+0.0	100
MAR 22	1549m	5.2	DD	157	2 11.5			185	1 56.2	-0.1	-0.7	134	1 55.2	-0.3	+0.2	101
MAR 25	1941	4.8	RD	198	19 25.9			354								
MAR 30	2460	6.1	RD	248	1 26.6			210	2 7.4	-2.8	+0.3	260	2 11.9	-2.8	-1.3	292
APR 1	2913	5.1	RD	285					23 51.7	+0.5	-3.3	325				
APR 12	904	7.1	DD	67					16 51.0	-2.2	+0.8	88	17 9.4	-2.6	+2.2	57
APR 18	1589	6.1	DD	134	17 18.9	-2.2	-0.1	67								
APR 28	2876	5.5	RD	255	22 44.1	-0.3	-1.1	271	22 34.9	-0.2	-2.3	307				
APR 28	2880	5.1	RD	255	23 28.3	-0.3	-2.5	306								
MAY 1	3169	6.2	RD	282	0 56.7	-0.5	-0.9	263	0 52.3	-0.8	-2.1	296				
MAY 12	1246	6.6	DD	72	18 58.4			172	18 51.5	-0.7	-0.4	124	18 54.9	-1.1	+0.6	92
MAY 15	1567	6.3	DD	106	22 23.9	-0.2	-1.5	155								
MAY 16	1658	6.4	DD	114	17 0.0	-2.8	-0.2	78								
MAY 16	1657	6.7	DD	115					18 1.9	-0.6	-4.3	172	17 40.3	-2.2	-2.3	137
MAY 16	1660	6.2	DD	115									19 8.1	-1.0	-3.6	163
MAY 16	1663	5.2	DD	116									20 8.2	-0.9	-3.0	159
MAY 16	1676	6.7	DD	118	23 40.4	-0.1	-2.5	167								
MAY 17	1770	5.9	DD	128	22 40.8	-1.8	+2.8	65								
MAY 18	1866	5.9	DD	137	17 53.4			54								
MAY 18	1874	7.5	DD	139									22 29.7	-0.9	-4.0	167
MAY 24	2674	6.0	RD	213	22 48.5	-1.2	-3.6	322								
MAY 25	2686	5.2	RD	214					1 3.6			191	1 42.8	-2.1	+2.1	235
MAY 26	2969	3.3	RD	238	20 49.9	+0.4	-2.8	317								
MAY 27	2995	6.2	RD	241									2 36.3	-1.9	+2.9	216
MAY 28	3146	6.5	RD	254	2 6.9	-1.9	+0.2	250	2 28.7	-2.6	-0.2	269	2 28.7	-3.9	-2.6	301
MAY 28	3278	5.4	RD	266	23 46.4	-0.4	-2.8	304								
MAY 31	35	6.4	RD	295	4 46.0	-2.4	-1.2	281								
JUN 1	167	5.7	RD	307	2 39.5	-0.7	-1.2	273	2 35.8	-1.5	-2.5	297				
JUN 13	MARS	0.3	DD	95					15 18.4	-0.9	-4.2	167	14 55.8	-2.2	-2.5	135
JUN 13	MARS	0.3	RB	95					16 29.8	-4.2	+1.1	255	16 39.9	-3.2	-1.0	289

					CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
DATE M D	S.C.	Mag.	Ph	ELG °	UT h m	a. m	b. m	P.A. °	UT h m	a. m	b. m	P.A. °	UT h m	a. m	b. m	P.A. °
JUN 13	1730	6.5	DD	97					21 2.4	-0.3	-2.8	164	20 51.4	-0.7	-0.8	126
JUN 14	1828	6.7	DD	108	19 32.7	-1.9	-0.8	123	19 53.4	-2.2	-1.1	85				
JUN 15	1937	6.1	DD	118	18 39.0	-2.1	-1.4	122	19 0.6	-3.2	+0.8	83				
JUN 16	2056	7.4	DD	131	20 30.6	-1.6	-2.5	148	20 39.1	-2.2	-0.4	111	20 49.6	-2.6	+1.4	77
JUN 30	404	5.2	RD	304	3 38.4	-1.2	-0.8	264	3 46.9	-2.1	-1.0	276	3 38.1			309
JUL 8	1486	4.6	DD	44	17 8.1	-1.3	+0.8	98	17 37.4			48				
JUL 9	1589	6.1	DD	56	18 37.6	-0.6	-0.5	134	18 43.8	-0.5	+0.6	99				
JUL 10	1696	7.0	DD	67	19 24.3	-0.5	-1.1	147	19 26.1	-0.5	+0.1	112	19 32.8	-0.5	+1.2	78
JUL 13	2016	6.5	DD	101									21 51.3	-0.6	-1.8	146
JUL 13	2020	6.6	DD	102	22 20.2	-0.5	+1.2	89								
JUL 14	2128	5.8	DD	113	21 37.6	-1.2	+3.8	49								
JUL 15	2231	6.9	DD	122					16 4.0	-1.6	-1.8	120				
JUL 15	2245	6.4	DD	124					20 2.8	-2.1	-3.2	150	19 54.7	-2.5	-0.8	114
JUL 18	2686	5.2	DD	160									16 35.9	-0.4	-2.2	131
JUL 22	3334	6.3	RD	219	22 45.5	-0.9	+3.0	194	23 14.7	-1.6	+1.8	219	23 31.7	-2.3	+0.9	244
JUL 26	354	5.5	RD	273					23 30.3	-0.4	+0.0	245	23 29.3	-0.8	-0.7	272
AUG 6	1658	6.4	DD	37	17 24.0	-0.3	-1.6	155	17 22.7	-0.5	-0.1	118	17 27.3	-0.5	+0.9	85
AUG 8	1866	5.9	DD	60	19 20.2	-0.6	-0.5	134	19 24.5	-0.3	+0.4	105				
AUG 9	1969	7.1	DD	71									19 15.8	-0.8	-1.5	140
AUG 13	2460	6.1	DD	116	17 23.2			165	17 16.5	-2.4	-1.6	119	17 18.2	-3.1	+0.1	86
AUG 17	2969	3.3	DD	160	1 22.9			358								
AUG 24	454	5.8	RD	256	0 33.6	-0.7	+0.7	220	0 49.0	-1.3	+0.8	231	0 58.8	-2.1	+0.3	253
AUG 29	1158	5.2	RD	317					2 58.6	-1.1	-1.7	293	2 43.7	-1.7	-3.2	322
SEP 5	1933	7.0	DD	40					16 50.7	-1.0	+1.5	80	17 22.7			22
SEP 5	1941	4.8	DD	41	18 28.5	-0.4	-0.1	126								
SEP 7	2158	7.3	DD	63					18 48.2			172	18 33.3	-1.0	-0.9	127
SEP 8	2279	6.2	DD	74	17 46.6	-2.0	+4.9	41								
SEP 9	2433	6.5	DD	88	21 27.1	-0.2	+2.0	63								
SEP 11	2722	7.1	DD	112	19 51.2	-1.4	+3.4	37	20 34.7			5				
SEP 12	2871	7.1	DD	123									16 31.5	-2.5	+1.3	58
SEP 13	3015	5.3	DD	136									16 31.7	-1.9	-1.8	114
SEP 13	3027	7.0	DD	138	19 25.9	-2.1	+0.6	71	19 55.3	-2.0	+1.8	54	20 21.4	-1.3	+3.4	27
SEP 20	404	5.2	RD	225	0 36.3			320								
SEP 22	832	4.7	RD	263					23 14.1	-1.3	-2.0	297				
SEP 22	836	5.5	RD	263					24 1.6	-1.3	-0.8	268	23 56.7	-1.9	-1.6	293
OCT 4	2128	5.8	DD	34	18 6.1	-0.4	+0.4	113								
OCT 7	2527	6.9	DD	70	20 8.9	-0.1	+2.3	52								
OCT 8	2674	6.0	DD	82	19 52.9	-0.8	+1.7	71	20 11.7	-0.2	+1.9	58	20 30.6	+0.5	+3.0	29
OCT 9	2830	6.9	DD	94	19 21.9	-1.9	+0.3	104	19 42.4	-1.4	+0.8	91	19 54.8	-0.9	+1.3	69
OCT 11	3145	6.8	DD	122	23 51.6	-0.4	+1.0	93								
OCT 12	3146	6.5	DD	122	0 7.9	-0.3	+1.2	83								
OCT 12	3270	6.1	DD	133									19 22.3	-3.7	-1.3	111
OCT 13	3294	6.9	DD	136	0 48.9	+0.1	+2.7	22								
OCT 23	1207	5.8	RD	269	2 39.5	-2.1	-1.8	300	2 45.0	-2.5	-2.9	323				
NOV 7	3072	6.6	DD	88	18 44.0	-1.8	+1.0	84	19 8.1	-1.3	+1.3	76	19 24.0	-0.8	+1.7	56
NOV 8	3205	6.8	DD	100									16 35.7	-1.7	+2.9	32
NOV 8	3208	6.5	DD	100					17 5.3	-1.0	+4.0	16				
NOV 9	3357	6.8	DD	115	18 48.3	-2.0	+1.1	66	19 17.2	-1.8	+1.6	59	19 38.6	-1.3	+2.4	39
NOV 19	1158	5.2	RD	237									2 19.7	-4.4	+4.0	224
DEC 3	2889	7.1	DD	45									17 4.8	-1.1	+0.2	100

					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	UT	a.	b.	P.A.	UT	a.	b.	P.A.	UT	a.	b.	P.A.
M	D				°	h m	m	m	°	h m	m	m	°	h m	m	m	°
DEC	6	3334	6.3	DD	85	21 11.3	-0.7	+0.8	103								
DEC	7	3470	7.0	DD	97	18 20.0	-1.9	+1.2	68	18 48.3	-1.6	+1.6	62	19 8.2	-1.2	+2.2	44
DEC	10	354	5.5	DD	139									23 7.3	-1.0	-0.2	111
DEC	16	1207	5.8	RD	213									19 36.5	-0.6	-0.3	260
DEC	17	1336	5.2	RD	226	22 1.6	-1.2	-1.9	297	21 58.9	-1.7	-2.5	315	21 30.2			357
DEC	19	1550	5.8	RD	249									22 8.3			223

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.

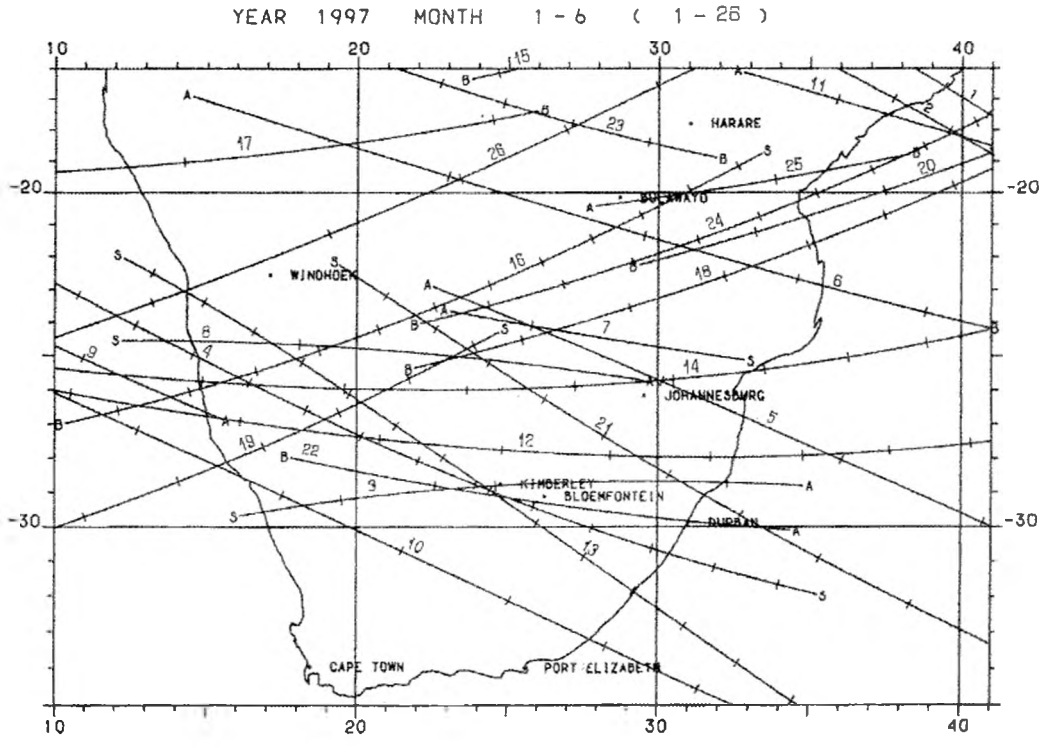
Interested observers - especially those living in the more distant regions - who wish to be informed of favourable grazes occurring in their neighbourhood, are therefore invited to contact the co-ordinator for grazing occultations:

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

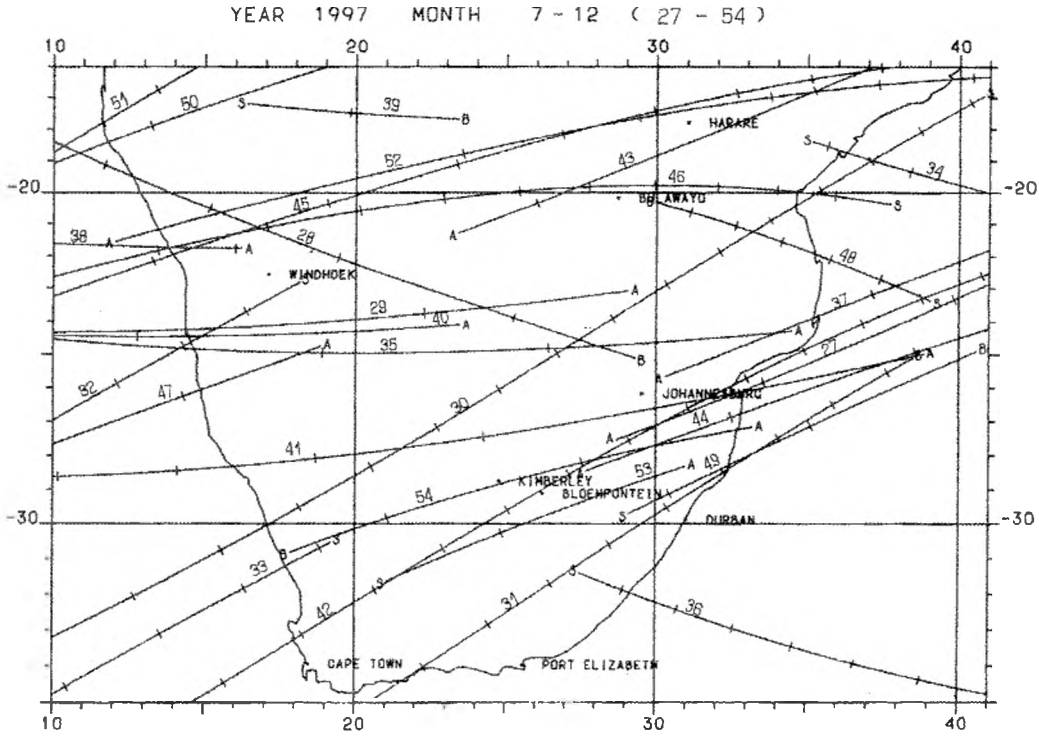
EXPLANATION OF THE COLUMN HEADINGS IN THE TABLES:

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 occulted 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 qiven 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	1830	6.84	1	2	3	36	37.42	-49.78	S	( )	( )
2	1947	7.08	1	3	3	25	11.92	-39.83	S	( )	( )
3	184	6.21	2	11	20	10	55.74	22.59	N	(S)	(A)
4	2223	4.02	3	1	4	12	57.46	-63.21	S	( )	(S)
5	2495	6.04	3	3	1	20	49.09	-43.06	S	(A)	( )
6	2830	6.92	3	5	3	56	1.11	-21.06	S	(A)	( )
7	3145	6.83	3	7	5	19	12.94	-5.17	S	(A)	(S)
8	257	4.50	3	11	19	40	34.22	9.81	N	(S)	(A)
9	985	6.86	3	17	0	14	20.85	58.39	N	( )	(A)
10	2454	7.16	3	30	0	52	34.95	-69.06	S	( )	( )
11	2871	7.10	4	28	23	23	37.15	-62.76	S	(A)	( )
12	3027	7.01	4	30	2	59	34.58	-49.98	S	( )	( )
13	1658	6.36	5	16	19	2	15.52	70.93	N	(S)	( )
14	3137	6.65	5	28	2	0	41.58	-64.25	S	( )	(B)
15	3146	6.50	5	28	3	42	33.02	-63.85	N	(B)	( )
16	3294	6.89	5	29	4	46	30.72	-51.86	N	(B)	(S)
17	3431	6.60	5	30	3	32	9.61	-40.77	S	( )	(B)
18	26	7.02	5	31	4	20	48.50	-29.53	N	(B)	( )
19	35	6.43	5	31	6	3	30.27	-28.88	N	( )	(S)
20	167	5.67	6	1	4	16	25.02	-19.74	N	(B)	( )
21	1516	6.96	6	11	18	30	6.53	35.55	N	(S)	( )
22	1730	6.48	6	13	23	16	34.47	55.72	S	(B)	(A)
23	1828	6.65	6	14	22	11	18.87	64.92	N	( )	(B)
24	3385	6.65	6	26	2	25	51.68	-66.46	N	(B)	( )
25	109	6.51	6	28	1	23	0.62	-44.09	S	(A)	(B)
26	404	5.16	6	30	4	57	57.65	-21.88	N	( )	( )



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
27	523	6.47	7	1	4	27	14.64	-13.80	N	(A)	( )
28	1486	4.58	7	8	19	32	11.29	13.86	N	( )	(B)
29	2016	6.54	7	14	0	1	11.54	59.11	S	( )	(A)
30	235	6.94	7	26	4	5	47.67	-57.03	N	( )	(S)
31	238	6.68	7	26	4	55	59.45	-56.87	N	( )	(S)
32	504	7.32	7	28	6	40	26.85	-34.15	N	( )	(S)
33	653	4.84	7	29	7	4	18.54	-24.29	N	( )	(S)
34	1746	7.14	8	7	17	49	2.42	15.45	N	(S)	( )
35	1969	7.11	8	9	21	26	4.26	32.71	S	( )	(A)
36	2072	6.74	8	10	18	5	52.71	41.27	N	(S)	( )
37	1038	6.83	8	28	3	45	56.58	-20.51	N	(A)	( )
38	1828	6.65	9	4	20	2	53.53	6.24	S	( )	(A)
39	1933	6.96	9	5	19	10	4.47	11.48	N	(S)	(B)
40	1937	6.07	9	5	20	18	8.02	11.72	S	( )	(A)
41	2158	7.32	9	7	20	39	46.32	27.03	S	( )	(A)
42	404	5.16	9	20	2	18	2.81	-84.93	N	( )	( )
43	832	4.73	9	23	0	44	16.33	-55.63	N	(A)	( )
44	1114	6.82	9	25	2	47	27.15	-34.75	N	(A)	( )
45	1124	6.94	9	25	4	2	57.18	-34.22	N	( )	( )
46	1207	5.79	10	23	3	35	57.68	-50.76	N	( )	(S)
47	2485	7.42	11	3	20	52	25.23	10.86	S	( )	(A)
48	1158	5.24	11	19	3	51	7.17	-77.27	S	(B)	(S)
49	2889	7.06	12	3	19	18	23.75	14.08	S	(S)	(B)
50	3188	5.43	12	5	22	41	47.48	33.89	S	( )	( )
51	3322	6.35	12	6	20	35	17.84	44.28	S	( )	( )
52	1336	5.16	12	17	23	10	13.68	-84.40	N	(A)	( )
53	3137	6.65	12	32	20	12	17.87	11.15	N	(S)	(A)
54	3431	6.60	12	34	21	26	40.73	29.72	N	(B)	(A)

PLANETARY 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 12 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 two or more observers, 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.

Note : In the table below "mag" stands for visual magnitude and "dur" is the approximate duration of the occultation in seconds, should an observer be in the centre of the track of the shadow.
"Az" and "alt" are the approximate azimuths and altitudes as seen from Bloemfontein.

OCCULTATIONS OF STARS BY MINOR PLANETS

Date	SAST	CAT	STAR	Mag.	RA (2000.0)	Dec		Planet	Mag.	Dur	Az	Alt
d	h m				h m s	° '				s		°
Jan 3	03 56	Lick4	3158	10.3	07 57 50	+14 50	125	Liberatrix	13.2	4	NW	30
Jan 18	03 00	PPM	97112	10.4	07 09 21	+24 48	112	Iphigenia	13.4	6	NW	20
Feb 11	03 41	PPM	194487	9.6	11 27 13	-05 38	541	Deborah	14.5	7	NW	60
Mar 13	04 14	PPM	179237	10.6	14 09 35	-00 30	13	Egeria	10.6	34	NW	55
Mar 30	00 35	PPM	127386	8.2	10 25 26	+11 09	139	Juewa	11.8	20	NW	20
May 10	21 48	PPM	290475	9.4	12 42 04	-37 12	759	Vinifera	14.6	5	S	88
May 13	04 31	PPM	720340	9.6	19 16 53	-18 15	803	Picka	14.8	13	N	80
May 14	03 23	PPM	761598	10.7	15 29 24	-45 52	285	Regina	14.9	4	SW	50
May 27	04 49	PPM	241119	8.3	23 03 27	-19 47	70	Panopaea	12.5	6	E	60
May 28	20 32	PPM	178659	6.4	12 01 02	-01 46	377	Campania	14.0	19	N	60
Jun 9	02 00	PPM	736211	9.8	20 27 18	-23 24	425	Cornelia	14.7	15	E	70
Jun 9	19 30	PPM	197668	9.7	14 33 22	-08 29	723	Hammonia	14.8	6	NE	50
Jun 15	22 30	PPM	269206	9.3	19 01 17	-27 33	971	Alsatia	14.6	5	E	45
Jun 20	01 32	PPM	297224	8.6	18 05 38	-32 51	75	Eurydike	11.3	7	SW	80
Jun 22	01 47	DM-34	#3181	10.1	18 25 06	-33 51	195	Eurykleia	13.2	7	SW	78
Jun 28	18 48	PPM	266519	8.8	17 11 06	-23 32	552	Sigelinde	13.7	8	E	30
Jun 29	04 03	PPM	238184	9.0	20 59 18	-10 15	1129	Neujmina	15.0	5	NW	65
Jul 16	19 10	DM-30	#3837	10.7	17 40 02	-29 11	108	Hecuba	13.1	7	E	45
Jul 17	05 56	CMC	701044	11.3	01 53 07	+15 54	101	Helena	12.7	3	N	45
Jul 17	19 27	DM+08	#2548	9.1	12 03 18	+06 21	18	Melpomene	12.1	5	NW	35
Aug 1	23 15	PPM	237723	9.4	20 38 50	-15 25	170	Maria	12.9	4	NE	75
Aug 8	03 00	PPM	721505	9.8	20 07 29	-15 16	783	Nora	12.0	7	NW	40
Aug 8	18 50	PPM	230559	9.3	15 40 15	-16 57	46	Hestia	13.2	13	N	85
Aug 8	20 38	PPM	322995	8.5	17 28 31	-46 52	735	Marghanna	13.0	29	S	70
Aug 12	22 54	PPM	263664	9.4	15 00 23	-23 58	280	Philia	17.1	3	NW	30
Aug 17	23 35	PPM	182724	9.5	00 50 36	-04 09	8	Flora	9.0	42	NW	30
Aug 20	02 32	PPM	721397	9.6	20 02 51	-17 36	783	Nora 124	12.4	8	NW	40
Sep 1	23 03	PPM	733353	9.7	17 36 13	-27 54	108	Hecuba	13.9	8	W	45
Sep 2	06 10	PPM	96490	8.8	06 45 23	+23 39	241	Germania	13.6	6	NE	35
Sep 5	05 39	PPM	182697	9.3	00 49 14	-06 10	8	Flora	8.5	29	NW	40
Sep 6	00 54	PPM	181497	9.9	23 37 14	-01 38	319	Leona	14.0	6	NW	60
Sep 13	00 08	PPM	268243	9.5	18 19 40	-22 32	20	Massalia	11.4	18	W	30
Sep 21	04 18	PPM	93885	10.5	04 55 07	+26 13	349	Dembowska	10.7	13	N	40
Oct 2	06 10	0664	00977	10.7	03 50 59	+13 29	253	Mathilde	13.7	16	NW	45
Oct 3	22 29	PPM	737333	9.9	23 01 34	-23 00	130	Elektra	11.0	24	N	85
Nov 7	22 49	PPM	146608	10.6	03 29 28	+09 41	253	Mathilde	13.0	6	NE	45
Nov 15	21 40	PPM	274606	9.6	23 07 00	-24 09	130	Elektra	11.7	19	W	65
Nov 22	22 35	PPM	239257	9.2	21 43 29	-12 16	489	Comacina	14.4	7	NW	30
Dec 21	02 35	PPM	119917	10.4	04 27 51	+15 09	404	Arsinoe	13.4	7	NW	20

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	39	May 11	11	56	21	Sep 18	11	54	5
11	12	8	1	21	11	56	34	28	11	50	36
21	12	11	23	31	11	57	38	Oct 8	11	47	31
31	12	13	29	Jun 10	11	59	25	18	11	45	8
Feb 10	12	14	15	20	12	1	32	28	11	43	47
20	12	13	44	30	12	3	37	Nov 7	11	43	42
Mar 2	12	12	8	Jul 10	12	5	20	17	11	44	59
12	12	9	45	20	12	6	19	27	11	47	39
22	12	6	53	30	12	6	23	Dec 7	11	51	30
Apr 1	12	3	51	Aug 9	12	5	28	17	11	56	9
11	12	1	2	19	12	3	34	27	12	1	6
21	11	58	41	29	12	0	52	31	12	3	3
May 1	11	57	4	Sep 8	11	57	38				

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

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

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

SIDEREAL TIME ON THE 30° MERIDIAN

	At 0 hrs h m	At 21 hrs h m		At 0 hrs h m	At 21 hrs h m		At 0 hrs h m	At 21 hrs h m
Jan 1	6 42	3 46	May 11	15 15	12 18	Sep 18	23 47	20 51
11	7 22	4 25	21	15 54	12 58	28	0 27	21 30
21	8 1	5 5	31	16 34	13 37	Oct 8	1 6	22 10
31	8 41	5 44	Jun 10	17 13	14 17	18	1 46	22 49
Feb 10	9 20	6 24	20	17 53	14 56	28	2 25	23 29
20	10 0	7 3	30	18 32	15 36	Nov 7	3 5	0 8
Mar 2	10 39	7 42	Jul 10	19 11	16 15	17	3 44	0 47
12	11 18	8 22	20	19 51	16 54	27	4 23	1 27
22	11 58	9 1	30	20 30	17 34	Dec 7	5 3	2 6
Apr 1	12 37	9 41	Aug 9	21 10	18 13	17	5 42	2 46
11	13 17	10 20	19	21 49	18 53	27	6 22	3 25
21	13 56	11 0	29	22 29	19 32	31	6 38	3 41
May 1	14 36	11 39	Sep 8	23 8	20 12			

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 (1997.5)

Star	R.A. h m	Dec. ° ′	Mag.	Sp.	Star	R.A. h m	Dec. ° ′	Mag.	Sp.
ACHERNAR	1 37.6	-57 15	0.6	B5	PROCYON	7 39.1	5 14	0.5	F5
ALDEBARAN	4 35.8	16 30	1.1	K5	REGULUS	10 8.2	11 59	1.3	B8
RIGEL	5 14.4	-8 12	0.3	B8	SPICA	13 25.1	-11 9	1.2	B2
BETELGEUSE	5 55.0	7 24	0.4	M0	ARCTURUS	14 15.6	19 12	0.2	K0
CANOPUS	6 23.9	-52 42	-0.9	F0	ANTARES	16 29.3	-26 25	1.2	M1
SIRIUS	6 45.0	-16 43	-1.6	A0	ALTAIR	19 50.7	8 52	0.9	A5

JULIAN DATE AT 1400 HOURS - SAST 1997

	JAN. 2450	FEB. 2450	MAR. 2450	APR. 2450	MAY 2450	JUN. 2450	JUL. 2450	AUG. 2450	SEP. 2450	OCT. 2450	NOV. 2450	DEC. 2450
1	450	481	509	540	570	601	631	662	693	723	754	784
2	451	482	510	541	571	602	632	663	694	724	755	785
3	452	483	511	542	572	603	633	664	695	725	756	786
4	453	484	512	543	573	604	634	665	696	726	757	787
5	454	485	513	544	574	605	635	666	697	727	758	788
6	455	486	514	545	575	606	636	667	698	728	759	789
7	456	487	515	546	576	607	637	668	699	729	760	790
8	457	488	516	547	577	608	638	669	700	730	761	791
9	458	489	517	548	578	609	639	670	701	731	762	792
10	459	490	518	549	579	610	640	671	702	732	763	793
11	460	491	519	550	580	611	641	672	703	733	764	794
12	461	492	520	551	581	612	642	673	704	734	765	795
13	462	493	521	552	582	613	643	674	705	735	766	796
14	463	494	522	553	583	614	644	675	706	736	767	797
15	464	495	523	554	584	615	645	676	707	737	768	798
16	465	496	524	555	585	616	646	677	708	738	769	799
17	466	497	525	556	586	617	647	678	709	739	770	800
18	467	498	526	557	587	618	648	679	710	740	771	801
19	468	499	527	558	588	619	649	680	711	741	772	802
20	469	500	528	559	589	620	650	681	712	742	773	803
21	470	501	529	560	590	621	651	682	713	743	774	804
22	471	502	530	561	591	622	652	683	714	744	775	805
23	472	503	531	562	592	623	653	684	715	745	776	806
24	473	504	532	563	593	624	654	685	716	746	777	807
25	474	505	533	564	594	625	655	686	717	747	778	808
26	475	506	534	565	595	626	656	687	718	748	779	809
27	476	507	535	566	596	627	657	688	719	749	780	810
28	477	508	536	567	597	628	658	689	720	750	781	811
29	478		537	568	598	629	659	690	721	751	782	812
30	479		538	569	599	630	660	691	722	752	783	813
31	480		539		600		661	692		753		814

JANUARY

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

FEBRUARY

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

MARCH

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

APRIL

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

MAY

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

JUNE

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

JULY

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

AUGUST

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

SEPTEMBER

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

OCTOBER

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

NOVEMBER

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

DECEMBER

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

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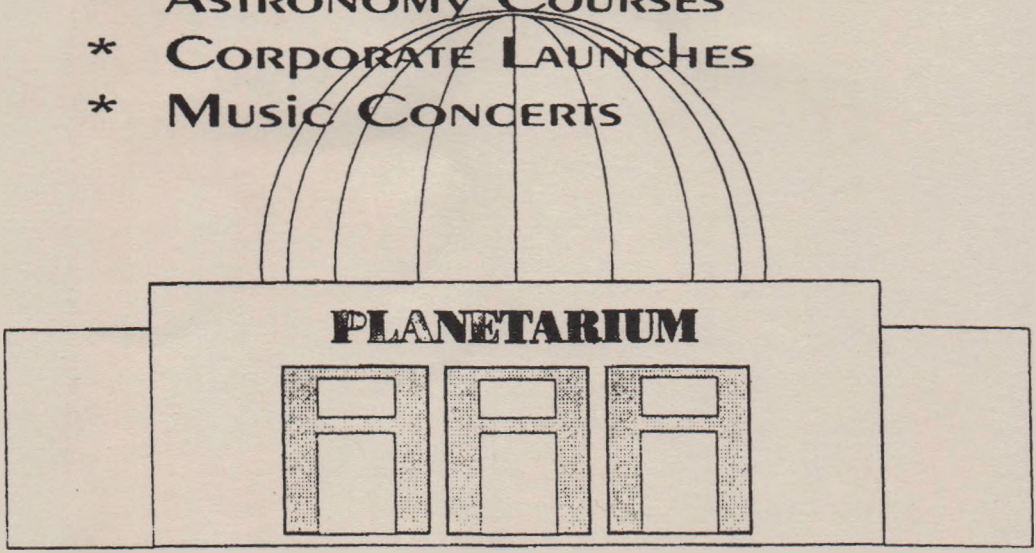

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