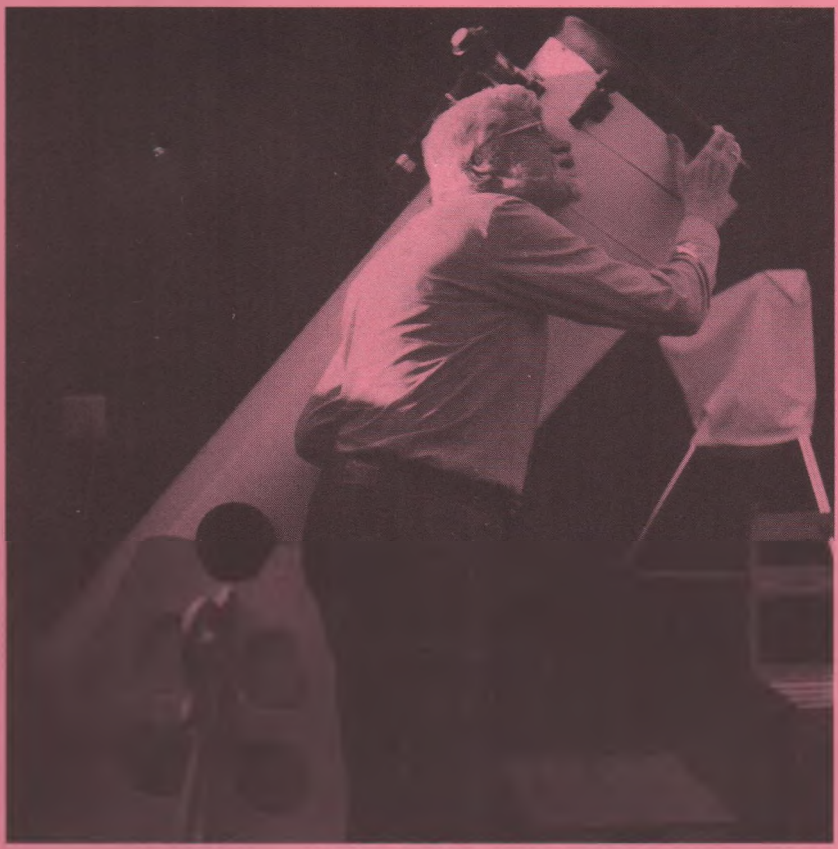
ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

2003



Astronomical Society of Southern Africa

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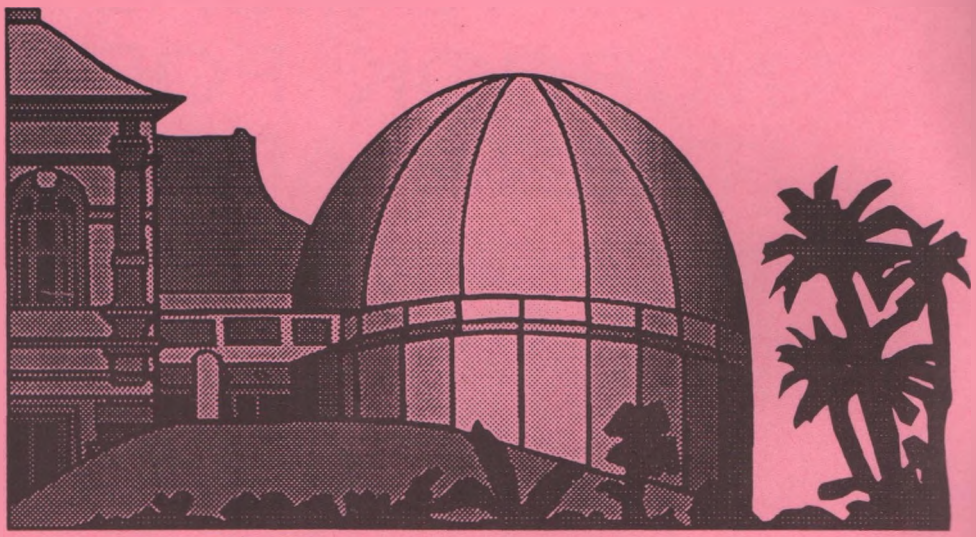

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ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 2003

The 57th 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
Albert Jansen of the Prince Albert Observatory with his Meade telescope. Photo April 2002

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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 2003, the Handbook of the British Astronomical Association for 2003 and the International Lunar Occultation Centre, Tokyo. Lunar eclipse diagrams were compiled from the NASA website http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html. The transit of Mercury data was adapted from website http://sunearth.gsfc.nasa.gov/eclipse/transit/transit.html. Both displaying the relevant papers by Fred Espinak. The star charts on pages 48, 50, 52 and 54 are from "A Beginner's Guide to the Southern Stars" by J.S. Bondietti, published by the South African Museum. The star charts on pages 49, 51 and 53 were adapted from charts output by Skymap 2.29 for Windows. The Planetary 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 visibility criteria data of The Horizon Chart for the Visibility of the Lunar Cresent at Sunset. Assistance in the compilation of this booklet was received from the Directors of the sections of the ASSA.

Further copies of this booklet are available at R20.00 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.

Although every care has been taken in the compilation of the Handbook,it is sold and distributed on the explicit understanding that neither the Society nor its members accept any responsibility for errors therein.

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) 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. Web page:www.saao.ac.za.

BOYDEN OBSERVATORY, situated at Mazelspoort, 25 km from Bloemfontein, is owned by the Dept of Physics of the University of the Free State. Observing facilities include a 1.52-m telescope, which was upgraded to a research telescope in October 2001, 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, 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 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: Prof. A Schoch (tel 051-4366 342), Dr M.Hoffman (tel 051-401 2924, email HoffmaMJ@sci.uovs.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 of the University of the Free State. Tel. 051-401 2924 (Dr. M. Hoffman). Web page:www.uovs.ac.za/nat/boyden/boyden.html

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 012-326 0742

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 skies and public open nights are held twice monthly at Last Quarter and New Moon. Enquiries to Mr. Chris Forder Tel 021-9134200. Web page:www.cederbergobs.org.za.

THE PRINCE ALBERT OBSERVATORY is open to the public by appointment. Facilities include a 4" solar telescope, a 10" Meade LX200 and a 16" Meade on an equatorial platform. Contact Mr. Albert Jansen at 3 Market Street, Prince Albert 6930, tel. 023-541 1871, email:agjansen@cybertrade.co.za.

THE ALOE RIDGE HOTEL OBSERVATORY is part of the hotel and game Reserve Complex some 40 km northwest of Johannesburg. Facilities include a 16" LX200 telescope, 1616XT CCD Camera and Autoguider. Telescope time is available for a fee to interested users. Contact Mr A. Richter, PO Box 3040, Honeydew, 2040, Tel 011-9572070, Fax 011-9572017 or website: www.aloeridge.com.

PLANETARIA

A planetarium is located within the South African Museum in Cape Town, containing a Minolta Series 4 projector and seating 120. Web page:www.museums.org.za/sam/planet/planetar.htm

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 led by Profs G F R Ellis and D R Matravers. The University of the Free State has a Dept. of Physics, headed by Prof.H C Swart, which offers post graduate studies in astro physics and a graduate program in astronomy in collaboration with UNISA. The Dept. of Physics and Electronics at Rhodes University, 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. Courses in Gamma Ray Astronomy and General Astrophysics form part of the regular honors and masters courses of the Dept. 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 E. Bloomhill, P O Box 2365, Bulawayo.

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 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.

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). The society's has an entrance fee of R20.00 and an annual subscription of R80.00. Members may also subscribe at a reduced rate to 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. This additional amount for "Sky and Telescope's" yearly subscription is subject to the Rand Dollar exchange rate, details of which are regularly published in MNASSA. A prospectus and application form may be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, P O Box 9, Observatory 7935. Web page:www.saao.ac.za/assa.

AUTONOMOUS LOCAL CENTRES OF THE ASSA hold regular meetings in Cape Town, Durban, Johannesburg, Bloemfontein, Pietermaritzburg, Pretoria, Harare and Sedgefield. 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 no society publications free of charge. Centres publish newsletters and journals carrying information on meetings, centre activities and topics of interest.

BLOEMFONTEIN CENTRE: Meetings are usually held monthly at Boyden Observatory, Mazelspoort. Phoning for confirmation beforehand is essential. The Centre publishes a monthly newsletter 'Die Naghemel' as well as a web site "Space Tides" www.spacetides.cjb.net. Secretarial address: PO Box 13004, Brandhof, 9324 or telephone 051-4058730 or 051-4367555(Braam van Zyl). Web page:www.geocities.com/assabfn.

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 monthly newsletter, the "Cape Observer". Secretarial address: P.O.Box 13018, Mowbray, 7705, or tel. 021-6856214.

DURBAN CENTRE: Regular monthly meetings are held at 19h15 on the second Wednesday of each month at Marist Brothers College, South Ridge Road, Durban. The centre publishes a monthly magazine "Ndaba". Secretarial address: P O Box 20578, Durban North, 4016, or telephone 031-564 7136 / 201 5829. Web page:www.astronomical.lia.net.

GARDEN ROUTE CENTRE. This centre covers the coastal area between Mossel Bay and Plettenberg Bay, holding regular monthly meetings on the first Saturday of every month except December at 15:00 in the hall of St Francis Church, Swallow Drive,

Sedgefield. Secretarial address: P O Box 2272,Knysna 6570, tel. 044-382-5912, e-mail: robind@pixie.co.za

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. The centre publishes a newsletter Cloudy Nights. Secretarial address:P O Box UA 428, Union Avenue, Harare, Zimbabwe. Web page:www.geocities.com.zimastro/assa.html.

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. 011-7163199/7163038. Web page:www.aqua.co.za/assa_jhb/assa001q.htm.

NATAL MIDLANDS CENTRE (Pietermaritzburg): Regular monthly meetings on the second Wednesday of each month starting at 19h30 at the Girl GuideCamp,Worlds View. The centre has a small observatory with a 5" refracter and a 12' reflector available for the use of members and regularlyopen to the public. The centre publishes a monthly newsletter, "Stardust". Secretarial address: P O Box 2106, Pietermaritzburg, 3200 tel 033-3433646. Web page:www.botany.unp.ac.za/nmc.htm.

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.
Web page:mafadi.aero.csir.co.za/assa/index.html.

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 Computing Section: Mr Tony Hilton, P O Box 68846, Bryanston, 2021. Phone (w) (011) 53 8714 or (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 :
Chris de Coning, 15 Wilkinson St., Gardens, 8001. Tel 021-4234538

THE DARK SKY SECTION of the Society under the direction of Cliff Turk has formed the South African Dark Sky Association (SADSA) with the objective of drawing people's attention to the problems of light pollution. These problems not only affect astronomers' views of the night sky but also cause a tremendous amount of money to be wasted on light which shines upwards and does no one any good. Properly designed and aimed light fittings will not only preserve our beautiful night sky for our children to see, but will save many thousands and perhaps even millions of Rands in energy costs.

There are many effective ways of dealing with what has become an international problem and the Dark Sky Section will provide a regular newsletter to those who are interested to learn more about the subject. Speakers will be arranged for any organisation or group which would like to hear more. It is intended to build up a set of slides illustrating ways of overcoming stray light and helping to avoid annoying glare.

Anyone, whether a member of ASSA or not, can obtain more information from the Director, ASSA Dark Sky Section, PO Box 9, Observatory, 7935 or email to cliffturk@yebo.co.za

THE ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA SCHOLARSHIP

The purpose of the ASSA Scholarship is to encourage the study of Astronomy. The Scholarship is available in support of 2nd and 3rd year undergraduate studies (and in exceptional cases, Honours) in astronomy subjects only, at any Southern African university, including those which offer astronomy courses to part-time students in distance-learning mode.

Criteria are a demonstrated interest in astronomy and a good academic record. Preference will be given to members of ASSA as well as to previous holders of the Scholarship who have made good progress in their studies. Preference will also be given to applicants who are not in receipt of other scholarships or similar funding.

The Scholarship will cover academic fees for astronomy subjects only, as well as a contribution towards the cost of prescribed books for these subjects, and is valid for one year. Payment of academic fees will be made directly to the university concerned.

The Scholarship shall be awarded based on an evaluation of the applications and the recommendations of the relevant university department. Applicants may be required to be interviewed at an ASSA Centre most convenient to the applicant. (The ASSA will bear no costs of the applicant in this regard).

Applications are hereby invited and should be forwarded to: Hon. Secretary, The ASSA, c/o PO Box 9, Observatory 7935 South Africa. The application should include the applicant's personal details, academic record, reasons for studying astronomy, astronomical activities to date, cost of astronomical courses for the year in question (i.e. funding requested), a statement of other bursaries and scholarships applied for or awarded, and any other details the applicant feels to be relevant. There is no standard application form. A statement of support from the university department concerned must be submitted by the university under separate cover.

Applications should be submitted by 31 December of the year preceding the year of study for which the scholarship application is made. Late applications will be considered, subject to the availability of funds. Queries may by addressed by e-mail to Maciej@telkomsa.net

DIARY OF PHENOMENA, CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h	
Jan	2	12	Mercury stationary
	2	22	NEW MOON
	4	1	Mercury 5°N. of Moon
	4	7	Earth at perihelion
	4	21	Neptune 5°N. of Moon
	6	3	UranuS 5°N. of Moon
	10	15	FIRST QUARTER
	11	3	Moon at apogee
	11	5	Venus greatest elong. W. (47°)
	11	22	Mercury in inferior conjunction
	15	22	Saturn 3°S. of Moon
	16	0	Venus 8°N. of Antares
	18	13	FULL MOON
	19	17	Jupiter 4°S. of Moon
	23	1	Mercury stationary
	24	0	Moon at perigee
	25	11	LAST QUARTER
	27	17	Mars 0°·4N. of Moon
	28	21	Venus 4°N. of Moon
	30	12	Mercury 5°N. of Moon
	31	2	Neptune in conjunction with Sun
	31	7	Mars 5°N. of Antares
Feb	1	13	NEW MOON
	2	11	Jupiter at opposition
	4	3	Mercury greatest elong. W. (25°)
	8	0	Moon at apogee
	9	13	FIRST QUARTER
	12	5	Saturn 3°S. of Moon
	15	20	Jupiter 4°S. of Moon
	16	8	Vesta stationary
	17	2	FULL MOON
	18	0	Uranus in conjunction with Sun
	19	18	Moon at perigee
	21	2	Mercury 1°·6S. of Neptune
	22	12	Saturn stationary
	23	19	LAST QUARTER
	25	7	Mars 1°·9N. of Moon
	27	13	Venus 5°N. of Moon
	28	15	Neptune 5°N. of Moon
Mar	1	17	Mercury 3°N. of Moon
	3	5	NEW MOON
	4	15	Mercury 1°·5S. of Uranus
	7	1	Pallas in conjunction with Sun
	7	19	Moon at apogee
	11	9	FIRST QUARTER
	11	14	Saturn 3°S. of Moon
	12	12	Juno stationary
	12	22	Venus 0°·2N. of Neptune
	15	2	Jupiter 4°S. of Moon
	18	13	FULL MOON
	19	21	Moon at perigee
	21	3	Equinox
	22	2	Mercury in superior conjunction
	23	19	Pluto stationery
	25	4	LAST QUARTER
	25	20	Mars 3°N. of Moon
	27	1	Vesta at opposition
	28	0	Neptune 5°N. of Moon
	28	15	Venus 0°·05N. of Uranus
	29	10	Uranus 5°N. of Moon
	29	12	Venus 5°N. of Moon
Apr	1	21	NEW MOON
	4	6	Moon at apogee
	4	7	Jupiter stationary
	8	0	Saturn 3°S. of Moon
Apr	16	17	Mercury greatest elong. E. (20°)
	16	22	FULL MOON
	17	7	Moon at perigee
	23	9	Mars 3°N. of Moon
	23	14	LAST QUARTER
	24	6	Neptune 5°N. of Moon
	25	18	Uranus 5°N. of Moon
	27	0	Mercury stationary
	28	19	Venus 3°N. of Moon
May	1	10	Moon at apogee
	1	14	NEW MOON
	3	13	Juno at opposition
	5	11	Saturn 3°S. of Moon
	7	9	Mercury in inferior conjunction. transit over Sun
	8	20	Jupiter 4°S. of Moon
	9	14	FIRST QUARTER
	13	16	Mars 2°S. of Neptune
	15	6	Vesta stationary
	15	18	Moon at perigee
	16	5	Neptune Stationary
	16	6	FULL MOON Eclipse
	17	1	Ceres in conjunction with Sun
	19	16	Mercury stationary
	21	14	Neptune 5°N. of Moon
	21	22	Mars 3°N. of Moon
	23	2	Uranus 5°N. of Moon
	23	3	LAST QUARTER
	28	2	Mercury 2°S. of Venus
	28	15	Moon at apogee
	29	5	Mercury 2°S. of Moon
	29	6	Venus 0°·1S. of Moon
	31	6	NEW MOON
Jun	1	23	Saturn 4°S. of Moon
	3	8	Mercury greatest elong. W. (24°)
	5	8	Jupiter 4°S. of Moon
	7	17	Uranus stationry
	7	22	FIRST QUARTER
	9	23	Pluto at opposition
	13	1	Moon at perigee
	14	13	FULL MOON
	17	23	Neptune 5°N. of Moon
	18	21	Venus 5°N. of Aldebaran
	19	8	Mars 1°·7N. of Moon
	19	10	Uranus 5°N. of Moon
	19	14	Mercury 4° N. of Aldebaran
	21	1	Mars 3° S. of Uranus
	21	4	Mercury 0°·4S. of Venus
	21	17	LAST QUARTER
	21	21	Solstice
	24	16	Saturn in conjunction with Sun
	25	4	Moon at apogee
	29	21	NEW MOON
Jul	2	18	Juno stationary
	2	23	Jupiter 4°S. of Moon
	4	8	Earth at aphelion
	5	12	Mercury in superior conjunction
	7	5	FIRST QUARTER
	8	10	Venus 0°·8N. of Saturn
	11	0	Moon at perigee
	13	21	FULL MOON
	15	7	Neptune 5°N. of Moon
	16	18	Uranus 5°N. of Moon
	17	10	Mars 0°·3S. of Moon
	21	9	LAST QUARTER

DIARY OF PHENOMENA, CONFIGURATIONS OF SUN, MOON AND PLANETS

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

THE SUN

BASIC DATA:

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

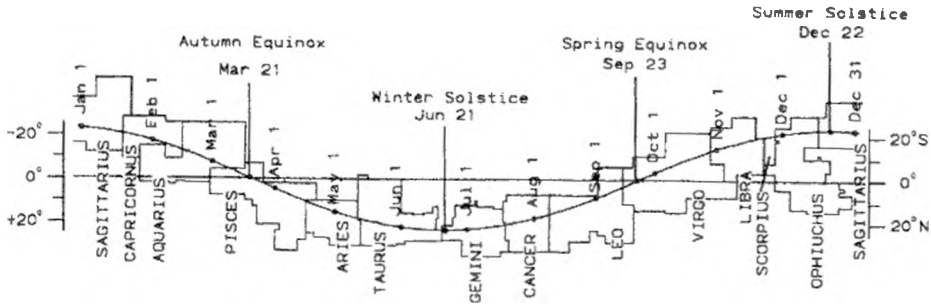
Mass: 1,99 x 10^{30}kg (330 000 times Earth mass)

Surface Temperature: Approximately 6 000°C

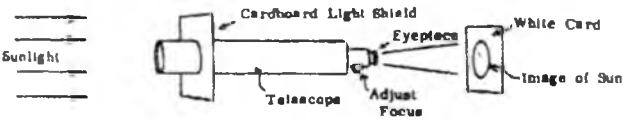
Temperature at centre: Approximately 10 million°C

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 2003 we will be closest to the Sun on January 4 (perihelion - approximate distance 147 million km) and furthest from the Sun on July 4 (aphelion - approximately 152 million km). During the year, the Sun appears to us to make a complete circuit of the sky (i.e. relative to the starry background) as indicated in the diagram.



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



THE SUN'S DECLINATION AT 02 HOURS:

Jan	1	-23°	5'	Apr	11	8°	13'	Jul	20	20°	1'
	11	-21	3		21	11	2		30	18	14
	21	-20	0	May	1	14	8	Aug	9	16	10
	31	-17	12		11	17	12		19	12	4
Feb	10	-14	7		21	20	0		29	9	16
	20	-11	2		31	21	2	Sep	8	5	9
Mar	2	-7	12	Jun	10	22	4		18	2	3
	12	-3	6		20	23	5		28	-1	2
	22	0	0		30	23	5	Oct	8	-5	9
Apr	1	4	7	Jul	10	22	4		18	-9	15

Oct	28	-12°	4'								
Nov	7	-16	10								
	17	-18	14								
	27	-21	2								
Dec	7	-22	4								
	17	-23	5								
	27	-23	5								

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

Neither the annular eclipse of 11 August nor the total eclipse of 23-24 November will be visible.

SOLAR SECTION

Solar observation is a very rewarding endeavour. The sun is an interesting object to observe and requires relatively little and cheap equipment. It provides great opportunities for either recreational purposes or involvement in global research projects/ networks.

The aims of the solar section are therefore to:
- promote solar observation in Southern Africa
- to assist the beginner to commence solar observation
- to coordinate observation programs for the serious observer
- to provide an information service to the public
- to maintain contact with a variety of international instititions

METHODS OF OBSERVATION

1. Visual observation of the sun disk (using suitable filters) or by projecting the image onto an appropriate screen. Any telescope from a 50 mm refractor or reflector can be used and provides an ideal opportunity for owners of small instruments to contribute immediately to science. Visual observation is utilised to detect sunspots and active areas.

2. SID programs (Sudden Ionosphere disturbance) is the monitoring of solar flares and changes of the Earth's magnetic field. SID observers construct and make use of very simple VLF radio's. Their observations are forwarded to international research institutions.

3. Photographing and drawing of visible features are also undertaken by some observers.

SOLAR TELESCOPES IN SOUTHERN AFRICA

1. Sutherland: Remote telescope for low degree solar oscillation. It belongs to the Birmingham University in Great Britain which has six remote telescopes all over the world.

2. Boyden: 20 cm Coelostat with facilities for narrow band Hydrogen Alpha investigation. The magnetic fields of the sun (employing the Zeeman effects) is one of the identified research projects.

Persons interested in observing the sun,or requiring information are invited to contact the Director of the Solar Section:
Braam van Zyl, Tel: 051-4367555 [a/h], e-mail: jalvzyl@mweb.co.za ,PO Box 13004 Brandhof 9324

The Moon

BASIC DATA

Diameter: 3 480 km (0,27 of Earth)
Mass: $7{,}35 \times 10^{22}$ kg (1/81 of Earth)
Surface Gravity: 0,16 of Earth
Average distance from Earth: 384 000 km, Perigee ±357 000km, Apogee ±407 000km

THE SURFACE OF THE MOON

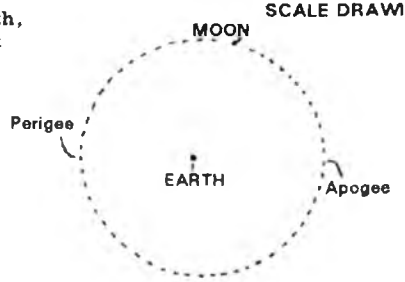
In common with the bodies of our solar system, the Moon's surface suffered bombardment by numerous minor bodies during the period 4,5 to 3,0 billion years ago. This has produced the heavily cratered topography now visible. Some particularly large impacts caused large circular depressions, which were 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.

SCALE DRAWING



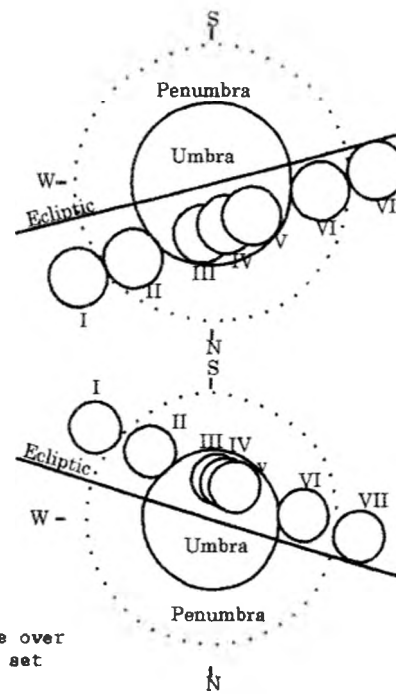
ECLIPSES OF THE MOON

Total Eclipse	d	h	m	
Moon enters penumbra	May 16	3	05.3	I
Moon enters umbra	May 16	4	02.7	II
Moon enters totality	May 16	5	13.7	III
Middle of eclipse	May 16	5	40.1	IV
Moon leaves totality	May 16	6	06.4	V
Moon leaves umbra	May 16	7	17.4	VI
Moon leaves penumbra	May 16	8	14.8	VII

Contacts of Umbra with Limb of Moon — Position Angles from the North Point
First 133.2 to East
Last 94.0 to West
Magnitude of the eclipse: 1.133

Total Eclipse	d	h	m	
Moon enters penumbra	Nov 9	0	15.1	I
Moon enters umbra	Nov 9	1	32.4	II
Moon enters totality	Nov 9	3	06.3	III
Middle of eclipse	Nov 9	3	18.5	IV
Moon leaves totality	Nov 9	3	30.7	V
Moon leaves umbra	Nov 9	5	04.5	VI
Moon leaves penumbra	Nov 9	6	21.9	VII

Contacts of Umbra with Limb of Moon — Position Angles from the North Point
First 41.6 to East
Last 86.5 to West
Magnitude of the eclipse: 1.022



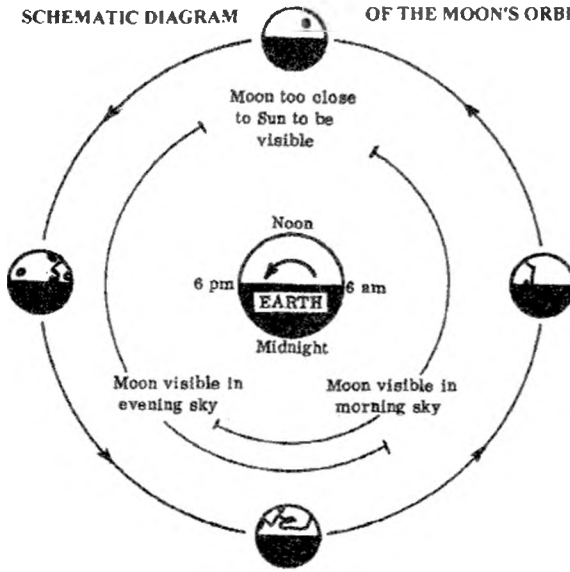
Most phases of both eclipses will be visible over the region, but in both cases the moon will set partially eclipsed.

PHASES and VISIBILITY

NEW MOON

	d	h	m
JAN	2	22	23
FEB	1	12	48
MAR	3	4	35
APR	1	21	19
MAY	1	14	15
MAY	31	6	20
JUN	29	20	39
JUL	29	8	53
AUG	27	19	26
SEP	26	5	09
OCT	25	14	50
NOV	24	0	59
DEC	23	11	43

SCHEMATIC DIAGRAM OF THE MOON'S ORBIT



FIRST QUARTER

	d	h	m
JAN	10	15	15
FEB	9	13	11
MAR	11	9	15
APR	10	1	40
MAY	9	13	53
JUN	7	22	28
JUL	7	4	32
AUG	5	9	28
SEP	3	14	34
OCT	2	21	09
NOV	1	6	25
NOV	30	19	16
DEC	30	12	03

LAST QUARTER

	d	h	m
JAN	25	10	33
FEB	23	18	46
MAR	25	3	51
APR	23	14	18
MAY	23	2	31
JUN	21	16	45
JUL	21	9	01
AUG	20	2	48
SEP	18	21	03
OCT	18	14	31
NOV	17	6	15
DEC	16	19	42

FULL MOON

	d	h	m
JAN	18	12	48
FEB	17	1	51
MAR	18	12	35
APR	16	21	36
MAY	16	5	36
JUN	14	13	16
JUL	13	21	21
AUG	12	6	48
SEP	10	18	36
OCT	10	9	27
NOV	9	3	13
DEC	8	22	37

MOON at PERIGEE

	d	h		d	h		d	h
Jan	24	0	Jun	13	1	Oct	26	14
Feb	19	18	Jul	11	0	Nov	24	1
Mar	19	21	Aug	6	16	Dec	22	14
Apr	17	7		31	21			
May	15	18	Sep	28	8			

MOON at APOGEE

	d	h		d	h		d	h
Jan	11	3	May	28	15	Oct	14	4
Feb	8	0	Jun	25	4	Nov	10	14
Mar	7	19	Jul	22	22	Dec	7	14
Apr	4	6	Aug	19	16			
May	1	10	Sep	16	11			

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.

LIBRATION

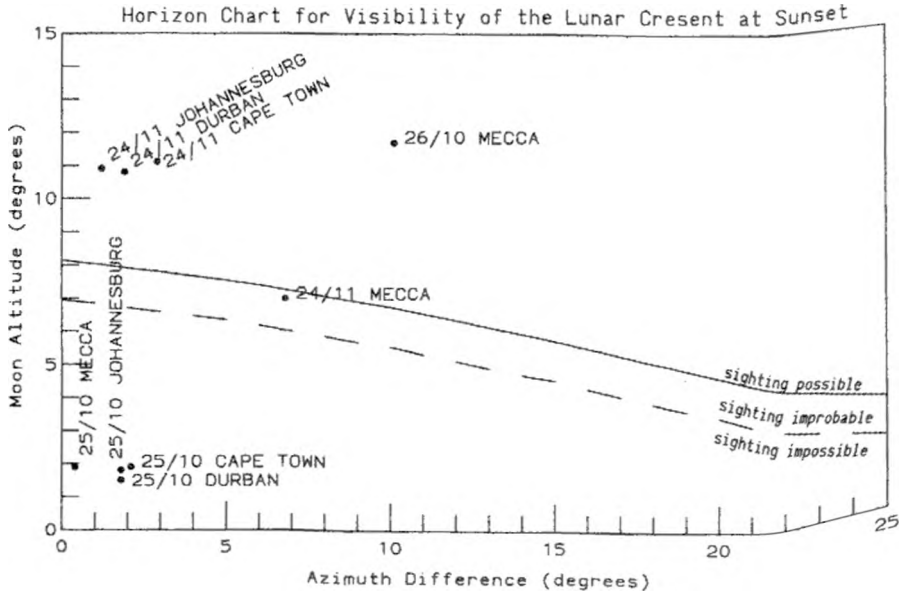
Maximum			Minimum			Maximum			Minimum		
Date	Size	P.A.	Date	Size	P.A.	Date	Size	P.A.	Date	Size	P.A.
d	°	°	d	°	°	d	°	°	d	°	°
Jan 6	8.3	302	Jan 13.03	3.1	33	Jul 3.47	8.7	161	Jul 10.21	0.7	99
Jan 20	7.6	165	26.94	2.6	257	16.72	8.9	297	23.58	0.8	49
Feb 2	7.9	305	Feb 9.01	3.2	27	30.34	8.1	162	Aug 6.15	0.4	197
Feb 15	8.2	152	22.47	3.6	252	Aug 13.03	8.4	300	19.80	0.6	71
Mar 1	8.0	304	Mar 8.20	2.9	25	26.34	8.3	159	Sep 1.98	1.1	254
Mar 15	9.3	146	21.30	3.4	241	Sep 8.98	8.4	302	15.96	0.2	71
Mar 28	8.8	299	Apr 4.67	2.4	29	22.74	9.1	154	28.99	1.2	246
Apr 11	10.2	147	18.03	2.4	237	Oct 5.84	9.1	299	Oct 13.18	0.5	308
Apr 24	9.7	295	May 2.21	1.7	26	20.48	9.9	152	26.70	0.9	271
May 9	10.2	151	16.00	1.1	236	Nov 2.11	10.0	294	Nov 9.81	0.8	193
May 22	10.0	293	29.85	1.1	41	17.35	10.1	153	23.69	1.2	36
Jun 6	9.6	156	Jun 12.91	0.4	309	29.85	10.4	291	Dec 7.27	1.3	220
Jun 19	9.6	294	26.20	0.8	12	Dec 14.98	9.5	155	21.64	2.4	49
						27.75	9.9	290			

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.

PREDICTIONS FOR YOUNG CRESCENT VISIBILITY FOR RAMADAAN AND SHAWWAAL

The tabulation below is for altitude and the difference in 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 chart.

OCCASION	DATE	CAPE TOWN		JOHANNESBURG		DURBAN		MECCA	
	d m	Alt°	DAzm°	Alt°	DAzm°	Alt°	DAzm°	Alt°	DAzm°
RAMADAAN	25 10	1.9	2.1	1.8	1.8	1.5	1.8	1.9	0.4
	26 10	16.5	4.5	16.5	2.2	16.2	3.2	11.7	10.1
SHAWWAAL	24 11	11.1	2.9	10.9	1.2	10.8	1.9	7.0	6.8
	25 11	24.3	8.5	24.7	4.5	24.3	6.2	17.9	16.2



2003 TIMES OF MOON RISE AND SET CAPE TOWN

For PORT ELIZABETH subtract 28 MINUTES

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

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

2003 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	03 41	17 56	05 24	19 22	04 15	18 00	05 48	18 11	06 18	17 44	07 50	18 22
2	04 36	18 59	06 24	20 02	05 12	18 36	06 39	18 41	07 10	18 18	08 45	19 13
3	05 36	19 56	07 22	20 38	06 08	19 09	07 31	19 11	08 04	18 55	09 37	20 08
4	06 38	20 46	08 17	21 10	07 02	19 40	08 22	19 43	08 59	19 37	10 26	21 06
5	07 39	21 29	09 10	21 40	07 54	20 09	09 15	20 17	09 55	20 24	11 11	22 06
6	08 39	22 07	10 02	22 09	08 45	20 39	10 10	20 56	10 49	21 17	11 51	23 06
7	09 35	22 40	10 53	22 39	09 36	21 10	11 05	21 40	11 40	22 13	12 29	
8	10 28	23 11	11 44	23 11	10 28	21 43	12 00	22 29	12 28	23 12	13 05	00 07
9	11 20	23 41	12 37	23 45	11 22	22 19	12 54	23 23	13 12		13 40	01 08
10	12 11		13 31		12 17	23 00	13 45		13 52	00 13	14 16	02 10
11	13 02	00 10	14 27	00 24	13 12	23 46	14 32	00 22	14 30	01 15	14 55	03 14
12	13 54	00 41	15 24	01 07	14 08		15 16	01 24	15 07	02 18	15 39	04 22
13	14 48	01 14	16 21	01 57	15 02	00 38	15 57	02 28	15 44	03 21	16 28	05 32
14	15 44	01 50	17 15	02 54	15 54	01 36	16 35	03 32	16 22	04 27	17 24	06 42
15	16 41	02 31	18 06	03 55	16 41	02 38	17 13	04 37	17 04	05 35	18 26	07 51
16	17 39	03 18	18 52	04 59	17 25	03 43	17 52	05 43	17 51	06 45	19 31	08 53
17	18 35	04 12	19 34	06 05	18 05	04 49	18 32	06 51	18 44	07 56	20 36	09 47
18	19 27	05 10	20 13	07 10	18 44	05 55	19 17	08 00	19 43	09 06	21 38	10 33
19	20 15	06 13	20 50	08 15	19 22	07 00	20 06	09 11	20 46	10 11	22 37	11 13
20	20 59	07 17	21 27	09 19	20 01	08 07	21 01	10 20	21 50	11 08	23 32	11 47
21	21 38	08 21	22 06	10 23	20 42	09 14	22 00	11 26	22 52	11 57		12 19
22	22 15	09 24	22 47	11 27	21 27	10 21	23 01	12 25	23 51	12 39	00 25	12 49
23	22 51	10 26	23 32	12 33	22 17	11 29		13 17		13 15	01 16	13 18
24	23 28	11 28		13 38	23 11	12 34	00 02	14 01	00 47	13 48	02 07	13 48
25		12 30	00 22	14 40		13 35	01 01	14 40	01 40	14 18	02 59	14 19
26	00 06	13 34	01 16	15 39	00 09	14 30	01 58	15 14	02 31	14 47	03 52	14 54
27	00 48	14 39	02 15	16 32	01 09	15 19	02 52	15 45	03 22	15 16	04 47	15 33
28	01 34	15 44	03 15	17 19	02 09	16 01	03 44	16 15	04 13	15 46	05 43	16 18
29	02 26	16 46			03 07	16 38	04 35	16 44	05 05	16 19	06 38	17 07
30	03 23	17 45			04 02	17 11	05 26	17 13	05 59	16 55	07 32	18 02
31	04 23	18 37			04 56	17 42			06 54	17 36		

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

2003 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	03 20	17 52	05 03	19 17	03 54	17 54	05 34	17 59	06 09	17 27	07 46	17 59
2	04 14	18 56	06 05	19 55	04 54	18 28	06 28	18 26	07 03	17 59	08 42	18 50
3	05 14	19 52	07 04	20 29	05 51	18 59	07 21	18 54	07 59	18 35	09 34	19 45
4	06 16	20 41	08 01	20 59	06 47	19 28	08 14	19 24	08 55	19 15	10 22	20 45
5	07 19	21 23	08 56	21 28	07 41	19 56	09 09	19 58	09 51	20 02	11 06	21 46
6	08 20	21 59	09 49	21 55	08 34	20 24	10 05	20 35	10 46	20 54	11 45	22 48
7	09 18	22 31	10 42	22 24	09 27	20 53	11 01	21 18	11 37	21 51	12 21	23 51
8	10 13	23 00	11 35	22 53	10 21	21 24	11 57	22 06	12 24	22 51	12 54	
9	11 07	23 28	12 30	23 26	11 16	21 59	12 51	23 01	13 06	23 54	13 27	00 54
10	11 59	23 56	13 26		12 12	22 38	13 41		13 45		14 01	01 58
11	12 52		14 23	00 03	13 09	23 24	14 28	00 00	14 21	00 58	14 38	03 05
12	13 46	00 24	15 21	00 46	14 05		15 10	01 03	14 55	02 02	15 19	04 14
13	14 41	00 56	16 18	01 35	14 59	00 16	15 49	02 09	15 30	03 08	16 07	05 26
14	15 39	01 30	17 12	02 31	15 50	01 14	16 25	03 15	16 06	04 16	17 02	06 39
15	16 37	02 10	18 01	03 33	16 36	02 17	17 01	04 23	16 46	05 26	18 03	07 48
16	17 36	02 56	18 45	04 39	17 17	03 23	17 37	05 31	17 31	06 39	19 08	08 50
17	18 32	03 49	19 25	05 46	17 56	04 31	18 15	06 41	18 22	07 52	20 15	09 43
18	19 23	04 48	20 02	06 54	18 32	05 39	18 57	07 53	19 20	09 03	21 19	10 28
19	20 10	05 52	20 38	08 00	19 08	06 47	19 45	09 05	20 23	10 08	22 19	11 06
20	20 52	06 57	21 12	09 07	19 45	07 56	20 38	10 16	21 28	11 05	23 16	11 38
21	21 29	08 03	21 49	10 13	20 24	09 05	21 37	11 23	22 31	11 53		12 08
22	22 04	09 08	22 28	11 20	21 07	10 15	22 38	12 22	23 32	12 33	00 11	12 36
23	22 38	10 13	23 11	12 27	21 55	11 24	23 41	13 13		13 07	01 05	13 03
24	23 12	11 17	24 00	13 33	22 49	12 31		13 56	00 30	13 38	01 58	13 31
25	23 49	12 21		14 37	23 46	13 32	00 42	14 33	01 25	14 06	02 51	14 01
26		13 27	00 54	15 36		14 27	01 40	15 06	02 18	14 34	03 46	14 35
27	00 28	14 34	01 52	16 28	00 47	15 14	02 36	15 35	03 11	15 01	04 42	15 12
28	01 13	15 40	02 53	17 14	01 48	15 55	03 30	16 03	04 04	15 29	05 39	15 55
29	02 04	16 43			02 47	16 30	04 23	16 30	04 58	16 00	06 36	16 45
30	03 00	17 41			03 45	17 02	05 16	16 57	05 53	16 35	07 30	17 39
31	04 01	18 33			04 40	17 31			06 50	17 14		

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

2003 TIMES OF MOON RISE AND SET HARARE

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

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

2003 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	04 34	18 34	06 18	20 01	05 07	18 39	06 34	18 56	07 00	18 34	08 27	19 16
2	05 31	19 36	07 16	20 42	06 03	19 17	07 24	19 27	07 51	19 09	09 21	20 07
3	06 31	20 33	08 12	21 19	06 57	19 52	08 13	19 59	08 43	19 48	10 14	21 02
4	07 32	21 24	09 06	21 53	07 49	20 24	09 04	20 32	09 37	20 31	11 03	22 00
5	08 32	22 08	09 57	22 25	08 39	20 55	09 55	21 09	10 31	21 19	11 49	22 58
6	09 30	22 47	10 47	22 56	09 29	21 26	10 48	21 49	11 25	22 11	12 31	23 57
7	10 24	23 23	11 36	23 27	10 19	21 59	11 42	22 34	12 17	23 07	13 10	
8	11 16	23 55	12 26		11 09	22 33	12 36	23 23	13 05		13 48	00 56
9	12 06		13 17	00 00	12 01	23 11	13 30		13 50	00 06	14 25	01 55
10	12 55	00 26	14 10	00 36	12 55	23 53	14 22	00 18	14 32	01 05	15 03	02 55
11	13 44	00 57	15 05	01 16	13 50		15 10	01 16	15 12	02 05	15 44	03 57
12	14 35	01 29	16 01	02 01	14 45	00 40	15 55	02 17	15 51	03 06	16 30	05 02
13	15 27	02 04	16 58	02 52	15 39	01 33	16 38	03 19	16 30	04 07	17 21	06 11
14	16 22	02 41	17 52	03 48	16 31	02 31	17 18	04 21	17 10	05 11	18 19	07 20
15	17 18	03 24	18 44	04 49	17 20	03 32	17 58	05 24	17 55	06 17	19 21	08 27
16	18 16	04 12	19 31	05 52	18 05	04 35	18 39	06 28	18 44	07 25	20 26	09 30
17	19 12	05 06	20 15	06 56	18 47	05 39	19 22	07 34	19 38	08 35	21 29	10 25
18	20 05	06 05	20 56	07 59	19 28	06 43	20 08	08 41	20 38	09 44	22 30	11 12
19	20 54	07 06	21 35	09 02	20 08	07 46	20 59	09 50	21 41	10 48	23 27	11 53
20	21 39	08 09	22 14	10 04	20 49	08 51	21 55	10 58	22 44	11 45		12 29
21	22 20	09 11	22 55	11 06	21 32	09 55	22 55	12 02	23 44	12 35	00 20	13 02
22	22 59	10 12	23 38	12 08	22 19	11 01	23 55	13 02		13 19	01 11	13 34
23	23 37	11 12		13 12	23 10	12 07		13 54	00 42	13 56	02 01	14 04
24		12 12	00 24	14 16		13 12	00 56	14 40	01 36	14 30	02 50	14 36
25	00 15	13 13	01 16	15 18	00 06	14 12	01 53	15 20	02 27	15 02	03 41	15 09
26	00 56	14 15	02 11	16 16	01 04	15 07	02 48	15 55	03 17	15 32	04 32	15 46
27	01 39	15 18	03 09	17 09	02 03	15 56	03 41	16 28	04 06	16 03	05 25	16 26
28	02 27	16 22	04 09	17 57	03 02	16 40	04 31	16 59	04 56	16 35	06 20	17 12
29	03 20	17 23			03 58	17 18	05 20	17 30	05 46	17 09	07 15	18 02
30	04 17	18 22			04 52	17 53	06 10	18 01	06 38	17 47	08 09	18 57
31	05 17	19 14			05 44	18 25			07 32	18 29		

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

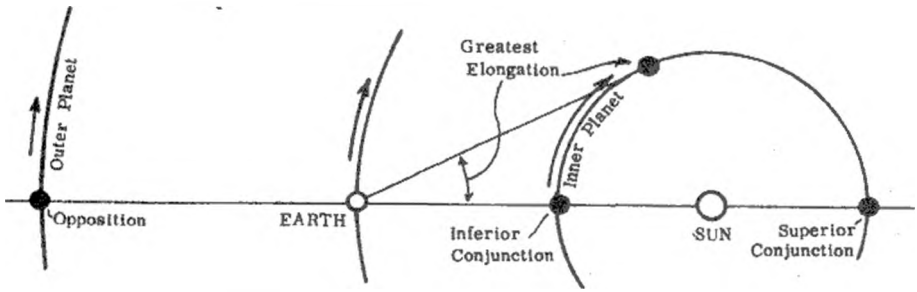
THE PLANETS

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′	18
Saturn	1 426	29.5	95.142	120.00	10h14m	26°44′	28
Uranus	2 868	84.0	14.559	52.00	17.2h	97°52′	21
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 18 (at mag.+0.9) to March 12 (at mag.-0.9),
May 16 (at mag.+1.2) to June 28 (at mag.-1.5) and
September 18 (at mag.+0.6) to October 13 (at mag.-1.2)

The best conditions for viewing will occur from late January until late February when Mercury will be found in Sagittarius and later in Capricornus and from late May to mid June when it will be found in Aries and Taurus.

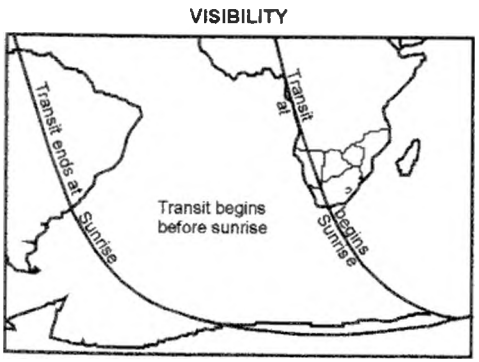
Mercury may also be seen low in the west after sunset between the following approximate dates:

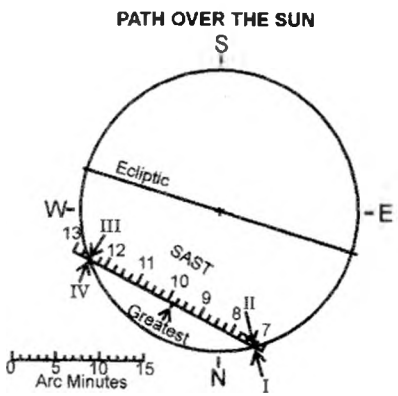
January 1 (at mag.+0.1) to January 6 (at mag.+0.5),
March 31 (at mag.-1.5) to April 28 (at mag.+0.9),
July 13 (at mag.-1.4) to September 4 (at mag.+1.3), and
November 10 (at mag.-0.7) to December 21 (at mag.+0.8)

The best conditions for viewing will be in August, when Mercury will be found in Leo.

	d h	d h	d h	d h
Superior Conjunction		Mar 22 2	Jul 5 12	Oct 25 12
Greatest Elongation East		Apr 16 17 (20°)	Aug 14 23 (27°)	Dec 9 8 (21°)
Stationary	Jan 2 12	Apr 27 0	Aug 28 2	Dec 15 15
Inferior Conjunction	Jan 11 22	May 7 9	Sep 11 4	Dec 27 3
Stationary	Jan 23 1	May 19 16	Sep 19 15	
Greatest Elongation West	Feb 4 3 (25°)	Jun 3 8 (24°)	Sep 27 2 (18°)	

The Transit of Mercury





	d	h	m	s	PA°	
Ingress, exterior contact	May 7	7	12	56	15	I
Ingress, interior contact		7	17	24	14	II
Greatest		9	52	23	333	
Egress, interior contact		12	27	19	202	III
Egress, exterior contact		12	31	46	291	IV

Note: These times are for an observer at Earth's centre. The actual contact times for any given observer may differ by up to several minutes. This is due to effects of parallax since Mercury's 12 arc-second diameter disk may be shifted up to nearly 16 arc-seconds from its geocentric coordinates depending on the observer's exact position on Earth. Greatest transit is the instant when Mercury passes closest to the Sun's centre (i.e. - minimum separation). During the 2003 transit,

Mercury's minimum separation from the Sun is 708 arc-seconds. The position angle is defined as the direction of Mercury with respect to the centre of the Sun's disk as measured counterclockwise from the celestial north point on the Sun.

VENUS

Venus will be in the morning sky from the beginning of the year (at mag.-4.5) until almost the end of the second week of July (at mag.-3.9).

It will become a evening sky object from late September (at mag. -3.9), where it remains for the rest of the year.

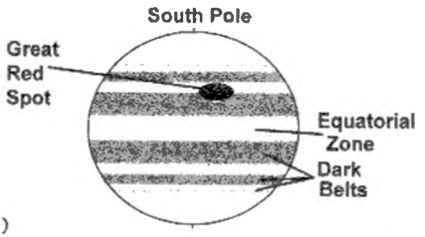
	d	h
Greatest Elongation West	Jan 11	5 (47°)
Venus superior conjunction	Aug 18	20

MARS

Mars, visible (at mag.+1.6) in the morning sky, begins the year in the constellation of Libra, passing through Scorpius in late January (at mag.+1.3), into Ophiuchus at the end of January, into Sagittarius in early March (at mag.+0.9), into Capricornus (at mag.+1.0) at the begining of the third week of April and into Aquarius in early June (at mag.-0.8). The planet will be visible for more than half the night by this time and towards the end of August (at mag.-2.9) will be seen throughout the night. It passes into Pisces in early December (at mag.-0.4) where it remains for the rest of the year as an evening sky object.

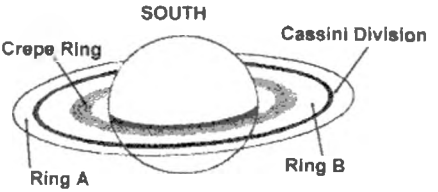
JUPITER

Jupiter (at mag.-2.5) begins the year in the evening sky, in Cancer where by early February it will be visible throughout the night. It passes into Leo (at mag.-1.8), at the end of June having become an evening sky object. In second week of August it will be too close to the Sun to be seen. It re-appears in the morning sky (at mag.-1.7) in early September in Leo where it remains for the rest of the year. By mid-December (at mag.-2.1) it can be seen for more that half the night.



SATURN

Saturn, found in Taurus (at mag.-0.4), will be seen for more than half the night until mid-March (at mag. 0.0) after which it becomes an evening sky object. It passes into Orion in the middle of May (at mag.+0.1) and in early June will be too close to the Sun to be seen. It reappears in the morning sky in mid-July in Gemini (at mag.+0.1) where it remains for the rest of the year. It will be seen for more that half the night by early October and by the end of the year will be visible all night (at mag.-0.5).

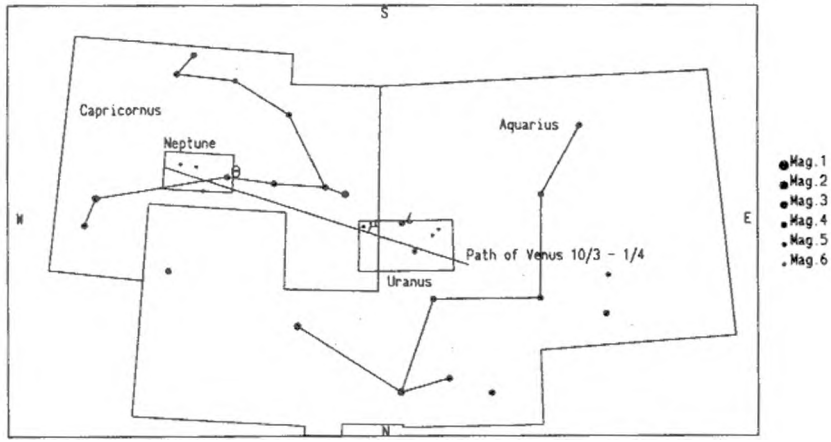


URANUS AND NEPTUNE

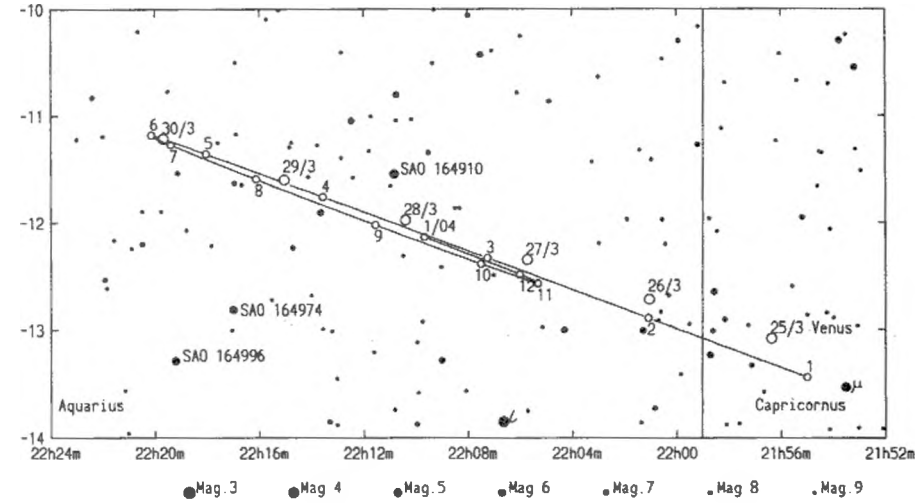
Uranus, visible with optical aid, found in Capricornus at the beginning of the year, passes into Aquarius in late January by which time it will be too close to the Sun to be seen. It will reappear in the morning sky in the second week of March. At opposition on August 24, it will be at magnitude 5.6. From late November it appears only in the evening sky.

Neptune, visible with optical aid, will set during the evening twilight for the first half of January. The planet will be found in the morning sky still in Capricornus, from late February. At opposition on August 23, it will be at magnitude +7.9. From early November it appears only in the evening sky.

Sky Chart for the Paths of Uranus and Neptune

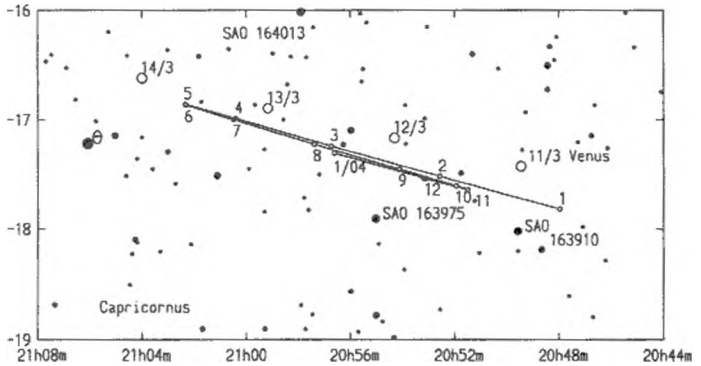


The Path of Uranus.



Mag. of Venus not to scale

The Path of Neptune.



PLUTO

Pluto at magnitude +14 is visible only in a telescope of at least 25cm aperture. It will be found first in Ophiuchus until late January and then in Serpens until early May when it returns to Ophiuchus.

EVENTS OF INTEREST

Evening Sky:

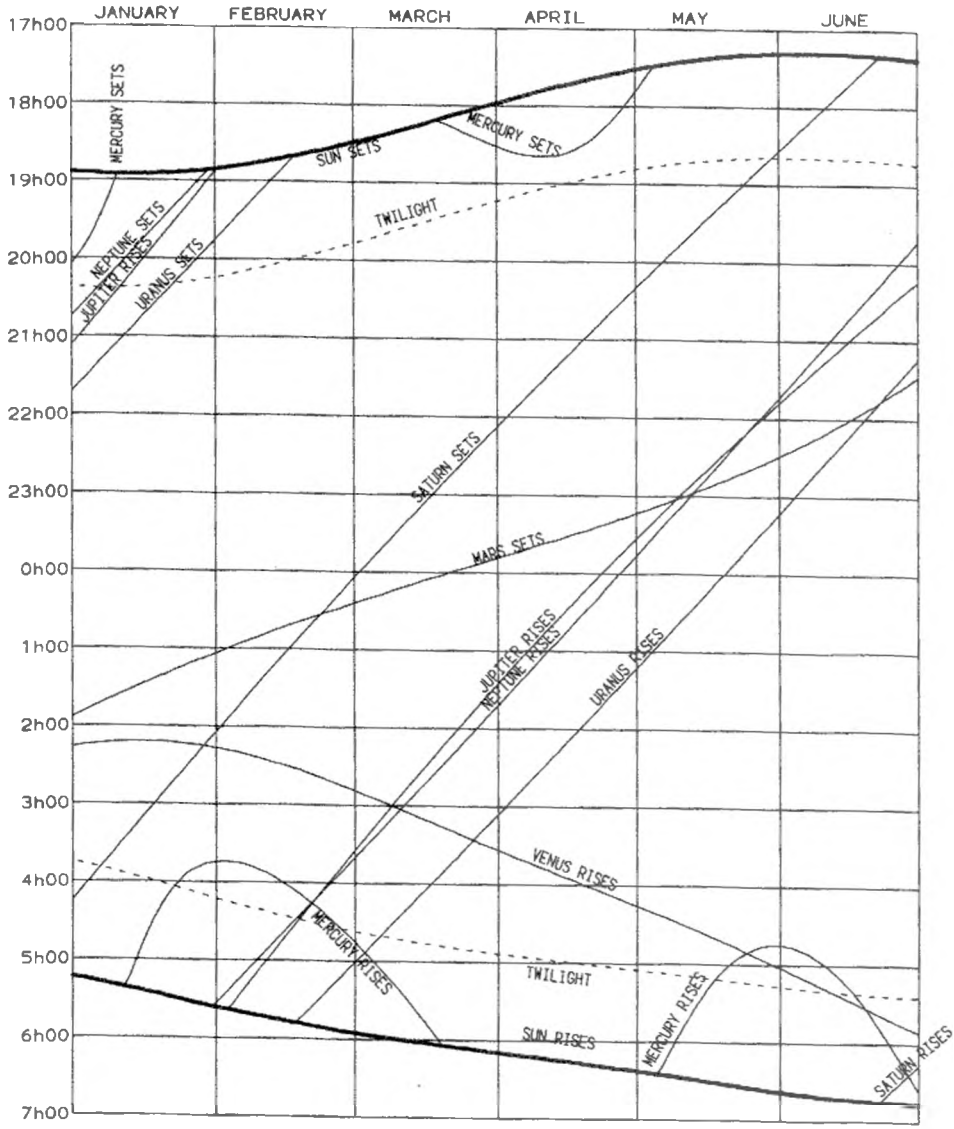
1 Jan	6 Jan	Mercury and Saturn visible
2 Feb	30 Mar	Jupiter and Saturn visible
31 Mar	28 Apr	Jupiter, Mercury and Saturn visible
29 Apr	6 Jun	Jupiter and Saturn visible
13 Jul	9 Aug	Jupiter and Mercury visible
26 Jul		Jupiter and Mercury in conjunction
28 Aug	4 Sep	Mercury and Mars visible
25 Sep	9 Nov	Mars and Venus visible
10 Sep	21 Dec	Mars, Mercury and Venus visible
22 Dec	30 Dec	Mars and Venus visible
31 Dec		Mars, Saturn and Venus visible

Morning Sky:

1 Jan	17 Jan	Mars, Jupiter and Venus visible
18 Jan	2 Feb	Jupiter, Mars, Mercury and Saturn visible
3 Feb	12 Mar	Mars, Mercury and Venus visible
13 Mar	15 May	Mars and Venus visible
16 May	28 Jun	Mars, Mercury and Venus visible
28 May		Mercury and Venus in conjunction
21 Jun		Mercury and Venus in conjunction
29 Jun	13 Jul	Mars and Venus visible
14 Jul	28 Aug	Mars and Saturn visible
8 Jul		Saturn and Venus in conjunction
5 Sep	17 Sep	Jupiter and Saturn visible
18 Sep	13 Oct	Mercury, Jupiter and Saturn visible
14 Oct	31 Dec	Jupiter and Saturn visible

TIMES OF RISING AND SETTING

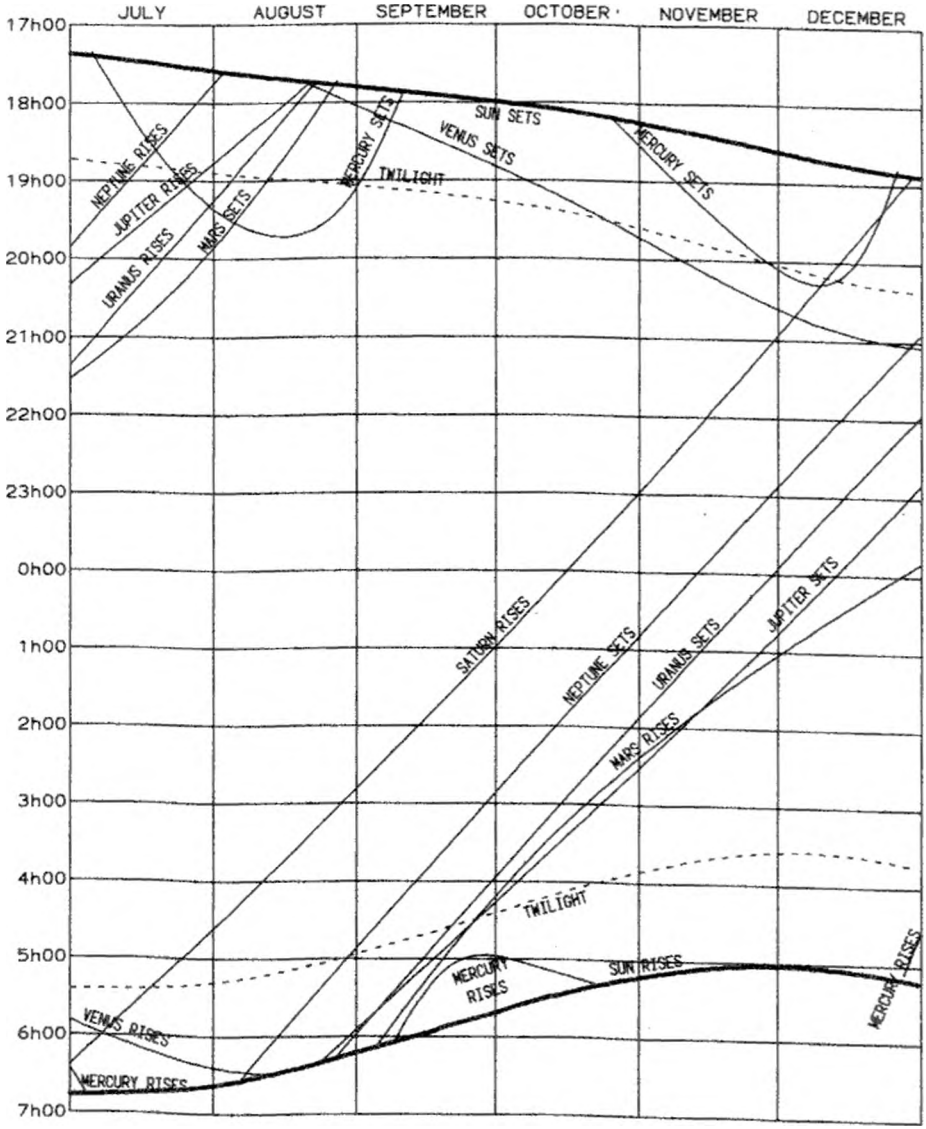
The times of rising and setting given by the diagram are accurate for position 30° East, 30° South and approximately correct for other places in Southern Africa. Strictly speaking, corrections for latitude and longitude should be applied, but the latitude correction is in general sufficiently small to 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



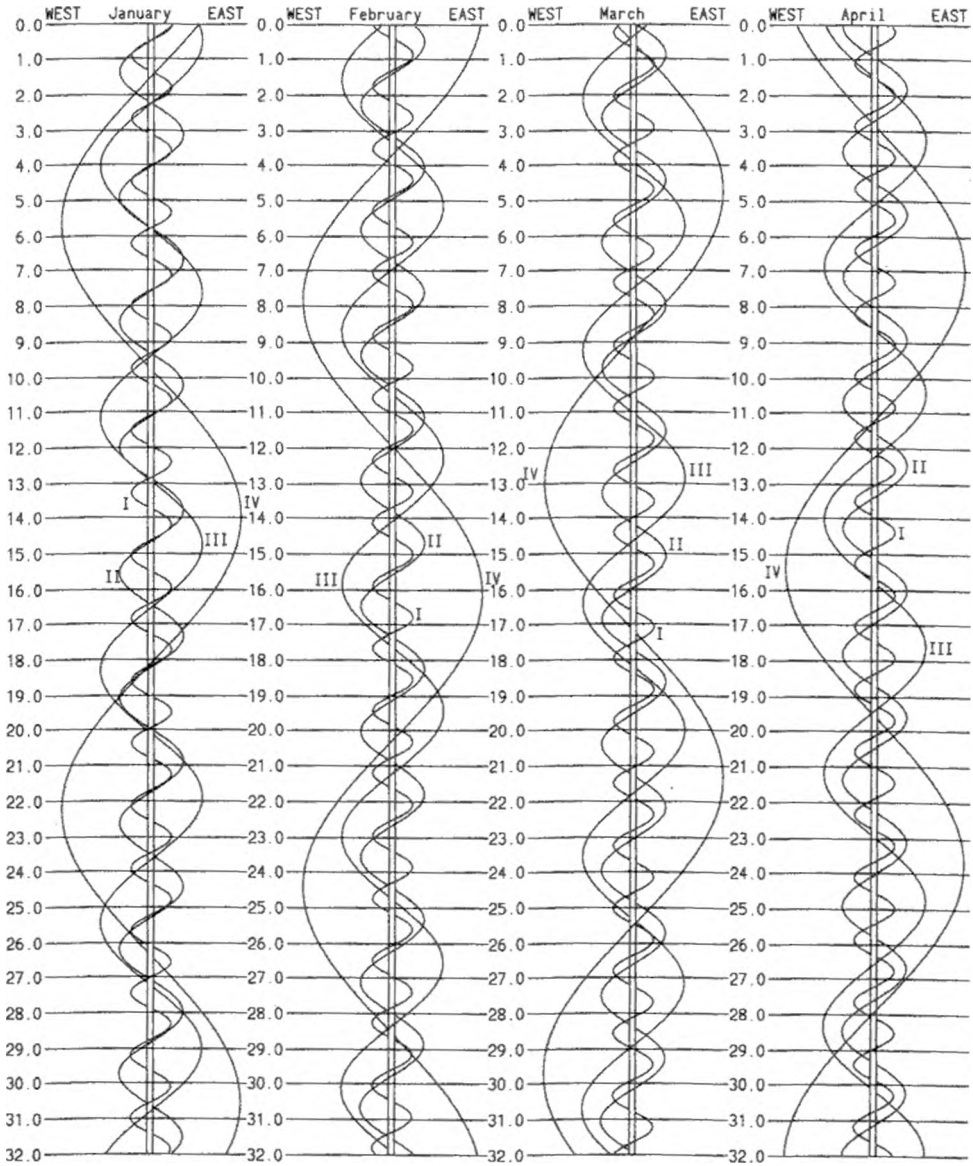
APPARENT PLACES:

	Mercury		Venus		Mars		Jupiter	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	20 1.3	-20 43	15 28.8	-15 15	15 9.2	-16 58	9 18.3	16 31
Jan 11	19 34.4	-18 52	16 8.6	-17 23	15 35.4	-18 41	9 14.5	16 50
Jan 21	18 53.5	-19 42	16 52.0	-19 14	16 2.0	-20 10	9 9.8	17 13
Jan 31	19 7.8	-21 1	17 38.2	-20 33	16 29.0	-21 24	9 4.6	17 37
Feb 10	19 52.7	-21 4	18 26.4	-21 4	16 56.5	-22 22	8 59.2	18 0
Feb 20	20 49.7	-19 11	19 15.8	-20 42	17 24.1	-23 3	8 54.2	18 22
Mar 2	21 51.7	-15 10	20 5.3	-19 24	17 52.0	-23 27	8 49.8	18 40
Mar 12	22 56.9	-9 1	20 54.3	-17 10	18 19.7	-23 34	8 46.3	18 53
Mar 22	0 5.7	-0 51	21 42.2	-14 8	18 47.3	-23 24	8 44.0	19 2
Apr 1	1 17.8	8 29	22 28.9	-10 26	19 14.6	-22 58	8 42.9	19 6
Apr 11	2 23.4	16 27	23 14.5	-6 14	19 41.3	-22 18	8 43.2	19 4
Apr 21	3 3.1	20 18	23 59.4	-1 43	20 7.3	-21 25	8 44.7	18 58
May 1	3 6.8	19 25	0 44.1	2 56	20 32.4	-20 22	8 47.3	18 47
May 11	2 47.6	15 14	1 29.1	7 32	20 56.6	-19 12	8 51.1	18 31
May 21	2 38.8	12 13	2 15.0	11 53	21 19.5	-17 58	8 55.8	18 11
May 31	2 55.8	12 53	3 2.4	15 48	21 41.0	-16 43	9 1.3	17 48
Jun 10	3 36.6	16 21	3 51.5	19 4	22 0.7	-15 32	9 7.6	17 21
Jun 20	4 39.8	20 52	4 42.4	21 32	22 18.4	-14 29	9 14.5	16 50
Jun 30	6 5.4	24 1	5 34.8	23 1	22 33.4	-13 40	9 21.8	16 16
Jul 10	7 39.6	23 13	6 28.1	23 23	22 45.1	-13 10	9 29.5	15 40
Jul 20	9 1.6	18 40	7 21.3	22 38	22 52.9	-13 3	9 37.5	15 1
Jul 30	10 6.0	12 27	8 13.7	20 46	22 56.0	-13 21	9 45.8	14 20
Aug 9	10 55.0	6 2	9 4.5	17 54	22 53.9	-14 2	9 54.1	13 37
Aug 19	11 28.4	0 36	9 53.6	14 12	22 47.1	-14 57	10 2.5	12 53
Aug 29	11 39.9	-2 18	10 41.1	9 51	22 37.2	-15 50	10 10.9	12 7
Sep 8	11 20.4	-0 13	11 27.2	5 3	22 26.9	-16 24	10 19.2	11 22
Sep 18	10 53.8	5 29	12 12.7	0 1	22 19.2	-16 26	10 27.3	10 36
Sep 28	11 12.9	6 22	12 58.1	-5 4	22 15.8	-15 55	10 35.2	9 51
Oct 8	12 8.9	1 8	13 44.2	-9 59	22 17.6	-14 55	10 42.8	9 8
Oct 18	13 12.2	-6 11	14 31.7	-14 32	22 24.1	-13 30	10 49.9	8 26
Oct 28	14 14.5	-13 9	15 21.0	-18 29	22 34.5	-11 46	10 56.6	7 47
Nov 7	15 16.7	-18 58	16 12.3	-21 37	22 48.1	-9 47	11 2.7	7 11
Nov 17	16 20.0	-23 13	17 5.4	-23 45	23 4.1	-7 35	11 8.1	6 40
Nov 27	17 23.9	-25 32	17 59.7	-24 42	23 21.9	-5 14	11 12.7	6 13
Dec 7	18 22.6	-25 35	18 54.3	-24 25	23 41.2	-2 46	11 16.4	5 53
Dec 17	18 54.7	-23 35	19 48.0	-22 55	0 1.5	-0 12	11 19.1	5 38
Dec 27	18 21.0	-21 2	20 39.8	-20 17	0 22.7	2 23	11 20.7	5 31

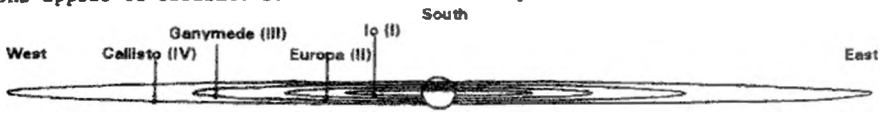
	Saturn		Uranus		Neptune		Pluto	
	RA	DEC	RA	DEC	RA	DEC	RA	DEC
	h m	° ′	h m	° ′	h m	° ′	h m	° ′
Jan 1	5 36.0	22 2	21 55.0	-13 26	20 48.0	-17 49	17 12.3	-13 45
Jan 11	5 32.9	22 2	21 56.8	-13 17	20 49.4	-17 44	17 13.8	-13 47
Jan 21	5 30.1	22 2	21 58.8	-13 6	20 50.9	-17 38	17 15.1	-13 47
Jan 31	5 28.0	22 2	22 0.9	-12 55	20 52.4	-17 32	17 16.2	-13 47
Feb 10	5 26.7	22 3	22 3.1	-12 43	20 54.0	-17 26	17 17.2	-13 47
Feb 20	5 26.1	22 5	22 5.3	-12 31	20 55.4	-17 20	17 18.0	-13 46
Mar 2	5 26.3	22 7	22 7.5	-12 19	20 56.9	-17 14	17 18.6	-13 45
Mar 12	5 27.3	22 10	22 9.6	-12 7	20 58.2	-17 9	17 19.0	-13 43
Mar 22	5 29.1	22 14	22 11.7	-11 56	20 59.4	-17 4	17 19.2	-13 41
Apr 1	5 31.6	22 17	22 13.6	-11 46	21 0.4	-16 59	17 19.1	-13 39
Apr 11	5 34.8	22 21	22 15.3	-11 36	21 1.3	-16 56	17 18.8	-13 36
Apr 21	5 38.5	22 25	22 16.8	-11 28	21 1.9	-16 53	17 18.3	-13 34
May 1	5 42.8	22 28	22 18.0	-11 21	21 2.3	-16 52	17 17.6	-13 32
May 11	5 47.5	22 32	22 19.0	-11 16	21 2.6	-16 51	17 16.8	-13 30
May 21	5 52.5	22 34	22 19.7	-11 13	21 2.6	-16 51	17 15.9	-13 29
May 31	5 57.8	22 36	22 20.1	-11 11	21 2.4	-16 52	17 14.8	-13 28
Jun 10	6 3.3	22 37	22 20.2	-11 11	21 1.9	-16 54	17 13.7	-13 27
Jun 20	6 8.9	22 37	22 20.0	-11 12	21 1.3	-16 56	17 12.7	-13 27
Jun 30	6 14.5	22 36	22 19.5	-11 16	21 0.6	-17 0	17 11.6	-13 28
Jul 10	6 20.1	22 35	22 18.7	-11 21	20 59.7	-17 4	17 10.7	-13 29
Jul 20	6 25.6	22 32	22 17.6	-11 27	20 58.7	-17 8	17 9.8	-13 31
Jul 30	6 30.9	22 29	22 16.4	-11 34	20 57.6	-17 13	17 9.1	-13 33
Aug 9	6 35.9	22 26	22 15.0	-11 42	20 56.5	-17 17	17 8.6	-13 36
Aug 19	6 40.5	22 22	22 13.5	-11 50	20 55.4	-17 22	17 8.2	-13 39
Aug 29	6 44.8	22 18	22 12.0	-11 59	20 54.4	-17 26	17 8.1	-13 43
Sep 8	6 48.5	22 14	22 10.5	-12 7	20 53.5	-17 30	17 8.2	-13 47
Sep 18	6 51.6	22 10	22 9.1	-12 15	20 52.7	-17 33	17 8.5	-13 51
Sep 28	6 54.1	22 7	22 7.8	-12 22	20 52.1	-17 36	17 9.0	-13 56
Oct 8	6 55.9	22 5	22 6.8	-12 27	20 51.7	-17 38	17 9.7	-14 0
Oct 18	6 57.0	22 3	22 6.0	-12 31	20 51.4	-17 39	17 10.7	-14 5
Oct 28	6 57.2	22 3	22 5.4	-12 34	20 51.4	-17 39	17 11.8	-14 9
Nov 7	6 56.6	22 4	22 5.2	-12 35	20 51.7	-17 38	17 13.0	-14 14
Nov 17	6 55.3	22 6	22 5.3	-12 34	20 52.1	-17 36	17 14.4	-14 18
Nov 27	6 53.3	22 9	22 5.8	-12 31	20 52.8	-17 34	17 15.8	-14 21
Dec 7	6 50.6	22 13	22 6.5	-12 26	20 53.7	-17 30	17 17.4	-14 24
Dec 17	6 47.5	22 18	22 7.6	-12 20	20 54.7	-17 26	17 18.9	-14 27
Dec 27	6 44.0	22 22	22 8.9	-12 12	20 56.0	-17 21	17 20.4	-14 29

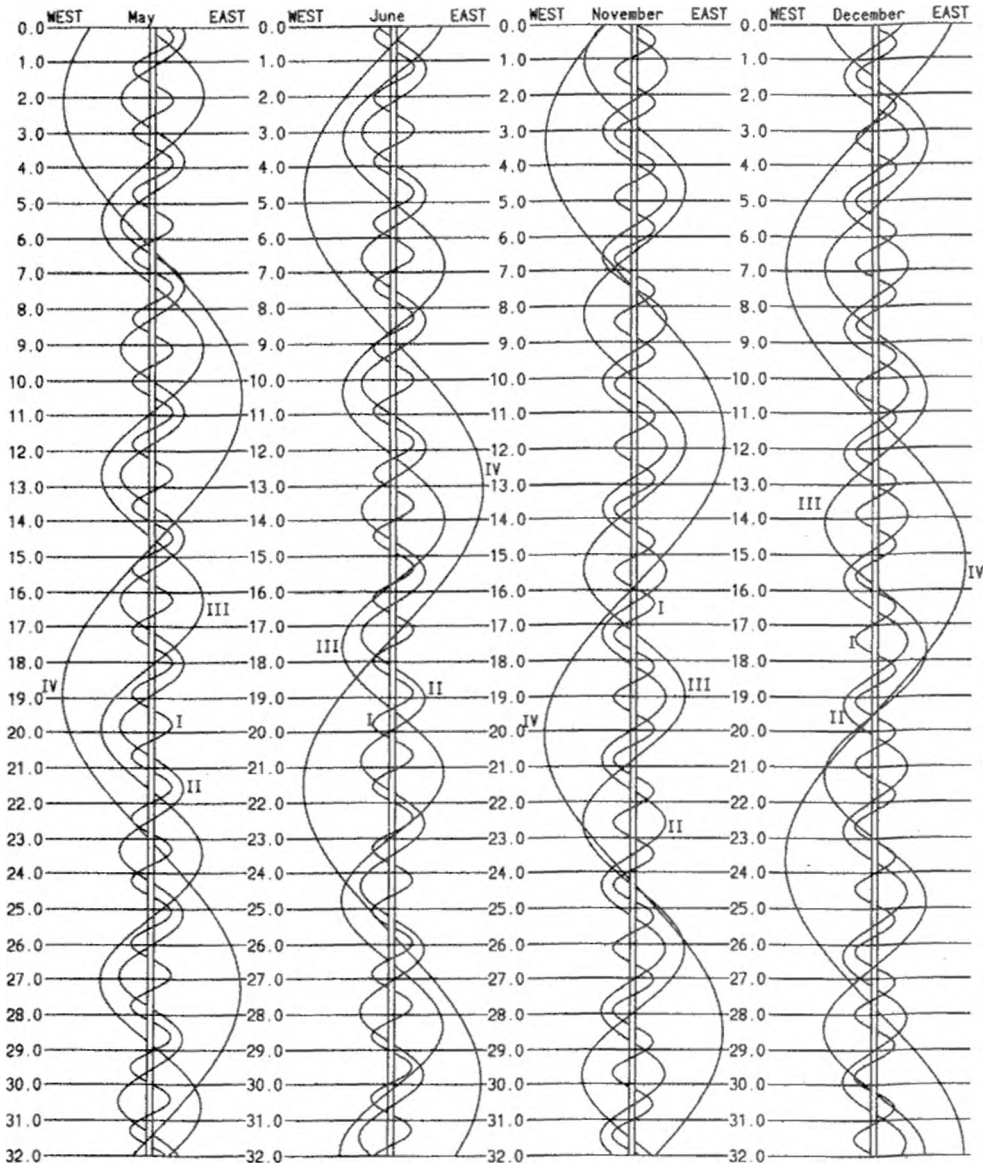
THE MOONS OF JUPITER

One of the most popular sights for an observer with a small telescope is Jupiter and its moons. Four of the sixteen - Io, Europa, Ganymede and Callisto - are generally clearly visible - they would just be visible to the naked eye were it not for the glare from the mother planet. As the diagram on the next page indicates, the system is seen almost edge-on so the moons always lie close to a straight line extending from the planet's equator. As they orbit, so they appear to oscillate from one side to the other, alternately passing in front and behind the planet. This motion is represented in the following diagrams which show how their



positions along such a straight line change during the 8 months when Jupiter is prominent. For each month, time increases downward; the disk of Jupiter is stretched to make the central column, and horizontal lines representing midnight (0am SAST), are shown for every day of the month. The wavy lines show how the moons appear to ossilate from each side of the planet to the other.





When the moons pass in front and behind the planet, transits, occultations and eclipses occur. Details of such phenomena, occurring between the end of astronomical twilight in the evening and its commencement in the morning when the planet is above the horizon in Southern Africa, are given in the table below.

EXPLANATION OF THE TABLE.

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

d	h	m		d	h	m		d	h	m		d	h	m	
Jan 01	01	06	IV.Sh.I.	Jan 19	00	26	I.Oc.R.	Feb 06	22	30	III.Tr.E.	Feb 26	01	15	I.Sh.E.
	05	00	I.Ec.D.		21	17	I.Sh.E.		22	57	III.Sh.E.		02	19	II.Tr.I.
	23	30	III.Sh.I.		21	29	III.Ec.D.	09	03	19	I.Oc.D.		03	28	II.Sh.I.
02	01	19	II.Ec.D.		21	37	I.Tr.E.	10	00	30	I.Tr.I.		19	41	I.Oc.D.
	02	16	I.Sh.I.		23	14	II.Oc.R.		00	41	I.Sh.I.		22	35	I.Ec.R.
	02	24	III.Tr.I.	20	02	28	III.Oc.R.		02	47	I.Tr.E.	27	19	08	I.Tr.E.
	03	-1	I.Tr.I.	24	05	11	I.Ec.D.		02	58	I.Sh.E.		19	44	I.Sh.E.
	03	05	III.Sh.E.	25	02	25	I.Sh.I.		03	01	II.Oc.D.		20	38	II.Oc.D.
	04	33	I.Sh.E.		02	37	I.Tr.I.		21	45	I.Oc.D.	28	00	42	II.Ec.R.
	05	16	I.Tr.E.		03	42	II.Sh.I.	11	00	16	I.Ec.R.		19	43	IV.Ec.R.
	23	29	I.Ec.D.		04	07	II.Tr.I.		21	13	I.Tr.E.	Mar 01	19	41	II.Sh.E.
03	02	30	I.Oc.R.		04	42	I.Sh.E.		21	27	I.Sh.E.		04	01	02 III.Ec.R.
	21	25	I.Tr.I.		04	54	I.Tr.E.		21	46	II.Tr.I.		03	00	I.Oc.D.
	22	47	II.Sh.E.		23	40	I.Ec.D.		22	15	II.Sh.I.	05	00	10	I.Tr.I.
	23	01	I.Sh.E.	26	02	10	I.Oc.R.	12	00	40	II.Tr.E.		00	52	I.Sh.I.
	23	42	I.Tr.E.		02	45	IV.Ec.D.		01	09	II.Sh.E.		02	27	I.Tr.E.
04	00	12	II.Tr.E.		20	53	I.Sh.I.		01	41	IV.Ec.R.		03	10	I.Sh.E.
09	03	27	III.Sh.I.		21	03	I.Tr.I.	13	19	33	II.Ec.R.		21	27	I.Oc.D.
	03	52	II.Ec.D.		22	16	II.Ec.D.		22	10	III.Tr.I.	06	00	29	I.Ec.R.
	04	09	I.Sh.I.		23	10	I.Sh.E.		23	19	III.Sh.I.		19	21	I.Sh.I.
	04	44	I.Tr.I.		23	20	I.Tr.E.	14	01	47	III.Tr.E.		20	54	I.Tr.E.
10	01	23	I.Ec.D.	27	01	27	III.Ec.D.		02	57	III.Sh.E.		21	38	I.Sh.E.
	04	15	I.Oc.R.		01	27	II.Oc.R.	17	02	14	I.Tr.I.		22	55	II.Oc.D.
	22	29	II.Sh.I.		05	44	III.Oc.R.		02	35	I.Sh.I.	07	03	17	II.Ec.R.
	22	38	I.Sh.I.		20	36	I.Oc.R.		04	31	I.Tr.E.	08	19	24	II.Sh.I.
	23	10	I.Tr.I.	28	19	56	II.Sh.E.		23	29	I.Oc.D.		20	42	II.Tr.E.
	23	35	II.Tr.I.		20	10	II.Tr.E.	18	02	11	I.Ec.R.		22	18	II.Sh.E.
11	00	55	I.Sh.E.	Feb 01	04	19	I.Sh.I.		20	40	I.Tr.I.		22	29	IV.Tr.E.
	01	24	II.Sh.E.		04	20	I.Tr.I.		21	04	I.Sh.I.	09	01	05	IV.Sh.I.
	01	27	I.Tr.E.	02	01	34	I.Ec.D.		22	57	I.Tr.E.	10	22	01	III.Oc.D.
	02	30	II.Tr.E.		03	53	I.Oc.R.		23	21	I.Sh.E.	12	01	57	I.Tr.I.
	22	41	I.Oc.R.		22	46	I.Tr.I.	19	00	02	II.Tr.I.		02	47	I.Sh.I.
12	21	00	II.Oc.R.		22	47	I.Sh.I.		00	52	II.Sh.I.		23	14	I.Oc.D.
	23	10	III.Oc.R.	03	00	48	II.Oc.D.		02	56	II.Tr.E.	13	02	25	I.Ec.R.
17	03	17	I.Ec.D.		01	03	I.Tr.E.		03	46	II.Sh.E.		20	24	I.Tr.I.
	22	38	IV.Tr.I.		01	04	I.Sh.E.		20	40	I.Ec.R.		21	16	I.Sh.I.
	23	52	IV.Sh.E.		03	42	II.Ec.R.	20	03	00	IV.Tr.I.		22	41	I.Tr.E.
18	00	31	I.Sh.I.		05	20	III.Oc.D.		22	08	II.Ec.R.		23	33	I.Sh.E.
	00	54	I.Tr.I.		20	01	I.Oc.D.	21	01	28	III.Tr.I.	14	01	14	II.Oc.D.
	01	05	II.Sh.I.		22	22	I.Ec.R.		03	18	III.Sh.I.		20	53	I.Ec.R.
	01	52	II.Tr.I.	04	19	29	I.Tr.E.	24	03	58	I.Tr.I.	15	20	10	II.Tr.I.
	02	48	I.Sh.E.		19	30	II.Tr.I.		21	03	III.Ec.R.		22	01	II.Sh.I.
	03	11	I.Tr.E.		19	33	I.Sh.E.	25	01	14	I.Oc.D.		23	04	II.Tr.E.
	03	24	IV.Tr.E.		19	38	II.Sh.I.		04	06	I.Ec.R.	16	00	54	II.Sh.E.
	04	00	II.Sh.E.		22	25	II.Tr.E.		22	25	I.Tr.I.		23	58	IV.Oc.D.
	04	46	II.Tr.E.		22	33	II.Sh.E.		22	58	I.Sh.I.	17	19	10	II.Ec.R.
	21	46	I.Ec.D.	06	19	20	III.Sh.I.	26	00	42	I.Tr.E.	18	01	31	III.Oc.D.

d	h	m	
Mar	20	01	02 I.Oc.D.
		22	12 I.Tr.I.
		23	10 I.Sh.I.
	21	00	28 I.Tr.E.
		01	27 I.Sh.E.
		18	49 III.Tr.E.
		19	14 III.Sh.I.
		19	29 I.Oc.D.
		22	48 I.Ec.R.
		22	51 III.Sh.E.
	22	18	56 I.Tr.E.
		19	56 I.Sh.E.
		22	34 II.Tr.I.
	23	00	38 II.Sh.I.
		01	28 II.Tr.E.
	24	21	45 II.Ec.R.
	25	19	06 IV.Sh.I.
		23	53 IV.Sh.E.
	28	00	01 I.Tr.I.
		01	05 I.Sh.I.
		18	50 III.Tr.I.
		21	19 I.Oc.D.
		22	26 III.Tr.E.
		23	14 III.Sh.I.
	29	00	43 I.Ec.R.
		19	34 I.Sh.I.
		20	45 I.Tr.E.
		21	51 I.Sh.E.
	30	01	01 II.Tr.I.
		19	12 I.Ec.R.
	31	19	13 II.Oc.D.
Apr	01	00	21 II.Ec.R.
	02	19	26 II.Sh.E.
		20	50 IV.Oc.R.
	04	22	32 III.Tr.I.
		23	10 I.Oc.D.
	05	20	19 I.Tr.I.
		21	29 I.Sh.I.
		22	36 I.Tr.E.
		23	45 I.Sh.E.
	06	21	07 I.Ec.R.
	07	21	40 II.Oc.D.
	08	21	00 III.Ec.R.
	09	19	10 II.Sh.I.
		19	37 II.Tr.E.
		22	03 II.Sh.E.
	12	01	02 I.Oc.D.
		22	11 I.Tr.I.
		23	24 I.Sh.I.
	13	00	28 I.Tr.E.
		19	30 I.Oc.D.
		23	03 I.Ec.R.
	14	18	56 I.Tr.E.
		20	09 I.Sh.E.
	15	00	10 II.Oc.D.
		19	56 III.Oc.R.
		21	21 III.Ec.D.
	16	19	17 II.Tr.I.
		21	47 II.Sh.I.
		22	09 II.Tr.E.
	17	00	39 II.Sh.E.
	18	18	50 II.Ec.R.
	19	21	00 IV.Ec.D.

d	h	m	
Apr	20	00	04 I.Tr.I.
		21	23 I.Oc.D.
	21	18	33 I.Tr.I.
		19	47 I.Sh.I.
		20	49 I.Tr.E.
		22	04 I.Sh.E.
	22	19	26 I.Ec.R.
		20	11 III.Oc.D.
		23	49 III.Oc.R.
	23	21	51 II.Tr.I.
	25	21	27 II.Ec.R.
	26	18	48 III.Sh.E.
	27	19	12 IV.Tr.I.
		23	18 I.Oc.D.
		23	58 IV.Tr.E.
	28	20	27 I.Tr.I.
		21	42 I.Sh.I.
		22	43 I.Tr.E.
	29	00	-1 I.Sh.E.
		21	22 I.Ec.R.
	30	18	28 I.Sh.E.
May	02	18	35 II.Oc.D.
	03	19	10 III.Sh.I.
		22	47 III.Sh.E.
	04	19	09 II.Sh.E.
	05	22	22 I.Tr.I.
	06	19	42 I.Oc.D.
		19	55 IV.Ec.R.
		23	17 I.Ec.R.
	07	19	08 I.Tr.E.
		20	23 I.Sh.E.
	09	21	12 II.Oc.D.
	10	21	42 III.Tr.E.
		23	11 III.Sh.I.
	11	18	54 II.Sh.I.
		19	15 II.Tr.E.
		21	45 II.Sh.E.
	13	21	38 I.Oc.D.
	14	18	16 IV.Tr.E.
		18	47 I.Tr.I.
		20	01 I.Sh.I.
		21	04 I.Tr.E.
		22	18 I.Sh.E.
	15	19	40 I.Ec.R.
	17	22	13 III.Tr.I.
	18	19	03 II.Tr.I.
		21	30 II.Sh.I.
		21	55 II.Tr.E.
	20	18	35 II.Ec.R.
	21	20	45 I.Tr.I.
		20	58 III.Ec.R.
		21	57 I.Sh.I.
	22	21	32 IV.Oc.D.
		21	35 I.Ec.R.
	23	18	42 I.Sh.E.
	25	21	44 II.Tr.I.
	27	21	11 II.Ec.R.
	28	20	12 III.Oc.R.
		21	18 III.Ec.D.
	29	20	03 I.Oc.D.
	30	18	21 I.Sh.I.
		19	29 I.Tr.E.
		20	38 I.Sh.E.

d	h	m	
May	31	19	13 IV.Sh.I.
Jun	03	18	38 II.Oc.D.
	04	20	48 III.Oc.D.
	05	18	50 II.Sh.E.
	06	19	11 I.Tr.I.
		20	16 I.Sh.I.
		21	28 I.Tr.E.
	07	19	54 I.Ec.R.
	08	18	46 III.Sh.E.
	10	21	23 II.Oc.D.
	12	18	34 II.Sh.I.
		19	24 II.Tr.E.
		21	26 II.Sh.E.
	13	21	10 I.Tr.I.
	14	18	30 I.Oc.D.
	15	18	44 III.Tr.E.
		18	57 I.Sh.E.
		19	08 III.Sh.I.
	19	19	17 II.Tr.I.
	21	18	21 II.Ec.R.
		20	30 I.Oc.D.
	22	18	35 I.Sh.I.
		19	26 III.Tr.I.
		19	57 I.Tr.E.
		20	52 I.Sh.E.
	23	18	12 I.Ec.R.
	29	19	40 I.Tr.I.
		20	30 I.Sh.I.
	30	20	06 I.Ec.R.
Jul	05	19	09 II.Oc.D.
	07	18	28 II.Sh.E.
		19	00 I.Oc.D.
	08	18	29 I.Tr.E.
		19	11 I.Sh.E.
	10	18	28 III.Oc.D.
	14	19	50 II.Tr.E.
	15	18	48 I.Sh.I.
	16	18	23 I.Ec.R.
	21	18	43 III.Sh.E.
Sep	26	05	40 IV.Sh.E.
Oct	05	04	44 I.Sh.I.
		05	26 I.Tr.I.
	06	04	53 I.Oc.R.
	08	05	15 II.Tr.E.
	14	04	13 I.Tr.E.
	15	05	10 II.Tr.I.
	19	04	50 III.Ec.D.
	21	03	55 I.Tr.I.
		05	18 I.Sh.E.
	28	04	54 I.Sh.I.
	29	05	19 I.Oc.R.
	31	03	44 II.Ec.D.
Nov	05	03	56 I.Ec.D.
	06	03	33 I.Sh.E.
		04	36 I.Tr.E.
	09	02	41 II.Tr.I.
		03	20 II.Sh.E.
	13	03	10 I.Sh.I.
		04	17 I.Tr.I.
	14	03	42 I.Oc.R.
	16	03	04 II.Sh.I.
	17	04	56 III.Oc.R.
	18	03	24 II.Oc.R.

d	h	m	
Nov	20	05	03 I.Sh.I.
	21	02	10 I.Ec.D.
	22	02	58 I.Tr.E.
	24	03	17 IV.Oc.D.
		04	13 III.Ec.R.
	28	04	03 I.Ec.D.
	29	01	25 I.Sh.I.
		02	38 I.Tr.I.
		03	41 I.Sh.E.
		04	53 I.Tr.E.
	30	02	02 I.Oc.R.
Dec	01	04	37 III.Ec.D.
	02	03	20 II.Ec.D.
		05	13 IV.Sh.E.
	04	02	46 II.Tr.E.
	05	03	-1 III.Tr.E.
	06	03	18 I.Sh.I.
		04	32 I.Tr.I.
	07	03	56 I.Oc.R.
	08	01	15 I.Tr.E.
	11	01	07 IV.Oc.R.
		02	33 II.Tr.I.
		02	54 II.Sh.E.
	12	02	02 III.Sh.E.
		03	35 III.Tr.I.
	13	05	12 I.Sh.I.
	14	02	18 I.Ec.D.
	15	00	53 I.Tr.I.
		01	56 I.Sh.E.
		03	08 I.Tr.E.
	18	02	38 II.Sh.I.
		05	06 II.Tr.I.
	19	02	30 III.Sh.I.
	20	03	03 II.Oc.R.
	21	04	11 I.Ec.D.
	22	01	33 I.Sh.I.
		02	45 I.Tr.I.
		03	49 I.Sh.E.
		05	-1 I.Tr.E.
	23	00	52 III.Oc.R.
		02	09 I.Oc.R.
	25	05	12 II.Sh.I.
	27	00	20 II.Ec.D.
		03	28 IV.Ec.D.
	28	23	40 II.Tr.E.
	29	03	26 I.Sh.I.
		04	36 I.Tr.I.
	30	00	00 III.Ec.R.
		00	33 I.Ec.D.
		01	18 III.Oc.D.
		04	00 I.Oc.R.
		04	39 III.Oc.R.
	31	00	10 I.Sh.E.
		01	18 I.Tr.E.

ECLIPSES AND OCCULTATIONS OF THE GALILEAN SATELLITES FOR 2003

EXPLANATION OF TABLE

SATELLITE IDENTIFICATION: 1 = Io, 2 = Europa, 3 = Ganymede, 4 = Callisto

EVENT: 1E2P means "1 eclipses 2 partially" (A=annular, T=total,O=penumbral)
102P means "1 occults 2 partially" (A=annular, T=total)

DL: light drop in mag.

FI1,FI2: orbit rotation angles (deg) at midevent, measured from superior conjunction with Jupiter, geocentric for an occultation, heliocentric for an eclipse

DIST: distance (Jup radii) of occulted or eclipsed satellite from center of Jup. at midevent

SEP: apparent separation between satellites in arcsec at midevent

SAT: satellite(s) within 10 arcsec of occulted/eclipsed satellite at midevent

ECLIPSES

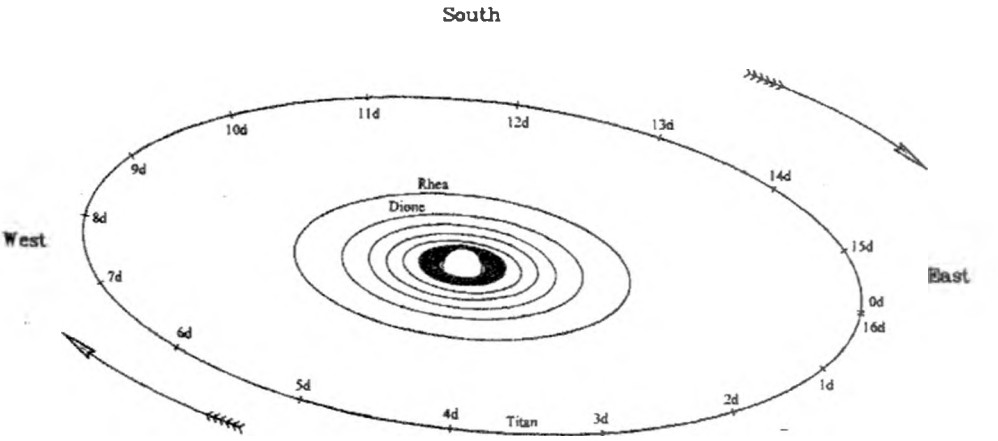
DATE(UT)			BEGIN		END		EVENT	DL	FI1	FI2	DIST	SEP	SAT
y	m	d	h	m	h	m		mag.				arcs.	
3	1	7	01	24.7	01	40.6	2E1P	0.46	142	101	5.9	13.2	2
3	1	14	04	34.0	04	58.0	2E1P	0.35	145	112	5.6	8.7	2
3	1	17	21	17.6	22	29.6	2E1P	0.45	161	148	3.4	5.2	2
3	1	27	21	43.9	22	0.8	2E3A	0.28	94	39	9.2	5.8	2
3	2	4	01	31.8	01	47.1	2E3A	0.31	99	38	9.4	1.8	2
3	2	18	22	39.0	22	57.6	4E3P	0.39	149	66	14.0	38.5	4
3	2	20	00	10.7	00	19.6	4E1Q	0.42	172	40	4.1	43.7	4
3	2	28	03	7.7	03	23.0	1E4A	0.54	254	348	3.3	55.2	1
3	3	9	23	59.0	24	10.7	4E2Q	0.23	199	295	7.9	75.2	4
3	3	11	19	16.9	19	28.2	2E3A	0.40	119	34	9.8	45.8	2
3	3	16	00	4.5	00	23.9	3E4A	0.59	245	329	10.5	83.5	3
3	3	17	20	17.9	20	26.9	1E3Q	0.07	256	337	3.8	45.4	1
3	3	18	22	41.4	22	52.1	2E3A	0.36	122	33	9.8	53.2	2
3	3	19	20	20.6	20	25.3	2E1Q	0.09	212	303	4.5	34.2	2
3	3	24	23	54.2	24	8.7	1E3P	0.14	271	337	3.7	44.3	1
3	3	25	22	2.5	22	14.1	1E3P	0.13	98	23	7.9	10.9	2
3	3	26	22	38.1	22	43.2	2E1P	0.18	211	306	4.2	38.1	2
3	4	2	01	25.6	01	35.4	1E3P	0.21	110	22	7.8	7.3	2
3	4	2	22	11.7	22	20.2	2E4Q	0.13	198	354	1.6	121.7	2
3	4	3	19	14.9	19	29.4	1E4Q	0.27	105	12	10.0	62.8	3
3	4	7	20	50.6	20	54.6	1E2Q	0.19	212	340	1.5	48.8	1
3	4	11	22	58.9	23	4.8	3E2Q	0.09	159	35	6.7	77.7	3
3	4	11	23	21.8	23	28.4	4E1Q	0.07	187	326	2.3	97.1	3
3	4	14	23	5.1	23	8.5	1E2Q	0.05	215	339	1.7	48.8	1
3	4	20	18	35.2	18	40.8	2E1A	0.54	206	316	3.2	45.8	2
3	4	27	20	50.6	20	56.1	2E1A	0.70	204	319	3.0	46.3	2
3	5	4	23	5.6	23	10.9	2E1A	0.54	203	322	2.7	46.2	2
3	5	5	19	34.3	20	23.2	2E4Q	0.05	292	341	3.8	74.3	2
3	5	14	18	46.1	18	52.8	1E3A	0.33	160	8	4.7	48.8	2
3	5	17	19	41.2	19	50.3	3E1P	0.75	161	58	5.5	56.1	3
3	5	21	21	30.4	21	36.6	1E3P	0.24	167	5	4.0	60.3	2
3	5	24	18	44.6	18	54.3	3E2P	0.83	150	52	8.4	58.3	3
3	5	29	18	56.0	18	59.9	2E1Q	0.12	198	331	1.9	41.5	2
3	5	31	22	5.5	22	15.7	3E2P	0.91	149	55	8.5	53.0	3

OCCULTATIONS

DATE(UT)			BEGIN		END		EVENT	DL	FI1	FI2	DIST	SEP	SAT
y	m	d	h	m	h	m		mag.				arcs.	
3	1	9	02	31.9	02	52.4	301P	0.08	170	153	2.7	1.1	3
3	1	14	23	24.2	23	30.7	201P	0.04	219	268	5.9	0.9	2
3	1	17	02	37.8	02	48.9	402P	0.50	160	77	9.2	0.5	4
3	1	19	03	1.0	03	10.0	403P	0.22	204	315	10.6	0.9	4
3	1	22	01	41.0	01	46.4	201P	0.03	219	272	5.9	0.9	2
3	1	27	22	17.8	22	31.5	203P	0.21	95	39	9.4	0.5	2
3	2	4	01	24.3	01	37.2	203A	0.23	99	38	9.3	0.3	2
3	2	11	04	27.4	04	39.6	203A	0.23	102	38	9.2	0.2	2
3	2	18	19	46.5	20	0.0	403P	0.47	150	63	13.4	0.4	4
3	2	19	22	27.9	22	33.7	401P	0.56	174	29	2.9	0.4	4
3	2	27	19	45.9	19	49.4	102P	0.35	195	350	1.6	0.3	1
3	2	27	23	58.8	24	5.7	104P	0.13	232	350	4.6	0.5	1
3	3	01	01	36.7	01	51.7	104P	0.07	89	13	5.9	0.8	1
3	3	6	21	45.8	21	49.4	102P	0.30	197	349	1.8	0.4	1
3	3	13	23	47.4	23	50.8	102P	0.26	200	348	2.0	0.4	1
3	3	18	19	38.4	19	46.3	203P	0.14	117	34	8.4	0.7	2
3	3	21	01	50.6	01	54.0	102P	0.23	202	346	2.2	0.5	1
3	3	25	22	44.7	22	51.4	203P	0.09	120	33	8.2	0.8	2
3	4	7	19	6.4	19	9.8	102P	0.21	207	343	2.7	0.5	1
3	4	14	21	15.9	21	19.5	102P	0.23	210	342	2.9	0.4	1
3	4	21	23	27.2	23	30.9	102P	0.26	212	340	3.2	0.4	1
3	5	16	19	20.5	19	24.9	102T	0.46	222	335	4.0	0.1	1
3	5	23	21	39.4	21	44.0	102T	0.46	225	333	4.2	0.1	1
3	6	16	19	43.3	19	49.9	401P	0.46	170	48	4.4	0.4	4
3	6	17	17	59.0	18	3.1	102P	0.12	237	328	4.9	0.5	1
3	6	17	18	9.1	18	13.7	402P	0.16	191	329	4.8	0.7	4
3	6	17	20	13.4	20	48.9	401T	0.67	193	258	5.8	0.1	4
3	6	24	20	25.9	20	29.1	102P	0.04	240	327	5.1	0.6	1
3	6	26	18	8.1	18	14.0	203A	0.23	158	14	3.6	0.2	2
3	7	7	18	5.6	18	9.3	201P	0.40	191	343	1.7	0.1	2
3	7	17	18	8.2	18	14.2	103A	0.29	216	346	3.5	0.1	1

THE MOONS OF SATURN

Saturn's moons are considerably fainter than the 4 Galilean moons of Jupiter. The diagram shows the orbits of 4 of Saturn's moons at opposition on December 31. The easiest to find is Titan (magnitude +8.5),according to the diagram and information in the table below.



TITAN

Eastern Elongation			Inferior Conjunction			Western Elongation			Superior Conjunction		
	d	h		d	h		d	h		d	h
									Jan	3	09.8
Jan	7	13.6	Jan	11	14.9	Jan	15	10.0		19	07.2
	23	11.0		27	12.6		31	07.8	Feb	4	05.0
Feb	8	08.9	Feb	12	10.7	Feb	16	06.0		20	03.3
	24	07.4		28	09.4	Mar	4	04.8	Mar	8	02.3
Mar	12	06.5	Mar	16	08.6		20	04.1		24	01.8
	28	06.2	Apr	1	08.3	Apr	5	04.0	Apr	9	01.8
Apr	13	06.4		17	08.5		21	04.2		25	02.2
	29	07.0	May	3	09.0	May	7	04.7	May	11	03.0
May	15	07.9		19	09.9		23	05.6		27	04.0
	31	09.0	Jun	4	10.8	Jun	8	06.5	Jun	12	05.2
Jun	16	10.2		20	11.9		24	07.5		28	06.4
Jul	2	11.5	Jul	6	13.0	Jul	10	08.6	Jul	14	07.6
	18	12.7		22	14.0		26	09.5		30	08.7
Aug	3	13.8	Aug	7	14.8	Aug	11	10.2	Aug	15	09.5
	19	14.6		23	15.4		27	10.7		31	10.1
Sep	4	15.1	Sep	8	15.6	Sep	12	10.9	Sep	16	10.2
	20	15.2		24	15.5		28	10.6	Oct	2	10.0
Oct	6	14.8	Oct	10	14.9	Oct	14	09.9		18	09.2
	22	13.8		26	13.8		30	08.7	Nov	3	07.8
Nov	7	12.3	Nov	11	12.2	Nov	15	06.9		19	05.9
	23	10.3		27	10.1	Dec	1	04.7	Dec	5	03.5
Dec	9	07.8	Dec	13	07.6		17	02.2		21	00.8
	25	05.0		29	04.9						

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 2003, 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	Designation	Perihelion Date	Possible Maximum Magnitude
Kopff	22P	2002 December 12	10
LINEAR	C/2001 RX14	2003 January 18	10
Brewington	154P	2003 February 19	10
LINEAR-NEAT	C/2001 HT50	2003 July 8	11
LINEAR	C/2002 O7	2003 September 20	9
Encke	2P	2003 December 29	8
LINEAR	C/2002 T7	2004 April 23	10
NEAT	C/2001 Q4	2004	9

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

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

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

In making the above observations it is essential that the observer uses the standard procedures developed and used by observers world-wide. Detailed notes on observing techniques and visibility of comets may be obtained from the Director at the address below. *Beginning observers should note that comets are notoriously unpredictable, and that the predicted brightness in the above table is given as a guide only.* The magnitude given is the total magnitude of the coma and the brightness is spread out across the whole diameter of the comet. For this reason the comet will appear much fainter than a star of the same magnitude. As a guide, a comet of magnitude 10-11 would appear about as bright as a star of magnitude 12-13.

Details on how to observe either comets or meteors are available from the Director of the Comet and Meteor Section, T P Cooper, P O Box 14740, Bredell, 1623.
Tel. 011-967-2250.
email: tpcoope@mweb.co.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 magnitude -3 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	DEC °	ZHR	VEL km/s	REC.WATCH BEGIN SAST	END SAST	OBSERVING CONDITIONS 2003
Alpha Crucids	Jan19	Jan06-Jan28	12h48	-63	<5	50	00h00	03h30	Full moon
Alpha Centaurids	Feb 8	Jan28-Feb23	14h00	-40	5	60	22h00	03h30	Good
Gamma Normids	Mar 13	Feb25-Mar22	16h36	-51	8	56	00h00	04h30	Good
Delta Pavonids	Apr 6	Mar11-Apr16	20h32	-63	5	59	02h00	04h30	Favourable
April Lyrids	Apr 22	Apr16-Apr24	18h05	+34	15	49	03h00	05h00	Unfavourable
Pi Puppids	Apr 23	Apr16-Apr25	07h20	-45	<5	18	19h00	22h00	Good
Alpha Scorpiids	May 3	Apr11-May12	16h00	-27	5	35	21h00	04h00	Favourable
Eta Aquarids	May 5	Apr21-May12	22h24	-02	60	65	04h00	05h30	Favourable
Chi Scorpiids	Jun 5	May27-Jun20	16h32	-14	5	21	21h00	04h30	Favourable
Sagittarids	Jun 11	Jun08-Jun16	20h16	-35	<5	52	20h00	05h30	Unfavourable
Theta Ophiuchids	Jun 13	Jun08-Jun16	17h48	-20	5	27	20h00	05h30	Unfavourable
June Lyrids	Jun 16	Jun11-Jun21	18h32	+35	9	31	23h30	02h00	Unfavourable
July Pheonicids	Jul 13	Jul10-Jul16	02h08	-48	<5	47	23h00	05h00	Unfavourable
Piscis Australids	Jul 28	Jul19-Aug17	22h40	-30	5	35	21h30	05h00	Favourable
Sth delta Aquarids	Jul 29	Jul21-Aug29	22h36	-16	25	42	22h00	05h00	New moon
alpha Capricornids	Jul 30	Jul15-Aug25	20h28	-10	5	25	20h00	04h00	New moon
Sth iota Aquarids	Aug 5	Jul15-Aug25	22h12	-15	<5	34	22h00	04h30	Good
Nth delta Aquarids	Aug 12	Jul14-Aug25	22h28	-05	5	42	23h00	05h00	Full moon
Nth iota Aquarids	Aug 19	Jul15-Sep20	21h48	-06	5	36	20h00	05h00	Poor
Orionids	Oct 21	Oct02-Nov07	06h20	+16	30	68	00h00	04h00	Good
Southern Taurids	Nov 5	Sep15-Dec01	03h20	+14	10	29	21h30	03h30	Unfavourable
Northern Taurids	Nov 12	Sep19-Dec01	04h00	+23	5	31	21h30	03h30	Unfavourable
Leonids	Nov 18	Nov14-Nov20	10h08	+22	10*	70	03h00	04h00	Poor
Dec. Phoenicids	Dec 6	Dec03-Dec09	01h12	-53	5	22	20h30	02h00	Unfavourable
Geminids	Dec 14	Dec04-Dec16	07h28	+33	50	36	23h30	03h00	Unfavourable
Velids	Dec 29	Dec05-Jan07	09h56	-51	5	40	22h30	03h30	Good

Notes to Table: 1.)The radiant of most showers drifts slightly eastward each night. The position given is for night of maximum. 2.)The ZHR is the expected maximum rate under observing conditions when stars of magnitude 6.5 can be discerned and with the radiant at the zenith. Rates under poorer conditions and when the radiant is low will consequently be lower. 3.)Showers listed as favourable are the best prospects for observation. Those listed as good may be observed under slight hindrance from the moon. 4.) *ZHR for Leonids is for non-storm activity. No storm activity is predicted for 2003, though enhanced rates of 100+ may be expected.

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:

Mr B Frazer P.O.Box 1017, Henley-on-Klip, 1962. Tel H (016) 366-0955, W (011) 871-0370, email fraserb@intekom.co.za

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.

Date		SAST		Name of Planet		Dur.	Occulted Star	Mag.	d mag
mth	d	h	m			s			
1	17	2	26.2	40	Harmonia	4.7	TYC 5567-00191-1	11.96	0.7
1	18	0	12.8	0	Jupiter	8885.3	TYC 1401-00341-1	9.33	0
1	27	20	38.3	393	Lampetia	6.3	TYC 4882-01689-1	12.48	1.7
1	28	1	38.3	227	Philosop	7	TYC 1403-00969-1	11.88	1.5
2	4	22	41.4	480	Hansa	5.2	TYC 5421-01271-1	10.39	2
2	8	1	51.1	173	Ino	12.8	TYC 4990-00526-1	11.77	2.1
2	24	20	14.4	686	Gersuind	3.4	TYC 4848-00318-1	11.47	3.3
2	28	0	18.1	4	Vesta	80.3	TYC 0297-00677-1	11.86	0
3	31	17	30.6	101	Helena	8.7	TYC 1930-00271-1	11.29	2.2
4	3	3	6.6	8	Flora	11.5	TYC 6272-00706-1	8.63	2.5
4	9	18	15.7	693	Zerbinet	5.5	TYC 5519-00881-1	11.84	2
4	14	3	41.7	81	Terpsich	10.6	TYC 7410-00155-1	12.15	2.3
4	23	1	23	535	Montague	15.8	HIP 81899	10.04	3.5
4	24	23	29.3	524	Fidelio	5.6	TYC 6132-00531-1	11.63	2.5
4	25	19	13.9	1647	Menelaus	5.6	HIP 59559	11.01	6.4
4	26	3	46.6	85	Io	8.1	TYC 5175-01472-1	11.83	0.9
4	27	22	15.2	693	Zerbinet	8.4	TYC 4938-00648-1	9.29	4.7
4	28	21	44.5	591	Irmgard	11.2	TYC 7891-00725-1	11.82	2.5
4	30	1	4.7	81	Terpsich	22	TYC 7423-00166-1	11.88	2.4
5	10	16	30.3	237	Coelesti	4.6	TYC 0308-00833-1	11.09	2.3
5	25	2	15.7	87	Sylvia	24	TYC 6832-00335-1	11.06	1.4
5	26	22	23.1	372	Palma	12	TYC 8306-01460-1	11.72	1.6
5	27	1	59.4	216	Kleopatr	12.3	TYC 5180-00277-1	11.53	1.1
6	1	19	42.9	48	Doris	21.9	TYC 0274-00978-1	11.66	1.3
6	14	22	6.9	259	Aletheia	17	TYC 6843-00744-1	10.86	1.2
6	14	22	52.7	328	Gudrun	9.8	TYC 7943-01050-1	11.77	2.3
6	20	1	21	709	Fringill	6.9	TYC 5247-00393-1	10.74	3.2
6	27	22	13.4	952	Caia	6.9	TYC 7901-01895-1	10.04	3.4
7	3	2	47	454	Mathesis	9.5	TYC 6920-00632-1	11.6	1.6
7	5	18	45.9	372	Palma	16.1	TYC 8280-02046-1	10.75	2.8
7	10	17	49	4	Vesta	22.7	TYC 0291-00094-1	11.34	0
7	11	19	24	328	Gudrun	8.4	TYC 7928-01412-1	10.03	3.8
7	19	22	53.8	399	Persepho	4.4	TYC 7919-00290-1	12.05	1.8
7	22	18	46.1	599	Luisa	7	TYC 6147-01306-1	11.17	2.6
8	2	20	59	58	Concordi	9.6	TYC 6298-00317-1	11.08	1.9
8	4	18	54	85	Io	24.3	TYC 0515-02325-1	11.63	0.3
8	8	17	53.4	4	Vesta	16.3	TYC 4962-00655-1	11.46	0
8	18	0	20.3	106	Dione	12.9	TYC 6373-00741-1	10.45	1.4
8	28	12	39.8	911	Agamemno	6.1	TYC 6725-00350-1	11.48	4.7
9	6	2	7.4	6	Hebe	6.1	TYC 0737-01308-1	11.52	0.3

Date		SAST		Name of Planet	Dur.	Occulted Star	Mag.	d mag
mth	d	h	m		s			
9	8	22	5.8	12 Victoria	7.2	TYC 5671-00522-1	10.79	0.6
9	12	23	35.9	285 Regina	8.6	TYC 5760-01212-1	12.65	1.8
9	23	23	8.8	829 Academia	6	TYC 5809-00229-1	11.39	2.9
9	26	20	31.2	375 Ursula	26.1	TYC 6910-00253-1	11.43	1.2
10	4	1	34.6	6 Hebe	8.8	TYC 0763-00158-1	11.05	0.4
10	7	2	4.4	83 Beatrix	8.2	TYC 0637-00667-1	11.94	1
10	12	19	58	198 Ampella	9.1	TYC 1750-01649-1	10.43	0.7
10	21	20	54.3	2 Pallas	32.4	TYC 5857-00932-1	11.45	0.1
10	29	20	13.6	584 Semirami	4.3	TYC 5193-00629-1	11.69	0.8
10	29	22	47.4	774 Armor	4.1	TYC 1207-00273-1	11.28	1.9
11	13	2	16.7	256 Walpurga	4.7	HIP 19818	9.69	4.9
12	10	21	51.7	674 Rachele	16.4	TAC +03#00515	11.48	0.9
12	23	22	40.6	431 Nephele	9.9	TYC 1396-02000-1	8.8	5.5
12	27	19	42.4	792 Metcalfi	6.1	TYC 1311-00366-1	10.38	2.9

TOTAL LUNAR OCCULTATIONS

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

An occultation occurs when the disk of the Moon moves in front of a star. Timings of occultations, to a precision of one-tenth of a second if possible are very valuable for studies of the Moon's shape and motion. Since only very modest equipment is required, amateurs can make important contributions in this field. Persons interested in making and reporting occultation observations are urged to contact the Director of the Society's Occultation Section:

Mr B Frazer P.O.Box 1017, Henley-on-Klip, 1962. Tel H (016) 366-0955, W (011) 871-0370, email fraserb@intekom.co.za

Predictions of occultations of all stars brighter than magnitude 7.5 supplied by Hydrographic Dept., Tokyo are given below. The main set of tables give predictions for three stations, namely:

	Clarke 1880	
	Longitude	Latitude
Cape Town	18°.475 E	33°.933 S
Johannesburg	28°.075 E	26°.182 S
Harare	31°.000 E	17°.800 S

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

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

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

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

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

EXPLANATIONS OF ABBREVIATIONS USED IN THE TABLES:

Z.C.	-	the number of the star in the Zodiacal Catalogue. An "m" following the number indicates the star is not single.
Mag.	-	the visual magnitude
Ph	-	the Phase: D = Disappearance, R = Reappearance
h.m.	-	the time of the occultation in UT
a,b	-	parameters in minutes for predicting times other than at standard stations (as explained above in the text)
P.A.	-	The Position Angle on the Moon's limb measured eastward from the north point

Observers who want to observe occultations of stars fainter than the ones listed, can contact Mr Fraser for additional data.

					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	Z.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 0	2302	2.9	RD	323					1 30.9	-0.1	-0.5	259	1 24.9	0.1	-0.9	284
JAN 7	3425	4.6	DD	60	19 39.1	-0.2	2.2	39	19 55.9	0.2	2.2	31				
JAN 10	219	5.1	DD	93	20 11.7	-1.9	0.7	106	20 32.4	-1.1	0.9	95	20 44.2	-0.8	1.2	75
JAN 13	533	6.3	DD	125					17 48.4	-1.1	2.3	22	18 18.8	-0.2	4.9	1
JAN 14	688	6.8	DD	136									17 16.0	-2.5	0.1	78
JAN 14	709	4.3	DD	138									23 18.3			158
JAN 15	822m	5.9	DD	147					17 21.4	-1.9	-0.7	88	17 25.0	-1.8	0.3	70
FEB 9	497	6.5	DD	94	19 9.4	-1.7	2.6	29	19 52.5			6				
FEB 12	912	7.0	DD	127					18 32.6	-2.4	1.9	40				
FEB 12	926	7.0	DD	128	20 47.1	-2.8	2.8	32								
FEB 14	1206	5.9	DD	151					17 59.9	-1.9	-0.6	87	18 4.5	-2.0	0.5	66
FEB 14	1211	6.2	DD	151					19 0.1			163	18 42.9	-2.7	-2.1	132
FEB 21	2088	6.2	RD	248	23 32.4	0.1	-2.7	346								
FEB 27	2864	4.7	RD	313	3 26.0	0.0	-2.6	313								
MAR 6	235	6.9	DD	40									16 47.5			344
MAR 9	586	7.0	DD	73	18 11.7	-1.9	2.3	41	18 55.2			11				
MAR 11	852m	5.0	DD	95					17 22.8	-2.9	-1.8	134	17 22.4	-3.1	-0.5	108
MAR 11	869	7.2	DD	96	20 19.6	-1.9	1.9	60								
MAR 13	1169	5.4	DD	121	23 8.8	-0.5	0.4	113								
MAR 14	1274	5.7	DD	130					16 52.7	-2.4	-3.2	153	16 39.0	-2.4	-1.9	127
MAR 14	1279	6.4	DD	130	17 34.5	-2.1	-2.8	152	17 37.6	-2.3	-1.9	132	17 32.2	-2.6	-1.1	111
MAR 14	1283	6.8	DD	131	19 11.7	-2.1	-1.0	119	19 30.1	-2.7	-0.1	94	19 44.3	-3.9	1.6	65
MAR 14	1290	6.8	DD	132	21 15.7	-1.0	-1.2	150	21 23.2	-1.6	-0.1	113	21 31.3	-2.4	0.8	83
MAR 20	2033	4.3	RD	215	21 35.4	-1.1	-1.3	278	21 33.7	-1.0	-1.8	309	21 18.5	-0.5	-2.4	334
MAR 21	2060	6.3	RD	218	4 0.9	-1.1	-1.7	333								
MAR 22	2307	4.1	RD	241					20 48.1	-0.5	-0.3	251	20 44.2	-0.2	-0.8	279
MAR 22	2310	4.6	RD	241									20 58.4	-0.9	0.1	249
MAR 23	2330	6.3	RD	243	0 29.6	-1.0	-1.9	306	0 14.9	0.2	-4.0	351				
MAR 23	2337	6.4	RD	244	1 59.0	-1.3	-2.3	319								
MAR 24	2490m	5.4	RD	257	1 45.6	-0.6	-3.0	328								
MAR 24	2500m	3.4	RD	259	4 17.2			224								
MAR 25	2652	6.4	RD	270	1 17.2	0.3	-3.8	337								
MAR 28	3106	5.4	RD	307	3 46.5	-0.5	-4.7	318								
APR 6	676	7.1	DD	53	17 11.9	-1.9	2.0	55	17 51.8			21				
APR 8	958	6.7	DD	76	18 15.2	-2.7	2.6	45								
APR 9	1088	5.6	DD	86					16 18.7	-2.8	-0.6	108	16 26.1	-3.2	0.3	86
APR 9	1105	6.5	DD	88	19 41.5	-1.2	0.3	115	19 59.4	-1.4	1.3	79	20 29.3			25
APR 10	1233	5.8	DD	99	17 16.9	-2.5	-0.2	89	17 49.9	-3.7	1.8	59				
APR 11	1363	5.2	DD	112	19 29.8			178	19 24.4	-1.4	-1.0	134	19 24.4	-2.2	-0.3	106
APR 11	1365	6.1	DD	112	19 53.6	-0.7	-1.6	158	19 57.8	-1.6	-0.4	119	20 3.8	-2.4	0.6	89
APR 11	1373	6.1	DD	113									22 17.4	0.1	-1.2	144
APR 19	2267	5.1	RD	213	2 54.1	-1.8	-0.2	291	3 3.6	-1.7	-1.8	323				
APR 21	2750	2.1	DB	250					21 51.2	0.3	-2.0	130	21 39.5	-0.2	-0.9	100
APR 21	2750	2.1	RD	250					22 44.8	-1.2	-0.1	248	22 43.3	-0.8	-0.9	280
APR 25	3202	6.1	RD	289					2 15.4	-1.6	1.2	225	2 25.1	-1.8	0.0	257
MAY 6	1056	7.0	DD	57	16 34.5	-2.4	1.3	73								
MAY 9	1432	7.0	DD	93	17 19.7	-3.5	1.1	65								
MAY 11	1689	5.5	DD	122	23 25.8			61								
MAY 12	1773	5.1	DD	131	16 20.3	-0.7	-2.2	148	16 14.6	-1.3	-1.7	123	16 7.7	-1.8	-1.0	100
MAY 13	1921	5.9	DD	148	22 29.9	-1.6	-0.4	117	22 53.4	-2.4	2.3	70				

DATE		I.C.	Mag.	Ph	ELG	CAPE TOWN E 18.5 S 33.9				JOHANNESBURG E 28.1 S 26.2				HARARE E 31.0 S 17.8			
M	D					UT	a.	b.	P.A.	UT	a.	b.	P.A.	UT	a.	b.	P.A.
					°	h m	m	m	°	h m	m	m	°	h m	m	m	°
MAY	13	1924	5.8	DD	149	23 20.1	-1.3	-0.3	121	23 37.4	-1.5	1.4	81				
MAY	14	2033	4.3	DD	160	18 17.4	-1.0	-1.6	114	18 23.9	-2.5	-0.2	77				
MAY	17	2490m	5.4	RD	203	19 35.1	0.2	-2.1	320								
MAY	17	2500m	3.4	RD	205	21 28.2	-2.5	1.0	232	21 46.2	-1.8	-0.9	279	21 38.8	-1.3	-2.0	311
MAY	18	2669	6.2	RD	218									21 42.2	-2.5	1.1	238
MAY	18	2676	6.5	RD	219					22 14.6	-3.0	2.3	223	22 28.1	-2.2	-0.2	264
MAY	21	3018	6.3	RD	247									2 12.4			192
MAY	22	3158	5.8	RD	259					1 41.6	-1.9	2.7	210	2 3.4	-2.5	1.2	240
MAY	22	3164	4.7	RD	260	3 24.8	-2.5	-0.5	271	3 47.8	-3.7	-1.3	287				
MAY	24	3413	6.4	RD	282									2 33.9	-1.3	2.9	202
JUN	4	1274	5.7	DD	51					16 38.1	0.6	-2.8	172	16 24.9	-0.9	-1.0	134
JUN	4	1279	6.4	DD	52	17 17.7			181	17 7.6	-0.7	-0.5	130	17 9.5	-1.3	0.3	99
JUN	7	1621	7.5	DD	88	16 19.4	-0.3	-2.9	176	16 13.3	-1.7	-1.6	136	16 9.1	-2.7	-0.9	110
JUN	8	1755	6.9	DD	104	22 47.5			51								
JUN	10	1969	7.1	DD	127									16 0.4	0.0	-3.3	175
JUN	10	1996	6.9	DD	132									23 39.4			185
JUN	12	2267	5.1	DD	159	23 24.3	-1.8	0.4	97	23 50.2	-1.4	2.2	64				
JUN	15	2750	2.1	DB	198					17 22.3	1.0	-2.6	152				
JUN	15	2750	2.1	RD	198					17 54.5	-1.1	0.8	225	17 57.7	-0.5	-0.3	261
JUN	18	3227	6.4	RD	239									22 21.8	-1.5	1.7	218
JUN	21	49	6.3	RD	274									23 14.1	-0.4	1.0	225
JUN	26	497	6.5	RD	319					3 5.7	-2.1	-3.2	299				
JUL	4	1598	6.4	DD	60									18 19.5	-0.1	-1.5	152
JUL	7	1933	7.0	DD	98					16 28.7	-0.9	-2.7	161	16 14.5	-1.9	-1.7	131
JUL	7	1937	6.1	DD	98									17 54.5	-0.8	-3.1	167
JUL	7	1941	4.8	DD	99	18 11.0	-1.1	-2.0	151	18 17.3	-2.1	-0.4	110	18 29.7	-3.6	2.3	70
JUL	8	2060	6.3	DD	111	16 30.6	-2.0	-1.0	101								
JUL	9	2192	6.2	DD	125									18 29.1	-0.9	-3.8	167
JUL	10	2348	7.1	DD	138	17 21.3	-1.4	-1.2	100	17 46.9			45				
JUL	11	2500m	3.4	DD	152	16 57.7	0.8	-3.8	169	16 38.7	-0.6	-1.7	123	16 31.0	-1.3	-0.7	94
JUL	15	3158	5.8	RD	206									19 7.9			180
JUL	15	3164	4.7	RD	207	20 52.5	-1.1	0.1	239	21 2.8	-1.6	-0.8	270	20 52.1	-1.7	-3.7	309
JUL	16	3175	4.8	RD	209	0 32.2	-2.3	0.5	255	1 0.5	-2.7	0.6	264	1 9.8	-3.9	-0.9	287
JUL	16	3304	6.4	RD	220	21 14.5	-0.8	-1.4	274	21 2.4			319				
JUL	17	3428	5.2	RD	231	21 1.6	-0.4	0.4	226	21 7.0	-0.8	-0.4	256	21 0.9	-0.9	-2.0	291
AUG	4	2036	6.9	DD	84									20 25.4	-0.7	-1.8	152
AUG	5	2160	6.6	DD	96	18 47.5	-2.5	2.1	69								
AUG	6	2293	7.2	DD	108	16 59.5	-0.7	-3.6	163	16 55.3	-2.1	-1.4	119	16 57.5	-3.2	0.2	86
AUG	7	2459	7.2	DD	124					20 48.6	-2.4	-2.7	147	20 43.7	-2.1	-0.5	113
AUG	8	2623m	7.5	DD	136	18 54.2	-2.4	0.8	68								
AUG	9	2657	6.7	DD	139	1 6.0	-0.3	1.1	85	1 15.5	0.1	1.0	78				
AUG	9	2804	5.9	DD	149	19 21.7			26								
AUG	20	660	4.4	RD	280									23 23.9	1.0	2.5	193
AUG	21	664	5.4	RD	281									0 8.6	0.2	1.4	212
AUG	30	1869	6.1	DD	39									16 27.1	-0.7	-1.6	147
AUG	31	1996	6.9	DD	53	17 21.0	-1.2	0.1	112	17 38.7	-1.0	1.7	76				
AUG	31	1997	6.8	DD	53	17 39.2	-0.9	-1.2	147	17 43.7	-0.9	0.0	114	17 50.2	-0.8	1.1	81
SEP	1	2117	5.3	DD	67									18 34.9	-1.3	-3.5	167
SEP	1	2118	2.9	DD	67									18 49.1			181
SEP	1	2118	2.9	RB	67									19 8.0			215

DATE M	D	Y.C.	Mag.	Ph	ELG °	CAPE TOWN E 18.5 S 33.9 UT h m	a. s	b. s	P.A. °	JOHANNESBURG E 28.1 S 26.2 UT h m	a. s	b. s	P.A. °	HARARE E 31.0 S 17.8 UT h m	a. s	b. s	P.A. °
SEP	5	2735	7.2	DD	118					16 31.7	-2.2	-1.2	104	16 36.9	-2.9	0.7	72
SEP	5	2740	6.3	DD	118	17 21.2	-2.0	-1.4	108	17 40.6	-2.7	0.6	77	18 3.0	-2.6	3.1	42
SEP	5	2750	2.1	DD	120	19 25.3	-1.5	5.0	25								
SEP	5	2750	2.1	RB	120	20 11.0	-3.1	-3.2	320								
SEP	6	2781	7.4	DD	122	0 9.9	-0.4	0.9	95								
SEP	16	599	4.5	RD	249									21 17.7	-1.1	-1.9	292
SEP	16	601	6.0	RD	249									21 41.1	-0.5	-0.1	255
SEP	17	743	5.7	RD	261									23 2.6	-0.9	-0.3	259
SEP	29	2217	5.5	DD	50					19 11.1			165				
OCT	1	2524	6.0	DD	76					17 10.8	-2.7	-3.1	147	17 5.5	-2.4	-0.6	112
OCT	4	2899	7.5	DD	105	0 0.6	0.6	1.9	38								
OCT	5	3158	5.8	DD	127									19 2.7			130
OCT	5	3164	4.7	DD	128	19 55.3	-2.5	0.5	84	20 24.7	-2.3	1.0	80	20 41.4	-1.7	1.5	64
OCT	6	3175	4.8	DD	130									0 4.0	-0.8	-0.2	113
OCT	6	3304	6.4	DD	140	21 27.4	-3.6	-0.6	109	21 57.8	-3.5	-0.6	111	22 7.2	-2.3	0.6	91
OCT	7	3425	4.6	DD	152	21 6.2	-2.0	1.3	60	21 37.3	-2.0	1.6	62	21 58.1	-1.6	2.0	49
OCT	13	455	6.1	RD	211									2 20.2	-1.6	4.5	190
OCT	14	582	5.8	RD	222	3 12.5	-2.6	-0.7	307								
OCT	16	844	5.7	RD	243	1 17.6	-1.8	0.2	239	1 42.5	-2.6	0.7	245	1 56.1	-3.3	0.3	262
OCT	27	2319	6.9	DD	32	18 39.5	-0.2	0.2	119								
OCT	28	2469	6.3	DD	45	17 46.5	-0.7	1.2	86	18 0.5	-0.2	1.3	74	18 13.4	0.4	2.0	48
OCT	28	2483	7.1	DD	46	19 29.4	-0.1	0.9	94								
OCT	29	2650	4.7	DD	59					18 35.7			155	18 29.2	-1.2	-0.4	118
OCT	30	2824	7.4	DD	72	18 0.4	-0.5	3.3	31	18 27.9	0.4	3.7	20				
OCT	31	2985	6.9	DD	86	21 10.5			148	21 18.1			137	21 16.8	-0.6	0.0	109
NOV	2	3265	6.6	DD	110	19 48.8	-0.3	3.2	14	20 15.7	-0.1	3.1	16	20 43.8	1.1	4.2	356
NOV	3	3392	7.1	DD	122	21 23.6	-1.3	1.9	57	21 48.9	-1.0	1.8	59	22 6.7	-0.6	1.9	46
NOV	26	2740	6.3	DD	39									16 47.8			15
NOV	28	3089	5.3	DD	68	21 20.7	0.1	1.2	78								
NOV	29	3214	6.6	DD	78					18 9.6	-3.0	-0.3	110	18 18.8	-2.0	0.6	90
NOV	29	3228	6.5	DD	80	21 9.7	-0.5	1.2	89	21 20.9	-0.1	1.0	84				
NOV	30	3356	5.9	DD	92	21 51.0	-0.3	1.8	58	22 5.0	0.1	1.6	52				
DEC	2	36	7.2	DD	113									16 54.2	-0.2	3.8	2
DEC	4	257	4.5	DD	135									16 53.8	1.1	4.6	350
DEC	20	2118	2.9	DB	317					8 32.8	-1.5	-2.1	147	8 26.7	-2.3	-0.8	114
DEC	20	2118	2.9	RD	318					9 42.2	-1.9	0.8	270	9 46.7	-1.7	-0.9	303
DEC	21	2233	5.5	RD	328	2 46.8	0.2	-1.5	304	2 31.0	0.4	-2.0	332				
DEC	28	3419	4.5	DD	70									17 7.2	-0.1	3.3	9
DEC	28	3425	4.6	DD	71									18 1.6	-2.6	-0.2	106
DEC	28	3434	7.4	DD	72									20 11.8			124
DEC	29	12	6.3	DD	83	19 55.0	-0.9	1.9	56	20 16.8	-0.5	1.9	52	20 34.6	-0.2	2.1	34
DEC	29	13	6.3	DD	83	20 16.3	-0.7	2.0	52	20 36.8	-0.3	2.0	46				
DEC	29	15	7.3	DD	84	20 52.6	-0.3	2.5	24								
DEC	31	226	6.6	DD	105					18 1.7	-1.1	2.7	20	18 31.3	-0.6	3.8	5

GRAZING OCCULTATIONS

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

The maps on the following pages have been prepared by the Hydrographic Dept., Tokyo to show the tracks of stars brighter than 7.5 magnitude which will graze the limb of the Moon when it is at a favourable elongation from the Sun and at least 10° above the observer's horizon (2° in the case of bright stars). Each track starts in the west at some arbitrary time given in the key and ends beyond the area of interest, except where the Moon is at a low altitude, the bright limb or sunlight interferes.

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

The equipment needed is similar to that used for ordinary or "total" occultations, but must, of course, be portable. A 75 mm refractor is ideal for average events, but instruments with a larger aperture have often shown their superiority under difficult conditions. Timing is best carried out with a portable tape recorder and a small FM radio tuned to a pre-arranged transmission.

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

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

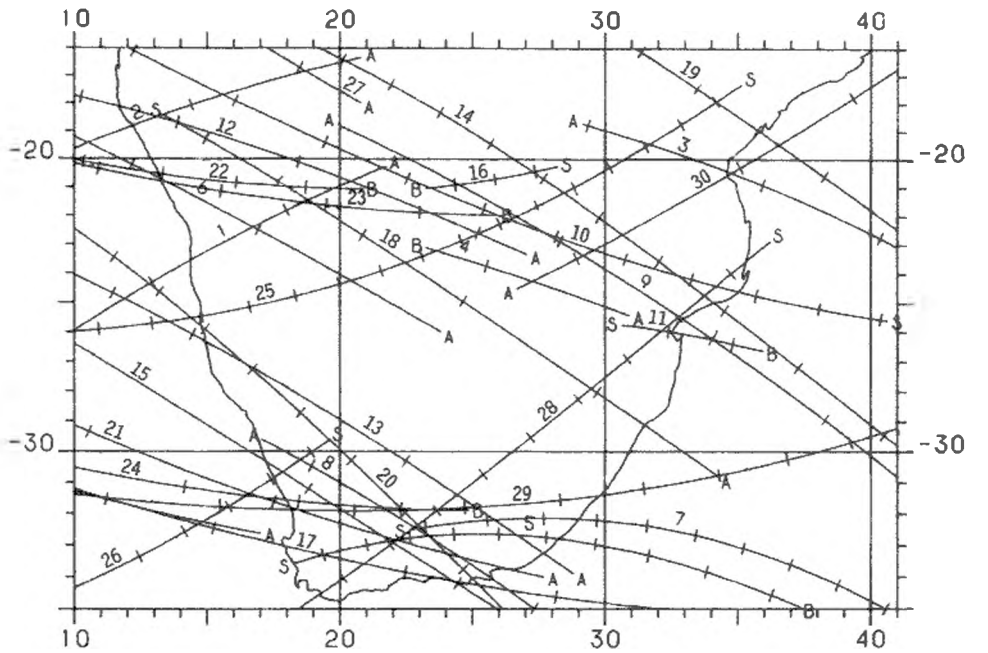
Mr B Frazer P.O.Box 1017, Henley-on-Klip, 1962. Tel H (016) 366-0955,
W (011) 871-0370, email fraserb@intekom.co.za

EXPLANATION OF THE COLUMN HEADINGS IN THE TABLES:

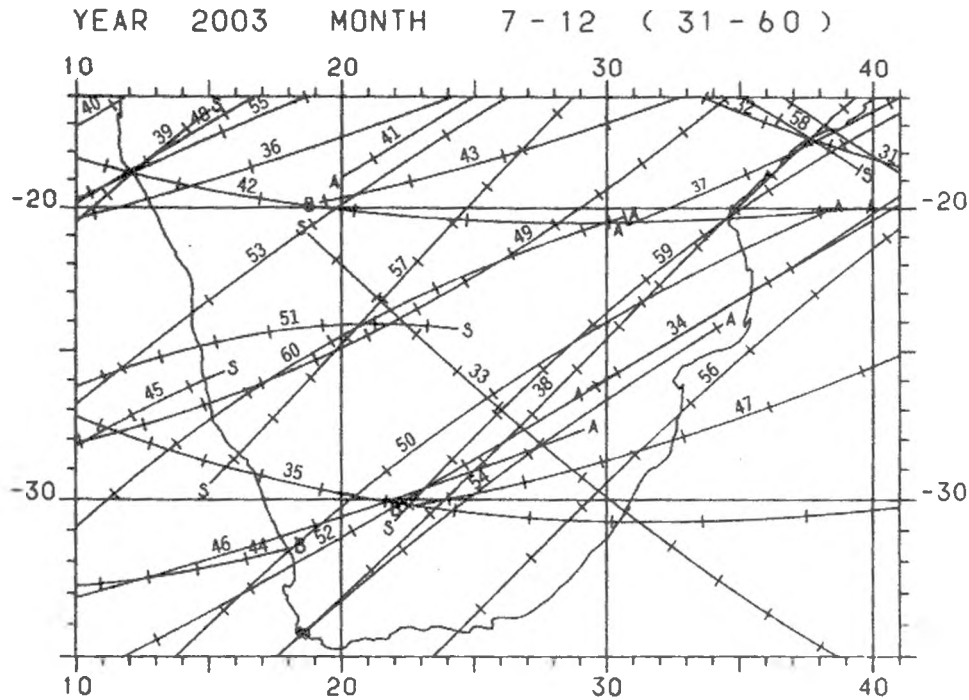
SEQ	: Sequential number in the year. The same number is attached to the corresponding track on the map.
NZC NO	: Zodiacal Catalogue number of the star.
MAG	: Magnitude of the star.
MON, DAY, H, M, S	: Month, day, hour, minute and second in SAST for the west end of the track.
SUNLIT (%)	: Percentage of 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 given for the points corresponding to the multiples of five minutes of every hour, while the prediction for the west end of each track is shown in the table. e.g.if the time for the west end of a track is 5h 43m 21s, the tick marks proceeding eastward correspond to 5h 45m 00s, 5h 50m 00s, 5h 55m 00s

YEAR 2003 MONTH 1 - 6 (1 - 30)



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
1	3304	6.37	1	6	21	26	13.07	16.48	S	( )	(A)
2	3428	5.16	1	7	22	31	13.00	24.78	S	( )	(A)
3	1994	6.51	1	25	0	14	51.98	-54.21	S	(A)	( )
4	586	6.95	3	9	21	8	14.30	35.19	N	(B)	(A)
5	852m	5.00	3	11	19	21	26.40	54.11	S	(S)	(B)
6	869	7.22	3	11	22	52	11.99	54.97	N	( )	(A)
7	1274	5.73	3	14	19	13	44.47	82.38	S	(S)	( )
8	2307	4.13	3	22	22	34	24.18	-73.50	S	(A)	( )
9	2310	4.58	3	22	22	41	1.67	-73.36	S	(A)	( )
10	2824	7.40	3	26	4	9	47.86	-38.39	S	( )	(S)
11	664	5.41	4	6	18	0	54.60	19.42	S	(S)	(B)
12	676	7.08	4	6	19	54	36.37	19.92	N	( )	(A)
13	958	6.72	4	8	20	32	24.31	37.55	N	( )	(A)
14	1233	5.83	4	10	19	52	37.91	57.62	N	( )	( )
15	2750	2.14	4	22	0	14	43.14	-66.15	S	( )	( )
16	2781	7.42	4	22	5	41	16.62	-64.55	N	(B)	(S)
17	3202	6.14	4	25	3	32	18.91	-33.42	S	( )	( )
18	1056	6.97	5	6	19	6	49.71	22.58	N	(S)	(A)
19	1181	6.82	5	7	18	14	33.59	31.16	N	( )	( )
20	1432	7.00	5	9	19	15	39.45	52.34	N	( )	( )
21	1689	5.47	5	12	1	34	31.30	75.61	N	( )	(A)
22	3018	6.33	5	21	3	4	26.49	-69.65	S	( )	(B)
23	3160	7.02	5	22	2	39	7.72	-59.46	S	( )	(B)
24	3158	5.79	5	22	2	45	44.23	-59.43	S	( )	(B)
25	3164	4.72	5	22	4	27	47.21	-58.92	N	( )	(S)
26	3304	6.37	5	23	6	28	19.01	-47.98	N	( )	(S)
27	1283	6.84	6	4	20	59	13.93	18.95	N	( )	(A)
28	3106	5.35	6	18	5	15	5.02	-82.95	N	( )	(S)
29	3358	7.18	6	20	1	15	46.96	-65.38	N	( )	( )
30	497	6.45	6	26	4	48	46.98	-11.58	N	(A)	( )



SEQ	NZC NO	MAG	MON	DAY	H	M	S	SUNLIT(%)	LIMIT		
31	1365	6.09	7	2	17	39	38.25	8.25	N	( )	( )
32	1941	4.83	7	7	20	54	56.68	57.21	N	( )	( )
33	2060	6.30	7	8	18	41	35.73	68.12	N	(S)	( )
34	586	6.95	7	24	3	29	23.90	-24.23	N	(A)	( )
35	2160	6.63	8	5	20	52	36.42	55.15	N	( )	( )
36	2319	6.92	8	7	0	44	19.68	67.69	S	( )	( )
37	413	6.81	8	19	0	6	49.48	-59.60	N	(A)	( )
38	423	6.38	8	19	3	48	5.58	-58.47	N	( )	( )
39	534	6.03	8	20	6	36	12.34	-48.25	N	( )	(S)
40	676	7.08	8	21	3	33	56.88	-39.48	N	( )	( )
41	958	6.72	8	23	4	24	23.53	-21.58	N	(A)	( )
42	1996	6.92	8	31	19	37	48.64	19.48	N	( )	(A)
43	2417	7.02	9	3	21	39	35.53	52.79	S	(B)	( )
44	2750	2.14	9	5	21	27	26.05	74.65	N	( )	(B)
45	909	6.08	9	19	6	15	20.05	-46.06	N	( )	(S)
46	2217	5.46	9	29	21	15	28.42	17.48	S	( )	(A)
47	2524	6.01	10	1	19	22	3.64	37.56	S	(B)	( )
48	2721	3.30	10	3	0	26	9.05	50.74	S	( )	( )
49	3158	5.79	10	5	20	19	37.35	80.29	S	( )	( )
50	3175	4.82	10	6	1	51	24.82	81.56	S	( )	(A)
51	1008	5.05	10	17	5	2	40.34	-63.25	N	( )	(S)
52	2650	4.69	10	29	20	23	2.65	23.64	S	( )	( )
53	2984	6.94	10	31	23	7	6.67	46.08	S	( )	( )
54	2985	6.88	10	31	23	13	34.88	46.18	S	( )	(A)
55	1213	6.96	11	15	1	54	33.93	-70.65	N	( )	( )
56	3214	6.61	11	29	20	10	10.50	39.64	S	( )	( )
57	3478	6.51	12	1	20	12	3.08	60.60	S	(S)	( )
58	2230	6.78	12	21	4	13	50.42	-7.44	S	( )	(S)
59	3425	4.56	12	28	19	48	21.93	33.04	S	(S)	( )
60	3434	7.38	12	28	21	51	40.23	33.75	S	( )	(A)

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 9.5×10^{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

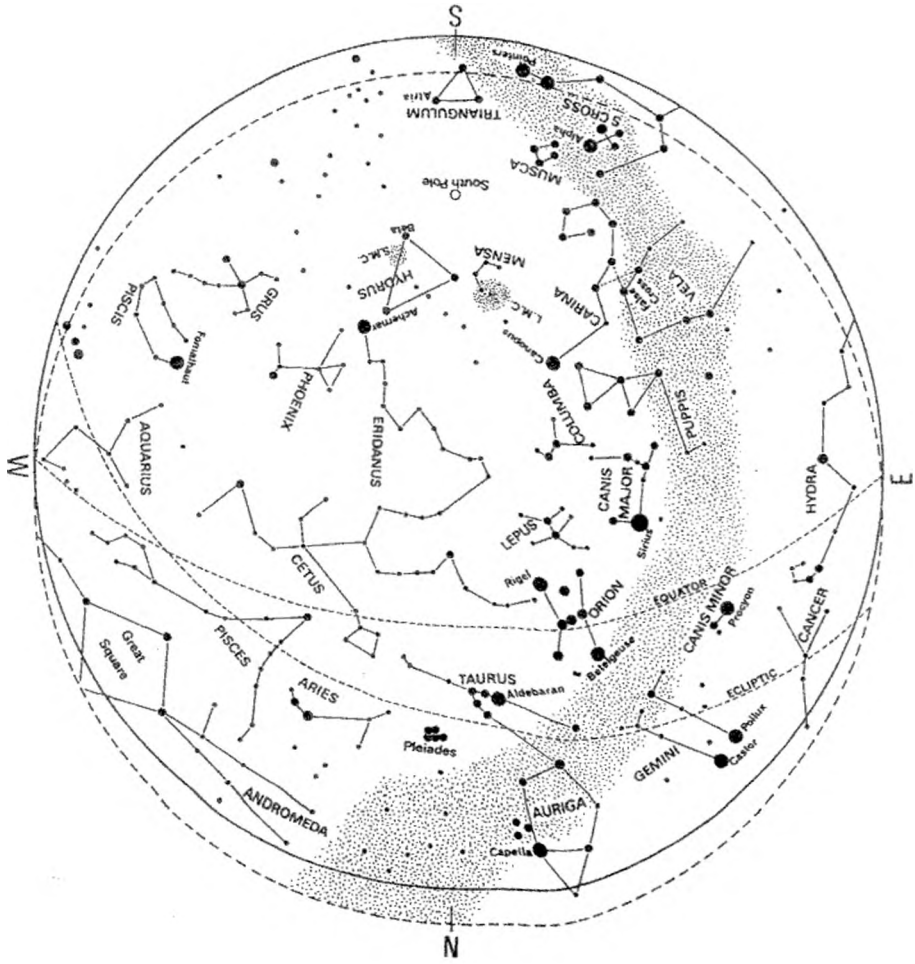
The star charts in this section show the night sky for each of the four seasons of the year. These seasonal charts depict stars down to magnitude 3.5 which is approximately what will be visible to the naked eye in city areas. Charts of 3 of the most interesting regions in the sky (showing stars down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



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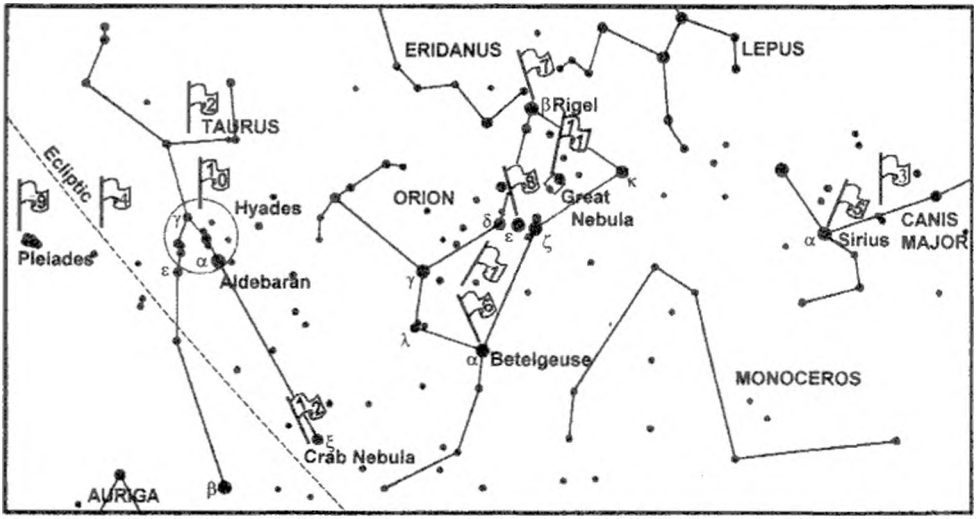
THE ORION REGION



THE ORION REGION

(1) The constellation of Orion. The figure of the legendary hunter of Greek mythology is unfortunately upside down when seen from Southern Africa. The faint stars by λ represent the head, α and γ the shoulders, δ - ε - ζ the belt, and β and κ the legs. Orion forms part of the "great hunting scene" in which he faces the onslaught of (2) Taurus, the bull. Only the forepart of the bull is depicted and, like Orion, it is upside down, α and β 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) 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.

(6) 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.

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

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

(9) 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.

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

(11) 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.

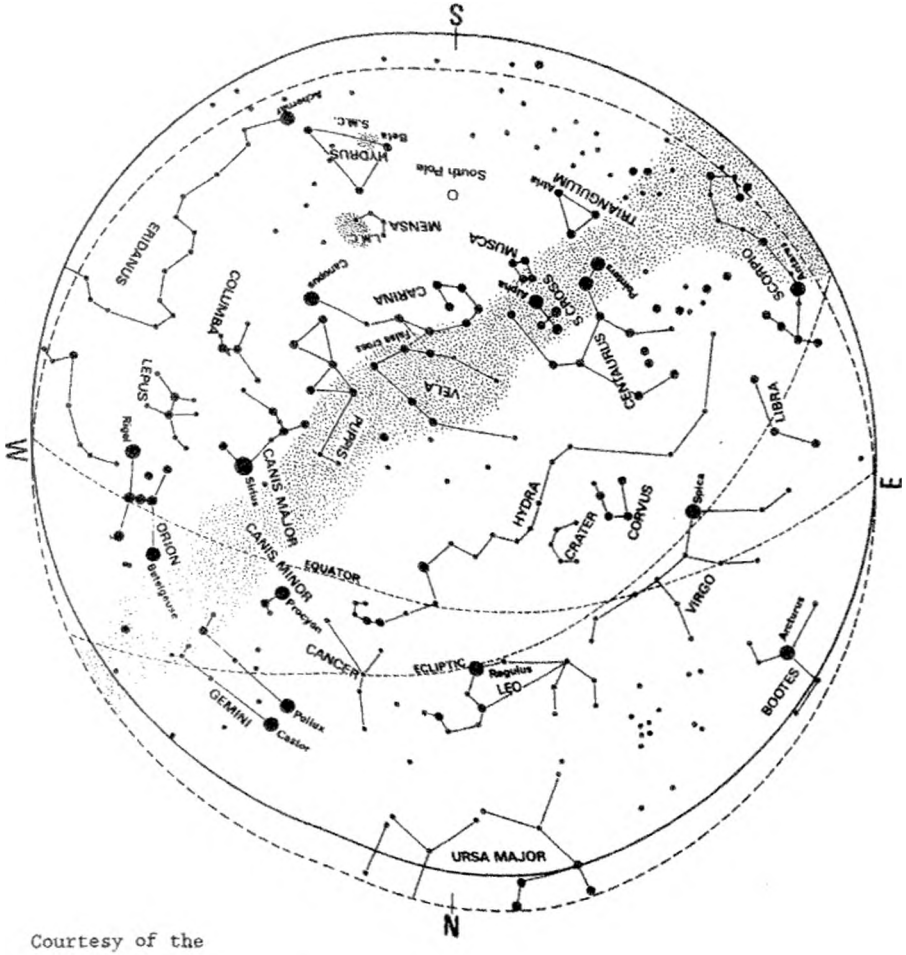
(12) The Crab Nebula, close to ξ ,is the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraordinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly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

THE AUTUMN SKY

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

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

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



Courtesy of the

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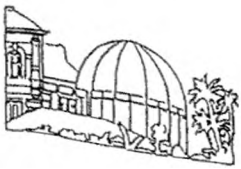

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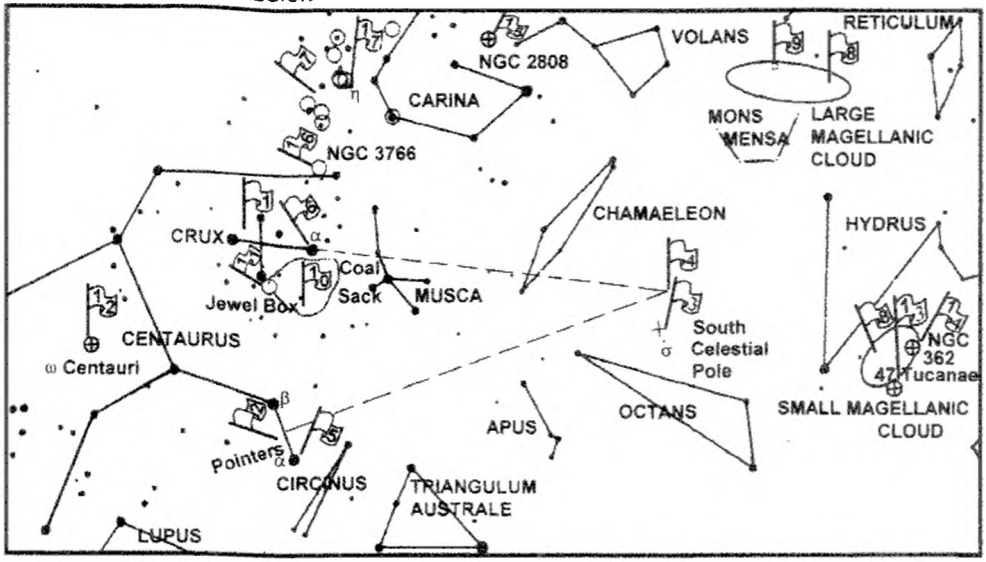
THE SOUTHERN CROSS REGION



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, shown in the Autumn Sky chart - 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. Nearby is σ Octantis, the nearest star to the Pole which is visible to the naked eye.

(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) β 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 section of the entire Milky Way with many star clusters.

(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 cluster. 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).

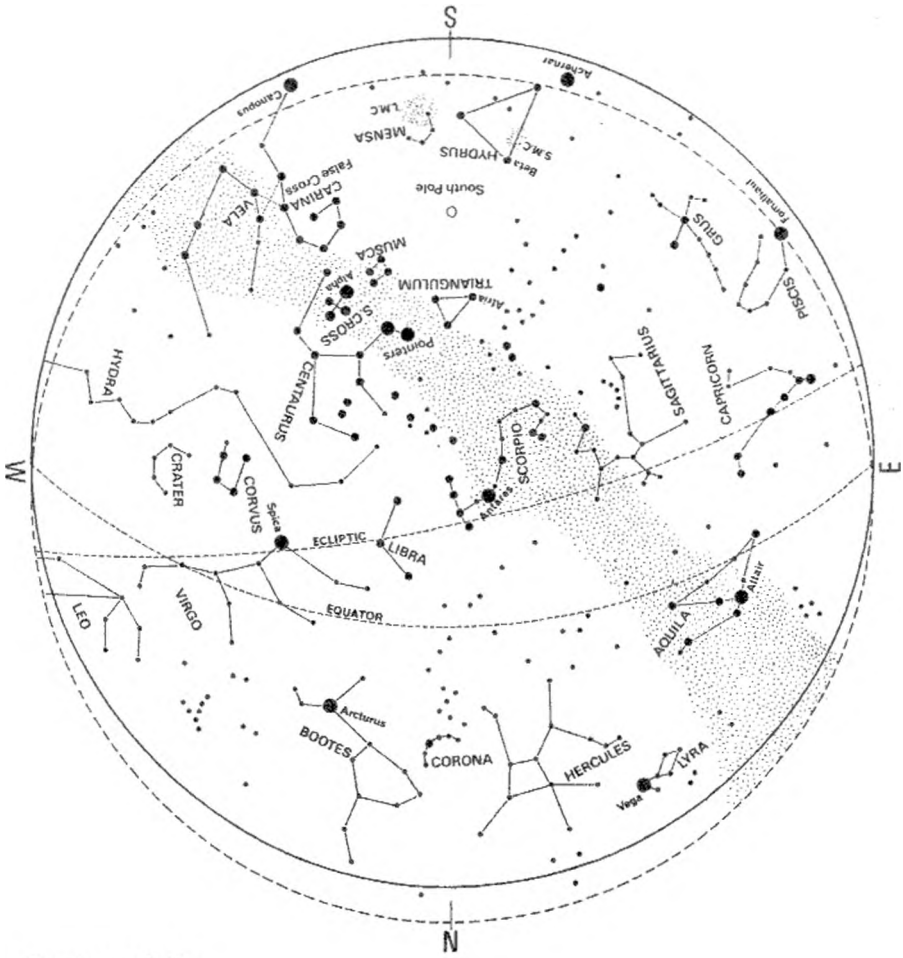
(17) The η Carinae nebula - site of a slow supernova that brightened to magnitude -0.8 in 1843 and is now of magnitude 6.4.

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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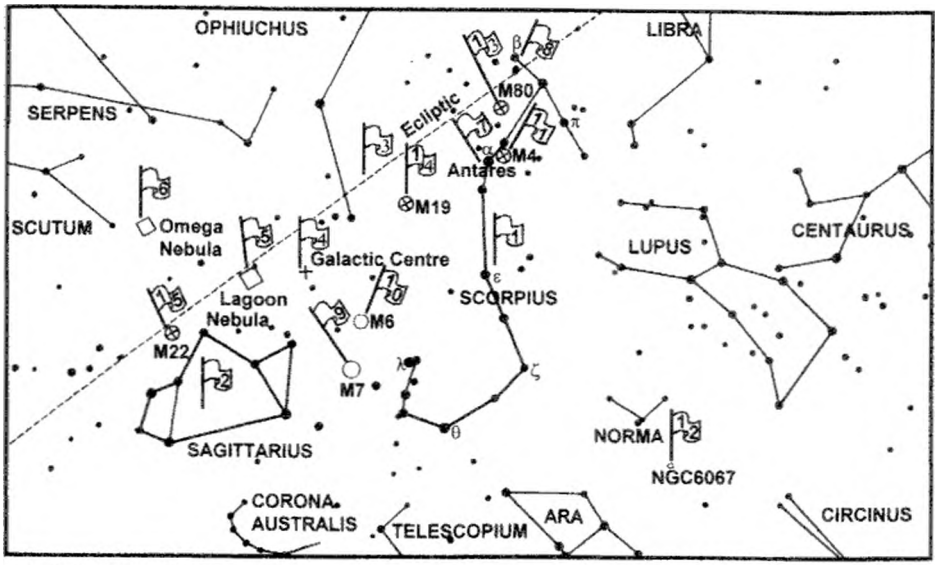
THE SCORPIUS REGION



THE SCORPIUS REGION

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

(2) Sagittarius - the figure of the centaur archer is very difficult to make out. A more easily recognisable asterism is the 'teapot'.

(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, see the chart opposite. Luminous nebulae include (5) the Lagoon nebula and (6) the Omega nebula. These are best seen with the aid of binoculars.

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

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

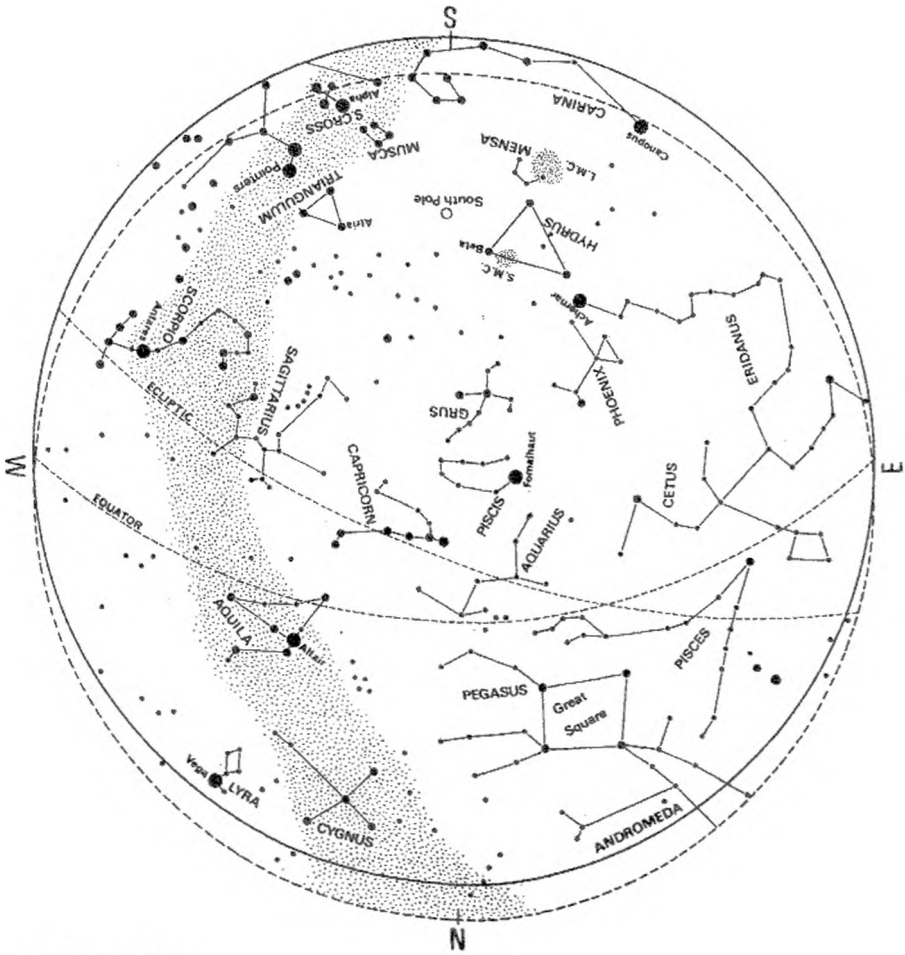
This region includes a number of galactic clusters including (9)M7, (10)M6, (11)M4 and (12) NGC 6067. (Use binoculars or a small telescope). Further from the plane of the Milky Way are some globular clusters: (13) M80 (14) M19 (15) M22.

THE SPRING SKY

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

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

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



Courtesy of the

PLANETARIUM  SA MUSEUM

VARIABLE STAR OBSERVING

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

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

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

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

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

Mr. J. Hers, P.O. Box 48, Sedgefield, 6573, Telephone 044-343-1736.

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

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

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

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

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

Typical examples include:

			Approximate magnitude range
021403	o	Ceti(Mira)	2.0-10.1
092962	R	Carinae	3.9-10.0
100661	S	Carinae	4.5-9.9

Among the eruptive variables, two groups are of special importance:
U Geminorum type. These are dwarf novae which have long periods of apparent quiescence at minimum, with sudden rises to maximum. A typical representative in the southern hemisphere is 040971 VW Hydri.
R. Coronae Borealis type. These are high luminosity variables with slow, non-periodic drops in brightness. A typical representative is 191033 RY Sagittarii.
Eclipsing Binary Stars have orbital planes which lie close to the line of sight of the observer. The two components periodically eclipse each other, thus causing variations in the apparent brightness of the system. Periods are generally short, of the order of hours, so that observational programmes need very careful planning. Monitoring these interesting stars is therefore for experienced observers only.

NOVA SEARCHING

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

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

DEEP SKY SECTION

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

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

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

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

IMAGING SECTION

This new section was formed in 1999. ASSA members who would like more information or would like to join the section should contact:

The ASSA, c/o SAAO, P O Box 9, Observatory, 7935

DOUBLE STAR SECTION

This is the Society's most recently formed Section and regular news bulletins are published as well as information on the section's web page at: http://www.skywatch.co.za. Even without specialised equipment, it is possible for both amateur and professional astronomers to contribute to the work of the Section as there is a long list of suspected double stars in the southern hemisphere which still have to be confirmed as such. Accurate measurements are an advantage but just confirmation of duplicity is a step in the right direction. Anyone interested should contact the Director:

Mr Chris de Villiers, email: astronomer@skywatch.co.za

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	2	20	May 11	11	55	17	Sep 18	11	53	10
11	12	6	44	21	11	55	27	28	11	49	41
21	12	10	8	31	11	56	31	Oct 8	11	46	34
31	12	12	19	Jun 10	11	58	16	18	11	44	8
Feb 10	12	13	9	20	12	0	22	28	11	42	44
20	12	12	41	30	12	2	29	Nov 7	11	42	35
Mar 2	12	11	8	Jul 10	12	4	13	17	11	43	48
12	12	8	47	20	12	5	14	27	11	46	25
22	12	5	55	30	12	5	21	Dec 7	11	50	12
Apr 1	12	2	54	Aug 9	12	4	28	17	11	54	49
11	12	0	4	19	12	2	36	27	11	59	47
21	11	57	42	29	11	59	57	31	12	1	44
May 1	11	56	3	Sep 8	11	56	43				

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

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

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

SIDEREAL TIME ON THE 30° MERIDIAN

	At 0 hrs	At 21 hrs		At 0 hrs	At 21 hrs		At 0 hrs	At 21 hrs
	h m	h m		h m	h m		h m	h m
Jan 1	6 41	3 44	May 11	15 13	12 17	Sep 18	23 46	20 49
11	7 20	4 23	21	15 53	12 56	28	0 25	21 29
21	7 59	5 3	31	16 32	13 35	Oct 8	1 5	22 8
31	8 39	5 42	Jun 10	17 11	14 15	18	1 44	22 47
Feb 10	9 18	6 22	20	17 51	14 54	28	2 23	23 27
20	9 58	7 1	30	18 30	15 34	Nov 7	3 3	0 6
Mar 2	10 37	7 41	Jul 10	19 10	16 13	17	3 42	0 46
12	11 17	8 20	20	19 49	16 53	27	4 22	1 25
22	11 56	8 59	30	20 29	17 32	Dec 7	5 1	2 5
Apr 1	12 35	9 39	Aug 9	21 8	18 11.	17	5 41	2 44
11	13 15	10 18	19	21 47	18 51	27	6 20	3 23
21	13 54	10 58	29	22 27	19 30	31	6 36	3 39
May 1	14 34	11 37	Sep 8	23 6	20 10			

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

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

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

TELESCOPE SETTING

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

A LIST OF BRIGHT STARS FOR CHECKING TELESCOPE CIRCLES (2003.5)

Star	R.A. h m	Dec. ° '	Mag.	Sp.	Star	R.A. h m	Dec. ° '	Mag.	Sp.
ACHERNAR	1 37.8	-57 13	0.6	B5	PROCYON	7 39.4	5 13	0.5	F5
ALDEBARAN	4 36.1	16 31	1.1	K5	REGULUS	10 8.5	11 57	1.3	B8
RIGEL	5 14.7	-8 12	0.3	B8	SPICA	13 25.4	-11 11	1.2	B2
BETELGEUSE	5 55.3	7 25	0.4	M0	ARCTURUS	14 15.8	19 10	0.2	K0
CANOPUS	6 24.0	-52 42	-0.9	F0	ANTARES	16 29.6	-26 26	1.2	M1
SIRIUS	6 45.3	-16 43	-1.6	A0	ALTAIR	19 51.0	8 53	0.9	A5

JULIAN DATE AT 1400 HOURS - SAST 2003

	JAN. 2452	FEB. 2452	MAR. 2452	APR. 2452	MAY 2452	JUN. 2452	JUL. 2452	AUG. 2452	SEP. 2452	OCT. 2452	NOV. 2452	DEC. 245
1	641	672	700	731	761	792	822	853	884	914	945	2975
2	642	673	701	732	762	793	823	854	885	915	946	2976
3	643	674	702	733	763	794	824	855	886	916	947	2977
4	644	675	703	734	764	795	825	856	887	917	948	2978
5	645	676	704	735	765	796	826	857	888	918	949	2979
6	646	677	705	736	766	797	827	858	889	919	950	2980
7	647	678	706	737	767	798	828	859	890	920	951	2981
8	648	679	707	738	768	799	829	860	891	921	952	2982
9	649	680	708	739	769	800	830	861	892	922	953	2983
10	650	681	709	740	770	801	831	862	893	923	954	2984
11	651	682	710	741	771	802	832	863	894	924	955	2985
12	652	683	711	742	772	803	833	864	895	925	956	2986
13	653	684	712	743	773	804	834	865	896	926	957	2987
14	654	685	713	744	774	805	835	866	897	927	958	2988
15	655	686	714	745	775	806	836	867	898	928	959	2989
16	656	687	715	746	776	807	837	868	899	929	960	2990
17	657	688	716	747	777	808	838	869	900	930	961	2991
18	658	689	717	748	778	809	839	870	901	931	962	2992
19	659	690	718	749	779	810	840	871	902	932	963	2993
20	660	691	719	750	780	811	841	872	903	933	964	2994
21	661	692	720	751	781	812	842	873	904	934	965	2995
22	662	693	721	752	782	813	843	874	905	935	966	2996
23	663	694	722	753	783	814	844	875	906	936	967	2997
24	664	695	723	754	784	815	845	876	907	937	968	2998
25	665	696	724	755	785	816	846	877	908	938	969	2999
26	666	697	725	756	786	817	847	878	909	939	970	3000
27	667	698	726	757	787	818	848	879	910	940	971	3001
28	668	699	727	758	788	819	849	880	911	941	972	3002
29	669		728	759	789	820	850	881	912	942	973	3003
30	670		729	760	790	821	851	882	913	943	974	3004
31	671		730		791		852	883		944		3005

JANUARY

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
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FEBRUARY

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APRIL

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MAY

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JUNE

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JULY

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AUGUST

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31						

SEPTEMBER

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28	29	30				

OCTOBER

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NOVEMBER

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30						

DECEMBER

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28	29	30	31			

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Dr D S Evans
Prof Ch Fehrenbach
Mr J Hers
Dr G Heyman
Mr R F Hurly
Mr A Slotegraaf
Mr C R G Turk

GILL MEDALLISTS

1956 H Knox Shaw
1957 W P Hirst
1958 J Jackson
1960 W H van den Bos
1963 A W J Cousins
1965 R H Stoy
1967 W S Finsen
1970 J C Bennett
1976 A D Thackeray
1981 C Papadopoulos
1983 M W Feast
1984 M D Overbeek
1988 D S Evans
1992 B Warner
1997 G Nicholson
1999 I S Glass

McINTYRE AWARDS

1971 D S Evans, T J Deeming, Mrs B K Evans & S Goldfarb
1983 B Warner

ASSA SCHOLARSHIP AWARDS

2002 M van Gend
2002 C D de Villiers

LONG SERVICE AWARDS

1984 J Churms
1988 R F Hurly
1993 H E Krumm
2000 C R G Turk

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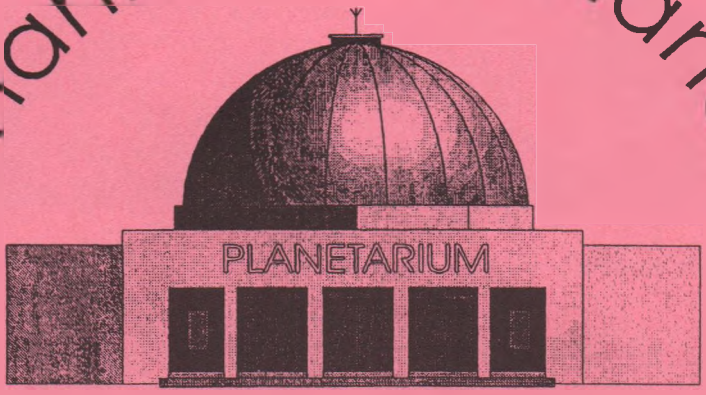

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